The Nanoscience Cooperative Research Center, CIC nanoGUNE, located in Donostia / San Sebastian, Basque Country (Spain), is currently looking for a

MASTER STUDENT

to work on

Nonlinear Optical Properties of Magnetic 2D van der Waals and Topological Materials for Next-Generation Quantum Technologies

NanoGUNE is a research center devoted to conducting world-class nanoscience research for a competitive growth of the Basque Country. NanoGUNE is a member of the Basque Research and Technology Alliance (BRTA) and is recognized by the Spanish Research Agency as a María de Maeztu Unit of Excellence.

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The charge and spin response of matter under light illumination holds great promise for next-generation energy-efficient quantum optoelectronic and optospintronic devices, as well as for quantum technological applications like quantum and neuromorphic computation.

In materials lacking bulk inversion symmetry, a DC current can be generated via a second-order nonlinear response, known as the bulk photovoltaic effect. A similar mechanism has been recently proposed for spin currents, where breaking time-reversal symmetry enables the generation of pure nonlinear spin currents without an accompanying charge flow. This project aims to explore charge and spin phototransport phenomena in two classes of materials: magnetic 2D van der Waals systems and 2D materials with topologically non-trivial phases. Both systems exhibit unique symmetry-breaking mechanisms and topological characteristics that make them ideal platforms for tuning their nonlinear optical response (intrinsic magnetism, interplay between bulk topology, quantum geometry and crystalline symmetries). Furthermore, we will explore whether the coexistence of magnetic order and non-trivial topology in certain materials can lead to synergistic effects, such as enhanced photocurrent generation or novel spin-charge separation mechanisms.

The **project** will employ a dual approach: 1) ab initio calculations using density functional theory and many-body perturbation theory to model electronic structures and nonlinear optical responses 2) Wannier-based tight-binding models and analytical methods to gain insights into the role of topological invariants and symmetry-breaking mechanisms. The master work can be continued as a Ph.D.

Candidates should **apply** by completing the **form below** and attaching the following documents:

a. A complete CV

b. A cover letter

The **deadline** for applications is **13/03/2025**.

NOTES:

(i) All applicants will receive an answer after the end of the selection process; but please note that due to the large number of submissions that are expected, we cannot provide individual feedback.
(ii) Additional information about nanoGUNE's commitment towards HR excellence in Research and Gender Equality are available on our website.
(iii) We encourage you to subscribe to our HR mailing list to receive information related to nanoGUNE's open positions and open calls for different training and talent attraction programs.