OPTICS & PHOTONICS International Congress

OPIC 2021

19-22 April 2021

Congress Program

Plenary Session

Joint Sessions

Specialized International Conferences

- ALPS 2021 : The 10th Advanced Lasers and Photon Sources
- BISC 2021 : The 7th Biomedical Imaging and Sensing Conference
- HEDS 2021 : International Conference on High Energy Density Science 2021
- ICNN 2021 : International Conference on Nano-photonics and Nano-optoelectronics 2021
- IoT-SNAP 2021 : IoT Enabling Sensing/Network/AI and Photonics Conference 2021
- LDC 2021 : Laser Display and Lighting Conference 2021
- LSSE 2021 : Laser Solutions for Space and the Earth 2021
- OMC 2021 : The 8th Optical Manipulation and Structured Materials Conference
- OPTM 2021 : Optical Technology and Measurement for Industrial Applications 2021
- OWPT 2021 : Optical Wireless and Fiber Power Transmission Conference 2021
- XOPT 2021 : International Conference on X-ray Optics and Applications 2021

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OPTICS & PHOTONICS International Congress 2021

Date: Monday 19 - Thursday 22 April 2021

Organized by OPTICS & PHOTONICS International Council

Specialized International Conference Organized by

The Laser Society of Japan
SPIE-The International Society for Optics and Photonics(USA)
Institute for Nano Quantum Electronics, The University of Tokyo
The Graduate School for the Creation of New Photonics Industries (GPI)
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OPIC 2021 Online Virtual Conference

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Professor, Keio University

The Optics and Photonics International Council (Japan) has organized the Optics and Photonics International Congress (OPIC) and the Optics and Photonics International Exhibition (OPIE) annually at Pacifico Yokohama since 2012. OPIC historically includes more than 10 technical conferences in related technology areas. It is extremely important to hold different optics-related technical conferences at one place at the same time because laser sources, light detection, and light active control are common elemental technologies. Sharing the supply and demand from each technical conference accelerates the development of these technologies and their applications.

OPIC is now one of the largest international conferences suitable to efficiently attract the latest advanced science and technology information of optics, photonics, and their applications. However, due to the world-wide spreading of the new coronavirus (COVID-19), the last OPIC 2020 was not held as an in-person conference, but as an online virtual conference. In spite of the online format, 11 technical professional conferences were held, with 421 participants and 490 contributed papers . It shows the significance of this congress, and we have renewed our awareness that this annual congress should never been interrupted.

Unfortunately, the coronavirus has not subsided even after a year. Considering the significance of this congress and putting the safety and health of the participants on primary importance, we have decided to hold OPIC 2021 as an online virtual conference similar to the last one.

For OPIE, both exhibitors and participants require true face-to-face interaction, but it is still difficult to realize. Therefore, we have decided to postpone the OPIE until 30th June – 2nd July. Though OPIE cannot be held at the same time as OPIC, we will provide the archives of OPIC during the holding period of OPIE.

OPIC 2021 is co-chaired by Yoshiaki Kato (Professor Emeritus, Osaka University), Christopher P. J. Barty (University of California, Irvine), Reinhart Poprawe (Senior Advisor Fraunhofer Gesellschaft, Chair for Lasertechnology RWTH Aachen), and Ruxin Li (Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences).

OPIC 2021 was originally composed of 11 technical professional conferences, covering the fields of lasers and photon sources (ALPS), biomedical imaging and sensing (BISC), high energy density science (HEDS), nano-photonics and nano-optoelectronics (ICNN), IoT enabling sensing/network/AI (IoT-SNAP), laser display and lighting (LDC), laser solutions for space and the earth (LSSE), optical manipulation and structured materials (OMC), optical technology and measurement for industrial applications (OPTM), optical wireless and fiber power transmission (OWPT), and x-ray optics and applications (XOPT).

Each technical professional conference arranges remote lectures, hybrid schemes combining some face-to-face lectures, or some poster presentations, so please see the website of each technical professional conference for details. However, participation in technical professional conferences and viewing of the abstracts during OPIC 2021 will be managed collectively by OPIC, so we will give maximum consideration to the convenience of participants. Most of presentation videos will be available on the website until 21st May (Japan standard time). All registered participants will have access to all archives from the registration accounts page, including presentations at conferences other than the one they registered for (more on this later) as well as plenary lectures. The presentation archives are protected from downloading but all registered participants can access and download the full abstracts of papers presented in OPIC 2021.

The OPIC 2021 plenary session will be held at 13:00-15:00 on Tuesday 20th April. Two prominent scientists are invited to give the plenary lectures: Prof. Keisuke Goda (University of Tokyo) and Dr. Shin-ichi Nagahama (Nichia Corporation, Japan).

The organizer would like to thank all who have submitted the papers and also the invited speakers who have agreed to make presentations at OPIC 2021. Since we made every effort to make this conference very useful to all participants, we hope you will bring back many fruits from OPIC 2021 and strengthen our communication in spite of this difficult situation.

The OPI Council sincerely appreciates the authorized support of the Ministry of Education, Culture, Sports, Science and Technology (MEXT), the Ministry of Economy, Trade and Industry (METI), the Ministry of Health, Labour and Welfare (WHLW), the Ministry of Land, Infrastructure, Transport and Tourism (MLIT), and Keidanren (Japan Business Federation), Japan Science and Technology Agency (JST), New Energy and Industrial Technology Development Organization (NEDO). We appreciate cooperation with the societies and agencies in Japan, USA, Germany, China, Taiwan, and Korea. Also, we would like to thank the funding organizations and companies for their strong support of OPIC 2021.

The organizers hope that we will get together again in OPIC2022 and celebrate overcoming the virus infection.

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OPIC 2021 Plenary Session

Photonic Innovations for Pandemic Management and a Brighter World

Tuesday, 20 April, 13:00-15:00 (Japan time)

Greeting by Congress Chair

Yoshiaki Kato, *Congress Chair, Professor Emeritus, Osaka University, Japan*

Plenary Talk I

13:05-14:00

Chair, Fumihiko Kannari, *Steering Committee Chair, Keio University, Japan*

COVID-19 & Photonics

Keisuke Goda, *The University of Tokyo, Japan*

Plenary Talk II

14:05-15:00

Chair, Kazuhisa Yamamoto, *Steering Committee Vice Chair, Osaka University, Japan*

Ga-N-based Laser Diodes and Their New Applications

Shin-ichi Nagahama, *NICHIA Corporation, Japan*

Plenary Session

Plenary Speech

COVID-19 & Photonics

Keisuke Goda

Department of Chemistry, University of Tokyo
Institute of Technological Sciences, Wuhan University, China
Department of Bioengineering, University of California, Los Angeles, United States
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Abstract

The COVID-19 pandemic has dramatically changed our life. According to WHO, as of October 2020, about 10% of the world population may have been infected with the SARS-CoV-2 virus, leading to more than one million confirmed deaths. While scientists are making efforts in various sectors to beat the pandemic, photonics plays an important role in coronavirus detection as well as clinical diagnosis and therapy of COVID-19 and its complications via optical sensing, spectroscopy, and imaging. For example, infrared thermography performs real-time thermal mapping of pedestrians on the street, whereas SERS sensitively identifies viruses in airborne aerosols and wastewaters. Moreover, photonics is an essential part of PCR testing (for detecting infections) and flow cytometry (for evaluating treatment effectiveness) via fluorescence detection. In this talk, as a good example of how photonics helps beat COVID-19, I will discuss my group's work on high-throughput optical imaging to study COVID-19-associated thrombosis.

Content

The COVID-19 pandemic has dramatically changed our life. According to WHO, as of October 2020, about 10% of the world population may have been infected with the SARS-CoV-2 virus, leading to more than one million confirmed deaths. While scientists are making efforts in various sectors to beat the pandemic, photonics plays an important role in coronavirus detection as well as clinical diagnosis and therapy of COVID-19 and its complications via optical sensing, spectroscopy, and imaging. For example, infrared thermography performs real-time thermal mapping of pedestrians on the street, whereas SERS sensitively identifies viruses in airborne aerosols and wastewaters. Moreover, photonics is an essential part of PCR testing (for detecting infections) and flow cytometry (for evaluating treatment effectiveness) via fluorescence detection. Meanwhile, optical telecommunication networks for higher Internet speeds are important for helping people do efficient work during stay-at-home periods.

It is well known that the severity of COVID-19 is associated with thrombosis and that the development of thrombosis is an aggravating factor in the prognosis of COVID-19. According to the "COVID-19 Related Thrombosis Questionnaire Survey" jointly published by the Japanese Ministry of Health, Labor and Welfare, the Japanese Society of Thrombosis and Haemostasis, and the Japanese Atherosclerosis Society in December 2020, approximately 20% of COVID-19 hospitalized patients in Japan develop thrombosis, and a wide variety of complex thrombosis such as cerebral infarction, myocardial infarction, pulmonary thromboembolism, and deep vein thrombosis are observed. However, effective prevention, diagnosis, and treatment of COVID-19-related thrombosis have not yet been established. Therefore, there is an urgent need to develop appropriate thrombogenic diagnostic tools that can be used for early assessment of the risk of COVID-19-related thrombosis and evaluation of antithrombotic therapy. While progress has been made in elucidating the pathogenesis of COVID-19-related thrombosis, one of the reasons for the lack of progress in assessing the risk of onset and severity of the disease in clinical practice is the inability to simultaneously analyze information on the structure, composition, statistics, and concentration of microthrombi in vivo. Blood test markers such as D-dimer, which have been widely applied clinically and have been reported to be

associated with various COVID-19-related thromboses, are quantitative assessments of thrombus formation, and there is no diagnostic tool for accurately evaluating thrombi. In addition, there have been many reports of COVID-19 cases in which cerebral infarction was confirmed even though D-dimer levels were low, indicating that D-dimer alone is insufficient for the diagnosis of COVID-19-related thrombosis.

To overcome this problem, my group has developed a method for high-throughput optical imaging equipped with a convolutional neural network that can acquire and intelligently analyze numerous bright-field images of single platelets and platelet aggregates (e.g., platelet-platelet aggregates, platelet-leukocyte aggregates, macrothrombocytes) in the blood of patients with COVID-19. Since it has the ability to directly evaluate the structure, composition, statistics, and concentration of platelet aggregates, it is advantageous over D-dimer testing and CT, holding promise for prevention, diagnosis, and treatment of COVID-19-associated thrombosis. This will lead to a reduction in the risk of severity and mortality in Japan and worldwide, and to an early end to the COVID-19 pandemic.

Keisuke Goda is a professor in the Department of Chemistry at the University of Tokyo in Japan, an adjunct professor in the Institute of Technological Sciences at Wuhan University in China, and an adjunct professor in the Department of Bioengineering at UCLA in USA. He obtained a BA degree from UC Berkeley summa cum laude in 2001 and a PhD from MIT in 2007, both in physics. At MIT, he worked on the development of gravitational-wave detectors in the LIGO group which led to the 2017 Nobel Prize in Physics. After several years of work on high-speed imaging and microfluidics at Caltech and UCLA, he joined the University of Tokyo as a professor in 2012. His research group focuses on the development of serendipity-enabling technologies based on laser-based molecular imaging and spectroscopy together with microfluidics and computational analytics to push the frontier of science. He has published >300 papers including many in top journals, filed >30 patents, and received numerous awards such as JSPS Prize, Japan Academy Medal, Yomiuri Gold Medal, MEXT Prize, and SPIE Biophotonics Technology Innovator Award. He is a fellow of SPIE and RSC.

Plenary Speech

GaN-Based Laser Diodes and Their New Applications

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Abstract

Visible light Laser Diodes (LDs) have many features that other light sources do not have, such as wide color reproduction range, small size, robustness, long lifetime, low power consumption, and small etendue. Recently, in GaN-based LDs, Green LDs have been mass-produced in addition to Blue LDs. By adding existing AlGaInP-based red LDs to these, RBG LDs are now available. As a result, laser displays that use LDs as the light source for laser TVs and laser projectors have been commercialized more and more. Currently, laser displays using visible light LDs are growing in the market. In addition to consumer applications, visible light LDs are also being used in new applications such as vehicles, lighting, and industrial applications such as laser processing. In this presentation, we will report on our history and current status of the development of GaN-based LDs and outline their new applications

Content

For GaN-based direct transition semiconductors, it is possible to fabricate crystals composed of AlxGayIn1-x-yN, and the bandgap at room temperature ranges from 0.8eV [1] for InN to 6.2eV [2] for AlN. Theoretically, it can cover not only blue to green region, but also infrared to vacuum ultraviolet region. In addition, compared to GaAs-based and ZnSe-based semiconductors, GaN-based semiconductors are environmentally friendly materials that do not contain any harmful substances even if they contain dopant materials. Since the first GaN-based semiconductor to achieve laser emission at the wavelength of 410 nm by current injection in 1995 [3], the characteristics of Laser Diodes (LDs) have improved dramatically [4,5,6,7,8,9]. In early 2000, it was widely used for large-capacity optical discs such as Blu-ray DiscsTM. In recent years, the emission wavelength range has expanded from blue [10] to the long wavelength range such as green [11,12,13] and which is attracting attention as light sources for laser displays.

Figures 1 and 2 show the progress of improving the Wall Plug Efficiency (WPE) of our blue and green LDs. Our blue LDs have been improved after the development of the blue LD of the light output of 1W and the WPE of 22% in 2007[11,14]. The WPE of our LDs at room temperature has increased more than twice and the light output has increased more than 5 times. The WPE of 48.1% and the optical output power of 5.67 W at operating current of 3A of our blue LD was reported in 2020 [15]. Although WPE of green LDs is lower than

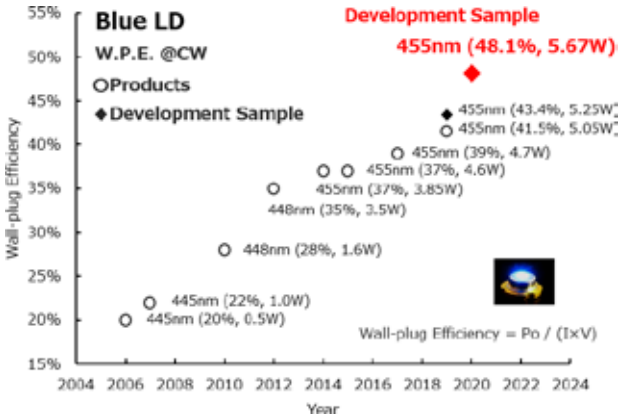

Fig. 1 The progress of blue LDs

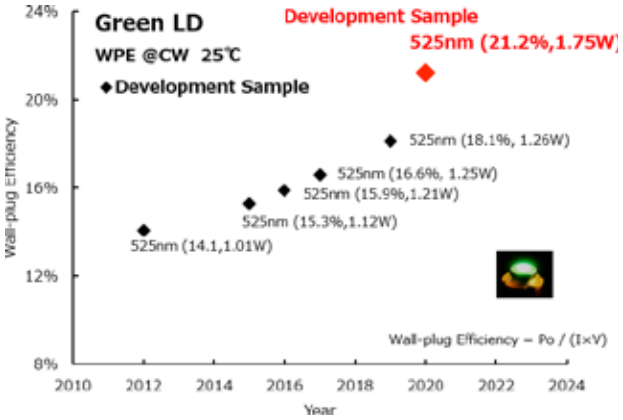

Fig. 2 The progress of Green LDs

that of blue LDs, green LDs are improving year by year like those blue LDs. Finally, the WPE of 21.2% and the optical output power of 1.75W of green LD are realized in 2020 [15].

In addition to commercialized AlInGaP-based red LDs, newly developed GaN-based blue and green LDs are being applied to the light sources for displays such as projectors [16]. These LDs have the advantages of having a wide color reproduction range, low power consumption, a small light emitting area of the light sources, and the feasibility of downsizing the devices.

The characteristics of LDs have been improved, and LDs have many advantages such as small size, robustness, and long lifetime. As a result of the use of GaN-based LDs as light sources for displays and the expansion of the market, the lights source cost has become more reasonable price. In this presentation, we will introduce examples of new applications starting, for automobiles such as LD headlights and HUDs, and for metal processing such as copper materials.

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Shin-ichi Nagahama is Principal Researcher and General Manager of LD business unit at Nichia corporation. He joined Nichia in 1991 and participated in the development of GaN-based blue LEDs. And in 1993, Nichia announced the world's first high-brightness blue LED. The following year, in 1994, he started developing GaN-based violet LDs, and succeeded in the world's first GaN-based LD emission by current injection in 1995. After that, he pushed forward with the development to cover a wider range of emission wavelengths, and as a result, UV (375 nm) to blue (460 nm) and green (532 nm) LDs have been commercialized. In 2002, he received his Ph.D. from Tokushima University, Japan. He has written more than 100 patents on GaN-based light emitting devices in Japan and more than 200 in foreign countries.

OPIC 2021

Specialized International Conferences

Conference Chairs' Welcome Letters & Committees

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The 10th Advanced Lasers and Photon Sources ALPS 2021

Sponsored by
The Laser Society of Japan

Conference Co-Chair **Hitoki Yoneda**

Institute for Laser Science, University of Electro-Communications

We are delighted to welcome you to the 10th Advanced Lasers and Photon Sources Conference (ALPS 2021).

It is great pleasure for us to have the 10th anniversary conference ALPS in this year. From the start year, ALPS conference is keeping to cover the science and technology related to lasers and photon sources, related basic research and industrial applications. As well known, excellent light sources are key components and technologies to promote and develop new scientific field and many applications. Role of the ALPS is exchanging the idea and the information related to these sophisticated light sources and new applications. This is the main reason why we can keep attractive conference condition during these ten years.

The ALPS conference is organized as part of the OPTICS & PHOTONICS International Congress (OPIC 2021), which consists of twelve optics-related scientific conferences. In the 10th ALPS we will have more than 100 excellent presentations to cover the recent advanced in this scientific field including 26 invited talks. The field included are novel optical materials, high average power lasers, high peak power lasers, novel solid-state, fiber, diode lasers, shorter wavelength light sources, terahertz devices, novel optical devices, optical frequency combs and their applications.

People knows that we still have severe limitation to move to the abroad and held the face-to-face conference due to the COVID-19. However, scientist's interests can exceed this limit and we believe we will have fruitful discussion time in 10th ALPS meeting. You are very welcome to join us and to enjoy your time at the ALPS conference.

Biomedical Imaging and Sensing Conference BISC 2021

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Conference Chair **Toyohiko Yatagai**

Center for Optical Research and Education, Utsunomiya University

On behalf of the organizing committee and program committee, it is our great pleasure that the 7-th Biomedical Imaging and Sensing Conference in Chiba University is going to open, within the framework of the OPTICS & PHOTONICS International Congress (OPIC 2021). Due to spreading of COVID-19, the conference this year is performed as a hybrid conference, an oral presentation and a digital presentaion via an internet system.

In biomedical optics and photonics, optical tools are employed for understanding and treatment of diseases, from the cellular level to macroscopic applications. At the cellular level, highly precise laser applications allows the manipulation, operation or stimulation of cells, even in living organisms or animals. Optical microscopy has been revolutionized by a thorough understanding of the different markers and their switching behavior. marker-free microscopy, like SHG or THG-microscopy is spreading into multiple biological and clinical imaging applications. OCT is continuously broadening its clinical applicability by even higher resolution, higher speed and more compact and the use of Doppler and polarization sensitivity for functional imaging.

In the field of optics and photonics, biomedical imaging and sensing areas are most quickly progressing and expanding. Techniques developed in these areas could bring us great steps in advances of physical, engineering and biological knowledge as well as optics and photonics technology. This Conference aims at covering several aspects from the fundamental studies at cellular level to clinical applications of various optical technologies.

Finally we hope the 7-th Biomedical Imaging and Sensing Conference contributes to the progress in this field and we hope you enjoy fruitful discussions in the Conference.

International Conference on High Energy Density Sciences 2021 HEDS 2021

Organized by
ILE, Osaka University; JSPS AsianCore program; Laser Society of Japan

Conference Chair
Youichi Sakawa
Osaka Univ., Japan

Conference Chair
Ryosuke Kodama
Osaka Univ., Japan

We are delighted that you have joined the 10th International Conference on High Energy Density Sciences (HEDS 2021) within the framework of OPICS & PHOTONICS International Congress (OPIC 2021), consisting of 12 Optics-related scientific conferences.

The main topic of HEDS 2021 is "Laser Astrophysics." "Laser Astrophysics," which combines the different fields of "astrophysics" and "power-laser engineering" with the keyword "plasma," is an interdisciplinary academic field. We would like to provide laboratory plasma researchers and astrophysical researchers with an opportunity to meet together and deepen their collaboration.

HEDS 2021 is co-sponsored by the Institute of Laser Engineering, Osaka University; the JSPS Core-to-Core Program, Asia-Africa Science Platforms; and the Laser Society of Japan.

We hope you enjoy your time during the conference, held both online and in-person at Osaka University.

International Conference on Nano-photonics and Nano-optoelectronics ICNN 2021

Sponsored & Organized by
Institute for Nano Quantum Information Electronics, The University of Tokyo

The General Chair **Yasuhiko Arakawa**
The University of Tokyo

We warmly welcome you to the International Conference on Nano-photonics and Nano-optoelectronics (ICNN 2021). The development of nanoscale devices is an area of research making great strides in both academic and industrial laboratories around the world. ICNN has been organized for the purpose of bringing together likeminded researchers working in the areas of nano-photonics and nano-optoelectronics, and to provide ample opportunities for peer interaction, inspiring presentations, exciting discussions, and invigorating debates. We are pleased to organize ICNN 2021 as one of the international scientific meetings of the Optics & Photonics International Congress 2021 (OPIC 2021).

The two and a half-day program of ICNN 2021 consists of oral sessions and poster session with 4 keynote talks, 11 invited talks, oral contributed talks, and poster presentations. In ICNN 2021, recent advances in nano-photonics and nano-optoelectronics will be featured by our 15 distinguished keynote and invited scientists; Harish Bhaskaran (UK), Chennupati Jagadish (Australia), Susumu Noda (Japan), Johann-Peter Reithmaier (Germany), Debashis Chanda (USA), Alexander Dorodnyy (Switzerland), Mark Holmes (Japan), Tobias Kippenberg (Switzerland), Di Liang (USA), Rupert Oulton (UK), Robert E. Simpson (Singapore), Takuo Tanaka (Japan), Din Ping Tsai (Hong Kong), Qi Jie Wang (Singapore), and Shiyoshi Yokoyama (Japan).

As the General Chair of ICNN 2021, I would like to express my sincere gratitude to all the oral speakers and poster presenters to discuss their technical achievements. Moreover, I thank all the conference committee members for their great contribution to the success of ICNN 2021, in particular, the program committee members for their critical reviewing of submitted papers.

We wish that all the participants enjoy fascinating presentations and discussion at ICNN 2021.

IoT Enabling Sensing/Network/AI and Photonics Conference
IoT-SNAP 2021

Sponsored & Organized by
The Graduate School for the Creation of New Photonics Industries (GPI)

Conference Chair
Norihiro Hagita
ATR Norihiro Hagita Laboratory, Japan

Conference Chair
Ronald Freund
Fraunhofer Heinrich Hertz Institute, Germany

Welcome to the IoT-SNAP2021. It will be held in virtual during 20th-23rd April, 2021.

The number of devices connected to IP networks will be more than three times the global population by 2023. There will be 29.3 billion networked devices by 2023, which accounts 3.6 devices per capita. Among them 14.7 billion will be Machine-to-Machine (M2M) connections.

Digital transformation (DX) is underway in many sectors such as manufacturing, automotive and transportation, and agriculture. IoT offers a great market opportunity both for M2M communication platformer as well as Over-The-Top (OTT) players or the application platformers.

IoT-SNAP has been inaugurated in 2018. The focus for IoT-SNAP are on the core technologies for SNAP, that is Sensing, Network, AI, and Photonics along with its applications and use cases. The participants from various sectors over the world, including the industries and academia will have opportunities to hear the cutting-edge technology of IoT and the novel use cases and exchange opinions on the IoT perspectives.

Category 1
Core Technologies
- Cyber physical security
- IoT wired/wireless networks
- Beyonnd 5G/6G
- AI/machine learning
- Big data analytics/science
- MOBILE edge computing
- Image processing
- Connected sensor systems
- Compressed sensing
- Others

Category 2
Applications and use cases
- Prevention and control for pandemics, COVID-19
- Healthcare and biomedical applications
- Smart city
- Smart mobility/MaaS
- Precision/smart agriculture
- Smart/flexible factory
- Smart civil engineering, construction and monitoring
- xR (VR/AR/MR) applications
- Field trial and social implementation
- Others

Category 3
Photonics Technologies
- Sensor/fiber sensor
- Imaging/image sensor
- Virus/biomedical sensor
- LiDAR
- Active and passive devices
- Integrated photonics
- Metasurface devices
- Terahertz
- Robotics
- Optical interconnect
- Visual light communications
- Underwater applications
- Others

Laser Display and Lighting Conference 2021
LDC 2021

Sponsored by
The Optical Society of Japan

Conference Co-chair
Prof. Kazuo Kuroda
Utsunomiya Univ.

Conference Co-chair
Prof. Hiroshi Murata
Mie Univ.

Conference Co-chair
Dr. Fergal Shevlin
DYOPTYKA

Welcome to the 10th Laser Display and Lighting Conference, LDC 2021!

LDC is an international conference on laser displays, laser lighting, and related technologies. The 1st, 2nd, 4th, and 6~8th LDC were held in Yokohama, Japan in 2012, 2013, 2015, and 2017~2019, respectively, the 3rd in Taichung, Taiwan in 2014, and the 5th in Jena, Germany in 2016. The 9th LDC was intended to be held in Yokohama, Japan, and switched to an on-line conference owing to the COVID-19 situation. The 10th LDC, LDC 2021 is being held as an on-line conference from 19st to 22nd April 2021. LDC 2021 is sponsored by the Optical Society of Japan, in cooperation with several academic societies and associations, and is operated by the Laser Display Research Group, the Optical Society of Japan.

LDC 2021 is intended to provide a central forum for the update and review of scientific and technical information on laser display and lighting covering a wide range of fields from fundamental research to systems and applications.

A total of 34 papers will be presented during the 4-day conference, consisting of 2 keynote talks, 15 invited papers, and 17 contributed papers; the relatively small number of submissions seems related to the difficulty of undertaking work of sufficient novelty for LDC over the last year due to the consequences of COVID-19 on our professional activities. A few post-deadline papers may be accepted.

In LDC 2021, three special sessions focusing on advanced AR, MR, VR XR technologies will be held on 19th and 20th April, where we will have stimulating invited talks from 6 expert speakers and contributed talks from 6 active speakers. Two exciting special sessions entitled 'Laser Technologies for Automotive Applications' will also be held with a number of distinguished speakers on 21st April. In these special sessions, state-of-the-art visible laser technology including excellent laser headlamps, advanced lidar, and new challenges for automotive, will be presented and discussed. After all the technical sessions, a ceremony for the LDC Best Paper Award and the LDC Student Award will be held for exceptional papers commended for their outstanding achievement.

We would like to extend our sincere thanks to all the presenters and participants of LDC 2021 for their contribution to the success of the conference. We also express our sincere thanks to the Takano-Eiichi Hikari-Kagaku-Kikin (Optical Science Foundation), the Japanese Society of Applied Physics, for the financial support. We hope that all the attendees enjoy the conference.

Laser Solutions for Space and the Earth 2021
LSSE 2021

Sponsored by
The Executive Committee of Laser Solution for Space and the Earth

Conference Chair **Toshikazu Ebisuzaki**
RIKEN

We are pleased that you have joined in Yokohama to attend to Laser Solutions for Space and the Earth (LSSE 2021). This is the 6th conference of LSSE organized as a part of the OPTICS & PHOTONICS International Congress (OPIC 2021). The aim of "Laser Solutions for Space and the Earth" is to discuss the application of emerging laser technologies to solve various problems for sustainable developments of space and the Earth.

We will organize the special session dedicated to the laser and other technologies against the pandemic due to the covid-19 virus, inviting two keynote lectures of Prof. Yoshihide Hayashizaki (RIKEN) and Prof. Yoko Aida. We also featured "Agri-Photonics (Smart agriculture and Laser plant factory)", "Infrastructure (Non-destructive Testing and Laser-Induced Breakdown Spectroscopy)", "Active Remote Sensing (Extreme Condition and Industrial Application)" and "Space Technology (Laser Debris Deorbit and UV imaging)", as the featured topics of the year 2021.

Taking into account the covid-19 pandemic situation, the session will take place via a remote conference system.

We hope you could enjoy the inspiring discussions in the many research fields in our conference, as we did in the last four conferences. We are looking forward to seeing you in April.

Optical Manipulation and Structured Materials Conference 2021 OMC 2021

Sponsored by
SPIE. and JSPS KAKENHI "Nano-material optical manipulation"

OMC 2021 Conference Chair **Takashige Omatsu**

Chiba Univ.
omatsu@faculty.chiba-u.jp

Since the first demonstration of an optical tweezer based on optical radiation forces (scattering and gradient forces) created by a tightly focused laser beam, optical tweezers have been widely investigated in a variety of research fields, including biology, physics, and chemistry.

Conventional optical tweezers have been mostly adopted to dielectric particles with a dimension range from hundreds of nanometers to tens of micrometers. However, they do not always enable us to efficiently trap metallic particles.

In recent years, plasmonic tweezers based on enhanced radiation forces owing to surface plasmon polaritons in metallic nanostructures have been successfully demonstrated to efficiently trap and manipulate both nanosacle-sized dielectric and metallic particles.

Also, structured lights, such as higher order Laguerre-Gaussian and Bessel beams carry optical angular momenta, and they provide unique tweezing abilities, for instance, for inducing an orbital motion of the trapped particles without employing mechanical systems.

Since 2014, the OMC has successfully collected more than 80 participants from home and abroad. The OMC 2021 conference will be held in Chiba University, and it aims to present and discuss up-to-date scientific subjects, new technologies, and applications related to the fields of optical and plasmonic tweezers, the manipulation of nanostructures, structured optical fields and their satellite topics.

The OMC 2021 will also have a special session to mourn the passing of Arthur Ashkin (Nobel Laureate), and Juan José Sáenz, known for his extraordinary accomplishments in optical trapping.

We hope that this conference will also facilitate scientific and professional networking as well as scientific inspiration through discussions.

Optical Technology and Measurement for Industrial Applications 2021 OPTM 2021

Sponsored by **SPIE., The Japan Society for Precision Engineering (JSPE)**

Conference Co-Chair
Takeshi Hatsuzawa
Laboratory for Future Interdisciplinary Research of Science and Technology (FIRST), Tokyo Institute of Technology

This is the third conference of OPTM (Optical Technology and Measurement for Industrial Applications Conference) since 2019. More than 50 presentations including oral and poster in 2019, and 20 oral and 15 poster presentation in 2020 have been presented. Although conference restrictions are increasing due to the spread of COVIDF-19, it looks like the OPTM activity has taken root among researchers.

The aim of the OPTM 2021 is to provide an international opportunity for introducing up-to-date technology in the filed of optical measurement and their applications for industries, at the same time, providing a networking opportunity among young researchers and students is another important role of the conference. Also in the venue, other optics related exhibitions and conferences will be hold, which will be a good chance to foster interest in different technical fields. We hope your visit to port of Yokohama will be a nice experience in your technical and research carrier.

Conference Co-Chair
Rainer Tutsch
Technische Universität Braunschweig

It is really a pleasure to me to welcome you to the third Conference of Optical Technology and Measurement for Industrial Applications. This year again the program committee was able to arrange a set of presentations that give an insight into various fields of optical metrology, covering topics from theoretical simulation to industrial applications. In these hard times of limited access to laboratories and travel restrictions this is not a matter of course and I want to express my appreciation to the members of the program committee and special thanks to the program committee chair, Professor Yukitoshi Otani. The young OPTM conference series is on a good way to become a cornerstone event for the scientific community in optical metrology.

Though I am happy that today´s information technology makes it possible to attend this conference even without being able to travel, it makes me sad that we do not have the opportunity to meet physically. International personal contacts are essential for the progress of science. The annual OPIC conference and trade fair event at Yokohama is an excellent setting for meeting international colleagues. I wish OPIC a flourishing future in the following years.

Even if you are not able to visit Yokohama this year I wish all of you a pleasant OPTM conference. I am sure that for everybody there is some new information to find and maybe you get aware of a colleague whom you did not know before.

Enjoy the conference and hopefully we will meet again next year at Yokohama!

Conference Co-Chair
Toru Yoshizawa
Tokyo University of Agriculture and Technology, Prof. Emeritus
Non-Profit Organization: 3D Associates, Director

We are delighted to have the 3rd conference on Optical Technology and Measurement for Industrial Applications (OPTM) as part of OPIC 2021. These years we have been forced to persevere through difficult times caused by natural (and human-made) disaster, and especially coronavirus pandemic.

This conference has potentially its origin in SPIE meetings and relates in any way to another concept optomechatronics that was originally born in Japan.

Conventionally research is apt to be evaluated higher from the theoretical or analytical viewpoint.

However, in addition to theoretical or analytical result, research should be also assessed from practical utility. Industrial-application-conscious research as well as fundamental research should be attracted more attention.

In the near future, after we succeed in overcoming problems, we expect truly useful and excellent result will be realized from the academic and practical viewpoint.

Let's enjoy this meeting and produce new result by exchanging opinions.

Optical Wireless and Fiber Power Transmission Conference 2021 OWPT 2021

Sponsored by
Optical Wireless Power Transmission Committee,
The Laser Society of Japan

Conference Chair **Tomoyuki Miyamoto**

Tokyo Institute of Technology

It is our great honor to welcome you to the 3rd Optical Wireless and Fiber Power Transmission Conference (OWPT 2021).

The OWPT 2021 is the international conference which is intended to provide a central forum for updating and reviewing scientific and technical information on optical wireless power transmission and optical fiber power transmission by covering a wide range of fields from fundamental research to systems and applications. The OWPT 2021 is organized as part of the OPTICS & PHOTONICS International Congress (OPIC 2021), which consists of 12 optics and photonics-related scientific conferences. The OWPT 2021 is sponsored by Optical Wireless Power Transmission Committee, the Laser Society of Japan in cooperation with Study Group of Optical Wireless Power Transmission in Japan. The OWPT 2021 consists of 1 plenary talk, 2 special talks, 11 invited talks, and more than 27 contributed papers aiming at great developments of the field covering novel materials/devices and components, systems and subsystems, applications, and related topics.

On the other hand, due to the new coronavirus (COVID-19) infections, the OWPT 2021 will be held as virtual (online). We would deeply appreciate your cooperation and understanding on our decision.

We hope that you join to the community and get latest activities and achievements of the scope of the OWPT 2021.

International Conference on X-ray Optics and Applications 2021 XOPT 2021

Co-Sponsored by
RIKEN SPring-8 Center
Research Center for Ultra-Precision Science & Technology, Osaka Univ.
Technical Committee for Ultraprecision Machining of JSPE

Conference Co-chair
Tetsuya Ishikawa
RIKEN

Conference Co-chair
Kazuto Yamauchi
Osaka University

We are pleased to host the International Conference on X-ray Optics and Applications (XOPT 2021) as part of the Optics and Photonics International Congress 2021 (OPIC 2021).

X-rays have played a vital role in many breakthrough scientific discoveries in recent years. Continuous innovations in X-ray optics, methodologies, and beamline instruments have laid the foundation for these achievements. For this conference, we are inviting leading experts in these fields worldwide to share the latest status of X-ray technology and developments and discuss their plans for the future. One important topic we would like to discuss is how state-of-the-art X-ray optics can explore the potential of the emerging DLSR (Diffraction-Limited Synchrotron Radiation) sources.

This year, due to the recent Coronavirus outbreak, XOPT 2021 will be held in a hybrid format, combining in-person (Osaka, Japan) and virtual presentations, on April 19 (Mon). For details, please visit the XOPT homepage (https://xopt.opicon.jp/).

We are happy to welcome you to participate in and enjoy the conference.

Conference Chairs
Tetsuya Ishikawa *RIKEN*
Kazuto Yamauchi *Osaka University*

Program committee
<Chair>
Makina Yabashi *RIKEN, Japan*
<Members>
Harald Sinn *European XFEL, Germany*

Steering committee
<Chair>
Jumpei Yamada *RIKEN, Japan*
<Members>
Ichiro Inoue *RIKEN, Japan*
Hidekazu Mimura *The University of Tokyo, Japan*
Satoshi Matsuyama *Nagoya University, Japan*
Hirokatsu Yumoto *JASRI, Japan*
Taito Osaka *RIKEN, Japan*
Takashi Kimura *The University of Tokyo, Japan*
Akihisa Takeuchi *JASRI, Japan*
Wataru Yashiro *Tohoku University, Japan*

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BISC & OMC

Tuesday, 20 April

[BISC & OMC] 8:45-10:15
Joint Session
Chair: Osamu Matoba
Kobe University

JS-Opening 8:45

Opening Remarks

BISC & OMC-01 9:00 ***Invited***

Photoacoustic Tomography and Compressed Ultrafast Photography
Lihong V. Wang
California Institute of Technology
Photoacoustic tomography (PAT) provides *in vivo* omniscale functional, metabolic, molecular, and histologic imaging across the scales of organelles through organisms. Compressed ultrafast photography (CUP) records 70 trillion frames per second in real time.

BISC & OMC-02 9:45 ***Invited***

Polarized Structured Illumination Microscopy
Karl Zhanghao[1,2], Meiqi Li[1,2], Peng Xi[1,2]
[1]Peking University, [2]Southern University of Science and Technology
Super-resolution (SR) microscopy provides the ultrastructure of subcellular organelles, yet conventional SR lacks the dipole orientation information. We developed polarized structured illumination microscopy (pSIM) to achieve fluorescence super-resolution polarization microscopy.

ALPS

Monday, 19 April

ALPS-1~6

[ALPS-Opening] 9:00-9:15
Opening Remarks
Chair: Hitoki Yoneda
Institute for Laser Science, University of Electro-Communications

[ALPS-1] 9:15-10:45
Novel optical materials/structure and applications
Chair: Shunsuke Kurosawa
Tohoku University

ALPS-1-01 9:15 ***Invited***

Novel single crystal halide scintillators based on Cs-Cu-I compositions
Martin Nikl[1], Shuangliang Cheng[2,3], Alena Beitlerova[1], Romana Kucerkova[1], Eva Mihokova[1], Guohao Ren[2], Yuntao Wu[2]
[1]Institute of Physics, Academy of Sciences of The Czech Republic, [2]Shanghai Institute of Ceramics, Chinese Academy of sciences, [3]University of Shanghai for Science and Technology
Novel single crystal halide scintillators based on undoped $CsCu_2I_3$and $Cs_3Cu_2I_5$ perovskite single crystal are presented. They show a unique combination of non-hygroscopic, self-absorption free, medium fast scintillation response, high light yield and ultralow afterglow characteristics which make them competetive for a number of applications.

ALPS-1-02 9:45 ***Invited***

(Tentative) Recent progress in nonlinear optical borate crystal
Zhanggui Hu
Tianjin University of Technology
This report will introduce the current research progress on nonlinear optical crystals in the DUV, UV, mid-far IR and terahertz ranges. In particular, the progresses on growth of large LiB_3O_5 and $KTiOPO_4$ will be reported.

ALPS-1-03 10:15

Electron density imaging of ultrafast plasma dynamics with two-color STAMP
Keitaro Shimada[1], Yuki Inada[2], Ayumu Ishijima[1], Takao Saiki[1], Ichiro Sakuma[1], Keiichi Nakagawa[1]
[1]The University of Tokyo, [2]Saitama University
We propose novel usage of two-color sequentially timed all-optical mapping photography for electron density imaging in under-dense plasma. The electron density distribution in air breakdown plasma ranged from 10^{24} to 10^{25} m^{-3}.

ALPS-1-04 10:30

Rod-Type Ce/Cr/Nd:YAG Ceramic Lasers Using White Light Pump Source
Taku Saiki[1], Tatsuya Iwatani[1], Hiroaki Furuse[2], Shinji Motokoshi[3], Yasushi Fujimoto[4], Masahiro Nakatsuka[3]
[1]Kansai University, [2]Kitami Institute of Technology, [3]Institute for Laser Technology, [4]Chiba Institute of Technology
Rod-type Ce^{3+}/Cr^{3+}/Nd:YAG ceramic pumped by white light such as solar light or flash lamp light was developed. Laser oscillations at free running mode were observed. The maximum output laser energy of 73 mJ was obtained.

[ALPS-2] 11:15-12:00
Mid-Infrared fiber sources
Chair: Shigeki Tokita
Osaka University

ALPS-2-01 11:15 ***Invited***

Towards power scaling of mid-infrared fiber lasers
Martin Bernier, Vincent Vincent Fortin, Yigit Ozan Aydin, Sebastien Magnan-Saucier, Real Vallee
COPL, Laval University, Canada
Output power from mid-infrared fiber lasers are now approaching the 50W-level, thanks to the rapid development of high performance fluoride fiber-based components. Recent results and strategies for further power scaling will be discussed.

ALPS-2-02 11:45

Multi-octave coherent supercontinuum generation under anomalous dispersion regime in ZBLAN fiber based on a master oscillator fiber amplifier
Seyed Ali Rezvani[1], Kazuhiko Ogawa[2], Takao Fuji[1]
[1]Toyota Technological Institute, [2]FiberLabs Inc.
A fully stable supercontinuum spanning from 0.35-4.5 μm is generated under anomalous dispersion in polarization-maintaining ZBLAN fiber using pulses at the vicinity of 2 μm from a master oscillator fiber amplifier

ALPS-7~11

[ALPS-7] 9:15-10:45
Quantum optics and their applications1
Chair: Masahiro Takeoka
NICT

ALPS-7-01 9:15 ***Invited***

Entangled Sensor Networks Empowered by Machine Learning
Zheshen Zhang[2,1], Yi Xia[1], Wei Li[2], Quntao Zhuang[3,1]
[1]J. C. Wyant College of Optical Sciences, University of Arizona, [2]Department of Materials Science and Engineering, University of Arizona, [3]Department of Electrical and Computer Engineering, University of Arizona
We report the experimental demonstration of supervised learning assisted by an entangled sensor network (SLAEN). We show an entanglement-enabled reduction in the error probability for classification of multidimensional radio-frequency signals.

ALPS-7-02 9:45

High-visibility two-photon interference with ultra-fast pumping laser
Yoshiaki Tsujimoto, Kentaro Wakui, Mikio Fujiwara, Masahide Sasaki, Masahiro Takeoka
National Institute of Information and Communications Technology
We report on the observation of high-visibility two-photon interference between heralded single photons generated by spontaneous parametric down-conversion with 3.2 GHz-repetition-rate mode-locked pump pulses.

ALPS-7-03 10:00

Evaluating an integrated silicon photonic nonlinear interferometer
Takafumi Ono[1,2], Gary F. Sinclair[3], Damien Bonneau[3], Mark G. Thompson[3], Jonathan F. C. Matthews[3], John G. Rarity[3]
[1]Kagawa University, [2]PRESTO, [3]University of Bristol
We experimentally observed constructive and destructive quantum interference in the production rate of the photon pairs generated by spontaneous four wave mixing of silicon waveguide.

ALPS-7-04 10:15

Arbitrary Mixing of Spectral Multimode Quantum States with Dispersion-Engineered Nonlinear Waveguide Crystal
Yuta Yamagishi[1], Aruto Hosaka[1], Kazufumi Tanji[1], Sunao Kurimura[2], Fumihiko Kannari[1]
[1]Keio University, [2]National Institute for Materials Science
As a method of quantum pulse gating in a quantum simulator, an arbitrary mixing method of multimode quantum states prepared in the frequency domain is experimentally demonstrated.

ALPS-7-05 10:30

Joint spectral intensity of two-photon emission from biexciton
Hiroya Seki[1], Dongeun Son[1], Yuta Uchibori[2], Jun Ishihara[2], Kensuke Miyajima[2], Ryosuke Shimizu[1]
[1]The University of Electro-Communications, [2]Tokyo University of Science
Conventional spectral measurements are insufficient for characterizing a photon photon-pair spectrum. We present a two-photon spectral measurement in 2D space to investigate nonlinear light-matter interactions and demonstrate it with photon-pair from biexciton.

[ALPS-8] 11:15-12:15
Quantum optics and their applications2
Chair: Ono Takafumi
Kagawa University

ALPS-8-01 11:15 ***Invited***

Quantum sensing using photons
Ryo Okamoto[1,2]
[1]Department of Electronic Science and Engineering, Kyoto University, [2]PRESTO, Japan Science and Technology Agency
Quantum sensing using photons is attracting attention since it outperforms sensing with classical light. Here we introduce recent progress of our theoretical and experimental studies on quantum sensing using photons.

ALPS-8-02 11:45

MIR single-shot ultrafast imaging with a combination of SF-STAMP and quantum imaging based on induced coherence with induced emission
Kazuki Takahashi, Riku Watase, Aruto Hosaka, Fumihiko Kannari
Keio University
We show that quantum imaging based on induced coherence with induced emission is possible, and propose a new mid-infrared single-shot ultrafast imaging scheme with a combination of SF-STAMP and quantum imaging.

ALPS-8-03 12:00

Colloidal quantum dots as high-performance single-photon sources: Improvements in purity and system efficiency
Toshiyuki Ihara[1], Shigehito Miki[1,2], Fumihiro China[1], Toshiki Yamada[1], Hirotaka Terai[1]
[1]National Institute of Information and Communications Technology, [2]Kobe University
We developed an advanced technique to improve the performance of single-photon source comprising of colloidal quantum dots. High single-photon purity showing $g^{(2)}(0)$=0.001 and high system efficiency of 1.4 % were observed.

ALPS

Monday, 19 April

ALPS-1~6

[ALPS-3] 13:00-14:15
Mode-locked oscillators
Chair: Masaki Tokurakawa
University Electro-Communications

ALPS-3-01 13:00 ***Invited***

Compact Kerr-lens mode-locked lasers
Shota Kimura, Shuntaro Tani, Yohei Kobayashi
The University of Tokyo
We developed a compact Kerr-lens mode-locked laser with a pulse repetition rate above 20 GHz. We also developed a Q-switched Kerr-lens mode-locked lasers with a repetition rate of 36 GHz.

ALPS-3-02 13:30

Kerr-lens mode-locked Yb:CaF_2 oscillator directly pumped by a laser diode
Satoshi Nakamura, Yuya Suzuki, Akira Shirakawa
The University of Electro-Communications
We demonstrated a Kerr-lens mode-locked Yb:CaF_2 oscillator with diode excitation.The shortest pulse duration of 85 fs with 220 mW average power was achieved. 133 fs, 510 mW pulses were also obtained.

ALPS-3-03 13:45

Development of Supercontinuum Laser Source at 2 μm Wavelength Using Tm-Ho co-doped Ultrashort Pulse Fiber Laser and OCT Imaging
Junya Yamamoto[1], Masahito Yamanaka[1], Ying Zhou[2], Takeshi Saitoh[2], Youichi Sakakibara[2], Norihiko Nishizawa[1]
[1]The University of Nagoya, [2]National Institute of Advanced Industrial Science and Technology
Highly efficient Tm-Ho co-doped ultrashort pulse fiber laser operating at 1.9 μm was developed using single wall carbon nanotube. Wideband supercontinuum at 2.0 μm was generated and high-resolution OCT imaging of human tooth was demonstrated.

ALPS-3-04 14:00

Transient dynamics of an ANDi mode-locked Yb-fiber laser oscillator monitored by time-stretch dispersive Fourier transform
Tomohiro Ishikawa[1], Muku Yoshizawa[2], Keisuke Isobe[1,3], Katsumi Midorikawa[1], Fumihiko Kannari[2]
[1]RIKEN, [2]Keio University, [3]Kyoto University
We investigated a gain-dependent transitional behaviour in build-up and shut-down processes of an ANDi mode-locked Yb fiber oscillator using a time-stretch dispersive Fourier transform scheme.

[ALPS-4] 14:45-15:45
High peak power fiber lasers
Chair: Shunichi Matsushita
Furukawa Electric Co., Ltd.

ALPS-4-01 14:45 ***Invited***

Coherent beam combining of large-scale fiber laser array: enabling technique and recent progress
Pu Zhou, Hongxiang Chang, Qi Chang, Tianyue Hou, Wenchang Lai, Yuqiu Zhang, Bo Ren, Tao Wang, Can Li, Pengfei Ma, Rongtao Su, Jian Wu, Yanxing Ma
National University of Defense Technology, China
In this presentation, we will introduce the enabling technique and recent progress for coherent beam combining of large-scale fiber lasers in our research group. Representative results, such as more than 500 W single frequency fiber laser, phase control of more than 100 laser channels, and experimental results in the case of atmosphere, will be provided and discussed.

ALPS-4-02 15:15

Generation of high energy ultrashort pulse using chirped pulse amplification and divided pulse amplification
Kota Sugimoto, Henrik Tünnermann, Akira Shirakawa
The University of Electro-Communications
We demonstrated fiber pulse amplification implementing divided pulse amplification together with chirped pulse amplification. And the combining efficiency is discussed.

ALPS-4-03 15:30

Laser Material Processing System Based on High-Peak-Power, Pulse-Width-Tunable Sub-Nanosecond Fiber Laser
Yutaka Nomura[1], Takeshi Hama[1], Masaki Iwama[1], Miyuta Naritomi[1], Ryo Kawahara[1], Jeffrey W. Nicholson[2], Shun-ichi Matsushita[1]
[1]Furukawa Electric Co. Ltd., [2]OFS Laboratories
A laser material processing system is developed based on a high-peak-power, pulse-width tunable sub-nanosecond erbium-doped fiber laser. Polyethylene terephthalate films with indium tin oxide coatings are processed with various laser parameters.

ALPS-7~11

[ALPS-9] 13:00-13:45
Optical frequency combs / Frequency stabilized lasers and applications1
Chair: Kaoru Minoshima
University Electro-Communications

ALPS-9-01 13:00 ***Invited***

Kerr solitons in photonic-crystal resonators
Scott Papp
NIST, US

ALPS-9-02 13:30

Generation of multiple solitons with help from a saturable absorber
Ayata Nakashima[1], Shun Fujii[1,2], Riku Imamura[1], Keigo Nagashima[1], Takasumi Tanabe[1]
[1]Keio University, [2]RIKEN Center for Advanced Photonics
We simulated the generation of a dissipative Kerr soliton in a microresonator with and without a saturable absorber. We found that more solitons are formed thanks to the saturable absorption effect.

[ALPS-10] 14:15-15:45
Optical frequency combs / Frequency stabilized lasers and applications2
Chair: Sho Ookubo
National Institute of Advanced Industrial Science and Technology

ALPS-10-01 14:15 ***Invited***

Route to attosecond resolved temporal soliton molecular dynamics
Youjian Song[1], Feng Zhou[1], Haochen Tian[1,2], Minglie Hu[1]
[1]Tianjin University, China, [2]The University of Electro-Communications, Japan
An unprecedented 5 zs/√Hz temporal resolution reveals 12-as rms relative timing jitter (integrated from 100 Hz to 1 MHz) between the two solitons that compose a soliton molecule in a Ti:sapphire laser.

ALPS-10-02 14:45

Digital-micromirro-device-based surface measurement using heterodyne interferometry with optical frequency comb
Guangyao Xu, Yue Wang, Shilin Xiong, Guanhao Wu
Tsinghua University
We demonstrate a digital-micromirror-device-based surface measurement system using optical frequency comb. A three-step and a MEMS device surface are reconstructed quickly and accurately with the heterodyne interference method and synthetic wavelength method.

ALPS-10-03 15:00

Dual-comb based distance and angle measurement method
Siyu Zhou, Vunam Le, Guanhao Wu
Tsinghua University
We propose a dynamic three degree-of-freedom measurement technique based on dual-comb interferometry and a self-designed grating-corner-cube combined sensor. The method exhibits a ranging precision of 13.5 nm and an angular precision of 0.088 arcsec.

ALPS-10-04 15:15

One-shot three-dimensional phase imaging with optical frequency comb
Takashi Kato[1,2], Tamaki Morito[1], Kazuhiro Terada[1], Shintaro Kurata[1,3], Kaoru Minoshima[1]
[1]The University of Electro-Communications, [2]JST, PRESTO, [3]IHI Corporation
One-shot three-dimensional phase imaging is demonstrated using a 15-ps chirped pulse of an optical frequency comb. We captured nm-level phase change in the $LiNbO_3$ crystal by developed all-optical Hilbert transform method.

ALPS-10-05 15:30

Development of a broadband phase-difference evaluation system for optical frequency combs using spectral interference fringe detection
Tamaki Morito[1], Takashi Kato[1,2], Kazuhiro Terada[1], Shintaro Kurata[1,3], Kaoru Minoshima[1]
[1]The University of Electro-Communications, [2]JST, PRESTO, [3]IHI Corporation
We developed a technique to precisely detect a 90° carrier-envelope-phase-difference in real-time between ultrashort pulse trains using spectral interference of combs. It provides high-precision in all-optical signal processing with comb, such as all-optical Hilbert transform.

ALPS

Monday, 19 April

ALPS-1~6

[ALPS-5] 16:00-16:45
Mid-Infrared and visible lasers
Chair: Shigeki Tokita
Osaka University

ALPS-5-01 16:00 ***Invited***

All-Solid-State Fe:ZnSe Mid-IR Femtosecond Lasers for Driving Extreme Nonlinear Optics

Fedor V. Potemkin
M.V. Lomonosov Moscow State University

We report on entering a new era of ultrafast lasers in intriguing mid-IR (greater than 4 um) spectral regions based on iron-doped chalcogenides. Together with the proposed recently Fe:ZnSe mid-IR oscillator with up to 400 mW average power and subpicosecond pulse duration a complete 20-GW 150-fs 3.5-mJ 4.4-um system opens the way to the novel class of table-top all-solid-state extremely multiband (from UV up to THz) laser-based sources.

ALPS-5-02 16:30

Generation of Sub-10-ns Pulses from a Passively *Q*-switched Pr^{3+}:$LiYF_4$ Laser

Hiroki Tanaka, Moritz Badtke, Lenn Ollenburg, Sascha Kalusniak, Christian Kränkel
Leibniz-Institut fuer Kristallzuechtung

We demonstrate a Pr^{3+}:$LiYF_4$ laser at 640 nm passively Q-switched by a Co^{2+}:$MgAl_2O_4$ spinel saturable absorber. A compact linear cavity as short as ≈8 mm enables to achieve a pulse duration of 8.5±1.0 ns.

[ALPS-6] 17:00-18:00
Novel optical devices, metamaterials, structure and applications 1
Chair: Takasumi Tanabe
Keio University

ALPS-6-01 17:00 ***Invited***

Photonic Crystal Optical Parametric Oscillator

Alfredo de Rossi[1], Sylvain Combrié[1], Gabriel Marty[2,1], Fabrice Raineri[3,2]
[1]Thales Research & Technology, [2]Centre de Nanosciences et de Nanotetchnologies, [3]Université Paris Diderot, Sorbonne Paris Cité

We demonstrate that Optical Parametric Oscillators are possible using a small (20µm-long) semiconductor Photonic Crystal Cavity when its high Q modes are thermally tuned into a triply resonant configuration. The lowest pump power threshold is estimated to 50 - 70µW. This source behaves as an ideal degenerate Optical Parametric Oscillator addressing the needs in the field of quantum optical circuits.

ALPS-6-02 17:30

Enhancement of Angular Goos-Hänchen Shift by Surface Plasmon Resonance for Sensing Applications

Cherrie May Olaya[1,2], Norihiko Hayazawa[1,2], Nathaniel Hermosa[1], Takuo Tanaka[1,2]
[1]University of the Philippines, [2]RIKEN

We demonstrate that tightly focusing the incident beam further enhances the angular Goos-Hänchen shift that was initially enhanced by the excitation of surface plasmon resonance on a gold film.

ALPS-6-03 17:45

Acousto-optic polarization controlling in $KY(WO_4)_2$ crystal for solid state laser Q-switching

Natalya F. Naumenko, Alexander I. Chizhikov, Konstantin B. Yushkov, Vladimir Ya. Molchanov
National University of Science and Technology MISIS

We propose a new type of an acousto-optic Q-switch based on $KY(WO_4)_2$ crystal. The Q-switch with two independent control channels enables switching polarization of laser emission.

ALPS-7~11

[ALPS-11] 16:15-17:30
Optical frequency combs / Frequency stabilized lasers and applications3
Chair: Takashi Kato[1,2]
[1]The University of Electro-Communications, [2]JST, PRESTO

ALPS-11-01 16:15

Quasi-dual-comb source opens new avenues for rapid spectroscopy

Risako Kameyama[1], Shigekazu Takizawa[1], Kotaro Hiramatsu[1,2,3,4], Keisuke Goda[1,5,6]
[1]Department of Chemistry, The University of Tokyo, [2]Research Center for Spectrochemistry, The University of Tokyo, [3]PRESTO, Japan Science and Technology Agency, [4]Kanagawa Institute of Industrial Science and Technology, [5]Department of Bioengineering, University of California, Los Angeles, [6]Institute of Technological Sciences, Wuhan University

We demonstrate a "quasi"-dual-comb source, which enhances the aqcuisition rate of dual-comb spectroscopy by one order of magnitude by rapidly modulating the repetition rate of one of the frequency combs.

ALPS-11-02 16:30

Passively stabilized visible dual-frequency-spacing astro-comb

Ruoao Yang[1], Wei Han[1], Yuxuan Ma[2], Fei Meng[1], Chen Li[1], Aimin Wang[1], Fei Zhao[3], Gang Zhao[3], Zhigang Zhang[1]
[1]State Key Laboratory of Advanced Optical Communication System and Networks, Department of Electronics, Peking University, Beijing 100871, China, [2]Deutsches Elektronen-Synchrotron DESY, Notkestraße 85, 22607 Hamburg, Germany, [3]National Astronomical Observatories CAS, Beijing 100012, China

We propose a dual-frequency-spacing astro-comb of 45 GHz and 30 GHz to cover 400-560 nm and 570-920 nm respectively, for the astro-spectrograph with the resolution around 50,000.

ALPS-11-03 16:45

Sensitivity improvement in dual-comb spectroscopy by tailoring the phase-slip in the interference signals

Ruichen ZHU, Takuto Adachi, Akifumi Asahara, Kaoru Minoshima
The University of Electro-Communications

Sensitivity improvement technique is developed by applying coherent control tailored by frequency parameters involved in dual-comb spectroscopy. A signal-to-noise ratio enhancement in the spectroscopic signal was successfully demonstrated by using phase modulated interference fringe signals.

ALPS-11-04 17:00 ***Invited***

Large-Scale Optical Synchronization System of the European XFEL

Jost Mueller, Sebastian Schulz, Matthias Felber, Thorsten Lamb, Falco Zummack, Anne-Laure Calendron, Mikheil Titberidze, Tomasz Kozak, Holger Schlarb
DESY

ALPS

Tuesday, 20 April

ALPS-12~13

[ALPS-12] 9:00-10:45
Novel optical devices, metamaterials, structure and applications 2
Chair: Takasumi Tanabe
Keio University

ALPS-12-01 9:00 *Invited*

Metamaterial Thermoelectric Conversion
Wakana Kubo
Tokyo University of Agriculture and Technology
Metamaterial enables a thermoelectric device to generate electricity even under homogeneous temperature environment.

ALPS-12-02 9:30

Metamaterial Perfect Absorber as Nanoheater
Mahiro Horikawa, Wakana Kubo
Tokyo University of Agriculture & Technology
Metamaterial perfect absorber (MPA) shows near perfect light absorption at resonance wavelengths. In this study, we focused on heat generation of MPA based on such strong absorption. Both experimental and numerical approaches were conducted to evaluate the performance of MPA as a nanoheater.

ALPS-12-03 9:45 *Invited*

Soliton microcomb and applications for long-distance ranging
Wenfu Zhang
Xi'an Institute of Optics and Precision Mechanics

ALPS-12-04 10:15

Microcomb-based 300 GHz oscillator stabilized to a microwave reference
Tomohiro Tetsumoto[1], Fumiya Ayano[2], Julian Webber[2], Tadao Nagatsuma[2], Antoine Rolland[1]
[1]IMRA America Inc., [2]Osaka University
We demonstrate 300 GHz wave generation based on a Kerr microresonator frequency comb stabilized to a microwave reference. The obtained phase noise is -88 dBc/Hz at 10 kHz offset frequency.

ALPS-12-05 10:30

Raman-comb-based wavelength source for optical communicatiom
Shuto Sugawara[1], Shuya Tanaka[1], Koshiro Wada[1], Shun Fujii[1,2], Hajime Kumazaki[1], Shun Tasaka[1], Shota Sota[1], Tamiki Ohtsuka[1], Satoki Kawanishi[1], Takasumi Tanabe[1], Soma Kogure[1]
[1]Department of Electronics and Electrical Engineering, Faculty of Science and Technology, Keio University, [2]Quantum Optoelectronics Research Team, RIKEN Center for Advanced Photonics
We demonstrate optical data transmission with a fused silica-resonator-based Raman comb. Our result shows the potential of the Raman comb as a multi-channel wavelength source for wavelength division multiplexing.

[ALPS-13] 11:15-12:30
Short wavelength light sources and applications
Chair: Hitoki Yoneda
Institute for Laser Science, University of Electro-Communications

ALPS-13-01 11:15 *Invited*

EUV/soft x-ray high-harmonic pulses structured in their spectral, spatial and polarization properties
Carlos Hernandez-Garcia
University of Salamanca
The use of structured driving beams in high-order harmonic generation allows a unique control over the properties of the emitted EUV/soft x-ray harmonics, such as their temporal (attosecond), spectral (line spacing) and polarization properties.

ALPS-13-02 11:45

Research on fractal and angular momentum of electromagnetic solitons
Zhongpeng Li
Shanghai Institute of Optics and Fine Mechanics, CAS
We report the fractal features and the angular momentum of electromagnetic solitons induced via a radially polarized laser and circularly polarized laser, respectively, on the basis of three-dimensional particle-in-cell simulations.

ALPS-13-03 12:00 *Invited*

From UV to XUV: Approaches to imaging ultrafast dynamics
Heide Ibrahim
Institut National de la Recherche Scientifique

ALPS-14~15

[ALPS-14] 9:00-10:45
High average power lasers and applications1
Chair: Fumihiko Kannari
Keio University

ALPS-14-01 9:00 *Invited*

Advances in quantum dot lasers and single photon sources
Yasuhiko Arakawa
The University of Tokyo
We discuss recent advances in quantum dot photonic devices, including the commercialization of quantum dot lasers and the realization of a single photon source at room temperature. The impacts of quantum dot lasers on silicon photonics will be emphasized.

ALPS-14-02 9:30 *Invited*

Tb-lasers: Current state and future prospects
Christian Kraenkel, Elena Castellano-Hernández, Sascha Kalusniak, Hiroki Tanaka
Leibniz-Institut fur Kristallzuechtung, Germany
Tb^{3+}-doped materials enable tremendous laser performance in the green and yellow spectral range when pumped with modern, blue emitting sources. Here we report the latest progress in this field.

ALPS-14-03 10:00

UV Pumping of Tb-based Solid-State Lasers with Visible Emission
Sascha Kalusniak, Hiroki Tanaka, Elena Castellano-Hernández, Christian Kränkel
Leibniz-Institut fuer Kristallzuechtung
We report on UV-pumped continuous wave laser operation of Tb^{3+}:$LiLuF_4$. Compared to conventional cyan-blue pumping, much higher UV absorption cross sections of Tb^{3+} allow for a significant enhancement of the optical-to-optical efficiency.

ALPS-14-04 10:15

Self-Pulsation and Active Q-switching of Tb^{3+}-doped YLF Laser Pumped by Blue-Diode Lasers
Yuta Shioya, Tatsuzo Uchida, Fumihiko Kannari
Keio University
We study the output performance of actively or passively Q-switched Tb^{3+}:YLF lasers pumped by blue-diode lasers. We also investigate self-pulsation in the Tb^{3+}:YLF laser.

ALPS-14-05 10:30

Acousto-optically Q-switched Tb:LiYF4 green lasers
Hengjun Chen, Hiyori Uehara, Ryo Yasuhara
National Institute for Fusion Science
We demonstrated the active-Q-switched Tb:LiYF4 green lasers with an acousto-optical modulator. At a designated repetition rate of 3 kHz, we achieved stable pulsed output with a typical pulse width of 190 ns and peak power of 580 W.

[ALPS-15] 11:15-12:15
High average power lasers and applications2
Chair: Fumihiko Kannari
Keio University

ALPS-15-01 11:15 *Invited*

250-J Yb:YAG ceramics laser system for laser processing platform in TACMI consortium
Takashi Sekine[1], Takashi Kurita[1], Yuma Hatano[1], Yuki Muramatsu[1], Masateru Kurata[1], Takaaki Morita[1], Takeshi Watari[1], Yuki Kabeya[1], Takuto Iguchi[1], Ryo Yoshimura[1], Yoshinori Tamaoki[1], Yasuki Takeuchi[1], Kazuki Kawai[1], Yujin Zheng[1], Yoshinori Kato[1], Norio Kurita[1], Toshiyuki Kawashima[1], Shigeki Tokita[2], Junji Kawanaka[2], Norimasa Ozaki[2], Youichiro Hironaka[2], Keisuke Shigemori[2], Ryosuke Kodama[2], Ryunosuke Kuroda[3], Eisuke Miura[3]
[1]Hamamatsu Photonics K.K., [2]Insutitute of LaserEngineering, Osaka University, [3]National Institute of Advanced Industrial Science and Technology
A 250-J output diode-pumped Yb:YAG ceramics laser system has been developed to construct a database of high energy pulsed laser processing as a Hamamatsu satellite in TACMI consortium.

ALPS-15-02 11:45

Evaluation of Thermal Expansion coefficients of Laser Gain Media by First Principles Calculation
Yoichi Sato[1,2], Takunori Taira[1,2]
[1]RIKEN SPring-8 Center, RIKEN, [2]Institute for Molecular Science
Thermal expansion coefficient (α) for laser ceramics were evaluated by the first principles calculation. α at 300 K for $Y_3Al_5O_{12}$, $Lu_3Al_5O_{12}$, Y_2O_3, Sc_2O_3, and Lu_2O_3 were estimated to 7.26, 7.52, 7.95,7.18, and 6.95×10^{-6} K^{-1}, respectively.

ALPS-15-03 12:00

Proof-of-principle experiment for realizing laser stripping injection at J-PARC proton accelerator facility.
Aoi Fuchi[1], Yurina Michine[1], Hitoki Yoneda[1], Hiroyuki Harada[2], Pranab K Saha[2], Atsushi Sato[3], Takanori Shibata[4], Michikazu Kinsho[2]
[1]Institute for Laser Science, University of Electro-Communications, [2]JAEA/J-PARC, [3]NAT, [4]KEK
Laser stripping experiments are demonstrated in high current proton accelerator J-PARC facility. Charge exchange component of 3MeV test bench lines is detected with long pulse 1 mm laser pulse.

Program

ALPS

Tuesday, 20 April

[ALPS-Poster] 15:00-17:09
ALPS Poster Short Talk Session

ALPS-Poster-01 15:00

Fabrication of highly-doped Er:Y_2O_3 transparent ceramics by pulsed electric current sintering (PECS)

Daigo Ueno, Mayu Imai, Masaya Akagawa, Hiroaki Furuse
Kitami Institute of Technology

Transparent Er highly doped Y_2O_3 ceramics with fine microstructures were fabricated by pulsed electric current sintering (PECS) technique. In this study, their optical properties and microstructures were studied.

ALPS-Poster-02 15:03

Optical properties of hexagonal fluorapatite (FAP) polycrystalline ceramics

Daichi Kato[1], Takumi Kato[1], Naohiro Horiuchi[2], Koji Morita[3], Byung-Nam Kim[3], Hiroaki Furuse[1]
[1]Kitami Institute of Technology, [2]Tokyo Medical and Dental University, [3]National Institute for Materials Science

We fabricated non-cubic transparent fluorapatite ceramics by using pulsed electric current sintering (PECS) technique. Their optical properties and microstructures for various sintering temperature and optimal sintering condition will be discussed.

ALPS-Poster-03 15:06

Development of Watt-class High-Power Mid-Infrared Quantum Cascade Laser and application for laser processing

Akio Ito[1], Takahide Ochiai[1], Tatsuo Dougakiuchi[1], Nobutaka Suzuki[1], Atsushi Sugiyama[1], Naota Akikusa[1], Tadataka Edamura[1], Hidehiko Yashiro[2], Masayuki Kakehata[2], Nobuhiro Umebayashi[2], Tadatake Sato[2]
[1]Hamamatsu Photonics K.K., [2]National Institute of Advanced Industrial Science and Technology (AIST)

Watt-class high-power quantum cascade laser (QCL) was developed with polarized beam combine technique at l=8.6 mm. High efficient laser thermal processing such as PTFE can be performed thanks to large absorption in mid-infrared.

ALPS-Poster-04 15:09

Beam shaping of fiber-out mid-infrared quantum cascade laser

Takahide Ochiai[1], Akio Ito[1], Tatsuo Dougakiuchi[1], Nobutaka Suzuki[1], Atsushi Sugiyama[1], Naota Akikusa[1], Tadataka Edamura[1], Hidehiko Yashiro[2], Masayuki Kakehata[2], Nobuhiro Umebayashi[2], Tadatake Sato[2]
[1]Hamamatsu Photonics K.K., [2]National Institute of Advanced Industrial Science and Technology (AIST)

Fiber delivery mid-infrared quantum cascade laser module using a hollow fiber was developed. Top-hat intensity profile of output was realized by mode scrambling, and line-shaped irradiation was obtained with a ZnSe diffractive optical element (DOE).

ALPS-Poster-05 15:12

Optical characterization of sapphire/YAG ceramic composite by Pulsed Electric Current Bonding (PECB)

Yuki Kagami[1], Hiroyuki Tanaka[1], Ryo Yasuhara[2], Hiroaki Furuse[1]
[1]Kitami Institute of Technology, [2]National Institute for Fusion Science

The optical properties including laser performance of sapphire/Nd:YAG composite by pulsed electric current bonding was studied for various initial surface flatness conditions.

ALPS-Poster-06 15:15

1 J/100 Hz ns laser pulses generation from cryogenically-cooled Yb:YAG rod amplifier with ink-cladding

Shotaro Kitajima[1], Jumpei Ogino[1], Shigeki Tokita[1], Zhaoyang Li[1], Shinji Motokoshi[2], Noboru morio[1], Koji Tsubakimoto[1], Hidetsugu Yoshida[1], Kana Fujioka[1], Ken-ichi Ueda[3], Ryosuke Kodama[1], Junji Kawanaka[1]
[1]Institute of Laser Engineering, Osaka University, [2]Institute of Laser Technology, [3]Institute for Laser Science, University of Electro-Communications

A stable operation of 1.1 J/100 Hz 10 ns laser pulses were achieved from a single cryogenically cooled Yb:YAG rod amplifier with ink-cladding. The efficiency and gain coefficient were 44% and 383, respectively.

ALPS-Poster-08 15:21

Dependence of CEP on the angle of incidence to the diffraction grating in chirped pulse amplification

Kaito Nishimiya, Takuma Noda, Kento Kubomura, Akira Suda
Tokyo University of Science

For CEP stabilization in a diffraction grating-based CPA system, the dependence of CEP on the angle of incidence to the diffraction grating and the f-2f interferometer is investigated by experiment and calculation.

ALPS-Poster-10 15:27

Few ns Q-switched Tm fiber laser

Takumi Yatsuda, Masaki Tokurakawa
University of Electro-Communications, ILS

We report an AOM Q-switched Tm fiber laser. Pulses as short as 3 ns with 80 μJ pulse energy was obtained. The mechanism of the pulse shortening would be attributed to Stimulated Brillouin back scattering.

ALPS-Poster-11 15:30

2 μm mode-locked lasers with normal dispersion Tm doped gain fibers

Yuya Uchizono[1], Takumi Sato[1], Yuhao Chen[2], Raghuraman Sidharthan[2], Seong Woo Yoo[2], Masaki Tokurakawa[1]
[1]University of Electro-Communications, ILS, [2]Nanyang Technological University

Using W-type index profile normal dispersion Tm silica fiber, 4 nJ pulse energy with ~60 nm spectral bandwidth was obtained. From Mamyshev configuration oscillator with Tm:ZBLAN double clad fiber, CW output was obtained.

ALPS-Poster-12 15:33

Study on Improvement of Velocity Measurement Accuracy in a Distance and Velocity Simultaneous Measurement Sensor by Self-Coupling Effect

Daiki Sato, Masanari Yamada, Daisuke Mizushima, Norio Tsuda, Jun Yamada
Aichi Institute of Technology

The semiconductor laser is modulated with triangular or arbitrary triangular waveforms, and the velocity is measured from the self-coupled signal obtained by the built-in photodiode. The measurement accuracy of the velocity is discussed.

ALPS-Poster-13 15:36

Investigation of high-energy KGW crystal-based single-pass Raman generator

Xinlin Lv[1,2], Junchi Chen[1], Yujie Peng[1], Yingbin Long[1], Guanting Liu[1], Yuxin Leng[1]
[1]State Key Laboratory of High Field Laser Physics and CAS Center for Excellence in Ultra-intense Laser Science, Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences, China, [2]Center of Materials Science and Optoelectronics Engineering, University of Chinese Academy of Sciences, Beijing 100049, China

The measured maximum output energy of two-order Stokes lasers is ~676 mJ with 2.8 J pumping energy; this is the highest Stokes energy output of the nanosecond solid-state Raman lasers to the best of our knowledge.

ALPS-Poster-14 15:39

Magneto-optic properties of synthetic quartz for DUV optical isolator

Yuki Tamaru[1], Hengjun Chen[3], Atsushi Fuchimukai[2], Hiyori Uehara[1,3], Taisuke Miura[2], Ryo Yasuhara[1,3]
[1]SOKENDAI (The Graduate University for Advanced Studies), [2]GIGAPHOTON INC., [3]National Institute for Fusion Science

The Verdet constant in a synthetic quartz was evaluated within the wavelength range of 190-300 nm. This material can be realized the optical isolator for DUV light sources with the moderate magnetic field.

ALPS-Poster-15 15:42

Attenuation by aerosols estimate with bistatic LiDAR in TA experiments.

Tomoyuki Nakamura[1], Takayuki Tomida[1], Katuya Yamazaki[2], Yuichiro Tameda[3], Shigeharu Udo[4]
[1]Graduate School of Shinshu University, [2]Chubu University, [3]Osaka Electro-Communication University, [4]Kanagawa University

Atmospheric observations were measured using bistatic LiDAR with a pulsed UV laser (355 nm). Telescope Array site in Utah, USA. The median of aerosol attenuation at 5 km above the ground is *0.042*.

ALPS-Poster-16 15:45

All-Optical 40GHz Switch Using Cascade Nonlinearities in a QPM-LN Device

Yutaka Fukuchi, Genki Abe, Kazumasa Kawanaka, Ryoichi Miyauchi
Tokyo University of Science

Characteristics of an all-optical switch using a 3-cm QPM-LN are investigated through switching experiments considering the temporal widths of the input clock and signal pulses. Stable and efficient 40GHz to 40GHz operation is successfully demonstrated.

ALPS-Poster-18 15:51

Stability of optical beats between longitudinal modes in laser chaos

Fumiyoshi Kuwashima1, Mona Jarrahi[2], Semih Cakmakayapan[2], Osamu Morikawa[3], Takuya Shirao[1], Kazuyuki Iwao[1], Kazuyoshi Kurihara[4], Hideaki Kitahara[5], Takashi Furuya[5], Kenji Wada[6], Makoto Nakajima[7], Masahiko Tani[5]
[1]Fukui Univ. of Tech., [2]Electrical and Computer Engineering Department, University of California Los Angeles, [3]Chair of Liberal Arts, Japan Coast Guard Academy, [4]School of Education., University. of Fukui, [5]Research Center for Development of Far-Infrared Region, University of Fukui, [6]Department of Physics and Electronics, Osaka Prefecture University, [7]Institute of Laser engineering, Osaka Univ

Stability of optical beats in a chaotically oscillating laser is compared to that of a free-running continuous-wave laser using a highly efficient plasmonic photomixer. The high stability of optical beats in chaotically oscillating lasers is verified.

ALPS-Poster-19 15:54

Optical data transmission with a dissipative Kerr soliton in an ultrahigh-Q MgF_2 microresonator

Shuya Tanaka[1], Shun Fujii[1,2], Koshiro Wada[1], Hajime Kumazaki[1], Soma Kogure[1], Shun Tasaka[1], Tamiki Ohtsuka[1], Satoki Kawanishi[1], Takasumi Tanabe[1]
[1]Keio university, [2]RIKEN Center for Advanced Photonics

We transmitted optical data over 40 km using a dissipative Kerr soliton from an MgF_2 microresonator. This result shows the potential of a microcomb as a wavelength division multiplexing light source covering the entire C-band.

ALPS-Poster-20 15:57

Development and stability evaluation of all polarization-maintaining optical frequency comb based on Figure9 type fiber laser

Kohei Kato, Hayato Suga, Masahito Yamanaka, Norihiko Nishizawa
The University of Nagoya

We developed all polarization-maintaining (PM) optical frequency comb based on dispersion managed, Er-doped Figure9 type fiber laser. In order to detect f_{ceo} signal with high SNR, we adopted a PM-in-line type delay line and balanced detector. The stable operation in the long period of time was achieved and the standard deviations was sub-mHz level.

ALPS-Poster-21 16:00

High-precision mutual control of two-color fiber combs

Tatsuya Hasegawa[1], Yugo Kusumi[1], Shigeki Sakuma[1], Akifumi Asahara[1], Yoshiaki Nakajima[1,2], Ryosuke Shimizu[1], Kaoru Minoshima[1]
[1]The University of Electro-Communications, [2]Toho University

We developed a technique for precise mutual control of two fiber combs generating different wavelength bands. The repetition frequencies and the relative optical mode frequency are precisely controlled and stabilized to the reference optical clock.

ALPS

Tuesday, 20 April

ALPS-Poster-22 16:03

Optical Phase Spectral Control of Orbital Angular Momentum Modes Studied by Dual-comb Imaging Spectroscopy

Akifumi Asahara, Takuto Adachi, Seishiro Akiyama, Kaoru Minoshima
The University of Electro-Communications

Orbital angular momentum (OAM)-dependent phase spectral change is characterized based on dual-comb imaging spectroscopy. The OAM-dependent phase measurement has a great potential as versatile light-wave manipulation technique, such as highly purified optical vortex generation.

ALPS-Poster-23 16:06

A dual-comb ranging system without aliasing based on free-running frequency combs

Ruilin Jiang, Siyu Zhou, Guanhao Wu
Tsinghua University

We present a free-running dual-comb ranging system. It includes two filtering channels and avoids the spectral aliasing. The system achieves a precision below 10μm and runs stably over long time without any frequency locking.

ALPS

Wednesday, 21 April

ALPS-16~18

[ALPS-16] 9:00-10:45
Ultra-high intensity lasers, technology and applications
Chair: Hiromitsu Kiriyama
National Institutes for Quantum and Radiological Science and Technology

ALPS-16-01 9:00 ***Invited***

10 PetaWatt Lasers for Extreme Light Physics
Christophe SIMON-BOISSON
Thales LAS France
Ultra-high intensity lasers are nowadays required to explore new frontiers of physics. Recently first ever achieved laser operation above 10 PetaWatt at ELI Nuclear Physics is described.

ALPS-16-02 9:30 ***Invited***

Free-electron laser with compact laser-plasma accelerators
Jeroen van Tilborg
Lawrence Berkeley National Laboratory
In this presentation, key aspects of laser-plasma-accelerator-driven light sources will be presented, including control of the laser system and accelerator, novel laser and electron beam diagnostics, and the path towards realizing a free-electron laser.

ALPS-16-03 10:00

Ultra-broadband concept for Exawatt-class lasers
Zhaoyang Li, Yoshiaki Kato, Junji Kawanaka
Osaka University
A new concept is proposed to increase the peak-power of ultra-intense lasers up to the Exawatt-class (10^{18} watt), and related key challenges are also examined.

ALPS-16-04 10:15

Direct mapping of attosecond electron dynamics
Chuliang Zhou[1,2], Yafeng Bai[1,2], Ye Tian[1,2], Ruxin Li[1,2,3]
[1]Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Science, [2]Center of Materials Science and Optoelectronics Engineering, University of Chinese Academy of Sciences, [3]ShanghaiTech University
Here we demonstrate a laser streaking concept for revealing the dynamics of free electrons emitted from a plasma mirror. Field-induced electron beam deflection demonstrates subcycle charge dynamics with a streaking speed of ~60 μrad as^{-1}.

ALPS-16-05 10:30

Development of ozone mixed gas optics in vacuum environment for high power lasers
Yurina Michine, Hitoki Yoneda
Institute for laser science, University of Electro-Communications
We propose the idea of a gas medium optics with a kJ/cm^2 damage threshold that operates maintenance-free in a vacuum environment.

[ALPS-17] 11:15-12:15
High energy lasers
Chair: Takashi Sekine
Hamamatsu Photonics K.K.

ALPS-17-01 11:15 ***Invited***

High energy frequency conversion at 10 Hz
Jonathan Phillips[1], Saumyabrata Banerjee[1], Paul Mason[1], Jodie Smith[1], Jacob Spear[1], Mariastefania De Vido[1], Klaus Ertel[1], Thomas Butcher[1], Gary Quinn[1,2], Danielle Clarke[1,2], Chris Edwards[1], Cristina Hernandez-Gomez[1], John Collier[1]
[1]Science and Technology Facility Council, Rutherford Appleton Laboratory, Harwell Science and Innovation Campus, [2]Institute of Photonic and Quantum Sciences, Heriot-Watt University
We report on the successful demonstration of second and third harmonic conversion of a high pulse energy, high average power 1030 nm diode pumped Yb:YAG nanosecond pulsed laser in a large aperture LBO crystal.

ALPS-17-02 11:45

Towards a first Joule-level activation of PEnELOPE
Daniel Peter Konrad Albach[1], Markus Löser[1], Mathias Siebold[1], Ulrich Schramm[1,2]
[1]Helmholtz-Zentrum Dresden-Rossendorf, [2]Technische Universität Dresden
We present a status update of the PENELOPE laser system currently under construction at the Helmholtz-Zentrum Dresden-Rossendorf in order to perform a first activation with pulses on the Joule scale, as well as improvements of the stretcher optics to support laser pulses in the order of 150 fs.

ALPS-17-03 12:00

Pulsed High Voltage System as Spark Pre-Ionizer: Featuring High Energy Stability and Narrow Pulse Repeatability CO2-TEA Lasers for High Spatial Resolution Remote Sensing.
Taieb Gasmi
Saint Louis University-Madrid Campus
We present a novel CO_2-TEA nitrogen tail pulse electro-optical shutter using a gas breakdown technique. The system uses a gas pre-ionizing high voltage pulse and laser self-induced gas plasma that absorb the energy contained within the energetic nitrogen tail of CO_2-TEA lasers. The fast high volage pulse generator is an all-solid-state exciter (ASSE) and offers several advantages such as low cost, reliability, and can also be used for high repetition rate operation.

ALPS-19~22

[ALPS-19] 9:00-10:45
Terahertz devices, nonlinear optics and applications1
Chair: Ken Morita
Chiba University

ALPS-19-01 9:00 ***Invited***

Real-time THz color scanner
Takeshi Yasui
Tokushima University
Real-time THz color scanner was proposed based on two-dimensional spatio-temporal THz imaging. The proposed system has the potential to expand the application scope of THz spectral imaging based on its rapid image acquisition rate.

ALPS-19-02 9:30

Modular 3D-Printed THz Plasmonic Waveguide Components
Yang Cao, Kathirvel Nallappan, Hichem Guerboukha, Guofu Xu, Maksim Skorobogatiy
Polytechnique Montreal
THz waveguide-based integrated circuits are of great utility in Terahertz communications. Here we propose a new type of modular 3D-printed micro-encapsulated two-wire plasmonic waveguide components to realize reconfigurable terahertz circuits for signal processing.

ALPS-19-03 9:45

Electro-optic sampling on spatio-temporal electric field profile around relativistic electron bunch
Masato Ota[1], Koichi Kan[2], Soichiro Komada[3], Yasunobu Arikawa[1], Tomoki Shimizu[1], Valynn Katrine Mag-Usara[1], Youichi Sakawa[1], Tatsunosuke Matsui[3], Makoto Nakajima[1]
[1]ILE Osaka University, [2]ISIR Osaka University, [3]Mie University
Longitudinal and transverse beam sizes of a relativistic electron bunch are obtained by measuring the spatio-temporal electric field profile through electro-optic sampling. The experimental result is verified by a three-dimensional particle-in-cell simulation.

ALPS-19-04 10:00

Intense Single-cycle Terahertz Generation on Metal Wires
Yushan Zeng, Liwei Song, Ye Tian
Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences
Using metallic wire exposed to high power femtosecond laser pulses, we demonstrated the generation and guidance of millijoule-level single-cycle Terahertz pulse on the wire target.

ALPS-19-05 10:15

12 kW Peak Power at 266-nm Generation by QPM Quartz Device
Kentaro Yoshii[1], Naoyuki Arai[1], Hideki Ishizuki[2,3], Takunori Taira[2,3]
[1]Murata Manufacturing Co., Ltd., [2]Institute for Molecular Science, National Institutes of Natural Sciences, [3]RIKEN SPring-8 Center
QPM quartz device fabricated by unique bonding technology of high-durability quartz plates could generated a 266-nm wave with 12 kW peak power. Possibility of efficient wavelength conversion by bonded QPM quartz will be discussed.

ALPS-19-06 10:30

Solid Core Dielectric Fibers for 10m Long Terahertz Communication Link
kathirvel nallappan, Yang Cao, Guofu Xu, Hichem Guerboukha, Chahe Nerguizian, Maksim Skorobogatiy
Ecole Polytechnique de Montreal
In this work, we present an in-depth experimental and numerical study of the short-range THz communications links that use subwavelength dielectric fibers for information transmission and define main challenges and trade-offs in the link implementation.

[ALPS-20] 11:15-12:30
Terahertz devices, nonlinear optics and applications2
Chair: Takashi Notake
RIKEN

ALPS-20-01 11:15 ***Invited***

Numerical Analysis of Coupled-Three-Wave-Mixing in Terahertz Wave Up-conversion detection
Shuzhen Fan[1,2], Xiaoqin Yin[1], Yongfu Li[1,2], Xingyu Zhang[1,3], Zhaojun Liu[1,3], Xian Zhao[1,2], Jiaxiong Fang[1,2,4]
[1]Key Laboratory of Laser & Infrared System (Shandong University), Ministry of Education, [2]Center for Optics Research and Engineering (CORE), Shandong University, [3]School of Information Science and Engineering, Shandong University, [4]Shanghai Institute of Technical Physics, Chinese Academy of Sciences
Difference-Frequency-Generation, which has been widely employed and analysed in Terahertz wave detection by nonlinear frequency up-conversion, usually accompanies with Sum-Frequency-generation in the nonlinear processes. Numerical analysis is given to help with the experimental scheme design.

ALPS-20-02 11:45

Development of a Noise-free Terahertz Parametric Generator using High-power Injection Seeding
Sota Mine, Kodo Kawase, Kosuke Murate
Nagoya University
In this study, noise-free THz-wave output from an injection-seeded THz-wave parametric generator (is-TPG) was achieved by high-power injection seeding. Compared to the conventional is-TPG, the S/N ratio was improved by more than 40 dB.

ALPS-20-03 12:00

Infinite 3D printed Micro-structured Fiber for THz Communications
Guofu Xu, Kathirvel Nallappan, Yang Cao, Maksim Skorobogatiy
Polytechnique Montreal
A micro-structured suspended-core polypropylene fiber is designed and characterized experimentally for signal transmission at 128 GHz carrier frequency. The fiber is 3D printed using a 45° inclined nozzle that enables continuous, length-unlimited Terahertz fiber fabrication.

ALPS

Wednesday, 21 April

ALPS-16~18

[ALPS-18] 13:15-14:00
High intensity short pulse lasers and technology
Chair: Takashi Sekine
Hamamatsu Photonics K.K.

ALPS-18-01 13:15

Generation of High-Energy Pulses in a Yb-Doped All-Double-Cladding-Fiber Mamyshev Oscillator
Tao Wang, Bo Ren, Can Li, Jian Wu, Rongtao Su, Pengfei Ma, Pu Zhou
National University of Defense Technology
An all-double-cladding-fiber high-energy Mamyshev oscillator was experimentally demonstrated. The achieved maximum single pulse energy was >80 nJ and could be compressed to <100 fs. The maximum peak power was >1 MW.

ALPS-18-02 13:30

102 nJ pulse energy, 1.5MW peak power generation with an all-fiber gain-managed nonlinearity amplifier
Bo Ren, Tao Wang, Can Li, Jian Wu, Rongtao Su, Pengfei Ma, Pu Zhou
National University of Defense Technology
An all-fiber gain-managed nonlinearity (GMN) amplifier was experimentally demonstrated. The achieved single pulse energy was 102 nJ and the compressed pulse duration was to 68 fs with 1.5 MW peak power at 1068nm central wavelength.

ALPS-18-03 13:45

Chirped-Pulse Test Signal Source for Picosecond Streak Camera Alignment
Vladimir Ya. Molchanov[1], Konstantin B. Yushkov[1], Pavel V. Kostryukov[1,2], Petr B. Gornostaev[3], Nikolay S. Vorobiev[3]
[1]National University of Science and Technology MISIS, [2]Lebedev Physical Institute of the Russian Academy of Sciences, [3]Prokhorov General Physics Institute of the Russian Academy of Sciences
We demonstrate arbitrary phase-only modulation of chirped laser pulses for in-line calibration and resolution measurement of a picosecond streak camera. A high-resolution acousto-optic dispersive delay line is used in a Ti:sapphire laser system.

[ALPS-Closing] 16:00-16:15
Closing Remarks
Chair: Hitoki Yoneda
Institute for Laser Science, University of Electro-Communications

ALPS-19~22

ALPS-20-04 12:15

The Impact of Extracavity Frequency Doubling in Infrared Yb-doped Pulsed Fiber Laser by Focusing Beam Size in a Nonlinear Crystal
Hsiu-Ting Wu, Yu-Pin Lan, Wen-Chang Huang Huang
College of Photonics, National Chiao Tung University
We have proven the experimental results by a theoretical model that the highest second harmonic conversion of 10.63% achieves as a fundamental beam of 28μm within the nonlinear crystal.

[ALPS-21] 13:30-15:00
Optical devices and techniques for bio and medical applications1
Chair: Tsuneyuki Ozaki
INRS-EMT

ALPS-21-01 13:30 ***Invited***

Development of machine learning approaches for quantitative super-resolution imaging of molecular interactions in neurons
Flavie Lavoie Cardinal
Laval University, Canada

ALPS-21-02 14:00 ***Invited***

Data and Energy Efficient Ultrafast Time Stretch Optical Imaging
Chao Wang
University of Kent

ALPS-21-03 14:30 ***Invited***

Single fiber fluoresce imaging by multimode interference-based spectral encoder
Takashi Katagiri
University of Toyama
A fiber imaging system we have proposed for ultra-small diameter endoscopes is introduced. This system is based on the spectrum encoding and acquires two-dimensional images with a single optical fiber without a lens or scanner.

[ALPS-22] 15:30-16:00
Optical devices and techniques for bio and medical applications2
Chair: Tsuneyuki Ozaki
INRS-EMT

ALPS-22-01 15:30

Enhancement of axial resolution of temporal focusing microscopy by using programmable time-multiplexed multi-line focusing
Keisuke Isobe[1,2], Kenta Inazawa[1,3], Tomohiro Ishikawa[1,3], Fumihiko Kannari [3], Kana Namiki[4], Atsushi Miyawaki[4,1], Katsumi Midorikawa[1]
[1]RIKEN Center for Advanced Photonics, [2]Kyoto University, [3]Keio University, [4]RIKEN Center for Brain Science
We solve the conflict between imaging speed and axial resolution in temporal focusing microscopy by using programmable time-multiplexed multi-line focusing with a digital micromirror device.

ALPS-22-02 15:45

Adaptive optics of wide-field temporal focusing microscopy combined with structured illumination microscopy
Tomohiro Ishikawa[1,2], Keisuke Isobe[1,3], Kenta Inazawa[1,2], Fumihiko Kannari[2], Katsumi Midorikawa[1]
[1]RIKEN, [2]Keio University, [3]Kyoto University
We demonstrated adaptive optics of wide-field temporal focusing microscopy under the condition of a strong out-of-focus fluorescence and a thick sample, which was based on the spatio-temporal lock-in detection with structured illumination microscopy.

ALPS

Poster

[ALPS-P]
ALPS Poster Session

ALPS-P-01

Fabrication of highly-doped Er:Y_2O_3 transparent ceramics by pulsed electric current sintering (PECS)

Daigo Ueno, Mayu Imai, Masaya Akagawa, Hiroaki Furuse
Kitami Institute of Technology

Transparent Er highly doped Y_2O_3 ceramics with fine microstructures were fabricated by pulsed electric current sintering (PECS) technique. In this study, their optical properties and microstructures were studied.

ALPS-P-02

Optical properties of hexagonal fluorapatite (FAP) polycrystalline ceramics

Daichi Kato[1], Takumi Kato[1], Naohiro Horiuchi[2], Koji Morita[3], Byung-Nam Kim[3], Hiroaki Furuse[1]
[1]Kitami Institute of Technology, [2]Tokyo Medical and Dental University, [3]National Institute for Materials Science

We fabricated non-cubic transparent fluorapatite ceramics by using pulsed electric current sintering (PECS) technique. Their optical properties and microstructures for various sintering temperature and optimal sintering condition will be discussed.

ALPS-P-03

Development of Watt-class High-Power Mid-Infrared Quantum Cascade Laser and application for laser processing

Akio Ito[1], Takahide Ochiai[1], Tatsuo Dougakiuchi[1], Nobutaka Suzuki[1], Atsushi Sugiyama[1], Naota Akikusa[1], Tadataka Edamura[1], Hidehiko Yashiro[2], Masayuki Kakehata[2], Nobuhiro Umebayashi[2], Tadatake Sato[2]
[1]Hamamatsu Photonics K.K., [2]National Institute of Advanced Industrial Science and Technology (AIST)

Watt-class high-power quantum cascade laser (QCL) was developed with polarized beam combine technique at l=8.6 mm. High efficient laser thermal processing such as PTFE can be performed thanks to large absorption in mid-infrared.

ALPS-P-04

Beam shaping of fiber-out mid-infrared quantum cascade laser

Takahide Ochiai[1], Akio Ito[1], Tatsuo Dougakiuchi[1], Nobutaka Suzuki[1], Atsushi Sugiyama[1], Naota Akikusa[1], Tadataka Edamura[1], Hidehiko Yashiro[2], Masayuki Kakehata[2], Nobuhiro Umebayashi[2], Tadatake Sato[2]
[1]Hamamatsu Photonics K.K., [2]National Institute of Advanced Industrial Science and Technology (AIST)

Fiber delivery mid-infrared quantum cascade laser module using a hollow fiber was developed. Top-hat intensity profile of output was realized by mode scrambling, and line-shaped irradiation was obtained with a ZnSe diffractive optical element (DOE).

ALPS-P-05

Optical characterization of sapphire/YAG ceramic composite by Pulsed Electric Current Bonding (PECB)

Yuki Kagami[1], Hiroyuki Tanaka[1], Ryo Yasuhara[2], Hiroaki Furuse[1]
[1]Kitami Institute of Technology, [2]National Institute for Fusion Science

The optical properties including laser performance of sapphire/Nd:YAG composite by pulsed electric current bonding was studied for various initial surface flatness conditions.

ALPS-P-06

1 J/100 Hz ns laser pulses generation from cryogenically-cooled Yb:YAG rod amplifier with ink-cladding

Shotaro Kitajima[1], Jumpei Ogino[1], Shigeki Tokita[1], Zhaoyang Li[1], Shinji Motokoshi[2], Noboru morio[1], Koji Tsubakimoto[1], Hidetsugu Yoshida[1], Kana Fujioka[1], Ken-ichi Ueda[3], Ryosuke Kodama[1], Junji Kawanaka[1]
[1]Institute of Laser Engineering, Osaka University, [2]Institute of Laser Technology, [3]Institute for Laser Science, University of Electro-Communications

A stable operation of 1.1 J/100 Hz 10 ns laser pulses were achieved from a single cryogenically cooled Yb:YAG rod amplifier with ink-cladding. The efficiency and gain coefficient were 44% and 383, respectively.

ALPS-P-08

Dependence of CEP on the angle of incidence to the diffraction grating in chirped pulse amplification

Kaito Nishimiya, Takuma Noda, Kento Kubomura, Akira Suda
Tokyo University of Science

For CEP stabilization in a diffraction grating-based CPA system, the dependence of CEP on the angle of incidence to the diffraction grating and the f-2f interferometer is investigated by experiment and calculation.

ALPS-P-10

Few ns Q-switched Tm fiber laser

Takumi Yatsuda, Masaki Tokurakawa
University of Electro-Communications, ILS

We report an AOM Q-switched Tm fiber laser. Pulses as short as 3 ns with 80 μJ pulse energy was obtained. The mechanism of the pulse shortening would be attributed to Stimulated Brillouin back scattering.

ALPS-P-11

2 μm mode-locked lasers with normal dispersion Tm doped gain fibers

Yuya Uchizono[1], Takumi Sato[1], Yuhao Chen[2], Raghuraman Sidharthan[2], Seong Woo Yoo[2], Masaki Tokurakawa[1]
[1]University of Electro-Communications, ILS, [2]Nanyang Technological University

Using W-type index profile normal dispersion Tm silica fiber, 4 nJ pulse energy with ~60 nm spectral bandwidth was obtained. From Mamyshev configuration oscillator with Tm:ZBLAN double clad fiber, CW output was obtained.

ALPS-P-12

Study on Improvement of Velocity Measurement Accuracy in a Distance and Velocity Simultaneous Measurement Sensor by Self-Coupling Effect

Daiki Sato, Masanari Yamada, Daisuke Mizushima, Norio Tsuda, Jun Yamada
Aichi Institute of Technology

The semiconductor laser is modulated with triangular or arbitrary triangular waveforms, and the velocity is measured from the self-coupled signal obtained by the built-in photodiode. The measurement accuracy of the velocity is discussed.

ALPS-P-13

Investigation of high-energy KGW crystal-based single-pass Raman generator

Xinlin Lv[1,2], Junchi Chen[1], Yujie Peng[1], Yingbin Long[1], Guanting Liu[1], Yuxin Leng[1]
[1]State Key Laboratory of High Field Laser Physics and CAS Center for Excellence in Ultra-intense Laser Science, Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences, China, [2]Center of Materials Science and Optoelectronics Engineering, University of Chinese Academy of Sciences, Beijing 100049, China

The measured maximum output energy of two-order Stokes lasers is ~676 mJ with 2.8 J pumping energy; this is the highest Stokes energy output of the nanosecond solid-state Raman lasers to the best of our knowledge.

ALPS-P-14

Magneto-optic properties of synthetic quartz for DUV optical isolator

Yuki Tamaru[1], Hengjun Chen[3], Atsushi Fuchimukai[2], Hiyori Uehara[1,3], Taisuke Miura[2], Ryo Yasuhara[1,3]
[1]SOKENDAI (The Graduate University for Advanced Studies), [2]GIGAPHOTON INC., [3]National Institute for Fusion Science

The Verdet constant in a synthetic quartz was evaluated within the wavelength range of 190-300 nm. This material can be realized the optical isolator for DUV light sources with the moderate magnetic field.

ALPS-P-15

Attenuation by aerosols estimate with bistatic LiDAR in TA experiments.

Tomoyuki Nakamura[1], Takayuki Tomida[1], Katuya Yamazaki[2], Yuichiro Tameda[3], Shigeharu Udo[4]
[1]Graduate School of Shinshu University, [2]Chubu University, [3]Osaka Electro-Communication University, [4]Kanagawa University

Atmospheric observations were measured using bistatic LiDAR with a pulsed UV laser (355 nm). Telescope Array site in Utah, USA. The median of aerosol attenuation at 5 km above the ground is *0.042*.

ALPS-P-16

All-Optical 40GHz Switch Using Cascade Nonlinearities in a QPM-LN Device

Yutaka Fukuchi, Genki Abe, Kazumasa Kawanaka, Ryoichi Miyauchi
Tokyo University of Science

Characteristics of an all-optical switch using a 3-cm QPM-LN are investigated through switching experiments considering the temporal widths of the input clock and signal pulses. Stable and efficient 40GHz to 40GHz operation is successfully demonstrated.

ALPS-P-18

Stability of optical beats between longitudinal modes in laser chaos

Fumiyoshi Kuwashima1, Mona Jarrahi[2], Semih Cakmakayapan[2], Osamu Morikawa[3], Takuya Shirao[1], Kazuyuki Iwao[1], Kazuyoshi Kurihara[4], Hideaki Kitahara[5], Takashi Furuya[5], Kenji Wada[6], Makoto Nakajima[7], Masahiko Tani[5]
[1]Fukui Univ. of Tech., [2]Electrical and Computer Engineering Department, University of California Los Angeles, [3]Chair of Liberal Arts, Japan Coast Guard Academy, [4]School of Education., University. of Fukui, [5]Research Center for Development of Far-Infrared Region, University of Fukui, [6]Department of Physics and Electronics, Osaka Prefecture University, [7]Institute of Laser engineering, Osaka Univ

Stability of optical beats in a chaotically oscillating laser is compared to that of a free-running continuous-wave laser using a highly efficient plasmonic photomixer. The high stability of optical beats in chaotically oscillating lasers is verified.

ALPS-P-19

Optical data transmission with a dissipative Kerr soliton in an ultrahigh-Q MgF_2 microresonator

Shuya Tanaka[1], Shun Fujii[1,2], Koshiro Wada[1], Hajime Kumazaki[1], Soma Kogure[1], Shun Tasaka[1], Tamiki Ohtsuka[1], Satoki Kawanishi[1], Takasumi Tanabe[1]
[1]Keio university, [2]RIKEN Center for Advanced Photonics

We transmitted optical data over 40 km using a dissipative Kerr soliton from an MgF_2 microresonator. This result shows the potential of a microcomb as a wavelength division multiplexing light source covering the entire C-band.

ALPS-P-20

Development and stability evaluation of all polarization-maintaining optical frequency comb based on Figure9 type fiber laser

Kohei Kato, Hayato Suga, Masahito Yamanaka, Norihiko Nishizawa
The University of Nagoya

We developed all polarization-maintaining (PM) optical frequency comb based on dispersion managed, Er-doped Figure9 type fiber laser. In order to detect f_{ceo} signal with high SNR, we adopted a PM-in-line type delay line and balanced detector. The stable operation in the long period of time was achieved and the standard deviations was sub-mHz level.

ALPS-P-21

High-precision mutual control of two-color fiber combs

Tatsuya Hasegawa[1], Yugo Kusumi[1], Shigeki Sakuma[1], Akifumi Asahara[1], Yoshiaki Nakajima[1,2], Ryosuke Shimizu[1], Kaoru Minoshima[1]
[1]The University of Electro-Communications, [2]Toho University

We developed a technique for precise mutual control of two fiber combs generating different wavelength bands. The repetition frequencies and the relative optical mode frequency are precisely controlled and stabilized to the reference optical clock.

ALPS

Poster

ALPS-P-22

Optical Phase Spectral Control of Orbital Angular Momentum Modes Studied by Dual-comb Imaging Spectroscopy

Akifumi Asahara, Takuto Adachi, Seishiro Akiyama, Kaoru Minoshima
The University of Electro-Communications

Orbital angular momentum (OAM)-dependent phase spectral change is characterized based on dual-comb imaging spectroscopy. The OAM-dependent phase measurement has a great potential as versatile light-wave manipulation technique, such as highly purified optical vortex generation.

ALPS-P-23

A dual-comb ranging system without aliasing based on free-running frequency combs

Ruilin Jiang, Siyu Zhou, Guanhao Wu
Tsinghua University

We present a free-running dual-comb ranging system. It includes two filtering channels and avoids the spectral aliasing. The system achieves a precision below 10μm and runs stably over long time without any frequency locking.

BISC

Monday, 19 April

[BISC Satellite in Taiwan] 9:15-11:00
Biomedical Application I
Chair: Kung-Bin Sung
National Taiwan University

BISC-Opening 9:15

Opening Remarks

BISC Satellite in Taiwan-01 9:30 *Invited*

Imaging and Molecular defects in Transcription Syndromes
Jean-Marc Egly
French Academy of Sciences

BISC Satellite in Taiwan-02 10:00 *Invited*

Image-based high content analysis on discovering anti-cancer drug targeting cancer stemness niche
Huei-Wen Chen
National Taiwan University

The tumourous microenvironment (TME) and intra-tumourous heterogeneity may fuel the cancer cell plasticity and evolution. We established a lung cancer stem cells (CSCs) and cancer-associated fibroblasts (CAFs) co-cultured system, a niche-based model to mimic the TME of patients and developed the image-based high-throughput drug screening with phenotypical parameters and stemness markers.

BISC Satellite in Taiwan-03 10:30 *Invited*

CT Radiomics of lung cancer
Yeun-Chung Chang
Department of Medical Imaging, NTUH

Lung cancer is the leading cause of cancer-related mortality worldwide with only an average five-year survival rate of around 19%. To provide adequate therapy for lung cancer, TNM staging has been widely used for supporting treatment management.

[BISC Satellite in Taiwan]11:15-12:45
Optical Coherence Tomography
Chair: Chia-Lung Hsieh
Academia Sinica

BISC Satellite in Taiwan-04 11:15 *Invited*

Deep learning empowered cellular-resolution optical coherence tomography
Sheng-Lung Huang
National Taiwan University

Cellular-resolution optical coherence tomography (OCT) could help unveil living organisms' functions and facilitate clinical disease/cancer diagnosis in the early stage. The cell size, orientation, and morphology are critical indicators to discriminate between normal and cancer cells.

BISC Satellite in Taiwan-05 11:45 *Invited*

OCT/OCTA-guided laser ablation for tumor treatment
Meng-Tsan Tsai, Hao-Wei Huang, Wen-Ju Chen, Tai-Ang Wang, Feng-Yu Chang
Chang Gung University

Laser ablation has come an alternative solution for tumor treatment, and it can be used to remove or shrink tumor tissue. In the previous reports, the pulsed lasers are the most common laser as the light source of laser treatment due to the controllable thermal damage, but it is difficult to use continuous-wave (CW) lasers for tissue ablation because of unpredictable laser damage and thermal effect.

BISC Satellite in Taiwan-06 12:15 *Invited*

A pilot study of developing a small footprint imaging platform with optical coherence tomography (OCT) and OCT angiography for mouse brain imaging *in vivo*
Hsiang-Chieh Lee[1],Ting-Hao Chen[1], Yi-Chun Wu[1], Chih-Chang Li[1], Yu-Wei Chang[1], Ming-An Chen[1], Ting-Yen Tsai[1], Chuan-Bor Chueh[1], Meng-Tsan Tsai[2], Yoshiaki Yasuno[3], Ming-Kai Pan[1]
[1]National Taiwan University, [2]Chang Gung University, [3]University of Tsukuba

Various technologies have been applied to investigate the mechanism of cerebral autoregulation with the mouse brain model, including neurovascular coupling where the changes in the blood oxygenation and blood volume, for example, represent the response to the changes in neural activity.

[BISC Satellite in Taiwan]14:00-16:00
Biomedical Application II
Chairs: Meng-Tsan Tsai
Chang Gung University
Shi-Wei Chu
National Taiwan University

BISC Satellite in Taiwan-07 14:00 *Invited*

Noninvasive quantification of neonatal bilirubin and hemoglobin levels using a handheld diffuse reflectance spectroscopy system
Sheng-Hao Tseng, Shih-Yu Tzeng, Nan-Yu Cheng, Jun-Yen Guo, Ming-Chein Fang
National Cheng Kung University

The prevalence rates of neonatal jaundice and anemia could reach 80% and 25%, respectively. We have developed a handheld diffuse reflectance spectroscopy system to noninvasively, accurately determine the bilirubin and hemoglobin levels of neonates.

BISC Satellite in Taiwan-08 14:30 *Invited*

New treatment opportunities for drug resistance in non-small cell lung cancer
S-Ja Tseng
National Taiwan University

Therapeutic outcomes in treating non-small cell lung cancer (NSCLC) are compromised by the emergence of drug resistance in response to epidermal growth factor receptor (EGFR)-tyrosine kinase inhibitor (TKI) targeted therapy. Clinical virotherapy has been successfully approved for use in cancer treatment by the US Food and Drug Administration (FDA), however a number of improvements are still sought to more broadly develop virotherapy.

BISC Satellite in Taiwan-09 15:00 *Invited*

Morphological Biomarker of Osteoarthritis Knees by Deep Learning
Gary Han Chang
National Taiwan University

MRI-based morphology of femorotibial joints has shown great promise in prediction of osteoarthritis risk and progression, albeit detailed segmentation of femorotibial joints in large volume remains to be difficult. In this work, we developed a morphological biomarker which reflect the changes in bone and cartilage shapes from knee MRI images using deep learning (DL).

BISC Satellite in Taiwan-10 15:30 *Invited*

Tracking molecular dynamics during spermatocyte divisions in the nematode *Caenorhabditis elegans*
Jui-Ching Wu, Shang-Yang Chen, Yu-Hao Chen
National Taiwan University

Spermatocytes exhibit a distinct type of cell division during which the duplicated genome undergoes two consecutive separations without pausing. Such repetition requires rearrangement of the division machineries in between the two separation events. Nonetheless, the mechanistic regulation underlining spermatocyte divisions has been poorly explored.

[BISC Satellite in Taiwan]16:15-18:15
Medical/Biological Imaging Instrumentation and Techniques
Chairs: Sheng-Lung Huang
National Taiwan University
Hsiang-Chieh Lee
National Taiwan University

BISC Satellite in Taiwan-11 16:15 *Invited*

Toward quantitative dosage analysis of transcranial photobiomodulation with near-infrared light
Kung-Bin Sung[1], Tzu-Chia Kao[1], Li-Da Huang[2], Wen-Wei Su[1]
[1]National Taiwan University, [2]The University of Texas at Austin

Transcranial photobiomodulation (tPBM) using near-infrared light has been demonstrated to produce neuroprotective and neuroenhancing effects of the brain non-invasively. We develop enabling techniques to quantify the photon energy delivered to the gray matter to facilitate both research and practical use of tPBM. Results revealed up to one order of magnitude variations in the delivery efficiency due to variations in optical properties and head structure.

BISC Satellite in Taiwan-12 16:45 *Invited*

High-speed dynamic cell imaging by scattering-based interference optical microscopy
Chia-Lung Hsieh
Academia Sinica

Label-free optical microscopy provides the opportunity to observe biological cells in their native forms, but the imaging sensitivity, spatiotemporal resolution, and molecular specificity are usually compromised especially compared to the fluorescence-based approaches.

BISC Satellite in Taiwan-13 17:15 *Invited*

Study of violin spruce woods with aid of two-photon hyperspectral imaging
Szu-Yu Chen, Po-Lin Chen, Hwan-Ching Tai, Jia-Wei Xu
National Central University

Violin-family instruments commonly use spruce as tonewood for the top plate. The acoustic quality is critically affected by the wood properties which have been shown different between modern and old ones due to chemical treatment and aging. In this research, a two-photon hyperspectral system was introduced to reveal the microscopic differences within spruce wood samples in both spatial and spectral domains.

BISC Satellite in Taiwan-14 17:45 *Invited*

High-speed volumetric imaging for brain
Shi-Wei Chu
National Taiwan University

Since the days of Cajal, optical microscopy has been a vital tool for physiology, and neuroscientists have accumulated significant amount of information on structures and functions of isolated neurons. However, to understand the emergent properties of a brain, functional observation of complicated neuronal networks is necessary, leading to the request of volumetric imaging with high speed, deep penetration, and sub-cellular resolution.

BISC

Tuesday, 20 April

[BISC-1] 15:30-17:15
Bioimaging with New Technologies
Chair: Yoshihisa Aizu
Muroran Institute of Technology

BISC-1-01 15:30 *Invited*

Photoacoustic imaging as a bridge from medical imaging to bioimaging
Miya Ishihara
National Defense Medical College, Japan
Photoacoustic imaging is a technology that can add quantitative depth information to optical imaging. The scope of photoacoustic imaging includes clinical, preclinical, and biological applications. We have developed three systems that adapt to each application. In my talk, I will introduce each system.

BISC-1-02 16:00 *Invited*

Fluorescence imaging to understand the molecular mechanism of DNA damage-triggered cellular reprogramming in plants
Yosuke Tamada[1], Akihiro Imai[2], Nan Gu[1]
[1]Utsunomiya University, [2]Hiroshima Institute of Technology
We recently discovered that massive but transient DNA damage can trigger cellular reprogramming of differentiated cells to stem cells. In the talk, we will introduce our recent progress and fluorescent imaging techniques enabling above discovery.

BISC-1-03 16:30

Focus-Shift using Rotating Planar Mirrors for Light Sheet Microscopy
Kenneth Li
Optonomous Technologies Inc.
This paper presents a focus-shift system capable of scanning a sample volume using simple rotating planar mirrors without distortions or chromatic aberrations. In synchronism with advanced scanning illumination techniques such as light sheet and lattice light sheet technologies, 3-dimensional images can be acquired at high speed without having to use electrically tunable lenses (ETL) with aberrations or translation of heavy lenses and fixture at low speed.

BISC-1-04 16:45

Physiological modulation of a biological cell by using direct electron beam exposure
Asahi Tanaka, Wataru Inami, Yoshimasa Kawata
Shizuoka University
We have developed stimulation method for a living biological cell by using direct electron beam exposure. This method is expected to generate reactive oxygen species in a live cell, which modulate physiological functions.

BISC-1-05 17:00

Deep ultraviolet based serial block-face imaging for 3-dimensional morphological assessment of the rodent brains
Deepa Kasaragod, Meina Zhu, Hidenori Aizawa
Hiroshima University
We present a deep ultraviolet (DUV) light microscope capable of serial block-face imaging of the whole rodent brain. The capability of the 3D-DUV microscope for quantitative volumetric analysis of the small substructures of habenula is shown. It is expected that large scale wide-field high resolution analysis of the smaller regions would allow for elucidating the functional changes linked with the morphological changes in brain under pathological conditions.

Wednesday, 21 April

[BISC-2] 9:00-10:00
Infrared and THz Imaging
Chair: Yasuhiro Awatsuji
Kyoto Institute of Technology

BISC-2-01 9:00 *Invited*

Application of infrared laser to living cells for manipulation of gene expression, and *in vivo* temperature measurement method
Takumi Tomoi[1], Joe Sakamoto[1], Suguru Ohe[2], Yosuke Tamada[2], Yasuhiro Kamei[1]
[1]National Institute of Basic Biology, [2]School of Engineering, Utsunomiya University
Combination of infrared laser heating through a microscope optics and heat shock response of cells achieves single-cell gene induction *in vivo*. We will introduce a live-cell manipulation technique and show representative data in living animals and plants. Further, we will discuss a local heating property *in vivo* through a temperature imaging technique using a fluorescent thermometer.

BISC-2-02 9:30

Estimating the dialectric parameters of water and gel using reflectance and transmission at 1.85 to 2.07 THz
Zoltan Vilagosh[1], Negin Foroughimehr[1], Alireza Lajevardipour[1], Dominique Appadoo[2], Saulius Juodkazis[3,4], Andrew Wood[1]
[1]Australian Centre for Electromagnetic Bioeffects Research, Swinburne University of Technology, Hawthorn, Australia, [2]Australian Synchrotron, THz Far Infrared Beamline, Clayton, Australia, [3]Optical Sciences Centre and ARC Training Centre in Surface Engineering for Advanced Materials (SEAM), Swinburne University of Technology, Hawthorn,Australia, [4]World Research Hub Initiative (WRHI), School of Materials and Chemical Technology, Ookayama, Meguro-ku, Tokyo 152-8550, Japan
A novel method of estimating the dielectric properties of water based substances in the 2.0 THz region involves using an ATR apparatus in a way that converts the apparatus to a reflection/transmission mode. It is best suited for 2.0 THz and above with a diamond crystal as the refractive index of diamond (2.40) and water (1.95 at 2.0 THz) are in the optimal ratio for excellent contrast.

BISC-2-03 9:45

Ceramic-based metamaterial for THz sensing applications
Mathieu Poulin, Maksim Skorobogatiy
Ecole Polytechnique de Montreal, Engineering Physics Department
We theoretically predict existence of Spoof Zenneck waves supported by a subwavelength corrugated surface in the terahertz spectral range, which corresponds to an alternative to plasmon-polariton for THz sensing application.

[BISC-3] 11:00-12:00
Optogentics
Chair: Yosuke Tamada
Utsunomiya University

BISC-3-01 11:00 *Invited*

Holographic optical probing of the computing properties of single neurons
Vincent Daria
The Australian National University, Australia
In this talk, I will summarize our efforts to probe the integrative and non-linear properties of dendrites of cortical pyramidal neurons using holographic structured illumination.

BISC-3-02 11:30 *Invited*

Optical control of cellular signaling pathways using animal opsins
Hisao Tsukamoto
Kobe University
Optical control of cellular responses is useful to understand biological functions. Animal opsins, light-sensitive G protein-coupled receptors (GPCRs), can be used as control tools to drive a wide variety of intracellular signaling pathways in a light-dependent manner. Here, I characterize molecular properties of invertebrate opsins as "ON-OFF" switch of GPCR signalings.

[BISC-4] 13:30-15:00
Digital Holography
Chair: Yusuke Ogura
Osaka University

BISC-4-01 13:30

High-speed planar lightwave circuit digital holographic microscope using a thin film heater for biological samples
Hideaki Gomi[1], Kazutaka Nakama[1], Shutaro Kodama[1], Katsunari Okamoto[2], Eriko Watanabe[1]
[1]The university of Electro-Communications, [2]Okamoto Laboratory
We developed a high-speed planar lightwave circuit digital holographic microscope (PLC-DHM) that used a thin film heater for thermo-optical phase shifter. Microscopic moving images of biological samples such as volvox and daphnia was obtained.

BISC-4-02 13:45

Lensless digital holographic microscope for label-free imaging
Manoj Kumar[1], Osamu Matoba[1], Mitsuhiro Morita[1], Yasuhiro Awatsuji[2]
[1]Kobe University, [2]Kyoto Institute of Technology
A new configuration of lensless digital holographic microscope based on a wedge plate is demonstrated. The system is simple in geometry, compact in size and highly stable in temporal phase measurements leading to the accurate investigations of minute membrane fluctuations of the biological cells.

BISC-4-03 14:00

Simultaneous three-dimensional tracking of a mother colony and a daughter colony of a moving *Volvox* by parallel phase-shifting digital holographic microscope
Junya Inamoto[1], Shuhei Genko[1], Tomoyoshi Inoue[1], Kenzo Nishio[1], Osamu Matoba[2], Toshihiro Kubota[3], Yasuhiro Awatsuji[1]
[1]Kyoto Institute of Technology, [2]Kobe University, [3]Kubota Holography Laboratory Corporation
We present simultaneous three-dimensional trajectories of a mother colony and a daughter colony of a *Volvox* dynamically moving in water. The trajectories were achieved at 1000 frames/s by a parallel phase-shifting digital holographic microscope.

BISC-4-04 14:15

Shape measurement of a droplet using phase-shifting burst digital holography
Takumi Ujiie, Yuta Ozawa, Yoshio Hayasaki
Utsunomiya Univ.
Phase-shifting digital holography with burst-imaging method is developed for measuring a shape of the dynamic object. In this research, a drying process of a liquid droplet on a glass substrate were observed.

BISC-4-05 14:30

Numerical Evaluations for Multiplicative Algebraic Reconstruction Technique
Tomohiro Aoyagi, Kouichi Ohtsubo
Toyo University
Multiplicative algebraic reconstruction techniques (MART) is one of POCS for solving a system of simultaneous equation. We applied the MART to image reconstruction problems and evaluate the image quality in computer simulations.

BISC-4-06 14:45

Image reconstruction of objects through diffusers with different diffusion angles
Takumi Tsukada, Taichi Nishijima, Wataru Watanabe
Ritsumeikan University
When objects are located in scattering media such as biomedical tissues, one must consider image reconstruction of objects between two scatterers or diffusers. In this paper, we capture speckle images through a 4-f imaging system; then we reconstruct objects through two diffusers by deep learning.

[BISC-5] 16:00-17:30
Deep Imaging
Chair: Wataru Watanabe
Ritsumeikan University

BISC-5-01 16:00 *Invited*

towards fluorescence imaging deep in scattering media
Sylvain Gigan
Sorbonne University
non-invasive linear fluorescence imaging deep in scattering media remains very challenging, due to the difficulty use fluorescence as a guide star. I will discuss several computational approaches, using either functional activity of neurons, or dynamic excitation through wavefront shaping, to achieve this goal.

BISC-5-02 16:30 *Invited*

3D imaging through Fourier lightfield microscopy
Emilio Sanchez-Ortiga, Hui Yun, Gabriele Scrofani, Manuel Martinez-Corral, Genaro Saavedra
3D Imaging and Display Laboratory, University of Valencia
Lightfield microscopy has been recently introduced in single-shot 3D bioimaging. In this contribution we review the state-of-the-art of a novel architecture in lightfield imaging: Fourier lightfield microscopy. We present this new paradigm, showing its state-of-the-art and describing some challenges that it should face in the near future.

BISC

Wednesday, 21 April

BISC-5-03 17:00 *Invited*

Deep tissue imaging by optical coherence tomography / microscopy at Optical Window III

Norihiko Nishizawa, Masahito Yamanaka
Nagoya University, Japan

High resolution optical coherence tomography and microscopy using fiber laser based super continuum were demonstrated at 1.7 um range. Precise structures of mouse brain were observed successfully at depth of up to 1.9 mm.

[BISC-6] 9:00-10:15
Nano and Structured Light
Chair: Osamu Matoba
Kobe University

BISC-6-01 9:00 *Invited*

***In vivo* fluorescence imaging of transplanted stem cells by quantum dots for regenerative medicine**

Hiroshi Yukawa[1,2]
[1]Nagoya University, [2]National Institutes for Quantum and Radiological Science and Technology

Quantum dots (QDs) have excellent fluorescence properties in comparison to traditional fluorescence probes. In this presentation, the applications of QDs such as stem cell labeling and *in vivo* imaging of transplanted stem cells is reported.

BISC-6-02 9:30 *Invited*

Multicolor tracking of single biomolecules with metallic nanoparticles at microsecond time resolution

Jun Ando
RIKEN

We developed a multicolor dark-field imaging system using silver and silver-gold alloy nanoparticles together with gold nanoparticles, and revealed fast motions of phospholipids in supported membranes and kinesins along microtubules at 100 μs time resolution.

Thursday, 22 April

BISC-6-03 10:00

Fluorescence tags using FRET networks and DNA structural change

Yusuke Ogura, Keita Hayashi, Suguru Shimomura, Jun Tanida
Osaka University

We present a method for constructing fluorescence tags using Förster resonance energy transfer networks and DNA nanostructures which can change in response to molecular input. Simulation results demonstrate the capability of the method.

[BISC-7] 11:00-12:00
Computational and Multimodal Imaging
Chair: Yuan Luo
National Taiwan University

BISC-7-01 11:00 *Invited*

First Photon-detection Ghost imaging for weak light imaging

Yasuhiro Mizutani, Shoma Kataoka, Tsutomu Uenohara, Yasuhiro Takaya
Osaka University

We propose a novel imaging method using the Ghost Imaging (GI) in a photon limited imaging by using the First Photon-detection Time (FPT). The GI with FPT (FPGI) was able to obtain high quality image than a conventional imaging method using same photon number. Furthermore, to improve the detection time, we modified machine learning to reduce the measurement number in the view point of noise influence.

BISC-7-02 11:30

Simultaneous light-field fluorescence and TIE-based phase imaging

SUDHEESH K RAJPUT[1], RYO SHINKE[1], Xiangyu Quan[1], Yasuhiro Awatsuji[2], OSAMU MATOBA[1]
[1]Kobe University, [2]Kyoto Institute of Technology

We propose a simultaneous imaging of fluorescence and phase information. Here, the fluorescence imaging can be performed by the concept of light field and phase information is obtained by solving the transport of intensity equation.

BISC-7-03 11:45

Integrated optical imaging system composed of optical time-of-flight and optical coherence tomography

Juan Manuel Franco Sanchez[1], Yuki Shimamoto[1], Shunya Masaki[1], Joel Cervantes[2], Quang Duc Pham[3], Keiichiro Kagawa[4], Hajime Nagahara[5], Yoshio Hayasaki[1]
[1]Utsunomiya University Center for Optical Research & Education (CORE), Utsunomiya University, Japan, [2]University Center of Exact Sciences and Engineering, Guadalajara University, Mexico, [3]National Center for Technological Progress, Vietnam, [4]Research Institute of Electronics, Shizuoka University, Japan, [5]Institute for Datability Science, Osaka University, Japan

In this research, an optical time-of-flight and an optical coherence tomography were integrated, because both methods have a measurable range that overlaps in the submillimeter range. The integrated optical imaging system has the maximum measurable range of several ten centimeters and the axial resolution of several micrometers, and also get inside observation ability derived from the feature of the optical coherence tomography.

[BISC-8] 13:30-15:00
Visualization and Processing
Chair: Izumi Nishidate
Tokyo University of Agriculture and Technology

BISC-8-01 13:30 *Invited*

Red blood cell flow dynamics at bifurcations of the brain capillaries

KAZUTO MASAMOTO, Ruka Sakuraba, Tomoya Niizawa
The University of Electro-Communications, Japan

Two-photon microscopy was used to concurrently image blood plasma and single blood cells expressing fluorescent proteins in the anesthetized rat cortex, and revealed that viscosity determines a direction of the cell's flow at the capillary bifurcations.

BISC-8-02 14:00

Imaging microplastics consumed by water organisms using a full-Stokes polarization camera

Nobuaki Endo, Nathan Hagen, Shuhei Shibata, Yukitoshi Otani
Utsunomiya University

Waterborne microplastics can be difficult to detect in situ. We report on a method of visualizing microplastics using their inherent birefringence. By using a full-Stokes polarization camera for measurement, the microplastics can be visualized and quantified in real-time. In addition, we show that the camera is able to visualize PET microplastics consumed by brine shrimps in vivo.

BISC-8-03 14:15

Bio-optic gas visualization system (Sniff-cam) for human volatiles

Kenta Iitani, Koji Toma, Takahiro Arakawa, Kohji Mitsubayashi
Tokyo Medical and Dental University

A bio-optic gas-imaging system (sniff-cam) with enzyme immobilized mesh demonstrates a spatiotemporal gas-imaging for human volatiles. The bio-fluorometric sniff-cam for ethanol was constructed with alcohol dehydrogenase (ADH) immobilized mesh and the NADH imaging unit, thus imaging human ethanol in the gas phase not only exhaled air but also transcutaneous vapor after drinking.

BISC-8-04 14:30

Finger region extraction using color of skin for hand-waving finger vein authentication

Hiroyuki Suzuki[1], Narissa Ditthapakdijanya[2], Takashi Komuro[3], Keiichiro Kagawa[4], Kazuya Nakano[5], Takashi Obi[2]
[1]Gunma University, [2]Tokyo Institute of Technology, [3]Saitama University, [4]Shizuoka University, [5]University of Miyazaki

We propose a finger region extraction method that takes color images with both of a near infra-red LED and identifies the finger region based on the skin color information.

BISC-8-05 14:45

Processing Bone Fracture Image before and after Surgery using GPU

Luis Cadena[1], Franklin Cadena[2], Alberto Albuja[1], Patricio Castillo[3], Gustavo Cadena[4]
[1]Universidad de las Fuerzas Armadas ESPE, [2]College Juan Suarez Chacon, [3]Universidad Técnica Particular de Loja UTPL, [4]Universidad Central del Ecuador

A fracture is the solution of continuity of bone tissue in any bone of the body occurs as a result of excessive stress that exceeds bone resistance, ie is the consequence of a single or multiple overload and occurs in milliseconds. This work presents an improved methodology for processing bone fracture images before and after surgery using segmentation and graphic accelerator cards to help the medical specialist in the analysis and evaluation of the images.

[BISC-P]
Poster Session

BISC-P-01

Quantitatively characterizing the microstructural features of collagen fiber bundles with or without tenocytes by Mueller imaging polarimeter

Chenle Cao[1], Jiazhi Wang[1], Guodong Zhou[1], Jianhui Li[1], Ke Liu[1], Lihui Liu[1], Li Li[2], Yanqiu Li[1]
[1]Key Laboratory of Photoelectron Imaging Technology and System of Ministry of Education, School of Optics and Photonics, Beijing Institute of Technology, [2]Chinese People's Liberation Army General Hospital, The 8th Medical Center

We apply the Mueller imaging polarimeter for quantitative detection of rabbit transplanted tendon samples, the results indicate that the retardance and the orientation angle parameters can distinguish rabbit tendon tissues with or without tenocytes.

BISC

Poster

BISC-P-02

Study on the cellular-level polarization characteristics of pathological sections with different preparation state by Mueller matrix polarimeter

Jiazhi Wang[1], Chenle Cao[1], Guodong Zhou[1], Li Li[2], Ke Liu[1], Jianfeng Wang[1], Yanqiu Li[1]
[1]Beijing Institute of Technology, [2]Chinese People's Liberation Army General Hospital, The 8th Medical Center

The paper studied the polarization characteristics of pathological sections with different preparation states (undewaxed, dewaxed or H-E stained), which provides the basis for the best selection of the slice preparation state during polarization diagnosis.

BISC-P-03

Investigation of noncontact fast-scanning internal-temperature measurement using a thermopile-infrared point detector

Masaki Hisaka
Osaka Electro-Communication University

A noncontact method using an infrared point detector to measure a thermal object's internal temperature was developed. We introduced the 2D fast-scanning system to reduce a thermal filament image's capturing time inside a miniature bulb.

BISC-P-04

Comparison of hepatocellular carcinoma and healthy liver tissues utilizing the optical polarized system

Vi Thao Nguyen[1,2], Truc Thanh Nguyen[1,2], Hai Thanh Le[3,2], Hung Quoc Phan[4], Hien Thi Thu Pham[1,2]
[1]School of Biomedical Engineering, International University, HCMC, Vietnam, [2]Vietnam National University HCMC, Vietnam, [3]Faculty of Mechanical Engineering, HCMC University of Technology, HCMC, Vietnam, [4]Mechanical Engineering Department, National United University, Miaoli 36063, Taiwan

Hepatocellular carcinoma (HCC) is the most frequent type of liver cancer. This study was applied an optical polarization system using the Stokes-Mueller matrix to differentiate the HCC tissues with normal ones, based on optical characteristics of cancerous and normal tissues with polarized light. It paves the way for non-invasive, real-time identification of HCC and early detection of liver cancer.

BISC-P-05

Two-Step Curve Fitting Combined with a Two-Layered Tissue Model to Quantify Intrinsic Fluorescence of Cervical Mucosal Tissue in Vivo

Guo-Sheng Lin[1], Chong Ian Mok[1], Kung-Bin Sung[1,2,3]
[1]Graduate Institute of Biomedical Electronics and Bioinformatics, National Taiwan University, [2]National Taiwan University, Department of Electrical Engineering, [3]National Taiwan University, Molecular Imaging Center

Fluorescence spectroscopy (FS) has been used to characterize tissue fluorophores in vivo for the diagnosis of precancers in the uterine cervix. In this study, a two-step curve fitting process is established to extract the intrinsic fluorescence intensity and spectrum of fluorophores including NADH and FAD in the epithelium and collagen crosslinks in the stroma.

BISC-P-06

Non-invasive quantification of the photon fluence rate in the prefrontal cortex for transcranial photobiomodulation (tPBM)

Yu-Peng Hsieh[1], Tzu-Chia Kao[2], Kung-Bin Sung[2]
[1]Department of Electrical Engineering, National Taiwan University, [2]Graduate Institute of Biomedical Electronics and Bioinformatics, National Taiwan University

Transcranial photobiomodulation (tPBM) has been applied to improve cognition in chronic traumatic brain injury, whereas tPBM-induced enhancement of the brain is dose-dependent. We perform Monte Carlo simulations and propose a machine-learning based model that predicts the fraction of the energy of photons delivered to the gray matter (GM) based on the diffuse reflectance exiting the scalp surface and demographic variables such as gender and age.

BISC-P-07

Enhancing Diagnosis of Gingivitis by Quantifying Gingival Tissue Functional Parameters with Diffuse Reflectance Spectroscopy

Chieh Yeh[1], I-Wen Huang[2], Yuan-Hsun Tsai[2], Po-Chi Hu[2], Tzu-Chia Liu[1], Guan-Hua Lai[1], Sheng-Hao Tseng[1], Yu-Chen Kuan[3]
[1]Department of Photonics, National Cheng Kung University, [2]Metal Industries Research and Development Centre, [3]Division of Periodontics, Department of Dentistry

Early gingivitis is difficult to assess by visual observation. We found that the tissue chromophore values derived from our diffuse reflectance spectroscopy system had a greater advantage over the conventional 2-wavelength reflectance ratio method.

BISC-P-08

High-speed and wide-field endoscopic optical coherence tomography imaging of the oral mucosa with a micromotor imaging catheter and polarization diversity detection

Ting-Yen Tsai[1], Chuan-Bor Chueh[1], Ting-Hao Chen[1], Meng-Shan Wu[1], Meng-Tsan Tsai[2,3], Hsiang-Chieh Lee[1,4,5]
[1]Graduate Institute of Photonics and Optoelectronics, National Taiwan University, [2]Department of Electrical Engineering, Chang Gung University, [3]Department of Neurosurgery, Chang Gung Memorial Hospital, [4]Department of Electrical Engineering, National Taiwan University, [5]Molecular Imaging Center, National Taiwan University

Due to the complex geometry of the oral cavity, it is challenging to perform wide-field optical coherence tomography (OCT) imaging of different regions of the oral mucosa, particularly in patients with opening difficulty due to submucosa fibrosis. In addition to changes in the tissue architectures, angiogenesis has been demonstrated to play an important role in the progression of oral neoplasm.

BISC-P-09

Graphics processing unit (GPU) accelerated microvascular imaging framework with optical coherence tomography (OCT) and OCT angiography techniques

Yu-Ling Chen[1], Ting-Hao Chen[1], Ting-Yen Tsai[1], Chuan-Bor Chueh[1], Yi-Chun Wu[1], Meng-Tsan Tsai[2,3], Cheng-Kuang Lee[4], Hsiang-Chieh Lee[1,5,6]
[1]Graduate Institute of Photonics and Optoelectronics, National Taiwan University, [2]Department of Electrical Engineering, Chang Gung University, [3]Department of Neurosurgery, Chang Gung Memorial Hospital, [4]NVidia AI Technology Center (NVAITC), NVidia, [5]Department of Electrical Engineering, National Taiwan University, [6]Molecular Imaging Center, National Taiwan University

Recently, the functional extension of optical coherence tomography (OCT) with OCT angiography (OCTA) allows volumetric imaging of the subsurface microvasculature without requiring exogenous contrast agents like conventional angiography techniques. However, performing OCTA requires intensive computation to extract the changes of OCT signal due to moving red blood cells in the microvascular network.

BISC-P-10

Quantitative absorption imaging of single nanoparticles by widefield interferometric photothermal microscopy

Yu-Chien Huang[1,2], Te-Hsin Chen[1], Jz-Yuan Juo[1], Shi-Wei Chu[2], Chia-Lung Hsieh[1]
[1]Academia Sinica, [2]National Taiwan University

We demonstrate widefield interferometric photothermal microscopy to detect the local refractive index changes of single nanoparticles induced by the dissipated heat due to light absorption (known as the thermal lens effect). The sensitivity of our system is sufficient for visualizing very small single gold nanoparticles, as small as 5 nm. We establish a model to explain the generation mechanism of the photothermal signal.

BISC-P-11

Label-free imaging of cell nucleus dynamics by coherence brightfield (COBRI) microscopy

Yi-Teng Hsiao, Chia-Ni Tsai, Chia-Lung Hsieh
Academia Sinica

We use coherent brightfield (COBRI) microscopy, a highly sensitive scattering-based interference microscopy, to capture the dynamic linear scattering signal of chromatin in live cells. A strategy of reconstructing the chromatin organization from the dynamic COBRI imaging is demonstrated. Using our methods, we investigate the processes of chromatin (de) condensation induced by chemical drugs at the unprecedented spatial and temporal resolutions.

BISC-P-12

Mueller matrix calculation using Electric field Monte Carlo simulation

Ying-Ju Tsai[1], Sunil Vyas[2], Yuan Luo[2,3], Kung-Bin Sung[1,3,4]
[1]Graduate Institute of Biomedical Electronics and Bioinformatics, National Taiwan University, [2]Institute of Medical Device and Imaging, National Taiwan University, [3]Molecular Imaging Center, National Taiwan University, [4]Department of Electrical Engineering, National Taiwan University

Understanding the propagating of light in biological tissues have long been an important issue. For this purpose, modeling scattering of light from laser radiation into turbid media has been studied. One of the common modeling tools is Monte Carlo simulation, and Mueller matrix method is a commonly used technique to study birefringence and depolarization properties of biological samples.

BISC-P-13

Multi-depth high resolution imaging with SAX microscopy

Chi-Hao Luo[1], Shi-Wei Chu[5], Kuang-Yuh Huang[1], Yuan Luo[2,3,4]
[1]Institute of Mechanical Engineering, National Taiwan University, [2]Institute of Medical Device and Imaging, National Taiwan University, [3]Molecular Imaging Center, National Taiwan University, [4]Yong-Lin Institute of Health, National Taiwan University, [5]Electro-Optical Engineering and Department of Electrical Engineering, National Taiwan University

We show multi-depth imaging in SAX microscope using tunable focusing lens without moving samples or microscope objective. Imaging properties of our system are experimentally measured using fluorescent beads.

BISC-P-14

Monitoring of pH by using stimulus responsive hydrogel and Fiber Bragg grating for bioreactor applicationMonitoring of pH by using stimulus responsive hydrogel and Fiber Bragg grating for bioreactor application

Aruna N
Lakireddy Bali Reddy College of Engineering

In this paper a pH monitoring system is demonstrated by utilizing wavelength modulated fiber optic techniques. A stimulus responsive hydrogel which exhibits a volume change with the change of pH is utilized to render a strain on FBG.

BISC-P-15

Carcinogenic chromium (VI) sensing using swelling characteristics of hydrogel on Fiber Bragg grating

Aruna N
Lakireddy Bali Reddy College of Engineering

The present article proposes carcinogenic Chromium (VI) metal ion sensor by a hydrogel coated etched FBG. Hydrogel synthesized from the blends of ATAC which is stimulus responsive to chromium ions suffers a volume change in different Cr solutions.

BISC

Poster

BISC-P-16

Development of a miniature imaging head combing wide-angle camera and optical coherence tomography for the semiautonomous laparoscope surgery procedure

Zheng-Jie Wu[1], Ting-Yen Tsai[1], Meng-Shan Wu[1], Cheng-Wei Chen[2], Hsiang-Chieh Lee[1,2,3]
[1]Graduate Institute of Photonics and Optoelectronics, National Taiwan University, [2]Department of Electrical Engineering, National Taiwan University, [3]Innovative Photonics Advanced Research Center, National Taiwan University

Serving as minimally invasive surgery, robotic surgery has become a promising treatment approach toward various diseases, such as Urology, Gastroenterology, or Gynecology. Although robotic surgery exhibits several advantages of decreasing the incision size and shorter patient stay, it still imposes extensive labor loading to the surgeons. Therefore, recently, semiautonomous laparoscope surgery has been emerged to improve the surgery precision further.

BISC-P-17

Quantification of Cardiac dynamics of zebrafish Larvae Using lightsheet fluorescence microscopy

Yu-Hsuan Huang, Po-Sheng Hu
National Yang Ming Chiao Tung University

Pathological disorder such as acute cardiovascular disease remains one of the major causes of death worldwide. Zebrafish has become an exquisite animal model for investigating many aspects of humanoid heart organ like structural morphogenesis, dynamic function and pathogenesis which allow screening efficiency of medicine.

BISC-P-18

Investigation of position and size for lymphedema with Infrared thermal imaging technology

Yi Feng Liu[1], Hsi-Chao Chen[1], Ying-Sheng Lin[2], Bo-Wei Lai[1], Min-Yi Jiang[1], Zheng-Ann Xiong[1], Wang-Tzu Hsi[1]
[1]National Yunlin University of Science and Technology, [2]National Taiwan University Hospital Yunlin Branch

The purpose is to utilize infrared-ray thermal imaging system to detect thermal temperature of the target, and the appearance of image by the digital image processing. The image of the infrared-ray thermal imager could get the related position and size of the lymphedema. The experiment measured the noncontact measurement of infrared images in the knee, calf belly and ankle of the patient's lower limb edema to observe the magnitude of its edema.

BISC-P-19

Quantification of the variation of skin properties induced by facial masks using diffuse reflectance spectroscopy

Yin-Yu Chen, Shih-Yu Tzeng, Yun-Yo Yen, Sheng-Hao Tseng
National Cheng Kung University

Facial masks are known to moisturize skin to maintain proper skin health. The global sheet face mask market size was valued at USD 257.9 million in 2018. Nevertheless, there are few academic literatures to discuss the effect of facial mask on skin. In this study, we compare the commercially available instrument with our DRS system by measuring the skin after applying facial masks.

BISC-P-20

Digital micro-mirror device based multi-focal confocal microscopy

Surag Athippillil Suresh[1,2], Sunil Vyas[2], J. Andrew Yeh[1], Yuan Luo[2]
[1]Institute of Nano Engineering and Microsystems, National Tsing Hua University, [2]Institute of Medical Device and Imaging, National Taiwan University

For acquiring optically sectioned images of volumetric samples from multiple depths without axial scanning, a confocal system which is able to obtain multi-plane images with a Digital Micro-Mirror Device (DMD) has been proposed. The focal points of the laser beam can be arbitrarily positioned to any multiple planes in the three dimensional object space by switching multiplexed binary hologram encoded in the DMD by Lee hologram.

BISC-P-21

Volume Holographic Beam Shaper for Super Gaussian Beams

Surag Athippillil Suresh[1,2], Sunil Vyas[2], J. Andrew Yeh[1], Yuan Luo[2]
[1]Institute of Nano Engineering and Microsystems, National Tsing Hua University, [2]Institute of Medical Device and Imaging, National Taiwan University

A volume holographic optical element is designed and fabricated using photopolymer (PQ-PMMA) for super Gaussian beam. A Lee hologram and Digital Micro Mirror Device (DMD) are used for modulating the laser beam to a uniform one all over its beam diameter. The efficiency and uniformity of super Gaussian beams generated through volume holographic optical component is experimentally demonstrated with optimized parameters.

BISC-P-22

Fast isotropic quantitative differential phase contrast microscopy using radially asymmetric color pupil

Yu-Hsiang Lin[1,2], An-Cin Li[2], Ying-Ju Chen[2], Yuan Luo[2]
[1]Department of Power Mechanical Engineering, National Tsing Hua University, [2]Institute of Medical Device and Imaging, National Taiwan University

Differential phase contrast microscopy based on twelve-axis measurements of half-circle pupil acquires isotropic phase information but suffers with poor imaging speed. We proposed a new method by modulating illumination pattern to realize isotropic PTF within three-axis measurements.

BISC-P-23

Moiré lens based long axial scanning telecentric imaging system

Yu-Hsin Chia[1,2], Sunil Vyas[2], Hsin-Yu Kuo[2,6], Yi-You Huang[5,1], Yuan Luo[2,3,4]
[1]Department of Biomedical Engineering, National Taiwan University, [2]Institute of Medical Device and Imaging, National Taiwan University, [3]Molecular Imaging Center, National Taiwan University, [4]YongLin Institute of Health, National Taiwan University, [5]Department of Biomedical Engineering, National Taiwan University Hospital, [6]Department of Physics, National Taiwan University

We present a telecentric design to obtain constant magnification with long axial scanning range in an optical sectioning microscope. A Moiré lens is included and utilized for this purpose. The design principles of our system are explained through mathematical expression and simulation results are provided for different conditions.

BISC-P-24

3D Archimedean spiral Metasurface for Enhances Broadband Optical Chirality

Hsin-Yu Kuo[1,2,3], Ming Lun Tseng[2], Zhan-Hong Lin[4], Yu-Jung Lu[1,2], Yuan Luo[3,5,6], Jer-Shing Huang[4], Din Ping Tsai[1,2,7]
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Metasurfaces comprising 3D chiral structures have shown great potential in chiroptical applications such as chiral optical components and sensing. So far, the main challenges lie in the nanofabrication and the limited operational bandwidth. Here, we present an effective nanofabrication method to create a 3D chiral metasurface with far- and near-field broadband chiroptical properties.

BISC-P-25

Investigation of laser-indued thermal effect with laser speckle contrast imaging

Wei-En Sia[1], Cheng-Yu Lee[1], Tai-Ang Wang[1,2], Wen-Ru Chen[1], Feng-Yu Chang[1], Meng-Tsan Tsai[1,3]
[1]Department of Electrical Engineering, Chang Gung University, [2]Department of Periodontics, Chang Gung Memorial Hospital, [3]Department of Neurosurgery, Chang Gung Memorial Hospital

The laser treatment is an ideal option to conduct a surgical resection since it enables to provide higher accuracy and to cause less damage when targeting invariant tissue areas. Compared to traditional mechanical or chemical treatment modalities, it can shrink or destroy cancer cells using a narrow, focused light beam without harming normal tissue nearby.

BISC-P-26

Characterization of vitiligo with optical coherence tomography

Po-Hsu Su[1], Bo-Huei Huang[1], Chau Yee Ng[2], Feng-Yu Chang[1], Meng-Tsan Tsai[1,3]
[1]Department of Electrical Engineering, Chang Gung University, [2]Department of Periodontics, Chang Gung Memorial Hospital, [3]Department of Neurosurgery, Chang Gung Memorial Hospital

Optical coherence tomography (OCT) can noninvasively reconstruct the three-dimensional microstructure of skin and OCT has been commonly used for clinical studies. Additionally, the functional imaging abilities have been intensively investigated in the past few years such as angiography, spectroscopy, polarization, elasticity, etc. The previous reports have demonstrated that OCT can be a powerful tool for diagnoses of skin disorders.

BISC-P-27

Airy light sheet microscope for *in-vivo* imaging of *C. elegans*

Hung-Chuan Hsu[1], Sunil Vyas[2], Kuang-Yuh Huang[1], Hsien-Shun Liao[1], Yuan Luo[2,3]
[1]Department of Mechanical Engineering, National Taiwan University, [2]Institute of Medical Devices and Imaging System, National Taiwan University, [3]Yong-Lin Institute of Health, National Taiwan University

The feature of rapid divergence of conventional Gaussian beam restricts the field of view in light sheet microscopy. Comparison with Gaussian beam, the Airy beams provides many advantages in light sheet microscopy such as larger field of view (FOV), longer penetration path, and self-reconstruction.

BISC-P-28

Deep neural networks enabled isotropic quantitative differential phase contrast microscopy

An-Cin Li[1], Yu-Hsiang Lin[2], Hsuan-Ming Huang[1], Yuan Luo[1,3,4]
[1]Institute of Medical Device and Imaging, National Taiwan University, [2]Department of Power Mechanical Engineering, National Tsing Hua University, [3]Molecular Imaging Center, National Taiwan University, [4]YongLin Institute of Health, National Taiwan University

We utilized U-net model for mapping from 1-axis phase reconstruction to 12- axis one. The results show that the deep neural network we proposed achieved expecting performance. The final testing loss value of our model after 1000 epochs of training achieved 6.7e-5 after normalized. The peak signal to noise ratio improvement is from 26dB to 30dB.

HEDS

Monday, 19 April

[HEDS-Opening] 9:00-9:10
Opening Remarks
Chair: Ryosuke Kodama
Osaka University

[HEDS-1] 9:10-10:25
Acceleration/Diagnostics I
Chair: Yasuhiro Kuramitsu
Osaka University

HEDS-1-01 9:10 *Invited*

Controlled injection of relativistic protons in wake-field by using dual-laser pulses

Shogo Isayama[1], Shih Hung Chen[2], Han Wei Chen[2], Yao Li Liu[2], Yasuhiro Kuramitsu[3], Yuji Fukuda[4]
[1]Interdisciplinary Graduate School of Engineering Sciences, Kyushu University, [2]Department of Physics, National Central University, [3]Graduate School of Engineering, Osaka University, [4]KPSI, QST

We propose an efficient hybrid acceleration scheme to generate relativistic protons using dual pulses and solid density and near critical density foils in tandem. The acceleration mechanism is the two stage acceleration process of radiation pressure acceleration and laser wakefield acceleration where the injection of relativistic ions into the wakefield is controlled by the parameters of the dual pulses.

HEDS-1-02 9:35 *Invited*

Wakefield Excitation and Associated Particle Acceleration in Relativistic Collisionless Shocks

Masanori Iwamoto[1], Takanobu Amano[2], Yosuke Matsumoto[3], Shuichi Matsukiyo[1], Masahiro Hoshino[2]
[1]Kyushu University, [2]University of Tokyo, [3]Chiba University

Relativistic collisionless shocks are ubiquitous in the universe, in which synchrotron maser instability produces intense electromagnetic waves and then induces wakefield in the upstream. Our 2D PIC simulation indeed confirms the wakefield excitation and demonstrates the particle acceleration in the upstream. In this talk, we discuss the mechanism of this particle acceleration in details.

HEDS-1-03 10:00 *Invited*

High energy density plasmas produced by the interaction between high intensity laser and structured medium ~A new platform studying magnetic confined plasmas using laser~

Yasuaki Kishimoto, Kenji Imadera, Ryutaro Matsui
Kyoto University

We studied high energy density plasmas by the interaction between high intensity laser and structure medium with sub-micron meter and found a new confinement state exceeding inertia time dominated by coherent magnetic structure.

[HEDS-2] 10:45-11:50
Acceleration/Diagnostics II
Chair: Yasuhiro Kuramitsu
Osaka University

HEDS-2-01 10:45 *Invited*

Investigating kinetic-scale current filamentation dynamics and associated magnetic fields in interpenetrating plasmas

George Swadling[1], Colin Bruulsema[2], Frederico Fiuza[3], Drew Higginson[1], Channing Huntington[1], Hye-Sook Park[1], Brad Pollock[1], Wojciech Rozmus[2], Hans Rinderknecht[4], Joe Katz[4], Andrew Birkel[5], James Ross[1]
[1]LLNL, [2]University of Alberta, [3]SLAC National Accelerator, [4]Laboratory for Laser Energetics, [5]Plasma Science and Fusion Center, MIT

Ion-stream filamentation and magnetic field generation was observed in interpenetrating plasmas, driven by the ion-Weibel instability. The interactions of counter propagating, collisionless plasma flows were probed using Thomson scattering, revealing anticorrelated modulations in the density of the two streams at the ion skin depth scale, and a correlated modulation in the plasma current consistent with a magnetic field amplitude ~ 30±6 T, ~ 1% of the flow KE.

HEDS-2-02 11:10 *Invited*

Applications of Solid State Nuclear Track Detectors for Measurements of Laser-Accelerated Ions

Masato Kanasaki
Kobe University

The characteristics and the methods of using solid state nuclear track detectors as an ion detector are introduced with the results from the recent studies measuring laser-accelerated ions.

HEDS-2-03 11:35

X-ray spectroscopy of relativistic plasma with controlled preplasma formation at J-KAREN-P experiments

Tatiana Pikuz[1,2], Maria A Alkhimova[2], Sergey N Ryazantsev[2], Igor Yu Skobelev[2,3], Sergey Pikuz[2,3], Artem S Martynenko[2], Maxim V Sedov[2], Alexey N Shatokhin[4,5], Eugene A Vishnyakov[4], Akito Sagisaka[6], Koichi Ogura[6], Bruno Gonzalez Izquierdo[6], Kotaro Kondo[6], Yasuhiro Miyasaka[6], Akira Kon[6], Masahiko Ishino[6], Masaharu Nishikino[6], Timur Zh Esirkepov[6], James K Koga[6], Masaki Kando[6], Hiromitsu Kiriyama[6], Kinimori Kondo[6], Ryosuke Kodama[7,8], Tetsuya Kawachi[6], Yuji Fukuda[6], Alexander S Pirozhkov[6], Youichi Sakawa[7]
[1]OTRI, Osaka University, [2]JIHT, RAS, [3]National Research Nuclear University MEPhI, [4]P.N. Lebedev Physical Institute, RAS, [5]Moscow Institute of Physics and Technology, [6]KPSI, QST, [7]ILE, Osaka University, [8]Graduate School of Engineering, Osaka University,

We will report on the new experiments performed at PW-class J-KAREN-P laser with the tailored plasma density profile created by specially incorporated prepulse both from the front and rear side of the solid target. The detailed analysis of plasma parameters provided by means of high-resolution x-ray spectroscopic methods, based on emission characteristics of plasma in the spectral range of Ne-like Fe and H-like Cl ionization states will be presented.

[HEDS-3] 13:00-15:00
Diagnostics/Reconnection
Chair: Tatiana Pikuz
Osaka University

HEDS-3-01 13:00 *Invited*

Cosmic Ray Muon Imaging of Khufu's Pyramid with Nuclear Emulsions

Kunihiro Morishima
Nagoya University

We are developing the nuclear emulsion technologies for observation of cosmic rays and its analysis for cosmic ray muon imaging.

HEDS-3-02 13:25 *Invited*

A Scintillator-based detector system to measure GeV class ions

Atsushi Tokiyasu[1], Yasuhiro Kuramitsu[2], Takumi Minami[2], Kou Iwasaki[2], Hideki Kohri[3], Yuki Abe[4], Yuji Fukuda[5], Satoshi Kodaira[6], Takafumi Asai[7], Masato Kanasaki[7]
[1]Research Center for Electron Photon science, Tohoku Univeristy, [2]Graduate School of Engineering, Osaka University, [3]RCNP, Osaka University, [4]ILE, Osaka University, [5]KPSI, QST, [6]NIRS, QST, [7]Graduate School of Maritime Sciences, Kobe University

It is essential to measure the energy of the accelerated ions in a real time manner to reveal the mechanism of laser ion acceleration. For this purpose, we proposed a detector system composed of scintillators and PMTs. In this talk, the detection principle and design concepts are reviewed. Test experimental results using HIMAC facility is reported. Future prospect to use the system for laser ion acceleration experiments with J-KAREN laser facility is also discussed.

HEDS-3-03 13:50

A New Measurement Method for Laser-accelerated Sub-GeV Protons utilizing Multiple Coulomb Scattering in an Emulsion Cloud Chamber

Takafumi Asai[1,2], Masato Kanasaki[1], Satoshi Jinno[3], Nobuko Kitagawa[4], Nobumichi Shutoh[5], Satoshi Kodaira[6], Tomoya Yamauchi[1], Keiji Oda[1], Kunihiro Morishima[4], Yuji Fukuda[2]
[1]Kobe University, [2]QST-KPSI, [3]The University of Tokyo, [4]Nagoya University, [5]Kindai University, [6]QST-NIRS

We have developed a new measurement method for laser-accelerated sub-GeV-class protons utilizing a multiple Coulomb scattering method in an Emulsion Cloud Chamber, which is a stack of nuclear emulsion films and scatterer plates.

HEDS-3-04 14:05 *Invited*

Generation of Megatesla Magnetic Fields by Microtube Implosion

Masakatsu Murakami[1], Javier Honrubia[2], Katheleen Weichman[3], Alex Arefiev[3], Sergei Bulanov[4]
[1]Osaka University, [2]Universidad Politécnica de Madrid, [3]UCSD, [4]ELI-Beamline

We have recently proposed a novel mechanism called a "microtube implosion," and demonstrated the generation of megatesla (MT) order magnetic fields via particle simulations. This is three orders of magnitude higher than what has ever been achieved in a laboratory. Such high magnetic fields are expected only in celestial bodies like neutron stars and black holes.

HEDS-3-05 14:30

Experimental investigation of magnetic reconnection in laser-driven self-generated magnetic field

Taichi Morita[1], Suzuto Matsuo[2], Takuto Kojima[2], Kento Aihara[3], Yasunobu Arikawa[4], Shunsuke Egashira[4], Shogo Isayama[1], Otono Kuramoto[4], Shuichi Matsukiyo[1], Yushiro Matsumoto[4], Kentaro Sakai[5], Kei Sugiyama[3], Taichi Takezaki[6], Ryo Yamazaki[3], Youichi Sakawa[4]
[1]Faculty of Engineering Sciences, Kyushu University, [2]Interdisciplinary, Graduate School of Engineering Sciences, Kyushu University, [3]Department of Physics and Mathematics, Aoyama Gakuin University, [4]ILE, Osaka University, [5]Graduate School of Engineering, Osaka University, [6]Faculty of Engineering, University of Toyama

We report the magnetic reconnection experiments with Gekko-XII laser beams. Magnetic reconnection was driven between adjacent two plasma plumes, and some plasma parameters and magnetic field structures around the diffusion region were measured and analysed.

[HEDS-4] 15:30-17:50
Collisionless Shock/Acceleration
Chair: Yuji Fukuda
QST

HEDS-4-01 15:30 *Invited*

Fast Particle Acceleration Mechanisms in Astroplasma and Laboratory Astrophysics

Masahiro Hoshino[1], Y. Matsumoto[2], M. Iwamoto[3], T. Amano[1]
[1]The University of Tokyo, [2]Chiba University, [3]Kyushu University

In the Universe, cosmic rays with energies up to $10^{15.5}$ eV are widely recognized to be accelerated by supernova shocks, and the more energetic cosmic rays with energies up to 10^{20} eV are believed to be generated by extragalactic relativistic shocks. The plasma mechanisms of those particle acceleration are still major unresolved problem, and we discuss our perspective of the astrophysical shock dynamics based on various plasma instabilities.

HEDS-4-02 15:55 *Invited*

Microstructures at near-Sun solar wind perpendicular interplanetary shocks: Predictions for Parker Solar Probe and Solar Orbiter

Zhongwei Yang[1], Shuichi Matsukiyo[2]
[1]State Key Laboratory of Space Weather, National Space Science Center, [2]Faculty of Engineering Sciences, Kyushu University

Based on the plasma parameters estimated from PSP at $10R_s$, microinstabilities and waves excited at perpendicular interplanetary shocks in the near-Sun solar wind are investigated by PIC simulations. Key findings: different types of ES waves are observed. The 1st one is ECH waves excited by ECDI, and the 2nd one around the upper hybrid frequency is excited by the accelerated ring-like electrons and the incident core. X mode emission is also observed.

HEDS

Monday, 19 April

HEDS-4-03 16:20 *Invited*

Kinetic Modeling of Electron Pre-acceleration at Low Mach Number Shocks in Merging Galaxy Clusters

Jacek Niemiec[1], Oleh Kobzar[2], Takanobu Amano[3], Masahiro Hoshino[3], Shuichi Matsukiyo[4], Yosuke Matsumoto[5], Martin Pohl[6,7], Karol Fułat[8]
[1]Institute of Nuclear Physics Polish Academy of Sciences, [2]Astronomical Observatory, Jagiellonian University, [3]University of Tokyo, [4]Kyushu University, [5]Chiba University, [6]Institute of Physics and Astronomy, University of Potsdam, [7]DESY-Zeuthen, [8]Faculty of Physics and Applied Computer Science, AGH University of Science and Technology

We report on recent large-scale 2D PIC studies of electron pre-acceleration in low-Mach-number shocks in high beta plasmas. We investigate the effects of shock front rippling and multi-scale turbulence in the shock transition on electron energization. We show that electron injection to DSA can be provided through the process of stochastic shock-drift acceleration.

HEDS-4-04 16:45 *Invited*

Energy spectra measured by New Horizon Mission around an interplanetary shock near Pluto: PIC simulations versus in situ experimental results

Bertrand Lembege[1], Zhongwei Yang[1,2]
[1]LATMOS-UVSQ-CNRS, [2]National Space Science Center -CAS

While traveling though the interplanetary medium, New Horizon's space mission has succeeded to measure very detailed energy spectra of solar wind and pickup ions (PUIs) in the upstream region of an interplanetary shock in Pluto environment at a distance of 34 A.U.[1]. Recent 1D PIC simulations of a shock have been performed including different solar wind ion (SWIs) and pick up ion (PUIs) populations and are compared with experimental data [2].

HEDS-4-05 17:10 *Invited*

Electron heating and ion acceleration in ultrarelativistic laser-solid interactions

Nicholas P Dover[1,2], Hironao Sakaki[2], Akira Kon[2], Kotaro Kondo[2], Hazel F Lowe[2], Oliver C Ettlinger[1], Mariya A Alkhimova[3], Emma Jane Ditter[1], Anatoly Ya. Faenov[4,3], Masahara Hata[4], George S Hicks[1], Natsumi Iwata[4], Hiromitsu Kiriyama[2], James K Koga[2], Takumi Miyahara[5,2], Tatsuhiko Miyatake[5,2], Tatiana A Pikuz[4,3], Alexander S Pirozhkov[2], Akito Sagisaka[2], Ulrich Schramm[6], Yasuhiko Sentoku[4], Kenichi Shiokawa[5,2], Yukinobu Watanabe[5], Tim Ziegler[6], Karl Zeil[6], Masaki Kando[2], Kiminori Kondo[2], Zulfikar Najmudin[1], Mamiko Nishiuchi[2]
[1]Imperial College London, [2]KPSI, [3]RAS, [4]Osaka University, [5]Kyushu University, [6]HZDR

We investigated the acceleration of energetic electrons and ions generated during ultra-high intensity laser-solid interactions, measuring the beam scaling with laser intensity. This leads to a stable proton source exceeding 30 MeV at 0.1 Hz.

HEDS-4-06 17:35

X-ray spectroscopy evidence of solid-density ultra-relativistic laser plasma in renewable micron-scale cryogenic clusters targets.

Sergey N. Ryazantsev[1,2], T. A. Pikuz[1,3], S. A. Pikuz[1,2], T. Kaji[4], H. Tanabe[4], T. Nakagawa[4], T. Asai[4,5], M. Kanasaki[4], T. Yamauchi[4], S. Jinno[6], T. Taguchi[7], K. Himeno[7], K. Iwasaki[7], K. Sakai[7], T. Minami[8], Y. Abe[8], A. Tokiyasu[9], H. Kohri[10], Y. Kuramitsu[7], Y. Sakawa[8], Y. Miyasaka[5], Ko. Kondo[5], A. Kon[5], A. S. Pirozhkov[5], M. Kando[5], K. Kondo[5], T. Kawachi[5], H. Kiriyama[5], Y. Fukuda[5]
[1]JIHT, RAS, [2]National Research Nuclear University MEPhI, [3]OTRI, Osaka University, [4]Graduate School of Maritime Sciences, [5]KPSI, QST, [6]Nuclear Professional School, The University of Tokyo, [7]Graduate School of Engineering Osaka University, [8]ILE, Osaka University, [9]ELPH, Tohoku University, [10]RCNP, Osaka University

Features of plasma X-ray spectracorresponding to a case of a high-intensity laser pulse interaction with a microns-scale cluster are discussed. The spectra were measured during irradiation of cryogenic (T = 140 K – 220 K) Ar flows by ultra-intensive (I = 10^{22} W/cm^2) femtosecond laser pulses generated by the J-KAREN-P laser.

Tuesday, 20 April

[HEDS-5] 9:00-10:15
Radiation I
Chair: Shuta Tanaka
Aoyama Gakuin University

HEDS-5-01 9:00 *Invited*

The electromagnetic cascade in neutron star and black hole magnetospheres

Shota Kisaka
Hiroshima University

The plasma injection mechanism to a relativistic outflow from neutron stars and black holes is long standing problem. The electromagnetic cascade in the magnetospheres is likely the source of plasma. As a result of pair cascade, the momentum distribution of flows consists of two component, a beam and a quasi-thermal component. We discuss the radiation mechanisms and the plasma processes in the neutron star and black hole magnetospheres based on PIC simulation results.

HEDS-5-02 9:25 *Invited*

Direct cosmic-ray measurements with CALET on the International Space Station

Yosui Akaike
Waseda University

The CALorimetric Electron Telescope (CALET), launched on August 2015, is a high-energy astroparticle physics experiment on the International Space Station to precisely measure the cosmic-ray electrons, gamma-rays and nuclei. The detector features the thickness of 30 radiation lengths and fine imaging capability, providing high energy resolution and particle identification. The detail of the on-orbit performance and the latest results will be presented.

HEDS-5-03 9:50 *Invited*

An Experimental Challenge with Accelerator and Plasma to Astrophysical Fast Radio Bursts

Yoske Sumitomo[1], Tomohiko Asai[1], Shota Kisaka[2], Yasushi Hayakawa[1], Shigeru Inagaki[3], Norita Kawanaka[4], Daichi Kobayashi[1], Haruhisa Koguchi[5], Shiomi Kumagai[1], Takeshi Sakai[1], Norihiro Sei[5], Taichi Seki[1]
[1]Nihon University, [2]Hiroshima University, [3]Kyushu University, [4]Kyoto University, [5]AIST

The Fast Radio Bursts are one of mysterious and highly bright astrophysical events whose mechanism is not yet understood. Now, we are initializing a research project mimicking the Fast Radio Bursts at our accelerator laboratory with our plasma technology. Here we illustrate two ongoing experiments focusing on the non-linear enhancement mechanisms of radiations from relativistic electrons.

[HEDS-6] 10:35-11:35
Radiation II
Chair: Shuta Tanaka
Aoyama Gakuin University

HEDS-6-01 10:35

Formation of a Supercritical Collisionless Shock in a Magnetized Uniform Plasma at Rest

Ryo Yamazaki[1], S. J. Tanaka[1], S. Matsukiyo[3], T. Morita[3], T. Takezaki[8], T. Umeda[5], Y. Ohira[6], K. Tomita[9], Y. Kuramitsu[2], Y, Sakawa[2], N. Ohnishi[4], A. Ishii[7]
[1]Aoyama Gakuin University, [2]Osaka University, [3]Kyushu University, [4]Tohoku University, [5]Nagoya University, [6]The University of Tokyo, [7]Max Planck Institute for Gravitational Physics, [8]University of Toyama, [9]Hokkaido University

We present our recent attempt to excite a collisionless shock propagating into magnetized plasma at rest using kilo-Jule-class high-power lasers. With a help of laser Thomson scattering and plasma self emission measurements, we see a possible signature of the collisionless shock with Alfven Mach number larger of around 15.

HEDS-6-02 10:50

Collective Thomson scattering as a diagnostics for non-equilibrium plasmas

Kentaro Sakai[1], Shogo Isayama[2], Taichi Morita[3], Shuichi Matsukiyo[2], Yasuhiro Kuramitsu[1]
[1]Graduate School of Engineering, Osaka University, [2]Department of Advanced Environmental Science and Engineering, Kyushu University, [3]Department of Advanced Energy Engineering Science, Kyushu University

We investigated collective Thomson scattering (CTS) in analytical and numerical manners to establish the analysis of non-equilibrium plasmas. Since the CTS spectrum in high energy density plasmas showing non-equilibrium distribution function is not well-understood, we theoretically calculate and numerically simulate the CTS spectrum. Our results makes it possible to directly measure two-stream instability via CTS.

HEDS-6-03 11:05

Multiple diagnostics in laser-plasma experiment at ~10^{22} W/cm^2

Alexander Pirozhkov[1], A. Sagisaka[1], K. Ogura[1], T.Zh. Esirkepov[1], B. Gonzalez Izquierdo[1], A.N. Shatokhin[2,3], E.A. Vishnyakov[2], C. Armstrong[4], T.A. Pikuz[5,6], M.A. Alkhimova[6], S.A. Pikuz[6], W. Yan[7], T.M. Jeong[7], S. Singh[8], P. Hadjisolomou[7], O. Finke[7], G. Grittani[7], M. Nevrkla[7], C. Lazzarini[7], A. Velyhan[7], T. Hayakawa[9], Y. Fukuda[1], J.K. Koga[1], M. Ishino[1], Ko. Kondo[1], Y. Miyasaka[1], A. Kon[1], M. Nishikino[1], A.O. Kolesnikov[2,3], et. al.[10,11]
[1]KPSI, QST, [2]LPI RAS, [3]MIPT, [4]CLF RAL, [5]OTRI, Osaka University, [6]JIHT RAS, [7]ELI-Beamlines, [8]IPP ASCR, [9]TARRI, QST, [10]KIAM RAS, [11]Dep. Phys., University of Strathclyde

We present multi-diagnostic results from laser-plasma experiment at ~10^{22} W/cm^2, including optical and high harmonics, soft x-rays, keV x-rays, and sub-MeV x-rays. We discuss methods to find at-focus target position and compare intensity dependences.

HEDS

Tuesday, 20 April

HEDS-6-04 11:20

Experimental Observation of Induced Compton Scattered Radiation with J-KAREN P Laser

Shuta Tanaka[1], Yasuhiro Kuramitsu[2], Yuji Fukuda[3], Ryo Yamazaki[1,2], Youichi Sakawa[2]
[1]Aoyama Gakuin University, [2]Osaka University, [3]KPSI

We report some experimental results of induced Compton scattering in order to observe the characteristic spectral signatures of induced Compton scattered light predicted by our previous study.

[HEDS-7] 15:30-17:55
Collisionless Shock/Radiation
Chair: Shuichi Matsukiyo
Kyushu University

HEDS-7-01 15:30 ***Invited***

MAVEN observations of the Martian bow shock and foreshock

Christian X. Mazelle
IRAP CNRS - The University of Toulouse - CNES

Without global magnetic field the bow shock of Mars has a size comparable to kinetic scales and is observed well inside the neutral exosphere. We discuss recent results by MAVEN on the microphysics of the shock and the electron foreshock.

HEDS-7-02 15:55 ***Invited***

Laboratory evidence for proton energization by collisionless shock surfing

Weipeng Yao[1,2], A. Fazzini[1], S. N. Chen[3], K. Burdonov[1,2], P. Antici[4], J. Béard[5], S. Bolaños[1], A. Ciardi[2], R. Diab[1], E. D. Filippov[6,7], S. Kisyov[3], V. Lelasseux[1], M. Miceli[8], Q. Moreno[9,10], V. Nastasa[3], S. Orlando[8], S. Pikuz[6,11], D. C. Popescu[3], G. Revet[1], X. Ribeyre[9], E. d'Humières[9], J. Fuchs[1]
[1]LULI - CNRS, CEA, UPMC Univ Paris 06 : Sorbonne Université, Ecole Polytechnique, Institut Polytechnique de Paris -, [2]Sorbonne Université, Observatoire de Paris, Université PSL, CNRS, LERMA, [3]ELI-NP, IFIN-HH, [4]INRS-EMT, [5]LNCMI, UPR 3228, CNRS-UGA-UPS-INSA, [6]JIHT, RAS, [7]IAP, RAS, [8]INAF–Osservatorio Astronomico di Palermo, [9]University of Bordeaux, Centre Lasers Intenses et Applications, CNRS, CEA, UMR, [10]ELI-Beamlines, Institute of Physics, Czech Academy of Sciences, [11]NRNU MEPhI

Collisionless shocks are held responsible for the production of non-thermal particles. Coupling high-powerful lasers with high-strength magnetic fields, we have investigated the generation of magnetized collisionless shock and the associated particle energization [1]. We have characterized the plasma density, temperature, as well as the EM fields and particle energization in the experiments and modeled the shock formation with both MHD and PIC simulation.

HEDS-7-03 16:20

Relativistic beam formation and magnetisation driven by the propagation of a gamma-ray beam in a pair plasma

Bertrand Martinez, Thomas Grismayer, Luís Oliveira Silva
GoLP, Instituto de Plasmas e Fusao Nuclear, Instituto Superior Tecnico, Universidade de Lisboa

Compton scattering of gamma rays in a pair plasma can drive the formation of a relativistic electron positron beam. This process is scrutinised theoretically and numerically via particle-in-cell simulations. The beam can prompt a beam-plasma instability and convert its kinetic energy into magnetic energy. We argue that this fundamental problem is relevant to study the energy dissipation of gamma-rays at the photosphere radius of a Gamma-Ray Burst.

HEDS-7-04 16:35 ***Invited***

High-field QED experiments with high-power lasers: current status and next steps

Gianluca Sarri Sarri
The Queen's University of Belfast

An overview of the current efforts in high-field QED experiments will be given [1,2], together with an outlook for the next few years [3,4]. [1] K. Poder et al., Phys. Rev. X (2018) [2] J. Cole et al., Phys. Rev. X (2018) [3] E-320 experiment at FACET-II (SLAC) [4] arXiv:1909.00860 (2019)

HEDS-7-05 17:00 ***Invited***

Theoretical studies on a radiating electron in high-intensity laser pulse

Keita Seto
ELI-NP/IFIN-HH

A theoretical model is discussed of polarization-dependent nonlinear Compton scattering with locally constant field approximation. The information of a polarization mode of an emitted photon provides a finer resolution of the collision process. Then we will discuss the conceptual design of its experiment at the ELI-NP laser facility.

HEDS-7-06 17:25

Generation of plasmas in the extreme photoionization-dominated regime using the VULCAN laser

Raj Laxmi Singh[1], Francis Keenan[1], Matthew Charlwood[1], Cormac Hyland[1], David Bailie[1], Steven White[1], Gianluca Sarri[1], Steven Rose[1], EDWARD Hill[2], David Riley[1]
[1]Queen's University Belfast, [2]Imperial College London

We conducted an experiment on VULCAN laser to produce Ar photoionised plasma (photoionisation parameter > 50 ergcms^{-1}). We recorded spatially- and spectrally-resolved data of the photoionised Ar plasma X-ray emission. We will present the results obtained from this experiment.

HEDS-7-07 17:40

Magnetised Transport in a Laser Generated Plasma Driven by Heat Flow

Adam Devlin Dearling[1], Christopher Arran[1], Philip Bradford[1], George Hicks[2], S Al-Atabi[2], Luca Antonelli[1], Ollie Ettlinger[2], Matthew Khan[1], Kevin Glize[3], Margaret Notley[3], Chris Walsh[2], Robert Kingham[2], Zulfikar Najmudin[2], Christopher Ridgers[1], Nigel Woolsey[1]
[1]University of York, [2]Imperial College London, [3]STFC Central Laser Facility

A recent experiment studied hot magnetised plasma on the nanosecond timescale. Transitioning from a fluid to a kinetic-like plasma regime, we are able to assess extended magneto-hydrodynamic (MHD) models. Data suggests that extended MHD models that include the Nernst effect are necessary to describe the plasmas evolution, with kinetic modelling required for more accurate results to be obtained.

Wednesday, 21 April

[HEDS-8] 9:00-10:15
Reconnection/Turbulence
Chair: Taichi Morita
Kyushu University

HEDS-8-01 9:00 ***Invited***

Nonthermal Electron and Ion Acceleration in Laser-Driven Magnetic Reconnection

Samuel Richard Totorica[1,2,3,4], Masahiro Hoshino[5], Tom Abel[6,7,2], Frederico Fiuza[1]
[1]SLAC National Accelerator Laboratory, [2]Kavli Institute for Particle Astrophysics and Cosmology, Stanford University, [3]Department of Astrophysical Sciences, Princeton University, [4]International Research Collaboration Center, National Institute of Natural Sciences, [5]Department of Earth and Planetary Science, University of Tokyo, [6]Department of Physics, Stanford University, [7]SLAC National Accelerator Laboratory

We present kinetic particle-in-cell simulations of laser-driven magnetic reconnection experiments at large system sizes. We analyze the nonthermal acceleration of electrons and ions and discuss the implications for space physics and atrophysics.

HEDS-8-02 9:25 ***Invited***

Particle dynamics in collisionless magnetic reconnection

Seiji Zenitani[1], Tsugunobu Nagai[2], Iku Shinohara[2], Hiroshi Hasegawa[2]
[1]Kobe University, [2]ISAS/JAXA

Magnetic reconnection plays a key role in many plasma systems. In a collisionless plasma, the physics of magnetic reconnection is controlled by complex particle motions inside its magnetic geometry. In this talk, we will overview our recent progress in particle dynamics near the X-line of magnetic reconnection, based on two-dimensional particle-in-cell (PIC) simulations.

HEDS-8-03 9:50 ***Invited***

Forming a long current sheet magnetic reconnection with intense lasers

Jiayong Zhong
Department of Astronomy, Beijing Normal University

We report here a group of long current magnetic reconnection experiments with a millimeter plasma device.

[HEDS-9] 10:35-11:55
Reconnection/Turbulence II
Chair: Taichi Morita
Kyushu University

HEDS-9-01 10:35 ***Invited***

Study of particle energy energization from laser-driven magnetic reconnection experiment

King Fai Farley Law[1], Jinyuan Dun[2], Yuki Abe[2], Alessio Morace[2], Yasunobu Arikawa[2], Mao Takemura[2], Shuwang Guo[2], Tetsuo Ozaki[3], Baojun Zhu[2], Phillipp Korneev[4], Joao Jorge Santos[5], Shinsuke Fujioka[2], Yutaka Ohira[1], Masahiro Hoshino[1]
[1]The University of Tokyo, [2]ILE, Osaka University, [3]NIFS, [4]National Research Nuclear University MEPhI, [5]CELIA, Bordeaux

In this work, the particle acceleration via magnetic reconnection is studied by laser-produced magnetized plasma. The energization of electrons and ions are investigated in the reconnection experiment and will be reported in details.

Program

HEDS

Wednesday, 21 April

HEDS-9-02 11:00 *Invited*

Exploring the late evolution of a Rayleigh-Taylor unstable system – an experimental insight on turbulence –

Gabriel Rigon[1,2], Bruno Albertazzi[2], Tatiana Pikuz[3,4], Paul Mabey[2], Victorien Bouffetier[5], Norimasa Ozaki[6,7], Tommaso Vinci[2], Emeric Fallize[8], Yuichi Inubushi[9,10], Nobuki Kamimura[6], Kento Katagiri[6], Sergey Makarov[4,11], Mario Manuel[12], Kohei Miyanishi[10], Sergey Pikuz[4,13], Olivier Poujade[8], Keiichi Sueda[10], Tadashi Togashi[10,9], Yuhei Umeda[6], Makina Yabashi[9,10], Toshinori Yabuuchi[9,10], Gianluca Gregori[14], Ryo Kodama[6], Alexis Casner[5], Michel Koenig[2,6]
[1]Graduate School of Science, Nagoya University, [2]LULI, CNRS, CEA, Institut Polytechnique de Paris, [3]OTRI, Osaka University, [4]JIHT RAS, [5]Université de Bordeaux, CNRS, CEA, CELIA, [6]Graduate School of Engineering, Osaka University, [7]ILE, Osaka, [8]CEA-DAM, DIF, [9]Japan Synchrotron Radiation Research Institute, [10]RIKKEN Spring8-Center, [11]Departement of Physics of accelerators and radiation medicine, [12]General Atomics, Inertial Fusion Technologies, [13]National Research Nuclear University MEPhI, [14]Departement of Physics, University of Oxford

In this talk we will present the results of a HED experiment performed on SACLA (Japanese X-FEL). This experiment is tailored to enable the growth of the Rayleigh-Taylor instability, until its turblent phase. Thank to the newly developed LiF based radiography, we manage to characterize this flow down to the micron scale, thus reveling unexpected features of the turbulence spectrum.

HEDS-9-03 11:25

B-field Generation by the Ion-Weibel Instability in Interpenetrating Plasmas of CH, Al, and Cu

Mario J-E Manuel[1], Swarvanu Ghosh[2], Marissa Adams[3], Raghuram Jonnalagadda[2], Channing Huntington[4], Bruce Remington[4], James Ross[4], Dimitri Ryutov[4], Youichi Sakawa[5], Hong Sio[4], George Swadling[4], Petros Tzeferacos[3], Scott Wilks[4], Farhat Beg[2], Hye-Sook Park[4]
[1]General Atomics, [2]University of California San Diego, [3]University of Rochester, [4]LLNL, [5]Osaka University

The ion-Weibel instability is a leading candidate mechanism for the formation of collisionless shocks observed in many astrophysical systems. Interpenetrating plasma flows drive the ion-Weibel instabilty and create B-fields that can mediate shock formation. Experimental results will be discussed that focused on studying the ion-Weibel instability under various plasma conditions through utilization of different ion species and experimental geometries.

HEDS-9-04 11:40

Magnetic field amplification by turbulent dynamo in relativistic collisionless shocks

Sara Tomita[1], Yutaka Ohira[2]
[1]Tohoku University, [2]The University of Tokyo

Recent magnetohydrodynamics simulations of relativistic shocks propagating into inhomogeneous media show that the ambient magnetic field is amplified by turbulent dynamo in the downstream region. We perform particle-in-cell simulations of relativistic collisionless shocks propagating into pair plasma with a density clump. We found that the magnetic field amplification does not work if the amplitude of the ambient density fluctuation is below a critical value.

[HEDS-10] 13:00-15:20
Turbulence
Chair: Takayoshi Sano
Osaka University

HEDS-10-01 13:00 *Invited*

Explosive phenomena on the Sun and protostars

Shinsuke Takasao
Osaka University

Solar flares are a typical example of explosions driven by magnetic reconnection. Newly-born stars or protostars are also known to produce explosions similar to solar flares, but protostellar flares are much more energetic than solar flares. In this talk, we will discuss how solar and protostellar flares occur based on observations and numerical simulations.

HEDS-10-02 13:25 *Invited*

Ion versus Electron Heating in Compressively Driven Astrophysical Gyrokinetic Turbulence

Yohei Kawazura[1], Alexander A. Schekochihin[2], Michael Barnes[2], Jason M. TenBarge[3], Yuguang Tong[4], Kristopher G. Klein[5], William Dorland[6]
[1]Tohoku University, [2]University of Oxford, [3]Princeton University, [4]University of California, Berkeley, [5]University of Arizona, [6]University of Maryland

We developed a gyrokinetic code in which turbulence is driven by a mixture of Alfvénic and compressive fluctuations. We found that the ion-to-electron heating ratio is an increasing function of the compressive-to-Alfvénic injection ratio. We also found that all the compressive injection goes to ion heating, and the partition of heating is decided at the injection scales.

HEDS-10-03 13:50 *Invited*

Direct numerical simulations of MHD turbulence in the solar wind

Munehito Shoda
National Astronomical Observatory of Japan

Recent results of direct numerical simulations of the solar wind turbulence are reported. It is found that compressional MHD turbulence plays a central role in heating and accelerating the fast solar wind. A direct comparison between simulation and PSP observation is also performed, which shows a nice similarity between the two data.

HEDS-10-04 14:15 *Invited*

On non-equilibrium Alfvenic fluctuations in the solar wind

Yasuhiro Nariyuki
University of Toyama

In this talk, a stochastic phenomenological model to describe the non-equilibrium Alfvenic state is presented. It is shown that the relative speeds in the "friction" terms are necessary to incorporate the information of the parallel bulk speeds of each ion species into the model. Dependence of energy dissipation on wave-number spectra will also be discussed.

HEDS-10-05 14:40 *Invited*

Magnetic-geometry-induced activation of zonal flows in magnetically confined plasma turbulence

Motoki Nakata[1,2], Seikichi Matsuoka[1,2], Masanori Nunami[1,2], NGS team[1]
[1]NIFS, [2]The Graduate University for Advanced Studies

Spontaneous emergence of zonal flows in fusion plasmas is recognized as a key mechanism for improved plasma confinement. Here, we present the recent progress in theoretical and numerical studies on the magnetic-geometry-induced activation of the zonal flows. Utilizing mathematical optimization techniques with an extended turbulence model, numerical explorations of 3-D magnetic geometry found a plasma in which the transport is reduced by enhanced zonal flows.

HEDS-10-06 15:05

Interactions between non-isotropic electroconvection turbulence and mean flows

Takaki Ohguri[1], Kenichi Nagaoka[1,2], Motoki Nakata[2,3], Shinji Yoshimura[1,2], Yoshiki Hidaka[4], Kenichiro Terasaka[4], Yohei Masada[5]
[1]Nagoya University, [2]NIFS, [3]SOKENDAI, [4]Kyushu University, [5]Aichi University of Education

We generated mean flows in crystal liquid and investigated interactions between the flow and electroconvection turbulence. It is found that convective turbulence might enlarges the effective viscosity on the mean flows.

[HEDS-11] 15:50-17:30
Asian-Core
Chair: Youichi Sakawa
Osaka University

HEDS-11-01 15:50 *Invited*

Laboratory astrophysics using large-scale laser systems-Formation of Weibel-instability mediated collisionless shock

Youichi Sakawa
Osaka University

We investigated Weibel-instability mediated collisionless shock (Weibel shock) in a self-generated turbulent magnetic field theoretically/computationally and experimentally using large-scale laser systems, Omega laser and the National Ignition Facility (NIF).

HEDS-11-02 16:15 *Invited*

Extreme terahertz bursts generated from relativistic laser-foil interactions

Guoqian Liao, Yutong Li, Jie Zhang
Institute of Physics, CAS

We report on the highly efficient generation of THz bursts from relativistic laser interactions with a metal foil. The THz spectra can be manipulated effectively by tuning the laser or target parameters. Furthermore, the THz radiation can serve as a unique laser-plasma diagnostic.

HEDS-11-03 16:40 *Invited*

Tunable relativistic single-cycle infrared pulses generated from laser plasma interactions

Chih-Hao Rick Pai[1], Zan Nie[2], Jie Zhang[3], Xiaonan Ning[3], Jianfei Hua[3], Chaojie Zhang[2], Yunxiao He[3], Yipeng Wu[2], Qianqian Su[2], Shuang Liu[3], Yue Ma[3], Zhi Cheng[3], Wei Lu[3], Hsu-Hsin Chu[1], Jyhpyng Wang[1,4], Warren B. Mori[2], Chan Joshi[2]
[1]Department of Physics, National Central University, [2]University of California Los Angeles, [3]Department of Engineering Physics, Tsinghua University, [4]Institute of Atomic and Molecular Sciences, Academia Sinica

We have demonstrated that a photon decelerator based on a precisely controlled laser-wakefield configuration can generate single cycle, tunable and broadband, infrared pulses in the mid-IR (5-14 μm) spectral region with relativistic intensities. Such a versatile tunable IR source may be scaled up and meet the demands of many cutting-edge applications in strong-field physics.

HEDS-11-04 17:05 *Invited*

Relativistic plasma at a hundredth of relativistic intensity

Krishnamurthy Manchikanti
TIFR, Mumbai and Hyderabad

Relativistic temperature plasmas are typically with 10^{18}wcm^{-2} intensity. Do mJ lasers at 10^{16}wcm^{-2} generate a MeV electron temperature plasma? Using dynamic structures of the critical density of a liquid drop, we show imaging quality electron beams with energy upto 7 MeV. Single-shot electron radiographs with the source size <15 microns is demonstrated. Two plasmon decay instability is shown to be a key feature behind such a scheme.

[HEDS-Closing] 17:30-17:40
Closing Remarks
Chair: Youichi Sakawa
Osaka University

HEDS

Poster

[HEDS-P]
Poster Session

HEDS-P-02

Screening Effect in the Magnetized Plasma and Its Impact on Weak Interactions

Yudong Luo[1,2], Michael A. Famiano[3], Toshitaka Kajino[2,4], Motohiko Kusakabe[4], A. Baha Balantekin[5]
[1]The University of Tokyo, [2]National Astronomical Observatory of Japan, [3]Western Michigan University, [4]Beihang University, [5]University of Wisconsin, Madison

Coulomb screening and its impact on weak interactions in magnetized plasma are investigated, we apply such impact in nucleosynthesis of different astrophysics site, point out screening could provide an observational signal in nucleosynthesis.

HEDS-P-04

Plasma heating via the interaction of whistler waves

Takayoshi Sano, Yusuke Tatsumi, Masayasu Hata, Yasuhiko Sentoku
Osaka University

We investigate what kind of plasma heating mechanism can work in a solar wind plasma, i.e., when whistler waves with different frequencies collide, using one-dimensional PIC simulations.

HEDS-P-05

Time-evolution of the magnetic field structure in laser-driven magnetic reconnection measured by proton radiography

Suzuto Matsuo[1], Taichi Morita[1], Takuto Kojima[1], Shogo Isayama[1], Shuichi Matsukiyo[1], Taichi Takezaki[2], Yasunobu Arikawa[3], Youichi Sakawa[3], Shunsuke Egashira[3], Otono Kuramoto[3], Yushiro Matsumoto[3], Kentaro Sakai[3], Ryo Yamazaki[4], Kei Sugiyama[4], Kento Aihara[4]
[1]Kyushu University, [2]University of Toyama, [3]Osaka university, [4]Aoyama Gakuin University

Our research group investigated time-evolution of the magnetic field structure in laser-driven magnetic reconnection by using proton radiography. We discuss the reconnection rate from obtained images.

HEDS-P-06

Characterizing Weibel Instability in Counter-Propagating Plasma Flows

Swarvanu Ghosh[1], Mario Manuel[2], Farhat Beg[1], Raghuram Jonnalagadda[1], Channing Moore Huntington[3], Bruce Remington[3], Steven Ross[3], Dmitri Dmitriyevich Ryutov[3], George Forester Swadling[3], Scott C Wilks[3], Hye-Sook Park[3], Marissa Adams[4], Petros Tzeferacos[4,5], Youichi Sakawa[6], Hong Sio[7]
[1]University of California San Diego, [2]General Atomics, [3]LLNL, [4]University of Rochester, [5]Laboratory for Laser Energetics, University of Rochester, [6]Osaka University, [7]Massachusetts Institute of Technology

Collisionless shocks are very common in universe, occuring in astrophysical systems like supernova remnants, bow shocks. These shocks are mediated by Weibel instabilities in astrophysical environments instead of Coloumb collisions. High-power lasers have provided a unique platform to study the electromagnetic Weibel instabilities in laboratory. We have carried out laser experiments at Omega Laser Facility to generate the unmagnetized collisionless shocks.

HEDS-P-07

Study on magnetized collisionless shocks using PIC simulation and laser experiment

Shuichi Matsukiyo[1,5], R. Yamazaki[2,5], T. Morita[1], K. Tomita[3], Y. Kuramitsu[4], T. Sano[5], S. J. Tanaka[2], T. Takezaki[6,7], S. Isayama[1], M Iwamoto[1], T. Nagano[1], S. Furukawa[1], H. Luo[1], T. Higuchi[8], H. Murakami[8], T. Horie[8], N. Katsuki[8], R. Hatsuyama[8], M. Edamoto[8], H. Nishioka[8], M. Takagi[8], T. Kojima[8], S. Tomita[9,10], T. Oguchi[6], N. Ishizaka[2], S Kakuchi[2], S. Sei[2], K. Sugiyama[2], K. Aihara[2], S. Kambayashi[2]
[1]Faculty of Engineering Sciences, Kyushu University, [2]Department of Physics and Mathematics, Aoyama Gakuin University, [3]Division of Quantum Science and Engineering, Hokkaido University, [4]Graduate School of Engineering, Osaka University, [5]ILE, Osaka University, [6]Faculty of Engineering, University of Toyama, [7]Department of Creative Engineering, National Institute of Technology, Kitakyushu College, [8]Interdisciplinary Graduate School of Engineering Sciences, Kyushu University, [9]Astronomical Institute, Tohoku University, [10]Frontier Research Institute for Interdisciplinary Sciences, Tohoku University

We develop the method of particle-in-cell (PIC) simulation of collisionless shock formation and development to mimic an experimental situation at the institute of laser engineering, Osaka Univ., and compare the results with the experiment conducted in 2019-2020.

HEDS-P-08

Turbulent Magnetic Field Amplification Relevant to Astrophysical Scenarios due to High-power LaserPlasma Interaction

Indraj Singh, R. Uma, R. P. Sharma
IIT Delhi

High-power lasers are being utilized for emulating many astrophysical scenarios in laboratory astrophysics. A theoretical model is proposed to study the turbulent magnetic field amplification, which ensues due to the high-power laser interaction with plasma.

HEDS-P-09

Simulation studies for turbulence generation and vortex formation in high beta plasma by nonlinear interaction of Extraordinary Laser and 3-D KAW

Himani Dewan, R Uma, R.P. Sharma
IIT Delhi

This investigation revolve around the nonlinear interplay between pump laser and 3D-Kinetic Alfvén wave. The equations are modelled accounting ponderomotive nonlinearity due to the pump wave and are crucial in investigating the astrophysical scenarios[1-3].

HEDS-P-10

Investigation on ion acceleration with graphene as a nanolayer target using ELI-NP laser

Takumi Minami[1], Yu-Tzu Liao[2], Takamasa Hihara[1], Kentaro Sakai[1], Takahiro Nishimoto[1], Masaki Takano[1], Hiromitsu Kiriyama[3], Yasunobu Arikawa[4], Youichi Sakawa[4], Alessio Morace[4], Shunsuke Egashira[4], Masato Ota[4], Tomohiro Izumi[4], Yoshiharu Nakagawa[4], Takafumi Asai[3,5], Kouki Nishimura[1], Yoshiaki Hayashi[1], Satoshi Jinno[6], Masato Kanasaki[5], Yuji Fukuda[3], Kazuo A Tanaka[1,7], Hideaki Habara[1], Wei-Yen Woon[2], Yasuhiro Kuramitsu[1]
[1]Guraduate school of engineering, Osaka University, [2]Department of Physics, National Central University, [3]KPSI, QST, [4]ILE, Osaka University, [5]Graduate School of Maritime Sciences, Kobe University, [6]Nuclear Professional School, School of Engineering, The University of Tokyo, [7]Extreme Light Infrastructure – Nuclear Physics

We are using large-area suspended graphene (LSG) targets in laser ion acceleration experiments. We show our numerical investigations with the experimental condition at ELI-NP using particle-in-cell (PIC) simulations.

ICNN

Monday, 19 April

[ICNN-1] 10:00-11:00
ICNN Session 1
Chair: Toshiharu SAIKI
Keio University

ICNN-Opening 10:00

Opening Remarks
Yasuhiko Arakawa
The University of Tokyo

ICNN-1-01 10:10 ***Invited***

Semiconductor Nanostructures for Optoelectronics Applications
Chennupati Jagadish
The Australian National University

In this talk, I will introduce the importance of nanowires and their potential applications and discuss about how these nanowires can be synthesized and how the shape, size and composition of the nanowires influence their structural and optical properties.

ICNN-1-02 10:45

Silicon Carbide Quantum Photonics in Triangular Geometry
Sridhar Majety, Pranta Saha, Marina Radulaski
University of California Davis

We explore triangular cross-section silicon carbide waveguides suitable for applications in quantum communications. Through simulations we optimize the waveguide geometry for maximum coupling efficiency of the color center emission to the fundamental transverse electric mode.

[ICNN-2] 11:20-12:05
ICNN Session 2
Chair: Toshiharu SAIKI
Keio University

ICNN-2-01 11:20 ***Invited***

Sb_2S_3 properties and application in displays and reprogrammable photonics
Robert Edward Simpson[1], Li Lu[1], Tingyu Teo[1], Alyssa Poh[1], Yunzheng Wang[1], Zhaogang Dong[2], Ramón Paniagua-Domínguez[2], Areniy I Kuznetsov[2], Joel KW Yang[1,2]
*[1]Singapore University of Technology and Design, [2]Institute of Materials Research and Engineering, A*STAR*

The objective of this presentation is to introduce Sb_2S_3 as a useful phase change material for reprogrammable visible and near infrared photonics. Several surprising results will be highlighted, including its birefringent nature.

ICNN-2-02 11:50

Si Perfect Absorber by Degenerate Critical Coupling in Visible Region
Rongyang Xu, Junichi Takahara
Osaka University

We propose a silicon perfect absorber based on degenerate critical coupling in the visible region. We also provide two methods to control loss so that the operational wavelength of the perfect absorber can be extended to the entire visible region.

[ICNN-3] 14:55-16:40
ICNN Session 3
Chair: Mark Holmes
The University of Tokyo

ICNN-3-01 14:55 ***Invited***

High Dimensional Quantum Meta-device
Din Ping TSAI
Hong Kong Polytechnic University

High dimensional quantum meta-device for entanglement light source is demonstrated by a 10 x 10 meta-lenses array. Two, three, and four-dimensional two-photon path-entanglement with different phase coded meta-lenses are demonstrated.

ICNN-3-02 15:25 ***Invited***

Optical metamaterial absorber and its application for spectroscopy
Takuo Tanaka[1,2]
[1]RIKEN, [2]Tokushima Univ.

Optical metamaterial consists of subwavelength structure were developed and studied for a versatile platform of ultra-sensitive detection of infinitesimal materials. Metamaterial IR absorber using metal-insulator-metal structure with a nanofluidic channel as an insulator layer was developed, and it dramatically improved the sensitivity of IR molecular spectrum compared to the conventional IR spectroscopies.

ICNN-3-03 15:55 ***Invited***

Efficient 120 Gbit/s OOK and 200 Gbit/s PAM4 transmitter using integrated silicon and polymer hybrid modulator
Shiyoshi Yokoyama[1], Guo-Wei Lu[1,2], Feng Qiu[1]
[1]Kyushu University, [2]Aizu University

The high efficient electro-optic polymer is used to demonstrate 120 Gbit/s OOK and 200 Gbit/s PAM4 modulations. The polymer is performed on the silicon Mach-Zehnder interferometer toward possible hybrid silicon and polymer photonic platform.

ICNN-3-04 16:25

Self-assembled liquid crystal metasurfaces for electro-optical control of light transmission, diffraction and anomalous refraction
Alena V. Mamonova[1], Maxim V. Gorkunov[1], Irina V. Kasyanova[1], Vladimir V. Artemov[1], Alexander A. Ezhov[1,2], Ivan V. Simdyankin[1], Sergei P. Palto[1]
[1]FSRC "Crystallography and Photonics", RAS, [2]Faculty of Physics, Lomonosov MSU

Liquid crystal metasurfaces are a new type of artificial soft matter systems exhibiting strong visible light diffraction. They can be efficiently optimized for various optical functionalities and allow millisecond-fast electro-optical switching between different regimes.

[ICNN-4] 17:00-18:20
ICNN Session 4
Chair: Tadashi Asano
Kyoto University

ICNN-4-01 17:00 ***Invited***

In-memory photonic computing approaches to photonic tensor cores
Harish Bhaskaran
Oxford University

ICNN-4-02 17:35 ***Invited***

Applications of low-loss adiabatic nano-focusing and nano-defocusing by hybrid gap plasmonic waveguides
Nicholas Gusken[1], Michael Nielsen[1,3], Xingyuan Shi[1], Paul Dichtl[1], Stefan Maier[1,2], Rupert F Oulton[1]
[1]Imperial College London, [2]Ludwig-Maximilians-Universität, [3]UNSW Sydney

We report integrated plasmonic elements for nano-focusing and nano-defocusing on a silicon photonics platform using hybrid gap plasmon waveguides. With 90% coupling efficiency to a 10 nm gap, we highlight potential applications through recent demonstrations.

ICNN-4-03 18:05

Directional Raman scattering coupled into plasmonic waveguide with near-unity couple efficiency
Fu Ming, Mónica Mota, Andrea Jacassi, Xiaofei Xiao, Rupert F. Oulton
Imperial College

We report directional broadband Raman scattering of light within a plasmonic slot waveguide. We demonstrate that 99% of the Raman photons produced couple directly into the waveguide mode due to enhanced spontaneous Raman scattering.

Tuesday, 20 April

[ICNN-5] 10:00-11:00
ICNN Session 5
Chair: Wakana Kubo
Tokyo University of Agriculture and Technology

ICNN-5-01 10:00 ***Invited***

Dirac Plasmon-Assisted Asymmetric Hot Carrier Generation for Room-Temperature Infrared Detection
Debashis Chanda
University of Central Florida

The talk will outline a novel strategy for uncooled, tunable, multispectral infrared detection. Due to the low photon energy, detection of infrared photons is challenging at room temperature. In this article, we demonstrate, for the first time, an asymmetric plasmon-induced hot-carrier Seebeck photodetection scheme at room temperature that exhibits a remarkable responsivity of 2900 V/W.

ICNN-5-02 10:30 ***Invited***

Improving the single photon emission properties of III-nitride quantum dots
Mark J Holmes, Sijia Xia, Tomoyuki Aoki, Kang Gao, Munetaka Arita, Yasuhiko Arakawa
The University of Tokyo

A review of our achievements on realising single photon emisison from III-nitride quantum dots.

[ICNN-6] 11:20-12:20
ICNN Session 6
Chair: Satoshi Iwamoto
The University of Tokyo

ICNN-6-01 11:20 ***Invited***

Electrically Pumped Photonic Topological Lasers
Qi Jie Wang
Nanyang Technological University

An electrically pumped topological laser with valley edge states, in a quantum cascade semiconductor laser platform, will be presented in this presentation. We have shown experimentally that photonic topological protected lasing states are realized in such designed photonic structures.

ICNN-6-02 11:50

Optical data transmission with a microresonator-based comb source
Soma Kogure[1], Tamiki Ohtsuka[1], Shun Fujii[1,2], Hajime Kumazaki[1], Koshiro Wada[1], Yosuke Hashimoto[3], Yuta Kobayashi[3], Tomohiro Araki[3], Kentaro Furusawa[4], Norihiko Sekine[4], Takasumi Tanabe[1]
[1]Keio University, [2]RIKEN, [3]JAXA, [4]NICT

Microcombs, or frequency comb generated in microresonator, have revolutionized photonics. In this talk we generate four types of microcombs including soliton comb and demonstrate data transmission with them to evaluate the signal integrity.

ICNN

Tuesday, 20 April

ICNN-6-03 12:05

Non-Hermitian, Topological, and Lorentz Non-reciprocal Photonic Metamaterials

Wang Tat Yau, Kai Fung Lee, Kin Hung Fung
The Hong Kong Polytechnic University

Non-Hermitian, Topological, and Lorentz non-reciprocal photonic metamaterials have attracted intense attention due to their complexities. Strongly dispersive materials such as plasmonic and ferromagnetic materials lead to additional difficulties in defining topological modes. In this talk, I will introduce recent progress in my group and discuss the bands and edge modes in these low-symmetry photonic systems.

[ICNN-7] 15:00-16:35
ICNN Session 7
Chair: Shinji Matsuo
NTT

ICNN-7-01 15:00

Formation and optical characteristics of ZnO:Tm,Yb/ZnO nanowires towards photovoltaic applications

Jun Tatebayashi, Tokuhito Nakajima, Naoto Nishiyama, Dolf Timmerman, Shuhei Ichikawa, Yasufumi Fujiwara
Osaka University

We report on the formation and optical characteristics of Tm,Yb-codoped ZnO films on ZnO nanowires grown by sputtering-assisted metal organic chemical vapor deposition. We observe luminescence at 489 nm from Tm^{3+} ions which is essential for the down-conversion process by growing ZnO:Tm,Yb films on the nanowire configuration.

ICNN-7-02 15:15

Fabrication and Characterization of L3 Nanocavities Designed Using Machine Learning

Takeshi Shibata, Takashi Asano, Susumu Noda
Kyoto University

We fabricate and characterize L3 type photonic crystal nanocavities optimized based on machine learning. A high loaded (unloaded) experimental *Q* factor of 2.9 (4.3) million is obtained, which largely exceed previously reported values.

ICNN-7-03 15:30

Optimizing the Position of Quantum Dot Layers to Increase Absorption: Towards High-Efficiency Quantum Dot Solar Cells

Yusuke Oteki[1,2], Maxime Giteau[2], Kei Fukushima[1,2], Kento Kitahara[1,2], Naoya Miyashita[2], Ryo Tamaki[2], Yoshitaka Okada[1,2]
[1]School of Engineering, University of Tokyo, [2]RCAST, University of Tokyo

The limitation efficiency of single-junction solar cells can theoretically be overcome by embedding quantum dot (QD) layers within the absorber material. However, a single QD layer absorbs only a small fraction of the incident light. In this work, we explain the interest of optimizing the position of QD layers to increase absorption and validate it experimentally with Fabry-Perot resonances.

ICNN-7-04 15:45

A multiphysics cellular automata model for phase change materials photonics

Yunzheng Wang[1], Jing Ning[1,3], Michel Bosman[2,3], Robert Simpson[1]
[1]Engineering pillar of Design, Singapore University of Technology and Design, Singapore, [2]Agency for Science Technology and Research, Institute of Materials Research and Engineering, Singapore, [3]Department of Material Science and Engineering, National University of Singapore, Singapore

Combining non-isothermal laser heating, Gillespie's Cellular Automata approach, effective medium theory and Fresnel's laws, we present a multiphysics Cellular Automata-based framework to model the transient optical response of new phase-change photonics devices during crystallization and amorphization, which will be clearly important for designing novel photonic devices.

ICNN-7-05 16:00 ***Invited***

Ultra-Narrow Linewidth of Quantum Dot Distributed Feedback Lasers

Johann Peter Reithmaier[1], Gadi Eisenstein[2], Bernd Witzigmann[3]
[1]Institute of Nanostructure Technologies and Analytics, CINSaT, University of Kassel, Germany, [2]Departm. of Electrical Engineering and Russell Berrie Nanotechnology Institute (RBNI), Technion, Israel, [3]Computational Electronics and Photonics Group, CINSaT, University of Kassel, Germany

In this talk, an overview is given on the recent progress to utilize the huge impact of the gain material itself on the emission linewidths of distributed feedback lasers. With the substitution of QWs by appropriate quantum dot (QD) layers, the linewidth can be drastically reduced without restricting device designs. Linewidth reduction by nearly two order of magnitudes to 20 kHz was obtained mainly originated by a strong reduction of the linewidth enhancement factor.

[ICNN-8] 16:55-18:25
ICNN Session 8
Chair: Wakana Kubo
Tokyo University of Agriculture and Technology

ICNN-8-01 16:55 ***Invited***

Ultra coherent nano mechanical oscillators for room temperature quantum feedback

Tobias Kippenberg
EPFL

ICNN-8-02 17:25 ***Invited***

Metamaterial Enhanced Photodetection

Alexander Dorodnyy, Stefan Martin Koepfli, Raphael Schwanninger, Nikola Dordevic, Shadi Nashashibi, Arif Gungor, Jasmin Smajic, Juerg Leuthold
Institute of Electromagnetic Fields, ETH Zurich

Metamaterial enhancement allows to build novel faster and more sensitive photodetectors. Plasmonic metamaterials can provide extraordinary angular stability approaching a full hemisphere range whereas dielectric ones yield ultra-high quality-factors on the order of hundred thousand.

ICNN-8-03 17:55

Complete design of a fully integrated graphene-based plasmon coupler for the infrared

Aswani Natarajan, Guillaume Demésy, Gilles Renversez
Aix-Marseille University & CNRS Institut Fresnel

A fully integrated efficient and tunable surface plasmon coupler composed of a realistic non-tapered dielectric waveguide with graphene patches and sheet is designed for the infrared and optimized through rigorous numerical and theoretical studies.

ICNN-8-04 18:10

Nonlinear Pancharatnam-Berry Phase Metasurfaces beyond the Dipole Approximation

Sylvain D. Gennaro, Yi Li, P. Dichtl, Stefan A. Maier, Rupert F. Oulton
Imperial College

We demonstrate nonlinear gold-antenna metasurfaces exhibiting both 2nd and 3rd order nonlinear processes. They produce diffraction orders not predicted by the generalized law of refraction, and thus require consideration of higher order antenna modes.

Wednesday, 21 April

[ICNN-9] 10:00-11:00
ICNN Session 9
Chair: Takahiro Nakamura
PETRA

ICNN-9-01 10:00 ***Invited***

Progress in Photonic Crystals -From Fundamental to State of the Arts for Society 5.0 -

Susumu Noda
Kyoto University

In this talk, I will review such progress of photonic crystals from the fundamental to State of the Arts for Society 5.0.

ICNN-9-02 10:30 ***Invited***

Robust and Versatile Integrated Photonics For Green Exascale Computing

Di Liang[1], Zhihong Huang[1], Geza Kurczveil[1], Sudharsanan Srinivasan[1], Binhao Wang[1], Erwen Li[1], Yuan Yuan[1], Bassem Tossoun[1], Yang-Hang Fan[2], Xiaoge Zeng[1], Zhixin Liu[3], Marco Fiorentino[1], Samuel M. Palermo[2], Raymond G. Beausoleil[1]
[1]Hewlett Packard Labs, [2]Texas A&M University, [3]University College London

We review our progress on fully integrated transceivers with heterogeneous quantum-dot (QD) lasers, novel microring modulators and SiGe avalanche photodetectors on silicon substrate, aiming to achieve overall operation sweet spot in a harsh environment.

[ICNN-10] 11:25-12:20
ICNN Session 10
Chair: Yasutomo Ota
The University of Tokyo

ICNN-10-01 11:25

Surface Plasmon-Enhanced Fluorescence Biosensor for Repeated Measurement of Cardiac Marker

Koji Toma, Koki Oishi, Takahiro Arakawa, Kohji Mitsubayashi
Tokyo Medical and Dental University

A surface plasmon-enhanced fluorescence immunosensor was developed for sensitive and repeated measurement of cardiac markers. The enhanced field by surface plasmon polaritons allowed concentration dependent sensor output and potential for repeated use of the sensor.

ICNN-10-02 11:40

Near-IR concealed images by single crystalline Silicon Mie resonators

Hiroyuki Ishimaru, Junichi Takahara
Osaka University

Many researches have been reported on controlling the scattering of light using Mie resonators. Backscattering of light using crystalline-Silicon (c-Si) Mie resonators can be applied to structural color images with diffraction limit resolution. We aim to extend such structural colors to near infrared (IR) region. In this study, we demonstrate "concealed images" at near-IR by c-Si Mie resonators, which cannot be seen in visible region.

ICNN

Wednesday, 21 April

ICNN-10-03 11:55

Single-base-resolved and millisecond SERS spectroscopy of DNA oligonucleotides using gold nanoparticle dimers spontaneously formed in aqueous suspension

Takumi Ikeda, Nozomi Hagiwara, Keiko Esashika, Toshiharu Saiki
Keio University

We develop a method to spontaneously form Au nanoparticle dimers, which sandwiches a single DNA oligonucleotide within a gap of less than 1 nm. SERS measurement of single AuNP dimers in aqueous suspension demonstrates single-base (sub-nanometer) resolution obtained within a 10-ms measurement period.

ICNN-Closing 12:10

Closing Remarks

Yasuhiko Arakawa
The University of Tokyo

Poster

[ICNN-P]
Poster Session

ICNN-P-01

Photoluminescence Enhancement by Plasmonic Resonance of Silver Nanoparticles on Bulk GaN Substrates

Seiya Kaito, Kohei Shimanoe, Tetsuya Matsuyama, Kenji Wada, Koichi Okamoto
Osaka Prefecture University

In the study, we used bulk GaN substrate as a sample to verify the PL enhancement using the quadrupole oscillation mode, and also tried to reproduce this effect of the PL enhancements based on electromagnetic field analysis calculation.

ICNN-P-02

Metamaterial Perfect Absorber as Heat Generator

Mahiro Horikawa, Wakana Kubo
Tokyo University of Agriculture and Technology

Metamaterial perfect absorber (MPA) is a nanostructure which shows near perfect light absorption for resonance wavelengths. In this study, we have examined the function of the MPA as a heat generator by installing the MPA to a plasmonic photo-thermoelectric device. We prooved that the MPA is an effective heat source compared to other simple plasmonic structures by both experimental and numerical approaches.

ICNN-P-03

Plasmonic Color Sensor using Random Ag Nano-Hemispheres on Mirror

Sayako Maeda, Koki Matsuda, Ryo Hasegawa, Tetsuya Matsuyama, Kenji Wada, Koichi Okamoto
Osaka Prefecture University

Recently, we have shown that random metal nano-hemispheres on a mirror substrate (NHoM) can be used as plasmonic metamaterials for controlling plasmonic color. In this study, we demonstrae that this structure achieves enhancement and sharpening of the resonance spectrum and enables high-sensitivity sensing with a large wavelength change range by calculations and experiments.

ICNN-P-04

Deep UV Surface Plasmon Resonance using Ga_2O_3 nano-particles on Al Substrate

Soshi Endo, Yuya Nakatsuka, Kohei Shimanoe, Tetsuya Matsuyama, Kenji Wada, Koichi Okamoto
Osaka Prefecture University

In this work, we propose a dielectric Ga_2O_3 nano-hemispherical structure on an Al substrate. This structure is expected to significantly reduce the incident light loss while having unique optical properties compared to Ga nano-particles.

ICNN-P-05

Enhancement in Output Power of Bi_2Te_3Thermoelectric Device by Infrared Metamaterial Absorber

Takuya Asakura, Kubo Wakana, Shohei Katsumata
Tokyo University of Agriculture and Technology

Metamaterial Perfect Absorber (MPA) is a metamaterial structure that absorbs almost 100% of incident light of a specific wavelength. In this study, we aimed to improve the output power of the thermoelectric conversion device by utilizing the local heat generated by the absorption loss of MPA.

ICNN-P-06

Mechanism of blue/green emission enhancement by surface plasmon resonance in polar/semi-polar InGaN/GaN quantum wells

Kento Ikeda[1], Kanata Kawai[1], Jun Kametani[1], Tetsuya Matsuyama[1], Kenji Wada[1], Narihito Okada[2], Kazuyuki Tadatomo[2], Koichi Okamoto[1]
[1]Osaka Prefecture University, [2]Yamaguchi University

QCSE can be reduced for QWs grown on semi-polar GaN substrates. In this study, surface plasmon enhanced light emissions were investigated for polar/semi-polar InGaN/GaN quantum wells by the micro PL and the time-resolved PL.

IoT-SNAP

Tuesday, 20 April

[IoT-SNAP-1] 15:30-17:10
IoT-SNAP Plenay
Chairs: Ronald Freund
Fraunhofer Heinrich Hertz Institute
Norihiro Hagita
ATR Intelligent Robotics and Communicatuon Laboratories

IoT-SNAP-Opening 15:30

Opening Remarks

IoT-SNAP-1-01 15:40 ***Keynote***

Forefront of Quantum Computing
Kohei Itoh
Keio University
Recent advancement in quantum computing is introduced. The first half of the talk encompasses the status of hardware developments such as superconducting qubits, ion trap qubits, silicon qubits, and photon qubits. The second half of the talk introduces the status of algorithm and software research at IBM Q Network Hub @ Keio University. Here both academic and industrial contributions of quantum computing research are highlighted.

IoT-SNAP-1-02 16:25 ***Keynote***

Communication by Light - Solutions for future IoT
Dominic Schulz
Heinrich Hertz Institute (HHI)
Optical wireless communication, also denoted as LiFi, is the communication by light and represents an alternative to radio frequencies for wireless transmission. With the properties of light, gigabit per second data rates, mobility support and low latencies, LiFi is a promising technology to serve the demanding requirements of future IoT applications. In this talk our current work of LiFi for various use cases is presented and the benefits for the IoT are highlighted.

Wednesday, 21 April

[IoT-SNAP-2] 10:00-11:30
Network
Chairs: Ved P Kafle
National Institute of Information and Communications Technology
Koji Sato
Mitsubishi Electric Corporation

IoT-SNAP-2-01 10:00 ***Invited***

The trend of Automotive Optical Ethernet: Technology and Standardization
Manabu Kagami
Nagoya Institute of Technology
This paper introduces the technical overview of the Automotive Optical Ethernet standard and the status of standardization in IEEE, ISO, and IEC.

IoT-SNAP-2-02 10:30 ***Invited***

Approaches to 5G Commercialization and Prospects for 6G
Yoshihisa Kishiyama
NTT DOCOMO, INC.
Commercial 5G services have already been launched around the world, and there is a growing interest in considering 6G and wireless technologies in the 2030s. In this presentation, we describe NTT DOCOMO's R & D efforts toward 5G, its worldview toward 6G, and wireless technology.

IoT-SNAP-2-03 11:00

Evaluation of Transmission Characteristics of Analog Radio over Plastic Optical Fiber with C-RAN Mobile Fronthaul System
Hiroki Yasuda[1,2], Hsuan Yun Kao[3], Toshinori Suzuki[1], Shota Ishimura[3], Kazuki Tanaka[3,2], Takamitsu Aiba[1], Tomohiro Wakabayashi[1], Tetsuya Kawanishi[2]
[1]Yazaki Corporation, [2]Waseda University, [3]KDDI Research, Inc.
We evaluate transmission characteristics of analog radio over plastic optical fiber with 28-GHz and 400-MHz bandwidth radio frequency signals when it is adapted to C-RAN mobile fronthaul system.

IoT-SNAP-2-04 11:15

Concept of Integrated Radar and Communication Transceiver
Atsushi Kanno
National Institute of Information and Communications Technology
The co-existence of the communication and ranging signal in a packet is proposed using a versatile transceiver configuration. The methods and feasibility for ranging are also discussed.

[IoT-SNAP-3] 11:30-11:36
IoT-SNAP Poster short talk
Chairs: Ved P Kafle
National Institute of Information and Communications Technology
Koji Sato
Mitsubishi Electric Corporation

IoT-SNAP-3-01 11:30

Basic Study of Pseudo Random Readout Profile Sensor for Compressed Sensing
Keisuke Uchida[1], Munenori Takumi[1,2], Katsuhiro Ishii[2], Ken-ichi Kitayama[2]
[1]Hamamatsu Photonics K.K., [2]The Graduate School for the Creation of New Photonics Industries
We proposed a pseudo random readout profile sensor for compressed sensing without optical modulators and demonstrated the proof-of-concept via numerical simulation.

IoT-SNAP-3-02 11:33

Defect detection method for clutch disk inspection using AI
Motoki Okazaki, Ryouhei Hanayama
The Graduate School for the Creation of New Photonics Industries
We propose a defect detection method for clutch disk using AI. It can be utilize to detect defects, which cannot be detected by conventional methods.

[IoT-SNAP-4] 15:30-17:15
AI
Chairs: Takahiro Ishii
Fujikura Ltd.
Akira Yamada
DOCOMO R&D Center

IoT-SNAP-4-01 15:30 ***Invited***

Visual Explanation of Deep Learning using Attention Branch Network
Hironobu Fujiyoshi
Chubu University
In this talk, we introduce Attention Branch Network (ABN), which outputs attention, an area that deep learning focuses on when determining inferential results. ABN is a deep learning network that can contribute to improving recognition performance while acquiring the attention mechanism. This technology holds great promise as an approach for interpreting the basis for decisions output by an AI system.

IoT-SNAP-4-02 16:00 ***Invited***

Multi-modal based conversational AI empowered by GPU
Xianchao Wu
NVIDIA
The talk covers speech recognition, natural language understanding and text-to-speech for end-to-end building multilingual conversational AI. Empowered by NVIDIA's NeMo, Megatron-BERT/GPT2 in model-parallel of 512+ GPUs and Triton inference server open-source solutions, we could build low latency real-time voice-to-voice chatbots for a list of languages to connect people with real-world services.

IoT-SNAP-4-03 16:30

Improving CNN-based Tracking Method for Visual Feedback System to Perform Online Tracking at 300fps
Chanrathnak Borann, Masaki Yamashita, Hiromasa Oku
Gunma University
In this research, we employed a state-of-the-art CNN-based GOTURN tracker by fine-tuning the network and incorporating it into an auto pan/tilt camera. The proposed method enabled a visual feedback system to perform online tracking at a speed exceeding 300 [fps].

IoT-SNAP-4-04 16:45

Multilayer dielectric mirror designing for high-power laser handling phase-only spatial light modulator
Tsubasa Watanabe, Yasushi Ohbayashi, Yu Takiguchi, Hiroshi Tanaka, Haruyoshi Toyoda
Hamamatsu Photonics K.K.
We report new designing of multilayer dielectric mirror deposited inside a phase-only spatial light modulator to avoid the damage by high power laser irradiation.

IoT-SNAP-4-05 17:00

24-hour activity quantification of stroke rehabilitation inpatients with an IoT wearable sensor network system
Takayuki Ogasawara[1], Masahiko Mukaino[2], Kenichi Matsunaga[1], Yohei Otaka[2], Hiroyoshi Togo[1], Masumi Yamaguchi[1], Hiroshi Nakashima[1], Shingo Tsukada[1], Eiichi Saitoh[2]
[1]NTT Corporation, [2]Fujita Health University
To quantify the 24-hour activity of stroke inpatients, we have developed a wearable system composed of smart clothing, networking devices, and a server.

IoT-SNAP

Thursday, 22 April

[IoT-SNAP-5] 10:00-11:45
Applications and use cases
Chairs: Takayuki Ogasawara
NTT Device Innovation Center
Yasuhisa Inada
Panasonic Corporation

IoT-SNAP-5-04 10:00 ***Invited***

Digital Transformation in Yamaha Motor
Norio Yamada
Yamaha Motor Co., Ltd.
Yamaha Motor has set up "Yamaha Motor to the Next Stage" as Digital Transformation in order to utilize the latest digital technology and data toward the realization of a long-term vision. And implementing three DX initiatives at the same time with linking each other. The outline of those activities will be introduced in this session.

IoT-SNAP-5-05 10:30 ***Invited***

Precision Agriculture with Remote Sensing
Kazuo Oki
Kyoto University of Advanced Science
Agricultural monitoring with remote sensing imagery can provide information on crop growth, which can be used for the agricultural management of a large agricultural area. Moreover, by obtaining information on crop coverage, crop production can be reliably predicted. For these reasons, the use of remote sensing technology to manage agricultural land has been increasing. Here, I introduce some new remote sensing methods for precision agriculture.

IoT-SNAP-5-06 11:00

A proposal on the access control mechanism for real time IoT services using ICN technology
Atsuko Yokotani[1], Hiroshi Mineno[1], Tetsuya Yokotani[2]
[1]Shizuoka University, [2]Kanazawa Institute of Technology
In this study, a mechanism is proposed for IoT services to avoid DDoS attacks using the demand assignment approach in ICN technology.

IoT-SNAP-5-07 11:15 ***Invited***

Environment monitoring using existing optical cables
Yukihide Yoda, Yoshiaki Aono, Koyo Mori
NEC
We propose using existing optical cables for distributed fiber optic sensing. It is enable to senses the world and give society new value such as providing efficient safety by monitoring infrastructure.

[IoT-SNAP-6] 13:30-15:10
Sensing
Chairs: Hiromasa Oku
Gunma University
Haruyoshi Toyoda
Hamamatsu Photonics K.K.

IoT-SNAP-6-01 13:30 ***Invited***

Remote sensing technology for agricultural field information using drone imagery
Ryo Sugiura
National Agriculture and Food Research Organization (NARO)
Aerial imaging using drones demonstrates significant potential for crop growth monitoring in large agricultural fields. Drone imagery provides sufficient details to view the crop status and even individual plants in a field. In this study, several image processing methods were developed to measure crop growth and detect crop diseases.

IoT-SNAP-6-02 14:00

Possible design of Rotman-lens antenna array for 90-GHz-band foreign object debris detection system
Atsushi Kanno, Naokatsu Yamamoto
National Institute of Information and Communications Technology
We review the Rotman-lens antenna array for rotation-less radar head. The comparable footprint can be realized by vertically stack configuration of antenna units.

IoT-SNAP-6-03 14:15 ***Invited***

Optical Sensing for Cyber Physical System at Sensing System Research Center of AIST
Makoto Fujimaki
AIST
The development of the IoT society requires the development of high-performance sensing systems to collect various meaningful information. In response to such demands, AIST launched the Sensing System Research Center (SSRC) in April 2019. SSRC is developing sensors based on optical, MEMS, and electronical technologies. In this talk, I will introduce optical sensing technologies that SSRC has been developing.

IoT-SNAP-6-04 14:45

Monitoring of skin volatiles using gas-phase biosensor for the non-invasive evaluation of volatile blood compounds
Takahiro Arakawa, Takuma Suzuki, Kenta Iitani, Koji Toma, Kohji Mitsubayashi
Tokyo Medical and Dental University
A highly sensitive and selective biochemical gas sensor (optical fiber-based biosensor) and real-time monitoring system with skin gas cell were constructed for the determination of ethanol gas concentration on human skin.

IoT-SNAP-Closing 15:00

Closing Remarks

Poster

[IoT-SNAP-P]
IoT-SNAP Poster Session

IoT-SNAP-P-01

Basic Study of Pseudo Random Readout Profile Sensor for Compressed Sensing
Keisuke Uchida[1], Munenori Takumi[1,2], Katsuhiro Ishii[2], Ken-ichi Kitayama[2]
[1]Hamamatsu Photonics K.K., [2]The Graduate School for the Creation of New Photonics Industries
We proposed a pseudo random readout profile sensor for compressed sensing without optical modulators and demonstrated the proof-of-concept via numerical simulation.

IoT-SNAP-P-02

Defect detection method for clutch disk inspection using AI
Motoki Okazaki, Ryouhei Hanayama
The Graduate School for the Creation of New Photonics Industries
We propose a defect detection method for clutch disk using AI. It can be utilize to detect defects, which cannot be detected by conventional methods.

LDC

Monday, 19 April

[LDC-Opening]13:00-13:10
Opening Remarks
Chairs: Kazuo Kuroda
Utsunomiya University
Fergal Shevlin
Dyoptyka

[LDC-1] 13:10-14:40
Keynote
Chairs: Sunao Kurimura
NIMS
Fergal Shevlin
Dyoptyka

LDC-1-01 13:10 ***Invited***

Laser Light Sources for Specialty and Automotive Lighting Applications

Paul Rudy
KYOCERA SLD Laser

We provide a description on the rapidly expanding capabilities of laser light technology, including 1000 lumen sources with luminance above 1000 cd/mm^2, more than 10x that of LEDs, from surface mount device components.

LDC-1-02 13:55 ***Invited***

Laser Technologies in Novel Medical Imaging

Albert P Heberle
Openwater

We are devising a new generation of portable medical imaging technologies for improved access to medical diagnoses and treatments. Our breakthrough systems use opto-electronics and holography together with novel lasers to enable low cost equipment that rivals the resolution and image quality of multi-million dollar medical imaging scanners.

[LDC-2] 14:55-16:10
AR, MR, VR, ... XR Technologies 1
- Aerial & Aquatic Display -
Chairs: Frank Fischer
Bosch Sensortec GmbH
Norihiro Ohse
Sony Group Corporation

LDC-2-01 14:55 ***Invited***

3D Interface by Parity Mirror and Its Applications

Yuki Maeda
Parity Innovations Co., Ltd.

An optical imaging device for air floating image display and its applications are introduced in this paper. An observer can see the air floating image by the naked eye and manipulate it by touching the air floating image using non-contact sensor.

LDC-2-02 15:25

Subjective Super-Resolution Display on Aerial LED Signage Formed with Aerial Imaging by Retro-Reflection

Kojiro Matsushita[1], Akinori Tsuji[2], Toyotaro Tokimoto[3], Hirotsugu Yamamoto[1,4]
[1]Utsunomiya University, [2]Tokushima University, [3]XAiX, LLC, [4]JST ACCEL

We have realized a novel aerial display that features higher resolution than the light-source LED. We have realized subjective super-resolution display, which makes viewers perceive finer resolution than the actual number of pixels, on aerial LED signage by use of our designed high-speed LED display circuit and aerial imaging optics.

LDC-2-03 15:40

Multiple Aquatic Image Formation with Faced Mirror Structure and Polarized AIRR

Kazunari Chiba[1], Masaki Yasugi[1,2], Hirotsugu Yamamoto[1,2]
[1]Utsunomiya University, [2]JST ACCEL

This paper proposes a new way of 3D display application. Multiple aquatic images were formed using the principle of infinity mirror and Aerial Imaging by Retro-Reflection (AIRR). We have successfully improved the brightness of aquatic images by use of polarization modulation.

LDC-2-04 15:55

Influence of Diverging Angle of the Light Source on the Image Spot Formed in Water by Use of Retro-Reflection

Daiki Kudo[1], Kazunari Chiba[1], Masaki Yasugi[1,2], Nao Ninomiya[1], Hirotsugu Yamamoto[1,2]
[1]Utsunomiya University, [2]JST ACCEL

The aquatic display has been realized with aerial imaging by retro-reflection (AIRR). We confirmed that the spread of a point image formed in water from a point source placed in the air changes depending on the divergence angle of the light from the source.

Tuesday, 20 April

[LDC-3] 10:00-11:30
AR, MR, VR, ... XR Technologies 2
- Viewing Angle in AR/VR Display and Devices -
Chairs: Hidekazu Hatanaka
Ushio
Tetsuya Yagi
NICHIA CORPORATION

LDC-3-01 10:00 ***Invited***

Expanding Field-of-view in Head-mounted Displays Considering Characteristics of Vision

Wataru Yamada, Hiroyuki Manabe
NTT DOCOMO, INC.

Field of view (FOV) is one of the key parameters for the performance of head-mounted displays. Focusing on the differences between central vision and peripheral vision, we developed a technique for expanding the FOV of a head-mounted display at low cost by using lenses with different levels of magnification.

LDC-3-02 10:30

Analysis on Viewing Angle in Aerial Display by Use of an LED Panel Covered with Apertured Retro-Reflector

Daiki Nishimura[1], Masaki Yasugi[1,2], Hirotsugu Yamamoto[1,2]
[1]Utsunomiya University, [2]JST, ACCEL

This paper proposes an analytical model on the viewing angle of the aerial image formed over an LED panel. Our optical system forms aerial signage over a specially fabricated LED panel. A half mirror is placed in front of the LED panel that is covered with retro-reflector with square-shaped holes.

LDC-3-03 10:45

Increasing Luminance of Aerial Image Formed with AIRR by Use of Dual Transparent Spheres

Kengo Fujii[1], Satoshi Maekawa[2], Hirotsugu Yamamoto[1,3]
[1]Utsunomiya University, [2]Parity Innovations Co., Ltd., [3]JST ACCEL

We propose a method to form aerial display by installing two transparent spheres in the light path of AIRR. By proposed method, we confirmed by simulation that the luminance of the aerial image was increased.

LDC-3-04 11:00 ***Invited***

Compact Full-color Laser Beam Projectors Based on Waveguide-type RGB Multiplexers

Toshio Katsuyama[1], Akira Nakao[1], Shoji Yamada[1], Osamu Kawasaki[2], Kazuki Iwabata[2], Koichi Horii[2], Akira Himeno[1,2]
[1]University of Fukui, [2]SEIREN KST Corp.

Compact full-color laser sources and laser beam scanning modules are demonstrated. Those are based on waveguide-type RGB multiplexers. In principle, their output laser beams are perfectly aligned, which inevitably leads to clear projection images. Thus, compact imaging projectors are constructed, which are applicable to a variety of imaging fields.

[LDC-4] 15:15-17:00
AR, MR, VR, ... XR Technologies 3
- xR Concepts -
Chairs: Ray-Hua Horng
National Chiao Tung University
Masafumi Ide
Lambda Works

LDC-4-01 15:15 ***Invited***

Introduction of xR Use Case at Toyota

Koichi Kayano
TOYOTA MOTOR CORPORATION

In general, there have been many examples of engineering using xR technology. However, unfortunately, there are few examples of its use in the customer service field. Toyota is currently demonstrating the use of HoloLens 2 in dealerships. This presentation will explain the case study, results, and points to keep in mind.

LDC-4-02 15:45 ***Invited***

Introducing KDDI's Activities in XR and Spatial Computing Towards 5G

Katsuhiro Kozuki
KDDI CORPORATION

The presentation will explain about KDDI's recent activities in VR, AR and MR(collectively XR) enhanced by its 5G system, mobile edge computing and AR cloud technologies with 5G smartphone and tethered AR glasses products. Introducing from PoC level promotional events to commercially available products and services on 5G networks.

LDC-4-03 16:15

Deforming Aerial Image by Use of Deflection of Beam Splitter in See-Through AIRR

Kosuke Inoue[1], Masaki Yasugi[1,2], Hirotsugu Yamamoto[1,2]
[1]Utsunomiya University, [2]JST, ACCEL

This paper proposes a novel aerial display optics to display a three-dimensional aerial image by intentionally creating irregular deflection. Irregular deflection is occurred by pulling the acrylic plate forward with a piano wire and partially raising it. We succeeded in forming aerial images that appear differently depending on the viewpoint.

LDC-4-04 16:30 ***Invited***

Why Lasers are Key to Make Smart and AR Glasses the Next Big Thing

Lucas Ginzinger
Bosch Sensortec GmbH

The world has been waiting for the big bang in consumer smart glasses not only since Google Glass. Besides use case readiness, the tech maturity is playing a major role in the delayed market of smart/AR glasses for consumers. In his presentation, Lucas Ginzinger, Head of Product Area Optics, talks on the major levers to overcome the hurdles for a successful market entry - the role of laser beam scanning projectors as the key enablers to high volume smart and AR glasses.

LDC

Wednesday, 21 April

[LDC-5] 10:00-11:45
Imaging / Lighting
Chairs: Hirotsugu Yamamoto
Utsunomiya University
Hisashi Masuda
Oxide Corporation

LDC-5-01 10:00 ***Invited***

Laser TV Progress with Visible Laser Improvement
Xianrong Liu
Hisense
Laser TV progress with visible laser improvement will be presented.

LDC-5-02 10:30 ***Invited***

Large-Scale Full-Parallax Full-Color Computer-Generated Holograms Reconstructed by Laser/LED Lighting
Kyoji Matsushima
Kansai University
Recently, full-color computer-generated holograms (CGH) are created by several techniques. These CGHs can be reconstructed using an LED or RGB laser light source. The creation and lighting techniques are introduced for promoting development of light sources for computer holography.

LDC-5-03 11:00

Improvement of Color Rendering Index of BGYR Laser Illuminats
Yoshio Manabe, Masato Ishino, Hiroshi Fuji, Akira Takamori, Junichi Kinoshita, Kana Fujioka, Kazuhisa Yamamoto
Institute of Laser Engineering, Osaka University
We have attempted to improve Color Rendering Index of Blue-Green-Yellow-Red four-color Laser illuminants. As a result, average color rendering index Ra and special CRI(R9) as high as 80 around at 5000 K were obtained by optimizing the BGYR wavelengths and their laser power densities.

LDC-5-04 11:15

Color Shift Behavior at Image Pattern Edges of Raster-scan RGB Mobile Laser Projectors
Junichi Kinoshita[1], Akira Takamori[1], Kazuhisa Yamamoto[1], Kazuo Kuroda[2], Koji Suzuki[3]
[1]Osaka Universitry, [2]Utsunomiya University, [3]OXIDE Corporation
Color shift behavior at image pattern edges of three rater-scan RGB mobile projectors is analyzed. The speckle noise effects are eliminated. Pure color shift is clearly picked up and analyzed.

LDC-5-05 11:30

Ultra High Resolution and VAC-free N3D Technology and its Applications
Chin-Yung Hsieh[1], Hao-Yu Liu[1], Ruey-Jer Weng[1], Wei-Yi Lu[1], Naoki Sumi[2]
[1]Innolux Corporation, [2]Innolux Japan K.K.
In this paper, we introduce the Innolux N3D technology with ultra high resolution and its vergence-accommodation conflict free feature. The N3D technology provide focus cues for nature viewing experience. Lot of 3D display applications can using this thehnology to improve its display quality.

[LDC-6] 13:00-14:30
Light Sources and Components
Chairs: Paul Rudy
KYOCERA SLD Laser
Hiroyuki Matsumoto
Iwasaki Electric

LDC-6-01 13:00 ***Invited***

Nanowire LEDs with Ultrastable Emission Characteristics and Monolithically Integrated Multicolour Emission
Zetian Mi, Xianhe Liu, Yi Sun, Yakshita Malhotra, Yuanpeng Wu
University of Michigan
We report on the design and demonstration of monolithically integrated InGaN/GaN micro-LEDs with multi-colour emission using selective area molecular beam epitaxy, which exhibit unique properties including ultrastable operation, extremely narrow linewidth, and highly directional emission.

LDC-6-02 13:30 ***Invited***

Emission Characteristics of Random Lasers and Their Control
Takashi Okamoto
Kyushu Institute of Technology
Random lasers are mirrorless lasers comprising scatterers and an active medium. Multiple scattering of light provides the feedback mechanism for lasing. In this talk, I will present the mechanisms and properties of a random laser and emission control methods.

LDC-6-03 14:00 ***Invited***

Purcell-Effect-Enhanced Red Emission from Eu Ions in GaN Cavities
Yasufumi Fujiwara, Dolf Timmerman, Shuhei Ichikawa, Jun Tatebayashi
Osaka University
Luminescence properties of a Eu-doped GaN microdisk cavity and a two-dimensional photonic crystal nanocavity are demonstrated. The resonant modes are coupled with indirectly excited Eu^{3+} ions and enhance drastically Eu emission, which is due to the Purcell effect.

[LDC-7] 14:45-15:45
Laser Technology for Automotive Applications 1
Chairs: Jared Kearns
Sony Group Corporation
Masaru Kuramoto
STANLEY ELECTRIC CO., LTD.

LDC-7-01 14:45 ***Invited***

Laser Crystal Phosphor Automobile Headlight Integrated with Beam Control and LiDAR
Kenneth Li[1], Y. P. Chang[2]
[1]Optonomous Technologies Inc., [2]Taiwan Color Optics, Inc.
This invited paper presents our current research in the subject of integrated Beam Control Headlight and LiDAR, which includes a DMD pixel-based system and a polygon scanning mirror-based system. Single crystal phosphor is used providing high efficiency and reliability to the system. The goal is to provide highly reliable, compact, and low-cost systems to be introduced into the mass market for autonomous vehicles.

LDC-7-02 15:15

Improvement of Color LiDAR with RGB Visible Single-Mode Laser Diodes
Masato Ishino, Tomoyuki Ohashi, Hiroshi Fuji, Kana Fujioka, Kazuhisa Yamamoto
Osaka University
We report on the performance improvement of a color LiDAR with RGB visible laser diodes (LD). By using LDs with single lateral mode as the light sources, a short pulse driver, and a high-sensitivity detector, distance and color evaluations with small deviations and a low LD-operation power have been achieved.

LDC-7-03 15:30

Thermal Property of AlN-Ce:YAG Composite Ceramics Phosphor for Laser Lighting
Takuya Sawada, Hiroshi Huji, Kenta Yagasaki, Hisashi Minemoto, Yukio Manabe, Kana Fujioka, Kazuhisa Yamamoto
Institute of Laser Engineering, Osaka University
We have developed AlN-Ce:YAG composite ceramics in order to suppress thermal quenching, and measured thermal property when the ceramics were irradiated with a high-power laser.

[LDC-8] 16:00-17:00
Laser Technology for Automotive Applications 2
Chairs: Abdelmalek Hanafi
BMW
Tatsushi Hamaguchi
Sony Group Corporation

LDC-8-01 16:00 ***Invited***

GaN-based Vertical-Cavity Surface-Emitting Lasers with Lattice-Matched AlInN/GaN DBRs
Tetsuya Takeuchi[1], Satoshi Kamiyama[1], Motoaki Iwaya[1], Isamu Akasaki[1,2]
[1]Meijo University, [2]Nagoya University
GaN-based vertical-cavity surface-emitting lasers (VCSELs) have been intensively developed, showing high performances toward practical uses. We show in-situ wafer curvature evolutions during the epitaxial growth of AlInN/GaN DBRs and an implementation of nano-height cylindrical waveguides in the VCSELs. Room-temperature continuous-wave operations of the VCSELs with large apertures up to 30 μm diameter have been demonstrated.

LDC-8-02 16:30

Freeform Lens Design for High-Efficient LED Low-Beam Headlamp Lens
Zhengbo Zhu, Shili Wei, Wenyi Li, Donglin Ma
Huazhong University of Science and Technology
We develop a least-squares ray mapping method to design freeform lens for LED-based low-beam headlamp optical system, the produced irradiance distribution conformed to the United Nations Economic Commission for Europe vehicle regulations (ECE) R112. The energy efficiency reaches up to 84% considering the Fresnel loss.

LDC-8-03 16:45

High Power Laser Phosphor Light Source Using Tilted Rotating Mirror
Kenneth Li[1], Y. P. Chang[2], Lion Wang[2], Andy Chen[2], Stark Tsai[2]
[1]Optonomous Technologies Inc., [2]Taiwan Color Optics, Inc.
This paper describes a stationary phosphor plate system excited by a scanning laser focused spot on the phosphor increasing the excitation area, while keeping the same etendue. Such scanning is created by using a tilted rotating mirror reflecting the input laser beam towards the phosphor plate and reflecting the output beam towards the direction of the input laser beam maintaining the small etendue of a single focus spot.

LDC

Thursday, 22 April

[LDC-9] 13:00-14:30
Smart Systems
Chairs: Young-Joo Kim
Yonsei University
Satoshi Ouchi
Hitachi, Ltd.

LDC-9-01 13:00 ***Invited***

Geo-marine science using visible light
Hiroshi Yoshida
JAMSTEC
Geo-marine science using visible light will be presented.

LDC-9-02 13:30 ***Invited***

Imperceptible Projected Marker Codes with Application to Calibration-Free Projection Mapping
Shingo Kagami
Tohoku University
This paper reviews our recent efforts on Digital Micromirror Device (DMD)-based approaches to embed imperceptible marker codes into video projection. An application to calibration-free projection mapping onto a moving surface is also described.

LDC-9-03 14:00

Scanning RGB Laser Beam Detection for Smart Laser Display System
Takeshi Ebara[1], Hiroshi Murata[1,2], Masato Ishino[2], Junichi Kinoshita[2], Kazuhisa Yamamoto[2]
[1]Mie University, [2]Institute of Laser Engineering, Osaka University
Interruption of scanning RGB laser beams was detected by use of a high-speed photodiode and high-speed oscilloscope to check a response time for controlling smart laser display operation. Clear electrical pulse train signals were obtained from the photodiode. These results are useful for safety control of smart laser display systems.

LDC-9-04 14:15

Extraction Method of Typical Traffic Lines of Pedestrians
Akinobu Watanabe
Hitachi, Ltd.
We developed the extraction method of typical traffic lines of pedestrians captured by TOF sensor, and grouping method of similar pathways with the typical traffic lines.

[LDC-10] 14:45-15:15
Novel and Emerging Technologies
Chair: Hiroshi Murata
Mie University

LDC-10-01 14:45

Design an Extreme Ultraviolet Illumination System with High Uniformity
Yanqiu Li, Qian Hao, Ke Liu, Xu Yan
Beijing Institute of Technology
In this paper, an extreme ultraviolet illumination system matching an NA 0.33 projection objective is designed. Simulation results show that this illumination system can achieve high uniformity on the mask plane under different illumination modes.

LDC-10-02 15:00

Colorization of Arc3D using Projector Lighting
Ikuya Saji[1], Masafumi Nakata[2], Yasuhiro Kashihara[2], Atsushi Hayashi[2], Hirotsugu Yamamoto[1,3]
[1]Utsunomiya University, [2]NSC Co., Ltd., [3]JST, ACCEL
This paper describes the colorization of Arc3D, which is an autostereoscopic display by use of arc-shaped scratches on a transparent substrate. Directional scattering on an arc changes the position of an bright spot depending on the viewing position. Arc3D has been colorized and switched by use of a projector lighting.

[LDC-Closing] 15:15-15:25
Closing Remarks
Chair: Sunao Kurimura
NIMS

LSSE

Monday, 19 April

[LSSE-1] 13:00-15:05
Keynote 1_Anti COVID 1
Chair: Toshikazu Ebisuzaki
RIKEN

LSSE-Opening 13:00

Opening Remarks

LSSE-1-01 13:05 ***Keynote***

Rapid Detection system for new coronavirus

Yoshihide Hayashizaki
RIKEN Preventive Medical Innovation Program

The key to recovering economic activity from the long-term period of Covid19 pandemic is how to safely hold events, transportation, meetings, and so on. We have developed a system that can detect the new coronavirus in about 20 minutes. An important point in conducting a test for new coronavirus is to perform a time-stamped snapshot test. In my speech, I would like to introduce a few examples of our experiences to prevent cluster formation.

LSSE-1-02 14:05 ***Invited***

Kaltech's photocatalytic technology efforts to address global environmental issues

Junichi Somei
Kaltech Corporation

Kaltech's photocatalytic technology has been demonstrated to be effective against the novel coronavirus through joint research with RIKEN and Nihon University School of Medicine.Apply photocatalytic technology to water purification as well as air purification. Photocatalysts discovered by Japanese researchers about 50 years ago contribute to global environmental problems, including pandemics.

LSSE-1-03 14:35 ***Invited***

Simultaneous laser measurement of the velocity and size of speech-generated droplets

Takeharu Murakami, Norihito Saito, Takayo Ogawa, Katsuhiko Tsuno, Michio Sakashita, Satoshi Wada
RIKEN

We propose a method that combines orthogonal Particle Tracking Velocimetry and Interferometric Mie Imaging to measure the velocity vector and size of speech droplets simultaneously.

[LSSE-2] 15:30-17:00
Keynote 2_Anti COVID 2
Chair: Satoshi Wada
RIKEN

LSSE-2-01 15:30 ***Keynote***

Light-based disinfection for SARS-COV2

Yoko Aida[1], Ryosuke Matsuura Matsuura[3], Chieh-Wen Lo[1], Junichi Somei[4], Heihachiro Ochiai[4], Kazuo Iimura[5], Masaru Nakazawa[1], Masami Takei[3], Yosimi Benno[2], Takeharu Murakami[2], Norihito Saito[2], Takayo Ogawa[2], Atsushi Shinjo[2], Satoshi Wada[2]
[1]The University of Tokyo, [2]RIKEN, [3]Nihon University School of Medicine, [4]Kaltech Co., LTD, [5]Farmroid Co., LTD

Light-based technologies, such as LED-TiO_2 photocatalytic reaction and UVC light, effectively inactivate SARS-CoV-2 by different mechanisms. Therefore, these tools could potentially save people from the risk of infectious diseases.

LSSE-2-02 16:30 ***Invited***

The effect of the UV sterilization robot UVBuster on the SARSCoV-2

Kazuki Iimura[1,2], Masami Takei[2], Yasuhiro Gon[3], Takeshi Sakamoto[4], Satoshi Wada[2,5]
[1]FARMROID Co., Ltd., [2]Division of Hematology and Rheumatology, Department of Medicine, Nihon University School of Medicine, [3]Division of Respiratory medicine, Department of Medicine, Nihon University School of Medicine, [4]Itabashi City, [5]Photonics Control Technology Team, RIKEN Center for Advanced Photonics

The SARS-CoV-2 RNA in the pharyngeal swab sample collected from the patient was destroyed by 254 nm UVC from the UV irradiation robot. In order to investigate the virus destruction mechanism by UV rays in detail, we set the UV irradiation time conditions to 5 seconds, 15 seconds, and 30 seconds in the P3 laboratory, and conducted infection experiments using two types of PCR methods and Vero cells.

Tuesday, 20 April

[LSSE-3] 10:30-11:30
Space Technology 1
Chair: Toshikazu Ebisuzaki
RIKEN

LSSE-3-01 10:30 ***Invited***

Simulation of Laser Beam Propagation in the Atmosphere

Yoshiaki Kato, Toshikazu Ebisuzaki, Tomohiro Tsukihana, Naoto Sakaki
RIKEN

We report on simulations of thermal blooming effect by high-power laser in the atmosphere.

LSSE-3-02 11:00 ***Invited***

1-kw Fiber Laser Beam Propagation in Water Vapor

Tomohiro Tsukihana
RIKEN

1-kW fiber laser at 1070nm was used to study the thermal blooming effect in water vapor. Specifically, the thermal blooming dependence on water-vapor absorption has been elucidated.

[LSSE-4] 15:30-17:00
Space Technology 2
Chair: Toshikazu Ebisuzaki
RIKEN

LSSE-4-01 15:30 ***Invited***

Atmospheric Turbulence Measurement Experiments Using Backscattering for Predictive Adaptive Optics Control

Takuya Noritake[1], Masashi Iwashimizu[1], Shingo Nishikata[1], Hiroyuki Daigo[1], Toshikazu Ebisuzaki[2], Naoto Sakaki[2], Tomohiro Tsukihana[2], Seiji Taniguchi[3], Masayuki Fujita[3], Haik Chosrowjan[3]
[1]Mitsubishi Heavy Industries, Co., Ltd., [2]Riken Institute, [3]Institute for Laser Technology

In order to realize high efficiency laser transmission, we must avoid atmospheric effects. This paper presents predictive adaptive optics control, which utilize backscattering of atmosphere and an absorption coefficient detector and the result of field experiments to take the atmospheric turbulence from backscattering.

LSSE-4-02 16:00 ***Invited***

End-of-Life Deorbit Service with a Pulsed Laser Onboard a Small Satellite

Tadanori Fukushima[1,2], Daisuke Hirata[1,2], Kazuma Adachi[1,2], Yuki Itaya[1,2], Jun Yamada[1], Katsuhiko Tsuno[2], Takayo Ogawa[2], Satoshi Wada[2], Toshikazu Ebisuzaki[2]
[1]SKY Perfect JSAT, [2]RIKEN

In order to removal debris(nonfunctional satellite), SKY Perfect JSAT Corporation has begun designing a brand-new end-of-life (EOL) deorbit service satellite. The Corporation aims to launch a demonstration satellite in 2024 to start service in 2026.

LSSE-4-03 16:30 ***Invited***

Machine Learning for processing of space images

Antonio Montarano[1], M. E. Bertaina[2], T. Ebisuzaki[3]
[1]Politecnico di Torino, [2]The University of Turin, [3]Riken

Machine Learning represents a powerful technique to recognize space images. We focused on a new approach that could be applied for any object moving linearly or with a known trajectory in the field of view of a telescope. We will report on the expected performance of our approach based on simulated space debris tracks and we will provide insights on how this strategy could be applied also as online trigger alert.

Wednesday, 21 April

[LSSE-5] 10:00-11:20
Industrial Application 1
Chair: Noboru Hasegawa
QST

LSSE-5-01 10:00 ***Invited***

Proposal of Phase Shift Optical Pulse Interference Seismograph and its Installation for Monitoring the Decommission of Fukushima Daiichi Nuclear Power Plant

A. Nishimura[1], H. Morishita[2], M. Yoshida[2]
[1]JAEA, [2]Hakusan Corp.

A phase shift optical pulse interference (PSOPI) sensor was tested to observe the vibration characteristics a cylindrical water tank in order to apply the seismic safety management for social infrastructure.

LSSE-5-02 10:30

Water Tank Window Vibration Characteristics due to Water Level by Laser Vibration Displacement Measurement and its Application

Akihiko Nishimura[1], Tomonori Yamada[1,2], Yoshinori Shimada[3], Hideki Morishita[4], Minoru Yoshida[4]
[1]Japan Atomic Energy Agency, [2]Wakasa Wan Energy Research Center, [3]Institute of Laser Engineering, [4]Hakusan Corp.

In JAEA-NARAHA, vibration Characteristics of a water tank due to water level rising is measured. Laser Doppler vibration displacement sensor is used. This technique can be applied for monitoring internal pressure of a shielded radioactive material capsule.

LSSE-5-03 10:50 ***Invited***

Laser-Induced Elastic Wave Methods for Inspection of Civil Infrastructure and Damage Detection in Concrete

Katsufumi Hashimoto, Tomoki Shiotani
Kyoto University

This study aims to apply elastic wave excitation technique with laser impact method to non-destructive inspection for detecting damage and defect in concrete of civil infrastructures.

[LSSE-6] 13:50-15:00
Agri-Photonics 1
Chair: Takayo Ogawa
RIKEN

LSSE-6-01 13:50

Noninvasive quantitative prediction of functional ingredient in apple using Raman spectroscopy and multivariate calibration

Kouhei Saitoh[1], Akinori Taketani[2], Takeharu Murakami[2], Michio Sakashita[2], Saki Miyajima[2], Takayo Ogawa[2], Satoshi Wada[2], Hayato Maeda[3], Yasutaka Hanada[1]
[1]Hirosaki University The graduate school of Science and Technology, [2]RIKEN Center for Advanced Photonics, [3]Hirosaki University The graduate School of Agriculture and Life Sciences

We present prediction of a functional ingredient in apple using Raman spectroscopy combined with multivariate calibration analysis. The method reveals great potential for rapid and nondestructive analysis of the ingredient.

LSSE

Wednesday, 21 April

LSSE-6-02 14:10 *Invited*

Open the door into the microbial world by single-cell analysis

Haruko Takeyama[1,2,3]
[1]*Department of Life Science and Medical Bioscience, Waseda University,* [2]*Computational Bio Big-Data Open Innovation Laboratory, AIST-Waseda University,* [3]*Research Organization for Nano & Life Innovation, Waseda University*

We have developed a platform for screening beneficial microbiomes and acquiring high-quality draft genomes at the single-cell level by a combination of droplet microfluidics and micro-Raman spectroscopy.

LSSE-6-03 14:40

Tentative

Yasukazu Nakamura
National Institute of Genetics

[LSSE-7] 16:00-17:00
Agri-Photonics 2
Chair: Kohsuke Chris Yamada
AOI-PARC

LSSE-7-01 16:00 *Invited*

Light effects on Spirulina platensis

Shy Chyi Wuang
Temasek Polytechnic

Spirulina platensis is widely used as health supplements. In this study, we investigated the effects of light spectrum on the growth and carotenoids accumulation in the cynanobacteria.

LSSE-7-02 16:30 *Invited*

Measuring and understanding plants to improve performances: Photonic sensors in large scale research infrastructure for plant sciences

Rick van de Zedde, Gerrit Polder
Wageningen University &Research (WUR)

The focus in this talk is to give insights and discuss the photonics sensors/ imaging systems that are used in the 6 modules of the Netherlands Plant Eco-phenotyping Centre (NPEC) , for instance hyperspectral imaging systems to scout for diseases on field mounted on a field phenotyping tractor.

Thursday, 22 April

[LSSE-8] 10:00-11:30
Mourning session for Dr. Shimada (ILT), who made a great contribution to the field of laser remote sensing 1
Chair: Noboru Hasegawa
QST

LSSE-8-01 10:00 *Invited*

Development of non-destructive inspection method for concrete elements in tunnel linings using laser remote sensing

Yoshiaki Oka
West Japan Railway Company

West Japan Railway Company and the Institute for Laser Technology Institute jointly developed a laser remote sensing system as an alternative to the impact acoustics method for detecting defective concrete elements in tunnel linings.

LSSE-8-02 10:30 *Invited*

Development and Application of Laser-Based Inspection Technique for Concrete Structure

Shinri Kurahashi, Oleg Kotyaev, Yoshinori Shimada
Institute for Laser Technology

I will introduce the history of the development and progress of remote inspection technology using lasers that Dr. Shimada has been working on and report the work in recent years.

LSSE-8-03 11:00 *Invited*

In memory of research and development of Laser directive noncontact diagnosis for maintaining degraded infrastructure (SIP) project with Dr. Shimada

Kiwamu Kase
RIKEN

Memories of the research and development of Laser directive noncontact diagnosis for maintaining degraded infrastructure (SIP) project with Dr. Shimada is addressed.

[LSSE-9] 13:00-15:00
Mourning session for Dr. Shimada (ILT), who made a great contribution to the field of laser remote sensing 2
Chair: Takashi Fujii
The University of Tokyo

LSSE-9-01 13:00 *Invited*

Soundness of heated concrete samples characterized by a laser driven ultrasonic technology

Tomonori Yamada[1,2], Hiroyuki Daido[3,2], Takuya Shibata[2]
[1]*WERC,* [2]*JAEA,* [3]*ILT*

We have demonstrated a full noncontact laser technology to measure the velocity of ultrasonic waves and their spectra propagated through degraded concrete samples exposed to specified high-temperature conditions.

LSSE-9-02 13:30 *Invited*

High power laser generated fine particles and fragments in laser processing

Hiroyuki Daido[1,2], Tomonori Yamada[2,4], Chikara Ito[2], Masabumi Miyabe[2], Takuya Shibata[2], Hiroyuki Fukukawa[1], Stephen Wells[3], Shuichi Hasegawa[3]
[1]*Institute for Laser Technology,* [2]*Japan Atomic Energy Agency,* [3]*The University of Tokyo,* [4]*The Wakasa Wan Energy Research Center*

We describe and investigate the production of particles and fragments from laser irradiated materials and their dispersion during laser processing. Observation of the dynamical processes as well as a morphological investigation were performed with a shadowgraph technique and an electron microscope. These studies will contribute to decommissioning of nuclear facilities as well as a variety of high power laser applications.

LSSE-9-03 14:00 *Invited*

Laser Hammering Method for Initial Stability Diagnosis of Pedicle Screw in Human Body

Katsuhiro Mikami[1], Daisuke Nakashima[2], Noboru Hasegawa[3], Toshiyuki Kitamura[3], Masaharu Nishikino[3], Takeo Nagura[2]
[1]*Kindai University,* [2]*Keio University,* [3]*National Institutes for Quantum and Radiological Science and Technology*

Laser hammering method is one of the effective laser sensing scheme. In this study, we adapted the scheme to medical field for stability diagnosis of orthopedic implants.

LSSE-9-04 14:30 *Invited*

Social Implementation for the Laser Hammering System

Noboru Hasegawa[1], Masaharu Nishikino[1,2], Hajime Okada[1,2], Shuji Kondo[1,2], Toshiyuki Kitamura[2,1], Shigeru Kogure[2], Satoshi Tomoto[3]
[1]*National Institutes for Quantum and Radiological Science and Technology,* [2]*Photon-Lab. Co., Ltd.,* [3]*CTI Engineering Co., Ltd.*

We are developing and implementing in society a remote non-destructive sensing system for concrete, Laser Hammering System (LHS). Several trial works are already performed in road tunnels, and establishment an operation method for effective utilization is in progress.

[LSSE-10] 16:00-16:50
Industrial Application 2
Chair: Akihiko Nishimura
Japan Atomic Energy Agency

LSSE-10-01 16:00

Influence of friction in bolt loosening inspection based on laser hammering method

Yuka Okamoto[1], Katsuhiro Mikami[1], Natsumi Sudo[1], Noboru Hasegawa[2], Masaharu Nishikino[2]
[1]*Kindai University,* [2]*National Institutes for Quantum and Radiological Science and Technology Kansai Photon Science Institute*

Laser hammering method can adapt into bolt loosening inspection. In this study, we evaluated the influence of friction in laser hammering method by measurement of the axial force.

LSSE-10-02 16:20

Remote diagnostics of composite insulator using laser-induced breakdown spectroscopy

Takashi Fujii[1], Taisei Homma[1], Akiko Kumada[1], Hiroya Homma[2], Yuji Oishi[2]
[1]*The University of Tokyo,* [2]*Central Research Institute of Electric Power Industry*

We describe the results of depth profiling of the surface degradation of silicone rubber composite insulators using laser-induced breakdown spectroscopy for the remote diagnostics of composite insulators.

LSSE-Closing 16:40

Closing Remarks

Program

OMC

Tuesday, 20 April

[OMC-1] 10:30-12:15
OMC-1
Chairs: Takashige Omatsu
Chiba University
Ryuji Morita
Hokkaido University

OMC-Opening 10:30

Opening Remarks

OMC-1-01 10:45 ***Invited***

Laser transverse modes with SU(2) representation

Yung-Fu Chen
National Yang Ming Chiao Tung University

We give a detailed overview of the theoretical description of the Hermite-Laguerre-Gaussian mode from the representation of SU(2) in the Jordan-Schwinger diagram.

OMC-1-02 11:15

Generation of geometrical Laguerre-Gaussian modes from a Nd:$GdVO_4$ laser with a degenerate cavity configuration

Yuanyuan Ma[1], Andrew J Lee[2], Helen M Pask[2], Katsuhiko Miyamoto[1,3], Takashige Omatsu[1,3]
[1]Chiba university, [2]MQ Photonics Research Centre, Macquarie University, [3]Molecular Chirality Research Center

We demonstrate the direct generation of geometrical Laguerre-Gaussian (LG) modes from an annular beam pumped Nd:$GdVO_4$ laser with a degeneracy cavity configuration. Such geometrical LG modes pave the way towards a myriad of applications, such as optical/quantum communication, optical trapping, and micro-fabrications.

OMC-1-03 11:30

Vector vortex generation from Raman laser cavity

Yoshihiro Nishigata[1], Shun Sasaki[1], Katsuhiko Miyamoto[1,2], Takashige Omatsu[1,2]
[1]Chiba University, [2]Molecular Chirality Research Center, Chiba University

The vector vortex mode generation from a $Ba(NO_3)_2$ Raman laser cavity pumped by a vector LG_{02} green laser was demonstrated. The 1st, 2nd, 3rd, and 4th Stokes outputs operated at a radially polarized mode. The maximum output energies of the 1st, 2nd, 3rd, and 4th Stokes were measured to be 0.33 mJ, 0.50 mJ, 0.32mJ and 0.03 mJ, respectively, at the maximum pump energy of 4.39 mJ.

OMC-1-04 11:45

Fiber optic one-dimensional Airy-like beam generation by creating an offset between the cylindrical lens and the fiber endface

Hyeonwoo Lee, Hyeung Joo Lee, Juwon Yoon, Kyunghwan Oh
Yonsei univerisity

Airy beam has been attracting the attention of current researchers for its unique characteristics such as self-healing property, non-diffractive nature, and self-accelerating beam trajectory. Here, we propose the generation of a fiber optic one-dimensional Airy-like beam using a micro-scale cylindrical lens. Furthermore, its intensity demonstrated a curved trajectory, which originates from the self-accelerating nature of the Airy-like beam.

OMC-1-05 12:00

Dispersion control of orbital angular momentum mode using a ring core with graded-index profile

Yong Soo Lee[1], Aeri Jung[1], Soeun Kim[2], Kyunghwan Oh[1]
[1]Yonsei University, [2]GIST

We propose an orbital angular momentum (OAM) photonic crystal fiber (PCF) that can control the dispersion of OAM mode by using a ring-core to which a graded-index profile is applied. Using the full-vectorial finite element method (FEM), the properties of the proposed OAM PCF were analyzed. We found that when the thickness of the ring-core to which the graded-index profile was applied is reduced, the dispersions of the modes guided to the core decrease overall.

[OMC-2] 15:30-17:00
OMC-2
Chairs: Masaaki Ashida
Osaka University
Sile Nic Chormaic
OIST

OMC-2-01 15:30

Optical trapping of Poly(N-isopropylacrylamide) gel particles using metalic nanostructures

Maho Kubota[1], Miyako Iida[1], Sayaka Hashimoto[1], Tatsuya Shoji[2], Yasuyuki Tsuboi[1]
[1]Osaka City University, [2]Kanagawa University

We investigated the optical trapping of gel particles with a new optical tweezers using nanostructured titanium crystals. When a laser beam was irradiated to the crystal, fluorescent gel particles were immediately trapped at the irradiation area. Furthermore, fluorescence spectroscopy analysis showed that fluorescence intensity increased upon trapping.

OMC-2-02 15:45

Analysis on spatial distribution of Poynting vectors for multimer plasmonic fields

Yuji Sunaba, Keiji Sasaki
RIES, Hokkaido University

We investigated the optical rotational manipulation in localized plasmonic fields with spin and orbital angular momenta. To clarify the force exerted on nanoparticles, we analyzed spatial distribution of Poynting vectors related to scattering force.

OMC-2-03 16:00

Orbital angular momentum mode generation using anisotrophic liquid crystal filled capillary

Hucksu Choi[1], Yongsoo Lee[1], Jonghee Eun[2], joonwo jung[2], Kyunghwan Oh[1]
[1]Yonsei University, [2]UNIST

It is known that chiral doped 5CB under a capillary boundary condition form a double-twist self-assembly structure. Since birefringence of 5CB has a negative charge, the double-twist structure is equivalent to the graded ring core waveguide. Since optical axis of LC structure has a topological charge, LP modes split into OAM modes. Also the chiral asymmetry of the waveguide made the nonzero OAM mode to be the highest effective index.

OMC-2-04 16:15

Spiral surface relief formation with Hermite-Gaussian beams with zero orbital angular momentum

Arata Tomita[1], Adam Vallés[1,2], Katsuhiko Miyamoto[1,2], Takashige Omatsu[1,2]
[1]Graduate School of Science and Engineering, Chiba University, [2]Molecular Chirality Research Center, Chiba University

We demonstrate the formation of spiral surface relief of azo-polymers by irradiation of a rotating Hermite-Gaussian beam with zero orbital angular momentum. This approach offers new fundamental physical insight of light matter interaction, and it paves the way towards advanced ultrahigh density optical data storages.

OMC-2-05 16:30 ***Invited***

Spin-orbit modal shaping of optical orbital angular momentum states

Etienne Brasselet
University of Bordeaux

When dealing with fields carrying orbital angular momentum usually, the control of both the azimuthal and the radial degrees of freedom remains an open fundamental and practical challenge. Here we present our recent developments of spin-orbit modal beam shapers in the context of light beams carrying orbital angular momentum.

Wednesday, 21 April

[OMC-3] 9:00-10:30
OMC-3
Chairs: Kei Murakoshi
Hokkaido University
Keiji Sasaki
Hokkaido University

OMC-3-01 9:00

Detection of Radiation Force due to Simultaneous Two-photon Absorption

Syoji Ito, Mizuki Hayasaka, Masato Mori, Masafumi Koga, Shinya Nakamura, Kenji Setoura, Hikaru Sotome, Hiroshi Miyasaka
Osaka Univesity

A polymer particle containing dye molecules was optically trapped with pulsed laser (800 nm, 200 fs). The trapping point shifted on the optical (Z-) axis towards the propagation direction of the femtosecond laser with increasing laser power. The Z-displacement was dependent on incident laser power and, from which we concluded that the positional shift along the Z-axis can be ascribed to the radiation force due to simultaneous two-photon absorption.

OMC-3-02 9:15

Optical trapping of amyloid fibrils of hen egg-white lysozyme

Ken-ichi Yuyama, Mai Miyazaki, Yasuyuki Tsuboi
Osaka City University

We demonstrate optical trapping of protein amyloid fibrils with the use of a tightly focused laser beam.Upon the focused laser irradiation, amyloid fibrils are attracted toward the laser focus and stably trapped there. After switching off the laser, the trapped amyloids start diffusion to the surrounding solution. Thus, optical force is effectively exerted on protein amyloid fibrils and useful to trap, assembly, and manipulate them.

OMC-3-03 9:30

Observation of Optical Molecuar Manipulation Dynamics at Solid-Liquid Interface via Surface Enhanced Raman Scattering

Nobuaki Oyamada, Hiro Minamimoto, Kei Murakoshi
Hokkaido University

Electric field induced by plasmon resonance could retard the Brownian motion at solid-liquid interface. We tried to reveal the factors for molecular manipulation within the localized electric field through SERS observations using Au array structure.

OMC-3-04 9:45

Optical trapping and assembly of particle clusters using hybrid plasmonic-photonic nanotweezers

Christophe Pin[1,2,3], Giovanni Magno[4,5], Aurore Ecarnot[4], Emmanuel Picard[2], Emmanuel Hadji[2], Vy Yam[4], Frédérique de Fornel[1], Béatrice Dagens[4], Benoît Cluzel[1]
[1]ICB, Université Bourgogne Franche-Comté, [2]CEA Grenoble, Université Grenoble Alpes, [3]RIES, Hokkaido University, [4]C2N, Université Paris-Saclay, [5]DEI, Politecnico di Bari

A periodic chain of gold nanorods coupled to a silicon waveguide is used to trap single beads and self-assembled bead clusters. The trapping efficiency and the stability of several cluster configurations are statistically analyzed.

OMC

Wednesday, 21 April

OMC-3-05 10:00

Size Separation of polymer gels using Plasmonic Optical Tweezers

Sayuri Wake[1], Tatsuya Shoji[2], Yasuyuki Tsuboi[1]
[1]Osaka City University, [2]Kanagawa University

We demonstrate plasmonic optical trapping of two types of thermoresponsive polymer gel particles labelled with fluorescent probes. The two types of polymer gel particles were trapped in accordance with their size in. Smaller gel particles were trapped near the irradiation area and larger gel particles were trapped outside of the smaller gel particles. We discuss a mechanism of separation of these particles.

OMC-3-06 10:15

Optical vortex induced microdroplet with a plasmonic nanocore

Haruki Kawaguchi[1], Kei Umesato[1], Kanta Takahashi[1], Keisaku Yamane[2], Ken-ichi Yuyama[3], Satoyuki Kawano[4], Katsuhiko Miyamoto[1,5], Takadhige Omatsu[1,5]
[1]Graduate School of Engineering, Chiba University, [2]Department of Applied Physics, Hokkaido University, [3]Department of Chemistry, Osaka City University, [4]Department of Mechanical Science and Bioengineering, Graduate School of Engineering Science, Osaka University, [5]Molecular Chirality Research Center, Chiba University

We demonstrate the creation of a microdroplet with a plasmonic Au nanoparticle core by employing the optical vortex laser-induced forward transfer technology. This Au particle is printed as a plasmonic nanocore with super spatial resolution.

[OMC-4] 11:00-12:00
OMC-4
Chair: Satoshi Ashihara
University of Tokyo

OMC-4-01 11:00

Optical trapping of a nanoparticle by a copper nanoantenna

Zhe Xu[1,2,3]
[1]Inspur Electronic Information Industry Co., Ltd., [2]State Key Laboratory of High-end Server & Storage Technology, [3]Inspur (Beijing) Electronic Information Industry Co., Ltd.

We demonstrate the optical trapping of a single dielectric nanoparticle in a microfluidic chamber using a coupled T-shaped copper plasmonic nanoantenna at 1064 nm wavelength for studying light–matter interactions. We present the finite element method numerical simulations to clarify the optical trapping process, including near-field distributions, optical forces, temperature rises, and thermal-induced fluid velocities.

OMC-4-02 11:15

Fluid convection driven by suspended particles in optical trapping

Tetsuro Tsuji[1], Chie Hosokawa[2,3], Tatsunori Kishimoto[2,4], Takumi Okubo[5], Suguru N. Kudoh[4], Satoyuki Kawano[5]
[1]Kyoto University, [2]Osaka City University, [3]National Institute of Advanced Industrial Science and Technology, [4]Kwansei Gakuin University, [5]Osaka University

We investigate a fluid convection induced by a focused laser beam in optical trapping. It is shown that the optical scattering force, which pushes suspended particles in the beam propagation direction, drags the fluid and can induce the convection. Such type of convection is significant compared with thermal convection for the dispersion of relatively large particles with the order of diameter 1 μm.

OMC-4-03 11:30

Analysis of small plastics in coastal surface water samples of Okinawa using optical tweezers-Raman spectroscopy

Domna G. Kotsifaki[1], Christina Ripken[1,2], Sile Nic Chormaic[1]
[1]Light-Matter Interactions for Quantum Technologies Unit, Okinawa Institute of Science and Technology Graduate University, Okinawa, Japan, [2]Marine Genomics Unit, Okinawa Institute of Science and Technology Graduate University, Okinawa, Japan

We employ an optical trapping-Raman spectroscopy technique for simultaneous characterization and monitoring of the physical and chemical properties of single small micro-plastics in a seawater environment. Through analysis of the data, we chemically identify the plastic and distinguish it from organic matter and/or mineral sediments. We categorize the particles based on their size and shapes. The technique paves the way for monitoring marine plastic pollution.

OMC-4-04 11:45

Optical Gradient Force on Gold Chiral Nanoparticles

Junsuke Yamanishi[1], Hyo-Yong Ahn[1], Shun Hashiyada[2], Ki Tae Nam[3], Hiromi Okamoto[1]
[1]Institute for Molecular Science, [2]RIKEN Center for Advanced Photonics, [3]Seoul National University

We investigate the CP-dependent gradient force on the chiral gold nanoparticles. We found that the dispersion of the position of the Brownian motion depends on the handedness of the incident light in both cases of D- and L-form particles.

[OMC-5] 13:30-15:00
OMC-5
Chair: Hajime Ishihara
Osaka University

OMC-5-01 13:30

Lensless phase retrieval based on convolutional neural network for holographic storage

Jianying Hao[1], Xiao Lin[1,2,3], Mingyong Chen[1], Yongkun Lin[1], Xiaodi Tan[1,2,3], Yuhong Ren[1]
[1]College of Photonic and Electronic Engineering, Fujian Normal University, [2]Fujian Provincial Key Laboratory of Photonics Technology, [3]Fujian Provincial Engineering Technology Research Center of Photoelectric Sensing Application

In this paper, a lensless non-interferometric phase retrieval method based on deep learning is proposed. We use a neural convolutional network to establish the relationship between the intensity images and the phase data pages. The phase can be retrieved directly by feeding the intensity image to the trained neural network.

OMC-5-02 13:45

Theoretical Study on Modeling and Sorting of Real Chiral Molecules by Using Resonant Optical Force

Takao Horai[1], Hiroki Eguchi[1], Takuya Iida[1], Hajime Ishihara[1,2]
[1]Osaka Prefecture University, [2]Osaka University

We theoretically study the chiral molecular sorting by using resonant optical force. Based on the coupled dipole model of a dye-molecule with chirality, we evaluate the optical force difference when irradiating the counter-propagating light waves with different circular polarizations. The result indicates the possibility of chiral molecular sorting by resonant optical force.

OMC-5-03 14:00

Low-damage and large scale optical condensation of useful bacteria with bubble-mimetic substrate

Kota Hayashi[1,2,3], Mamoru Tamura[1,3], Shiho Tokonami[2,3], Takuya Iida[1,3]
[1]Grad. Sch. Sci. in Osaka Pref. Univ., [2]Grad. Sch. Eng. in Osaka Pref. Univ., [3]RILACS in Osaka Pref. Univ.

The substrate to control spatial configuration of heat generation by photothermal effect based on laser irradiation on metallic nanostructure enabled to assemble microbes by light-induced convection without thermal damage.

OMC-5-04 14:15

Interaction optical torque induced by plasmon coupling

An'an Wu, Yoshito Y Tanaka, Tsutomu Shimura
The University of Tokyo

Interaction optical torque can be generated and enhanced by the plasmon coupling between twisted nanorods, depending its configuration. It implements the rotations to mutually perpendicular and parallel arrangements of the nanorods with different mode excitations.

OMC-5-05 14:30

Isotopic Hydrogen Evolution Reactions under Plasmonic Excitation

Hiro Minamimoto, Daiki Sato, Kei Murakoshi
Hokkaido University

The excitation of the localized surface plasmon leads to the generation of highly localized electric field. The huge field gradient within the field can manipulate molecular behavior, resulting in the modulation of chemical reactions. In this study, we have observed the effect of the plasmonic excitation on the plasmon-induced hydrogen evolution reactions through various photoelectrochemical measurements.

OMC-5-06 14:45

Laser processing simulation for Marangoni-driven needle formation under optical vortex

Mamoru Tamura[1], Takashige Omatsu[2], Takuya Iida[1]
[1]Osaka Prefecture University, [2]Chiba University

Using the simulation method to solve the thermo-fluid dynamics of molten metal under laser heating, we found the Marangoni effect can contribute to the needle formation in the optical vortex laser processing.

[OMC-6] 15:30-17:00
OMC-6
Chair: Ryuji Morita
Hokkaido University

OMC-6-01 15:30

Detection of the transverse spin of light by twisting anisotropic particles near an optical nanofiber waveguide

Georgiy Tkachenko[1], Ivan Toftul[2], Alexey Vylegzhanin[1], Viet Giang Truong[1], Mihail Petrov[2], Sile Nic Chormaic[1]
[1]Okinawa Institute of Science and Technology, [2]ITMO University

We report on a direct optomechanical detection of the transverse spin angular momentum of light by spinning an anisotropic microparticle in the evanescent field near a single-mode optical nanofiber waveguide.

OMC-6-02 15:45

Electromagnetic near-field responses of a chiral molecule on a metal surface

Hikaru Yoneji[1], Nobuhiko Yokoshi[1], Hajime Ishihara[1,2]
[1]Osaka Prefecture University, [2]Osaka University

We developed a generalized discrete dipole approximation method that treats both electric and magnetic polarizations simultaneously and investigated near-field electric and near-field magnetic fields for a single achiral/chiral molecule in the vicinity of gold nanostructures.

OMC-6-03 16:00 ***Invited***

Non-equilibrium Properties of an Active Nanoparticle in a Harmonic Potential

Falko Schmidt[2], Giovanni Volpe[2], Hana Sipova-Jungova[3], Mikael Käll[3], Alois Wurger[1]
[1]The University of Bordeaux, [2]University of Gothenburg, [3]Chalmers University

We study active gold nanoparticles in a near-critical water-lutidine mixture, heated and trapped by a focussed laser beam. As their mean free path becomes comparable to the trap radius, we observe a non-equilibrium probability density, differing signficantly from the Boltzmann distribution. The particles show orbital motion in the trap and dynamical polarization, that is, their position in the trap and the orientation of their active axis are correlated.

OMC-6-04 16:30 ***Invited***

Hydrodynamic micro manipulation on an optical tweezers platform

Une Butaite[1], David Phillips[1], Jonathan Taylor[2], Graham Gibson[2], Ying-Lung Ho[3], Mike Taverne[3]
[1]University of Exeter, [2]University of Glasgow, [3]University of Bristol

While extremely useful, optical tweezers are nonetheless limited by the types of materials that they can trap, and can be harmful for living organisms. In our work we propose a new platform where optically trapped micro-rotors immersed in water act as fluid impellers to facilitate real-time feedback control of any freely diffusing particle.

OMC

Thursday, 22 April

[OMC-7] 9:00-10:30
OMC-7
Chairs: Kyoko Kitamura
Kyoto Institute of Technology
Takashige Omatsu
Chiba University

OMC-7-01 9:00 ***Invited***

Optical fiber-based traps for particle trapping and manipulation
Sile Nic Chormaic
Okinawa Institute of Science and Technology Graduate University
Optical traps using optical fibers facilitate the trapping and characterization of different particles. We will introduce several configurations and illustrate the variety of measurements that can be made.

OMC-7-02 9:30

Optical trapping of nanoparticles suspended in water with a bull's eye-type plasmonic chip
Takashi Koizumi[1], Tomoya Nagasue[2], Keiko Tawa[2], Chie Hosokawa[1]
[1]Osaka City University, [2]Kwansei Gakuin University
We demonstrate surface plasmon resonance (SPR) based optical trapping of quantum-dot (QD) nanoparticles suspended in water with a bull's eye-type plasmonic chip. The particle dynamics of QD suspensions at the laser focus was evaluated by fluorescence correlation spectroscopy.

OMC-7-03 9:45

Tapered glass capillaries for the optical manipulation and sorting of nanoparticles: practical considerations
Christophe Pin, Ryohei Otsuka, Keiji Sasaki
Hokkaido University
Optical sorting techniques based on tapered glass capillaries are studied. Optical transport and sorting of fluorescent nanodiamonds based on their size is demonstrated. Methods to improve light-guiding properties and prevent uncontrolled liquid flow are discussed.

OMC-7-04 10:00

Deformation of Optical Vortex Beam by Off-axis Incident-beam from Spiral Phase Plate Center
Miki Kitazawa, Kyoko Kitamura, Shogo Ura
Kyoto Institute of Technology
An optical vortex beam (OVB) is obtained when a Gaussian beam is transmitted through an appropriately designed spiral phase plate (SPP). The OVB can be deformed by displacements of the optical axis of the incident Gaussian beam from the center of the SPP. We calculated the deformation of OVB using theoretical simulations and discussed the results. These results are important for fabrication of a SPP integrated laser.

OMC-7-05 10:15

Abrupt U-turn of the dielectric particle by anti-parallel fiber optic Bessel beams
Yoon juwon
The University of Yonsei
We suggest a new way of using Bessel beams to achieve n-dimensional optical control of high-refractive index microparticles. The non-diffractive property of this beam, the beam diameter is much longer than that of a general Gaussian beam and has a self-healing property that suppresses the deformation of the beam.

[OMC-8] 11:15-12:00
OMC-8
Chair: Christophe Pin
Hokkaido University

OMC-8-02 11:15

Acousto-optic annular beam shaping for optical traps and lattices
Dmitry V. Obydennov [1,2], Konstantin B. Yushkov[1], Vladimir Ya. Molchanov[1]
[1]National University of Science and Technology MISIS, [2]Lomonosov Moscow State University
We propose a novel concept of using a noncollinear AOTF as a spatial beam shaping device for programmable laser beam shaping. The AOTF transfer function symmetry is used to provide a ring-shaped field distribution.

OMC-8-03 11:30 ***Invited***

Environmental sensing with structured beams
Martin Philip John Lavery[1], Zhaozhong Chen[1], Mingjian Chen[2], David McKee[3], Alison Yao[3]
[1]University of Glasgow, [2]Xidian University, [3]University of Strathclyde
We will present an overview of research progress in the application of the novel optical interactions of spatially structured optical modes for environmental sensing, leading to increased measurement sensitivity of suspended particulates and environmental properties.

[OMC-9] 13:30-15:00
OMC-9
Chair: Yoko Miyamoto
The University of Electro-Communications

OMC-9-01 13:30 ***Invited***

Observation of the Dyakonov surface wave mode propagating at a hyperbolic metasurface at the visible frequency
Jingbo Sun, Yan Li, Yongzheng Wen, Ji Zhou
School of materials science and engineering Tsinghua University
We experimentally demonstrate the Dyakonov surface wave mode at visible frequency in a hyperbolic metasurface, which is highly directional and lossless, and has significant applications in two-dimensional photonic circuits and devices.

OMC-9-02 14:00

Incoherent Optical Tweezer on a Nanostructured Rare Metal
Sayaka Hashimoto, Ryota Takao, Ken-Ichi Yuyama, Tatsuya Shoji, Yasuyuki Tsuboi
Osaka City University
We demonstrate a technique of stable optical trapping of submicron polymeric beads on nanostructured rare metal surfaces (RMS) without the use of lasers. Fluorescent polymer beads with diameter $d = 20 – 500$ nm were successfully trapped on the nanostructured RMS by low-intensity focused illumination of incoherent light at λ =370 m from a Hg lamp.

OMC-9-03 14:15

Optical properties of semiconductor microspheres fabricated via laser ablation in superfluid helium
Yosuke Minowa, Tomoki Nagao, Masaaki Ashida
Osaka University
We fabricated semiconductor microspheres via pulsed laser ablation in superfluid helium. We demonstrated that the microspheres with voids can have a high-quality-factor whispering gallery mode if the void is positioned near the microsphere's center.

OMC-9-04 14:30

Autonomous vibration of a luminescent thin film arising from luminescence-induced optical force
Hideki Arahari[1], Hajime Ishihara[1,2]
[1]Osaka Prefecture University, [2]Osaka University
We propose an unconventional type of optical manipulation by luminescence-induced optical force (LiOF). Designing the dielectric environment surrounding materials, the LiOF can be generated. Here, we demonstrate that LiOF autonomously drives the motion of materials.

OMC-9-05 14:45

Accelerating Bessel-like beam
Hyeung Joo Lee, Hyeonwoo Lee, Kyunghwan Oh
Yonesei University
Optical tweezing technology is used for versatile micro-nano particle manipulations. For trajectory control, a variety of self-accelerating beams with bending trajectory have been investigated. However, because of their imperfection of low curvature in microscopic environment, we devised new all-fiber self-accelerating Bessel-like beam generator enhanced with high curvature. This research would contribute to living cell or micro particle manipulation.

[OMC-10] 15:30-17:00
Ashkin & Saenz Memorial
Chair: Takashige Omatsu
Chiba University

OMC-10 15:30

Panel Discussion

OMC-Closing 16:50

Closing Remarks

OMC

Poster (Live Poster Session: Thu. 22 April, 12:30-13:30)

[OMC-P]
Poster Session

OMC-P-01

Synthesis of ring-shaped Ag-Pt nanoparticles for the application to plasmon-enhanced electrocatalysts

Tatsuya Kameyama[1,2], Naoki Ota[1], Kosuke Sasamoto[1], Tsukasa Torimoto[1]
[1]Nagoya University, [2]JST-PRESTO

Ring-shaped Ag-Pt nanoparticles (NRs) showing an LSPR peak were prepared via galvanic replacement of Ag nanoplates with H_2PtCl_6. The intensity and wavelength of the peak was controllable by changing the chemical composition of the NRs. The Ag-Pt NRs exhibited an electrocatalytic activity for oxygen reduction reaction, which was enhanced by the photoexcitation of LSPR.

OMC-P-02

Design of AlN-subwavelength grating for deep ultraviolet wavelength reflector operating at 244 nm of wavelength

Yuusuke Takashima[1,2], Atsuki Sasada[1], Kentaro Nagamatsu[1,2,3], Masanobu Haraguchi[1,2,3], Yoshiki Naoi[1,2,3]
[1]Faculty of Science and Technology, Tokushima University, [2]Graduate School of Technology, Industrial and Social Science, Tokushima University, [3]Institute of Post-LED Photonics, Tokushima University

Highly reflective reflector (> 99.9%) operating at deep ultraviolet (DUV) wavelength region around 244 nm was proposed by using subwavelength grating (SWG) patterned AlN substrate.This extremely high reflectivity, polarization selectivity and compactness of our AlN-SWG are very useful for various DUV applications, such as cavity of DUV laser diodes.

OMC-P-03

An improved phase retrieval method in holographic data storage based on embedded encoding

changyu yu[1], S. Wang[1], Ruixian Chen[1], Jianying Hao[1], Qijing Zheng[1], Jinyu Wang[1], Xianying Qiu[1], Dakui Lin[1], Yi Yang[1], Hui Li[1,3], Xiaodi Tan[2], Xiao Lin[1]
[1]Fujian Normal University, [2]Fujian Provincial Key Laboratory of Photonics Technology, Fuzhou, [3]Fujian Provincial Engineering Technology Research Center of Photoelectric Sensing Application,Fuzhou

This paper proposes to use embedded data to improve the intensity of high-frequency information in the Fourier intensity distribution, thereby improving noise immunity. In simulation, the convergence speed of BER (the bit error rate) is faster under the same number of iterations.

OMC-P-04

Phase retrieval by aberration compensation in holographic data storage

Suping Wang[1], Changyu Yu[1], Ruixian Chen[1], Jianying Hao[1], Qijing Zheng[1], Jinyu Wang[1], Xianying Qiu[1], Dakui Lin[1], Yi Yang[1], Hui Li[1,3], Xiao Lin[1], Xiaodi Tan[2]
[1]Fujian Normal University, [2]Fujian Provincial Key Laboratory of Photonics Technology, Fuzhou, [3]Fujian Provincial Engineering Technology Research Center of Photoelectric Sensing Application, Fuzhou

In this paper, we mainly study the influence of spherical aberration on phase transformation. By establishing the light field with wavefront aberration, we study the influence of wavefront aberration on phase recovery and propose the image restoration algorithm for aberration compensation .The feasibility of the theory is proved.

OMC-P-05

Electrochromic performance of an all-solid-state ITO/WO_3/Li-NbO_3/V_2O_5/ITO electrochromic device deposited by magnetron sputtering

RI-JUN Li, Hsi-Chao Chen, Yu-Hung Yen, Tan-Fu Liu, Bo-Jun Guo, Chi-Yang Lai, Chu-Han Huang
National Yunlin University of Science and Technology

The proposal of the research was used vanadium pentoxide (V_2O_5) as an auxiliary discoloration layer was deposited by magnetron sputtering with different oxygen flow, and the cycle durability and transmittance variation were investigated using a spectrophotometer.

OMC-P-06

Collinear non-interferometric phase retrieval holographic data storage with single reference pixel

Qijing Zheng[1], Xianying Qiu[1], Jianying Hao[1], Ruixian Chen[1], Changyu Yu[1], Suping Wang[1], Kun Wang[1], Yi Yang[1], Dakui Lin[1], Hui Li[1,2], Xiao Lin[1], Xiaodi Tan[1,3]
[1]Fujian Normal University of China, [2]Fujian Provincial Engineering Technology Research Center of Photoelectric Sensing Application, [3]Fujian Provincial Key Laborator y of Photonics Technology

A method for collinear non-interferometric phase retrieval holographic data storage using a single reference pixel is proposed. Increasing the intensity of the reference beam can achieve phase retrieval using only one reference pixel. As the intensity of the reference beam becomes stronger within a certain range, the number of iterations gradually decreases.

OPTM

Tuesday, 20 April

[OPTM-1] 15:30-17:00
OPTM Session 1
Chair: Yukitoshi Otani
Utsunomiya University

OPTM-1-01 15:30

Openning remarks
Yukitoshi Otani[1], Toru Yoshizawa[2], Takashi Hatsuzawa[3], Rainer Tutsch[4]
[1]Utsunomiya University, [2]NPO 3D association, [3]Tokyo Insitute of Technology, [4]Technische Universität Braunschweig

OPTM-1-02 15:45 *Invited*

Single pixel imaging and its applications
Kouichi Nitta
Kobe University
In this presentation, the principle of SPI is explained. In the SPI, two dimensional spatial modulation for optical signals is an important operations. A procedure for renewal of the modulation has been proposed. This procedure with spatial pattern shift is suitable for a some specific implementation based on SPI. Especially, it is useful for imaging of a target moving at a constant velocity. This procedure is introduced and usefulness of it is discussed.

OPTM-1-03 16:15

Ghost Imaging with Probability Estimation Using Convolutional Neural Network - Improving Estimation Accuracy Using Parallel Convolutional Neural Network -
Shoma Kataoka, Yasuhiro Mizutani, Tsutomu Uenohara, Yasuhiro Takaya
Osaka University
Deep learning ghost imaging (DLGI) is a method to obtain high-quality images from images obtained by ghost imaging with fewer measurements. We improved the accuracy of DLGI by parallelizing the convolutional layers.

OPTM-1-04 16:30

Time of flight three-dimensional imaging camera using temporal compressive sampling technique
Quang Duc Pham[1,2], Yoshio Hayasaki[3]
[1]National Center for Technological Progress Vietnam, [2]Vietnam Institute of Science Technology and Innovation, [3]Utsunomiya University Center for Optical Research and Education
A new type camera constructed by an active light source and a high frame rate imaging sensor was introduced. The intensity of the light encoded by the compressive sensing technique and a gigahertz range carrier wave generator was illuminated the object. The waveform of the carrier wave can be reconstructed with few frames by the compressive sensing technique. Resultantly, 3D image of the object was extracted from the phase of the carrier wave in very short time.

OPTM-1-05 16:45

On the possibility of visualization of relief of rough surfaces via laser induced thermal emission
Kateryna Zelenska[1], Olga Tkach[2], Serge Zelensky[2], Olexandr Kolesnik[2], Toru Aoki[1]
[1]Research Institute of Electronics, Shizuoka University, [2]Faculty of Physics, Taras Shevchenko National University of Kyiv
Computer simulation is performed for pulsed laser heating of a surface with submicrometer-sized truncated-cone-shaped peaks and holes. Transient temperature field is calculated, and the visual appearance of the surface roughness elements is modeled with the laser-induced thermal emission.

Wednesday, 21 April

[OPTM-2] 9:00-10:15
OPTM Session 2
Chair: Masaki Michihata
The Univesity of Tokyo

OPTM-2-01 9:00 *Invited*

Preparation of Luminescent Si Nanocrystals from Rice Husks
Kimihisa Matsumoto[1], So Ito[1], Kazuhide Kamiya[1], Mitsuru Inada[2], Hidehiro Yasuda[3]
[1]Toyama Prefectural University, [2]Kansai University, [3]Osaka University
Luminescent Si nanocrystals were prepared from rice husks and the optical properties and structure analysis were studied. By the transmission electron microscope observation of the Si powder from rice husks, aggregates that are composed of Si nanoparticles with crystalline structure were confirmed. Room temperature PL with near infrared-red regions were observed from the Si nanocrystals.

OPTM-2-02 9:30

Simulation Study on Diameter Measurement Technique for Submicrometer-sized Tapered Fibers with Standing Wave Illumination
Sojiro Murakami[1], Shotaro Kadoya[2], Masaki Michihata[1], Satoru Takahashi[2]
[1]School of Engineering, Department of Precision Engineering, The University of Tokyo, [2]Research Center for Advanced Science and Technology, The University of Tokyo
In this research, we propose an in-process measurement method of the diameter of sub-micro-optical fiber such as a tapered optical fiber. The proposed technique is based on analyzing optically scattered light generated by standing wave illumination. From the result of numerical simulation based on finite element method (FEM), it was revealed that the optical fiber of 100 nm in diameter can be evaluated with the standing wave illumination.

OPTM-2-03 9:45

Shape Control Using Hologram-Assisted Talbot Lithography
Naoki Ura[1], Yasuhiro Mizutani[1], Ryu Ezaki[1], Tsutomu Uenohara[1], Yoshihiko Makiura[2], Yasuhiro Takaya[1]
[1]Osaka University, [2]Kurabo Industries Ltd.
To improve the processing flexibility of Talbot lithography, we studied the learning of CNN to improve the accuracy of the method to control the period of the structure by hologram-assisted Talbot lithography.

OPTM-2-04 10:00

Hologram optimized in holographic laser processing system
Honghao Zhang[1], Satoshi Hasegawa[1], Haruyoshi Toyoda[2], Yoshio Hayasaki[1]
[1]The university of Utsunomiya, [2]Central Research Laboratory, Hamamatsu Photonics K.K.
We proposed an optimization method of a hologram in holographic laser processing. This method provides the holographic laser processing system with high-stability, that is, the ability to dynamically compensate for system imperfections, and has the ability to be suitable for a wide range of high-precision, high-throughput applications in the field of 3D manufacturing.

[OPTM-3] 11:00-12:00
OPTM Session 3
Chair: Motoharu Fujigaki
University of Fukui

OPTM-3-01 11:00 *Invited*

3D profile measurement of openings with optical caliper
Lianhua Jin[1], Takuma Ashizawa[1], Toru Yoshizawa[2]
[1]University of Yamanashi, [2]NPO 3D Associates
We developed an optical caliper for measurement of 3D profiles of openings. It consists of a disk beam generator and a camera. The 3D inner profile of an art craft was measured with this system.

OPTM-3-02 11:30

Modeling the dynamic optical gain in a 3D printed waveguide due to polymer swelling
Kunal Sharma[1], Waleed S Mohammed[2], Tanujjal Bora[1]
[1]Asian Institute of Technology, [2]Bangkok University
A theoretical model is developed to study the dynamic optical gain in the transmitted optical power through a 3D printed photopolymer waveguide. The developed model shows that the solvent molecules diffused in the photopolymer and develops a swelling layer that acts as cladding. The formation of the cladding layer results in a reduction of surface scattering losses and an increase in the transmitted optical power.

OPTM-3-03 11:45

Single-step fabrication of microfiber long period grating structure through a modulated arc discharge process
Mohammad Javad Khodarahmi[2], Pedram Hosseini[1], Mohmmad Kazemzadeh[2], Hamidreza Karimi-Alavijeh[2]
[1]Polytechnic University of Turin, [2]The University of Isfahan
We present a novel approach to fabricate optical microfiber long period grating (MF-LPG) structures through a single-step technique. This method is based on heating and pulling single-mode fiber optics via a modulated arc discharge process.

[OPTM-4] 13:30-15:00
OPTM Session 4
Chair: Lianhua Jin
University of Yamanashi

OPTM-4-01 13:30 *Invited*

Noise floor comparison of optical displacement measuring interferometer between air and vacuum environments
Masato Aketagawa[1], Kousuke Sakasai[1], Masato Higuchi[1], Dong Wei[1], Thanh Dong Nguyen[2]
[1]Nagaoka University of Technology, [2]Hanoi University of Science and Technology
In this presentation, we discuss noise floor comparisons of an optical displacement measuring interferometer between air and vacuum environments. A heterodyne interferometer and its phasemeter, with the resolution of 10-6 radian, implemented in a field programmable gate array (FPGA) are utilized for the comparison. A heterodyne laser source consists of a frequency stabilized He-Ne laser and two acoustic optic modulators (AOMs).

OPTM

Wednesday, 21 April

OPTM-4-02 14:00

Radius measurement of large aperture long-focal-length lens using computer-generated hologram

Jian-Peng Cui, Zhi-Gang Li, Zhen-Jun Bao, Heng Zhao, Ning Zhang, Jie Liu, Di-Long Wu, Hua Xu, Ping Ma
Chengdu Fine Optical Engineering Research Center

In this paper, we will present a method of using 450 mm × 450 mm transmission computer-generated hologram (CGH) to measure the radius of curvature of 440 mm × 440mm large aperture long-focal-length lens.

OPTM-4-03 14:15

Out-of-plane displacement measurement using laser parallel fringes generated in camera with diffraction grating

Wei Jiang, Takuya Hara, Motoharu Fujigaki
University of Fukui

For measuring out-of-plane displacement with phase analysis method, a diffraction grating was used to generated laser parallel fringes in a camera. A green laser, a diffraction grating and an industrial camera were used as experimental devices. Phase difference was calculated by images before and after displacement. Laser parallel fringes can be generated in a camera and displacement was successfully measured.

OPTM-4-04 14:30 *Invited*

Optically smooth and optically rough surfaces in 3D profilometry

Pavel Pavlicek
Palacky University Olomouc

The operation of optical 3D measurement methods depends on whether the measured surface is optically smooth or rough. We present an analysis on which conditons the surface is classified as one or the other.

[OPTM-5] 15:30-17:00
OPTM Session 5
Chair: Kazuhide Kamiya
Toyama Prefectural University

OPTM-5-01 15:30 *Invited*

Mid-infrared (LWIR) Hyperspectral camera for on-site analysis

Ichiro Ishimaru
Kagawa University

For on-site analysis in the remote world, we proposed 3 kinds of Fourier transform spectroscopic imager whose optical configuration were the near-common-path phase-shift interferometer. And to measure suspending solutions and biological samples without preparations like smart toiles and non-invasive blood glucose sensors, we proposed 2 types of the ultrasonic-assisted spectroscopy.

OPTM-5-02 16:00 *Invited*

Fringe Projection Method for 3D Shape Measurement Using Linear LED Device and Cylindrical Lens Array

Motoharu Fujigaki, Takuya Hara
University of Fukui

Recently, it is required to improve the fringe projection device to develop a compact and fast 3D shape measurement. In this study, a fringe projection method using a linear LED device and a cylindrical lens array to improve the LSSM is proposed. In the case of a conventional light-source-stepping method, the half of the emitted power is wasted at the grating plate.

OPTM-5-03 16:30

The FDTD analysis for diffraction limited microgroove structure with standing wave illumination for the realization of coherent structured illumination microscopy

Yizhao Guan[1], Masahiro Kume[1], Shotaro Kadoya[2], Masaki Michihata[2,1], Satoru Takahashi[2]
[1]Department of Precision Engineering, The University of Tokyo, [2]Research Center for Advanced Science and Technology (RCAST), The University of Tokyo

In this research, the depth measurement of microgroove structures with coherent Structured Illumination Microscopy (SIM) is studied. FDTD analysis is applied for observing the near-field response of microgroove narrower than the diffraction limit under the standing-wave illumination. The near-field phase shows depth dependency in this analysis.

OPTM-5-04 16:45

Resolution evaluation of displacement measuring interferometer with sinusoidal phase modulation and modified phase-locked loop

Masato Higuchi, Tomohiro Sowa, Dong Wei, Masato Aketagawa
Nagaoka University of Technology

A resolution evaluation of displacement measuring interferometer using a sinusoidal phase modulation (SPM) and a modified phase-locked loop (PLL) is discribed in this presentation. Displacement measuring interferometer with frequency stabilized light source has advantages of high resolution and traceable to the definition, and the combination of the SPM and modified PLL is one of the interpolation methods.

Thursday, 22 April

[OPTM-6] 9:00-10:30
OPTM Session 6
Chair: Nathan Hagen
Utsunomiya University

OPTM-6-01 9:00 *Invited*

Fourier Demodulation Approach for a Rotating Polarizer Analyzer Polarimeter for Retardance Measurements

David Ignacio Serrano Garcia, Francisco Joel Cervantes Lozano, Geliztle Alejandra Parra Escamilla, Jorge L. Flores Nuñez, Guillermo Garcia Torales
University Center of Exact Sciences and Engineering (CUCEI) - Electronics Department - University of Guadalajara

We present a demodulation approach for a rotating polarizer-analyzer polarimeter dedicated to retardance measurements. Through the Mueller matrix approach and the theoretical Fourier transform, we developed a demodulation algorithm considering the two linear polarizers' initial orientation as calibration. We present experimental results showing the feasibility of our proposal.

OPTM-6-02 9:30

RGB full Stokes imaging by color polarization cameras

Yukitoshi Otani, Shuhei Shibata, Nathan Hagen
Utsunomiya University

RGB full Stokes imaging by color polarization cameras

OPTM-6-03 9:45

Large scale thin film thickness uniformity extraction based on dynamic spectroscopic ellipsometry

Gukhyeon Hwang, Sukhyun Choi, Vamara Dembele, Saeid Kheiryzadehkhanghah, Inho Choi, Chung Song Kim, Daesuk Kim
Jeonbuk National University

This paper describes a new approach for large-scale thin film thickness mapping based on dynamic spectroscopic ellipsometry. The proposed system can provide a real time thin film uniformity measurement capability with high precision. We expect the proposed scheme can be applied for various large-scale thin film deposition process applications such as roll to roll manufacturing where real time process uniformity monitoring becomes crucial.

OPTM-6-04 10:00 *Invited*

Spectroscopic polarization measurement and control using channeled spectrum

Kazuhiko OKA[1], Keisaku YAMANE[2], Moritsugu SAKAMOTO[3], Ryuji MORITA[2]
[1]Hirosaki University, [2]Hokkaido University, [3]Nagaoka University of Technology

Polarization measurement and control using channeled spectrum has several unique features and useful for various spectroscopic instruments. Its basic features and several applications are described in this presentation.

[OPTM-7] 11:00-12:00
OPTM Session 7
Chair: Kazuhiko Oka
Hirosaki University

OPTM-7-01 11:00 *Invited*

Extended range dynamic calibration for channeled spectropolarimetry

Nathan Hagen[1], Benjamin D. Chrysler[2]
[1]Utsunomiya University, [2]University of Arizona

We show how to extending the temperature range of channeled spectropolarimetry's dynamic calibration method to handle virtually all practical scenarios. This is demonstrated by running a channeled spectropolarimeter continuously over a temperature change of 40 degC, achieving stable reconstruction of the spectrally-resolved polarization state over this entire range.

OPTM-7-02 11:30

Ellipsometric characterizations of individual nanoform structures

Tim Kaeseberg[1], Jana Grundmann[1], Sven Teichert[1], Matthias Wurm[1], Thomas Siefke[1,2], Stefanie Kroker[1,3], Bernd Bodermann[1]
[1]Physikalisch-Technische Bundesanstalt Braunschweig, [2]Institute of Applied Physics, Abbe Center of Photonics, Friedrich-Schiller-Universität Jena, [3]Laboratory for Emerging Nanometrology, Technische Universität Braunschweig

We constructed an imaging Mueller matrix ellipsometer for measurements in both transmission and reflection. Additionally, we designed, fabricated, and characterized nanostructures with simple shapes to examine the link between Mueller matrix elements and geometrical features.

OPTM-7-03 11:45

Optical and Anisotropic Stress Properties of Flexible $(Ta_2O_5/SiO_2)^2$ Anti-reflection Film Deposited by E-gun Evaporation with Ion-beam Assisted Deposition

Kun-Hong Chen, Chen Hsi Chao, Chen Sheng Bin, Chen Guan Yu, Wu Tsung Tse, Kuo Chou Kai
National Yunlin University of Science and Technology

The research proposal was used tantalum pentoxide (Ta_2O_5) and silicon dioxide (SiO_2) as the high and low refractive index for the multilayer anti-reflection (AR) films were deposited on a flexible polyethylene terephthalate (PET) by electron-beam evaporator with ion-beam assisted deposition (IAD). The optical and stress properties of these multilayer $(Ta_2O_5/SiO_2)^2$ films were investigated.

OPTM

Poster

[OPTM-P]
Poster Session

OPTM-P-01

Calibration of the astigmatism errors induced by misalignment of quadri-wave lateral shearing interferometer

Yiwei Si, Ke Liu, Yanqiu Li, Peng Qin, Hui Zhong
Beijing Institute of Technology

In this paper, the astigmatism errors induced by misalignment of quadri-wave lateral shearing interferometer are analyzed using the optical wave interference and wavefront reconstruction theory. This paper can provide technical support for the alignment of QWLSI with small shearing ratio and high precision.

OPTM-P-02

Quality Map guided parallel Phase unwrapping algorithm for multi-lateral shearing interferometry

Liang Wang, Ke Liu, Yanqiu Li
Beijing Institute of Technology

The quality map guided algorithm is a reliable algorithm in the phase unwrapping of two-dimensional interferogram. In this paper, the computer unified device architecture (CUDA) programming platform is used to realize the parallel processing of the phase derivative variance map, the maximum phase gradient map, and the pseudo-correlation quality map, in order to improve the speed of phase unwrapping.

OPTM-P-03

Fast calibration for Star test polarimetry via polarization orthogonal basis mapping

Tianlei Ning, Guodong Zhou, Jiazhi Wang, Yanqiu Li
School of Optics and Photonics, Beijing Institute of Technology

This paper develops a fast calibration method for Star test polarimetry by measuring three intensity distribution of orthogonal polarization state and an intensity distribution of left-handed circular polarization to rapidly calibrate the theoretical model.

OWPT

Monday, 19 April

[OWPT-1] 13:45-15:00
OWPT Session 1
Chairs: M. Matsuura
UEC
T. Maruyama
Kanazawa Univ.

OWPT-Opening 13:45

Opening Remarks

OWPT-1-01 14:00 *Invited*

Novel Low-cost Fabrication Method (H-VPE) of III-V Photovoltaic Devices
Yasushi Shoji
National Institute of Advanced Industrial Science and Technology (AIST)
Hydride vapor phase epitaxy (HVPE) has received attention as a low-cost fabrication method for III-V solar cells, an alternative to MOVPE. The low epitaxial cost can be realized because of the use of group-III precursors generated through high-efficiency reactions involving less expensive pure metals and HCl gas. In this presentation, we report the performances of III-V solar cells grown by HVPE.

OWPT-1-02 14:30

Responses of Typical Photovoltaic Cell to Dual Laser Irradiation
Rui-Ting Chang[1,2], Cong Liu[1,2], Chen-Guang Huang[1,2], Chen-Wu Wu[1]
[1]Institute of Mechanics, Chinese Academy of Sciences, [2]School of Engineering Science, University of Chinese Academy of Sciences
The responses of typical photovoltaic (PV) cell to dual laser irradiation were investigated for laser power beaming. The limit tests were conducted on the PV cells illuminated simultaneously by continuous wave laser and multi-pulse laser. The failure patterns of the PV cells were characterized by optical microscope and the maximum useful power density were obtained for various combinations of the dual lasers.

OWPT-1-03 14:45

Tapered Redirection Waveguide in Two Dimensionally connected PhotoRecepto-Conversion Scheme (2DPRCS)
Akira Ishibashi, Tsuyoshi Kasai, Nobuo Sawamura
Hokkaido University
Demonstrated is a tapered-waveguide-based example of Two-Dimensionally connected PhotoRecepto-Conversion Scheme (2DPRCS), in which photo-harvesting/photoreception is spatially decoupled from, but two-dimensionally connected to, photoelectric conversion by thin waveguide. The 2DPRCS would serve as a key technology not only for high efficiency solar- cell systems but also for robust optical wireless power transmission or laser power beaming.

[OWPT-2] 15:30-17:00
OWPT Session 2
Chairs: T. Miyamoto
Tokyo Tech
M. Matsuura
UEC

OWPT-2-01 15:30 *Invited*

Free-space Laser Communication Systems
Alexis Kudryashov
Institute of Geosphere Dynamics RAS
This paper presents the advantages and disadvantages of each of these approaches. The results obtained with the use of these systems are presented. Recommendation for achieving higher performance are presented.

OWPT-2-02 16:00

Free Space Optical Link for Simultaneous Power and 1 Gb/s Data Transmission
John Fakidis[1], Henning Helmers[2], Harald Haas[1]
[1]University of Strathclyde, Light Fidelity Research and Development Centre, [2]Fraunhofer Institute for Solar Energy Systems ISE
We study the trade-off between power and data transfer for a two-meter wireless gallium-arsenide laser and photovoltaic link. The use of orthogonal frequency-division multiplexing with adaptive bit and power loading results in a peak data rate of 1041 Mb/s. The photovoltaic receiver is shown to offer simultaneous power harvesting with 41.6% efficiency under the irradiance of 0.3 W/cm^2 and a data rate of 784 Mb/s.

OWPT-2-03 16:15

Charging Requirements and Verification Experiments for the Introduction of Optical Wireless Power-transmission Systems for Smart Devices
Naomi Uchiyama, Hirohito Yamada
Tohoku University
As an example, charging requirements of a portable media player were shown, and a verification experiment was carried out. We also investigated the wavelength of the light source. It was found that it can be charged by storing electricity in an electric double layer capacitor and the power from a solar cell was higher when using near-infrared light than when using visible light.

OWPT-2-04 16:30

Optimization of Dimension and Output Power of the Portable LED-based OWPT System for Compact IoT
Yuhuan Zhou, Mingzhi Zhao, Tomoyuki Miyamoto
FIRST, Tokyo Institute of Technology
Optical wireless power transmission technology, which has advantages like long distance transmission and good directionality, is still at the initial stage. Considering the relatively loose regulation and other merits, researching on LED-based OWPT system is imperative. In this research, LED-based OWPT system has been optimized in two directions, the dimension and output power.

OWPT-2-05 16:45 *Plenary*

The Road Towards Zero-Energy Gigabit Wireless Transceivers
Harald Haas
University of Strathclyde
We demonstrate that it is possible to simultaneously transfer power and receive high-speed digital data using the same photovoltaic (PV) cell. Different PV technologies are reviewed in this context and potential use cases are highlighted. The proposed dual use of PV cells has the potential to play a major role towards net-zero wireless networks, while enabling the continuous growth in the number of connected devices, data rate performance and coverage to mitigate the digital divide.

Tuesday, 20 April

[OWPT-3] 9:00-10:30
OWPT Session 3
Chairs: S. Uchida
Chiba Inst. Tech.
T. Takeuchi
Meijo Univ.

OWPT-3-01 9:00 *Invited*

Power and Spectral Range Options for Optical Power Converter Products
Simon Fafard
Broadcom
High-performance Optical Power Converters (OPCs) enable more applications at new wavelengths and higher output powers. Broadcom's patented VEHSA multi-junction OPCs exhibit high-efficiency conversion at manageable external loads. This paper reviews how we extended the power outputs from 600mW to 2W and higher, and how the spectral range options extend from the 800-830nm range to other key laser diode wavelengths such as 980nm and 1500nm.

OWPT-3-02 9:30 *Invited*

GaN-based Solar Cells and their Application to Optical Wireless Power Transmission System
Makoto Miyoshi
Nagoya Institute of Technology
To consider the application of GaN-based solar cells to the optical wireless power transmission system, their photovoltaic performance was evaluated under monochromatic light irradiations. The results predicted that their power conversion efficiency can reach to 60% or higher with a high-power light irradiation, an anti-reflection coating and the suppression of carrier recombination processes.

OWPT-3-03 10:00

Fabrication and Characterization of GaP Based Photovoltaic Devices for Short Wavelength Range Optical Wireless Power Transmission
Masakazu Arai, Akira Kushiyama, Koji Maeda
University of Miyazaki
We fabricated two types of GaP photovoltaic devices with different electrode shape and passivation and evaluated the characteristics. We successfully confirmed high open circuit voltage as high as 1.74 V under blue laser irradiation.

OWPT-3-04 10:15

Non-Uniform Illumination Impacts on O-Band InGaAsP and Metamorphic GaInAs Photonic Power Converters
Meghan Nicole Beattie[1], Henning Helmers[2], Christopher E. Valdivia[1], David Lackner[2], Oliver Höhn[2], Karin Hinzer[1]
[1]SUNLAB, Centre for Research in Photonics, University of Ottawa, [2]Fraunhofer Institute for Solar Energy Systems ISE
Single-junction photonic power converters designed for operation in the telecommunications O-band are measured under 1319-nm laser illumination with a range of beam diameters. Device performance is found to improve as the illumination becomes more uniform. Two absorber materials are evaluated in this study, InGaAsP lattice-matched to InP and metamorphic GaInAs on lattice-mismatched GaAs with maximum efficiencies of nearly 53% and 49% respectively.

[OWPT-4] 15:30-17:00
OWPT Session 4
Chairs: A. Ishibashi
Hokkaido Univ.
T. Yamaguchi
Kogakuin Univ.

OWPT-4-01 15:30 *Invited*

Industrial Advancement of III/V Metamorphic Technology for High Efficiency Infrared Laser Power Converters
Victor Khorenko, Gregor Keller, Thorsten Wierzkowski
AZUR SPACE Solar Power GmbH
III/V semiconductors structures enable optical power converters for the infrared spectral range 800-1550 nm. For wavelengths <860 nm, GaAs is the material of choice whereas larger wavelengths need metamorphic InGaAs. The use of cost-efficient Ge substrates instead of GaAs or InP is the key for making LPCs affordable for volume applications. We successfully demonstrate this approach on 975 nm LPCs with an efficiency of 60% comparable to AZUR's 810-830 nm LPCs.

OWPT-4-02 16:00

Design of AlGaAs Laser Power Converters for the First Transmission Window
Marina Delgado Romero[1,2], Iván García Vara[1,2], Carlos Algora Del Valle[1,2]
[1]Technical University of Madrid, [2]Instituto de Energía Solar
We analyze the potential of increasing the bandgap using AlGaAs to minimize the energy difference between 808 nm wavelength photons and the GaAs bandgap energy. The optimum aluminum content is 7% reaching a maximum ideal efficiency of 77% at 50 W/cm^2.

OWPT-4-03 16:15

Target Recognition for Outdoor Optical Wireless Power Transmission Using Solar-Blind Deep UV LED marker
Shota Sato, Sicheng Lu, Alexander William Setiawan Putra, Takeo Maruyama
The University of Kanazawa
In optical wireless power transmission (OWPT) using camera to recognize the target. Target marker for recognition is one of the important elements. In this research, solar-blind deep UV LED is proposed as the target marker for outdoor OWPT system and the operational distance is calculated to be around 100 m. The Result means that it can potentially be used for long distance OWPT system.

OWPT-4-04 16:30 *Invited*

Optical Wireless Power at Eye-safe Wavelengths: Challenges and Opportunities
Stephen J Sweeney, Timothy D Eales, Scott D Jarvis, Jayanta Mukherjee
University of Surrey
The potential of optical wireless power in a multitude of applications has led to a strong growth in the development of technologies to support it. However, it has also led to a strong need to develop eye-safe approaches with high efficiency. In this paper we describe some of the technical challenges associated with developing optical wireless power technologies at eye-safe wavelengths.

OWPT

Wednesday, 21 April

[OWPT-5] 9:00-10:30
OWPT Session 5
Chairs: H. Yamada
Tohoku Univ.
T. Tayagaki
AIST

OWPT-5-01 9:00 ***Special***

Augmenting the Performance of Microwave Wireless Power Networks by Incorporating Metasurface-Based Mesh Nodes
Chris Davlantes
Reach Labs
Conventional microwave wireless power networks struggle to serve many devices at long distances simultaneously while maintaining a high power transfer efficiency to every node in the network. By adopting a mesh architecture enabled by adaptive metasurfaces, this work overcomes the limitations of prior WPT networks and provides a compelling avenue for further research. Theoretical calculations and simulations are presented.

OWPT-5-02 9:30 ***Invited***

Power Beaming and Space Applications
Paul Jaffe
Naval Research Laboratory
Power beaming technology has made significant recent strides in consumer, industrial, and defense sectors. Though proposed for many decades for various space applications, few significant demonstrations of power beaming technology have taken place in space. The scale of envisioned space power beaming applications ranges from those over short distances within spacecraft, medium distances between spacecraft or platforms on celestial bodies, long distances between space and celestial bodies, and very long distances for beamed energy propulsion. Each is explored herein.

OWPT-5-03 10:00 ***Special***

In-wheel Motor EV and Dynamic Charging using Wireless Power Transfer
Hiroshi Fujimoto, Osamu Shimizu
The University of Tokyo
In our laboratory, a second-generation wireless in-wheel motor (W-IWM2) having the capability of dynamic wireless power transfer (D-WPT) on its wheel side has been developed. The D-WPT technology can drastically extend the driving range of electric vehicles. The W-IWM3 is also developed to reduce the size and to increase the power. This talk introduces the development of the W-IWM2 and W-IWM3 with the experimental results.

[OWPT-6] 15:30-17:00
OWPT Session 6
Chairs: K. Ikeda
CRIEPI
M. Kohtoku
Furukawa Electric

OWPT-6-01 15:30 ***Invited***

New Frontiers in III-V Based Photonic Power Converters
Henning Helmers
Fraunhofer Institute for Solar Energy Systems ISE
This paper gives an overview on research and development conducted at Fraunhofer ISE regarding III-V based photovoltaic cells used as photonic power converters (PPC).

OWPT-6-02 16:00

Current Mismatch and Luminescence Coupling in Three-junction Photonic Power Converters with and without Back Reflector
Esther Lopez[1,2], Oliver Höhn[1], Meike Schauerte[1], David Lackner[1], Michael Schachtner[1], S. Kasimir Reichmuth[1], Henning Helmers[1]
[1]Fraunhofer Institute for Solar Energy Systems ISE, Freiburg, Germany, [2]Instituto de Energía Solar – Universidad Politécnica de Madrid, Madrid, Spain
In this work the coupling process efficiency in three-junction photonic power converters based on GaAs/AlGaAs rear-heterojunction subcells is experimentally quantified. A coupling process efficiency of 32 % ± 9 % from top and middle subcells to the limiting bottom subcell is found. Furthermore, it is evidenced how a back reflector affects luminescence coupling of these devices by re-directing photons that are emitted by the bottom subcell towards the upper subcells.

OWPT-6-03 16:15

Power-over-Fiber Smart Sensor Fully-Connected in a Hybrid Fiber/ Power Distribution Cable
Fabio Renato Bassan[1], Joao Batista Rosolem[1], Claudio Floridia[1], Bruno Nogueira Aires[1], Rodrigo Peres[1], Javier Francisco Aprea[2], Carlos Alexandre Meireles do Nascimento[3], Fabiano Fruett[4]
[1]CPQD - Research and Development Center in Telecommunications, [2]IMS Power Quality, [3]CEMIG, [4]Unicamp
This work presents the results of the field tests of an innovative utilization concept for power-over-fiber (PoF) current and voltage sensor. Using optical, optoelectronic, and electrical technology the smart sensor was tested with powering, metering, and data transmission functions performed simultaneously in a 13.8 kV hybrid aerial fiber/power distribution cable of experimental field installation.

OWPT-6-04 16:30 ***Invited***

High Power Single Mode Expanded Beam Fiber Optic Connectors for Power over Fiber Applications
Andrea Tonini, Alfio Cerini, Victor Coggi
Diamond SA
Technologies of high-power single-mode fiber connectors for Power Over Fiber applications are explored.

Thursday, 22 April

[OWPT-7] 9:00-10:30
OWPT Session 7
Chairs: T. Motohiro
Nagoya Univ.
N. Mori
Yamashita Denso

OWPT-7-01 9:00 ***Invited***

Improving Performance Metrics for Power Beaming
Tom Nugent
PowerLight Technologies
System engineering-focused metrics for laser power beaming enables comparisons as systems improve and evolve to field-ready products. This paper defines metrics on efficiency, power density and specific power for laser receivers, and foreign object parameters for active safety sensing, and presents data for each of them. Requirements for use-cases and areas for improvement are described.

OWPT-7-02 9:30 ***Invited***

Longitudinal Current Crowding in High Power Diode Lasers
Jenna Campbell, Michelle Labrecque, Elliot Burke, Kevin McClune, Daniel Renner, Paul Leisher
Freedom Photonics LLC
Longitudinal current crowding (LCC) is a power saturation effect wherein current density becomes unevenly distributed along the cavity length of high power diode lasers resulting in efficiency loss. In this work, we present theoretical modelling and experimental results characterizing the LCC effect, discuss strategies and show results on its mitigation, and report on the role of temperature nonuniformity on LCC. Mitigation of LCC is believed to be a key factor in future power and brightness scaling of diode lasers.

OWPT-7-03 10:00

Improvement of Power Conversion Efficiency of VCSELs by 3D Resistance and Light Absorption Control using Proton Implantation for Use in OWPT
Tomoyuki Miyamoto, Hayato Sakamoto
Tokyo Institute of Technology
Improving the power conversion efficiency (PCE) of VCSELs by 3D control of the carrier concentration, which is the main mechanism of electrical resistance and light absorption, was investigated using proton implantation technique just above the active region. The fabricated VCSELs showed an improvement in PCE of about 1.1 times without a significant deterioration of other characteristics. This technique will be useful to improve the efficiency of OWPT.

OWPT-7-04 10:15

Conversion Efficiency Measurements for Optical Devices Based on Calorimetric Method
Terubumi Saito, Takaki Chiba, Momo Karita, Shigeki Tsuchiya
Tohoku Institute of Technology
Conversion efficiencies of optical devices, both sources and receivers have been measured based on a calorimetric method. To automatize the operation, a negative feedback control circuit to maintain constant temperature by adjusting the electrical power to the heater has been developed and proved to work successfully.

[OWPT-8] 11:00-12:00
OWPT Session 8
Chairs: M. Arai
Univ. of Miyazaki
W. Kubo
TUAT

OWPT-8-01 11:00

Beam Control Stabilization of OWPT System with Recognition Module and its Application to Multiple Light Source OWPT System
Jing Tang, Koji Ueda, Tomoyuki Miyamoto
Tokyo Institute of Technology
Multiple light source systems are attractive to OWPT because of high efficient transmission capabilities. In addition, high functionalities such as selection of efficient transmission paths can be prepared by multiple light sources. In this research, we constructed an OWPT system with improved stability in both recognition and beam control, and demonstrated a system with real time switching.

OWPT-8-02 11:15

Moving Target Position Prediction for Optical Wireless Power Transmission System using Machine Learning
Sicheng Lu, Alexander William Setiawan Putra, Kosuke Imamura, Takeo Maruyama
Kanazawa University
In OWPT system using camera for target recognition, prediction of the next position of target which is captured by the camera is important to ensure that laser can be steered to follow moving target. Machine learning is implemented to predict next position of target on next captured frame. Using machine learning method, 75% improvement for error position has been achieved in simulation compared with linear prediction method.

OWPT-8-03 11:30

Safety System of Optical Wireless Power Transmission by Suppressing Light Beam Irradiation to Human using Camera
MA XiaoJie, Tomoyuki Miyamoto
Tokyo Institute of Technology
OWPT systems has some safety problems, such as unexpected, unnecessary, light irradiation to human and other objects. In this report, a moving object detection scheme based on OpenCV and python is constructed as the initial safety system of the OWPT system. The movement of multiple objects can be detected at the same time. The required operation characteristics such as response time and limitations of detection are also discussed.

OWPT-Closing 11:45

Closing Remarks

OWPT

Poster (Live Poster: Tue. 20 and Wed. 21 April, 11:00-12:00)

[OWPT-P]
Poster Session

OWPT-P-01

Numerical Analysis of Multi-particle Mie Scattering Characteristics for Improvement of Solar Cell Appearance in OWPT System

Yu Liu, Tomoyuki Miyamoto
Tokyo Institute of Technology

Color filters and frosted glass can change the black surface characteristics of the solar cell of OWPT to impressive appearance. In order to improve the efficiency of OWPT even under the light scattering, we proposed application of Mie scattering which depended on incident wavelength to control the appearance of solar cell side in OWPT system. We analyzed scattering characteristics of single particle and multi particle Mie scattering.

OWPT-P-02

Simultaneous Fiber Transmission of Control and Mobile Communication Signals in Power-over-Fiber Drones for Airborne Base Stations

Taiki Kobatake, Natsuki Shindo, Motoharu Matsuura
The University of Electro-Communications

In this work, we present a power-over-fiber drone design for air borne base stations, and experimentally demonstrate the simultaneous transmission of control and mobile communication signals using an optical fiber for air borne station applications using power-over-fiber drones.

OWPT-P-03

Evaluation of Wavelength Dependence in Feed light Transmission Loss of Double-Clad Fiber for Power-over-Fiber Applications

Suguru Fujita, Tadanobu Higuchi, Hikaru Mamiya, Motoharu Matsuura
The University of Electro-Communications

We evaluate the feed light transmission loss of double-clad fibers for power-over-fiber applications. We also compare the wavelength dependence of the double-clad fibers. In this evaluation, we show that the wavelength dependence of the transmission loss of double-clad fibers is quite different from those of conventional optical fibers, and it depends on the structures of double-clad fibers and other factors.

OWPT-P-04

For Fabrication of Waveguides based on Polydimethylsiloxane for Multistriped Orthogonal Photon-Photocarrier Propagation Solar Cell (MOP3SC) System

Xingbai Hong, Jiaxing Yu, Nobuo Sawamura, Akira Ishibashi
Hokkaido University

A solar cell is an electrical device that converts the energy of light directly into electricity by the photovoltaic effect, which is a physical and chemical phenomenon. We propose a two-dimensional photoreceptor-conversion (2DPRC) scheme in which the photoreception part is spatially decoupled from, but is two-dimensionally connected to the photo-conversion part by a redirection waveguide (RWG). We expect the Polydimethylsiloxane may implement this system.

OWPT-P-05

Optical Wireless Communication and Power Transmission with Long-distance Propagation in Atmospheric Turbulence

Konami Yada, Yui Takagi, Kayo Ogawa
Japan Women's University

In long-distance propagation, scintillation and beam wonder occur due to the influence of atmospheric fluctuations, so there is concern about power loss. Therefore, in this research, we proposed the LG mode multiplexing method that applies a compensation filter and LG beams in order to realize multiplex communication that is resistant to turbulence while ensuring reception intensity.

OWPT-P-06

Effect of Uniform Laser Irradiation on the Efficiency of GaAs Solar Cells for Optical Wireless Power Transmission

Kazuki Kurooka, Shinya Honda, Yuki Komuro, Ryouta Warigaya, Shiro Uchida
Chiba Institute of Technology

We investigated the uniformity dependence of laser irradiation intensity on the conversion efficiency of solar cells. It was found that the optimum design of the electrode area changes between uniform irradiation and non-uniform irradiation.

OWPT-P-07

Investigation of Laser Wireless Power Transmission using Infrared InGaAsP/InGaAs 2-junction Solar Cell

Nozomi Matsuoka[1], Tomoyuki Kato[1], Yuki Komuro[1], Li Xuefei[2], Shulong Lu[2], Shiro Uchida[1]
[1]Chiba Institute of Technoligy, [2]Suzhou Institute of Nano-Tech and Nano-Bionics

We irradiated an infrared InGaAsP/InGaAs 2-junction solar cell with two infrared lasers simultaneously. The photoelectric conversion efficiency of 23.8% was achieved, which was as good as that of the single-junction InGaAs solar cell.

OWPT-P-08

Energy Conversion Efficiency under Different Input Electrical Power Conditions in Visible LED based OWPT System

Haruka Yokoyama[1], Naoki Yosuke[1], Tomohiro Yamaguchi[1], Tomoyuki Miyamoto[2], Takeyoshi Onuma[1], Tohru Honda[1]
[1]Kogakuin University, [2]Tokyo Institute of Technology

Visible-LED-based OWPT system was constructed with visible LEDs and Si solar cell. The total energy conversion efficiency in the OWPT system was investigated as a function of input electrical power for LEDs. It was found that the total energy conversion efficiency decreased with the increase in the input electrical power of LED. The tendency was well corelated with the wall plug efficiency of LED.

OWPT-P-09

Laser Wireless Power Transmission in Seawater Environment

Shunki Hayashi, Yuma Aoki, Yuki Komuro, Tomoya Sudo, Tomoyuki Kato, WONG Yiu Leumg, Shiro Uchida
Chiba Institute of Technology

Laser wireless power transmission in seawater was tested using blue, green, orange-red lasers and a GaInP solar cell. Green laser had the highest 60.3% optical transmittance and 21.6% system efficiency with 30 cm seawater penetration.

OWPT-P-10

Visible Laser Wireless Power Transmission Using a Beam Expander

Yiu Leung WONG, Taaiga Shibuya, Ryouta Warigaya, Yuki Komuro, Shunki Hayashi, Tomota Sudou, Tomoyuki Katou, Shiro Uchida
Chiba Institute of Technology

The long-distance optical wireless power-transmission was examined using a red-orange 609nm solid-state laser and a GaInP solar cell. We found that the incorporation of a beam expander could improve the beam reaching rates over 80m.

OWPT-P-11

Experimental Investigation of Electrode Design for Photovoltaic device for Laser Receiving Photovoltaic Device

Akira Kushiyama, Masakazu Arai
University of Miyazaki

For high conversion efficiency of laser light receiving device, we experimentally investigated the electrode size and pitch dependence of photovoltaic characteristics of GaAs based device. Clear tendency against shadowing loss was observed under laser irradiation.

XOPT

Monday, 19 April

[XOPT-1-01] 9:30-9:40
Opening Remarks
Chair: Tetsuya Ishikawa
RIKEN SPring-8 Center

[XOPT-2] 9:40-10:40
Advances in X-ray mirror
Chair: Takashi Kimura
The University of Tokyo

XOPT-2-01 9:40 *Invited*

Advanced X-ray optics and metrology development at NSLS-II

Mourad Idir, Lei Huang, Tianyi Wang
BNL/NSLS-II

During this talk, we will present our recent work on our newly established stitching interferometry platform, and our upgraded Nano Surface Profiler (NSP) for synchrotron mirror metrology. Thanks to these new metrology capabilities, we have developed our in house Ion Beam Figuring deterministic polishing system. Some new achieved results will be shown during the talk.

XOPT-2-02 10:10 *Invited*

Development of sub-micron soft x-ray free-electron laser focusing system at SACLA

Hiroto Motoyama
The University of Tokyo

Ellipsoidal mirrors are promising optics for focusing soft x-rays down to sub-micromtre size without chromatic aberration. A soft x-ray focusing system combining an ellipsoidal mirror and a K-B mirror was developed at SACLA. The focused beam size is 500 x 550 nm with a maximum peak intensity of ~10^{16} W/cm^2 at the photon energy of 100 eV. The microscopic properties of materials having absorption edges in the soft x-ray region will be investigated with the system.

[XOPT-3] 11:00-12:00
X-ray optics
Chair: Taito Osaka
RIKEN SPring-8 Center

XOPT-3-01 11:00

Wave-optical simulation for soft X-ray focusing optics using coherent mode decomposition

Yoko Takeo[1,2], Takashi Tanaka[3], Yasunori Senba[2,3], Haruhiko Ohashi[2,3], Hidekazu Mimura[1]
[1]The University of Tokyo, [2]Japan Synchrotron Radiation Research Institute (JASRI), [3]RIKEN SPring-8 Center (RSC)

Spatial and temporal coherence of the soft X-ray focusing beam was estimated using wave-optical calculation with coherent mode decomposition. Quality of reconstructed images in ptychography measurement was compared between simulation and experimental results.

XOPT-3-02 11:15

Processing a micro-channel-cut crystal monochromator using Ni wire for reflection self-seeded X-ray free-electron laser

Shotaro Matsumura[1], Shota Nakano[1], Yasuhisa Sano[1], Taito Osaka[1,2], Ichiro Inoue[2], Makina Yabashi[2], Kazuto Yamauchi[1]
[1]Osaka University, [2]RIKEN SPring-8 Center

A high-quality channel-cut crystal monochromator with a gap width of ~100 μm is indispensable for reflection self-seeded X-ray free-electron laser. We report the details about instrument and results of processing the crystal.

XOPT-3-03 11:30

Optimization of mirror deformation method for hybrid bender combining mechanical and piezoelectric bending

Yuka Nishioka[1], Takato Inoue[1], Satoshi Matsuyama[2], Junki Sonoyama[3], Kazuteru Akiyama[3], Hiroki Nakamori[4], Yasuhisa Sano[1], Yoshiki Kohmura[5], Makina Yabashi[5], Tetsuya Ishikawa[5], Kazuto Yamauchi[1]
[1]Osaka University, [2]Nagoya University, [3]TOYAMA, [4]JTEC Corporation, [5]RIKEN/Spring-8

We will discuss the optimal deformation method for the hybrid bender combining mechanical and piezoelectric bending and the achievable accuracy of this method.

XOPT-3-04 11:45

Development of sub-5 nm focusing system based on precise deformable mirrors

Takato Inoue[1], Satoshi Matsuyama[1,2], Yuto Tanaka[1], Kohei Futamura[1], Yoshio Ichii[3], Jumpei Yamada[4], Yasuhisa Sano[1], Yoshiki Kohmura[4], Makina Yabashi[4,5], Tetsuya Ishikawa[4], Kazuto Yamauchi[1]
[1]Osaka University, [2]Nagoya University, [3]JTEC Corporation, [4]RIKEN SPring-8 Center, [5]Japan Synchrotron Radiation Research Institute

To focus X-ray down to sub-5 nm, shape error on mirrors should be less than 0.6 nm PV. We installed a deformable mirror. In FEM simulation, the mirror could correct a shape error produced by fabrication processes.

[XOPT-4] 13:00-14:00
Wavefront / Imaging
Chair: Hiroto Motoyama
The University of Tokyo

XOPT-4-01 13:00

Single-grating interferometer for hard X-ray sub-10nm focusing mirror system

Jumpei Yamada[1], Satoshi Matsuyama[2], Nami Nakamura[3], Takato Inoue[3], Taito Osaka[1], Ichiro Inoue[1], Hirokatsu Yumoto[4], Takashi Koyama[4], Haruhiko Ohashi[4], Kazuto Yamauchi[3], Makina Yabashi[1]
[1]RIKEN SPring-8 Center, [2]Nagoya University, [3]Osaka University, [4]JASRI

X-ray single-grating interferometry was applied to conduct accurate wavefront corrections for hard X-ray nanofocusing mirrors. Systematic errors in the interferometer were carefully examined, and the mirror shapes were directly corrected using a differential deposition technique based on the measured wavefront errors.

XOPT-4-02 13:15

Development of wavefront sensing in full-field X-ray microscopy

Yuto Tanaka[1], Satoshi Matsuyama[1,2], Takato Inoue[1], Nami Nakamura[1], Jumpei Yamada[1,3], Yoshiki Kohmura[3], Makina Yabashi[3], Kazuhiko Omote[4], Tetsuya Ishikawa[3], Kazuto Yamauchi[1]
[1]Osaka University, [2]Nagoya University, [3]RIKEN SPring-8 Center, [4]Rigaku Corporation

We proposed an in-situ wavefront measurement based on the intensity information near the focus. Applying this method, we were able to measure wavefront aberrations of the AKB mirrors in the magnifying geometry.

XOPT-4-03 13:30 *Invited*

Nano-scale Chemical State Visualization of Functional Materials Using Ptychography-XAFS

Nozomu Ishiguro, Yukio Takahshi
Tohoku University

Ptychography- XAFS, a combination of ptychography imaging using coherent X-rays and XAFS spectroscopy, is one of the most promising tools for visualizing not only the mesoscopic structures but also their chemical states of the non-uniform materials in nano-scale. Here, we report demonstrations of nano -scale chemical state visualization of practical functional materials using ptychography-XAFS measurements.

[XOPT-5] 14:10-15:10
Application / Detectors
Chair: Satoshi Matsuyama
Nagoya University

XOPT-5-01 14:10 *Invited*

Feasibility study on 3D dynamic X-ray elastography for soft tissue and soft materials

Chika Kamezawa[1], Liang Xiaoyu[2], Tetsuro Shirasawa[3], Akio Yoneyama[4], Kentaro Kajiwara[5], Kazuyuki Hyodo[1], Wataru Yashiro[2]
[1]Photon Factory, Institute of Materials Structure Science/ KEK, [2]Institute of Multidisciplinary Research for Advanced Materials (IMRAM), Tohoku University, [3]National Metrology Institute of Japan (NMIJ), National Institute of Advanced Industrial Science and Technology (AIST), [4]SAGA Light Source, [5]Japan Synchrotron Radiation Research Institute (JASRI)

We are developing dynamic x-ray elastography for soft tissue and soft materials. We show preliminary results of three-dimensional maps of storage and loss moduli using white synchrotron x-rays and high speed x-ray camera.

XOPT-5-02 14:30 *Invited*

Additive Manufacturing for X-ray optical applications

Adam Kubec[1], Frank Seiboth[2], Mikhail Lyubomirskiy[2], Frieder Koch[1], Andreas Schropp[2], Christian David[1], Christian Schroer[2,3]
[1]Paul Scherrer Institut, [2]DESY, [3]Universität Hamburg

3D-printing allows making various kinds of X-ray optical components. Structures can be made to focus beams, correct for phase existing optics or adding custom phase modifications such as a topological charge, or act as samples.

XOPT-5-03 14:50 *Invited*

CITIUS: a 17400 frames/s X-ray imaging detector with a linear response over 600 Mcps/pixel

Takaki Hatsui
RIKEN SPring-8 Center

Recent advances in photon sources deliver intense x-rays on to X-ray imaging detectors; photon counting detectors are challenged due to its limited count rate. The CITIUS detector has been developed to overcome this limitation. Experimental results will be reported with an emphasis on its high dynamic range capability, where CITIUS can detect over 600 Mcps/pixel.

[XOPT-6] 15:20-16:30
FEL-related topics
Chair: Ichiro Inoue
RIKEN SPring-8 Center

XOPT-6-01 15:20 *Invited*

Measurement of transient optical phase change as a potential diagnostics tool for extreme-ultraviolet free-electron-laser pump optical-probe experiments

Victor Tkachenko[1,2], Sven Toleikis[3], Vladimir Lipp[2], Beata Ziaja[4], Ulrich Teubner[1]
[1]University of Applied Sciences, Emden, Germany, [2]Center for Free-Electron Laser Science CFEL, DESY, Hamburg, Germany, [3]Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany, [4]Institute of Nuclear Physics, Polish Academy of Sciences, Krakow, Poland

Transient optical properties are typical observables in extreme-ultraviolet-pump optical-probe experiments. Here we propose to additionally measure transient phase change of the optical probe pulse. Our computational study demonstrates that, at correctly tuned pulse parameters, such measurement can provide a strong enough signal enabling access to more information on transient state of the target.

XOPT-6-02 15:40 *Invited*

A diamond channel cut monochromator for operation at high energy and high repetition rate at the EuXFEL: a numerical modeling of the thermal load effects

Kelin Tasca[1], Ilia Petrov[1], Fang Yang[1], Sergey Terentyev[2], Maurizio Vannoni[1], Liubov Samoylova[1]
[1]European X-ray Free Electron Laser, [2]Technol Inst Superhard & Novel Carbon Mat

A diamond channel cut monochromator for operation at high energy and high repetition rate at the EuXFEL: a numerical modeling of the thermal load effects will be presented.

XOPT-6-03 16:00 *Invited*

Hanbury Brown and Twiss Interferometry at X-ray Free-Electron Lasers

Ivan Vartaniants
Deutsches Elektronen-Synchrotron DESY

The basic idea of the Hanbury Brown and Twiss (HBT) interferometry is to determine the statistical properties of radiation from the normalized second-order intensity correlation function obtained by measuring the coincident response at two detector positions. We implemented HBT interferometry at different X-ray free-electron laser (XFEL) sources from XUV to hard X-ray range. Recent results obtained at European XFEL and PAL XFEL facilities will be presented.

[XOPT-7] 16:40-17:40
Novel optics/methods
Chair: Makina Yabashi
RIKEN SPring-8 Center

XOPT-7-01 16:40 *Invited*

Thermoelastic stability of Bragg reflectors under pulsed heat load in an XFELO

Immo Bahns[1], Wolfgang Hillert[2], Patrick Rauer[1], Joerg Rossbach[2], Harald Sinn[1]
[1]European XFEL, [2]Universität Hamburg

Thermoelastic stability of Bragg reflectors under pulsed heat load in an XFELO will be presented.

XOPT

Monday, 19 April

XOPT-7-02 17:00 *Invited*

Laboratory based hard X-ray microscopy with Multilayer-Laue-Lens for full-field imaging

Juergen Gluch[1], Peter Gawlitza[2], Sven Niese[3], Reiner Dietsch[3], Norman Huber[4], Ehrenfried Zschech[1]
[1]Frauhofer IKTS, [2]Fraunhofer IWS, [3]AXO DRESDEN GmbH, [4]Huber Diffraktionstechnik GmbH & Co. KG

A laboratory nano X-ray computed tomography (nano-XCT) system that is designed for the photon energy range > 10 keV and that uses multilayer optics for sample illumination and as objective lens will be presented. A multilayer Laue lens (MLL) is used for full-field imaging. We will demonstrate images of test structures acquired with MLLs at photon energies of 8 keV (Cu-Ka) and 17.5 keV (Mo-Ka).

XOPT-7-03 17:20 *Invited*

Multi-Focus Off-Axis Zone Plates for Experiments at X-Ray Free Electron Lasers

Florian Doering[1,2], Benedikt Roesner[1], Martin Beye[3], Robin Engel[3], Loic Le Guyader[4], Andreas Scherz[4], Manuel Langer[1], Adam Kubec[1], Armin Kleibert[1], Joerg Raabe[1], Carlos Vaz[1], Christian David[1]
[1]Paul Scherrer Institut, [2]XRnanotech, [3]FLASH/DESY, [4]European XFEL

We have designed a new type of X-ray optic that combines the beam-splitting functionality of a transmission grating with the focusing capabilities of a zone plate and hence, enables multi-focus experiments at XFELs.

[XOPT-Closing] 17:40-17:50
Closing Remarks
Chair: Kazuto Yamauchi
Osaka University

PLAN TO PARTICIPATE

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2021年度 公益財団法人 天田財団［助成事業］

金属等の塑性加工及びレーザプロセッシングに関する

研究開発助成・国際交流助成の募集

募集内容

金属等[注1]の塑性を利用した加工及び高密度エネルギー下での諸特性を利用した加工に必要な技術[注2]の調査・研究に対する助成及びその国際交流の助成を行います。

注1：金属等とは、金属・プラスチック・CFRP・セラミックス・複合材料等も含みます。
注2：加工に間接的に影響を及ぼす技術（例：IoT・AI・CPS）等も含みます。

● 研究開発助成 【募集期間】2021年6月1日～7月31日　総額／約2億2,000万円

	助成プログラム名称	最高助成金（万円）	募集件数（塑性・レーザ合算）
①	**重点研究開発助成** 技術動向や社会情勢のニーズを重点研究課題として顕在化させ、それに対して独創的、革新的な研究に対する助成	1,000	4～6
②	**一般研究開発助成** 基礎的、試験的、実用的な研究で助成対象分野の進展に期待できる研究に対する助成	200 又は 300	40～50
③	**奨励研究助成（※若手研究者枠）** 助成対象分野の若手研究者の育成、挑戦的研究に対する助成	200	16～18

● 国際交流助成 【募集期間】2021年6月1日～7月31日 （当期予算が残った場合は追加募集します）　総額／約1,000万円

	助成プログラム名称	最高助成金（万円）	募集件数（塑性・レーザ合算）
④	**国際会議等準備及び開催助成** 国内で開催される権威ある機関、又は団体が主催する国際会議等の準備及び開催への助成	100	2～4
⑤	**第1回 国際会議等準備及び開催助成** 海外で開催実績があり、国内で初めて開催される権威ある機関、又は団体が主催する国際会議等の準備及び開催への助成（初回限定）	150	1
⑥	**国際会議等参加助成** 海外で開催される権威ある機関、又は団体が主催する国際会議等に参加し、発表や運営の役割を担う者の旅費等に対する助成（ポスドク・院生同行1名可）	1名の場合／ 35 2名の場合／ 70	8～10 2～4
⑦	**国際会議等参加助成（若手枠）** 海外で開催される権威ある機関、又は団体が主催する国際会議等に参加し、発表等を行う若手研究者の旅費等に対する助成	35	2～4
⑧	**国際シンポジウム等準備及び開催助成（※若手研究者枠）** 自らが中心的な役割を担い、3ヶ国以上の研究者を招請して開催する小規模の研究交流会等への準備及び開催への助成	50	1

※若手研究者枠：2022年3月31日時点で満39歳以下、かつ弊財団の研究開発助成受給の未経験者

申込方法

弊財団HPに研究者登録後、各助成プログラムを選択してください。
https://www.amada-f.or.jp/
または 天田財団 検索

問い合わせ

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SCAT研究助成を公募します。

一般財団法人テレコム先端技術研究支援センターは、次の研究助成を行っております。詳細はホームページhttps://www.scat.or.jp/josei/をご覧ください。奮ってご応募ください。

研究費助成

先端的な情報通信技術分野の研究の円滑な推進を支援することを目的として、研究に関わる経費の助成を行います(助成金は研究のための諸費用に使用できます)。

①応募資格　先端的な情報通信技術分野の研究を行っている研究者又は研究グループ
②助成額　　１件当たり総額250万円以下
③助成期間　２年又は3年
④募集期間　**令和３年９月１日(水)～１０月２９日(金)**
（参考）　令和２年度　採用件数　新規２０件

研究奨励金

次世代を担う若い研究者の育成を目的として、研究奨励金の支給を行います。

①応募資格　先端的な情報通信技術分野の研究を専攻する、
大学院博士後期課程への進学予定者で、研究科長が推薦する学生
②助成額　　１名当たり月額10万円
③助成期間　大学院博士後期課程在学中の3年を超えない期間
④募集期間　**令和３年９月１日(水)～１１月３０日(火)**
（参考）　令和２年度　採用件数　新規４名

国際会議助成

国際研究交流の促進を目的として、国際会議開催費の助成を行います。

①応募資格　先端的な情報通信技術分野の国際会議を主催する学会、
研究グループなどの責任者
②助成額　　１件当たり25万円以下
③募集期間　**令和３年９月１日(水)～１０月２９日(金)**
（参考）　令和２年度　採用件数　新規１９件

応募要領、応募方法等はホームページでご確認ください。

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