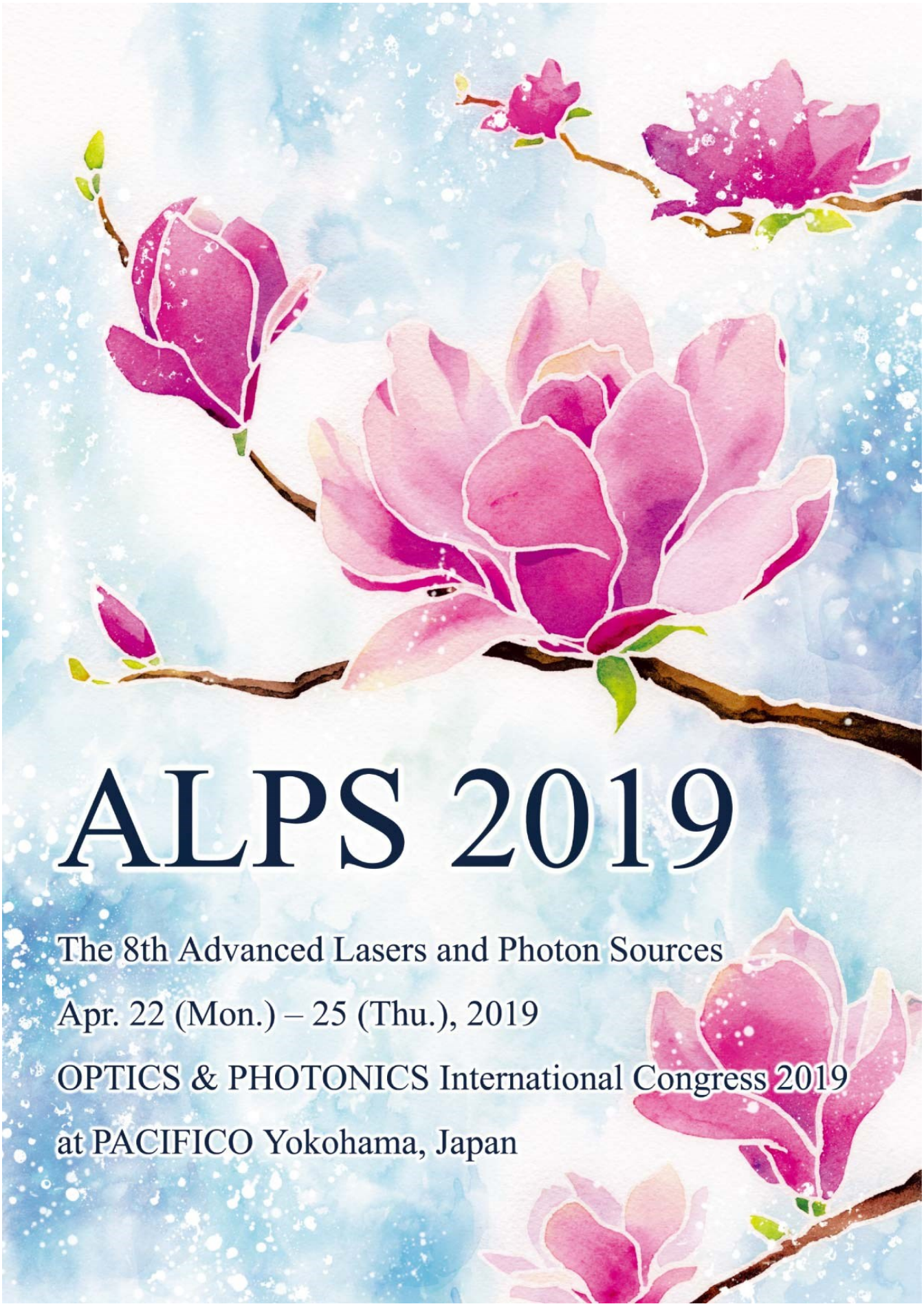

# ALPS 2019

The 8th Advanced Lasers and Photon Sources

Apr. 22 (Mon.) – 25 (Thu.), 2019

OPTICS & PHOTONICS International Congress 2019

at PACIFICO Yokohama, Japan


# ALPS2019 Program

The 8th Advanced Lasers and Photon Sources conference will be held on 22-25 April 2019.
In ALPS2019, a presentation number is defined as ALPS-<#1>-<#2>.
The number <#1> indicates the session order in the ALPS2019 conference.
The number <#2> indicates the presentation order in the session.

| Category | Session | Topics |
|---|---|---|
| A. | ALPS-12 [A1]<br>ALPS-14 [A2] | Novel optical materials/structure and applications |
| B. | ALPS-1 [B1]<br>ALPS-2 [B2] | High average power lasers and applications |
| C. | ALPS-9 [C1]<br>ALPS-11 [C2]<br>ALPS-13 [C3] | High peak power lasers, high pulse energy lasers and applications |
| D. | ALPS-15 [D1]<br>ALPS-19 [D2]<br>ALPS-20 [D3] | Novel solid state / fiber / diode lasers and applications |
| E. | ALPS-17 [E] | Short wavelength light sources and applications |
| F. | ALPS-16 [F1]<br>ALPS-18 [F2] | Terahertz devices, nonlinear optics and applications |
| G. | ALPS-8 [G1]<br>ALPS-10 [G2] | Novel optical devices, metamaterials, structure and applications |
| H. | ALPS-3 [H] | Optical devices and techniques for bio and medical applications |
| I. | ALPS-5 [I1]<br>ALPS-7 [I2] | Optical frequency combs / Frequency stabilized lasers and applications |
| J. | JS-2 [ALPS-J] | Joint session ALPS+HEDS+XOPT<br>JS-2-1 (ALPS), JS-2-2 (HEADS), and JS-2-3 (XOPT) |
| ACUIL. | ALPS-4 [ACUIL1]<br>ALPS-6 [ACUIL2] | Special sessions co-organized with ACUIL<br>Ultra-high intensity lasers and applications |
| P. | ALPS-P1<br>ALPS-P2 | Poster sessions: P1(Category A,B,C, and E)<br>and P2(Category D, F, G, H, and I) |

# Monday, 22nd April 2019, Room 303

## Opening remarks
9:00 - 9:15 Room 303

**Hitoki Yoneda**
*Institute for Laser Science, The University of Electro-Communications (UEC)*

## ALPS-1 [B1] High power lasers 1
9:15 - 10:30 Room 303

**Chair: Ryo Yasuhara**
*National Institute for Fusion Science*

**ALPS-1-01** *invited*
**9:15**
**High-average-power DUV picosecond pulse generation based on a gain-switched LD and hybrid MOPA**
Kenta Kohno[1], Yosuke Orii[1], Kimihiko Shibuya[1], Seiji Shimizu[1], Masashi Yoshimura[3], Yosuke Mori[2], Junichi Nishimae[4], George Okada[1]
*1. Spectronix, 2. Graduate School of Engineering, Osaka University, 3. Institute of Laser Engineering, Osaka University, 4. Advanced Technology R & D Center, Mitsubishi Electric Corporation*
Picosecond pulse laser source, based on laser diode gain switched seed laser combined with fiber and bulk hybrid amplifier configuration, is practical for high efficient frequency conversion generating DUV lasers with high reliability for long-term operations.

**ALPS-1-02**
**9:45**
**1-J, 300-Hz Laser System by Using High Peak Power Laser-Diode Pumped Nd:YAG Amplifiers for Industrial Applications**
Takaaki Morita, Takashi Kurita, Yoshinori Kato, Takuto Iguchi, Takashi Sekine, Yoshinori Tamaoki, Yasuki Takeuchi, Norio Kurita, Kazuki Kawai, Toshiyuki Kawashima
*HAMAMATSU PHOTONICS K.K.*
A high power laser-diode pumped Nd:YAG laser system with 1064 nm, 1-J output energy at 300-Hz repetition rate had been achieved. We had evaluated compensation of thermal birefringence in front-end laser system.

**ALPS-1-03**
**10:00**
**Purification of the liquid media of stimulated Brillouin scattering phase conjugate mirrors for high average laser system**
Seongwoo Cha, Hong Jin Kong
*KAIST*
To develop an SBS-PCM for high average power coherent beam combination laser, the SBS liquid medium was purified by membrane filters using two different methods and the results were compared.

**ALPS-1-04**
**10:15**
**Kerr-Lens Mode-Locked Yb:LuAG Ceramic Thin-Disk Laser**
Shotaro Kitajima[1], Akira Shirakawa[1], Hideki Yagi[2], Takagimi Yanagitani[2]
*1. Institute for Laser Science, University of Electro-Communications, 2. Konoshima Chemical Co. Ltd.*
Kerr-lens mode-locked Yb:LuAG ceramic thin-disk laser was demonstrated. An average output power of 16 W with a pulse duration of 161 fs was achieved. The shortest pulse duration was 112 fs with 4.3W average power.

-----Break (10:30 - 11:00) -----

# Monday, 22nd April 2019, Room 303

## ALPS-2 [B2] High power lasers 2

11:00 - 12:00 Room 303

**Chair: Junji Kawanaka**
*Institute of Laser Engineering, Osaka University*

**ALPS-2-01** **Canceled**

**ALPS-2-02**
**11:00**
**Experimental and Theoretical Studies of the Diode Pumped Alkali Lasers**
Boris Barmashenko, Ilya Auslender, Eyal Yacoby, Karol Waichman, Salman Rosenwaks
*Ben-Gurion University of the Negev*
Experimental and theoretical studies of the output power, temperature rise in the gain volume and beam quality of the output beam of the flowing-gas diode pumped Cs lasers are reported.

**ALPS-2-03**
**11:15**
**Diode pumped rubidium laser based on etalon effects of alkali cell windows**
Fangjin Ning[1,2], Zhiyong Li[1], Rongqing Tan[1,2], Liemao Hu[1,2], Songyang Liu[1,2]
*1. Institute of Electronics, Chinese Academy of Sciences, 2. School of Electronic, Electronical and Communication Engineering, University of Chinese Academy of Sciences*
We demonstrated there are etalon effects due to the un-coated inner faces of the alkali cell. Based on a rubidium cell with highly-parallel windows, 2.7 W rubidium laser with optical efficiency of 20.9% and slope efficiency of 31.8% is obtained by adopting no traditional output couplers.

**ALPS-2-04**
*invited*
**11:30**
**Rare earth doped Aluminium oxide/nitride ceramics for light emitting application**
Yasuhiro Kodera, Elias H Penilla, Andrew T Wieg, Luis F Devia-Cruz, Matthew A Duarte, Corey L Hardin, Javier E Garay
*UC San Diego*
We produced rare earth (RE) doped aluminum oxide/nitride bulk ceramics. With unique light-emitting properties, RE-doped $Al_2O_3$ and AlN showed thermo-mechanical figure of merit of 24 times and 60 times of single crystal of Nd:YAG.

-----Lunch (12:00 - 13:00) -----

# Monday, 22nd April 2019, Room 511+512

## ALPS-3 [H] Biomedical imaging

11:00 - 12:30 Room 511+512

**Chair: Masayuki Suzuki**
*Doshisha University*

**ALPS-3-01** *invited* **11:00**

### AI cell sorting - where photonics meets microfluidics and AI

Keisuke Goda[1,2,3], Nao Nitta[1,2], Takeaki Sugimura[1,2], Yoichiro Hosokawa[4], Sotaro Uemura[1], Yasuyuki Ozeki[1]
*1. University of Tokyo, 2. Japan Science and Technology Agency, 3. University of California, Los Angeles, 4. Nara Institute of Science and Technology*

I introduce AI cell sorting – a machine intelligence technology that achieves real-time fluorescence-image-activated cell sorting at a high throughput of ~100 events per second. It holds promise for making machine-based discoveries in biology and medicine.

**ALPS-3-02** *invited* **11:30**

### In-vivo tomographic visualization of intracochlear vibration using supercontinuum multifrequency-swept optical coherence microscope

Samuel Choi[1,3], Fumiaki Nin[2,3], Takeru Ota[2,3], Hiroshi Hibino[2,3]
*1. Faculty of engineering, Niigata University, 2. School of Medicine, Department of Molecular Physiology, Niigata University, 3. AMED-CREST, AMED*

Multifrequency swept optical coherence microscope with a supercontinuum was developed for in-vivo intracochlear vibration measurement of a guinea pig. 3D OCT and en-face vibration imaging were successfully conducted with a depth resolution of 2.7 micrometers.

**ALPS-3-03** **12:00**

### Fluorescence imaging with $Y_2O_3$:Yb nanoparticles in the second near-infrared window

Yoshiki Akino[1], Masahito Yamanaka[1], Niioka Hirohiko[2], Taichi Furukawa[3], Norihiko Nisizawa[1]
*1. The University of Nagoya, 2. The University of Osaka, 3. The University of Yokohama National*

We proposed the use of fluorescence emission of Yb-doped nanoparticles in the second NIR window for deep tissue imaging. In this study, fluorescence imaging through 1.5 mm-thick tissue phantom and live cell imaging were demonstrated.

**ALPS-3-04** **12:15**

### Establishment of a novel measurement technique for pedicle screw stability -LASER resonance frequency analysis–

Daisuke Nakashima[1], Katsuhiro Mikami[2], Toshiyuki Kitamura[2], Noboru Hasegawa[2], Hajime Okada[2], Masaharu Nishikino[2], Shinri Kurahashi[2], Takeo Nagura[1], Hiromasa Kawana[3], Nobuyuki Fujita[1], Morio Matsumoto[1], Masaya Nakamura[1]
*1. Department of Orthopaedic Surgery, Keio University School of Medicine, 2. The National Institutes for Quantum and Radiological Science and Technology Quantum Beam Science Research Directorate Kansai Photon Science Institute, 3. Department of Dentistry and Oral Surgery, Keio University School of Medicine*

Laser-Resonance Frequency Analysis (RFA) is a quantitative, repeatable and non-invasive method to measure the orthopaedic implant stability. There is a possibility that Laser-RFA can be replaced the conventional methods: pull-out force and insertion torque.

-----Lunch (12:30 - 13:30) -----

# Monday, 22nd April 2019, Room 303

## ALPS-4 [ACUIL1] Ultra-high intensity lasers

13:00 - 15:10 Room 303

**Chair: Chang Hee Nam**
*Institute for Basic Science*

**ALPS-4-01**
**13:00**

### Opening address

Chang Hee Nam
*Institute for Basic Science*
Opening remark of special sessions co-organized with ACUIL.

**ALPS-4-02**
**13:05**

### Recent Progress on the ultra-intense and ultra-fast laser facility at SIOM from SULF to SEL

Yuxin Leng, Xiaoyan Liang, Ruxin Li, Zhizhan Xu
*State Key Laboratory of High Field Laser Physics, Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences*
We will report the new progress of the latest progress of the three international user platforms in the Shanghai Super-intense Ultra-fast Laser Facility and the station of the extreme light, which contain a 100PW laser system.

**ALPS-4-03**
**13:30**

### Ultra-intense sub-20 fs laser for nonlinear Compton scattering

Seong Ku Lee[1,2], Jae Hee Sung[1,2], Hwang Woon Lee[1], Jin Woo Yoon[1,2], Chang Hee Nam[1,3]
*1. IBS-GIST, 2. APRI-GIST, 3. Dept. of Physics and Photon Science, GIST*
Performances of an ultra-intense laser at CoReLS have been improved to explore high field science, especially the pair production based on nonlinear Compton scattering. The laser focus intensity of $6\times10^{22}$ W/cm$^2$ was achieved. The pulse duration was shortened from 19 fs to 17 fs by pumping an OPCPA preamplifier with a shaped pump pulse. In this talk, status of the ultra-intense laser for nonlinear Compton scattering at CoReLS is presented.

**ALPS-4-04**
**13:55**

### Recent Performance and Progress on the J-KAREN-P High Intensity Laser Facility

Hiromitsu Kiriyama, Alexander S. Pirozhkov, Mamiko Nishiuchi, Yuji Fukuda, Koichi Ogura, Akito Sagisaka, Yasuhiro Miyasaka, Michiaki Mori, Hironao Sakaki, Nicholas P. Dover, Kotaro Kondo, Hazel F. Lowe, James K. Koga, Timur Zh. Esirkepov, Nobuhiko Nakanii, Kai Huang, Masaki Kando, Kiminori Kondo, Tetsuya Kawachi
*National Institutes for Quantum and Radiological Science and Technology*
J-KAREN-P is an infrastructure to provide an intensity capacity surpassing $10^{22}$ W/cm$^2$ at 0.1 Hz. Laser performance of amplification and compression and detailed investigation of spatiotemporal quality are presented.

**ALPS-4-05**
**14:20**

### Innovative Power Laser System Developed at Osaka University

Junji Kawanaka[1], Shigeki Tokita[1], Junpei Ogino[1], Kana Fujioka[1], Xiaoyang Guo[1], Hidetsugu Yoshida[1], Koji Tsubakimoto[1], Zhaoyang Li[1], Masaki Sakamoto[1], Noboru Morio[1], Ryo Yasuhara[2], Shinji Motokoshi[3], Tomomasa Okubo[4], Yoshiki Nakata[1], Masashi Yoshimura[1], Yasushi Fujimoto[5], Ken-ichi Ueda[6], Masayuki Fujita[3], Noriaki Miyanaga[3], Ryosuke Kodama[1]
*1. Osaka University, 2. National Institute for Fusion Science, 3. Institute for Laser Technology, 4. Tokyo University of Technology, 5. Chiba Institute of Technology, 6. University of Electro-Communications*
100Hz innovative power laser system up to kilo-joules has been conceptually designed with cryogenically-cooled large-aperture active-mirror amplifier and beam combining technique.

**ALPS-4-06**
**14:45**

## A multi-function high-intensity laser driver for intense radiation sources - Xingguang-III facility

Qihua Zhu
*Laser Fusion Research Center, China Academy of Engineering Physics*

We developed a high-intensity laser facility with synchronized femtosecond, picosecond and nanosecond laser beams. The Xingguang-III laser has been operated for more than 3 years and three beams have been operated for multiple experiments independently or in various combined ways. New and valuable results have been generated.

-----Break (15:10 - 15:40) -----

# Monday, 22nd April 2019, Room 511+512

## ALPS-5 [I1] Dual-comb

13:30 - 15:00 Room 511+512

**Chair: Mitsuru Musya**

*Institute for Laser Science, University of Electro-Communications (UEC)*

**ALPS-5-01** *invited* **13:30**

### Advances in Optical Time Transfer using Frequency Combs

Nathan R. Newbury[1], Hugo Bergeron[1], Martha Bodine[1], Kevin Cossel[1], Jennifer Ellis[1], Emily Hannah[1], Sarah Stevenson[1], William Swann[1], Jean-Daniel Deschenes[2], Laura Sinclair[1]

*1. National Institute of Standards and Technology, 2. Octosig*

I will describe the use of coherent fiber frequency combs for free-space time-frequency transfer over long turbulent air path. This approach can enable future optical clock networks.

**ALPS-5-02 14:00**

### Dual-comb Based Angle Measurement Using a Grating and a Corner Cube Combined Sensor

Siyu Zhou, Vunam Le, Guanhao Wu

*Tsinghua University*

We present an angle measurement method based on dual-comb interferometry. It uses a grating and a corner cube combined passive sensor. The precision is better than 0.25 arc-second within the range of 100 arc-seconds.

**ALPS-5-03 14:15**

### Rapid Characterization of Orbital Angular Momentum Spectrum of Arbitrary Optical Vortex using Dual-comb Spectroscopy

Akifumi Asahara[1,2], Takuto Adachi[1], Yue Wang[1,2], Kaoru Minoshima[1,2]

*1. The University of Electro-Communications, 2. JST, ERATO MINOSHIMA Intelligent Optical Synthesizer*

Orbital angular momentum spectrum of light was characterized using dual-comb spectroscopy (DCS). With spatial partial detection technique, conventional DCS was extended. The concept was demonstrated by observing an optical vortex generated by a q-plate.

**ALPS-5-04 14:30**

### Bidirectional dual-comb fiber laser with controllability of carrier-envelope-offset frequency

Yoshiaki Nakajima[1,2], Yuya Hata[1,2], Yugo Kusumi[1], Kaoru Minoshima[1,2]

*1. The University of Electro-Communications, 2. JST, ERATO MINOSHIMA Intelligent Optical Synthesizer Project*

We develop a bidirectional dual-comb fiber laser that generates two high-coherence ultra-broadband frequency combs with slightly different repetition rates. Carrier-envelope-offset frequency beat notes with a signal-to-noise-ratio of 30 dB were demonstrated with high controllabity.

**ALPS-5-05 14:45**

### Mutually coherent all-polarization-maintained dual-comb fiber laser with nonlinear amplifying loop mirror

Yoshiaki Nakajima[1,2], Yuya Hata[1,2], Yugo Kusumi[1], Kaoru Minoshima[1,2]

*1. The University of Electro-Communications, 2. JST, ERATO MINOSHIMA Intelligent Optical Synthesizer Project*

An all-polarization-maintaining, polarization-multiplexed dual-comb fiber laser with nonlinear amplifying loop mirror has been demonstrated. The generated two mutually coherent frequency combs with slightly different repetition rates at the same center wavelength without nonlinear spectral broadening.

-----Break (15:00 - 15:30) -----

# Monday, 22nd April 2019, Room 303

## ALPS-6 [ACUIL2] Applications of ultra-high intensity lasers

15:40 - 17:45 Room 303

**Chair: Hiromitsu Kiriyama**
*National Institutes for Quantum and Radiological Science and Technology*

**ALPS-6-01**
**15:40**

### Collisionless Shock Acceleration in Near Critical Density Relativistic Plasma

Chang Hee Nam[1,2], Prashant Kumar Singh[1], Vishwa Bandhu Pathak[1], Seong Ku Lee[1,2]
*1. Institute for Basic Science, 2. GIST*
An electrostatic collisionless shock was explored using a high-density helium gas target, containing a small fraction of hydrogen, driven with a PW Ti:Sapphire laser.

**ALPS-6-02**
**16:05**

### Strong terahertz pulses generated from relativistic laser- produced plasmas

Yutong Li
*Institute of Physics, Chinese Academy of Sciences*
In this talk, we will concentrate on the THz generation due to coherent transition radiation of relativistic laser-driven electron beams when they pass the solid-vacuum boundary. THz pulses >10 mJ has been observed.

**ALPS-6-03**
**16:30**

### Experimental Demonstration of a Laser Proton Accelerator with Image-Relaying Beam Transport

Chen Lin, Minjian Wu, Jungao Zhu, Qing Liao, Yixing Geng, Changcai Li, Xiaohan Xu, Dongyu Li, Tong Yang, Yinren Shou, Dahui Wang, Pengjie Wang, Yanying Zhao, Jiaer Chen , Wenjun Ma, Haiyang Lu, Xueqing Yan
*Peking University*
A Compact LAser Plasma Accelerator (CLAPA) that can reliably deliver protons with different energies less than 10 MeV, <1% energy spread, several to tens of pC charge for flexible, multipurpose use is demonstrated.

**ALPS-6-04**
**16:55**

### Dynamic structure enable relativistic electron plasma generation is microdroplet plasma

Krishnamurthy Manchikanti
*Tata Institute of Fundamental Research*
Plasma electron temperatures > 0.5 MeV are generated only with relativistic intensities. Challenge is to bring down intensity and use high repetition rate lasers. We show that dynamic structures generated in size limited matter brings down the required intensities by a 100 fold and super relativistic 1MeV temperature plasma is generated even at $10^{16}$ W/cm$^2$.

**ALPS-6-05**
**17:20**

### 500 TW Ti:sapphire laser at ETRI

Dong Hoon Song, Sang-Kyun Lee, Won Bae Cho, Dong Ho Shin, Moon Youn Jung
*Electronics and Telecommunications Research Institute*
Overview of the ETRI 500 TW laser consisting of double CPA stages as well as the upgrade toward a PW level will be presented.

# Monday, 22nd April 2019, Room 511+512

## ALPS-7 [I2] Comb applications

15:30 - 17:00 Room 511+512

**Chair: Nathan Newbury**
*National Institute of Standards and Technology*

**ALPS-7-01** *invited* **15:30**

### Miniature chip-based frequency combs: physics and applications

Kerry Vahala
*California Institute of Technology*

The physics of coherently pumped solitons in high-Q microcavities for generation of frequency microcombs is reviewed. Demonstrations of spectroscopy tools using soliton microcombs are presented along with work towards integrated clocks and frequency synthesizers.

**ALPS-7-02** *invited* **16:00**

### Low timing jitter femtosecond fiber lasers and applications

Minglie Hu
*Tianjin University*

Passively mode-locked fiber lasers emit femtosecond pulse trains with excellent short-term stability. In this reports, we will review the sub-femtosecond precision timing jitter characterization methods and approaches for ultralow timing jitter femtosecond fiber laser design. An overview of the applications on ultralow timing jitter femtosecond fiber laser will also be presented.

**ALPS-7-03 16:30**

### Timing Jitter Suppression through Relative Intensity Noise Stabilization in High-repetition-rate Mode-locked Fiber Lasers

Yan Wang[1], Haochen Tian[2], Dong Hou[3], Fei Meng[1], Yuxuan Ma[1], Hao Xu[1], Franz Kärtner[4], Youjian Song[2], Zhigang Zhang[1]
*1. Peking University, 2. Tianjin University, 3. University of Electronic Science and Technology of China, 4. Deutsches Elektronen-Synchrotron*

We suppress the timing jitter of 882 MHz mode-locked fiber lasers through RIN stabilization. The jitter spectrum was suppressed by ~10 dB from ~3 kHz to 30 kHz with a unity-gain crossing of 80 kHz.

**ALPS-7-04 16:45**

### One-shot three-dimensional imaging using a stabilized all-optical Hilbert transform with optical frequency comb

Takashi Kato[1,2], Megumi Uchida[2,1], Yurina Tanaka[1,2], Kaoru Minoshima[1,2]
*1. The University of Electro-Communications, 2. JST, ERATO MINOSHIMA Intelligent Optical Synthesizer (IOS)*

One-shot three-dimensional imaging using a novel all-optical Hilbert transform by use of precise carrier-phase and envelope utilizing frequency control of optical frequency comb is reported. Non-scanning measurement of a 200-square-pixels profile shape with μm-level uncertainty was demonstrated.


# Tuesday, 23rd April 2019, Room 303

## JS-2 [ALPS-J] ALPS-HEDS-XOPT joint session

13:30 - 15:00 Room 303

**Chair: Hitoki Yoneda**
*Institute for Laser Science, University of Electro-Communications (UEC)*
**Akifumi Yogo**
*Institute of Laser Engineering, Osaka University*
**Makina Yabashi**
*RIKEN SPring-8 Center*

**JS-2[ALPS-J]-01**
*invited*
**13:30**

**Recent advances on the BELLA PW laser for collaborative research in laser plasma science**
Csaba Toth
*Lawrence Berkeley National Laboratory*
Laser-plasma-driven electron and ion acceleration research with well-characterized 33 femtosecond, 1 Hz laser pulses. Operational experience and latest results by “users" of the facility is described.

**JS-2[ALPS-J]-02**
*invited*
**14:00**

**Status and Prospect of high energy density science with high power lasers at Osaka University**
Ryosuke Kodama
*ILE Osaka-U*
Issues related to JEPoC

**JS-2[ALPS-J]-03**
*invited*
**14:30**

**Status of the EBS Programme Implementation at the ESRF**
Francesco Sette
*European Synchrotron Radiation Facility*
I will present the ESRF EBS programme and discuss some of the new scientific opportunities which are expected thanks to the new X-ray source performances. I will also present information on the present status of the programme and on the degree of its advancement.

-----Break (15:00 - 15:15) -----

# Tuesday, 23rd April 2019, Room 511+512

## ALPS-8 [G1] Modulation, wavelength conversion and measurement with linear and nonlinear processes

13:30 - 15:00 Room 511+512

**Chair: Takasumi Tanabe**
*Keio University*

**ALPS-8-01** *invited* **13:30**

### Linear Frequency Conversion in Rapidly Time-variant Metasurfaces

Bumki Min
*KAIST*

The frequencies of electromagnetic waves are found to be converted as the waves propagate through a temporally varying medium. Thus, effective temporal control of the medium lies at the heart of linear frequency conversion.

**ALPS-8-02** *invited* **14:00**

### Efficient SHG in Periodically Poled Lithium Niobate Microresonators

Fang Bo, Li Zhang, Zhenzhong Hao, Wenbo Mao, Ang Gao, Guoquan Zhang, Jingjun Xu
*MOE Key Laboratory of Weak-Light Nonlinear Photonics, TEDA Institute of Applied Physics and School of Physics, Nankai University*

Efficient second-order nonlinear optical effects were demonstrated in periodically poled lithium niobate microdisk resonators on a chip benefiting from the successful employment of $d_{33}$ for the first time.

**ALPS-8-03** **14:30**

### A study on the modulation of vector optical field with near-field conformal

Xibo Sun, Yuanchao Geng, Lanqin Liu, Qihua Zhu
*Research Center of Laser Fusion, China Academy of Engineering Physics*

This paper designs a setup consisting of cascade biaxial crystals and 4f-system. A unitary-matrix-expressed modulation of the light field is realized, resulting in an inhomogeneous polarization structure with near-field intensity conformal.

**ALPS-8-04** **14:45**

### Hong-Ou-Mandel Interference between Photons Encoded with Orthogonal Spectra

Aruto Hosaka[1], Masaya Tomita[1], Yoshiaki Tsujimoto[2], Shintaro Niimura[1], Akihito Omi[1], Kentaro Wakui[2], Mikio Fujiwara[2], Yutaka Shikano[3,4], Masahiro Takeoka[2], Fumihiko Kannari[3,1]
*1. Keio Univ., 2. NICT, 3. Keio Quantum Computing Center, 4. Chapman Univ.*

We report an experimental demonstration of a frequency-domain Hong-Ou-Mandel (HOM) interference between spectrally shaped ultrafast single-photon pulses. HOM dip with a visibility of 64.8 % is observed between two indistinguishable single photons in spectrally orthogonal modes.

-----Break (15:00 - 15:30) -----

# Tuesday, 23rd April 2019, Room 303

## ALPS-9 [C1] Ultra-high intensity lasers and technology

15:15 - 17:00 Room 303

**Chair: Hiromitsu Kiriyama**
*National Institutes for Quantum and Radiological Science and Technology*

**ALPS-9-01** *invited*
**15:15**

### Recent status and progress of SULF 10 PW Laser

Xiaoyan Liang, Yuxin Leng, Ruxin Li, Zhizhan Xu
*Shanghai Institute of Optics and Fine Mechanics*

The amplified energy from SULF laser reached to 339J with a 235-mm-diameter Ti:sapphire boost amplifier. With a compressed pulse width of 21fs, the peak power is 10.3 PW.

**ALPS-9-02**
**15:45**

### Overview of a multi-petawatt OPCPA laser facility

kainan zhou
*Laser Fusion Research Center, China Academy of Engineering Physics*

To validate the overall technical scheme of lasers aimed at exa-watt (EW) peak power, a multi-PW laser facility based on the all-OPCPA technique was developed in China Academy of Engineering Physics (CAEP).

**ALPS-9-03**
**16:00**

### A 100-J class laser processing system with variable parameters for the database/platform in the TACMI consortium

Takashi Sekine[1], Takashi Kurita[1], Yasuki Takeuchi[1], Takeshi Watari[1], Takaaki Morita[1], Masateru Kurata[1], Yuma Hatano[1], Yuki Kabeya[1], Yuki Muramatsu[1], Takuto Iguchi[1], Ryo Yoshimura[1], Kazuki Kawai[1], Yoshinori Tamaoki[1], Yujin Zheng[1], Yoshinori Kato[1], Norio Kurita[1], Toshiyuki Kawashima[1], Shigeki Tokita[2], Junji Kawanaka[2], Yoichiro Hironaka[2], Kohei Miyanishi[2], Keisuke Shigemori[2], Takeshi Matsuoka[2], Norimasa Ozaki[2], Ryosuke Kodama[2], Eisuke Miura[3], Ryunosuke Kuroda[3]
*1. Hamamatsu Photonics K.K., 2. Osaka University, 3. National Institute of Advanced Industrial Science and Technology*

A next generation laser processing platform has been constructed. For an investigation of high energy laser pulse solution, a 100-J class diode-pumped solid-state laser with variable parameter has been developing.

**ALPS-9-04**
**16:15**

### Possible method for single-optical-cycle 100 petawatt lasers

Zhaoyang Li
*Institute of Laser Engineering, Osaka University*

By using a large-aperture wide-angle non-collinear optical parametric chirped amplification (WNOPCPA), a single cycle 100 petawatt laser is demonstrated in simulation, which is another choice for sub-exawatt lasers.

**ALPS-9-05**
**16:30**

### Wavefront optimization of Meter-size Gratings for 10PW-class lasers

Arnaud Cotel
*HORIBA Scientific*

We present the latest results on diffracted wavefront optimization of Meter-size gratings production for 10PW-class laser pulse compression. Wavefront optimization of the holographic recording setup allows us to achieve very low holographic error ($< \lambda/30$ RMS) and wavefront quality close to the substrate value.

**ALPS-9-06**
**16:45**

## 600 mm deformable mirrors for multy PW lasers

Alexis Kudryashov[1,2], Vadim Samarkin[1,2], Alexander Alexandrov[1], Pavel Romanov[1], Julia Sheldakova[1]
*1. Institue of Geosphere Dynamics RAS, 2. AKAoptics SAS*

Deformable mirror with the size of 410x470 mm for high power lasers was developed. The results of the measurements of the main characteristics of the proposed mirrors are presented in this paper. The possibility of correction of the aberrations in high power lasers was numerically demonstrated.

# Tuesday, 23rd April 2019, Room 511+512

## ALPS-10 [G2] Metamaterial, metasurface and new materials for laser applications

15:30 - 16:30 Room 511+512

**Chair: Tomohiro Amemiya**
*Tokyo Institute of Technology*

**ALPS-10-01** *invited*
**15:30**
**Optical Nanoantennas for Plasmon Enhanced Infrared Spectroscopy**
Kai Chen
*Jinan University*
Optical nanoantennas can concentrate light into nanoscale volumes enhancing light-matter interactions. A variety of nanoantennas have been introduced and their applications in the surface-enhanced infrared spectroscopy are discussed.

**ALPS-10-02**
**16:00**
**Correlation between Optical Absorption and Device Performance of Metamaterial Perfect Absorber Solar Cells**
Tomohisa Isegawa[1], Shoei Katsumata[1], Takayuki Okamoto[2], Wakana Kubo[1]
*1. Tokyo University of Agriculture and Technology, 2. RIKEN*
We examined a correlation between a light absorption characteristic and a device performance of the metamaterial perfect absorber solar cell.

**ALPS-10-03**
**16:15**
**No-show**

# Wednesday, 24th April 2019, Room 303

## ALPS-11 [C2] Ultra-short pulse high intensity lasers and technology

9:15 - 10:30 Room 303

**Chair: Takashi Sekine**
*Hamamatsu Photonics K.K.*

**ALPS-11-01** *invited*
**9:15**
### Construction of multi-terawatt ALLEGRA laser system operating at 1 kHz repetition rate at ELI-Beamlines

Pavel Bakule[1], Roman Antipenkov[1], František Batysta[1,2], Robert Boge[1], Emily Erdman[1,3], MIchael Greco[1], Jonathan Tyler Green[1], Martin Horáček[1], Zbyněk Hubka[1,2], Lukáš Indra[1,2], Karel Majer[1], Petr Mazůrek[1], Tomáš Mazanec[1], Jack Alexander Naylon[1], Jakub Novák[1], Petr Strkula[1], Václav Šobr[1], Alexandr Špaček[1,2], Murat Torun[1], Boguslaw Tykalewicz[1], Bedřich Rus[1]
*1. ELI-Beamlines, 2. Czech Technical University in Prague, 3. Charles University in Prague*
High repetition rate OPCPA based ALLEGRA laser system has been developed at ELI Beamlines to pump XUV and X-ray secondary sources. The system is currently operating at 1 kHz, generating 20 mJ, sub-20 fs pulses.

**ALPS-11-02**
**9:45**
### Carbon Nanotube Mode-Locked Cr:ZnS Laser with 400 nm Tuning Range

Daiki Okazaki[1], Hayato Arai[2], Esko I. Kauppinen[3], Shohei Chiashi[2], Shigeo Maruyama[2,4], Satoshi Ashihara[1]
*1. Institute of Industrial Science, The University of Tokyo, 2. Departure of Mechanical Engineering, The University of Tokyo, 3. Department of Applied Physics, Aalto University School of Science, 4. Energy Nano Engineering Lab., National Institute of Advanced Industrial Science and Technology (AIST)*
We develop a mode-locked Cr:ZnS laser emitting 50-fs pulses using a single walled carbon nanotube film which has a resonant absorption around 2.4 μm, and realize the central-wavelength tuning range of 400 nm.

**ALPS-11-03**
**10:00**
### Development of ultra-low loss and high efficient cavity switch with UV writing ozone mixed gas switch

Yurina Michine, Hitoki Yoneda
*University of Electro-Communications*
Ultra-low loss and high efficient high power laser switch is expected to achieve enhancement cavity for high power lasers. We propose our ozone mixed gas diffraction optics to use for this applications.

**ALPS-11-04**
**10:15**
### All-ytterbium frontend for high-energy field synthesis and molecular fieldoscopy

Hanieh Fattahi
*Max Planck Institute of Quantum optics (MPQ)*
An all-ytterbium frontend suitable for generating high-energy, high-power light transients is presented. We demonstrate that the temporal jitter in this scheme is only limited to long-term drift, allowing for stable light transient generation.

-----Break (10:30 - 10:45) -----

# Wednesday, 24th April 2019, Room 511+512

## ALPS-12 [A1] Optical materials / structure and applications 1

9:00 - 10:30 Room 511+512

**Chair: Masashi Yoshimura**
*Osaka University*

**ALPS-12-01** *invited* **9:00**
**Quasi-phase-matched GaAs stacks for mid-infrared wavelength conversion fabricated with the room-temperature bonding**
Ichiro Shoji
*Chuo University*
We have fabricated quasi-phase-matching stacks of multiple GaAs plates for high-power wavelength conversion in mid-infrared region. A stack of 53 plates generates 20 times higher-power second harmonic of a $CO_2$ laser than the 9-plate stack.

**ALPS-12-02 9:30**
**Terbium Aluminium Garnet Ceramics for High-Average-Power LaserIsolators**
Shigeki Tokita[1], Megumi Nishio[1], Hiyori Uehara[1], Takagimi Yanagitani[2], Kana Fujioka[1], Junji Kawanaka[1], Ryo Yasuhara[3]
*1. Osaka University, 2. Konoshima Chemical Co., Ltd., 3. National Institute for Fusion Science*
Thermal and optical properties of a high-quality terbium aluminium garnet (TAG) ceramic was evaluated experimentally. It is expected that the TAG ceramic can be used as 10 kW-level high-power isolator at a low temperature.

**ALPS-12-03 9:45**
**Temperature dependence of laser-induced damage by multiple pulses irradiation**
Haruka Ogawa[1,3], Shinji Motokoshi[2], Masashi Yoshimura[3], Takahisa Jitsuno[3], Kana Fujioka[3], Masayuki Imanishi[1], Yusuke Mori[1]
*1. Grad, Sch. of Eng., Osaka Univ., 2. Inst. for Laser Tech, 3. ILE Osaka Univ.*
It was found laser-induced defects/damage caused by multiple laser pulses irradiation, which had 10-ns pulse width at 193-nm wavelength, for silica glass were suppressed by heating it.

**ALPS-12-04 10:00**
**Group 10 based transition metal dichalcogenides 2D materials used for laser photonic applications**
Yuen Hong Tsang, Long Hui Zeng, Hui Long, Chun Yin Tang, Ping Kwong Cheng, Xinyu Wang, Mohammad Ismail Hossain, Wayesh Qarony, Sainan Ma
*The Hong Kong Polytechnic University*
The report summarizes our recent research works related to the novel group 10 2D TMDs materials, e.g. $PtSe_2$, $PtS_2$, and $PdSe_2$ used for the applications of ultrafast mode locking lasers and high performance broadband photodetectors.

**ALPS-12-05 10:15**
**Evaluation of Sensing Structure of Laser Microphone using Self-coupling Effect of Laser Diode for Spherical Sound Wave**
Daisuke Mizushima, Norio Tsuda, Jun Yamada
*Aichi Institute of Technology*
In laser microphone using the self-coupling effect of laser diodes, detection of spherical sound waves is difficult. Therefore, a multiple reflection sensor structure is proposed. The sound pressure distribution was reconstructed by the new sensor.

-----Break (10:30 - 11:00) -----

# Wednesday, 24th April 2019, Room 303

## ALPS-13 [C3] Measurements and applications of high intensity lasers

10:45 - 12:00 Room 303

**Chair: Pavel Bakule**

*Institute of Physics of the Czech Academy of Sciences, ELI Beamlines*

**ALPS-13-01 10:45**

### 3D spatiotemporal distortion and detection of femtosecond petawatt lasers

Zhaoyang Li

*Institute of Laser Engineering, Osaka University*

A spatiotemporal coupling (STC) induced 3D spatiotemporal distortion (STD) in femtosecond petawatt lasers is introduced. Two detection methods of multiple-slit spatiotemporal interferometry (MSTI) and space-scanned double-slit spatiotemporal interferometry (SDSTI) are proposed.

**ALPS-13-02 11:00**

### Time-resolved soft X-ray absorption spectroscopy of nitric oxide near N K-edge at 400 eV

Nariyuki Saito, Hiroki Sannohe, Nobuhisa Ishii, Teruto Kanai, Jiro Itatani

*The Institute for Solid State Physics, the University of Tokyo*

We report on the time-resolved X-ray absorption spectroscopy of nitric oxide at N K-edge (400 eV) using high harmonics generated by a 1.6-μm light source.

**ALPS-13-03 11:15**

### Temporal Change of the Optical Properties of Titanium Surface Irradiated by Femtosecond-Laser Pulses

Yuki Furukawa[1,2], Sadaoki Kojima[1], Shunsuke Inoue[1,2], Masaki Hashida[1,2], Shuji Sakabe[1,2]

*1. Institute for Chemical Research, Kyoto University, 2. Graduate School of Science, Kyoto University*

We've measured the temporal change of the optical properties of titanium surface irradiated by femtosecond-laser pulses in the fluence lower than the ablation-threshold. The reduction of the light-penetration-depth is observed at around 100ps after irradiation.

**ALPS-13-04 11:30**

### Attosecond Soft-X-Ray Spectroscopy of the Opto-Electronic Response of a Transition Metal Dichalcogenide Material

Barbara Buades[1], Iker Leon[1], Nicola DiPalo[1], Daniel Rivas[1,2], Themistoklis P.H. Sidiropoulos[1], Stefano Severino[1], Maurizio Reduzzi[1], Seth Cousin[1], Michael Hemmer[1], Claudia Cocchi[3], Eric Pellegrin[4], Javier Herrero[4], Samuel Manas[5], Eugenio Coronado[5], Thomas Danz[6], Claudia Draxl[3], Mitsuharu Uemoto[7], Kazuhiro Yabana[7], Martin Schultze[8], Simon Wall[1], Antonio Picon[1,9], Jens Biegert[1,10]

*1. ICFO - The Institute of Photonic Sciences, 2. European XFEL GmbH, 3. Humboldt-Universität, 4. ALBA Synchrotron Light Source, , 5. Universitat de València, 6. University of Göttingen, 7. University of Tsukuba, 8. Ludwig-Maximilians- Universität, 9. Universidad Autónoma de Madrid, 10. ICREA,*

We use attosecond soft X-ray pulses between 284 eV to 543 eV for orbital-selective and real-time probing of the opto-electronic response of semi metallic $TiS_2$.

**ALPS-13-05 11:45**

### Time-resolved imaging of photoresist stripping dynamics induced by laser irradiation

Naoki Nishioka[1,2], Yuji Umeda[1], Daichi Shima[1], Ono Koichi[1], Tomosumi Kamimura[1], Hideo Horibe[2], Masashi Yoshimura[3], Ryosuke Nakamura[3]

*1. Osaka Institute of Technology, 2. Osaka City University, 3. Osaka University*

Time-resolved imaging system is developed to elucidate photoresist stripping dynamics induced by laser irradiation and demonstrates that the resist was removed from a Si-wafer in atmosphere at 15 us and in water at 30 ms.

-----Lunch (12:00 - 13:15) -----


# Wednesday, 24th April 2019, Room 511+512

## ALPS-14 [A2] Optical materials / structure and applications 2

11:00 - 12:00 Room 511+512

**Chair: Takunori Taira**
*RIKEN SPring-8 Center*

**ALPS-14-01** *invited* **11:00**
**PPLN-based compact modelocked laser**
Ursula Keller
*ETH Zurich*
Second-order nonlinear interactions offer many properties advantageous to ultrafast laser sources. In the context of gigahertz rate modelocked lasers we have developed self-defocusing intracavity adiabatic quasi-phase-matching devices, which resolve the long-standing Q-switching damage problem.

**ALPS-14-02** **11:30**
**High performance lead-free electro-optic and magneto-optic polycrystalline materials**
Javier Garay, Yasuhiro Kodera
*UC San Diego*
We produced high performance lead-free electro-optic and magneto-optic transparent material. The BZT-BCT ceramic has an effective DC EO coefficient whch is higher than $LiNbO_3$ while the MO materials have higher MO coefficient (verdet constant) than TGG.

**ALPS-14-03** **11:45**
**Super-flat white-light generation in multi-thin plates**
Shaobo Fang
*Institute of Physics, Chinese Academy of Sciences*
We demonstrated the white-light generation in multi-thin plates via two-color induced-phase modulation.

-----Lunch (12:00 - 13:15) -----

# Wednesday, 24th April 2019, Exhibition Hall A

## ALPS-P1 Poster Session 1

13:15 - 14:45 Exhibition Hall A

**ALPS-P1-01** **Development of transparent Er:$Y_2O_3$ ceramics fabricated by spark plasma sintering**

Mayu Imai, Hiroaki Furuse
*Kitami Institute of Technology*

Transparent Er doped $Y_2O_3$ fine-grained ceramics were fabricated by spark plasma sintering technique. The in-line transmittance of 80% at 1700 nm with a grain size of 480 nm was obtained for 10 at.% Er:$Y_2O_3$.

**ALPS-P1-02** **Development of high-quality $CsLiB_6O_{10}$ crystal for high-power DUV application**

Masashi Yoshimura[1], Goh Ando[1], Yoshinori Takahashi[1], Ryota Murai[1], Kosaku Kato[1], Makoto Nakajima[1], Masayuki Imanishi[2], Yusuke Mori[2]
*1. Institute of Laser Engineering, Osaka University, 2. Graduate School of Engineering, Osaka University*

A high-quality CLBO crystal with the size of 126 mm × 75 mm × 55 mm and the weight of 531 g was grown from Li-poor flux. It has higher UV-induced damage resistance than previous crystals.

**ALPS-P1-03** **Crystal growth and optical properties of $SrB_4O_7$ crystal for DUV laser application**

Tsuyoshi Sugita[1,2], Yasunori Tanaka[3], Ryota Murai[2], Yoshinori Takahashi[2], Masayuki Imanishi[3], Yusuke Mori[3,4], Masashi Yoshimura[2,4]
*1. Nikon Corporation, 2. Institute of Laser Engineering, Osaka University, 3. Graduate School of Engineering, Osaka University, 4. SOSHO CHOKO Incorporated*

We grew $SrB_4O_7$ (SBO) single crystal with dimensions 60 × 9.2 × 18 $mm^3$ using the Kyropoulos method. The optical properties of SBO crystal were evaluated, which showed high transmittance in the deep ultraviolet region.

**ALPS-P1-04** **Canceled**

**ALPS-P1-05** **An approach to make a variable wavelength laser by GaN/InGaN-MQW with high-reflection DBR and external mirror**

Yen-Chun Chen[1], Yu-Pin Lan[1]
*1. National Chiao Tung University*

An approach to realize wavelength variable laser system by a direct bandgap semiconductor material with different element concentration as laser gain medium and external cavity.

**ALPS-P1-06** **No-show**

**ALPS-P1-07** **3.6 kW Higher-Order Mode Fibre Amplifier**

Kai Han[1,2,3], Rui Song[1,2,3], Weiqiang Yang[1,2,3], Xuexue Luo[1], Xiaolin Wang[1,2,3], Xiaoming Xi[1,2,3]
*1. College of Advanced Interdisciplinary Studies, National University of Defense Technology, 2. State Key Laboratory of Pulsed Power Laser Technology, 3. Hunan Provincial Key Laboratory of High Energy Laser Technology*

A 3.6kW monolithic fibre amplifier pumped at 976 nm in a forward-pump scheme is demonstrated experimentally based on a 30/600 YDF. The seed and the output light exhibits a stable $LP_{01}$ and $LP_{11}$ modes, respectively.

**ALPS-P1-08** **Development of kW-class Yb:YAG TRAM CW Laser Oscillator with Direct Jet impingement Cooling**

Haik Chosrowjan[1], Seiji Taniguchi[1], Masayuki Fujita[1], Dazhi Li[1], Shinji Motokoshi[1], Yasukazu Izawa[1], Shingo Nishikata[2], Tomoya Morioka[2], Koichi Hamamoto[2], Hiroshi Ikebuchi[2], Yuichi Ohtani[2], Takeshi Kaneko[2], Hiroyuki Daigo[2]
*1. Institute for Laser Technology, 2. Mitsubishi Heavy Industries, Ltd.*

Temperature characteristics and output power of Yb:YAG TRAM (Total-Reflection Active Mirror) laser using zero-phonon line excitation (@969-nm) and direct water jet cooling have been investigated. kW-class, CW lasing with 63 % slope efficiency was demonstrated.

**ALPS-P1-09** **Characteristics of multi-pass amplification by use of Yb:YAG active mirror**

Ryo Kageyama, Keigo Maeda, Takuto Ogura, Takeshi Higashiguchi
*Utsunomiya university*

We characterized the thermal lens effects with wavefront distortions of Yb:YAG active mirror amplifier. The output power at 1030 nm was higher than 1 W at a repetition rate of 6 kHz.

**ALPS-P1-10** **Regenerative amplification of visible picosecond laser pulses with Praseodymium-doped gain media**

Shogo Fujita, Naoto Sugiyama, Fumihiko Kannari
*Keio University*

We have demonstrated amplification of 639-nm picosecond laser pulses by InGaN diode-pumped $Pr^{3+}$-doped gain materials. Two amplifiers, a single pass Pr:$AlF_3$ fiber and a regenerative Pr:YLF, are employed.

**ALPS-P1-11** **High gain femtosecond CPA laser system based on Yb:YAG single crystal fiber boosters with different geometries**

Elena Sall[1], Sergey Chizhov[2], Byunghak Lee[1], Jun Wan Kim[1], Juhee Yang[1]
*1. Korea Electrotetechnology Research Institute, 2. Institute of Applied Physics of Russian Academy of Sciences, Nizhny Novgorod, Russia*

We report a study of femtosecond pulses amplification based on Yb:YAG single crystal fiber (SCF) boosters with different geometries. The SCF with optimized geometry for each amplification stage results in total gain up to $10^4$. Experimentally it is shown that direct boosting approach is limited by self-focusing at 3.5 μJ pulse energy level. To suppress nonlinear effects in the crystal CPA approach is used.

**ALPS-P1-12** **Spectral behavior of amplified near-infrared supercontinuum beam in ytterbium-doped double-clad passive fiber**

Misaki Shoji[1], Natsumi Shinozaki[1], Kazuyuki Sakaue [2], Takeshi Higashiguchi[1]
*1. Utsunomiya University, 2. Photon Science Center, The University of Tokyo*

The flat spectra was observed with a power of 6.2 W in the near-infrared spectral range of 1 - 2.3 μm, which represents a bandwidth of 1.1 μm at the 20-m-long Yb-doped double-clad passive fiber.

**ALPS-P1-13** **Generation of single-cycle shortwave infrared pulses in BBO-based cascaded optical parametric amplifier**

Yu-Chieh Lin, Yasuo Nabekawa, Katsumi Midorikawa
*Attosecond Science Research Team, RIKEN*

Nearly-transform-limited, 5.3 fs shortwave infrared pulses with central wavelength 1.7 μm are generated within BBO-based cascaded degenerate optical parametric amplifier.

**ALPS-P1-14** **Parametric Amplification of Mid-Infrared Optical Pulses with Monolithic Carrier-Envelope Phase Stabilization by Multi-Plate Pulse Compression**

Nobuhisa Ishii, Peiyu Xia, Teruto Kanai, Jiro Itatani
*The Institute for Solid State Physics, The University of Tokyo*

We report on the development of an optical parametric amplifier that produces mid-infrared optical pulses (56 μJ, 120 fs, 3.0 μm, 6 kHz) with monolithic carrier-envelope phase stabilization via a multi-plate spectral broadening scheme.

**ALPS-P1-15** **Characteristics of longitudinally excited $CO_2$ laser operating at a high repetition rate**

Kohei Sakamoto[1], Kazuyuki Uno[1], Takahisa Jitsuno[2]
*1. University of Yamanashi, 2. Osaka University*

We investigated characteristics of a longitudinally excited $CO_2$ laser at a repetition rate of 300 Hz or less. The laser output energy did not depend on a repetition rate in a same low gas pressure.

**ALPS-P1-16** **Key technologies for the high power cryogenically-cooled active-mirror amplifier**

jumpei ogino[1], Shigeki Tokita[1], Li Zhaoyang[1], Naohiro Yamaguchi[1], Shinji Motokoshi[2], Masaaki Sakamoto[1], Noboru Morio[1], Koji Tsubakimoto[1], Hidetsugu Yoshida[1], Kana Fujioka[1], Junji Kawanaka[1]
*1. Institute of Laser Engineering, Osaka University, 2. Institute for Laser Technology*

We are developing the 100 J, 100 Hz cryogenically-cooled active-mirror amplifier. It is necessary to develop the Key technology about cooling structure, bonding, wave front compensation. We will report a overview and currently result.

**ALPS-P1-17** **Recovery dynamics of semiconductor saturable absorber for ultra-high intensity lasers**

Koichi Ogura, Yasuhiro Miyasaka, Hiromitsu Kiriyama
*National Institutes for Quantum and Radiological Science and Technology*

We have experimentally investigated the recovery dynamics of a semiconductor-doped glass saturable absorber, as a temporal pulse cleaner for ultra-high intensity laser facilities. We present the detailed performance as a temporal filter.

**ALPS-P1-18** **Development of a diode-pumped stable laser for low-jitter OPCPA pumping**

Yasuhiro Miyasaka, Hiromitsu Kiriyama, Maki Kishimoto, Michiaki Mori, Kotaro Kondo, Masaki Kando, Kiminori Kondo
*National Institutes for Quantum and Radiological Science and Technology*

1064nm pulses generated by photonic crystal fiber from Ti:sapphire oscillator pulses are amplified to 200mJ (RMS:< 0.2%) in LD-pumped amplifiers at 10Hz. Harmonically converted laser energy (532nm) of 130mJ are obtained with LBO frequency doubler.

**ALPS-P1-19** **No-show**

**ALPS-P1-20** **Large Diameter TGG Ceramic Faraday Rotator for kW Class Average Power Laser**

Hidetsugu Yoshida, Shigeki Tokita, Koji Tsubakimoto, Junji Kawanaka
*Institute of Laser Engineering, Osaka University*

A large diameter Faraday isolator for few kW average laser systems was developed using over 50-mm diameter TGG ceramic. The wavefront distortion of TGG ceramic was 0.1-0.2 wave. The maximum magnetic field provided by a permanent magnet was 1.4-1.5T.

**ALPS-P1-21** **Fabrication of GelMA Hydrogel Micro/Nano Structures Using Femtosecond Laser Two-photon Polymerization**

ziyuan shi, yanping yuan, jimin chen, dongfang li, chengyu zhang, haida chen
*Institute of Laser Engineering,Beijing University of Technology*

Microstructures were fabricated in methacrylate gelatin(GelMA) hydrogel solution using two-photon polymerization(TPP). Swelling ratio and cytotoxicity of materials were measured.

**ALPS-P1-22** **Single-shot 2-D burst imaging in sub-nanosecond region with spectrally sweeping ultrafast laser pulses**

Hirofumi Nemoto, Takakazu Suzuki, Yuki Yamaguchi, Kazuki Takasawa, Kazuki Matsushita, Fumihiko Kannari
*Keio University*

We generate spectrally sweeping burst pulses for ultrafast imaging. Adopting those pulses to sequentially timed all-optical mapping photography utilizing spectral filtering (SF-STAMP), we realize single-shot 2-D burst imaging in a sub-nanosecond time window.

**ALPS-P1-23** **Electron temperature of high-pressure argon plasma induced by femtosecond laser**

Yuki Mori, Kosuke Tsuchida, Norio Tsuda, Jun Yamada
*Aichi Institute of Technology*

For the femtosecond laser argon plasma, the electron temperature distribution along light axis and pressure dependency were measured.

**ALPS-P1-24** **Short Pulse Light Source at 193nm for Hybrid ArF Laser**

Yuuki Tamaru, Hironori Igarashi, Chen Qu, Atsushi Fuchimukai, Yoshihiko Murakami, Yasuhiro Kamba, Taisuke Miura, Junichi Fujimoto, Hakaru Mizoguchi
*Gigaphoton Inc.*

We demonstrate a short pulse generation at 193nm for micromachining application. Seed pulse of 160mW output is generated by the cascaded sum frequency generation using CLBOs and is amplified up to 10W by ArF amplifier.

**ALPS-P1-25** **Laser wavelength dependence of the soft x-ray spectra in a bismuth plasma**

Hiromu Kawasaki, Yuta Shimada, Misaki Shoji, Aina Tanaka, Takeshi Higashiguchi
*Utsunomiya University*

The effect of irradiated laser wavelength in a bismuth soft x-ray source was considered by comparing the water-window soft x-ray emissions. The soft x-ray emission for 532-nm laser was stronger than that of 1064-nm laser.

-----break (14:45 - 15:30) -----

# Wednesday, 24th April 2019, Exhibition Hall A

## ALPS-P2 Poster Session 2

15:30 - 17:00 Exhibition Hall A

**ALPS-P2-01** **Spectroscopic properties of heavily $Er^{3+}$doped silica glass**

Yu Yamasaki[1,2], Rieko Azuma[1], Yoshio Kagebayashi[1], Kana Fujioka[3], Yasushi Fujimoto[2]
*1. Ushio Inc., 2. Chiba Institute of Technology, 3. Institute of Laser Engineering, Osaka University*

Heavily $Er^{3+}$ doped (over 10000ppm) silica glasses were fabricated by Zeolite method and examined on their spectroscopic properties. This glass can be applicable for fabricating a short-length fiber core and its fiber laser oscillator.

**ALPS-P2-02** **Measurement of small signal gain in Pr-doped waterproof fluoride glass fiber**

Takumi Ikeda[1], Sokuto Itou[1], Yuki Fukuda[1], Shota Kajikawa[2], Minoru Yoshida[2], Yasushi Fujimoto[1]
*1. Chiba Institute of Technology, 2. KINDAI University*

We report a result of small signal gain property of Pr-doped fluoro-aluminate glass (Pr:WPFG) fiber. This result will provide the precise discussion of laser cavity design and power scaling of Pr:WPFG fiber laser.

**ALPS-P2-03** **Dispersion-managed Tm-doped ultrashort pulse fiber laser using SWNT at 2 μm wavelength region**

Kenta Watanabe[1], Ying Zhou[2], Takeshi Saito[2], Youichi Sakakibara[2], Norihiko Nishizawa[1]
*1. Nagoya University, 2. National Institute of Advanced Industrial Science and Technology*

High power Tm-doped ultrashort pulse fiber laser operated at λ=2 μm region was demonstrated using single wall carbon nanotube dispersed in polyimide film. A 1.68 nJ, 211 fs high energy ultrashort pulse was obtained stably.

**ALPS-P2-04** **Dispersion management and analysis of all PM Er-doped passively mode-locked fiber laser with nonlinear amplifying loop mirror**

Hayato Suga, Mashahito Yamanaka, Norihiko Nishizawa
*Nagoya University*

We investigated dispersion management of all polarization maintaining Er-doped Figure 9 fiber laser. Typical mode-locking operation was stably obtained from the anomalous to the normal net dispersion region both experimentally and numerically.

**ALPS-P2-05** **Nonlinear Polarization rotation dispersion managed soliton mode-locked laser using normal dispersion Tm silica fiber**

Takumi Sato[1], Yuhao Chen[2], Raghuraman Sidharthan[2], Seongwoo Yoo[2], Masaki Tokurakawa[1]
*1. Institute for Laser Science, University of Electro-Communications, 2. School of and Electronic Engineering, Nanyang Technological University*

We report a nonlinear polarization rotation dispersion managed soliton mode-locked laser. This laser creates an average power of 12.3mW at a repetition rate of 11.9MHz. Center wavelength and spectral bandwidth are ~1953nm and ~4nm, respectively.

**ALPS-P2-06** **Supercontinuum Generation Directly from a Random Fiber Laser**

RUI SONG, Lanjian Chen, Weiqiang Yang, Feng He, Kai Han, Jing Hou, Quan Sun, Yu Ning
*National University of Defense Technology*

A near-infrared supercontinuum with more than 600nm spectral width and low coherence is achieved directly from a random fiber laser, which provides a simple and low cost method to obtain supercontinuum for various applications.

**ALPS-P2-07** **Experimental Research of a 2μm Pulsed Laser Based on a Supercontinuum Source**

Weiqiang Yang[1,2,3], Rui Song[1,2,3], Feng He[1,2,3], Kai Han[1,2,3], Quan Sun[1,2,3], Yu Ning[1,2,3]
*1. College of Advanced Interdisciplinary Studies, National University of Defense Technology, 2. State Key Laboratory of Pulsed Power Laser Technology, 3. Hunan Provincial Key Laboratory of High Energy Laser Technology*

An all-fiber integrated 2 μm pulsed laser with a supercontinuum source as the pump light has been reported, which provides a new way to get 2 μm pulsed lasers.

**ALPS-P2-08** **Development of a novel Herriott-multipass cavity laser oscillator with SESAM located at the compensated position for q-parameter preservation**

Seong-Hoon Kwon, Do-Kyeong Ko
*Gwangju Institute of Science and Technology*

We developed a novel Herriott-mulipass cavity (HMPC) laser oscillator in which the saturable absorber mirror (SESAM) and the prism pair are compatible through the changed position of the SESAM.

**ALPS-P2-09** **Amplification Property of Ce/Cr/Nd:YAG Ceramic Active-Mirror Laser Using White-light Pump Source**

Taku Saiki[1], Yusuke Kon[1], Takato Nakamachi[1], Takanori Hayashi[1], Hiroaki Furuse[2], Shinji Motokoshi[3], Yasusi Fujimoto[4], Masahiro Nakatsuka[3,5]
*1. Kansai University, 2. Kitami Institute of Technology, 3. Instutute for Laser Technology, 4. Chiba Instutute of Technology, 5. Instutute of Laser Engineering, Osaka University*

Active-mirror laser using $Ce^{3+}/Cr^{3+}$/Nd:YAG ceramic has been developed. Amplification property of CW laser for the active mirror under lamp (quasi-solar) light pumping had been investigated experimentally and numerically.

**ALPS-P2-10** **Accuracy for Diffuse Reflection Object of Velocity and Distance Simultaneous Measurement Sensor by Self-Coupling Signal**

Masanari Yamada, Norio Tsuda, Jun Yamada
*Aichi Institute of Technology*

Velocity and distance simultaneous measurement by self - coupling effect of semiconductor laser was studied. Improvement of the light receiver circuit made it possible to measure diffuse reflection object.

**ALPS-P2-11** **Signal processing using moving average method of self-coupling laser terminal voltage distance sensor**

Tatsuya Ohba, Norio Tsuda, Jun Yamada
*Aichi Institute of Technology*

To improve the measurement accuracy of Self-coupled laser terminal voltage distance sensor, the signal components of self-coupling signal were investigated and the effectiveness of moving average method was confirmed.

**ALPS-P2-12** **Method Verification of Intensity Decision of Laser Microphone Using Deep Learning**

Ryota Mori, Norio Tsuda, Jun Yamada
*Aichi Institute of Technology*

The Laser Microphone is unprecedented microphones that don't use diaphragm membranes. We verified whether the desired the sound pressure intensity can be determined even in the presence of superimposed noise by using Deep Learning.

**ALPS-P2-13** **Design concentration lens and simulate solar-pumped solid-state lasers by using a DPSS laser**

Bo-Wei Huang[1], Shi-Wei Wang[1], Yen-Chun Chen[2], Min-Che Chiang[3], Yu-Pin Lan[1]
*1. National Chiao Tung University, Institute of Lighting and Energy Photonics, College of Photonics, 2. National Chiao Tung University, Institute of Photonic System, College of Photonics, 3. National Chiao Tung University, Institute of Imaging and Biomedical Photonics*

We present a more efficient method of natural energy to process the reduction reaction of a magnesium oxide by using a solar-pumped solid-state laser. The DPSS is utilized to be a simulated model.

**ALPS-P2-14** **Development of intense terahertz source aiming at highly time resolved measurement of terahertz induced periodic surface structure formation**

Chikai Hosokawa[1], Masaki Hashida[1], Takeshi Nagashima[2], Shunsuke Inoue[1], Shuji Sakabe[1]
*1. ICR Kyoto University, 2. Setsunan University*

Aiming at high time resolution measurement of LIPSS formation process, we developed an intense terahertz source and succeed to generate single-cycle terahertz pulses with a maximum energy of 118 μJ.

**ALPS-P2-15** **Single-shot 2D burst ultrafast imaging in terahertz region utilizing SF-STAMP**

Kazuki Takasawa[1], Takakazu Suzuki[1], Yuki Yamaguchi[1], Hirofumi Nemoto[1], Masahiko Tani[2], Hideaki Kitahara[2], Dmitry S. Bulgarevich[2], Fumihiko Kannari[1]
*1. Keio University, 2. University of Fukui*

We demonstrated single shot burst imaging method in the terahertz region of ultrafast phenomenon by combining conventional terahertz imaging method with SF-STAMP. This method can be extended to single shot multi spectral imaging.

**ALPS-P2-16** **The modulation of femtosecond SPP wavepackets induced by MIM nano cavities**

Naoki Ichiji, Atsushi Kubo
*The University of Tsukuba*

By using time-resolved pump-probe technique and FDTD simulation, we reveal an optical functionality of MIM nano cavity as a spectrum filter that induces significant changes in shapes of SPP wave packets.

**ALPS-P2-17** **Fabrication of nano graphene wire employing ultrafast nanofocused surface plasmon pulses**

Takumi Matsuda, Keita Tomita, Fumihiko Kannari
*Keio Univ.*

We achieve photoreduction of graphene oxidethin film bysurface polariton-plasmon pulses nanofocused by a tapered gold tip and fabricate a nano graphene wire of which width is beyond the diffraction limit. Moreover, we monitor the reduction process by selective in situ CARS measurements.

**ALPS-P2-18** **Improvement of image quality of rigid-endoscope OCT system using two-dimensional KTN optical scanner**

Masato Ohmi[1], Kanagawa Rena[1], Shogo Yagi[2]
*1. Osaka University, 2. NTT Advance Technology Corporation*

We developed rigid-endoscope OCT system using KTN optical scanner for a diagnosis in the orthopedic surgery fields. In this paper, we improved the image quality of OCT image by resampling process of OCT signals. The present system demonstrates that biological image was measured by using KTN optical scanner for having degree of freedom in sample arm as OCT.

**ALPS-P2-19** **Wavelength Modulation Spectroscopy of Linalool Using Broadband 3μm Difference Frequency Laser**

Shota Kato[1], Hiroki Ishikawa[1], Kazuki Uchiyama[1], Ayumu Maruyama[2], Masaki Asobe[1], Kazuyoku Tei[2], Shigeru Yamaguchi[2], Noriaki Hirayama[3]
*1. Graduate School of Engineering, Tokai University, 2. Graduate School of Science, Tokai University, 3. Institute of Advanced Biosciences, Tokai University*

We measured absorption spectra of linalool by using a broadband mid-infrared light source. We demonstrated that contrast between peaks due to water and linalool can be improved by using proper modulation depth.

**ALPS-P2-20** **No-show**

**ALPS-P2-21** **Dual-comb Spectroscopy Technique for Magneto-optic Effect Measurements**

Takuto Adachi[1], Akifumi Asahara[1,2], Yusuke Odagiri[1,2,3], Masayuki Shirakawa[4], Yue Wang[1,2], Chikako Ishibashi[2,3], Satoshi Hatano[2,3], Eiji Tokunaga[4], Kaoru Minoshima[1,2]
*1. The University of Electro-Communications, 2. Japan Science and Technology Agency (JST), ERATO MINOSHIMA Intelligent Optical Synthesizer (IOS) Project, 3. Neoark Corporation, 4. Tokyo University of Science*

We developed a new technique for characterizing magneto-optic effect using dual-comb spectroscopy. The Faraday rotation of a rare-earth material was measured by the developed method as a proof-of-concept experiment.

**ALPS-P2-22** **Development of Dual-Comb Faraday Effect Measurement Equipment**

Yusuke Odagiri[1,2,3], Akifumi Asahara[2,3], Takuto Adachi[2], Masayuki Shirakawa[4], Yue Wang[2,3], Chikako Ishibashi[1,3], Satoshi Hatano[1,3], Eiji Tokunaga[4], Kaoru Minoshima[2,3]
*1. NEOARK Corporation, 2. The University of Electro-Communications, 3. JST, ERATO MINOSHIMA Intelligent Optical Synthesizer Project, 4. Tokyo University of Science*

We developed a Faraday effect measurement equipment using dual-comb spectroscopy. Spectral information is obtained with a higher resolution in a shorter acquisition time. Measurement of a magnetic hysteresis loop of a magnetic material was demonstrated.

**ALPS-P2-23** **Improvement of Q factor and dispersion of crystalline microresonator towards soliton comb generation**

Shuya Tanaka[1], Mika Fuchida[1], Shun Fujii[1], Hikaru Amano[2], Akihiro Kubota[1], Ryo Suzuki[1], Yasuhiro Kakinuma[2], Tanasumi Tanabe[1]
*1. Department of Electronics and Electrical Engineering, Faculty of Science and Technology, Keio University, 2. Department of System Design Engineering, Faculty of Science and Technology, Keio University*

This paper describes an order of magnitude improvement in the Q factor of a $MgF_2$ crystalline microresonator realized with elaborate hand polishing. A precise dispersion measurement reveals that the dispersion of the resonator changed little.

**ALPS-P2-24** **Tailored generation of a highly-discrete Raman type comb**

Weiyong Liu[1,2], Chiaki Ohae[1,2], Jian Zheng[1], Soma Tahara[1], Masaru Suzuki[1,3], Kaoru Minoshima[1,2,3], Masayuki Katsuragawa[1,2,3]
*1. Graduate School of Informatics and Engineering, the University of Electro-Communications, 2. JST, ERATO MINOSHIMA Intelligent Optical Synthesizer Project (IOS), 3. Institute for Advanced Science, the University of Electro-Communications*

We discuss how we can have a wide freedom to engineer nonlinear optical processes by manipulating relative phases among the relevant electromagnetic fields. We report, as a typical example, tailored generation of a highly-discrete Raman type comb.

**ALPS-P2-25** **Development of broadband bidirectional dual-comb fiber laser with narrow relative linewidth**

Yuya Hata[1,2], Yoshiaki Nakajima[1,2], Kaoru Minoshima[1,2]
*1. The University of Electro-Communications, 2. JST, ERATO Minoshima Intelligent Optical Synthesizer Project*

We developed a bidirectional mode-locked Er:fiber ring laser for dual-comb spectroscopy. Narrow relative linewidth of < 5 Hz was achieved between the bidirectional outputs without any active stabilization, which is attractive for practical ultra-broadband spectroscopy.

**ALPS-P2-26** **High-accuracy shape measurement technique using two-color interferometry with optical frequency combs with air fluctuation compensation**

Yoshihisa Ikisawa[1,2], Yoshiaki Nakajima[1,2], Guanhao Wu[3], Kaoru Minoshima[1,2]
*1. The University of Electro-Communications (UEC), 2. Japan Science and Technology Agency (JST), ERATO MINOSHIMA Intelligent Optical Synthesizer (IOS) Project, 3. Tsinghua University*

We developed a high-accuracy shape measurement technique with self-correction of air fluctuation using two-color interferometry with an optical frequency comb. Without additional setup, synthetic wavelength interferometry is incorporated, which could greatly expand the measurement range.

**ALPS-P2-27** **Technique of Digital Control of Laser Oscillation Frequencies by means of Difference Frequency Stabilization of a Microchip Laser**

Iyon Titok Sugiarto[1,2], Takahiro Masaki[1], Masaharu Hyodo[1]
*1. Kanazawa University, 2. Research Center for Physics-Indonesian Institute of Sciences (LIPI)*

Experiments on digital control of laser oscillation frequencies of a dual-mode microchip laser was demonstrated by means of difference frequency stabilization between the two longitudinal oscillation modes using a digital feedback control.

**ALPS-P2-28** **No-show**

# Thursday, 25th April 2019, Room 303

## ALPS-15 [D1] Novel material and wavelength lasers

9:00 - 10:30 Room 303

**Chair: Dingyuan Tang**
*Nanyang Technological University*

**ALPS-15-01** *invited* **9:00**
**Diamond Raman Lasers**
Richard Mildren
*Macquarie University*
Laser action in diamond via stimulated scattering provides a pathway to new laser capabilities in power, narrow linewidths and wavelength range. This paper will review the latest developments and highlight future directions of outstanding promise.

**ALPS-15-02** **9:30**
**Characteristic of visible lasing with a $Pr^{3+}$-doped oxide crystal $YAlO_3$**
Shogo Fujita, Fumihiko Kannari
*Keio University*
We demonstrate power scaling of continuous wave $Pr^{3+}$:$YAlO_3$ (YAP) laser and obtained output power of 1230 mW at 747 nm. We also study the effect of thermal lensing in $Pr^{3+}$:YAP.

**ALPS-15-03** **9:45**
**Efficient continuous-wave operation of Er:YAP single crystal laser at 2.92 µm**
Hiroki Kawase[1], Ryo Yasuhara[1,2]
*1. SOKENDAI (The Graduate University for Advanced Studies), 2. National Institutes of Natural Sciences, National Institute for Fusion Science*
An efficient 2.92 µm continuous-wave laser was performed by the diode-pumped Er:YAP at room-temperature. The obtained 34% slope efficiency was greater than quantum defect efficiency. Er:YAP has the potential for developing mid-IR laser.

**ALPS-15-04** **10:00**
**Fabrication of Er-doped Microresonator for On-Chip Mode-locked Laser with CNT as Saturable Absorber**
Riku Imamura[1], Shun Fujii[1], Tomoki Suzuki[1], Ryo Suzuki[1], Rammaru Ishida[1], Mizuki Ito[1], Hideyuki Maki[2,4], Lan Yang[3], Takasumi Tanabe[1]
*1. Department of Electronics and Electrical Engineering, Keio University, 2. Department of Applied Physics and Physico-Informatics, Keio University, 3. Department of Electrical and Systems Engineering, Washington University, 4. PRESTO, Japan Science and Technology Agency*
A microresonator-based mode-locked laser has a high pulse repetition rate. In this work, we explore the possibility of a passive mode-locked laser with CNT as a saturable absorber and erbium-doped microresonator.

**ALPS-15-05** **10:15**
**High Quality-Factor Kerr-lens Mode-locked Tm:$Sc_2O_3$ Laser with anomalous spectral broadening**
Anna Suzuki[1], Christian Kränkel[2], Masaki Tokurakawa[1]
*1. Institute for Laser Science, The University of Electro-Communications, 2. Zentrum für Lasermaterialien, Leibniz-Institut für Kristallzüchtung*
We developed a high quality-factor Kerr-lens mode-locked Tm:$Sc_2O_3$ laser with dispersion compensation mirror. Spectral bandwidth of 55 nm at 17 mW average output power was obtained.

-----Break (10:30 - 11:00) -----

# Thursday, 25th April 2019, Room 304

## ALPS-16 [F1] Terahertz applications

9:00 - 10:30 Room 304

**Chair: Takashi Notake**
*RIKEN SPring-8 Center*

**ALPS-16-01** *invited* **9:00**
**Terahertz manipulation of magnetization and terahertz devices based on the magnetic materials**
Makoto Nakajima
*Osaka University*
Terahertz pulses with the magnetic field components can excite directly and control the magnetization and spin precessions in magnetic materials. Applications such as terahertz emitter and detectors based on magnetic materials were demonstrated.

**ALPS-16-02 9:30**
**Sub-THz spectroscopy using laser chaos**
Fumiyoshi Kuwashima[1], Takuya Shirao[1], Kazuyuki Iwao[1], Masahiko Tani[2], Kazuyoshi Kurihara[3], Kohji Yamamoto[2], Osamu Morikawa[4], Hideaki Kitahara[2], Makoto Nakajima[5]
*1. Fukui Univ. of Tech., 2. Research Center for Development of Far-Infrared Region, University of Fukui, 3. Fac. of Educ., Univ. of Fukui, 4. Chair of Liberal Arts, Japan Coast Guard Academy, 5. Institute of Laser engineering, Osaka Univ.*
Stable THz waves are obtained from the multimode-laser diode excited photoconductive antennas using a laser chaos. This THz wave is suitable for the spectroscopy. In this paper, it is applied to distinguish water and oil.

**ALPS-16-03 9:45**
**Index-Tunable Terahertz Metamaterials with Lowered Loss Based on Double-Layered Asymmetric Closed-Ring Resonator Arrays**
Tatsunosuke Matsui, Shun Taniguchi, Yuki Watanabe
*Mie University*
We demonstrate index-tunable terahertz metamaterials based on double-layered closed-ring resonator arrays. The index-tuning can be realized by slightly shifting relative position of the arrays. Introducing asymmetry is quite effective to lower a reflection loss.

**ALPS-16-04 10:00**
**Terahertz Semiconductor Quantum Devices and Their Applications**
Juncheng Cao
*Shanghai Institute of Microsystem and Information Technology, Chinese Academy of Sciences*
We have developed Terahertz (THz) semiconductor quantum cascade lasers (QCL) and THz quantum-well photodetector (QWP). We demonstrate the real-time THz communication and imaging based on the THz QCL and THz QWP.

**ALPS-16-05 10:15**
**The observation of spin reorientation phase transition in $Sm_{1-x}Er_xFeO_3$ by terahertz time domain spectroscopy**
Yohei Koike, Kazumasa Hirota, Hongsong Qiu, Shodai Kimoto, Kosaku Kato, Masashi Yoshimura, Makoto Nakajima
*Institute of Laser Engineering, Osaka University*
Through the observation of two magnetic resonance modes, we succeeded to observe spin reorientation phase transition occurs at 480 K and 310 K for $SmFeO_3$ and $Sm_{0.3}Er_{0.7}FeO_3$ single crystals, respectively.

-----Break (10:30 - 11:00) -----

# Thursday, 25th April 2019, Room 303

## ALPS-17 [E] Ultrashort light source and application

11:00 - 11:45 Room 303

**Chair: Hiroki Mashiko**
*NTT BRL*

**ALPS-17-01**
*invited*
**11:00**

### Femtosecond-laser-driven micro undulator for THz emission

Ye Tian
*Shanghai Institute of Optics and Fine Mechanics*
We have proposed a novel micro-undulator mechanism for intense Terahertz radiation source based on a high intensity femotosecond laser-driven microwire.

**ALPS-17-02**
**11:30**

### Actively stabilized extreme ultraviolet attosecond interferometer

Koji Asaga[1,2], Hiroki Mashiko[2], Yuta Chisuga[3,2], Ikufumi Katayama[3], Jun Takeda[3], Tadashi Nishikawa[1], Katsuya Oguri[2], Hideki Gotoh[2]
*1. Tokyo Denki University , 2. NTT Basic Research Laboratories, 3. Yokohama National University*
We constructed actively stabilized XUV interferometer towards attosecond phase sensitive spectroscopy. The interferometer has the stability of 7.8-as root-mean-squire over 12 hours, which can be accurately controlled with 10-as delay scanning.

-----Lunch (11:45 - 13:15) -----

# Thursday, 25th April 2019, Room 304

## ALPS-18 [F2] Terahertz applications and nonlinear optics

11:00 - 11:45 Room 304

**Chair: Makoto Nakajima**
*Osaka University*

**ALPS-18-01** *invited*
**11:00**

**Large Phase Modulation of THz Wave Based on Dynamic Mode Coupling Metasurfaces**

Yuncheng Zhao[1], Yaxin Zhang[1], Shixiong Liang[2], Qiwu Shi[3], Zhihong Feng[2], Wanxia Huang[3], Ziqiang Yang[1]
*1. University of Electronic Science and Technology of China, 2. Hebei Semiconductor Research Institute, 3. Sichuan University*

The enhanced resonant meta-units couple the traditional dipolar and inductance-capacitance resonances together to realize a coupling mode. By nesting 2DEG/$VO_2$ nanostructure in the coupling mode metasurface, 137 degree dynamic phase shifting of THz wave is achieved.

**ALPS-18-02**
**11:30**

**Observation of Nonlinear Propagation Effects in High Harmonic Generation from Bulk Gallium Arsenide**

Peiyu Xia, Changsu Kim, Faming Lu, Nobuhisa Ishii, Teruto Kanai, Hidefumi Akiyama , Jiro Itatani
*Institute for Solid State Physics, The University of Tokyo*

High harmonic generation in reflection and transmission from GaAs samples with different thicknesses revealed that nonlinear propagation effects of the fundamental MIR pulses significantly changed overall spectra, cutoff energy, and crystal orientation dependences.

-----Lunch (11:45 - 13:15) -----

# Thursday, 25th April 2019, Room 303

## ALPS-19 [D2] Ultrafast and advanced lasers

13:15 - 15:00 Room 303

**Chair: Richard Mildren**
*Macquarie University*

**ALPS-19-01** *invited* **13:15**

### Physics and applications of monolithic mode-locked lasers with ultra-low intrinsic noise

Mamoru Endo[1], Manoj Kalubovilage[1], Thomas R Schibli[1,2]
*1. Department of Physics, University of Colorado, 2. JILA, NIST, and University of Colorado*
Starting with an analysis of the fundamental noise in mode-locked lasers, we realize a monolithic laser, operating at 1 GHz fundamental pulse repetition rate, with attosecond free-running timing jitter. A few applications will be discussed.

**ALPS-19-02** *invited* **13:45**

### Oxide semiconductors for nonlinear optics and ultrafast pulse lasers

Jianrong Qiu
*Zhejiang University*
We found that oxide semiconductors exhibit ultrafast optical nonlinearity at wavelength close to the epsilon-near-zero (ENZ) point in the infrared range. The spectral range of NLO response can be finely tuned by the plasma frequency of the materials which can be controlled by doping. They can be used as saturable absorbers and generate Q-switched or mode-locked pulses.

**ALPS-19-03** **14:15**

### 360 fs pulses with gigawatt peak power from a Tm:YAP based ring cavity regenerative amplifier

Seyed Ali Rezvani[1], Makoto Suzuki[2], Pavel Malevich[3], Clement Livache[1,4], Jean Vincent de Montgolfier[1,4], Yutaka Nomura[1], Noraiki Tsurumachi[2], Takao Fuji[1]
*1. IMS, 2. Kagawa Uni., 3. TU WIEN, 4. Chimie ParisTech*
We present a 2 GW peak power ring cavity diode-pumped Tm:YAP regenerative amplifier operating at 1 kHz repetition rate and centered at 1937 nm with 360 fs pulse duration.

**ALPS-19-04** **14:30**

### Dual Wavelength and Widely Tunable Operation of Nd,Gd:$SrF_2$ Laser

Vaclav Kubecek[1], Michal Jelinek[1], Miroslav Cech[1], David Vyhlidal[1], Fengkai Ma[2], Dapeng Jiang[2], Liangbi Su[2]
*1. Czech Technical University in Prague, Faculty of Nuclear Sciences and Physical Engineering, 2. 2CAS Key Laboratory of Transparent and Opto-functional Inorganic Materials, Shanghai Institute of Ceramics, Chinese Academy of Sciences*
Linearly polarized dual wavelength operation of Nd,Gd:$SrF_2$ laser with slope efficiency of 34.9% is reported. Generation at single wavelength tuneable over 30 nm was achieved using a birefringent etalon in resonator.

**ALPS-19-05** **14:45**

### Neural Network Controlled Coherent Beam Combining

Henrik Tuennermann, Akira Shirakawa
*Institute for Laser Science(ILS), University of Electro-Communications(UEC)*
Relative phase control is the key component of power scaling via coherent beam combining. We demonstrate the use of artificial intelligence methods to solve this and highlight potential advantages and challenges.

-----Break (15:00 - 15:30) -----

# Thursday, 25th April 2019, Room 303

## ALPS-20 [D3] Fiber lasers

15:30 - 16:30 Room 303

**Chair: Thomas Schibli**
*University of Colorado*

**ALPS-20-01** *invited* **15:30**

**Dark-bright vector soliton emission fiber lasers**

Dingyuan Tang[1], Xiao Hu[1], Jun Guo[2], Luming Zhao[2], Jie Ma[2]
*1. Nanyang Technological University, 2. Jiangsu Normal University*

We report on experimental observations of dark-bright vector soliton emission of fiber lasers and show both theoretically and numerically that the operation of the lasers is governed by the incoherently coupled nonlinear Schrodinger equations (NLSEs).

**ALPS-20-02** **16:00**

**Spectral dynamics of build-up femtosecond pulse in mode-locked Yb fibre laser with time stretch spectroscopy**

Masayuki Suzuki, Hiroto Kuroda
*Aich Medical University*

We report on spectral and temporal dynamics of a build-up femtosecond pulse in a homemade all polarizing maintained mode-locked Yb fibre laser with a saturable absorber by using time stretch spectroscopy.

**ALPS-20-03** **16:15**

**Liner Polarization High Peak Power Pulse Amplification By Using A Polarization Maintaining Very Large Mode Area Er-Doped Fiber Amplifier**

Hiroshi Hashimoto[1], Ryo Kawahara[1], Jeffrey W. Nicholson[2], Eisuke Otani[1], Shun-ichi Matsushita[1]
*1. Laboratories for Fusion Core Technologies, Furukawa Electric Co. Ltd., 2. OFS Laboratories*

We demonstrated more than 120kW peak power pulse amplification of 1ns pulse with linear polarization more than 18dB polarization extinction ratio and high beam quality by using a polarization maintaining very large mode area Er-doped fiber amplifier.

## Award ceremony

16:30 - 16:40 Room 303

**Junji Kawanaka**
*Institute of Laser Engineering, Osaka University*

## Closing remarks

16:40 - 16:45 Room 303

**Fumihiko Kannari**
*Keio University*