MINISTERIO
DE ECONOMÍA
Y COMPETITIVIDAD

ICMAB
INSTITUT DE CIÈNCIA DE MATERIALS DE BARCELONA
EXCELENCIA SEVERO OCHOA
CSIC
CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS

EXPRESSION OF INTEREST FOR DOCTORAL PROGRAMME COFUND DOC-FAM

PROJECT TITLE / JOB POSITION TITLE:

Nanophotonic metasurfaces with enhanced functionality and topological properties

JOB POSITION DESCRIPTION:
(max. 2.000 characters – including spaces)
Include all the relevant information about the position, role and responsibilities required within the project/group

As described in the Research Project, the candidate will follow his/her PhD Thesis in the field of nanophotonics. To achieve the proposed scientific objectives, he/she will have access to all required laboratories, all located within ICMAB premises. In particular, he/she will access our optical laboratory, which includes high-resolution microscopy and angle-resolved spectroscopy in the near-IR-VIS range as well as appropriate equipment for studying optical response under applied electric and magnetic fields. The candidate will be tasked with defining nanophotonic devices with appropriate geometry with submicron length-scales using electron beam lithography and characterizing them in the ICMAB optical laboratory. He/she will carry out finite-difference time-domain (FDTD) simulations to further elucidate the light propagation in the nanophotonic devices. The supervisor of the project will provide all the necessary means for the successful candidate to attend schools and relevant international scientific meetings and workshops. The candidate will benefit also from training in the use of FDTD calculations to explore topologically nontrivial photonic crystal lattices. The candidate will also benefit from international collaborations across Europe.

RESEARCH PROJECT / RESEARCH GROUP DESCRIPTION:
(max. 2.000 characters – including spaces)

Over the last years our investigation on photonic and plasmonic crystals has revealed photonic / plasmon effects that increase the magneto-optic response [1-4]. Additionally, we have demonstrated the nonreciprocal propagation of plasmons in the presence of magnetic fields [4]. All this research is relevant to achieving unidirectional propagation of spatially confined electromagnetic waves, indispensable for the development of on-chip optical communications in photonic circuitry.

To further push the boundaries of the field of nanophotonics, we will pursue two distinct approaches that aim towards creating actively controllable nanophotonic devices: (i)

integration of electro- and magneto-optic materials into nanophotonic metasurfaces to enable using electric (magnetic) fields to control confined electromagnetic waves; (ii) special topologies designed in the wavevector space that enable helical edge propagation of modes that flow unimpeded by imperfections or back-reflections. The latter are akin to quantum spin Hall in fermionic systems, which have been demonstrated in honeycomb photonic dielectric lattices. The candidate will use primarily these tools: (i) Finite-difference time-domain simulations to design metasurfaces and topological photonic crystals; (ii) Angle-resolved reflectance/transmission spectroscopy, which can resolve reciprocal space maps from near-IR to violet, with scanning beam sizes down to few microns. Particularly, beyond the more common real space imaging, this methodology will enable the direct visualization of helical edge states and Dirac cones in the photonic crystal band structure. The student will be supervised by Dr. Gervasi Herranz, whose activity can be reached through the Researcher ID: G-2770-2014.

[1] JM. Caicedo et al., ACS Nano, 2011.
[2] Rubio-Roy et al., Langmuir 2012.
[3] Vlasin et al., Physical Review Applied 2014.
[4] R. Cichelero et al., to be submitted soon.

ACADEMIC BACKGROUND / SKILLS:
(max. 1.000 characters – including spaces)
Include all the relevant information about the expected academic requirements and skills required for the position

Candidates should be fluent in English, both spoken and written, with a strong background in solid state physics and optics. Programming and mathematical skills will be particularly appreciated. A curious, enquiring spirit and enthusiasm for Science are more than welcome.

GROUP LEADER:

Title: Dr.
Full name: Gervasi Herranz
Email: gherranz@icmab.cat
Research project / Research Group website: http://departments.icmab.es/mulfox/

RELATED LINKS TO THE POSITION (optional)
URL: https://gervasi-herranz.blog

Title link: