Perfil (FD) Codi projecte: PID2023-148620NB-I00

El projecte amb codi **PID2023-148620NB-I00** (finançat per l'Agència Estatal d'Investigació) del Departament Departament de Física de la Universitat Politècnica de Catalunya (UPC) convoca la sol·licitud d'un doctorand en el projecte anomenat: **Incremento de las interacciones no lineales en metasuperficies ópticas (Enhancement of nonlinear interactions in optical metasurfaces)**.

Descripció del lloc de Treball / Description of the working place

The research activity will be carried out in the Nonlinear Optics and Lasers Laboratory of the Nonlinear Dynamics, Nonlinear Optics and Lasers (DONLL) research group at UPC in the fields of nonlinear optics and nanophotonics, assuring good motivation to pursue a future scientific career.
The PhD fellow will register within the Computational and Applied Physics PhD Program, Doctorate School of UPC.
The student will work on the design and measurement of novel nanophotonic structures performing a combination of theoretical and experimental tasks: develop numerical simulations, set new experimental set-ups and experimentally proving the optical properties of the nanostructures. Occasionally he/she could participate in the sample fabrication through short stays in our collaborator's labs.

The working plan and academic training of the student will be organized in the following stages:

- Bibliographic study of the state-of-the-art literature (articles, books, reviews...);
- Leading the advance of the assigned tasks in close collaboration with the research team, combining theoretical and experimental aspects of the project;
- Actively participate in the DONLL group meetings, presenting and discussing the results with the other members of the group. The broad scientific interests of the group will help the student to enlarge his/her scientific horizon, improving his/her motivation, training and knowledge.
- Attend and disseminate the results in international and national conferences.
- Write articles for publication in international high-impact peer-reviewed journals;
- Attend seminars organized by the main Universities and research institutes in the Barcelona area, specialized seminars on transverse skills: how to write papers or projects, oral presentation and International Summer Schools in the fields of interest of the student.
- Short research stays in our collaborator groups and institutions.
- Learn how to use our extended collaborations to start his/her own research network.
- Continuous evaluation of the research stage by the supervisors and also by the doctorate program through the presentation of the research plan.
- The Doctoral School offers many training activities to introduce students to research, safety workshops, scientific writing workshops, networking, etc.
- Write and present his/her PhD thesis after approximately four years.

Perfil candidat/a / Candidate profile

- Bachelor's and Master's degree in physics, physical engineering, photonics, electrical and/or electronic engineering, other related degrees.
- Knowledge of optics and photonics in general and of nonlinear optics in particular.
- Experience in experimental physics will be positively evaluated.
- Programing and computational skills.
- Fluent speaking and writing English level.

Breu descripció del projecte / Short description of the project

The study of the interaction of ultrashort laser pulses with nano-structured materials having geometrical features below the wavelength of light can find relevant applications in almost every aspect of modern Photonics. In particular, optical metasurfaces have recently emerged as a novel platform for studying nonlinear (NL) light-matter interaction at the nanoscale. The main purpose of this project is to search for new functionalities in this new field by postulating and experimentally demonstrating novel nano-patterned thin-layer metasurfaces capable to mold the flow of light in a way that provides field enhancement and localization. The linear and nonlinear mechanisms proposed for optical field enhancement include implementation of the phase-locked harmonic generation in opaque region of semiconductors, excitation of plasmonic waves in metals, topological

surface waves in dielectrics and the novel concept of time crystals or time refraction. In the latter case, one exploits sudden changes that occur nearly instantaneously in the background dielectric constant and generate new frequencies much more efficiently that classical nonlinearities. In brief, we aim to maximize and extend the potential impact of nonlinear metasurfaces to the development of new nanophotonic devices, such as multiple frequency generators, tunable emitters extended in the UV and optical sensors, advancing in two interconnected fields: nanomaterials and nonlinear optics.