# NANOMETA 2017 Table of Contents

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The papers included in this digest comprise the short summaries of the 6th International Topical Meeting on Nanophotonics and Metamaterial Conference held in Seefeld in Tirol, Austria from 4 to 7 January 2017. The extended version of the papers (1-page summaries in pdf format) will be made available on line during a time period of 2 months beginning from the conference. A link with login and password is provided on a separate sheet.

All web browsers (Firefox, Internet Explorer, Safari or similar) will allow you to download the digest. A .pdf viewer (tested with Adobe Acrobat) will be necessary to view the papers. This software can be downloaded from http://www.adobe.com

The papers reflect the authors’ opinion and are published as presented and without any change in the interest of timely dissemination. Their inclusion in these publications does not necessarily constitute endorsement by the editors, the European Physical Society.

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http://www.epletters.net/

http://www.sciencemag.org/

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Nanometa 2017 Exhibitors:

- http://www.mountainphotonics.de/
- http://www.neaspec.com/
- https://www.photond.com/
- http://iopscience.iop.org/
The 6th International Topical Meeting on Nanophotonics and Metamaterials
4 – 7 January 2017, Seefeld in Tirol, Austria

NANOMETA 2017 aims to bring together the international Nanotechnology, Photonics and Materials research communities where most recent and challenging results and plans are discussed in the informal setting on a glorious mountaineering resort. The technical programme will include invited and selected contributed papers in the areas of

- Plasmonics, Metamaterials and Metadevices
- Quantum and Topological Nanophotonics
- New Metrails for Nanophotonics
- Optical Super-resolution

The conference will be organised in two oral parallel sessions (Nanophotonics and Metamaterials) and will feature joint plenary sessions. The conference timetable will be arranged in a way that permits mid-day breaks for recreational activities and informal contact between participants.

The programme will feature 249 presentations over 4 days including 5 plenary, 4 breakthrough, 44 invited including 1 upgrade, 53 oral presentations, 1 technology talk and 142 posters from 27 different countries.

Poster Sessions
Nanometa 2017 will present a total of 142 posters split into two poster sessions, which will take place on Thursday 5 January 2017 and Friday 6 January 2017 from 17:00 to 18:30. There will be no oral presentations during this time. Light snacks and soft drinks will be provided during the sessions.

Poster Prizes
A poster competition sponsored by Journal of Optics, (http://iopscience.iop.org/2040-8986) and Science Magazine (http://www.sciencemag.org/) will be organised to award the best posters presented by research students. The prizes will be awarded on the Closing Ceremony, which will take place on Saturday evening 7 January 2017.

Instructions for Poster Presenters
Each author is provided with one bulletin board measuring 130 cm high and 120 cm wide on which to display a summary of the paper. Fixing material (tape) will be provided. The boards will be marked with the poster session code. Authors are requested to display their poster on their allocated board in the early afternoon of the day of their presentation. In order to present their work and answer questions, authors are requested to be present in the vicinity of their poster on the day of their presentation during 17:00-18:30.

Speakers’ Information
Speakers are asked to check-in with the session chair in the conference room ten minutes before the session begins. The conference rooms are equipped with microphone, beamer, and computer. Presenters may transfer their presentation files by USB memory stick. It will also be possible to give the presentations from own notebooks. A screen switch to connect several notebooks simultaneously to the data projector will be arranged. Individual notebooks will need to be connected to the box during the breaks.

The presentation times for oral sessions are as follows:
- Plenary talks: 1-hour presentation including 10 minutes for discussion.
- Breakthrough talks: 30 minutes presentation including 10 minutes for discussion.
- Invited talks: 30 minutes presentation including 10 minutes for discussion.
- Oral talks: 15 minutes presentation including 3 minutes for discussion.
- Technology talk: 45 minutes presentation including 15 minutes for discussion.

EPS-QEOD Prize for Research into the Science of Light Award Ceremony
The ceremony will announce and recognize the third recipient of the EPS Quantum Electronics and Optics Division Prize for Research into the Science of Light. The Prize is awarded in recognition of scientific excellence in the area of electromagnetic science in its broadest sense, across the entire spectrum of electromagnetic waves. The event will take place on Thursday 5 January 2017, 20:45 – 21:00, Olympia room.
The 2017 Prize for Research into the Science of Light is awarded to Professor Albert Polman for “mastering light at the nanoscale and for demonstrating novel applications in nanoscale optical circuits, photovoltaics, and super-resolution imaging”.

Albert Polman is a scientific group leader at the FOM Institute AMOLF in Amsterdam, the Netherlands, and professor of photonic materials for photovoltaics at the University of Amsterdam. He obtained his Ph.D. from the University of Utrecht in 1989, was a post-doctoral researcher at AT&T Bell Laboratories until 1991, and then became a scientific group leader at AMOLF. From 2006 - 2013 he also served as director of AMOLF.

Albert Polman is an elected member of the Royal Netherlands Academy of Arts and Sciences (KNAW), Fellow of the Materials Research Society (MRS) and the Optical Society of America (OSA), and recipient of two ERC Advanced Investigator Grants (2011, 2016), the Physica Prize of the Dutch Physical Society (2014), the Julius Springer Award for Applied Physics (2014), the ENI Renewable Energy Prize (2012), and the MRS Materials Innovation and Charac-terization Award (2012).

Albert Polman is one of the early pioneers in the research area of nanophotonics. His research group focuses on the realization of nanoscale metamaterials with tailored optical properties that do not exist in nature. He also designs and fabricates novel photovoltaic architectures with enhanced power con-version efficiency based on semiconductor and dielectric metasurfaces. Polman’s group is the inventor of angle-resolved cathodo-luminescence microscopy, that is, a novel super-resolution microscopy technique that creates images with 10 nanometer resolution. The instrument is brought on the market by the start-up Delmic, which Polman co-founded.

Reception
A beer reception will be organised on Saturday 7 January 2017 from 19:00-20:00.

Conference Language
The official language of the conference is English.

Conference Digest
The registration fee includes one printed programme and the one-page summaries available on-line.

On-site Facilities
Wireless high speed Internet is available for both rooms (Olympia and Seefeld-Tirol) and the lounges. A message board around the registration area will be installed. The nearest bank machine is about 500 m away from the centre.

Registration Information
The registration fees for the meeting include admission to all technical sessions of the conference on “Nanophotonics and Metamaterials”. It includes coffee breaks (Wednesday through Saturday) as mentioned on the programme. Lunches are not included.

Conference Registration Hours

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<tr>
<th>Date</th>
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<tbody>
<tr>
<td>Tuesday 3 January</td>
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<td>Wednesday 4 January</td>
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<td>Thursday 5 January</td>
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<td>Friday 6 January</td>
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<tr>
<td>Saturday 7 January</td>
<td>08:15-11:45</td>
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**Conference Management**
The European Physical Society provides the Conference management, 6 rue des Frères Lumière, 68200 Mulhouse, France. This programme is edited by P. Helfenstein and A. Wobst.

**Conference Location**
NANOMETA 2017 will take place at the “Olympia” Congress Centre in the heart of Seefeld:
**Olympia Sport and Kongresszentrum Seefeld – Tirol GmbH**
Klosterstrasse 600
6100 Seefeld
Austria
Phone: +43 (0) 5212 32 20
Website: [http://www.seefeld-sports.at](http://www.seefeld-sports.at)

The Olympia room is on the first level and the Seefeld/Tirol room is on the basement level.
The registration area is on the same level as the Olympia room.

**Austria**
Austria is a central European predominately mountainous country. Eight other countries line the Austrian border: Italy, Switzerland, the Principality of Liechtenstein, Germany, the Czech Republic, Slovakia, Hungary, and Slovenia. Lying on the Danube River, the Austrian capital of Vienna is partly surrounded by the hills of the Vienna Woods.

Austria’s population, which has just surpassed eight million, is 93% German speaking, and 20% of the global population resides in Vienna. Still, the country has a diverse ethnic mix that includes six officially recognised ethnic groups: Croats, Czechs, Hungarians, Roma/Sinti, Slovaks and Slovenes. While about 73% of the Austrian population is Roman Catholic, there are eleven other officially recognised religions.

**Currency**
Euro is the official currency in Austria.
Major credit cards (VISA, MasterCard/Euro card, American Express, Diners…) are generally accepted in airports, train stations, hotels, larger shop, etc.

**Weather in Seefeld**
Framed by the Mountain Range of the Karwendel National Park, Seefeld is situated on a sunny high-altitude plateau 1,200 m above sea level and is 150 km from Munich and Innsbruck is 21 km away. The weather in January is very pleasant, cold but with warm winter sunshine. However, as in the mountains the weather may rapidly vary. The Seefeld weather forecast can be viewed at [http://www.seefeld.com/en](http://www.seefeld.com/en)

**Seefeld**
Seefeld with its around 3000 inhabitants is a major ski resort in the heart of the Tyrol Mountains, Austria, at the centre of untouched nature. It is a multi-faceted resort that is a magnet for guests from all over the world and combines nature, sport, wellness and a holiday atmosphere. The village is a true paradise for nature-lovers as well as alpine ski enthusiasts.

In Seefeld you can find excellent downhill and cross-country skiing, ice rink, indoor swimming pool, fantastic restaurants and a good choice of quality hotels. The magnificent mountain scenery of the Karwendel Alpine Park and the Wetterstein range surrounds all of Seefeld. There you will find a wide range of sports, relaxation and health facilities for everyone.

You can rent or buy your equipment! 25 uphill facilities between 1,200 m and 2,100 m and ski runs for all levels and ambitions are awaiting you. Besides Alpine skiing you should also try cross-country skiing on 283,5 km of well-groomed tracks, ideal for skaters and classic cross country skiing fans. Or choose from the wide range of winter hiking trails (approx. 80 km), Alpine curling (on more than 30 ice curling alleys) or a romantic ride in a horse-drawn sleigh across glittering winter landscapes. Seefeld holds numerous ski jumping hills, of which the biggest is Toni Seelos Olympiaschanze.
Here in the Olympia Region on the Seefeld plateau, walkers, mountaineers and climbers have their work cut out choosing their next adventure from the tightly woven network of 450 kilometres of hiking trails and mountain paths. Destinations in the region include the breath-taking countryside of the Wetterstein range and the Zugspitze, the Karwendel nature park with the well-known Ahornboden area, the Mieminger chain of peaks with the mighty Hohe Munde and the nature preserve of the Wildmoos. Around 143 kilometres of cleared and prepared winter walking trails are available in the region - a map with descriptions of all walks and cross-country trails is available in all information offices.

The Bergbahnen Rosshütte lifts will whisk you to over 2000 meters altitude in just a few minutes. In winter, enjoy 19 kilometres of beautifully prepared ski runs.

Indoor and outdoor pools, sauna, massage, tanning beds - all that and more is on offer at Olympia Sport- and Kongresszentrum. On top of that, it boasts a modern cinema, seminar and conference rooms and, in winter, an ice-skating rink. A few hotels offer free entrance passes to the indoor swimming pool.

Don't miss the highpoint of the Seefeld nightlife - the highest casino in Austria. The casino, at the start of the pedestrian area (open every day from 2:00 pm), is known as the most welcoming in the world, helped by its elegant atmosphere and the range of games of chance on offer.

**Olympiaregion Seefeld Card (ORS Card):** Guests staying in the Olympiaregion Seefeld usually benefit from local advantages and price reductions. You will receive your Olympiaregion Seefeld guest card directly from your accommodation provider immediately upon your arrival. Upon presentation of your card and/or after having extras electronically added to your card, you can take advantage of a wide spectrum of discounts and special offers. The brochure detailing the list of all guest card services and benefits, along with other detailed information, can be downloaded at [http://www.seefeld.com/en/region-tyrol-service/guest-card/olympiaregion-seefeld-card](http://www.seefeld.com/en/region-tyrol-service/guest-card/olympiaregion-seefeld-card).

The Olympiaregion Seefeld’s programme of winter activities offers 15 unique experiences for young and old alike - free of charge and exclusively for Olympiaregion Seefeld cardholders! To take part simply register in advance for the activities of your choice by having them electronically added to your guest card, either by your accommodation provider or in any of the information offices.

Among the activities proposed, you will, for example, find a guided historical walk through Seefeld (in English or German), a lesson in alpine-style curling (in English or German), a cross-country ski ticket valid for the entire duration of your stay for just €15.00 (one-day ticket just €5.00). NB: This offer applies only when you have the ticket electronically added beforehand to your guest card by your accommodation provider or in any of the information offices. NEW! Holders of cross-country ski tickets enjoy free use of the local buses during the respective validity period. Children up to the age of 15 years enjoy free use of the cross-country ski tracks.

With this card, a bus pass for the local bus network valid throughout the duration of your stay will just cost €12.00! You can use all the local buses between the villages of Seefeld, Leutasch, Möserr/Buchen, Reith and Scharnitz. This offer likewise applies only when you have the bus pass electronically added beforehand to your guest card by your accommodation provider or in any of the information offices. For journeys outside these villages, the VVT rates (local public transport network rates) apply. Children up to the age of 15 years enjoy free travel on the local buses when in possession of a guest card.

Holders of the Olympiaregion Seefeld card make an immediate ‘win’ with a 15 % discount on the Seefeld Casino Welcome Package (normal price €30.00) which includes chips to the value of €30.00, a glass of sparkling wine and a surprise gift. To gain admission to the casino you must be at least 18 years of age and in possession of valid photo-ID. No pre-registration required. Simply show your guest card at the casino entrance.

With this card you will benefit from a ‘Hot and Steamy’ offer every Tuesday evening (excluding public holidays) in the Olympic sauna of the Olympia Sport & Congress Centre Seefeld. Upon presentation of your Olympiaregion Seefeld guest card, you receive a special admission rate of €13.00 for 2.5 hours. No registration required. In addition, you enjoy 10 % discount on the current valid price of a 4-hour or full-day single admission ticket for the swimming pool. Valid from Monday to Friday (excluding public holidays).

Don’t forget to ask about your Seefeld guest card at your accommodation provider!
Additional direct bus - Seefeld-Leutasch *
Daily between Seefeld ‘Apotheken-Parkplatz’ (car park near the pharmacy) and Leutasch/Weidach-Oberleutasch (from 23.12.2016 to 6.3.2017).

Nightliner bus - Seefeld-Leutasch *
Every evening between Seefeld railway station and Leutasch/Weidach–Oberleutasch. On the night-skiing evenings (Wednesday-Saturday) from the Rosshütte ski area (dependent on snow conditions).

Shuttle bus and ski bus within Seefeld *
Free of charge during the 2016/2017-winter season.
New routes including evening shuttle bus from the Rosshütte ski area to the centre of Seefeld.

You don't need a car in the village. In winter the free ski buses will take you to the different ski areas and there is also a free shuttle bus around the village.

* Detailed timetables are available in all information offices.

Further tourist information may be obtained at the Information office:
Olympiaregion Seefeld
Klosterstraße 43
A - 6100 Seefeld
Tel: +43 (0) 508800
Fax: +43 (0) 50880-51
Email: info@seefeld.com
Website: [http://www.seefeld.com](http://www.seefeld.com)

The office also offers a direct on line search for accommodation.

Conference Committee:

Conference Chairs:

Nikolay Zheludev, University of Southampton, Southampton, UK and NTU Singapore, Singapore

Nikolay Zheludev, directs the Centre for Photonic Metamaterials at Southampton University, UK and Centre for Disruptive Photonic Technologies at Nanyang Technological University, Singapore. He is also deputy director of the Optoelectronics Research Centre at Southampton and co-Director of the Photonics institute at NTU, Singapore. His research interests are in nanophotonics and metamaterials. His personal awards include the Thomas Young Medal for “global leadership and pioneering, seminal work in optical metamaterials and nanophotonics”, Senior Professorships of the Engineering and Physical Sciences Research Council (UK) and the Leverhulme Trust and the Royal Society Wolfson Research Fellowship. He was awarded MSc, PhD and DSc from Moscow State University. Professor Zheludev is the Editor-in-Chief of the IOP "Journal of Optics".
Conference Chairs: (continued)

Harald Giessen, University of Stuttgart, Stuttgart, Germany

Harald Giessen, graduated from Kaiserslautern University with a diploma in physics and obtained his M.S. and Ph.D. in optical sciences from the University of Arizona in 1995. After a postdoc at the Max-Planck-Institute for Solid State Research in Stuttgart he moved to Marburg as Assistant Professor. From 2001-2004, he was associate professor at the University of Bonn. Since 2005, he holds the Chair for Ultrafast Nano-Optics in the department of physics at the University of Stuttgart. He is a fellow of the Optical Society of America and received an ERC Advanced Grant in 2012 in the area of complex plasmonics. He was co-chair (2014) and chair (2016) of the Gordon Conference on Plasmonics and Nanophotonics. He is on the advisory board of the journals "Advanced Optical Materials", "Nanophotonics: The Journal", "ACS Photonics", and "ACS Sensors". He is a topical editor for ultrafast nanooptics, plasmonics, and ultrafast lasers and pulse generation of the journal "Light: Science & Applications" of Nature Publishing Group.

Programme Committee Members:

Javier Aizpurua, Center for Material Physics, Donostia - San Sebastian, Spain
Andrea Alù, The University of Texas at Austin, Austin, TX, USA
Dmitri N. Basov, University of California in San Diego, La Jolla, CA, USA
Houtong Chen, Los Alamos National Laboratory, New Mexico, United States
Tal Ellenbogen, Tel Aviv University, Tel Aviv, Israel
Nader Engheta, University of Pennsylvania, Philadelphia, PA, USA
Rachel Grange, ETH Zurich, Zurich, Switzerland
Oliver Graydon, Nature Photonics, London, United Kingdom
L.(Kohus) Kuipers, AMOLF-FOM, Amsterdam, The Netherlands
Stefan Linden, University of Bonn, Bonn, Germany
Na Liu, University of Heidelberg, Heidelberg, Germany
Maria Maragkou, Nature Materials, London, United Kingdom
Bumki Min, KAIST, Daejeon, South Korea
Alberto Moscatelli, Nature Nanotechnology, London, United Kingdom
Ian Osborne, Science Magazine, Cambridge, United Kingdom
Yehiam Prior, Weizmann Institute of Science, Rehovot, Israel
Valerio Pruneri, ICFO - The Institute of Photonic Sciences, Castelldefels (Barcelona), Spain
Anne Roberts, The University of Melbourne, Parkville, Australia
Takuo Tanaka, RIKEN, Wako, Saitama, Japan
Thomas Taubner, RWTH Aachen University, Aachen, Germany
Jing Hua Teng, Institute of Materials Research and Engineering, A*STAR, Singapore
Din Ping Tsai, National Taiwan University, Taipei, Taiwan
Augustine Urbas, Air Force Research Laboratory, Wright-Patterson Air Force Base, USA
Jason Valentine, Vanderbilt University, Nashville, TN, USA
Niek van Hulst, ICFO - The Institute of Photonic Sciences, Castelldefels (Barcelona), Spain
Jeong Weon Wu, Ewha Womans University, Seoul, South Korea
Hua Zhang, Nanyang Technological University, Singapore, Singapore
Lei Zhou, Fudan University Shanghai, Shanghai, China
### Wednesday 4 January 2017

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<td>08:35-09:45</td>
<td>Oral session WED1o: Opening Session and Plenary Session 1</td>
<td>Coffee Break (Olympia lobby)</td>
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<tr>
<td>09:45-10:00</td>
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<td>Oral session WED2o: Nanolasers and New Emission Phenomena</td>
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<tr>
<td>10:00-12:00</td>
<td>Oral session WED2o: Topological Photonics</td>
<td>10:00-12:00</td>
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<td>12:00-17:00</td>
<td>Lunch Break</td>
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<tr>
<td>17:00-18:45</td>
<td>Oral session WED3o: Metamaterials and Metadevices</td>
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<td>18:45-19:00</td>
<td>Coffee Break (Olympia lobby)</td>
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<td>19:00-20:00</td>
<td>Oral session WED4o: Breakthrough Session 1</td>
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### Thursday 5 January 2017

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<tr>
<td>08:30-09:30</td>
<td>Oral session THU1o: Plenary Session 2</td>
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<tr>
<td>09:30-09:45</td>
<td>Coffee Break (Olympia lobby)</td>
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<td>09:45-12:00</td>
<td>Oral session THU2o: Nanophotonics and Metamaterials</td>
<td>Oral session THU2s: Quantum Plasmonics and Quantum Systems</td>
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<td>12:00-16:15</td>
<td>Lunch Break</td>
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<td>16:15-17:00</td>
<td>Oral session THU3o: Technology Talk by Neaspec</td>
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<tr>
<td>17:00-18:30</td>
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<td>17:00-18:30 Poster Session I THU4f With snacks and drinks</td>
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**Olympia Room**

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<td>Oral session THU5o Novel Effects</td>
<td>Oral session THU5s Topological Phenomena</td>
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<td>Break</td>
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<td>19:45-20:30</td>
<td>Oral session THU6o Plenary Session 3</td>
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<tr>
<td>20:45-21:00</td>
<td>THU7o Awards Ceremony</td>
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### Friday 6 January 2017

**Olympia Room**

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<tr>
<td>08:30-09:30</td>
<td>Oral session FRI1o Plenary Session 4</td>
<td>Coffee Break (Olympia lobby)</td>
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<td>09:30-09:45</td>
<td>Coffee Break (Olympia lobby)</td>
<td>09:30-09:45 Coffee Break (Olympia lobby)</td>
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<tr>
<td>09:45-11:15</td>
<td>Oral session FRI2o Lenses and Light Manipulation</td>
<td>09:45-11:15 Oral session FRI2s Metamaterials and Metasurfaces</td>
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<tr>
<td>11:15-11:30</td>
<td>Break</td>
<td>11:15-11:30 Break</td>
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<tr>
<td>11:30-13:15</td>
<td>Oral session FRI3o Ultrafast Nanophotonics</td>
<td>11:30-13:00 Oral session FRI3s Single Nanoparticles and Strong Coupling</td>
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<tr>
<td>13:00-17:00</td>
<td>Lunch Break</td>
<td>13:00-17:00 Lunch Break</td>
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**FOYER Olympia**

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<th>Time</th>
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<tbody>
<tr>
<td>17:00-18:30</td>
<td>Poster Session II – FRI5f With snacks and drinks</td>
<td>17:00-18:30 Poster Session II – FRI5f With snacks and drinks</td>
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**Olympia Room**

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<tbody>
<tr>
<td>18:30-20:30</td>
<td>Oral session FRI6o Electron Beam Nanophotonics</td>
<td>Oral session FRI6s Nanophotonics Devices</td>
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<tr>
<td>08:30-09:30</td>
<td>Oral session SAT1o Plenary Session 5</td>
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<td>09:30-09:45</td>
<td>Break</td>
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<tr>
<td>09:45-11:15</td>
<td>Oral session SAT2o Polaritonics</td>
<td>09:45-11:15 Oral session SAT2s Programme Committee Top Picks</td>
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<td>11:15-11:30</td>
<td>Coffee Break (Olympia lobby)</td>
<td>11:15-11:30 Coffee Break (Olympia lobby)</td>
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<tr>
<td>11:30-13:00</td>
<td>Oral session SAT3o Novel Phenomena</td>
<td>11:30-13:00 Oral session SAT3s Metasurfaces</td>
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<tr>
<td>13:00-16:00</td>
<td>Lunch Break</td>
<td>13:00-16:00 Lunch Break</td>
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<tr>
<td>16:00-17:30</td>
<td>Oral session SAT4o Reconfigurable and Tuneable</td>
<td>16:00-17:30 Oral session SAT4s Nanoscopy and Imaging</td>
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<tr>
<td>17:30-17:45</td>
<td>Break</td>
<td>17:30-17:45 Break</td>
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<tr>
<td>17:45-18:45</td>
<td>Oral session SAT5o Breakthrough Session 3</td>
<td>17:45-18:45 Oral session SAT5s Breakthrough Session 4</td>
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<tr>
<td>18:45-19:00</td>
<td>Oral session SAT6o Student Prize award and Closing Ceremony</td>
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<td>19:00-20:00</td>
<td>Beer reception</td>
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**Wednesday 4 January 2017**

**WED1o: Opening and Plenary Session 1, 08:35-09:45 - Olympia Room**

**The Orbital Angular Momentum of Light: 25 Years On**  
**Miles Padgett, University of Glasgow, Glasgow, United Kingdom**

Over the last twenty-five years numerous groups have used OAM in many areas of optical physics. This lecture will review the field of OAM and highlight some areas of new opportunities.

Miles Padgett holds the Kelvin Chair of Natural Philosophy at the University of Glasgow. He is fascinated by light both classical and quantum - specifically light’s angular momentum. In 2001 he was elected a Fellow of the Royal Society of Edinburgh (RSE) and in 2014 a Fellow of the Royal Society, the UK’s National Academy. In 2009, with Les Allen, he won the Institute of Physics Young Medal, in 2014 the RSE Kelvin Medal and in 2015 the Science of Light Prize from the European Physical Society.

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**Thursday 5 January 2017**

**THU1o: Plenary Session 2, 08:30-09:30 - Olympia Room**

**Rydberg Excitons in Cuprous Oxide**  
**Manfred Bayer, Experimentelle Physik 2, TU Dortmund, Dortmund, Germany**

Rydberg excitons in cuprous oxide with µm-extension demonstrate huge interactions similar to Rydberg atoms. Consequences like the Rydberg blockade will be dicussed and also efforts to demonstrate quantum coherent phenomena due to their favorable coherence.

Manfred Bayer has studied physics at the University of Würzburg where he did also his PhD working studying low-dimensional electronic and photonic structures. Since 2002 he is professor at TU Dortmund. His research interests concern laser spectroscopy of condensed matter and in particular semiconductors with a specific focus on quantum phenomena.

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**THU6o: Plenary Session 3, 19:45-20:30 - Olympia Room**

**Quantum Plasmonics and Polaritons in 2d Materials**  
**Frank Koppens, ICFO - The Institute of Photonic Sciences, Castelldefels (Barcelona), Spain**

In this talk, we will show several examples of 2d material heterostructure devices with novel ways of exciting, controlling and detecting polaritons. In addition, we challenge the limits of propagating plasmon confinement and test quantum theories of the dynamic response of the electron system.

Frank Koppens obtained his PhD in experimental physics at Delft University, at the Kavli Institute of Nanoscience, The Netherlands. After a postdoctoral fellowship at Harvard University, since August 2010, Koppens is a group leader at the Institute of Photonic Sciences (ICFO). He has received the Christiaan Huygensprijs 2012, the Premis Nacional de Reserca, the IUPAP young scientist prize in optics, and four ERC awards (Starting grant, Consolidator grant and two proof-of-concept grants). Prof. Koppens is leader of the optoelectronics package of the graphene flagship (1B€ project for 10 years). The quantum nano-optoelectronics group of Prof. Koppens focuses on both science and technology of novel two-dimensional materials and quantum materials. Extraordinary interactions between light and matter are being investigated, and probed at ultra-fast timescales and nano-scale lengthscalss. The group also develops devices with applications for wearables, sensing, photodetection, infrared imaging, power conversion and nano-scale light processing and switching.
Friday 6 January 2017

FRI1o: Plenary Session 4, 08:30-09:30 - Olympia Room
High Performance Metaoptics at Visible Wavelengths

Federico Capasso, Harvard John A. Paulson School of Engineering and Applied Sciences, Harvard University, USA

Using a new Titanium Dioxide atomic layer deposition process we demonstrated metadevices across the visible: high NA diffraction limited metalenses, meta-axicons, high-resolution miniature spectrometers and complex helical beams based on spin-to-orbital angular momentum conversion.

Federico Capasso is the Robert Wallace Professor of Applied Physics at Harvard University, which he joined in 2003 after 27 years at Bell Labs where his career advanced from postdoctoral fellow to Vice President for Physical Research. He pioneered bandstructure engineering of semiconductor heterostructures, including the invention of the quantum cascade laser; investigated Casimir forces using micromechanics and performed the first measurement of the repulsive Casimir force. Recent contributions include wavefront control using metasurfaces and a new class of flat optical components such as high efficiency diffraction limited metalenses. He is the recipient of the 2016 Balzan prize for Applied Photonics. Other awards include the King Faisal Prize for Science, the IEEE Edison Medal, the American Physical Society Arthur Schawlow Prize, the SPIE Gold Medal, the Rumford Prize of the American Academy of Arts and Sciences, the Franklin Institute Wetherill Medal, the European Physical Society Quantum Electronics Prize, the Materials Research Society Medal, and the Jan Czochralski Award for lifetime achievement in Materials Science. He is a member of the National Academy of Sciences, the National Academy of Engineering, the American Academy of Arts and Sciences, the Academia Europaea and a foreign member of the Accademia dei Lincei; he holds honorary doctorates from Lund University, University Paris-Diderot and University of Bologna.

Saturday 7 January 2017

SAT1o: Plenary Session 5, 08:30-09:30 - Olympia Room
Exciton-Polarons and Polaritons in Atomically Thin Semiconductors

Atac Imamoglu, ETH Zurich, Zurich, Switzerland

Interacting polariton-electron system in two-dimensional materials realizes a new class of Bose-Fermi mixtures exhibiting novel many-body physics.

Atac Imamoglu has been full Professor of Quantum Electronics at the Department of Physics of the ETH Zurich since December 2002, where he is heading the research group on Quantum Photonics. Prof. Imamoglu received his Ph.D from Stanford University with a dissertation on electromagnetically induced transparency and lasers without inversion. After postdoctoral stays at NTT Basic Research Laboratories in Tokyo, Japan and at the Institute of Theoretical Atomic and Molecular Physics at Harvard University in Cambridge, Massachusetts, he joined The University of California at Santa Barbara as an Assistant Professor in 1993. He was promoted to Associate Professorship in 1997 and to full Professorship in 1999. Prof. Imamoglu has pioneered the use of quantum dots in study of quantum optical phenomena. In particular, his group demonstrated the first quantum dot single photon source, the Purcell effect in quantum dot cavity-QED, and the use of photon correlation spectroscopy. Prof. Imamoglu has received the Charles Townes Award of OSA in 2010, IEEE Quantum Electronics Award in 2009, Wolfgang Paul Award of the Humboldt Foundation in 2002 and David and Lucile Packard Fellowship in 1996. His research has been supported by 2 ERC Advanced Investigator Grants. He is a fellow of the American Physical Society and of the Optical Society of America.
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<td><strong>WED4o: Breakthrough Session 1</strong></td>
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<td>19:00-19:30</td>
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<td>Topological Insulator Lasers Mordechai (Moti) Segev, Technion - Israel Institute of Technology, Haifa, Israel</td>
<td>Taming the Dynamics of a Levitated Nanoparticle: From Bistability to Cooling Romain Quidant, ICFO, Barcelona, Spain</td>
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<td><strong>SAT5o: Breakthrough Session 3</strong></td>
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<td>18:15-18:45</td>
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<tr>
<td>Quantum Effects in Time Dependent ENZ Materials Daniele Faccio, Institute of Photonics and Quantum Sciences, Heriot-Watt University, Edinburgh, United Kingdom</td>
<td>Turning Forbidden Transitions into Dominant Transitions: Towards Efficient Sources of Entangled Light Nicholas Rivera, Ido Kaminer, and Marin Soljacic, MIT, Cambridge, MA, USA</td>
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<tr>
<td>10:00-12:00</td>
<td><strong>WED2o: Topological Photonics</strong></td>
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<td>10:00-10:30</td>
<td><strong>WED2o.1</strong> Mixing and Matching Photonic Topological Phases: From Robust Delay Lines to Topological Cavities Gennady Shvets, The University of Texas at Austin, United States and Cornell University, School of Applied and Engineering Physics, Ithaca, NY, USA</td>
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<tr>
<td>11:30-12:00</td>
<td><strong>WED2o.6</strong> Mimicking Quantum Systems with Plasmonic Waveguide Arrays Felix Bleckmann¹, Zlata Cherpakova¹, Daniel Friesen¹, Andrea Alberti¹, and Stefan Linden¹ —¹Physikalisches Institut, Universität Bonn, Bonn, Germany —²Institut für Angewandte Physik, Universität Bonn, Bonn, Germany</td>
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<td>17:00-18:45</td>
<td><strong>WED3o: Metamaterials and Metadevices</strong></td>
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<td>17:00-17:30</td>
<td><strong>WED3o.1</strong> Quantum Effects in Actively Tunable Metadevices Mark Brongersma, Stanford University, USA</td>
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<td>17:30-18:00</td>
<td><strong>WED3o.2</strong> Metadevice of three dimensional split ring resonators Pin Chieh Wu¹,², Chun Yen Liao¹, Wei-Yi Tsai¹, Mu-Ku Chen¹, Cheng Hung Chu¹, Huijun Wu², Hsiang-Chu Wang², Greg Sun³, Ai Qun Liu³, Nikolay Zheludev², and Din Ping Tsai¹² —¹National Taiwan Univ., Taipei, Taiwan —²Research Center for Applied Sciences, Academia Sinica,Taipei, Taiwan —³Univ. of Massachusetts, Boston, USA —⁴School of Electrical and Electronic</td>
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### Invited Talks at a Glance

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<tr>
<td>18:15-19:00</td>
<td><strong>Three-Dimensional Metamaterials for Nonlinear Holography</strong></td>
<td>Yehiam Prior¹, Ora Bitton², and Euclides Almeida¹ — ¹Department of</td>
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<td>Chemical Physics, Weizmann Institute of Science, Rehovot, Israel —</td>
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<td>²Chemical Research Support, Weizmann Institute of Science, Rehovot, Israel</td>
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<td>19:00-20:00</td>
<td><strong>Breakthrough Session 1</strong></td>
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<td>19:30-20:00</td>
<td><strong>Structured super oscillating beams of photons and electrons</strong></td>
<td>Ady ARIE, Tel-Aviv University, Tel-Aviv, Israel</td>
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<td>19:45-12:00</td>
<td><strong>Plasmonic Metal Nitrides for Local Heating and Energy Applications</strong></td>
<td>Urcan Guler¹, Alberto Naldoni¹², Harsha Reddy¹, Zhaxylyk Kudyshev¹,</td>
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<td>Alexander Kildishev¹, Alexendra Boltasseva¹, and Vladimir Shalaev¹ — ¹</td>
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<td>Purdue University, West Lafayette, IN, USA — ²CNR-Istituto di</td>
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<td>Scienze e Tecnologie Molecolari, Milan, Italy</td>
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<td>10:15-11:45</td>
<td><strong>Tailoring materials for nanophotonic applications</strong></td>
<td>Aveek Dutta, Krishnakali Chaudhuri, Clayton Devault, Jongbun Kim,</td>
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<td>Soham Saha, Urcan Guler, Vladimir Shalaev, and Alexandra Boltasseva,</td>
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### Thursday 5 January 2017

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<td><strong>Seefeld Room</strong></td>
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<td>09:45-10:15</td>
<td><strong>The Case for Quantum Plasmonics</strong></td>
<td>Sergey Bozhevolny¹, and Jacob Khurgin³ — ¹University of Southern</td>
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<td>Denmark, Odense, Denmark — ³Johns Hopkins University, Baltimore, USA</td>
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<td>09:45-12:00</td>
<td><strong>THU2s: Quantum Plasmonics and Quantum Systems</strong></td>
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<td>10:45-11:15</td>
<td>Metal Halide Perovskite Nano-Platelets</td>
<td>Jochen Feldmann</td>
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<td>THU2o.3</td>
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<td>11:15-11:45</td>
<td>Enhancing Nonlinear Optical Signal of Perovskite Nanomaterials</td>
<td>Rachel Grange</td>
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<td>THU2o.4</td>
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<td>18:30-19:00</td>
<td>Plasmonics of topological insulators</td>
<td>Jun Yin1, Giorgio Adamo2, Harish Krishnamoorthy3, Jinkyu So2, Alexander Dubrovkin2, Yidong Chong2, Nikolay Zheludev1,3, and Cesare Soci 1,2 — 1School of Physical and Mathematical Sciences, 21 Nanyang Link, Singapore — 2Centre for Disruptive Photonic Technologies, Nanyang Technological University, 21 Nanyang Link, Singapore — 3Optoelectronics Research Centre, University of Southampton, UK</td>
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<td>THU5s.1</td>
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<td>19:00-19:30</td>
<td>Towards Topological Quantum Transport in Photonic Structures</td>
<td>Mohammad Hafezi</td>
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<tr>
<td>THU5s.2</td>
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<td>09:45-11:15</td>
<td>Lenses and Light Manipulation</td>
<td>Layered Metasurfaces for Functional Light Shaping and Manipulation</td>
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<tr>
<td>FRI2o.1</td>
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<tr>
<td>09:45-11:15</td>
<td>Metamaterials and Metasurfaces</td>
<td>Spin- and orbital-Hall effect in cyclic group symmetric metamaterial</td>
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<td>FRI2s.1</td>
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<td>Optical antireflection without index match using bi-layer metasurfaces</td>
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<td>10:45-11:15</td>
<td>FRI2o.4</td>
<td>Nano-Sieves for Visible Light Manipulation</td>
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<td>FRI2s.3</td>
<td>Metasurfaces with Nonlinear Berry Phases in Space and Time</td>
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<td>11:30-13:00</td>
<td>FRI3o: Ultrafast Nanophotonics</td>
<td>Nanosystems in ultrafast and superstrong fields: Attosecond phenomena</td>
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<tr>
<td>11:30-12:00</td>
<td>FRI3s: Single Nanoparticles and Strong Coupling</td>
<td>Single Molecule Strong Coupling, and Light Confinement &lt;1nm\textsuperscript{3}</td>
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<td>12:30-13:00</td>
<td>FRI3o.4</td>
<td>Ultrafast Nanophotonic Phenomena using Graphene</td>
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<td>12:30-13:00</td>
<td>FRI3s.3</td>
<td>Nonlinear Optics with a Few Photons and a Single Molecule</td>
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<td>18:30-20:30</td>
<td>FRI6o: Electron Beam Nanophotonics</td>
<td>Single-photon time-resolved cathodoluminescence imaging spectroscopy</td>
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<tr>
<td>19:00-19:30</td>
<td>FRI6o.2</td>
<td>Electron Microscopy of Electromagnetic Waveforms</td>
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<td>19:30-20:00</td>
<td>FRI6o.3</td>
<td>Ultrafast point-projection electron microscopy of thin carbon films</td>
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## Invited Talks at a Glance

**NANOMETA 2017**

**Saturday 7 January 2017**

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<th>Authors</th>
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<tbody>
<tr>
<td>09:45-11:15</td>
<td>Olympia</td>
<td><strong>SAT2o: Polaritonics</strong></td>
<td>Polariton mapping in 2D materials</td>
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<td><strong>Rainer Hillenbrand, CIC nanoGUNE, San Sebastian, Spain</strong></td>
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<tr>
<td>09:45-10:15</td>
<td>Seefeld</td>
<td><strong>SAT2o.1</strong></td>
<td>Mid-IR to THz Polaritonics: Approaches Towards Alternative Materials and Active Optics</td>
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<td>10:15-10:45</td>
<td>Seefeld</td>
<td><strong>SAT2o.2</strong></td>
<td>Reversible Switching of Highly Confined Phonon-Polaritons with an Ultrathin Phase-change Material</td>
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<td><strong>Peining Li</strong>, <strong>Xi-aosheng Yang</strong>, <strong>Tobias W.W. Maß</strong>, <strong>Julian Hanss</strong>, <strong>Martin Lewin</strong>, <strong>Ann-Katrin U. Michel</strong>, <strong>Dmitry Chigrin</strong>, <strong>Matthias Wuttig</strong>, and <strong>Thomas Taubner, Institute of Physics (IA), RWTH Aachen University, Aachen, Germany</strong></td>
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<tr>
<td>11:30-13:00</td>
<td>Seefeld</td>
<td><strong>SAT3s: Metasurfaces</strong></td>
<td>High-Efficiency Metasurfaces in Reflective and Transmissive Geometries</td>
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<td><strong>Lei Zhou, Fudan University, Shanghai, China</strong></td>
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<tr>
<td>11:30-12:00</td>
<td>Seefeld</td>
<td><strong>SAT3s.1</strong></td>
<td>Multipolar Interference Effects for Advanced Light Control with Dielectric Nanoantennas and</td>
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<td><strong>Metasurfaces</strong></td>
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<td><strong>Arseny Kuznetsov, Data Storage Institute, A*STAR (Agency for Science, Technology and Research), Singapore</strong></td>
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<td>12:00-12:30</td>
<td>Seefeld</td>
<td><strong>SAT3s.2</strong></td>
<td>Multifunctional Nano-Structured Optical Surfaces for Industrial Applications</td>
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<td>12:30-13:00</td>
<td>Seefeld</td>
<td><strong>SAT3s.3</strong></td>
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<td>16:30-17:30</td>
<td>SAT4o: Reconfigureable and Tuneable</td>
<td><strong>16:00-16:30 SAT4o.1</strong> Tunable metasurfaces by atomic media Jonathan Bar-David, Liron Stern, and Uriel Levy, The Hebrew University of Jerusalem, Jerusalem, Israel</td>
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<td>SAT4s: Nanoscopy and Imaging</td>
<td><strong>16:00-16:30 SAT4s.1</strong> Ultratrace plasmonic sensing with quantum states of light Benjamin Lawrie, and Raphael Pooser, Quantum Information Science Group, Oak Ridge National Laboratory, Oak Ridge TN USA</td>
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<td>17:45-18:15</td>
<td>SAT5o: Breakthrough Session 3</td>
<td><strong>17:45-18:15 SAT5o.1</strong> Twists and Turns of Nanoscale Light Koub Kuipers, Quantum Nanoscience dept., Kavli Institute for Nanoscience, Delft, NL</td>
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<td>SAT6s: Breakthrough Session 4</td>
<td><strong>17:45-18:15 SAT6s.1</strong> Harnessing Loss in Plasmonic Metamaterials Jason Valentine¹, Wei Li¹, Wenyi Wang¹, Lucas Besteiro², and Alexander Govorov² —¹Vanderbilt University, Nashville, TN, USA —²Ohio University, Athens, OH, USA</td>
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WED1o: Opening and Plenary Session 1
Chaired by Nader Engheta, University of Pennsylvania, Philadelphia, USA
Time: Wednesday, 8:35–9:45  Location: Olympia
Opening Remarks - Nikolay Zheludev & Harald Giessen

WED2o: Topological Photonics
Chaired by Frank Koppens, ICFO, Barcelona, Spain
Time: Wednesday, 10:00–12:00  Location: Olympia

WED2s: Nanolasers and New Emission Phenomena
Chaired by Bumki Min, KAIST, Daejeon, South Korea
Time: Wednesday, 10:00–12:00  Location: Seefeld/Tirol

9:45–10:00: Coffee Break (Olympia lobby)

WED2o.2 10:30
Testing Robustness of Photonic Topological Edge States — • Fei Gao1, Zhen Gao1, Hongsheng Chen1,2, Ling Lu1, Yidong Chong1,2, and Baile Zhang1,2 — 1Division of Physics and Applied Physics, School of Physical and Mathematical Sciences, Nanyang Technological University, Singapore 637371, Singapore. — 2State Key Laboratory of Modern Optical Instrumentation, Zhejiang University, Hangzhou 310027, China. — *School of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139, USA. — *Centre for Disruptive Photonic Technologies, Nanyang Technological University, Singapore 637371, Singapore.

On a tunable platform of designer surface plasmon structure, we systematically test the robustness of photonic topological states against common time-reversal-invariant photonic defects, including those that can break topological protection.

Oral  WED2o.3 10:45
Linear and Nonlinear Weyl Point Photonic Lattices — • Daniel Leykam1, Yidong Chong1,2, Mikael C. Rechtsman1, Jiho Noh1, Sheng Huang1, and Kevin Chen1 — 1School of Physical and Mathematical Sciences, Nanyang Technological University, Singapore — 2Centre for Disruptive Photonic Technologies, Nanyang Technological University, Singapore — *School of Physics, The Pennsylvania State University, University Park, USA — *Department of Electrical and Computer Engineering, University of Pittsburgh, Pittsburgh, USA

Invited  WED2s.1 10:00
Colloidal-quantum-dot spasers and plasmonic amplifiers — • Stephan Kress1, Jian Cui1, Patrik Rohner2, David Kim3, Felipe Antolínez1, Karl-August Zaininger4, Sriharsha Jayanti1, Patrizia Richner1, Kevin McPeak1, Dimos Poulikakos1, and *David Norris — 1Optical Materials Engineering Laboratory, ETH Zurich, Zurich, Switzerland — 2Laboratory of Thermodynamics in Emerging Technologies, ETH Zurich, Zurich, Switzerland

We introduce a versatile class of quantum-dot-based spasers that allow controlled generation, extraction, and manipulation of plasmons. The resulting spaser platform is deployable at different wavelengths, size scales, and geometries for fundamental studies and applications.

Invited  WED2s.2 10:30
Dynamics of Strong Coupling and Nano-Lasing in Nanoplasmic Systems — • Erwin Hess — The Blackett Laboratory, Department of Physics, Imperial College London, London, UK

The dynamics light strongly coupled with single quantum emitters (molecules, quantum dots) in nanoplasmic cavities at room temperature provides the basis for strong coupling spectroscopy and paves the way for few- or single-molecule lasing.

Plenary  WED1o.1 8:45
The Orbital Angular Momentum of Light: 25 Years On — • Miles Padgett — University of Glasgow, Scotland, UK

Over the last twenty five years numerous groups have used OAM in many areas of optical physics. This lecture will review the field of OAM and highlight some areas of new opportunities.

Invited  WED2o.1 10:00
Mixing and Matching Photonic Topological Phases: From Robust Delay Lines to Topological Cavities — • Gennady Shvets — The University of Texas at Austin, United States — Cornell University, School of Applied and Engineering Physics, Ithaca, NY 14853, USA.

I will describe our recent work on the photonic emulation of three topological phases corresponding to quantum Hall, spin-Hall, and valley-Hall interactions. New topology-enabled paradigms for a variety of photonic devices are proposed.
We demonstrate laser-written photonic lattices exhibiting “type-II” Weyl points. Unidirectional “Fermi arc” edge modes can be switched on or off using Kerr nonlinearity or by tuning the lattice parameters or probe frequency.

**Oral**

**WED2o.4 11:00**

**Optical Access to Topological Insulator Spin Dynamics**

*Panna, Dmitry, Marijnev, Rajat, Sabag, Evyatar, Bouscher, Leonid, Rybak, Amit, Ribak, Amit, Kanigel, Alex, Hayat, Technion, Haifa, Israel*

We demonstrate all-optical access to topological-insulator ultrafast spin dynamics using transient-reflectivity measurements by controlling photon energy and polarization. Our approach distinguishes bulk and surface state responses, providing a practical tool for studying topological insulator dynamics.

**Oral**

**WED2o.5 11:15**

**Topologically Protected Graphene Plasmons**

*Pan, Deng, Xu, Hongxing, Abaro, Javier García de, Wuhan University, Wuhan, China, ICFO-Institut de Ciencies Fotoniques, The Barcelona Institute of Science and Technology, Spain*

We theoretically demonstrate that a honeycomb superlattice of doped graphene nanoribbons supports topologically protected unidirectional plasmon edge states when exposed to a magnetic field of only a few tesla.

**Invited**

**WED2o.6 11:30**

**Mimicking Quantum Systems with Plasmonic Waveguide Arrays**

*Blekmann, Felix, Cherpakova, Zlata, Friesen, Daniel, Alberti, Andrea, Linden, Stefan, University of Bonn, Germany, Physikalisches Institut, University of Bonn, Germany*

Arrays of evanescently coupled plasmonic waveguides can show dynamics that resemble quantum mechanical phenomena. Here, we report on the observation of topologically protected edge states, Anderson localization, and directional light transport in plasmonic ratchets.

**Oral**

**WED2s.3 11:00**

**Ion Emission from Gold Nanostructures Using Impulsively Excited Surface Plasmons**

*Shi, Liping, Iwan, Blanca, Ribeau, Quentin, Andrade, José R. C., Han, Seungwoi, Kim, Hyunwoong, Bouly, Willem, Franz, Dominik, Nicola, Rana, Heidenblut, Torsten, Morgner, Uwe, Kim, Seung-Woo, Merdji, Hamed, Kovačev, Milutin, University of Hannover, Germany, QUEST Centre for Quantum Engineering and Space-Time Research, Hannover, Germany, 3LIDYL, CE A, CNRS, Université Paris-Saclay, France, Department of Mechanical Engineering, Korea Advanced Institute of Science and Technology, South Korea, Institut für Werkstoffkunde, Leibniz Universität Hannover, Germany, Laser Zentrum Hannover, Germany, Laser Physics and Nonlinear Optics, McMaster University, University of Twente, Enschede, The Netherlands, Laser-Laboratorium Göttingen, Göttingen, Germany*

We demonstrate the ion ejection from plasmonic nanostructures under the irradiation of ultrashort pulses from femtosecond oscillator at ultralow fluence. The underlying mechanism is attributed to the surface optical rectification as well as ponderomotive acceleration.

**Oral**

**WED2s.4 11:15**

**Electrical Excitation of Plasmons in Graphene through the 2D Čerenkov Effect**

*Kaminer, Ido, Tenenbaum, Yaniv, Katan, Hrvoje, Buljan, Yichen, Shen, Ognjen Ilie, Josue, Lopez, Liang-Jie, Song, John, Ioannopoulos, Main, Soljacic, MIT, Cambridge, USA, Technion, Haifa, Israel, University of Zagreb, Croatia, SMITech, Singapore, Singapore*

We show that charge carriers flowing inside graphene can emit graphene plasmons (GPS) through a 2D Čerenkov effect (2D ČE), providing a highly efficient, tunable, and ultrafast conversion mechanism from electrical signal to plasmonic excitation.

**Invited**

**WED2s.5 11:30**

**Tailoring resonance of SPP with cavity modes for high performance OLEDs**

*Sun, Hong-Bo, Zhang, Xu-Lin, Wang, Jing, Zheng, U. Lin, Cheng, Chao, State Key Laboratory on Integrated Optoelectronics, College of Electronic Science and Engineering, Jilin University, China, Soh, Kiang chun, Changchun 130012, China*

We proposed light outcoupling strategies for organic light emitting devices by tailoring the resonance of surface plasmon-polaritons and cavity modes. The device performance including both viewing characteristics and electroluminescence efficiency could then be improved considerably.

12:00–17:00: Lunch Break
Quantum Effects in Actively Tunable Metadevices — **Mark Brongersma** — Stanford University

Electrically-tunable metasurfaces are demonstrated using indium tin oxide as an active medium. We demonstrate the importance of quantum effects in the ITO to the operation of these devices.

**Invited**

**WED3o.1** 17:00

Quantum Effects in Actively Tunable Metadevices — **Mark Brongersma** — Stanford University

**WED3o.2** 17:30

Metadevice of three dimensional split ring resonators — **Pin Chieh Wu**1,2, Chun Yen Liao1, Wei-Yi Tsai1, Mu-Ku Chen1, Cheng Hung Chu2, Huijun Wu2, Hsiang-Chu Wang2, Greg Sun3, Ai Qun Liu4, Nikolay Zheludev5, and **Cinz Pend Tsai**1,2 — 1Department of Physics, National Taiwan University, Taipei 10617, Taiwan — 2Research Center for Applied Sciences, Academia Sinica, Taipei 11529, Taiwan — 3Department of Physics, University of Massachusetts Boston, Boston, Massachusetts 02125, USA — 4School of Electrical and Electronic Engineering, Nanyang Technological University, Singapore 639798, Singapore — 5Optoelectronics Research Centre, University of Southampton, Southampton SO17 1BJ, UK

A novel type of split-ring resonator, called vertical split-ring resonator (VSRR) is designed and investigated, including its fundamental resonances and potential applications in meta-optics.

**Oral**

**WED3o.3** 18:00

All-dielectric near-field nanolasers based on non-radiating anapole modes — **Juan Sebastian Totero Gongora**1, Andrei E. Miroshnichenko2, Yuri S. Kivshar2, and Andrea Fratalocchi2 — 1PRIMALIGHT, King Abdullah University of Science and Technology (KAUST), Thuwal 23955-6900, Saudi Arabia — 2Nonlinear Physics Centre, Research School of Physics and Engineering, Australian National University, Canberra, ACT 2601, Australia

We demonstrate a novel type of near-field nanolaser based on the amplification via stimulated emission of non-radiating anapole modes. We discuss different application ranging from spontaneously polarized nanolasers, to on-chip ultrafast pulse generation.

**Invited**

**WED3o.4** 18:15

Three-Dimensional Metamaterials for Nonlinear Holography — **Yehiam Prior**1, Ora Bitton2, and Euclides Almeida1 — 1Department of Chemical Physics, Weizmann Institute of Science, Rehovot 76100, Israel — 2Chemical Research Support, Weizmann Institute of Science, Rehovot 76100, Israel

Multilayer metamaterials, each consisting of a different set of nanoantennas, are shown to generate background-free nonlinear holograms at a new frequency. Prospects for future device applications are discussed.

**WED3s: Sensing and Nanoplasmonics Chemistry**

Chaired by Stefan Linden, University of Bonn, Bonn, Germany

Time: Wednesday, 17:00–18:45 Location: Seeffeld/Tirol

**Invited**

**WED3s.1** 17:00

Graphene and Metal Plasmonic Biosensors — **Hatrice Altug** — EPFL - Ecole Polytechnique Federale de Lausanne, Lausanne, Switzerland

We will show the use of graphene and metal plasmonics interfaced with biology and chemistry for demonstration of cutting-edge biosensing technologies. The new devices will be exploited for detection of infectious pathogens and disease biomarkers.

**Invited**

**WED3s.2** 17:30

Metasurfaces for optical field sensing — **Ann Roberts** — School of Physics, The University of Melbourne, Australia

Metasurfaces provide a compact approach to extracting information from optical wavefields. Here we present a metasurface-enabled photodetector that converts information about the state of a polarisation to an electrical signal.

**Oral**

**WED3s.3** 18:00

Observing nanoscale hydrogen diffusion in plasmonic magnesium particles — **Florian Sterl**1, Nikolai Strohfeldt1, Ronald Griessen2, and Harald Griessen1 — 14th Physics Institute and Research Center SCPE, University of Stuttgart, Stuttgart, Germany — 2Faculty of Sciences, Division of Physics and Astronomy, VU University, Amsterdam, The Netherlands

We demonstrate the use of magnesium nanoparticles for active plasmonics, with visible resonances that can be switched off and on via hydrogen exposure. We furthermore investigate the nanoscale diffusion of hydrogen and the degradation mechanisms.

**Oral**

**WED3s.4** 18:15

Plasmonic for mid-infrared on-chip sensing — **Benedikt Schwarz**1, Daniela Ristantic2, Hermann Detz2, Aaron Maxwell Andrews1, Werner Schrenk1, and Gottfried Strasser1 — 1Institute for Solid State Electronics and Center of Micro- and Nanostructures, TU Wien, Vienna, Austria — 2Austrian Academy of Sciences, Vienna, Austria

Plasmonic waveguides are well-suited for direct absorption spectroscopy of liquids. Dielectric-loading helps to increase the confinement, while maintaining a large overlap with the analyte. Excitation and detection is achieved via on-chip integrated quantum cascade devices.
Site-specific surface chemistry driven by hot-electrons — Emanlio Cortés, Wei Xie, Javier Cambiaso, Adam Jermyn, Ravishankar Sundaraman, Prineha Narang, Sebastian Schlücker, and Stefan Mayer

Invited

Structured super oscillating beams of photons and electrons — Ady Arie — Tel-Aviv University, Tel-Aviv, Israel

We present topological insulator lasers: lasers whose cavity is robust to disorder and defects, with high slope efficiency that remains unchanged even under large disorder, because the cavity acts as a “superconductor for light”.

18:45–19:00: Coffee Break (Olympia lobby)

WED4s: Breakthrough Session 2

Invited

Designing Whispering Gallery Modes via Transformation Optics — Yushin Kim, Soo-Young Lee, Jung-Wan Ryu, Inbo Kim, Jae-Hyung Han, Heung-Sik Tae, Muhan Choi, and Bumki Min

We first report on the unique linear and nonlinear mechanical properties of a levitated nanoparticle in vacuum, including its outstanding sensing capability and bistable dynamics. Subsequently, we present our efforts in cooling its motion towards mechanical ground state at room temperature.
Plasmonic Metal Nitrides for Local Heating and Energy Applications —...
Thursday Sessions

Invited THU2o.3 10:45
Metal Halide Perovskite Nano-Platelets — •JOCHEN FELDMANN
— LMU, Munich, Germany
Synthesis routes and optical investigations of highly fluorescent metal halide perovskite nano-platelets with controllable thickness down to one monolayer are reported.

Invited THU2o.4 11:15
Enhancing Nonlinear Optical Signal of Perovskite Nanomaterials — •RACHEL GRANGE — ETH Zurich, Institute for Quantum Electronics, Zurich, Switzerland
We demonstrate how to enhance nonlinear optical properties of Perovskite materials at the nanoscale: with plasmonics in potassium niobate nanowire, with Mie resonances in barium titanate nanoparticles and with phase matching in lithium niobate nanowaveguides.

Oral THU2s.4 10:45
Use of plasmonic nanoantennas in non-classical light sources — •JAKOB STRAUDEL, KAROLINA SLOWIK, RAFAL SARNIAK, ROBERT FILTER, and CARSTEN ROCKSTUHL — 1Institute of Theoretical Solid State Physics, Karlsruhe Institute of Technology, 76131 Karlsruhe, Germany — 2Institute of Physics, Nicolaus Copernicus University, 87-100 Torun, Poland — 3Centre for Astronomy, Nicolaus Copernicus University, 87-100 Torun, Poland — 4Institute of Condensed Matter Theory and Solid State Optics, Friedrich-Schiller-University Jena, 07743 Jena, Germany
We demonstrate how plasmonic nanoantennas allow the emission of light with non-classical properties from coupled quantum emitters. We demonstrate their usefulness in novel light sources beyond a modification of the emission rate and directivity.

Oral THU2s.5 11:00
Plasmon-assisted high-harmonic generation in graphene — •JOEL COX, ANDREA MARINI, and JAVIER GARCÍA DE ABAJO — 1ICFO-Institut de Ciencies Fotoniques, The Barcelona Institute of Science and Technology, 08860 Castelldefels (Barcelona), Spain — 2ICREA-Institució Catalana de Recerca i Estudis Avançats, Passeig Lluís Companys 23, 08010 Barcelona, Spain
We demonstrate that doped graphene nanostructures combine strong plasmonic near-field enhancement and a pronounced intrinsic nonlinearity that result in efficient broadband high-harmonic generation within a single material platform.

Oral THU2s.6 11:15
Surface-Plasmon-Polariton Laser based on an Open-Cavity Fabry-Perot Resonator — •WENQI ZHU, CHENG ZHANG, AMIT AGRAWAL, and HENRI LEZEC — 1Center for Nanoscale Science and Technology, National Institute of Standards and Technology, Gaithersburg, MD 20899, USA — 2Maryland Nanocenter, University of Maryland, College Park, MD, 20742 USA
An open-cavity Fabry-Perot resonator enables room-temperature lasing of propagating surface plasmons with a record-narrow linewidth.

Oral THU2s.7 11:30
Nanoscale thermal light emission from atomically thin MoS2 — •LUKAS DUBUSCH, SIMONE SCHULER, VASILI PEREBINOS, and THOMAS MUELLER — 1Vienna University of Technology, Institute of Photonics, Vienna, Austria — 2Skolkovo Institute of Science and Technology, Skolkovo, Russia
The low thermal conductivity of monolayer MoS2 allows the electron temperature to reach ~1650 K, accompanied by visible light emission, as a result of Joule heating if suspended over a distance of only 150 nm.
strong improvement of long-term chemical and thermal stability of silver nanoantennas and thin films — xiaolong wang, christian santschi, and olivier martin — nanophotonics and metrology laboratory, epfl, lausanne, switzerland

We demonstrate that water is responsible for silver degradation. A dehydration process is developed to fabricate long-term chemical and thermal stable silver nanoantennas and films under ambient condition for applications near the UV range.

12:00–16:15: Lunch Break

THU3o: Technology Talk by Neaspec
Chaired by Harald Giessen, Stuttgart University, Germany

Time: Thursday, 16:15–17:00

17:00

THU4f: Poster Session I

Poster

Quantum correlations enhanced super-resolution localization microscopy enabled by a fiber bundle camera — yonatan israel, ron tenne, dan oron, and yaron silberberg — department of physics of complex systems, weizmann institute of science, rehovot 76100, israel

We present a method that utilizes quantum correlation measurements for multi-emitter sub-diffraction localization in a time-dependent scene. This is demonstrated using a newly developed imaging configuration based on fiber bundle coupled single-photon avalanche detectors.

Near-field microscopy and spectroscopy at the nanoscale — max eisele — neaspec gmbh, martinsried, germany

See the nanoworld: neaspec introduces neaSNOM, the next generation imaging and spectroscopy tool with nanometer spatial resolution that is based on near-field microscopy. This talk will highlight recent technological advances and new scientific applications in the field of near-field microscopy using the neaSNOM microscope.

Photon Bunching in Time-Resolved Cathodoluminescence Imaging Spectroscopy — sophie meuret, toon coenen, michael latzel, hans zeijlemaker, silke christiansen, and albert polman — center for nanophotonics, fom institute amolf, amsterdam, the netherlands

Time-resolved cathodoluminescence spectroscopy on InGaN/GaN quantum wells shows high photon bunching behavior, and provides a direct measure of electron-exciton interaction and deep subwavelength spatially-resolved spontaneous emission lifetimes in nanoscale quantum systems.

Poster

Probing Nanoscale Plasmonic Facets using Polarization Spectroscopy — marie-elena kleemann, jan mertens, xuezhi zheng, sean cormier, vlad turek, felix benz, rohit chikkarady, and jeremy baumberg — nanophotonics centre, cavendish laboratory, university of cambridge, cambridge, uk

Coupled plasmonic structures are of immense interest due to extreme light localization. In plasmonic nano-cavities, we find strongly coupled plasmon modes show extreme polarization dependence on the exact nano-geometry at the gap region.

Thermal time-resolved cathodoluminescence spectroscopy on InGaN/GaN quantum wellsshow high photon bunching behavior, and provides a direct measure of electron-exciton interaction and deep subwavelength spatially-resolved spontaneous emission lifetimes in nanoscale quantum systems.

We show that the intracavity photonic crystals with spatial filtering functionalities strongly spatial characteristics of microchip laser beam: the angular divergence of the beam is reduced, and the radiation brightness is substantially increased.

Correlated Photon Pairs From Microwafer Polaritons — mathias sassermann, zoltán vörös, gregor weihä, and wolfgang langbein — institute for experimental physics, innsbruck, austria

In this contribution, we present our experimental results on the generation of correlated photon pairs based on high-quality microwafer structures. We present measurements on how various system parameters influence the polarization quantum correlations.

Coupling of nitrogen-vacancy centers in a nanodiamond to a silver nanocube — sebastian k.h. andersen, shailesh kumar, and sergei i. bozhevolnyi — university of southern denmark

We experimentally study the emission of multiple/single nitrogen-vacancy centers contained in a nanodiamond (ND), placed near a silver nanocube with an atomic force microscope. The ND-cube system emit background free, strongly polarized light with a lifetime reduction of 4.1.
Deterministic fabrication of dielectric loaded waveguides coupled to single nitrogen vacancy centers in nanodiamonds — Hamidreza Siampour, Shafees Kumar, and Sergey I. Bozhevolnyi — Centre for Nano Optics, University of Southern Denmark, Campusvej 55, DK-5230 Odense M, Denmark

We report on the fabrication of dielectric-loaded-waveguides which are excited by single-nitrogen-vacancy (NV) centers in nanodiamonds. The waveguides are deterministically written onto the pre-characterized nanodiamonds by using electron beam lithography of hydrogen silsesquioxane (HSQ) resist on silver-coated silicon substrate.

Photon Triplets from a Nanowire Quantum Dot Molecule — Milad Khoshnegar, Tobias Huber, Ana Predojevic, Dan Dalacu, Maximilian Prilsmüller, Philipp Tamara, Brahim Lounis, Philip Poole, and Hamed Majeed — Department of Electrical and Computer Engineering, University of Waterloo, Waterloo, Ontario N2L 3G1, Canada — Joint Quantum Institute, National Institute of Standards and Technology and Univ. of Maryland, Gaithersburg, MD 20849, USA — Institute for Quantum Physics, University Ulm, Albert-Einstein-Allee 11, 89081 Ulm, Germany — National Research Council of Canada, 1200 Montreal Road, Ottawa, Ontario K1A 0R6, Canada — Institut für Experimentalphysik, Universität Innsbruck, Technikerstr. 25, 6020 Innsbruck, Austria — Université Bordeaux, LP2N Institut d’Optique et CNRS, Talence F-33405, France

A multi-excitonic cascade in an InAsP quantum dot molecule inside pure wurtzite InP nanowires emits three photons in a row. The photon triplet emission rate of our source surpasses all other triplet sources reported before.

Nano-chirality detection with vortex plasmon modes — Benjamin Lawrie, Sang-Yeon Cho, Roderick Davidson, and Jordan Hachtel — Quantum Information Science Group, Oak Ridge National Laboratory, Oak Ridge TN USA — School of Electrical and Computer Engineering, New Mexico State University, Las Cruces NM, USA — Department of Physics and Astronomy, Vanderbilt University, Nashville TN USA — Materials Science and Technology Division, Oak Ridge National Laboratory, Oak Ridge TN USA

Cathodoluminescence spectroscopy in a scanning transmission electron microscope is used to probe the spatio-spectral response of nanoscale aperture plasmonic vortex generators. Further, we demonstrate that plasmonic vortex modes can probe the chirality of nanoscale materials.

Investigation of the Stimulated Emission of Surface Plasmon Polaritons by Colloidal Quantum Dots in Plasmonic Resonators and Waveguides — Jian Cui, Stephan J. P. Kress, Patrik Rohner, David K. Kim, Felipe V. Antolinez, Karl-Augustin Zaininger, Srirsha V. Jayanti, Patrizia Richner, Kevin M. McPeak, Dimos Poulikakos, and David J. Norris — Optical Materials Engineering Laboratory, ETH Zurich, Zurich, Switzerland — Laboratory of Thermodynamics in Emerging Technologies, ETH Zurich, Zurich, Switzerland

Colloidal quantum dots are solution-processable nanomaterials that can be easily integrated into plasmonic block resonators and waveguides. Surface plasmon polaritons generated by this versatile combination may serve as the basis for more complex plasmonic circuits.
We show the condensation of exciton-polaritons in a system of strongly coupled molecular excitons with plasmonic lattice resonances in an open and planar cavity at room temperature.

Poster THU4f.20 17:00
Exciton-Polariton Lasing from Surface Lattice Resonances — •Mohammad Ramezani1, Alexi Halpin1, Antonio Fernandez-Dominguez2, Johannes Feist2, Said Rahimzadeh-Kalaleh Rodriguez2, Francisco J. Garcia-Vidal3,4, and Jaime Gomez Rivas1,3,5 — 1Dutch Institute for Fundamental Energy Research (DIFFER), De Zaale 20, 5612 AJ, Eindhoven, the Netherlands — 2Department of Physica Teorica de la Materia Condensada and Condensed Matter Physics Center (IFIMAC), Universidad Autonoma de Madrid, E-28049 Madrid, Spain — 3Laboratoire de Photonique et Nanostructures, LPN/CNRS, Route de Nozay, 91460 Marcoussis, France — 4Donostia International Physics Center (DIPC), E-20018 Donostia/San Sebastian, Spain — 5COBRA Research Institute, Eindhoven University of Technology, P.O. Box 513, 5600 MB Eindhoven, The Netherlands

Poster THU4f.21 17:00
On the Aharonov-Bohm effect and generation of electromagnetic potentials in the context of dynamic anapoles — •Nikita Nemkov1,2, Alexey Basharin1, and Vassily Fedotov1 — 1Moscow Institute of Physics and Technology, 141700 Dolgoprudny, Moscow region, Russia — 2National University of Science and Technology, The Laboratory of Superconductive metamaterials, 119049 Moscow, Russia — 3Optoelectronics Research Centre, University of Southampton, Southampton SO17 1BJ, UK

Using a very simple yet general formalism we show that there are no other non-radiating sources than dynamic anapoles, which admit the observation of the time-dependent Aharonov-Bohm effect but do not generate propagating electromagnetic potentials.

Poster THU4f.22 17:00
Light-Induced "Plasmonic" Properties of Organic Materials: Bistability, Surface (exciton) Polaritons and Transverse Structures in Bistable Organic thin Films — •Boris Fainberg1,2,3, Nikolay Rosanov4, and Nikolay Veretennikov4,5 — 1Faculty of Science, Holon Institute of Technology, Holon, Israel — 2School of Chemistry, Tel-Aviv University, Tel-Aviv, Israel — 3TUM University, St. Petersburg 197101, Russia — 4Vavilov State Optical Institute, St. Petersburg 199053, Russia

We develop a theory of light-induced "plasmonic" properties of organic materials closely related to experiment. We demonstrate bistability of populations resulting in bistability of surface (exciton) polaritons, and transverse structures in bistable organic thin films.

Poster THU4f.23 17:00
Attractive Coulomb Interaction of 2D Rydberg Excitons — •Vakif Shamezarian1,2,3, Ivan Shelykh1,2,4, and Oleksandr Kyriienko5 — 1University of Iceland, Reykjavik, Iceland — 2Russian-Armenian (Slavonic) University, Yerevan, Armenia — 3TUM University, St. Petersburg, Russia — 4Nanyang Technological University, Singapore — 5Niels Bohr Institute, University of Copenhagen, Copenhagen, Denmark

We analyze the Coulomb scattering of highly excited excitons in direct bandgap semiconductor quantum wells. Contrary to the ground state, the interaction between excited excitons is attractive and grows linearly with exciton principal quantum number.

Poster THU4f.24 17:00
Complex Epsilon-Near-Zero nanostructures for broadband light squeezing and advanced material engineering — •Gael Favreau1, Juan S. Totero Gongora1, Yi Tian2, Marcella Bonifazi1, Henning Galinski2, Federico Capasso3, and Andrea Fratalocchi4 — 1PRIMALIGHT, King Abdullah University of Science and Technology, Thuwal, Saudi Arabia — 2Harvard School of Engineering and Applied Sciences, Harvard University, Cambridge, USA — 3Laboratory for Nanometallurgy, ETH Zurich, Zurich, Switzerland

We present the design and experimental realization of a new nanomaterial concept based on a random network of broadband epsilon-near-zero nanostructures created through transformation optics of disordered metals. We discuss recent applications of these materials.
Plasmonic response of chalcogenides and switchable all-dielectric metamaterials — Behrad GholiPous1,2, Davide Piccinotti1, Jen Yang2, Artemios Karvounis1, Jun Yin1, Cesare Soci1, Brian E. Hayden2, Kevin F. MacDonald1, and Nikolay I. Zheludev1,3 — 1Optoelectronics Research Centre & Centre for Photonics Metamaterials, University of Southampton, UK — 2Department of Chemistry, University of Southampton, UK — 3Centre for Disruptive Photonic Technologies, School of Physical and Mathematical Sciences & The Photonics Institute, Nanyang Technological University, Singapore

Crystalline germanium antimony telluride shows a profound plasmonic response in the optical–UV spectral range that disappears in the chalcogenides’ amorphous state. We harness this effect to realize tuneable and plasmonic/all-dielectric phase-change memory metasurfaces.

Dynamically induced chiral phonon transport in an optomechanical system — Seung-Hwi Kim1, Yun-Nong Xu2, Jacob M. Taylor3, and Gaurav Bahl1 — 1Mechanical Science and Engineering, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801, USA — 2Joint Quantum Institute, University of Maryland, College Park, Maryland 20742, USA — 3Joint Center for Quantum Information and Computer Science, National Institute of Standards and Technology, Gaithersburg, Maryland 20899, USA

We demonstrate dynamical induction of chiral phonon transport in optomechanical resonators by means of traveling-wave acousto-optical interaction. The phenomenon results in unidirectional defect tolerant transport and chiral cooling of high-Q phonon modes in the system.

Optical imaging of an exciton-plasmon wave function confined in a single WS2 nanotube — Lena Yadgarov1, Ettam Vinegrad, Michael Mrejen, Haim Suchowski, and Ora Chesnovsky1 — 1Tel Aviv University, Tel Aviv, Israel

Recently it was discovered that WS2 semiconducting nanotubes retain not only excitonic, but also plasmonic resonances. To elucidate the origin of this phenomena, their optical properties were studied using far field and near field techniques.

Directional Emission from Active Dielectric Nano Antennas — Manuel Peter1, André Hildbrandt2, Jens Förstner2, and Stefan Linden1 — 1Universität Paderborn, Paderborn, Germany

We present our recent results on highly directive emission of active dielectric nano antennas. The design is based on the classic Yagi-Uda antenna. The active elements are quantum dots precisely deposited into the feed gap.

Cascaded emission of photon pairs from localized defects in monolayered WSe2 — Yuming He, Oliver Iff, Nils Lundt, Vasilij Baumann, SVEN Höfling, and Christian Schneider — Technische Physik, Am Hubland, 97074 Würzburg, Germany

We discuss the emission of single photons, the dynamics of the dark exciton as well as the cascaded emission of photon pairs via the biexciton cascade from a localized defect in a monolayer of WSe2.

Photon Statistics in the Luminescence of Colloidal Quantum Wells — Ron Tenne1,2, Miki Kazes1, Lothar Houben1, and Dan Oron1 — 1Department of Complex Systems, Weizmann Institute of Science, Rehovot 76100, Israel — 2Chemical Research Support, Weizmann Institute of Science, Rehovot 76100, Israel

Photon pair emission in the luminescence of colloidal CdSe quantum wells (CQWs), a recent addition to the nanocrystal family, can be completely suppressed by the introduction of only a few Te atoms per CQW.

Electrical Detection of Single Graphene Plasmonics — Renwen Yu1, and Javier García de Abajo1,2 — 1ICFO-Institut de Ciències Fotòniques, The Barcelona Institute of Science and Technology, 08860 Castelldefels (Barcelona), Spain — 2ICREA-Institució Catalana de Recerca i Estudis Avançats, Passeig Lluis Companys 23, 08010 Barcelona, Spain

We show graphene nanostructures are capable of realizing on-chip electrical detection of single plasmons. A 2-fold increase in the electrical current across a graphene nanojunction caused by the excitation of a single plasmon is predicted.

Low-loss CMOS copper plasmonics — Dmitry Fedyanin1, Dmitry Yakubovsky2, Roman Kirtsen3, and Valentin Volkov1,2 — 1Moscow Institute of Physics and Technology, Dolgoprudny, Russian Federation — 2University of Southern Denmark, Odense, Denmark

We demonstrate experimentally that nanoscale copper plasmonic components fabricated in a simple complementary metal-oxide semiconductor (CMOS) compatible process can outperform gold plasmonic components, showing the same level of mode confinement and lower losses.

Collimating Single NV Fluorescence using a Kerker Condition based Antenna — Niko Nikolay1, Stefan Fasold2, Günter Kewes2, Isabelle Staude2, and Oliver Benson1 — 1Humboldt Universität zu Berlin, Berlin, Germany — 2Institute of Applied Physics, Friedrich-Schiller-University Jena, Jena, Germany

We will introduce a collimating dielectric antenna with a sub-wavelength size and discuss the coupling to the nitrogen-vacancy center in nanodiamond. Experimental results will be complemented by numerical calculations.

Confined Surface Waves in Layered Dielectric Materials — Alexander M. Dubrovin1, Bo Qiang1, Nikolay I. Zheludev1,2, and Qi Jie Wang1,3 — 1Centre for Disruptive Photonics Technologies, TPI, SPMS, Nanyang Technological University, Singapore — 2Optoelectronics Research Centre and Centre for Photonic Metamaterials, University of Southampton, UK — 3OPTIMUS, Centre for Optoelectronics and Biophotonics, School of EEE, Nanyang Technological University, Singapore

We demonstrate deep subwavelength confinement of surface phonon-polaritons in silicon carbide by capping the crystal with...
nанометрических слоях MoS2. На поверхности наблюдается спектр конфинации в присутствии свободного пространства на длине волны 11.15 микрометров.

Poster
THU4f.36 17:00
**Luminescence of All-Dielectric Solution-processed Perovskite Metamaterial** — Giorgio Adams1, Behrad Gholipour2, Muhammad D. Birowosuto3, Harish N. S. Krishnamoorthy4, Daniele Cortecchia5, Kar Cheng Lew1, Jin Kyu Soi5, Nikolay I. Zheludev5,6, and Cesare Soci7 — 1Centre for Disruptive Photonics Technologies, TPI, SPMS, Nanyang Technological University, 21 Nanyang Link, Singapore 637371 — 2Optoelectronics Research Centre & Centre for Photonic Metamaterials, University of Southampton, SO17 1BJ, UK — 3CINTRA UMI CNRS/NTU/THALES 3288, 50 Nanyang Drive, Singapore 637553 — 4Interdisciplinary Graduate School, Nanyang Technological University, Singapore 639798 — 5Energy Research Institute @ NTU (ERI@N), Nanyang Technological University, 50 Nanyang Drive, Singapore 637553

We demonstrate that periodic subwavelength nanostructuring of solution-processed organolead halide perovskite films creates optical resonances, position of which can be controlled by design. Such metamaterial nanostructuring strongly enhances photo- and cathodo-luminescence of the films.

Poster
THU4f.37 17:00
**High-Speed Operation of a Compact ENZ Electroabsorption Modulator Based on Transparent Conducting Oxides** — Gordon A. Keeler, Kent M. Geib, Darwin K. Serkland, S. Parameswaran, Ting S. Luk, Joel R. Wendt, Salvatore Campione, Jon Ihlefeld, and Alejando J. Grine — Sandia National Laboratories, Albuquerque, USA

We describe the design, fabrication, and characterization of a fast epsilon-near-zero electroabsorption modulator based on carrier density tuning in indium oxide. The 4-micron-long device operates at multi-gigahertz rates over a broad range of telecommunications wavelengths.

Poster
THU4f.38 17:00
**High-Tc Superconductor-Semiconductor Photon-Assisted Tunneling** — Dmitry Panna, Shlomi Boucher, Vicky Perepelook, Leonid Rybak, and Alex Hayat — Technion, Haifa, Israel

We demonstrate photon-assisted tunneling in Bi-2212/Si junctions. The significant shift in conductance spectra observed with increasing light intensity, provides new approaches to deep HighTc band structure investigation with applications in light detection.

Poster
THU4f.39 17:00
**Semiconductor-Superconductor Optoelectronic Devices** — Dmitry Panna, Shlomi Boucher, Leonid Rybak, and Alex Hayat — Technion, Haifa, Israel

We demonstrated superconducting proximity in semiconductor light-emitting structures proposed for enhanced two-photon gain, electrically-driven entangled-photon generation and Bell state analyzers. We produced high-temperature superconductivity in topological insulators Bi2Se3 and Bi2Te3 and high-temperature semiconductor-semiconductor tunnel diodes.

Poster
THU4f.40 17:00
**Solar Thermal Characterisation of Micro-Patterned Solar Absorbers** — HanYu Cen1, Sara Nunez-Sanchez2, Nathan Ahmad3, Ian Bickerton2, Neil Fox2, and Martin Cryan2 — 1Department of Electrical and Electronic Engineering, University of Bristol — 2School of Chemistry, University of Bristol, UK

This paper presents fabrication results showing large area laser patterning of molybdenum for use as a solar thermal absorber. Measured solar absorptance and temperature rise results show good performance.

Poster
THU4f.41 17:00
**Experimental demonstration of perfect absorption for monolayer graphene coupled with subwavelength gratings on top of a gold mirror** — Chucai Guo, Zhihong Zhu, Jianfa Zhang, Weimin Ye, and Shiqiao Qin — College of Optoelectronic Science and Engineering, National University of Defense Technology, Changsha 410073, China

Peak absorptions over 99% at wavelength around 1.5 μm with full-width at half maximum (FWHM) about 20 nm are experimentally demonstrated for monolayer graphene coupled with subwavelength gratings on top of a gold mirror.

Poster
THU4f.42 17:00
**Gallium Nitride Grating Coupler Fabrication Using Displacement Talbot Lithography** — Simeng Jia1, Emmanuel Le Bouilbar2, Jon Pugh1, Duncan Allsopp3, Philip Shields4, and Martin Cryan1 — 1Department of Electrical and Electronic Engineering, University of Bristol, UK — 2Department of Electrical and Electronic Engineering, University of Bath, UK

GaN grating couplers are fabricated using displacement Talbot lithography. Twenty eight couplers were fabricated simultaneously such that “cut-back” loss measurements can be performed. Preliminary results show 2.5dB coupling loss and 5dB/mm slab waveguide loss.

Poster
THU4f.43 17:00
**Far-Field Natural Optical Activity of Disordered Media** — Felipe A. Pinheiro1, Vasili A. Fedotov2, Nikitas Papamikis3, and Nikolai I. Zheludev4 — 1Instituto de Fysca, Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil — 2Optoelectronics Research Centre & Centre for Photonic Metamaterials, University of Southampton, Southampton, UK — 3TPi and Centre for Disruptive Photonic Technologies, Nanyang Technological University, Singapore

We demonstrate natural optical activity in disordered ensembles of non-chiral plasmonic resonators and show that the statistical distributions of the rotary power and spatial dichroism are strongly dependent on the scattering mean free path in diffusive random media.

Poster
THU4f.44 17:00
**Hybrid Resonant Mode Structure of a Single InGaN/GaN Nanorod** — Jon Pugh1, Gunnar Kusch2, Robert Martin2, and Martin Cryan1 — 1Department of Electrical & Electronic Engineering, University of Bristol — 2SUPA, University of Strathclyde

We present Finite-Difference Time-Domain simulations and cathodoluminescence measurement of an InGaN/GaN core-shell nanorod. Agreement between the two suggests an optical cavity is formed supporting Fabry-Perot-like modes vertically that have the same whispering-gallery-like order in-plane.

Poster
THU4f.45 17:00
**Cellular Response upon Interaction with Graphene Quantum Dot having Different Nanophotonic Effect** — SeongBeom Jeon and Kyusik Yun — Department of bionanotechnology, Gachon University, Seongnam, Republic of Korea

Graphene quantum dots (GQDs), which were synthesized by bottom-up and top-down approach, having different nanophotonic effect are investigated and suggested that GQDs have a potential as biomarker due to low cytotoxicity and excellent photo-luminescent properties.
Poster THU4f.46 17:00

Complex Nonlinear Dynamics in Doped Zinc Oxide — Marcello Ferrera¹, Nathaniel Kinsey², Clayton Devault³, Matteo Clerici¹, Jongkum Kim¹, Enrico Carnemolla¹, Amir Shaltout³, Daniele Facchio¹, Vladimir Shalaev⁴, and Alexandra Boltasseva³ — ¹Institute of Photonics and Quantum Sciences, Heriot-Watt University, SUPA, Edinburgh, Scotland, EH14 4AS, UK — ²School of Engineering, Virginia Commonwealth University, Richmond, Virginia 23284-3072, USA — ³School of Electrical and Computer Engineering and Birck Nanotechnology Center, Purdue University, West Lafayette, IN, 47907, USA — ⁴School of Engineering, University of Glasgow, Glasgow, G12 8LT, UK

The complex nonlinear dynamics of optically pumped aluminium-doped zinc-oxide is experimentally studied in both time and frequency. Interband and intraband excitations produce large, ultra-fast, and opposite change of the permittivity, which can be algebraically superimposed.

Poster THU4f.47 17:00


Gallium phosphide nanoantennas are shown to be applicable in non linear and quantum optics, due to their low absorption and strong electric field enhancement at visible wavelengths as demonstrated by fabricated structures together with simulated and experimental spectra.

Poster THU4f.48 17:00

withdrawn

Poster THU4f.49 17:00

Multilayered Plasmonic Nanostars for Photon Management in Organic Light-Emitting Diodes — Battulga Munkhrat¹, Johannes Ziegler¹, Hannes Pöhl Pöhl¹, Christian Wörster¹, Dmitry Sivun¹, Patrick Denk¹, Thomas A. Klár¹, Markus C. Scharber², and Calin Hrelescu¹ — ¹Institute of Applied Physics, Johannes Kepler University Linz, Linz, Austria — ²Linz Institute for Organic Solar Cells (LIOS)/Institute of Physical Chemistry, Johannes Kepler University Linz, Linz, Austria

Multilayered hybrid plasmonic nanostars boost the performance of organic light-emitting diodes. The nanostars act as nanoantennas, thus accelerating the radiative recombination of excitons as well as improving the light-out-coupling.

Poster THU4f.50 17:00

Displacement Talbot Lithography: an alternative technique to fabricate nanostructured metamaterials — Emmanuel Le Boulbar — Department of Electrical and Electronic Engineering/University of Bath, Bath, UK

Complex nano-features are patterned in resist via multiple exposures and lateral displacement using Displacement Talbot Lithography. Results show bowtie and dashes were obtained. Sub 100nm patterning of complex structures and lift-off process will be demonstrated.

Poster THU4f.51 17:00

Ultrafast Temporal Dynamics of Hybrid Exciton–Localized-Surface-Plasmons in Composite Metasurfaces — Elad Eizner¹, Katherin Akulov⁴, Tal Schwartz⁵, and Tal Ellenbogen¹ — ¹Department of Physical Electronics, Fleischman Faculty of Engineering, Tel Aviv University, Tel Aviv 69978, Israel — ²School of Chemistry, Raymond and Beverly Sackler Faculty of Exact Sciences, Tel Aviv University, Tel Aviv 69978, Israel

We study the kinetics of strongly coupled exciton-localized surface plasmons in aluminum nanoantenna-metasurfaces platform using transient absorption spectroscopy and observe significantly increased ultrafast nonlinearities compared to the case of bare metasurfaces.

Poster THU4f.52 17:00

Hot-Electron Dynamics and Thermalization in Small Metallic Nanoparticles — Jose Ramon Martinez Saavedra¹, Ana Asenjo-Garcia¹, and Javier Garcia de Abajo¹² — ¹ICFO-The Institute of Photonic Sciences, Castelldefels, Spain — ²ICREA, Barcelona, Spain

In this work we theoretically study the temporal evolution of optically excited conduction electrons in small plasmon-supporting gold and silver nanoparticles.

Poster THU4f.53 17:00

Hot-spot Engineering in 3D Multi-branched Nanostructures — Manohar Chirumamilla¹, Anisha Chirumamilla², Alexander S. Roberts¹, Remo Proietti Zaccaria³, Francesco De Angelis⁴, Peter Kler Kristensen⁵, Roman Krahne⁶, Sergey I. Bozhevolnyi⁷, Kjeld Pedersen⁵, and Andrea Toma⁸ — ³Department of Physics & Nanotechnology, Aalborg University, Skjernvej 4A, 9220 Aalborg Øst, Denmark — ⁴Nanostructures Department, Istituto Italiano di Tecnologia, Via Morego 30, Genova, 16163, Italy — ⁵Centre for Nano Optics, University of Southern Denmark, Campusvej 55, 5230 Odense M, Denmark

The detection of analyte molecules at ultralow concentrations, down to the single/few molecule is addressed with the breakthrough concept of plasmonic hot-spot engineering. Here we present fabrication and characterization of multi-branched nanostructures (up to 10 branches) for ultra-sensitive detection of Rhodamine-6G and p-Aminothiophenol molecules.

Poster THU4f.54 17:00

Genetic design and optimization of all-dielectric metasurface — Victor Egorov, Michael Eitan, and Jacob Scheuer — School of EE, Tel-Aviv University, Tel-Aviv, Israel

We propose and demonstrate a genetic approach for designing all-dielectric metasurfaces and implement it for realizing wide angle beam deflectors. Compared to the common design approaches, higher transmission efficiency, particularly at wide angles, is obtained.

Poster THU4f.55 17:00

Lasing without a cavity in graphene random metamaterials — Andrea Marini¹ and F Javier Garcia de Abajo¹² — ¹ICFO-Institut de Ciencies Fotoniques, The Barcelona Institute of Science and Technology, 08860 Castelldefels (Barcelona), Spain — ²ICREA-Institución Catalana de Recerca i Estudis Avançats, Passeig Lluís Companys 23, 08010 Barcelona, Spain

Here we demonstrate a novel mechanism leading to stable and tunable single-mode cavity-free lasing characterized by a well-determined and highly coherent spatial pattern.
Plasmonic Nano-Oven — Juijun Meng1,2, Renwen Yu1, and Javier García de Abajo1,3 — 1ICFO, Castelldefels (Barcelona), Spain — 2Zhejiang University, Hangzhou, China — 1ICREA, Barcelona, Spain

We design metallodielectric multishells exhibiting strong light absorption at their core region, accompanied by weak absorption in the outer shells. This produces unprecedentedly high inner temperatures confined by thermal barriers under cw illumination conditions.
Poster THU4f.67 17:00
**Spontaneous fabrication of plasmonic nanostructures** — *Jamie Stokes, Walter Somerville, Ali Adawi, Martin Buzzza, and Tommy Horozov* — School of Mathematics and Physical Sciences, University of Hull, Hull, UK

This paper presents a technique to spontaneously fabricate metal/dielectric particle clusters which form the basis of plasmonic structures. The proof-of-concept work highlights the potential importance of this method for the future in the use of nanostructures.

Poster THU4f.68 17:00
**Polarized emission of CdSe/CdS nanocrystals coupled to ordered and disordered plasmonic structures** — *Stéphane Bulle*, Thi Phuong Lien Ung, Fabien Eloi, Jean-Pierre Hervier, Xavier Quelin, Arunandan Kumar, Alexandre Bouhelier, Jean-Claude Weber, Gérard Colas des Francs, Michel Nasiłowski, and Benoît Dubertret — GEMaC, Université de Versailles-Saint-Quentin-en-Yvelines, Versailles, France — 2ICR, Université de Bourgogne, Dijon, France — 2LPM, ESPCI, Paris, France

In this paper, the fluorescence polarization of a single nanoemitter is controlled by a plasmonic grating coupler and analysed on a disordered gold film. High polarization ratios can be obtained.

Poster THU4f.69 17:00
**Nanoporous Gold Nanoparticles and the Related Hybrid Nanoparticles** — *Dong Wang and Peter Schaaff* — Institute of materials science and engineering and institute of Micro- and nanotechnology, TU Ilmenau, Ilmenau, Germany

Due to the combined effects of size and porosity, the Nanoporous Gold Nanoparticles (NP-G-NPs) and the related hybrid porous NPs exhibit greater plasmonic tunability and significantly higher local field enhancement as compared to solid NPs.

Poster THU4f.70 17:00
**Chiral absorption of GaAs-AlGaAs-GaAs nanowires partially coated with gold by means of photo-acoustic technique** — *Grigore Leahu*, Emilija Petronjievic, Alessandro Belardini, Marco Centini, Teemu Hakkarainen, E. Koviusalo, M. R. Piron, Mireia Guina, and Concita Sibilla — *Sapienza Università di Roma, SBAI Department — 2ORC Tampere University of Technology

Partial covering of III-V semiconductor nanowires inducing symmetry breaking which leads to chiral response. Here we report on chiral absorption of GaAs-AlGaAs-GaAs NWs partially covered with gold, by means of photo acoustic (PA) technique.

Poster THU4f.71 17:00
**Surface Plasmons in Arrays of Tapered Grooves fabricated in Crystalline Gold Plates: Optical Properties** — *Manuel Gonçalves*, Vaishnavi Rao, Gregor Neusser, Christine Kranz, Boris Mizaikoff, and Othmar Marti — 1Institute of Experimental Physics - Ulm University, Ulm, Germany — 2Institute of Analytical and Bioanalytical Chemistry - Ulm University, Ulm, Germany

The optical properties of arrays of tapered grooves fabricated by FIB in crystalline gold plates were investigated. Strong polarization sensitivity and enhanced reflection comparing to flat gold for some spectral bands was found.

Poster THU4f.72 17:00
**Fluorescence properties of single CdSe/CdS nanocrystals coupled to gold plasmonic structures at 4 K** — *Antoine Coste*, Fabien Eloi, Stéphane Bulle, Xavier Quelin, Arunandan Kumar, Alexandre Bouhelier, Jean-Claude Weber, Gérard Colas des Francs, Michel Nasiłowski, Benoît Dubertret, and Jean-Pierre Hervier — 1Groupe d’Étude de la Matière Condensée, Université de Versailles-Saint-Quentin-en-Yvelines, CNRS UMR8635, 45 avenue des Etats-Unis, 78035 Versailles, France — 2Laboratoire Interdisciplinaire Carnot de Bourgogne (ICB), UMR 6301 CNRS, Université de Bourgogne, 9 Avenue Savary, BP 47870, 21078 Dijon Cedex, France — 3Laboratoire de Physique et d’Étude des Matériaux, CNRS UMR8213, ESPCI, 10 rue Vauquelin, 75231 Paris, France — 4Institut Universitaire de France, 103, bd Saint-Michel, 75005 Paris, France

The coupling between thick-shell CdSe/CdS colloidal nanocrystals and a flat gold film exhibits a strong decrease of ohmic losses at 4K. Results concerning the enhancement of single nanocrystals fluorescence by a gold grating are reported.

Poster THU4f.73 17:00
**Integrating plasmonic nanostructures into silicon waveguides** — *Alba Espinosa-Soria, Amadeu Giró, and Alejandro Martínez* — Nanophotonics Technology Center, Universitat Politècnica de València, Camino de Vera s/n, Valencia, 46022, Spain

We show numerically and experimentally that a gold nanoantenna embedded into a gap created in a silicon waveguide can be efficiently excited at telecom wavelengths achieving contrast beyond 10 dB in transmission.

Poster THU4f.74 17:00
**Optical Ring Resonator Embedding a Metasurface Mirror** — *Gal Ehrlich*, Moshe Zohar, Mark Auslender, and Shlomo Hava — 1Ben Gurion University, Beer-Sheva, Israel — 2Sami Shamoon College of Engineering, Beer Sheva, Israel

We study a novel two flat mirrors and a nanograting mirror arrangement for coupling -1st diffracted order beam into a cavity. The intracavity and combined throughput light power buildup show high sensitivity to the cavity dimensions.
Thursday Sessions

**THU5o: Novel Effects**

**Invited**

**THU5o.1 18:30**

**Controlled Generation of Wakes in Interfering Propagating Plasmons**

- Basudeb Sain, Roy Kaner, and Yeiam Prior

- Weizmann Institute of Science, Rehovot, Israel

The interference of two propagating plasmons with different velocities generates wakes, which are measured in the near field and controlled by the geometry and symmetry of the individual cavities and the entire array.

Oral **THU5o.2 18:45**

**Photo-induced force mapping of nanophotonic structures**

- Thejaswi Tumkur, Xiao Yang, Chloe Doiron, Benjamin Cerjan, Naoki Halas, Peter Nordlander, and Isabelle Thomann

- Rice University, Houston, TX USA

We demonstrate the ability to map photo-induced forces in plasmonic nanostructures. We also calculate optically induced force components between a nanoscale tip (with a realistic geometry) and sample and compare with measured force intensity profiles.

Oral **THU5o.3 19:00**

**Hyperbolic surface polaritons revealed by near-field optical microscopy at the edges of van de Waals materials**

- Peining Li

- Institute of Physics, Chinese Academy of Sciences, Beijing, China

- Cesare Scopa

- Institute of Physics, Chinese Academy of Sciences, Beijing, China

We present the first experimental real-space optical images of hyperbolic surface polaritons propagating along the edges of thin h-BN flakes. We also provide a comparative study of volume and surface-confined h-BN hyperbolic polaritons.

Oral **THU5o.4 19:15**

**Curved Space Nanophotonics**

- Yossef Kabessa

- Yonatan Sharabi

- Or Tal

- Nader Engheta

- Gadi Eisenstein

- Aharon J. Agranat

- Mordechai Segev

- Department of Physics, Harvard University, Cambridge, Massachusetts

- Department of Applied Physics, The Hebrew University, Jerusalem

- Technion, Haifa, Israel

- Department of Electrical and Systems Engineering, University of Pennsylvania, Philadelphia, Pennsylvania

We present three dimensional nanophotonic structures inspired by General Relativity concepts, enabling curvature control over light evolution and velocities, and demonstrate tunneling of light through radiation modes, suggesting implications to enhancing light-matter interaction.

**THU5s: Topological Phenomena**

**Invited**

**THU5s.1 18:30**

**Plasmonics of topological insulators**

- Jun Yin

- Harish Krishnamoorthy

- Jinkyu So

- Alexander Dubrovkin

- Yidong Chong

- Nikolay Zheludev

- Division of Physics and Applied Physics, School of Physical and Mathematical Sciences, 21 Nanyang Link, Singapore

- Centre for Disruptive Photonic Technologies, Nanyang Technological University, 21 Nanyang Link, Singapore

We discuss the plasmonic properties of chalcogenide topological insulators arising from interband transitions and Drude-like response of metallic surface states in the UV to near-IR, which provide a new platform for electronics and photonics integration.
THU6o: Plenary Session 3
Chaired by Mark Stockman, University of Georgia, USA
Time: Thursday, 19:45–20:45 Location: Olympia

**Plenary** THU6o.1 19:45

Quantum plasmonics and polaritons in 2d materials —
F. Kopfens — ICFO - The Institute of Photonics Sciences
In this talk, we will show several examples of 2d material heterostructure devices with novel ways of exciting, controlling and detecting polaritons. In addition, we challenge the limits of propagating plasmon confinement and test quantum theories of the dynamic response of the electron system.

THU7o: Awards Ceremony
Chaired by Oliver Graydon, Nature Photonics, London, United Kingdom
Time: Thursday, 20:45–21:00 Location: Olympia
Friday Sessions

FRI1o: Plenary Session 4
Chaired by Ian Osborne, Science Magazine, Cambridge, United Kingdom
Time: Friday, 8:30–9:30 Location: Olympia

Plenary FRI1o.1 8:30
High Performance Metaoptics at Visible Wavelengths —
• Federico Capasso — Harvard John A. Paulson School of Engineering and Applied Sciences, Harvard University
Using a new Titanium Dioxide atomic layer deposition process we demonstrated meta-devices across the visible: high NA diffraction limited metasenes, meta-axicons, high resolution miniature spectrometers and complex helical beams based on spin-to-orbital angular momentum conversion.

9:30–9:45: Coffee Break (Olympia lobby)

FRI2o: Lenses and Light Manipulation
Chaired by Alexandra Boltasseva, Purdue University, West Lafayette, USA
Time: Friday, 9:45–11:15 Location: Olympia

Invited FRI2o.1 9:45
Layered Metasurfaces for Functional Light Shaping and Manipulation — Ori Aviat1, Euclides Almeida1, Yehiam Prior2, and Tal Ellenbogen1 — Tel-Aviv University, Tel-Aviv, Israel — Weizmann Institute of Science, Rehovot, Israel
Using vertical stacking of plasmonic metasurfaces composed of different materials, we demonstrate multifunctional elements in the visible regime, including lens with white focus, elements for STED microscopy and lenses with anomalous diffraction.

Oral FRI2o.2 10:15
Merging micro- and nanooptics — Harald Giessen1, S. Theile1, and A. Herrkommer2 — 4th Physics Institute and Research Center SCoPE, University of Stuttgart, Stuttgart, Germany — Institute for Technical Optics and Research Center SCoPE, University of Stuttgart, Germany
We demonstrate miniaturized micro- and nano-optics. Our approach uses femtosecond 3D direct laser writing. Aberration-corrected performance for large angles of incidence is achieved, and our approach solves the common problem of off-axis coma in metasurfaces.

Oral FRI2o.3 10:30
Achromatic Super-oscillatory Lenses — Guanghui Yuan1, Edward T. F. Rogers2,3, and Nikolay I. Zheludev1,3 — TPI & Centre for Disruptive Photonic Technologies, Nanyang Technological University, Singapore 637371, Singapore — Optoelectronics Research Centre & Centre for Photonic Metamaterials, University of Southampton, UK — Institute for Life Sciences, University of Southampton, Highfield, Southampton, SO17 1BJ, UK
Super-oscillatory lenses deliver sub-diffraction focusing and label free bio-imaging. Here we report a new generation of apochromatic and achromatic super-oscillatory lenses that focus light of different wavelengths into the same hotspot.

FRI2s: Metamaterials and Metasurfaces
Chaired by Sergey Bozhevolnyi, University of Southern Denmark, Odense, Denmark
Time: Friday, 9:45–11:15 Location: Seefeld/Tirol

Invited FRI2s.1 9:45
Spin- and orbital-Hall effect in cyclic group symmetric metamaterial — Yeon Ui Lee1, Igor Ozerov2, Frederic Bedu3, Frederic Pages2, and Jeong Weon Wu1 — Department of Physics, Quantum Metamaterial Research Center, Ewha Womans University, Seoul 120-750, Korea — Aix Marseille University, CNRS, CINaM UMR 7325, Campus de Luminy, Case 913, 13288, Marseille, France
A cyclic group symmetric metasurface is introduced to demonstrate generation of vortex beam exhibiting spin-dependent transverse shift, i.e., spin- and orbital-Hall effect, attributed to an alteration of dynamical phase of scattered beam.

Invited FRI2s.2 10:15
Optical antireflection without index match using bi-layer metasurfaces — Hou-Tong Chen1, Li Huang2, Chun-Chieh Chang2, Beibei Zeng1, and John Nogan1 — Los Alamos National Laboratory, Los Alamos, USA — Harbin Institute of Technology, Harbin, China — Sandia National Laboratories, Albuquerque, USA
Fresnel reflection occurs at interfaces of optical components made of dielectric materials. Here we show high-performance antireflection can be accomplished using bi-layer metasurface structures that can avoid the use of any additional dielectric materials.
This talk will introduce our works on visible light manipulation using nano-sieves, including high performance distortion free holograms, helical metasurfaces for spatial multiplexing of vortexes and twisted focusing of vortex beam by logarithmic spiral slits.

11:15–11:30: Break

FRI3o: Ultrafast Nanophotonics

Chaired by Vlad Shalaev, Purdue University, West Lafayette, USA

Time: Friday, 11:30–13:15

Invited

FRI3o.1 11:30

Nanosystems in ultrafast and superstrong fields: Attosecond phenomena — •Mark Stockman — Georgia State University, Atlanta, GA 30303, USA

We present our latest results for a new class of phenomena in condensed matter nanoptics when a strong optical field on the order of 10–30 V/nm changes a solid within optical cycle.

Oral

FRI3o.2 12:00

Optical Temporal Super-Resolution using Supercorrelations — Yaniv Eliezer, Liran Hareli, Lila Lobachinsky, Sahar Fromm, and •Alon Bahabad — Tel-Aviv University, Tel-Aviv, Israel

Using an optical pulse with a supercorrelating envelope we experimentally break the temporal focusing Fourier-transform limit by 67% while maintaining ∼30% visibility. Simulations demonstrate the ability of such pulses to achieve temporal super-resolution.

Oral

FRI3o.3 12:15

Ultrafast strong-field plasmonics in the mid-infrared wavelength regime — Péter Racz,1, Stephen M. Teichmann,2, Marcelo F. Ciappina,3, Zsuzsanna Pápa,4, José A. Pérez-Hernandez,5, Alexandre Thai,2, Júlia Fekete1, Abdul Y. Elezzari,6, László Veisz7, Jens Biegert,2, and •Péter Domn1,8 — 1Wigner Research Centre for Physics, Budapest, Hungary — 2ICFO–Institut de Ciències Fotòniques, Barcelona, Spain — 3Max-Planck-Institut für Quantenoptik, Garching, Germany — 4ELI-ALPS Research Institute, Szeged, Hungary — 5Centro de Láseres Pulsados (CLPU), Salamanca, Spain — 6University of Alberta, Edmonton, Canada

By surface plasmon generation with a mid-infrared femtosecond laser source, strong-field processes could be demonstrated at an unprecedentedly low (< 1 GW/cm^2) focused laser intensity.

FRI3o.4 12:30

Ultrafast Nanophotonic Phenomena using Graphene — •Javier García de Abajo — ICFO, Barcelona, Spain

I will review recent advances in graphene nanophotonics, including a new class of random metamaterials with gain, plasmon-assisted nonlinear optical sensing, ultrafast radiative heat transfer, and plasmon-driven generation of intense high harmonics.

FRI3s: Single Nanoparticles and Strong Coupling

Chaired by Arseniy Kuznetsov, A*STAR Singapore, Singapore

Time: Friday, 11:30–13:00

Invited

FRI3s.1 11:30

Single Molecule Strong Coupling, and Light Confinement < 1 nm — •Jeremy Baumberg — University of Cambridge, Cambridge, UK

We show that using self-assembled nanoparticle-on-mirror plasmonic cavities allows single-molecule strong coupling, and enables light confinement below 1 nm cubic.

Invited

FRI3s.2 12:00

Driving Nanoplasmonics to the Atomic Scale — •Javier Aizpurua — Center for Materials Physics, San Sebastian, Spain — Donostia International Physics Center, San Sebastian, Spain

Atomic features in plasmonic nanocavities are shown to provide ultra-confinement of light at subnanometric scale, producing a novel and extreme optical ‘pico-cavity’ that can be exploited in atomically-resolved molecular spectroscopy, quantum nanooptics and optoelectronic transport.

FRI3s.3 12:30

Nonlinear Optics with a Few Photons and a Single Molecule — •Vahid Sandoghdar — Max Planck Institute for the Science of Light, Erlangen, Germany

The main discussion will be on nonlinear optical phenomena in a simple two-level atom. We will see that a single organic molecule can act as an efficient nonlinear medium for switching weak beams of light.
temperatures below a graphene sheet. We find that nonlocal effects are important for properties of a subwavelength dielectric grating on a monolayer. We present a theoretical investigation of the nonlocal optical technology, Gothenburg, Sweden

Optical Signatures of Nonlocal Plasmons in Graphene

Poster FRI5f.1 17:00

Detectors and directly integrated in optoelectronic circuits operating at telecommunication wavelengths.

Optical Signatures of Nonlocal Plasmons in Graphene

Poster FRI5f.1 17:00

Detectionless s-SNOM using MIR and THz QCLs — Fritz Kehlmann1, Clemens Liewald1, Gaetano Scamarco2, Lorenzo Columbo2, Rainer Hillenbrand3, Miriam S. Vitte1,1, Enrico Dardanis4, and Vezio Bianchi4 — 1Soft Condensed Matter Group and CeNS, Ludwig-Maximilians-Universität, München, Germany — 2Dipartimento Interateneo di Fisica, Università degli Studi di Bari & CNR-IFN UOS, via Amendola 173, Bari, Italy — 3CIC Nanogune, San Sebastian, Spain — 4CNR-NANO, NEST and Scuola Normale Superiore, Pisa, Italy

Backscattering near-field optical microscopy (s-SNOM) can operate by simply sensing feedback-induced perturbations in the drive voltage of an illuminating quantum cascade laser (QCL), a highly welcome solution for the THz region which lacks fast simple detectors.

13:15/13:00–16:30: Lunch Break

FR1f5: Poster Session II

Time: Friday, 17:00–18:30

Poster FRI5f.1 17:00

Optical Signatures of Nonlocal Plasmons in Graphene — Tobias Wenger, Giovanni Viola, Philippe Tassin, Mikael Fogelström, and Jari Kinaret — Chalmers University of Technology, Gothenburg, Sweden

We present a theoretical investigation of the nonlocal optical properties of a subwavelength dielectric grating on a monolayer graphene sheet. We find that nonlocal effects are important for temperatures below 15% of the Fermi temperature.

Poster FRI5f.2 17:00

Anticorrelation of Hot-Spot Strength between Two Gold Bipyramids with One-Photon Photoluminescence from d-Band Holes — Dmitriy Sivun, Cynthia Viatal, Battulga Munchbat, Nikita Arnold, Thomas A. Klar, and Calin Hrelescu — Institute of Applied Physics, Johannes Kepler University Linz, Linz, Austria

Here, we experimentally and numerically show that the hot-spot intensity between two gold bipyramids anticorrelates with the one-photon photoluminescence from the dimers, where the plasmonic coupling is adjusted mechanically by varying the interparticle distance.

Poster FRI5f.3 17:00


We investigate the graphene plasmons enhanced optical forces and show that these forces may be explored for optical trapping and manipulation of nanometric biomolecules and particles with mid-IR light.

Poster FRI5f.4 17:00

Highly-responsive nanoscale plasmonic germanium photodetector for silicon photonics — Igor A. Khramtsov, Illya M. Fradkin, and Dmitry Yu. Fedyanin — Moscow Institute of Physics and Technology, Dolgoprudny, Russian Federation

We demonstrate a low-power CMOS-compatible deep-subwavelength copper-germanium plasmonic photodetector, which can be easily coupled to silicon nanophotonic waveguides and directly integrated in optoelectronic circuits operating within the efficiency limit for ultra-thin plasmonic surfaces. This also enables tunable and multifunctional flat optical elements.

Poster FRI5f.5 17:00

Instantaneous spatial variation of Green’s tensor in complex nanostructures via robust eigenmode expansion — Parry Y. Chen1,2, David J. Bergman1, and Yonatan Shvam2 — 1School of Physics and Astronomy, Tel Aviv University, Israel — 2Unit of Electro-optic Engineering, Ben-Gurion University, Israel

Variation of Green’s tensor in both source and detector position within complex nanostructures is simultaneously obtained in a single simulation, via an eigenmode expansion that resolves all implementation and interpretation difficulties of quasi-normal-mode methods.

Poster FRI5f.6 17:00

Geometry Dependence of Surface Lattice Resonances in Plasmonic Nanoparticle Arrays — Ru Guo, Tommi K. Hakala, and Päivi Törmä — COMP Centre of Excellence, Department of Applied Physics, Aalto University, P.O.Box 15100, FI-00076 Aalto, Finland

Surface lattice resonances supported by metallic nanoparticle arrays with different geometries have been investigated. Experimental measurements show they have remarkably different polarization-dependent extinction dispersions. A general theoretical framework has been proposed to interpret these features.

Poster FRI5f.7 17:00

Reduced phase gradient metasurfaces for efficient light manipulation — Claudio Hail, Hadi Eghbali, and Dimos Poulikakos — ETH Zürich, Switzerland

Efficient anomalous refraction with gradient metasurfaces is achieved by co-polarized scattering despite reduced phase coverage. While surpassing the cross-polarization light-bending efficiency limit for ultra-thin plasmonic surfaces, this also enables tunable and multifunctional flat optical elements.
Optical vortices in cylindrically symmetric all-dielectric optical scatterers — Rodrigo Asenso1, Juan Jose Saenz2, Gabriel Molina-Terriza1, and Aritz Garcia-Etxarri1 — 1Donostia International Physics Center, Paseo Manuel de Lardizabal 4, Donostia-San Sebastian 20018, Spain — 2Donostia International Physics Center, Paseo Manuel de Lardizabal 4, Donostia-San Sebastian 20018, Spain In this contribution, we show that cylindrically symmetric all-dielectric nano-particles when illuminated by circularly polarized light at the first Kerker condition of anomalous scattering generate an optical vortex in the back scattering direction.

Diagonal Plasmonic Modes in Transmission Through Coupled Cavities — Roy Kaner, Basudeb Sain, Yaara Bondy, and Yehiam Prior — Weizmann Institute of Science, Rehovot, Israel The far field optical transmission through pairs of coupled nanocavities with different gaps between them shows modes-like behavior which results from the coupling between localized and propagating surface plasmons.

Polarization-resolved Spectroscopy Using Multiresonant Plasmonic Bull’s-Eye Antennas — Eva De Leo, Arno Cocina, Boris Le Feber, Ferry Prins, and David J. Norris — Optical Materials Engineering Laboratory, ETH Zürich, Switzerland We introduce multiresonant plasmonic bull’s-eyes in which distinct polarization states are mapped directly onto a spectrally dependent imaging condition. We demonstrate how this form of structured light enables advanced concepts in display and spectroscopy applications.

Shape approaches for enhancing plasmon propagation in graphene — Mario Miscuglio, Davide Spirito, Remo Proietti-Zaccaria, and Roman Krahne — Istituto Italiano di Tecnologia (IIT), Genoa, Italy We explore, through numerical simulations, the excitation of plasmons in graphene launched by metal antennas and we report several approaches to focus and manipulate the plasmon signal through graphene based nano-patterned structures which provide unprecedented plasmon propagation.

Mutual coupling of short-circuited, vertical metal nanoantennas — Tobias W. W. Møll1, Martin Reininghaus2, Ruslan Röhrich1, Nils Gehlich2, Dmitriy N. Chigrin3, and Thomas Taubner1 — 1Institute of Physics (IA), RWTH Aachen University, 52056 Aachen, Germany — 2Fraunhofer Institute for Laser Technology, Steinbachstr. 15, 52074 Aachen, Germany We present an analytical RLC-circuit model for vertical metal nanoantennas on a metallic ground plane. Applying our model to GIR-FTIR measurements of different antenna arrangements, evidence for significant ground plane coupling is found.

Time dependent control of electromagnetic heating by plasmonic nanostructures — Valentina Giorgis1, Rodrigo Lima2, and Andrei Malyshev3 — 1Université Catholique, ISPEN, Lille, France — 2GISC and GFTC, Universidade Federal de Alagoas, Instituto de Fisica, Av. Lourival Melo Mota s/n, 57072-970 Maceió, Brasil — 3GISC, Universidad Complutense de Madrid, Avda. Complutense s/n, 28040 Madrid, Spain We demonstrate the feasibility of time dependent control of electromagnetic heating of nanoscale volumes by means of plasmonic nanostructures, such as arrays of metal nanoparticles.

Semiconductor nanocrystals precisely placed on plasmonic hole arrays show highly directed emission dictated by the plasmonic modes. Momentum-resolved lifetime measurements reveal detailed information on the plasmonically modified density of optical states.

Aperture Nanoantenna Arrays for UV/Blue Sensing Applications — Quang Minh Ngo1, Ying-Lung D. Ho2, Jon Pugh3, Philip Shields3, Duncan Allsopp4, and Martin Cryan5 — 1Institute of Materials Science, Vietnam Academy of Science & Technology, Vietnam — 2Department of Electrical and Electronic Engineering, University of Bristol, UK — 3Department of Electronic and Electrical Engineering, University of Bath, UK An aperture nanoantenna array is designed and fabricated in the upper layer of an aluminum-silica-aluminum trilayer structure, this is predicted to significantly increase of the intensity enhancement and the directivity of fluorescence emission.

Spin-dependently manipulating the optical frontwave with dielectric metasurface — Bo Wang, Dong Yang, Qhuang Gong, and Yan Li — State Key Laboratory for Mesoscopic Physics, Department of Physics, Peking University and Collaborative Innovation Center of Quantum Matter, Beijing 100871, China We design a dielectric metasurface in which both the geometric phase and resonant mode of the meta-atom in each pixel contribute to the local phase change. Therefore, it manipulates the frontwave of light beams spin-dependently.

Broadband solar absorbers and narrowband thermal emitters based on refractory thin-film resonators — Alexander S. Roberts1, Manohar Chirumamilla2, Fei Ding3, Deyong Wang3, Peter Kjer Kristensen4, Kjeld Pedersen5, and Sergey I. Bozhevolnyi1 — 1Centre for Nano Optics, University of Southern Denmark, Campusvej 55, 5230 Odense M, Denmark — 2Department of Physics & Nanotechnology, Aalborg University, Skjernvej 4A, 9220 Aalborg Øst, Denmark Perfect broadband absorbers and narrowband emitters, suitable for (solar) thermophotovoltaics and solar concentrated power, based on thin-film resonators and made of refractory materials are reported with working temperatures exceeding 800 °C.
Graphene Plasmons in Triangular Wedges and Grooves

Friday 2

We present a scheme for complete Bell-state analysis by Cooper-pair-based two-photon absorption in superconducting-proximity based semiconductor photodetectors. We show high detection purity of the specified Bell-state. The theoretically-demonstrated effects can have important implications on quantum-information.

Poster

withdrawn

Poster

Zero index metamaterial for enhanced transmission and beaming — Hodjat Hajian, Ekrem Ozbay, and Humeyra Caglayan — Bilkent University NANOTAM, Ankara, TURKEY

Using near-zero index (NZI) metamaterial, we theoretically and experimentally investigate light transmission through a subwavelength metallic aperture. Our results show that the presence of the NZI system enhances the transmission of light through it.

Poster

Optical resonances and their normalization: Efficient modeling of nonphotonic devices — Thomas Weis1, Dominik Floess1, Martin Schäferling1, Martin Mesch1, Harald Giessen1, Wolfgang Langbein2, and Egor A. Mulaiov2

14th Physics Institute and Research Center SCOPE, University of Stuttgart, Pfaffenwaldring 57, D-70550 Stuttgart, Germany — 2School of Physics and Astronomy, Cardiff University, The Parade, CF24 3AA, Cardiff, United Kingdom

We present our analytical approach to normalize optically active resonances in arrays of plasmonic nanoantennas and photonic crystal slabs. This allows us to efficiently describe various phenomena such as the impact of nanoantennas on quantum emitters as well as resonance frequency shifts and linewidth changes in refractive index sensing.

Poster

Graphene Plasmons in Triangular Wedges and Grooves — Paulo André D. Gonçalves1,2, Eduardo J. C. Dias1,2, Sanshuixiong Xiao1,2, Mikhail I. Vasilievsky1, Niels Asger Mortensen1,2, and Nuno M. R. Peres1 — Department of Photonics Engineering, Technical University of Denmark, 2800 Kgs. Lyngby, Denmark — 2Center for Nanostructured Graphene, Technical University of Denmark, 2800 Kgs. Lyngby, Denmark — 3Department and Center of Physics, University of Minho, PT-4710-057 Braga, Portugal

We studied plasmons in graphene-covered triangular wedges and grooves using a quasi-analytic model to characterize the plasmon-dispersion and field distributions. Our results show that the typical flat-graphene spectrum is now reshaped by a geometrical factor.

Poster

Numerical Studies of Sum-Frequency-Generation in Split-Ring-Resonators — Shay Keren-Zur and Tal Ellenbogen — Tel Aviv University, Tel Aviv, Israel

The hydrodynamic model of surface currents in metal nanoparticles is extended to sum frequency generation processes. We show how this extension allows investigating better the dependence of the nonlinear interaction on the participating modes.

Poster

Deep-Groove Nickel Gratings for Solar Thermal Absorbers — Nathan Ahmad1, Sara Nunez-Sanchez2, Emmanuel Le Boublard3, Duncan W E Allsopp2, Philip A Shields3, and Martin Cryan1

1University of Bristol, Bristol, United Kingdom — 2University of Bath, Bath, United Kingdom

This paper presents measured and modelled optical absorptance of deep-groove nickel nano-gratings fabricated using a large area nanopatterning technique. The results show broadband optical absorption can be achieved using simple linear grating structures in nickel.

Poster

Cathodoluminescence nanospectroscopy of hybrid photonic nanostructures — Sandro Mignuzzi and Riccardo Sapienza — Department of Physics, King’s College London, Strand, London WC2R 2LS, United Kingdom

Cathodoluminescence nanospectroscopy is employed to directly image the spatial distribution eigenmodes of hybrid and all-dielectric novel photonic structures. Angle-resolved measurements allow to gain insight into the modal dispersion.

Poster

Plasmonic terahertz micro-ring resonators — Jessieneta Anthony and Rainer Leonhardt — The University of Auckland, Auckland, New Zealand

We present simulation results of subwavelength corrugated metal channels for THz frequencies. We observed coupling of the TM field into a micro-ring resonator placed at various coupling distances and calculated Q-factors ranging from 11 to 15 for the micro-ring.

Poster

Simulations of lasing in coupled vertically standing nanowire cavities — Ivan Ditycovski and Tal Ellenbogen — Tel Aviv University, Tel Aviv, Israel

We present a novel way to generate single mode lasing from semiconductor nanowire lasers. By coupling two standing nanowires with different sizes, we use the Vernier effect to achieve monochromatic lasing from the coupled cavity.

Poster

Polarized Scattering versus Unpolarized Photoluminescence from Single Gold Nanospheres — Cynthia Vidal1, Dmitry Vidal1, Johannes Ziegler1, Dong Wang2, Peter Schattschneider1, and Thomas A. Klar1

1Institute of Applied Physics, Johannes Kepler University Linz, 4040 Linz, Austria — 2Institute of Materials Engineering and Institute of Micro- and Nanotechnologies MacroNano, Technische Universität Ilmenau, 98693 Ilmenau, Germany

Nanospheres comprise three-dimensionally percolated gold/air filaments of sub-20 nm diameter. They cannot be assigned an effective permittivity. Scattering from spherical nanospheres shows decisive polarization dependence whereas photoluminescence from d-hole recombination is far less polarized.
A Universal Design to Realize a Tunable Perfect Absorber from Infrared to Microwave — Fatima Omeis 1, Rafik Smaali 1, Antoine Moreau 1, Thibiry Taliercio 2, Fernando Gonzalez-Posada 1, Laurent Cerutti 1, and Emmanuel Centeno 2 — 1Université Blaise Pascal, Institut Pascal, BP 10448, F-63000 Clermont-Ferrand, France — 2Université Montpellier, IES, UMR 5214, F-34000, Montpellier, France

We propose a universal design that can be used as a recipe to realize ultra-thin perfect absorbers operating from infrared to microwave frequencies whatever the materials (metal and dielectric) involved and for all polarization states of light.

Investigating Chiral Near-Fields Using Handled Metamaterials — Lauren E. Barr, Simon A. R. Horsley, Alastair P. Hoppins, and Euan Hendry — Electromagnetic and Acoustic Materials Group, Department of Physics and Astronomy, University of Exeter, Exeter, UK

Defining a chiral electromagnetic field as parallel electric and magnetic fields with a π/2 phase difference, we study the importance of non-local effects in near-field interactions between chiral antennas and barely sub-wavelength chiral meta-atoms.

Tunable quenching of reflection from nanoplasmonic mirror-on-mirror metamaterials — Debabrata Sikdar, Joshua B Edel, and Alexei A Kornyshev — Imperial College London, London, United Kingdom

We unveil a novel class of optical metamaterials, comprising 2D-array of gold nanoparticles self-assembled on a silver film, featuring tailorable frequency-selective drastic (100%) quenching of reflection—via investigations using quasi-static effective-medium-theory, verified against full-wave simulations.

Bianisotropy: A route towards non-reciprocal optical metasurfaces — Mark Lawrence — Stanford University, Stanford, USA

We theoretically demonstrate nonreciprocal transmission through dielectric metasurfaces. This unidirectionality relies on the nonlinear Kerr effect within bianisotropic Mie nanoresonators, and provides a foundation for nanoscale optical diodes.

Active modulation of visible light with graphene-loaded ultrathin metal plasmonic antennas — Renwen Yu 1, Valerio Pruneri 1,2, and Javier García de Abaño 1,2 — 1ICFO-Institut de Ciencies Fòtoniques, The Barcelona Institute of Science and Technology, 08860 Castelldefels (Barcelona), Spain — 2ICREA-Institució Catalana de Recerca i Estudis Avançats, Barcelona 08010, Spain

We show that planar nanostructures patterned in ultrathin metal-graphene hybrid films sustain highly tunable plasmons. A remarkable modulation depth exceeding 90% in transmission and even more dramatic in reflection (>600%) is predicted.

Nonlinear Plasmonic Sensing with Nanographene — Renwen Yu 1, Joel Cox 1, and Javier García de Abaño 1,2 — 1ICFO-Institut de Ciencies Fòtoniques, The Barcelona Institute of Science and Technology, 08860 Castelldefels (Barcelona), Spain — 2ICREA-Institució Catalana de Recerca i Estudis Avançats, Passeig Lluis Companys 23, 08010 Barcelona, Spain

We identify a new mechanism revealing the presence of individual molecules through the radical changes of graphene plasmons. A strong second-harmonic signal emerges due to a redistribution of conduction electrons produced by interaction with molecules.


Metal adhesion layer type and thickness are optimized to realize well-isolated resonances in plasmonic Au nanohole arrays fabricated on transparent substrates. We demonstrate selective suppression of nonessential modes without sensitivity degradation, enabling ultrasensitive label-free biodetection.

Intrinsic optical bistability in nanomechanical metamaterials at milliwatt power levels — Jun-Yu Ou 1, Artemios Karvounis 1, Kevin F. MacDonald 1, and Nikolay I. Zheludev 1,2 — 1Optoelectronics Research Centre & Centre for Photonic Metamaterials, University of Southampton, Southampton, SO17 1BJ, UK — 2Centre for Disruptive Photonic Tech-
nologies, School of Physical and Mathematical Sciences & The Photonics Institute, Nanyang Technological University, Singapore 637371

We report the first demonstration of optical bistability in nanomechanical metamaterials - arrays of plasmonic or dielectric resonators on flexible nano-membranes. Bistability results from the nonlinearity of the near-field forces induced by light.

**Poster**

FR15F.42 17:00

**All-Optical Manipulation of Light with Plasmonic Metasurfaces** — Timothy Davis and Ann Roberts — University of Melbourne, School of Physics, Parkville Victoria Australia

Optical phase detection, all-optical modulation and switching are demonstrated experimentally using metasurfaces of plasmonic circuits. The circuits mimic the Wheatstone bridge configuration in electronics and perform mathematical difference operations at the sub-wavelength scale.

**Poster**

FR15F.43 17:00

**Nonlocal Holey Metal Films – Anomalous Diffraction brings Spatial Dispersion to Experimentally Accessible Length Scales** — Christian David1, Johan Christensen1,2, and N. Asger Mortensen1,3 — DTU Fotonik, Department of Photon Engineering, Technical University of Denmark, DK-2800 Kongens Lyngby, Denmark — 2Instituto Gregorio Millán Barbany, Universidad Carlos III de Madrid, ES-28916 Leganés (Madrid), Spain — 3Center for Nanostructured Graphene, Technical University of Denmark, DK-2800 Kongens Lyngby, Denmark

Nonlocal response of nanoscale features strongly influences a textured device on a large scale in the interplay with collective optical modes. Plasmonic crystals enable a new route to study nonlocality at experimentally feasible length scales.

**Poster**

FR15F.44 17:00

**Polarisation mediated wavelength multiplexing in dielectric metasurfaces** — Daniel Stillings2 and Thomas F. Krauss — University of York, York, United Kingdom

Dielectric metasurfaces promise high efficiency microscale alternatives to traditional optics. Moreover, they enable entirely novel optical functionalities. Here we demonstrate two distinct functionalities at different wavelengths with a single metasurface design by utilising orthogonal polarisations.

**Poster**

FR15F.45 17:00

**Nonlinear Plasmonics at High Temperatures & Thermo-optic Metamaterials** — Yonatan Sivan — unit of electro-optics engineering, Ben-Gurion University, Israel

We fully explain recent experimental results of scattering of intense CW illumination from metal nanospheres by accounting for both temperature dependence and non-equilibrium (hot-)electron dynamics. Finally, we demonstrate highly nonlinear thermo-optic metamaterials.

**Poster**

FR15F.46 17:00

**Wavelength Scaling in Antenna-Enhanced Infrared Spectroscopy: Towards the Far-IR and THz Region** — Kenia Weber1, Maxim L. Nesterov1, Thomas Weiss1, Michael Scherer2, Mario Hentschel1, Jochen Vogt1, Christian Huck1, Weiwu Li1, Martin Dressel1, Harald Giessen1, and Frank Neubrech1 — 14th Physics Institute and Research Center SCOPe, Stuttgart, Germany — 2InnovationLab GmbH and Institut für Hochfrequenztechnik, Heidelberg, Germany — 3Kirchhoff Institute for Physics, Heidelberg, Germany — 4Physikalisches Institut and Research Center SCOPe

We study the wavelength scaling behaviour of surface-enhanced infrared absorption (SEIRA) towards terahertz frequencies. By performing antenna-enhanced spectroscopy of molecules in a spectral range from 16 to 45 THz we find a scaling law.

**Poster**

FR15F.47 17:00

**Visible-Frequency Dielectric Metasurfaces for Color Holograms** — Yan Li, Bo Wang, Dong Yang, and Qhuang Gong — Peking University, Beijing, China

It is demonstrated that silicon metasurfaces formed by metamolecules consisting of three kinds of nano-blocks multiplexed in a subwavelength unit can simultaneously manipulate wavefronts of red, green, and blue light beams to generate color holograms.

**Poster**

FR15F.48 17:00

**Signature of Strong Coupling on Nanoparticles: Revealing Absorption Anticrossing by tuning the Dielectric Environment** — Felix Stett1,2, Wouter Koopman3, and Matthias Bargheer1,3 — 1Institut für Physik & Astronomie, Universität Potsdam, Karl-Liebknecht-Str. 24-25, 14476 Potsdam, Germany — 2Humboldt-Universität zu Berlin, School of Analytical Sciences Adlershof (SALSA) Sitz: Albert-Einstein-Str. 5-9, Unter den Linden 6, 10099 Berlin, Germany — 3Helmholtz Zentrum Berlin, Albert-Einstein-Str. 15, 12489 Berlin, Germany

For cyanine-dyed covered gold nanospheres and nanorods the resonances are tuned by thin polyelectrolyte covers. Both systems show an anticrossing in extinction indicating strong coupling. However absorption reveals only the rods are strongly coupled.

**Poster**

FR15F.49 17:00

**Single Particle Nanoplasmonic Sensing in Individual Nanofluidic Channels** — Joachim Fritzschke1, David Albinsson2, Michael Fritzschke3, Tomas J. Antosiewicz2, Fredrik Westerlund2, and Christoph Langhammer1,2 — 1Department of Physics, Chalmers University of Technology, 41296 Göteborg, Sweden — 2Centre of New Technologies, University of Warsaw, 02-097 Warsaw, Poland — 3Department of Biology and Biological Engineering, Chalmers University of Technology, 41296 Göteborg, Sweden — 4Human Physiology Institute, University of Oldenburg, Oldenburg, Germany — 5Max Planck Institute for Intelligent Systems, Stuttgart, Germany

Combining the precise mass transport control of nanofluidics with the single particle sensing abilities of nanoplasmonics we demonstrate real time single particle parallel readout of multiple nanofluidic channels from the same chip using plasmonic nanospectroscopy.

**Poster**

FR15F.50 17:00

**Transverse and Longitudinal Resonances in Plasmonic Gold Tapers** — Surong Guo1, Nahid Talebi1, Wilfried Sigle1, Ralf Volgelgesang2, Gunther Richter2, Martin Essmann2, Simon F. Becker7, Christoph Lienau7, and Peter A. van Aken7 — 1Max Planck Institute for Solid State Research, Stuttgart, Germany — 2Institute of Physics and Center of Interface Science, Carl von Ossietzky University of Oldenburg, Oldenburg, Germany — 3Max Planck Institute for Intelligent Systems, Stuttgart, Germany

We disentangle the link and distinction between the two different dynamic mechanisms, reflection and phase matching, of surface plasmons excited by relativistic electrons in a three-dimensional single-crystalline gold taper.

**Poster**

FR15F.51 17:00

**Direct writing using electrons – Novel routes to truly three-dimensional fabrication** — Katja Höflisch2,3, Caspar Haverkamp1, Silke Christiansen1,3,4, and Ivo Utke1 — 1Helmholtz-Zentrum Berlin für Materialien und Energie, Hahn-Meitner-Platz 1, D–14109 Berlin, Germany — 2Empa - Swiss Federal Laboratories for Materials Science and Technology,
Feuerwerkerstrasse 39, CH - 3602 Thun, Switzerland — 1Max-Planck-Institute for the Science of Light, G"unther-Scharowsky-Str. 1, 91058 Er-langen, Germany — 1Physics Department, Freie Universit"at Berlin, Berlin, Germany

The direct writing using a focused electron beam for the local decomposition of a precursor medium is a process which allows for the fabrication of truly three-dimensional structures on the nanometer scale.

**Poster**

**All-dielectric anapole source — Alexey Basharin and Nikita Nemkov** — National University of Science and Technology, The Laboratory of Superconducting metamaterials, Moscow, Russia

We demonstrate experimentally all-dielectric anapole based on four high-index SrTiO3 dielectric cylinders excited by the dipole antenna in microwave. We analyze experimentally the field distributions of anapole and far-field characteristics of the toroidal/anapole regimes.

**Poster**

**High-Q Toroidal and Anapole Resonances in Metamaterials — Manoj Gupta1,2 and Manoj Gupta1,2** — 1Division of Physics and Applied Physics, School of Physical and Mathematical Sciences, 2Nanyang Link, Singapore 637371 — 2Centre for Disruptive Photonic Technologies, The Photonics Institute, Nanyang Technological University, 21 Nanyang Link, Singapore 637371

Toroidal dipole and anapole resonances enhance quality factor and figure of merit values of the asymmetric line shape resonances. Excitation of toroidal dipole mode provides an edge over to traditional Fano resonances in planar metasurface.

**Poster withdrawn**

**Opto-mechanical manipulation via SPP generation — Mikhail I. Petrov1,2, Sergey V. Sukhov1,3,4, Andrei A. Bogdanov1,5, Aliakandra A. Ivinskaya5, Natalia O. Kostina1, Aristotele Dogariu5, and Alexander S. Shalin1,5,6** — 1ITMO University, Birzhevaja line 14, 199034 St. Petersburg, Russia — 2Academic University RAS, Khlopina 8/3, 199034 St. Petersburg, Russia — 3CREOL, University of Central Florida, 4000 Central Florida Blvd., Orlando, Florida 32816, USA — 4Kotelinkov Institute of Radio Engineering and Electronics of Russian Academy of Sciences (Ulyanovsk branch), 48 Goncharov Str., Ulyanovsk 432011, Russia — 5Ioffe Institute, 26 Politekhnicheskaya, St Petersburg 194021, Russia — 6Ulyanovsk State University, Lev Tolstoy str. 42, 432017 Ulyanovsk, Russia

We suggest opto-mechanical manipulation using SPP excitation. We show that one can achieve effect of optical pulling by asymmetric generation of SPP due to spin-locking effect, and optical binding based on the exchange of SPPs.

**Poster**

**Generation of Flying Electromagnetic Doughnuts via Spatiotemporal Conversion of Transverse Electromagnetic Pulses — Tim Raybould1, Nikitas Papaioannou1, Vassili A. Fedotov1, Ian Youngs2, and Nikolay I. Zheludev1,3** — 1Optoelectronics Research Centre & Centre for Photonic Metamaterials, University of Southampton, Southampton, UK — 2Platform Systems Division, DSTL, Salisbury, UK — 3TPi and Centre for Disruptive Photonic Technologies, Nanyang Technological University, Singapore

We introduce a new class of metamaterials that allow simultaneous spatial and temporal control of electromagnetic waveforms and present for the first time the generation of flying doughnuts, single-cycle pulses of toroidal topology.

**Poster**

**Improving beam quality in Broad Area Semiconductor amplifiers by spatiotemporal modulation — Shubham Kumar1, Ramon Herrero1, Muriel Botey1, and Kestutis Staliunas1,2** — 1Universitat Politecnica de Catalunya, Terrassa, Spain — 2Institucio Catalana de Recerca i Estudis Avancats (ICREA), Barcelona, Spain

We demonstrate the suppression of modulation instabilities in Broad Area Semiconductor amplifiers through a spatiotemporal modulation of the pump profile. The result is a significant improvement in the output beam quality at high powers.

**Poster**

**Fluorescence Enhancement and Emission Steering Using Large Scale Nanoantenna Arrays — Neciah Dorn1, Andrei Sbaria2, Pedro Estrela3, Simon Pope4, Niklaas Buurma5, Adrian Porch6, Les Bailie6, and Martin J. Cryan1** — 1Department of Electrical and Electronic Engineering, University of Bristol, Bristol, United Kingdom — 2H.H. Wills Physics Laboratory, School of Physics, University of Bristol, Bristol, United Kingdom — 3Centre for Advanced Sensor Technologies, Department of Electronic & Electrical Engineering, University of Bath, United Kingdom — 4Cardiff School of Chemistry, Cardiff University, Cardiff, United Kingdom — 5Physical Organic Chemistry Centre, School of Chemistry, Cardiff University, Cardiff, United Kingdom — 6School of Engineering, Cardiff University, Cardiff, United Kingdom — 7Cardiff School of Pharmacy and Pharmaceutical Sciences, Cardiff University, Cardiff, United Kingdom

In this paper, we demonstrate up to 75x enhanced fluorescence and emission steering from two organic fluorophores coupled to large scale aluminium nanoantenna arrays. These results highlight the potential of nanoantennas enhancing fluorometric sensing applications.

**Poster**

**On the Impact of Quenching in Active Plasmonic Systems — Günter Kewes and Oliver Benson** — Humboldt-Universität, Berlin, Germany

Plasmonics strives to reach new functionality by formation of optimized hybrid systems with emitters. Here we identify two simple numbers that almost fully characterize efficiency and productivity of such systems discussed on three relevant examples.

**Poster**

**Demonstration of optical hybrid surface waves supported by resonant hyperbolic metamaterial** — Anton Samusev1, Radu Malureanu2, Osamu Takayma3, Ivan Mukhin1,2, Dmitry Permyakov4, Ivan Sinev5, Dmitry Baranov4, Ivan Iorsh4, Andrei Bogdanov1,5, and Andrei Lavrinenko1,2 — 1ITMO University, St. Petersburg, Russia — 2Technical University of Denmark, Kongens Lyngby, Denmark — 3St. Petersburg Academic University, St. Petersburg, Russia

We experimentally observe a new type of optical surface waves in resonant hyperbolic metamaterial. We reveal a topological transition from elliptic to hyperbolic regime for TE-plasmons and predict self-collimating quasi-one-dimensional propagation of surface waves.

**Poster**

**Reconfiguring Optical Antennas with Insulator-Metal Phase Transitions — Nikita Butakov1, Ilya Valmiantski1, Christian Urban2, Ivan Schuller3, and Jon Schuller1** — 1University of California, Santa Barbara, USA — 2University of California, San Diego, USA

We experimentally demonstrate thermally reconfigurable metamaterials utilizing insulator-metal phase transitions. We show
that VO2 resonators support smooth switching between dielectric and plasmonic resonances, and by placing Silicon resonators on VO2 we enable broad continuous tuning.

**Poster FRIS.62 17:00**

**Spin control of light with hyperbolic metasurfaces** — **Andrey Bogdanov**, Oleh Yermakov, Anton Ovcharenko, Ivan Iorsh, Konstantin Blokhin, Yuri Kivshar — 1ITAM University, St. Petersburg, Russia — 2Center for Emergent Matter Science, RIKEN, Japan — 3Australian National University, Canberra, Australia

We reveal the breaking of spin-momentum locking for the surface waves localized at hyperbolic metasurface. We show that their spin can be engineered to have an arbitrary value and direction with respect to the wavevector.

**Poster FRIS.63 17:00**

**Nonlinear Enhancement by Surface Lattice Resonance at the Emission Frequency** — **Lior Michaeli**, Shay Keren-Zur, Ori Avayu, Haim Suchowski, and Tal Ellenbogen — 1Department of Physical Electronics, Faculty of Engineering, Tel-Aviv University, Tel-Aviv 6779801, Israel — 2Raymond and Beverly Sackler School of Physics & Astronomy, Tel-Aviv University, Tel-Aviv 6779801, Israel

We experimentally demonstrate 31-fold enhancement of the second harmonic field emitted from a nonlinear metasurface due to surface lattice resonance at the generated nonlinear mode.

**Poster FRIS.64 17:00**

**Wide-Angle, Broadband Graded Metasurfaces for Back Reflection** — **Verena Nieder**, Nasim Mohammadi Estahki, Mark Knight, Hamidreza Chalal, Albert Polman, and Andrea Alo — 1FOM Institute AMOLF, Amsterdam, The Netherlands — 2Department of Electrical and Systems Engineering, Philadelphia, USA — 3Department of Electrical and Computer Engineering, Austin, USA

We demonstrate a gradient metasurface that achieves near-unity back reflection at a wavelength of 700 nm and incoming angle of 35.7 degrees, and efficient operation over a broad angular range and bandwidth.

**Poster FRIS.65 17:00**

**Selective metasurface absorbers for solar thermal applications** — **Chenglong Wan** — university of bristol, bristol, uk

This paper presents measured and modelled absorbance for metal-dielectric-metal metasurfaces with amorphous carbon as the inter-layer. Strong absorbance is obtained across the solar spectrum and low emissivity is obtained in the thermal infra-red band.

**Poster FRIS.66 17:00**

**Experimental Proof of Energy Backflow and Gigantic Local Wavevectors in Super-oscillatory Optical Fields** — **Guanghui Yuan** and Nikolay I. Zheludev — 1TPI & Centre for Disruptive Photonic Technologies, Nanyang Technological University, Singapore 637371, Singapore — 2Optoelectronics Research Centre & Centre for Photonic Metamaterials, University of Southampton, UK

For the first time we experimentally demonstrate that electromagnetic field near a super-oscillatory optical focus has zones with energy backflow and gigantic local wavevectors exceeding the wavevector of incident light several times over.

**Poster FRIS.67 17:00**

**Generation of 11-fs Dark Pulses via Coherent Perfect Absorption in Plasmonic Metamaterial** — **Venkatram Nalla**, João Valente, Sun Handong, and Nikolay I. Zheludev — 1Centre for Disruptive Photonic Technologies, SPMS, The Photonic Institute, Nanyang Technological University, Singapore — 2Optoelectronics Research Centre and Centre for Photonic Metamaterials, University of Southampton, Highfield, Southampton, UK

We demonstrate generation of ultra-short 11 fs dark pulses using the coherent absorption process on a plasmonic absorber. The dark pulses appear as a power dip on the envelope of a long carrier pulse and are characterized using cross-correlation technique.

**Poster FRIS.68 17:00**

**Repulsion of dipoles from two-dimensional materials** — **Francisco J. Rodríguez-Fortuño**, Michelle F. Picardi, and Anatoly V. Zayats — King’s College London, Department of Physics, London WC2R 2LS, UK

Dipolar particles scattering near a two-dimensional material sheet can experience a repulsive force away from the surface, depending on the sheet conductivity. Broad bandwidth of repulsion can be achieved in graphene tuning the chemical potential.

**Poster FRIS.69 17:00**

**High-density optical data storage using dual-color plasmonic nano-pixels** — **Esmail Heydari, Justin Sperling, Steven Neale, and Alasdair Clark** — University of Glasgow, Glasgow, UK

We demonstrate a new plasmonic approach to high-density optical data storage; using dual-color plasmonic nano-pixels to encode two information sets into the same unit area using single arrays of two-state metal nano-apertures.

**Poster FRIS.70 17:00**

**Toward lossless nonreciprocity through spatiotemporal modulation** — **Christopher W. Peterson**, Jennifer T. Bernhard, and Gaurav Bahl — University of Illinois at Urbana-Champaign, Champaign, IL, USA

We experimentally demonstrate nonreciprocal absorption induced by coupling a wave to a resonance through multiple spatially separated and time-modulated couplers, a method that could be used to create nonreciprocal metamaterials for any wave phenomenon.

**Poster FRIS.71 17:00**

**Lasing in dark and bright modes of a finite-sized plasmonic lattice** — **Tommi Hakala**, Heikki Rekola, Aaro Väkeväinen, Jani Martikainen, Marek Necada, Antti Mohlannen, Rui Guo, and Päivi Törmä — COMP Centre of Excellence, Department of Applied Physics, Aalto University School of Science, FI-00076 Aalto, Finland

We report on lasing at the visible wavelengths in both dark and bright modes of a plasmonic lattice combined with fluorescent molecules. A new concept to access and utilize the dark modes is introduced, which is based on a gradual, coherent build-up of dipole moments in a finite lattice.

**Poster FRIS.72 17:00**

**Nonlinear Holography with Metamaterials** — **Euclides Almeida, Ora Bitton, and Yehiam Prior** — Weizmann Institute of Science, Rehovot, Israel

We demonstrate a novel type of holography based on nonlinear metamaterials, in which the image is formed at the third-harmonic frequency of the input beam. The computer generated holograms show polarization response and 3D features.
Resistance Measurement of Nano-Patterned Transparent Conductors — •Chenguang Wang, Usho Hahm, Azusa Takeuchi, Takashi Sagawa, and Martin Cryan — 1Department of Electrical and Electronic Engineering, University of Bristol, Bristol, UK — 2Graduate School of Energy Science, Kyoto University, Kyoto, Japan

This paper shows fabrication results for 1D and 2D patterned thin films of ITO and performs four-point probe resistance measurements which compare very well with numerical modelling.

FRI60: Electron Beam Nanophotonics

Chairied by Uriel Levy, Hebrew University of Jerusalem, Israel

Time: Friday, 18:30–20:30  Location: Olympia

Invited  FRI60.1 18:30

Single-photon time-resolved cathodoluminescence imaging spectroscopy — •Albert Polman — FOM Institute AMOLF, Amsterdam, the Netherlands

We use a 30 keV time-resolved cathodoluminescence microscopy to create femtosecond plasmonic and photonic wave packets on metallic and dielectric metasurfaces and create strong photon bunching of quantum emitters

Invited  FRI60.2 19:00

Electron Microscopy of Electromagnetic Waveforms — •Peter Baum — Ludwig-Maximilians-Universität München — Max-Planck-Institut für Quantenoptik

Electron microscopy is advanced to see the oscillating electromagnetic fields in metamaterials or nanophotonic devices with sub-optical-cycle and subwavelength resolution.

Invited  FRI60.3 19:30

Ultrafast point-projection electron microscopy of thin carbon films — Jan Vogelsang, Petra Gross, and •Christoph Lienau — Institut für Physik and Center of Interface Science, Carl von Ossietzky Universität, 26129 Oldenburg, Germany

We report highly efficient photoelectron emission from gold nanotapers via long-range plasmonic nanofocusing. This new source of remotely-generated few-femtosecond electron pulses is implemented in a point-projection-microscope and first steps towards ultrafast electron microscopy are discussed.

FRI65: Nanophotonic Devices

Chairied by Thomas Taubner, RWTH Aachen University, Aachen, Germany

Time: Friday, 18:30–20:30  Location: Seefeld/Tirol

Invited  FRI65.1 18:30

Going to the Extreme with Low-Index Photonics — •Nader Engheta — University of Pennsylvania, Philadelphia, USA

We discuss some of our ongoing work on near-zero-parameter photonic platforms with peculiar light-matter interaction. A variety of phenomena unique to such extreme photonics are exploited with potential applications for novel wave-based and quantum-based devices

Invited  FRI65.2 19:00

Trapping Light in Plain Sight: Embedded Eigenstates in Nanophotonics — •Andrea Alu and Francesco Monticone — Department of Electrical and Computer Engineering, University of Texas at Austin

We discuss the possibilities and potentials of trapping and confining light in open 2D and 3D nanophotonic structures with embedded eigenstates within the radiation continuum, discussing their origin, and presenting a metamaterial platform that allows realizing them.

Oral  FRI65.3 19:30

Fibre-coupled photonic metadevices — Angelos Xomalis, Davide Piccinotti, Artemios Kavvouisis, Haohe Zhang, Vassili Savinov, Behrad Gholfoulpour, Yongmin Jung, Anna C. Peacock, Eric Plum, Kevin F. MacDonald, David J. Richardson, and Nikola I. Zheludev — 1University of Southampton, Southampton, UK — 2Nanyang Technological University, Singapore

We report on metadevices realised by integration of functional metamaterials with single-mode telecoms fibres. These include plasmonic and all-dielectric nonlinear, nano-opto-mechanical and phase-change switching, dispersion manipulation and coherent absorber metadevices.

Oral  FRI65.4 19:45

Ultra-Wide Plasmonic Tuning of InSb Dielectric-ENZ Resonators — •Prasad P. Iyer, Miheer Pemkharkar, Chris J. Palmstrom, and Jon A Schuller — 1Department of Electrical and Computer Engineering, University of California Santa Barbara, Santa Barbara, USA — 2Department of Material Science and Engineering, University of California Santa Barbara, Santa Barbara, USA

Thermal tuning of InSb dielectric resonators is experimentally demonstrated based on free-carrier and electron mass modu- lation. Dielectric (i-InSb) cylinders on a doped InSb ENZ substrate form red-shifting TE and blue-shifting TM resonances tunable over 1.5 μm.

Oral  FRI65.5 20:00

Nanoantenna electrode for ultrabright electrically pumped solid-state single-photon sources — •Ilya M. Fradkin, Mario Acio, and Dmitriy Yu. Fedyanin — 1Moscow Institute of Physics and Technology, Dolgoprudny, Russian Federation — 2University of Siegen, Siegen, Germany — 3European Laboratory
of magnitude, hence allowing for characterization of electron-induced polarizations of a sample with attosecond time resolution.

Oral FRI6o.5 20:15
Photon bunching and antibunching in cathodoluminescence at high currents — Benjamin Lawrie¹, Raphael Pooser¹, Jordan Hachtel¹,², and Roderick Davidson¹ — ¹Quantum Information Science Group, Oak Ridge National Laboratory, Oak Ridge TN USA — ²Department of Physics and Astronomy, Vanderbilt University, Nashville TN USA

We probe the photon statistics of diamond NV centers coupled to plasmonic nanoresonators by cathodoluminescence spectroscopy in a scanning transmission electron microscope, and demonstrate GHz oscillations between bunched and antibunched states under nanoamp excitation currents.

Oral FRI6s.6 20:15
Meta-Atoms on Merry-go-round — Dmitry Filonov¹,², Vitali Kozlov¹, Ben Z. Steinberg¹, and Pavel Ginzburg¹,² — ¹School of Electrical Engineering, Tel Aviv University, Tel Aviv, 69978, Israel — ²ITMO University, St. Petersburg 197101, Russia

Electromagnetic interactions in accelerating reference frames inspires variety of intriguing phenomena. Axially rotating subwavelength (cm-range) meta-atoms, will be discussed and effects of asymmetric scattering and micro-Doppler frequency comb generation will be demonstrated.
**SAT1o: Plenary Session 5**

Chaired by Ann Roberts, University of Melbourne, Parkville, Australia

Time: Saturday, 8:30–9:30  
Location: Olympia

**Plenary**  
SAT1o.1 8:30

Exciton-Polarons and Polaritons in Atomically Thin Semiconductors — ATAC Imamoglu — ETH Zurich, Switzerland

Interacting polariton-electron system in two dimensional materials realizes a new class of Bose-Fermi mixtures exhibiting novel many-body physics.

**SAT2o: Polaritons**

Chaired by Albert Polman, AMOLF, Amsterdam, Netherlands

Time: Saturday, 9:45–11:15  
Location: Olympia

**Invited**  
SAT2o.1 9:45

Polariton mapping in 2D materials — Rainer Hillenbrand — CIC nanoGUNE, San Sebastian, Spain

Near-field microscopy is employed to image and analyse resonating IR graphene plasmons, acoustic THz graphene plasmons in a photodetector device with split-gate architecture, and hyperbolic phonon polaritons in boron nitride nanostructures.

**SAT2s: Programme Committee Top Picks**

Chaired by Javier García de Abajo, ICFO, Barcelona, Spain

Time: Saturday, 9:45–11:15  
Location: Seefeld/Tirol

**Oral**  
SAT2s.1 9:45

Nonlinear and quantum optics with polaritons in semiconductor microcavities — Said Rodriguez — Centre de Nanosciences et de Nanotechnologies, CNRS

We investigate highly nonlinear dynamics and steady-states of semiconductor microcavities, in the classical and quantum regime. We demonstrate how the phase that polaritons pick when hopping between coupled cavities can be controlled through polariton-polariton interactions.

**Oral**  
SAT2s.2 10:00

Nonlinear Atoms on Demand — Dmitry Filonov, Boris A. Kramer, Boris A. Malomed, and Pavel Ginzburg — School of Electrical Engineering, Tel Aviv University, Tel Aviv, 69978, Israel — IMT University, St. Petersburg 197101, Russia

Nonlinear light-matter interactions and their applications are constrained by properties of available materials. Doubly resonant nonlinear meta-atoms for tailoring efficiencies of high-harmonic generations on demand are proposed, analysed and characterized in the GHz spectral range.

**Oral**  
SAT2s.3 10:15

Optical Control of Polarization in Nonlinear Anisotropic Metamaterials — Luke H. Nichols, Francisco J. Rodríguez-Fortuño, Mazhar E. Nasir, R. Margoth Cordova-Castro, Nicolas Olivier, Gregory A. Wurtz, and Anatoly V. Zayats — Department of Physics, King’s College London, Strand, London WC2R 2LS, UK — Department of Physics, The University of Sheffield, Sheffield S10 2TN, UK — Department of Physics, University of North Florida, Jacksonville, Florida 32224, USA

Using the strong nonlinear response and highly anisotropic optical properties of hyperbolic metamaterials, we demonstrate sub-picosecond all-optical switching of the polarization state of transmitted light under both control light illumination and self-action regimes.

**Oral**  
SAT2s.4 10:30

On-chip single photon transfer with site-controlled quantum dots coupled to photonic crystal waveguides — Bruno Rigel, Clément Jarlov, Benjamin Dwir, Alon Rudra, Alexey Lyasota, Irina Kulkova, and Elyahu Kapon — LPN, Lausanne, Switzerland

9:30–9:45: Break
Reversible Switching of Highly Confined Phonon-Polaritons with an Ultrathin Phase-change Material — Peining Li, Xiaosheng Yang, Tobias WW. Mass, Julian Hanss, Martin Lewin, Ann-Katrin U. Michel, Dmitry Cheglin, Matthias Wuttig, and Thomas Taubner — Institute of Physics (IA), RWTH Aachen University, 52056 Aachen, Germany

We use a phase-change material as a switchable dielectric environment for surface phonon polaritons and realize the all-optical, non-volatile, and reversible switching of resonators for these ultra-confined polaritons.

We demonstrate the optical coupling of multiple, site-controlled semiconductor quantum dots to photonic crystal waveguide structures. The impact of the exact position and emission spectrum of the QDs on the coupling efficiency is elucidated.

Unravelling the Lorentz Non-reciprocal Optical Response of Hybrid Magnetoplasmonic Systems — Dominik Floss4, Thomas Weiss3, Sergii Tkhostov2, and Harald Giesen3 — 1Physics Institute and Research Centre SCOPE, University of Stuttgart, 70569 Stuttgart, Germany — 2A. M. Prokhorov General Physical Institute, Russian Academy of Sciences, 119991 Moscow, Russia

Flexible Metasurface Holograms In the Visible Range — Alexey Nikitin3, Pablo Alonso1, Saul Velez1, Stefan Mastel1, Alba Centeno1, Amaia Pesquera1, Amaia Zurutuza1, Felix Casanova1, Luis Hueso1, Frank Koppens4, and Rainer Hillenbrand5 — 1CIC nanoGUNE, E-20018, Donostia-San Sebastian, Spain — 2IKERBASQUE, Basque Foundation for Science, 48011 Bilbao, Spain — 3Graphenea SA, E-20018 Donostia-San Sebastian, Spain. — 4ICFO-Institut de Ciéncies Fotòniques, Mediterranean Technology Park, E-08860 Castelldefels (Barcelona), Spain — 5CIC NanoGUNE and EHU/UPV, E-20018, Donostia-San Sebastian, Spain

We apply near-field nanoscopy to analyze in real space, for the first time, plasmon modes in tailored disk and rectangular graphene nanoresonators at mid-infrared frequencies.

Oral

Imaging of sheet and edge plasmonic modes in nanostructured graphene — Alexey Nikitin3, Pablo Alonso1, Saul Velez1, Stefan Mastel1, Alba Centeno1, Amaia Pesquera1, Amaia Zurutuza1, Felix Casanova1, Luis Hueso1, Frank Koppens4, and Rainer Hillenbrand5 — 1CIC nanoGUNE, E-20018, Donostia-San Sebastian, Spain — 2IKERBASQUE, Basque Foundation for Science, 48011 Bilbao, Spain — 3Graphenea SA, E-20018 Donostia-San Sebastian, Spain. — 4ICFO-Institut de Ciéncies Fotòniques, Mediterranean Technology Park, E-08860 Castelldefels (Barcelona), Spain — 5CIC NanoGUNE and EHU/UPV, E-20018, Donostia-San Sebastian, Spain

11:15–11:30: Coffee Break (Olympia lobby)

SAT3o: Novel Phenomena

Chaired by Cesare Soci, Nanyang Technological University, Singapore

Time: Saturday, 11:30–13:00 Location: Olympia

Flexible Metasurface Holograms In the Visible Range — James Burch1, Danan Wen2, Xianzhong Chen3, and Andrea Di Falco1 — 1University of St Andrews, St Andrews, UK — 2Heriot-Watt University, Edinburgh, UK

Metasurface holograms are typically fabricated on rigid substrates. Here we experimentally demonstrate broadband, flexible, conformable, helicity multiplexed metasurface holograms operating in the visible range, which offer increased potential for out-of-the-lab applications.

Three Dimensional Optical Nanoscopy with Excited-State Saturation Microscopy — Reenu Baby1,2, Jean-Baptiste Trebbia1,2, Philippe Tamarat1,2, and Ibrahim Louinis1,2 — 1Université Bordeaux, LP2N, Talence F-33405, France — 2Institut d’Optique & CNRS, LP2N, Talence F-33405, France

We have developed a cryogenic super-resolution optical microscopy called Excited-State saturation to image single fluorescent emitters with few nanometers resolution in three dimensions with extremely low excitation intensities compared to other room temperature techniques.

High-Efficiency Metasurfaces in Reflective and Transmissive Geometries — Lei Zhou — Physics Department, Fudan University, Shanghai 200433, China

We briefly summarize our latest results on meta-surfaces, including establishing a complete phase diagram for metal/insulator/metal metasurfaces, realizing high-efficiency SPP couplers, and achieving nearly 100%-efficiency spin-photons in geometric-phase metasurfaces.
Highly efficient water splitting devices based on random micro- to nanostructuring of silicon semiconductors
— Marcella Bonifazi1, Hui Chun Fu2, Jr Hau He2, Andrea Fratalocchi1, and Juan Sebastian Totero Gongora1 — 1PRIMALIGHT, King Abdullah University of Science and Technology (KAUST), Thuwal, Saudi Arabia — 2Computer, Electrical, and Mathematical Science and Engineering Division (CEMSE), King Abdullah University of Science and Technology (KAUST), Thuwal, Saudi Arabia
By combining theory and experiments we demonstrate an optimized water splitting device based on layers of suitably nanostructured silicon. Experiments report that this strategy allows to reach quantum efficiencies (QEs) up to 95%.

Optical range plasmonics of niobium around the superconducting transition temperature — Chen Yen Liao1,2, Harish N. S. Krishnamoorthy1, Vassili Savinov1, Jun-Yu Ou1, Kaveh Delafanazari1, Chunli Huang1, Giorgio Adamo1, Eric Plum1, Kevin F. MacDonald1, Yidong D. Chong2, Cesare Souci1, Feo V. Kusmartsev3, Din Ping Tsai2,3, and Nikolay I. Zheludev1,4 — 1Optoelectronics Research Centre & Centre for Photonic Metamaterials, University of Southampton, UK — 2Department of Physics, National Taiwan University, Taipei, Taiwan — 3Research Center for Applied Sciences, Academia Sinica, Taipei, Taiwan — 4Centre for Disruptive Photonic Technologies, TPI, SPMS, Nanyang Technological University, Singapore — 5Department of Physics, Loughborough University, Loughborough, UK
We show that a niobium metamaterial exhibits optical plasmonic resonances which change in a critical way near the superconducting transition temperature of 9K. This suggest a hitherto unknown link between superconductivity and optical range plasmonics.

Quasi-1D systems for spin photon interfaces — John Rarity — QET Labs, MVB School of Engineering, University of Bristol, Woodland Road, Bristol, BS8 1UB, UK
We demonstrate a large conditional phase shift of an input single photon by a single dot spin in a 1D-cavity system showing that in principle deterministic entangling operations could be realised.

Octave-Spanning Coherent Hyperspectral Near-field imaging of Plasmonic Nanostructures — Michael Mrejen, Uri Arieli, Assaf Levanon, Achiya Nagler, and Haim Suchowski — Raymond and Beverly Sackler School of Physics and Astronomy, Tel Aviv University, Tel Aviv 69978, Israel
We experimentally observe hyperspectral near-field response of plasmonic nanostructure with deep subwavelength spatial resolution using a combined nano-FTIR SNOM illuminated by ultrabroadband few-cycle femtosecond source.

Multipolar Interference Effects for Advanced Light Control — Mehmet A. Noyan1, Kavitha K. Gopalan1, Renu A. Maniyyara1, Miriam M. Martin-Frances1, Vahagn Mkhitaryan1, Juan Rombaut Segarra1, Miquel Rude1, Rafael Sibilo1, Ilaria Mannelli1, Josep Canet Ferrer1, and Valerio Pruneri1,2 — 1ICFO-Institut de Ciencies Fotoniques, Castelldefels, The Barcelona Institute of Science and Technology, 08860, Castelldefels, Spain — 2ICREA-Institució Catalana de Recerca i Estudis Avançats, 08010 Barcelona, Spain
We will present recent results on glass surfaces modified by ultrathin materials and nano-structuring to tailor the optical, electrical and wetting properties for applications in display screens, solar cells and smart windows.

13:00–16:00: Lunch Break
SAT4o: Reconfigureable and Tuneable
Chairied by Kevin F. MacDonald, University of Southampton, United Kingdom

Time: Saturday, 16:00–17:30
Location: Olympia

Invited SAT4o.1 16:00
Tunable metasurfaces by atomic media — JONATHAN BAR-David, LIRON STERN, and URIEL LEVY — The Hebrew University of Jerusalem, Jerusalem, Israel

In recent years dielectric and metallic nanoscale metasurfaces are attracting growing attention and are being used for variety of applications.

Oral SAT4o.2 16:30
Metasurface back reflectors for external control over semiconductor nanowire resonances — JORIK VAN DE GROEP and MARK L. BRONGERSMA — Geballe Laboratory for Advanced Materials, Stanford University, Stanford, California, USA

We demonstrate how metasurface back reflectors can be used to obtain external control over the resonance amplitude, spectrum and angular response of Si nanowires, without altering the physical shape or dielectric surrounding of the nanowire.

Oral SAT4o.3 16:45
Graphene-based Electro-Optical Modulators of Amplitude, Phase and Polarization — NIMA DABIDIAN, SHOURYA DUTTA-GUPTA, ISKANDAR KHOLOMANOV, MIKHAIL BELKIN, and GENNADY SHVETS — University of Texas at Austin

We experimentally demonstrate amplitude, phase and polarization modulation of mid-IR light using graphene-integrated plasmonic metasurfaces. Our measurement show 10 dB modulation of amplitude and 55 degree phase modulation.

Oral SAT4o.4 17:00
Reconfigurable thermo-optically tuned meta-atoms — TOMER LEWI, NIKITA BUTAKOV, HAYDEN EVANS, ALEXANDER MIKHAILOVSKY, and JON SCHULLER — University of California Santa Barbara, Santa Barbara, CA, USA

We demonstrate ultra-wide dynamic tuning of PbTe nanoparticles in the infrared. Taking advantage of the extremely large thermo-optic coefficient and high refractive index of PbTe, we demonstrate high-Q Mie-resonances that are tuned by several linewidths.

Oral SAT4o.5 17:15
A Near-Infrared Thermo-Optically Tunable Flat-Lens — JON PUGH, ANDREI SABIA, and MARTIN CRYAN — 1 Department of Electrical & Electronic Engineering, University of Bristol — 2 H. H. Wills Physical Laboratory, University of Bristol

We present a slot-grating flat lens fabricated in a 360nm thick layer of amorphous silicon-on-aluminum. The high dn/dT of amorphous silicon has the potential to enable thermo-optic focusing and steering via NiCr resistive heater loops.

SAT4s: Nanoscopy and Imaging
Chairied by Tal Ellenbogen, Tel Aviv University, Tel Aviv, Israel

Time: Saturday, 16:00–17:30
Location: Seefeld/Tirol

Invited SAT4s.1 16:00
Ultratrace plasmonic sensing with quantum states of light — BENJIN LAWRIE and RAFAEL POOSER — Quantum Information Science Group, Oak Ridge National Laboratory, Oak Ridge TN USA

Four-wave mixing in 85Rb is leveraged for squeezed plasmonic sensors, for plasmonic sensors utilizing quantum noise as the signal transducer, and for nonlinear interferometric plasmonic sensors, enabling trace detection of signals previously buried in quantum noise.

Oral SAT4s.2 16:30
Compressed Sensing near-field THz Imaging — RAYKO STANCHEV, SAMUEL HORNERT, PETER HOBSON, DAVID PHILLIPS, and EVAN HENDRY — 1 University of Exeter, Stocker Road, Exeter, EX4 4QL, UK — 2 QinetiQ limited, Cody Technology Park, Ively Road, Farnborough, GU14 0LX, UK — 3 University of Glasgow, Glasgow, G12 8QG, UK

Semiconductors can be switched from dielectrics to conductors through electron-hole pair photoexcitation. Using a patterned excitation-beam, we demonstrate subwavelength (λ/50) THz imaging compatible with compressed sensing.

Oral SAT4s.3 16:45
Measuring nanoplasmic field enhancement with ultrafast photoelectrons — PÉTER RÁCZ, ZSUZSANNA PÁPA, ISTVÁN MÁRTON, JUDIT BUDAI, and PÉTER DOMBI — 1 Wigner Research Centre for Physics, Budapest, Hungary — 2 ELI-ALPS Research Institute, Szeged, Hungary — 3 University of Szeged, Szeged, Hungary

We measured the maximum of nanoplasmic field enhancement (from x11 up to x58) for both propagating and localized surface plasmons with the help of ultrafast photoelectrons induced by femtosecond laser pulses.

Oral SAT4s.4 17:00
Vectorial near-field coupling on the nano-scale — MARTIN ESMANN, SIMON F. BECKER, JULIA WITZ, GUNTER WITTSCHER, RALF VOGELGESANG, and CHRISTOPH LIEHAN — 1 Institut für Physik, Carl von Ossietzky Universität, 26129 Oldenburg, Germany — 2 Institut für Chemie, Carl von Ossietzky Universität, 26129 Oldenburg, Germany

Dipole-dipole coupling is spectroscopically investigated with a novel Scanning Near-Field Optical Microscope based on Surface Plasmon Polariton nanofocusing. Coupling-induced spectral shifts and line broadening observed in individual gold nanoparticles on 5nm length scales present a fundamentally new way to interrogate dipole-dipole couplings in nanosystems in the spatio-temporal and temporal domain.

Oral SAT4s.5 17:15
STED nanoscopy assisted by small metal nanoparticles — YONATAN SIVAN, MATTHEW R. FOREMAN, NICOLAI T. URBAN, and STEFAN W. HELL — 1 Unit of Electro-Optics Engineering, Ben-Gurion University — 2 Max Planck Institute for Science of Light, Erlangen, Germany — 3 Max Planck Institute for Biophysical Chemistry, Gottingen, Germany

We show ~100nm resolution using low intensity in a stimulated-emission-depletion (STED) microscope using 20nm gold spheres coated with fluorophores in aqueous environment, along with up to 3-fold reduction of bleaching rate.
17:30–17:45: Break

**SAT5o: Breakthrough Session 3**

Chaired by Andrea Alu, University of Texas, Austin, USA

Time: Saturday, 17:45–18:45  
Location: Olympia

**Invited**  
SAT5o.1  17:45

Twists and Turns of Nanoscale Light — **Koos Kuipers** — QuantumNanoscience dept., Kavli institute for Nanoscience, Delft, NL.

Light at the nanoscale often behaves completely different from light in the far field. Here we present its behaviour in chaotic cavities and nonlinear slow light waveguides.

**Breakthrough**  
SAT5o.2  18:15

Quantum Effects in Time Dependent ENZ Materials. — **Daniele Faccio, Angus Jain, Clas Westerberg, Stefano Vezzoli, and Thomas Roger** — Institute of Photonics and Quantum Sciences, Heriot-Watt University, Edinburgh, UK

Time dependent epsilon-near-zero materials are studied in the context of the interaction with the quantum vacuum. Starting from a model derived from quantum cosmology, we predict spontaneous emission of photon pairs at the ENZ wavelength.

**SAT5s: Breakthrough Session 4**

Chaired by Javier Aizpurua, Center for Material Physics, Donostia - San Sebastian, Spain

Time: Saturday, 17:45–18:45  
Location: Seefeld/Tirol

**Invited**  
SAT5s.1  17:45

Harnessing Loss in Plasmonic Metamaterials — **Jason Valentine’, Wei Li’, Wentao Wang’, Lucas Besteiro’,** and **Alexander Govorov** — 1Vanderbilt University, Nashville, TN, USA — 2Ohio University, Athens, OH, USA

In this talk I will discuss the use of plasmonic metamaterials, combined with bulk and 2D semiconductors, for generating and harnessing hot electrons in optoelectronic devices.

**Breakthrough**  
SAT5s.2  18:15

Turning Forbidden Transitions into Dominant Transitions: Towards Efficient Sources of Entangled Light — **Nicholas Rivera, Ido Kaminer, and Marin Soljacic** — MIT, Cambridge MA, USA

We demonstrate that using phonon-polaritons in thin (quasi-2D) polar dielectrics, it is possible to turn forbidden transitions into dominant transitions, allowing for emitters of entangled light with quantum efficiencies exceeding 90%.

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**SAT6o: Student Prize Award and Closing Ceremony**

Chaired by Nikolay Zheludev & Harald Giessen

Time: Saturday, 18:45–19:00  
Location: Olympia

Distribution of the Student Poster Prizes sponsored by Journal of Optics and Science Magazine

Closing Remarks by Nikolay Zheludev and Harald Giessen

19:00–20:00: Beer Reception (Olympia lobby)
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