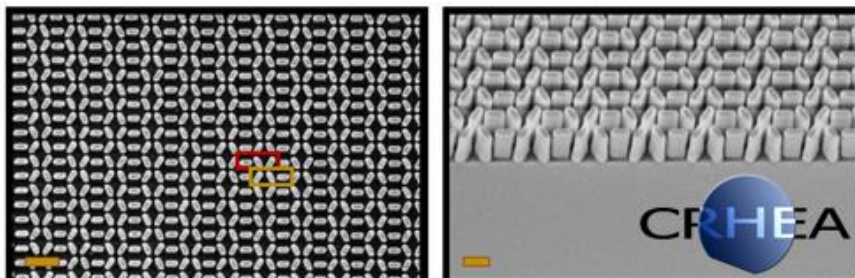




# 1st COLLOQUIUM ON THE PHYSICS AND APPLICATIONS OF METASURFACES

Cargèse, Corsica (France) June 14-18 2021



## Important news

### Ajaccio arrival and departure:

Group arrival at Ajaccio airport and port:

Shuttles are organized from the airport or port of Ajaccio depending on the flight and boat schedules from mainland France. To organize your arrival as well as possible, a reception service is set up at the airport. Two accommodations sites are available. We will organize the rooms according to arrival hours. For onsite accommodation, the staff will greet you and direct you to the rooms. The other participants will be taken to the various accommodations located in the village.

Those arriving by their own means are kindly requested to be at the Institute when the shuttle arrives, in order to benefit from the general accommodation in the accommodation.

For those arriving at late hours, taxi can be booked by the Institute.

### COVID test before departure:

#### **To go to Corsica:**

You need to provide the joined attestation with your negative COVID test or vaccine passport.

#### **To return from Corsica:**

For those who will need a COVID test to before departure please send me an email.

An appointment will be managed on Wednesday 16th at 8.00 AM at the Ajaccio Health center.

**Please let me know if you need one.**

**For French resident there is no need to get a COVID test to go back.**

### Accommodation and catering:

- The scientific Cargèse center has 27 rooms. Other rooms or apartments are located near the Institute (5 min by foot) or in the village of Cargèse (20 min by foot).

**Please let me know if you have any mobility problem.**

### Registration fees:

The registration fees cover:

- Accommodation from Sunday 13th to Thursday 17th included.
- 6 lunches, breakfasts and the gala dinner.



## Program:

### Short topic description:

Conventional optical components control light using gradual phase accumulation through propagation in refractive materials. Recently, ultrathin optical interfaces capable of controlling the light properties, including amplitude - phase - polarization and the dispersion of light, have been proposed for mid infrared and optical wavelengths. These devices, called metasurfaces, rely on the scattering properties of ultrathin subwavelength scale optical resonators patterned at interfaces. The design was influenced by the ability to control scattering of light from wavelength scale dielectric or metallic nanoparticles in the resonant scattering regime or in the non-resonant one using the geometric phase.

Since about ten years, the concept of metasurfaces has gained considerable attention in the optics community, offering new perspectives for the realization of optical components with unexpected optical functionalities. Devices such as holograms, polarimeters, cameras, lasers with arbitrary wavefronts, polarization sensitive imaging, quantum optical components with extended functionalities have been proposed.

The purpose of this workshop is to gather the academic community working on metasurfaces. The topics of interests are fundamental principles and technological applications of metasurfaces, targeting new phenomena and advanced optical functionality of metasurfaces, with a careful attention on their applications in realistic optical systems.

### Program

The workshop contains special sessions addressing both scientific and industrial purpose and an educational afternoon session with a young research forum (this one will be updated by the students themselves in a week or so). The workshop consists of conventional presentations, including 4 special sessions involving academics and industrials (Monday, Tuesday, Wednesday and Friday morning), and one full day (Thursday) devoted for graduate students and postdocs to present their own work in a non-intimidating environment, to build collaborative networks with their peers, and prepare them for active participation to the scientific community.

Every day, two main research topics will be considered with a morning and an afternoon dedicated session. A tutorial/keynote presentation have been selected to present and introduce the subject. We will select two discussion leaders for each plenary: an academic and a student involved in the young research forum organization. The afternoon time from 1:30 pm to 4:30 pm will be left as unstructured time to stimulate discussion among all participants. We will organize two poster sessions during these afternoon in which all participants would have sufficient time to engage and discuss freely.

**Online access will be available free of charge:** A zoom link will be emailed to the participants at the beginning of each sessions for online speakers to join the sessions.



**Monday 14 June:** the first session is entitled “**Fundamentals and the physics of metasurfaces**”.

The development of metasurfaces and their current deployment in real world applications require proper understanding of the underlying physical mechanisms, new design method leading to high efficient and reliable devices and proper simulation methods. The morning and opening session will be devoted to the introduction of those basic concepts and the theoretical development in the field, ranging from basic Mie decomposition to the most advanced diffractive optics modeling. The afternoon session will be the opportunity to present and discuss recent advances on theoretical modelling, and their impact on experimental design. Suitable topics considered in this sessions range from modelling of metasurfaces, e.g., through thin sheet transmission conditions, Numerical treatment, e.g., with FDTD/FEM methods, Optimization and inverse design methodologies, e.g., with gradient-based, evolutionary and machine learning algorithms.

**Tuesday 15 June:** the second session is entitled “**New functionalities and applications of Metasurfaces**”. In this session, we will discuss new principle, technological and emerging applications, trying to emphasize practical developments of metasurface prototypes in imaging systems, sensing, communication system, quantum optics applications, polarimetry and data storage. In this afternoon, we consider as well new materials, structures, and advanced optical functionality of metasurfaces. In connection with the previous session, important progress toward scalable measurements and characterization methods for reliability testing will be of interest.

**Wednesday 16 June:** the third session is entitled “**Passive and Tunable Materials for nanophotonics**”. In this session, we discuss new nanofabrication methods and new materials for passive and active nanophotonics. We will present new development of metasurfaces and their deployment in real world applications requires scalable nanofabrication methods able to reproduce a large number of devices. Techniques such as nanoimprinting, deep UV lithography and top-down nanofabrication process will be discussed. The morning session is devoted to new materials for metasurfaces (e.g., 2D materials, oxides/nitrides, phase-change materials, high-index dielectrics). The afternoon will be devoted to new imaging and metasurface characterization techniques including phase and full polarization measurements.

**Thursday 17 June:** the forth session is entitled “**Nonlinear, tunable metasurface and applications**”. We will discuss innovative nonlinear light manipulation with nanostructures and nonlinear metasurfaces. In the afternoon, the students will organize the “**Young research forum**”. The organization of this afternoon is currently given to students and postdocs and the schedule will be updated the morning before the forum.

**Friday 18 June:** the firth and last session is entitled “**Perspectives and Metasurface device integration**”. This last morning will be devoted to open /round table discussions on emerging applications. It is a more transversal session, opened to topics susceptible of further widening the research directions and exploring the potential impact of metasurfaces and metamaterials in other field of research. Special attention will be given to the fields of quantum optics, neuromorphic and topological photonic devices, AR/VR devices, holographic displays, polarimetric camera and phase imaging devices.



## Fundamentals and the physics of Metasurfaces

### Monday June 14 Morning session: Theoretical description of metasurfaces

8:30 Breakfast

8:45am “Welcome and Opening Ceremony”

9:00-10:00am Didactic/general audience presentation: **K. Achouri**

Title: “Multipolar Modeling of Spatially Dispersive Metasurfaces”

10:00-10h30 Contributed talk: **N. Bonod**

Title: “Description of all-Dielectric Antennas through their Quasi-normal Modes”

10:30 Coffee break

10:45-11h15 Contributed talk: **N. Lebbe**

Title: “Homogenization technique for metasurfaces”

11:15-11:45 Contributed talk: **Y. Sivan (Online)**

Title: “Eigenpermittivity normal mode expansions - recent progress”

11:45-12:15 Contributed talk: **P.A. Huidobro (online)**

Title: “Space-time metamaterials: dragging and amplifying light”

### Monday June 14 Afternoon/evening session: Modelling, simulation and optimization of metasurfaces

4:00 Coffee

4:15-5:00pm Didactic/general audience presentation: **P. Wiecha**

Title “Introduction to deep learning and its applications in nano-optics”

5:00-5:30 Contributed talk: **S. Lanteri**

Title: “DIOGENeS: a software suite for exploring nanoscale light-matter interactions”

5:30-6:00 Contributed talk: **M. Elsayy**

Title: “RGB metalens Optimization through advanced statistical learning”

6:00-6:30 Contributed talk: **P. Ferrand**

Title: “Quantitative imaging of metasurfaces by a gradient-based phase-retrieval strategy: the power of vectorial ptychography ”

6:30-7:00 Contributed talk: **C. Majorel**



Title: “Deep learning and a dressed polarizability model to simulate large aperiodic plasmonic metasurfaces”

## New functionalities and applications of Metasurfaces

### Tuesday June 15 Morning session: Resonant and non-resonant light scattering

8:30 Breakfast

9:00-10:00am Didactic/general audience presentation: **Q. Song**

Title: “Metasurfaces by encircling topological singularities”

10:00-10h30 Contributed talk: **R. Colom** (online)

Title: “Quasinormal mode expansion of optical far-field quantities”

10:30 Coffee break

10:45-11:15 Contributed talk: **P. Bouteyre**

Title: “Investigation on topological properties of non-Hermitian metasurfaces”

11:15-11:45 Contributed talk: **R. Sawant**

Title: “Hybrid refractive-diffractive metaoptics”

11:45-12h15 Contributed talk: **N. Destouches**

Title: “Laser processing of random plasmonic metasurfaces for high-end color printing”

### Afternoon Poster session

### Tuesday June 15 Afternoon/evening session: From metasurface devices to metasystems

4:00 Coffee

4:15-5:00pm Didactic/general audience presentation: **P. Genevet**

Title: “Metasurface System Integration”

5:00-5:30 Contributed talk: **A. Borne**

Title: “Quasinormal modes expansion for second-order nonlinear optical processes in nano resonators”

5 :30-6:00 Contributed talk: **G. Amboli**

Title: “Pseudo-chiral metasurfaces for the detection of chiral molecules”

6:00-6:30 Contributed talk: **R. J. Martins**

Title: “MHz-Metasurface beam deflection for LiDAR”

6:30-7:00 Editorial talk: « Nanophotonics » , **D. Couwenberg**



Title: ""

**21h retransmission de France/Allemagne**

## Characterization, fabrication techniques and emerging materials for Metasurfaces

### Wednesday June 16 Morning session: **Materials for Metasurfaces**

8:30 Breakfast

9:00-10:00 time slot available for COVID PCR test for people travelling outside of France

10:30-11:30am Didactic/general audience presentation: **S. Cuff**

Title: "Phase-Change-materials for Metasurfaces"

11:30-12h00 Contributed talk: **D. Gerard**

Title: "Self-similar aluminum nanostructures for metasurfaces"

12:30-13h00 Contributed talk: **C. Turbil**

Title: "Nanoimprinting technology for large-area metasurface replication"

### Wednesday June 16 Afternoon/evening session: **New functionalities and applications of Metasurfaces: Imaging and optical characterization**

4:00 Coffee break

4:15-5:00pm Didactic/general audience presentation: **Isabelle Staude** (online)

Title: "All-Dielectric metasurfaces"

5:00-5:30 Contributed talk: **H. S. Nguyen**

Title: "Magic configurations in Moiré Superlattice of Bilayer photonic metasurface: Flatbands and Localization"

5:30-6:00 Contributed talk: **L. Berguiga**

Title: "Phase Change Materials in thin films for light modulation and sensor applications"

6:00-6:30 Contributed talk: **Howard Lee** (online, confirmed)

Title: "ENZ materials and related applications"

6:30-7:00 Contributed talk: **S. Khadir**

Title: "Quantitative phase imaging of scalar and vectorial metasurfaces"



7h30- Gala Dinner

## Nonlinear, tunable Metasurfaces and applications

### Thursday June 17 Morning session: **New Metasurfaces in the nonlinear regime**

8:30 Breakfast

9:00-9:15 Announcement by the students of their “Young research forum” afternoon program + 2mn teasing of student presentations

9:15-10:00am Didactic/general audience presentation: **R. Grange**

Title: “Bottom-up and top-down nonlinear and electro-optic metasurfaces”

10:00-10h30 Contributed talk: **De Angelis C.**

Title: “Harmonic generation at the nanoscale: efficiency and tunability”

10:30 Coffee break

10:45-11h15 Contributed talk: **G. Leo**

Title: “Harmonic generation at the nanoscale: direction and wavefront control”

11:15-11:45 Contributed talk: **E. Mikheeva**

Title: “Photosensitive chalcogenide metasurfaces”

11:45-12:15 Contributed talk: **T. Ellenbogen** (Online, confirmed)

Title: “”

12:15-12:45 Contributed talk: Anne-Laure **Fehrembach**,

Title: “SHG with metasurfaces”

### **Afternoon Poster session**

Thursday June 17 Afternoon/evening session: **Young research forum:** The students will be charged to organize this afternoon session. The students will be preparing the program among themselves during a training session on Wed. Afternoon. The official program of the “young researcher forum” will be announced on Thursday Morning during the morning opening session.

4:00 Coffee

4:15-7:00 students presentations and discussions



## Perspectives

### Friday June 18 Morning session:

8:30 Breakfast

9:00-10:00am contributed talk: **Junsuk Rho** (Online, confirmed).

10:00-10h30 Contributed talk: “tour de table” discussions

10h30-10h45 outstanding poster award celebration

11:00-12h00 Contributed talk: **Y. Kivshar** (online, confirmed)

12:00-12h30: “tour de table” and wrap-up. Students will also have the occasion to share their thoughts, vision and perspectives on the field of metasurfaces.