

## **PIERS2019 report**

### **Tomoki S L Prugger Suzuki (M2)**

From the 17<sup>th</sup> of June to the 20<sup>th</sup> of June, I attended PIERS2019 conference in Rome. It was the largest PIERS ever organized with 1800 participants and 20+ sessions in parallel. Many keynote and invited talks were featured during the conference and it was hard deciding what session to attend because of the large number of simultaneous talks.

Besides the conference, Rome is a beautiful city with its own atmosphere and flavor, dirty and chaotic at first impression, but deeper immersion reveals stunning beauty and unforgettable experiences.

Although many participants registered in the conference, sessions never held more than 20-30 listeners: I imagine Rome is a great attraction also outside the conference venue.

Many fields of photonics were discussed during the 4 days. Nanophotonics always hosted the largest number of participants and many interesting talks, such as “nanomaterial-enhanced Integrated Photonics” from Prof. Armani – discussing the potentialities of nanomaterials integrated on WGM microresonators for enhanced capabilities in sensing and lasing – and “Progress on Neuromorphic Silicon Photonics” by Prof. Prucnal – explaining how photonics have taken huge steps forward since the 1980 to be now practical.

Metamaterials and Plasmonics are still in their research stage, but it gathered a lot of attention and lively discussions about their basic theory, such as in the talk “The complex-valued nature of the mode volume of photonics and plasmonic nanocavities” by Prof. Philippe Lalanne. If fabrication at nanoscale and theory can advance hand in hand, I prospect reasonable success for these fields in the near future, as they allow strong manipulation of light.

Session related to photo-responsive materials and light robotics drew my personal interest because of their fascinating behavior. By using photochemical elastomers or patterned light, light can be used as a remote actuator. “Light Robots Based on Shape-changing Materials” by Prof. Arri Priimagi was particularly interesting being able to replicate caterpillar movement at eye-safe light powers. However, to me this field sounds more of a hobby and I am curious to see what it can bring to the table in the next years.

Disordered Photonics on the other hand has seemed to focus its attention on the Opacity Problem, which is how to realize white materials by controlling scattering of nanoparticles. It involves complex calculations to derive optimal filling factors and geometries. The goal is to substitute TiO<sub>2</sub> for whitening industrial products, as it is unsafe and environmentally unfriendly.

The session focusing on soliton generation in fiber lasers – closely related to my research topic – did not introduce any new schemes of soliton generation, but works were focused on improving performance, such as “Polarization Soliton Dynamics in Linear Ultrafast Fiber Lasers” by Prof. Michelle Y. Sander – achieving 1GHz with highly doped Thulium fiber and “Voltage Controlled

Graphene Supercapacitors for Femtosecond Pulse Generation in the Near Infrared” by Prof. Alphan Sennaroglu.

“Ablation-cooled Laser-material Processing at GHz Repetition Rates” by Prof. E. Ilday explained the importance of changing direction of laser processing of materials towards ablation cooling with nJ pulses at >100GHz rate, instead of high power uJ pulses used in nowadays industry. This is a very important application of our research on a pulsed WGM microlaser but femtosecond pulses need to be generated at >100GHz to be of any practical use in this sense.

My session was in the afternoon of the last day, therefore not many listeners joined the session and not many of the field of lasers. Therefore, questions didn't rise any important points or problems to share, but interest of listeners was perceived.

Finally, it was great first experience of international conference and made me realize how much I do not know outside fiber lasers and microresonators, sparking the necessity in me to learn more and research harder.

## ATTENDED SESSIONS

### Session 1A14

#### Large-scale Silicon Photonic Switches

- *Kyungmok Kwon (University of California), Tae Joon Seok (Gwangju Institute of Science and Technology), Johannes Henriksson (University of California), Jianheng Luo (University of California), and Ming C. Wu (University of California, Berkeley)*

#### Large-scale Silicon Photonics Switch for High Throughput and Energy Efficient Datacenter Network

- *Kazuhiro Ikeda (National Institute of Advanced Industrial Science and Technology (AIST)), Keiji Suzuki (National Institute of Advanced Industrial Science and Technology (AIST)), Ryotaro Konoike (National Institute of Advanced Industrial Science and Technology (AIST)), Shu Namiki (National Institute of Advanced Industrial Science and Technology (AIST)), and Hitoshi Kawashima (National Institute of Advanced Industrial Science and Technology (AIST))*

#### Nanomaterial-enhanced Integrated Photonics

- *Andrea M. Armani (University of Southern California), Hyungwoo Choi (University of Southern California), Xiaoqin Shen (University of Southern California), Andre Kovach (University of Southern California), and Jinghan He (University of Southern California)*

#### Kerr Nonlinear Optical Signal Processing in Ultra-silicon-rich Nitride-based Devices

- *Dawn T. H. Tan (Singapore University of Technology and Design), Kelvin J. A. Ooi (Xiamen University Malaysia), D. K. T. Ng (Technology and Research (A\*STAR)), E. Sahin (Singapore University of Technology and Design), J. W. Choi (Singapore University of Technology and Design), P. Xing (Singapore University of Technology and Design), G. F. R. Chen (Singapore University of Technology and Design), B. U. Sohn (Singapore University of Technology and Design), and H. Gao (Singapore University of Technology and Design)*

Enabling Novel Features of Heterogeneous III-V on Si Lasers with Resonant Si Embedded Photonic Molecules Mirrors

- **G. F. M. De Rezende (University of Campinas)**, Gunther Roelkens (Ghent University-IMEC), and Newton C. Frateschi (Universidade Estadual de Campinas)

Mechanism of Ultra-broad Wavelength Tuning Range from InP/InGaAs Nano-lasers Grown on SOI

- Wai Kit Ng (Hong Kong University of Science and Technology), Yu Han (Hong Kong University of Science and Technology), Kei-May Lau (Hong Kong University of Science and Technology), and **Kam Sing Wong (Hong Kong University of Science and Technology)**

Progress on Neuromorphic Silicon Photonics [Keynote]

- **Paul R. Prucnal (Princeton University)**, Alexander N. Tait (NIST), Mitchell A. Nahmias (Princeton University), Thomas Ferreira De Lima (Princeton University), Hsuan-Tung Peng (Princeton University), and Bhavin J. Shastri (Queen's University)

Slow Plasmonic and Photonic Waveguides: A Parallel

- **Philippe Lalanne (Institut d'Optique-LP2N/CNRS)**

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Parity-time and Other Symmetries in Optics and Photonics [Keynote]

- **Demetrios N. Christodoulides (University of Central Florida)**

Topological Light Sources

- **Boubacar Kante (University of California San Diego)**

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Manipulation and Cell Injection of Fluorescence Microsensor with Multiple Wavelength Lights

- **Hisataka Maruyama (Nagoya University)**, Ryota Yanagawa (Nagoya University), and Fumihito Arai (Nagoya University)

Indirect Optical Manipulation of Live Cells and Its Application in Multiview Microscopy

- **Pal Ormos (Institute of Biophysics, Biological Research Centre)**, Andras Buzas (Institute of Biophysics, Biological Research Centre), Tamas Fekete (Institute of Biophysics, Biological Research Centre), Istvan Grexa (Institute of Biophysics, Biological Research Centre), Gaszton Vizsnyiczai (Institute of Biophysics, Biological Research Centre), and Lorand Kelemen (Institute of Biophysics, Biological Research Centre)

Disk-tip Microtools for Light Robotics

- **Einstom Engay (Technical University of Denmark)**, Alexandre Wetzel (Technical University of Denmark), Ada-Ioana Bunea (Technical University of Denmark), and Jesper Gluckstad (Technical University of Denmark)

Light Robots Based on Shape-changing Materials

- **Arri Priimagi (Tampere University of Technology)**

Soft Microrobots Controlled by Structured Light

- **Stefano Palagi** (*Istituto Italiano di Tecnologia*)

### 3D Printing for Light-fueled Polymeric Microrobots

- **Sara Nocentini** (*European Laboratory for Non-linear Spectroscopy*), **Daniele Martella** (*European Laboratory for Non-linear Spectroscopy*), **Camilla Parmeggiani** (*University of Florence*), and **Diederik S. Wiersma** (*University of Florence*)

### Biomimetic 3D Micro-structures for Soft Micro-robotics

- **Larisa Florea** (*Trinity College Dublin*), **Alexa Ennis** (*Trinity College Dublin*), and **Colm Delaney** (*University College Dublin*)

### Circumgyration of Nonlinear Nanoparticles by Focusing Gaussian Ultrashort Pulses

- **Yaqiang Qin** (*Institute of Genetics and Developmental Biology, Chinese Academy of Sciences*), **Lu Huang** (*Institute of Genetics and Developmental Biology, Chinese Academy of Sciences*), and **Yuqiang Jiang** (*Institute of Genetics and Developmental Biology, Chinese Academy of Sciences*)

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### The Complex-valued Nature of the Mode Volume of Photonic and Plasmonic Nanocavities

- **Philippe Lalanne** (*Institut d'Optique-LP2N/CNRS*)

### Ultra Sensitive Biological Detection with Optical Resonances

- **Frank Vollmer** (*University of Exeter*)

### Polymeric Whispering Gallery Resonators

- **Heinz Kalt** (*Karlsruhe Institute of Technology (KIT)*)

### Finite Element Simulations of Optical Resonances in Dispersive Nanoresonators

- **Sven Burger** (*Zuse Institute Berlin*), **Felix Binkowski** (*Zuse Institute Berlin*), and **Lin Zschiedrich** (*JCMwave GmbH*)

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### Modal Analysis of Dielectric Mie Resonators

- **R. Colom** (*Aix Marseille Univ., CNRS, Centrale Marseille, Institut Fresnel*), **R. C. R. C. McPhedran** (*University of Sydney*), **Brian Stout** (*Domaine Universitaire de Saint Jérôme*), and **Nicolas Bonod** (*Aix Marseille Univ., CNRS, Centrale Marseille, Institut Fresnel*)

### Light-matter Interaction in Optical Resonators: Spectral Expansion by Riesz Projection

- **Lin Zschiedrich** (*JCMwave GmbH*), **Felix Binkowski** (*Zuse Institute Berlin*), and **Sven Burger** (*Zuse Institute Berlin*)

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### Role of Anisotropy and Refractive Index in Scattering and Whiteness Optimization

- **Gianni Jacucci** (*University of Cambridge*), **Jacopo Bertolotti** (*University of Exeter*), and **Silvia Vignolini** (*University of Cambridge*)

## All-optical Radio-frequency Modulation of Anderson-localized Modes

- **Guillermo Arregui** (*Catalan Institute of Nanoscience and Nanotechnology (ICN2)*)

## Massively-parallel Calculation of Multiple Light Scattering in Discrete Random Media

- **Lorenzo Pattelli** (*University of Florence*), **Amos Egel** (*Light Technology Institute, Karlsruhe Institute of Technology (KIT)*), **Ulrich Lemmer** (*Light Technology Institute, Karlsruhe Institute of Technology (KIT)*), and **Diederik S. Wiersma** (*University of Florence*)

*Optimized Reflectance in Bioinspired Polymer Network Structures*

- **Lorenzo Pattelli** (*University of Florence*), **Weizhi Zou** (*Beijing National Laboratory for Molecular Sciences, CAS Research/Education Center for Excellence in Molecular Sciences, Laboratory of Polymer Physics*), **Jing Guo** (*Beijing National Laboratory for Molecular Sciences, CAS Research/Education Center for Excellence in Molecular Sciences, Laboratory of Polymer Physics*), **Shijia Yang** (*Beijing National Laboratory for Molecular Sciences, CAS Research/Education Center for Excellence in Molecular Sciences, Laboratory of Polymer Physics*), **Meng Yang** (*Beijing National Laboratory for Molecular Sciences, CAS Research/Education Center for Excellence in Molecular Sciences, Laboratory of Polymer Physics*), **Ning Zhao** (*Beijing National Laboratory for Molecular Sciences, CAS Research/Education Center for Excellence in Molecular Sciences, Laboratory of Polymer Physics*), **Jian Xu** (*Institute of Chemistry, Chinese Academy of Sciences*), and **Diederik S. Wiersma** (*University of Florence*)

## Correlations and Entropy of the LDOS in Disordered Photonic Systems

- **Francesco Riboli** (*European Laboratory for Nonlinear Spectroscopy (LENS)*)

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## Advanced Designs for Passively Modelocked Fibre Lasers

- **Neil G. R. Broderick** (*University of Auckland*), **Claude Agueraray** (*University of Auckland*), **Miro Erkintalo** (*University of Auckland*), and \*\*\*

## Polarization Soliton Dynamics in Linear Ultrafast Fiber Lasers

- **Junjie Zeng** (*Boston University*) and **Michelle Y. Sander** (*Boston University*)

## Repetition Rate Adjustable Dual-wavelength Solitons Fiber Laser Based on Highly Nonlinear Fiber

- **Qianchao Wu** (*The University Town of Shenzhen*), **Yong Yao** (*Harbin Institute of Technology*), **Yanfu Yang** (*Harbin Institute of Technology*), **Jiajun Tian** (*Harbin Institute of Technology*), **Ke Xu** (*Harbin Institute of Technology*), **Yunxu Sun** (*The University Town of Shenzhen*), and **Jun Jun Xiao** (*Harbin Institute of Technology*)

## Dynamics of High Peak Power Pulses near 1.9 $\mu\text{m}$ in a Standard Single-mode Telecom Fiber

- **Aleksandr I. Donodin** (*Bauman Moscow State Technical University*), **Vasilii Sergeevich Voropaev** (*Bauman Moscow State Technical University*), **A. I. Voronec** (*Bauman Moscow State Technical University*), **V. A. Lazarev** (*Bauman Moscow State Technical University*), **M. K. Tarabrin** (*Bauman Moscow State Technical University*), and **Valeriy E. Karasik** (*Bauman Moscow State Technical University*)

## Frequency Comb Optical Two-way Time-frequency Transfer

- **Laura C. Sinclair (National Institute of Standards and Technology)**, Jean-Daniel Deschenes (Octosig Consulting Inc.), \*\*\*, \*\*\*, \*\*\*, \*\*\*, \*\*\*, \*\*\*, and Nathan R. Newbury (National Institute of Standards and Technology)

#### New Optical Comb Spectroscopy Combined with Optical Vortex

- **Akifumi Asahara (University of Electro-Communications)** and Kaoru Minoshima (Japan Science and Technology Agency, ERATO MINOSHIMA Intelligent Optical Synthesizer)

#### Voltage Controlled Graphene Supercapacitors for Femtosecond Pulse Generation in the Near Infrared

- **Alphan Sennaroglu (Koc University)**, Isinsu Baylam (Koc University), Nurbek Kakenov (Bilkent University), Coskun Kocabas (Bilkent University), and Sarper Ozharar (Bahcesehir University)

#### Novel Ultrashort-pulse Sources

- **William Renninger (University of Rochester)**

#### High Power Multi-soliton and Noise-like Pulse Generation Regimes in a Passively Mode-locked Thulium-doped All-fiber Ring Oscillator

- **Vasilii Sergeevich Voropaev (Bauman Moscow State Technical University)**, **Aleksandr I. Donodin (Bauman Moscow State Technical University)**, A. I. Voronets (Bauman Moscow State Technical University), D. S. Vlasov (Bauman Moscow State Technical University), D. T. Batov (Bauman Moscow State Technical University), V. A. Lazarev (Bauman Moscow State Technical University), M. K. Tarabrin (Bauman Moscow State Technical University), \*\*\*, and A. A. Krylov (Fiber Optics Research Center of the Russian Academy of Sciences)

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#### Disruption Prediction Approaches Using Machine Learning Tools in Tokamaks

- **Giuliana Sias (University of Cagliari)**, Barbara Cannas (University of Cagliari), Sara Carcangiu (University of Cagliari), A. Fanni (University of Cagliari), \*\*\*, A. Pau (EUROfusion Consortium), and \*\*\*

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#### Underwater Suspended Particle Monitoring by Hyperspectral Lidar

- **Guangyu Zhao (South China Normal University)**, \*\*\*, \*\*\*, \*\*\*, and Sune Svanberg (Lund University)

#### Skew Detection and Ortho-rectification for System Corrected Landsat TM Images

- **Hiroyuki Saito (Hirosaki University)** and Yuta Miura (Hirosaki University)

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#### Clusters of Nanoparticles as Isotropic Huygens Sources for Metasurfaces Applications

• **R. Dezert (CNRS, Université de Bordeaux)**, R. Elancheliyan (CNRS, Université de Bordeaux), V. Ponsinet (CNRS, Université de Bordeaux), O. Mondain-Monval (University of Bordeaux), Philippe Barois (CNRS, Université de Bordeaux), P. Richetti (CNRS, Université de Bordeaux), and A. Baron (CNRS, Université de Bordeaux)

#### Generation and Manipulation of Superoscillating Light Beams via Geometric Metasurface

• Yanwen Hu (Jinan University), **Shenhe Fu (Jinan University)**, Hao Yin (Guangdong Higher Educ. Inst.), Zhen Li (Jinan University), and Zhenqiang Chen (Jinan University)

#### Ablation-cooled Laser-material Processing at GHz Repetition Rates

• **F. Oemer Ilday (Bilkent Univ)**

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#### Detection of Lead, Pb(II), in Water Using Silicon Nanowire Ring-resonators

• \*\*\*, John E. Saunders (Queen's University), \*\*\*, \*\*\*, \*\*\*, Dan-Xia Xu (National Research Council Canada (NRC)), and **Hans-Peter Loock (National Research Council of Canada)**

#### Differential Tuning and Coupling of Whispering Gallery Modes

• **Matthew R. Foreman (Imperial College London)**, Florian Sedlmeir (Max Planck Institute for the Science of Light), and Harald G. L. Schwefel (University of Otago)

#### Quantum Nondemolition Measurement of Light Intensity Fluctuations in Cavity Optomechanics

• Antonio Pontin (University College London), Michele Bonaldi (Institute of Materials for Electronics and Magnetism, FBK Division, and INFN TIFPA), Antonio Borrielli (Institute of Materials for Electronics and Magnetism, FBK Division, and INFN TIFPA), Lorenzo Marconi (CNR, Istituto Nazionale di Ottica), **Francesco Marino (CNR, Istituto Nazionale di Ottica)**, Gregory Pandraud (Delft University of Technology), Giovanni A. Prodi (Università di Trento), Pasqualina M. Sarro (Delft University of Technology), Enrico Serra (Italy and Delft University of Technology), and Francesco Marin (Università di Firenze and INFN)

#### Coupling of Mechanical Motion with Frequency Comb and Brillouin Lasing in Whispering Gallery Modes

• **Takasumi Tanabe (Keio University)**, Ryo Suzuki (Keio University), and Yoshihiro Honda (Keio University)

#### Managing Coupled Wavelengths and Modes in Waveguide-microresonator Systems

• S. Berneschi (Istituto di Fisica Applicata "Nello Carrara", C.N.R.), Andrea Barucci (Istituto di Fisica Applicata "Nello Carrara", C.N.R.), Francesco Chiavaioli ("Nello Carrara" Institute of Applied Physics (IFAC-CNR)), Mario Christian Falconi (Polytechnic University of Bari), Daniele Farnesi (Istituto di Fisica Applicata "Nello Carrara", C.N.R.), Gabriele Frigenti (Institute of Applied Physics, National Research Council of Italy), Immacolata Angelica Grimaldi (Consiglio Nazionale delle Ricerche (IREA-CNR)), Dario Laneve (Polytechnic University of Bari), Stefano Pelli (Istituto di Fisica Applicata "Nello Carrara", C.N.R.), Gianluca Persichetti (Consiglio Nazionale delle Ricerche (IREA-CNR)), Silvia Soria (Istituto di Fisica Applicata "Nello Carrara", C.N.R.), Genni Testa (Consiglio Nazionale delle Ricerche (IREA-CNR)), Cosimo Trono (Istituto di Fisica Applicata "Nello Carrara", C.N.R.),

*Francesco Prudenzano (Politecnico di Bari), Romeo Bernini (Consiglio Nazionale delle Ricerche (IREA-CNR)), and **Gualtiero Nunzi Conti (Istituto di Fisica Applicata "Nello Carrara", C.N.R.)***

#### Opto-mechanical Effects in High-Q Liquid Droplet Microresonators

• *Antonio Giorgini (CNR - Istituto Nazionale di Ottica (INO)), Saverio Avino (Istituto Nazionale di Ottica (INO)), Pietro Malara (Istituto Nazionale di Ottica (INO)), Paolo De Natale (CNR --- INO, Istituto Nazionale di Ottica), and **Gianluca Gagliardi (CNR, Istituto Nazionale di Ottica (INO))***

#### Structural Protein-based Whispering Gallery Mode Resonators

• ***Melik C. Demirel (Pennsylvania State University)***

#### Single-particle Spectroscopy and Microscopy with Optical Microresonators

• ***Cecilia H. Vollbrecht (University of Wisconsin-Madison)**, Levi Hogan (University of Wisconsin-Madison), Erik H. Horak (University of Wisconsin-Madison), Cassandra A. Knapper (University of Wisconsin-Madison), Feng Pan (University of Wisconsin-Madison), Morgan T. Rea (University of Wisconsin-Madison), and Randall H. Goldsmith (University of Wisconsin-Madison)*

#### Using d33 in Lithium Niobate Microdisk Resonators

• ***Fang Bo (Nankai University)**, Zhenzhong Hao (Nankai University), Li Zhang (Nankai University), Wenbo Mao (Nankai University), Ang Gao (Nankai University), Guoquan Zhang (Nankai University), and Jingjun Xu (Nankai University)*

#### Enhanced Sagnac Sensitivity at Exceptional Point

• ***Mercedeh Khajavikhan (University of Central Florida)**, \*\*\*, \*\*\*, and Demetrios N. Christodoulides (University of Central Florida)*