Donostia International Physics Center

DIPC POST-DOCTORAL POSITIONS

The Donostia International Physics Center DIPC is currently accepting applications for post-doctoral appointments. This is a unique opportunity for highly motivated junior researchers with a recent PhD degree in physics or related fields to join some of the DIPC high-profile research teams.

Interested candidates please send an updated CV, a brief statement of interest, and contact information to postdoc@dipc.org. Reference letters are welcome but not indispensable. The particular position(s) to which the candidate is applying should be stated as well. Although candidates are encouraged to contact the project supervisors to know further details about the proposed research activity, please be aware that the application will be evaluated only if it is submitted directly to the email address mentioned above (postdoc@dipc.org).

Next review of applications is scheduled for July 20th 2018. Applications must be received before this date and will be evaluated by a Committee designed by the DIPC board on the basis of the following criteria (with point weights indicated in parentheses):

- CV of the candidate (40%)
- Adequacy of the candidate's scientific background to the project (40%)
- Reference letters (10%)
- Others: Diversity in gender, race, nationality, etc. (10%)

Evaluation results will be communicated to the candidates soon after. Positions will only be filled if qualified candidates are found.

The DIPC could revoke its decision in case the candidate breaches the condition of joining before the deadline indicated in this call, proceeding in that case to grant the position to the next candidate based on the classification order, and provided that he has obtained a score higher than 50 (out of 100) in the evaluation of his candidature.

However, the selected candidate may keep the position if, in the opinion of the Evaluation Committee, he duly justifies the reasons why he can't join before the specified deadline, and as long as the project allows it.

The duration of the appointment will be 1 year. The appointment could be renewed for a second year, subject to performance and to the availability of funding.

The salary will be 32000 euros per year before taxes.

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JOB OPENINGS

- Spectral and transport properties of pseudo-spin one systems

Supervisor: Dario Bercioux (dario.bercioux@dipc.org). Reference: 2018/17.

We are looking for a postdoc to theoretically investigate the spectral and transport properties of pseudo-spin one systems. We aim to investigate this type of systems in several contests: both at the level of the low-energy approximation as well as at the lattice level, *e.g.*, looking at the properties of the Lieb and dice lattices. We will focus both on electronic systems and also on photonic ones showing a similar physics. Also, we will consider effects of spin-orbit interaction and orbital magnetic fields.

Researchers with a strong background in Dirac physics, excellent communication skills and good command of English are ideal candidates. We are looking for a highly motivated candidate, ready to travel for meeting with our collaborators in London and Utrecht.

- Tensor network methods for quantum many-body systems

Supervisor: Roman Orus (roman.orus@uni-mainz.de). Reference: 2018/18.

Tensor network states and methods have become a reference tool to understand many of the properties of quantum many-body systems, both at the analytical and the numerical level. In recent years, it has also become clear that they are the correct language to understand many of the key properties of matter such as topological order, gauge symmetries, and more. Furthermore, they are also at the core of new numerical simulation algorithms for quantum matter.

We are looking for a postdoc with broad expertise in computational physics (ideally Matlab, Python and/or C++), as well as in tensor network states and methods, both at the analytical and the programming levels. The ideal candidate should also have a background in quantum many-body entanglement, quantum information, and condensed matter physics. This includes key topics on strongly correlated systems such as topological order, quantum criticality, conformal field theory, low-dimensional magnetism, frustrated spin systems, and a perspective on different numerical approaches.

The goal of this project will be the numerical development of tensor network numerical methods for a variety of situations, focusing on higher-dimensional systems in the thermodynamic limit using infinite Projected Entangled Pair States (iPEPS). In particular, we will implement new numerical strategies for iPEPS algorithms, as well as use them in the simulation of frustrated quantum antiferromagnets, lattice gauge theories and open quantum systems.

- *Plasmon-based colorimetric biosensors for liquid biopsy*

Supervisor: Marek Grzelczak (colsyschem@gmail.com, https://colsyschem.github.io).
Reference: 2018/19.

Plasmonic nanomaterials have potential to become an active component in point-of-care devices for the efficient discrimination of cancer biomarkers in physiological media (liquid biopsy). Especially attractive are noble metal nanoparticles that can transduce the presence of chemical mutation into an optical signal. Within the context of the development of plasmon-based biosensors for liquid biopsy, Colloidal Systems Chemistry group at Donostia International Physics Center has an opening for a postdoctoral position. We look for the candidate possessing the Ph.D. degree in Chemistry. Demonstrated experience in biosensing, design DNA sequences, computational simulations of DNA structures, synthesis and chemical manipulation of metal nanoparticles are requested. The successful candidate will join highly interdisciplinary environment covering academics and industrial partners. Thus, the candidate should demonstrate excellent communication skills and the ability to keep industry-standard records and data analysis. Programming skills in Python would be an advantage.

- Transport properties of nanoporous graphene

Supervisor: Aran Garcia-Lekue (wmbgalea@ehu.eus). Reference: 2018/19.

Recently, the successful synthesis of a new multifunctional material has been reported, which is composed of a graphene membrane with pores whose size, shape and density can be tuned with atomic precision at the nanoscale. This material, whose electronic and conductance properties have been simulated at the DIPC, exhibits several unique properties. On one hand, its semiconductor character opens the door to its application in electronic devices. On the other hand, it can act as a highly-selective molecular sieve.

Within this project, we plan to further investigate the properties of this new 2D material. In particular, the tuning of its electronic and transport properties depending on the size, shape and chemical composition of the pores will be analyzed. Our results will be used to propose practical routes to optimize the characteristics of nanoporous graphene. This project will benefit from our close collaboration with various experimental research groups.

- Simulation of Photoactivation processes to activate Platinum prodrugs

Supervisor: Xabier López (xabier.lopez@ehu.es). Reference: 2018/24.

Phototherapy, in which a photon activates a prodrug to be transformed in toxic cis-platin, has become an important strategy in cancer therapy. Theoretical simulations can help in elucidating the mechanism of photoreduction of platin complexes, a necessary step for the activation of the prodrug. In the present project, several theoretical methods will be used to study the excited states of Pt complexes in conjunction with riboflavins in various environments: gas-phase, solvent and in NOX protein. Several methods will be used for this purpose: QM, QM/MM, classical MD simulations and continuum solvation models.

- Dark Matter Theory and Predictions

Supervisor: Tom Broadhurst (xabier.lopez@ehu.es). Reference: 2018/27.

The candidate is expected to develop further the leading interpretations for Universal dark matter and relic neutrinos by comparison forefront data that we have direct access to, including Hubble and JWST Space Telescope images of strong lensing clusters, the J-PAS wide field imaging survey (Teruel/Javalhambre) and deep imaging and spectroscopy from the GTC telescope on La Palma and preparations for the EUCLID satellite mission.

This work will benefit from predictions that can be inferred from pioneering cosmological simulations of Bose-Condensate dark matter and also the state-of-the-art MXXL/CDM simulations of Dr Raul Angulo at DIPC on tests of large scale structure and the influence of the relic neutrino contribution on JPAS cluster counts and clustering in collaboration with Dr. Silvia Bonoli at the DIPC.

- Current-induced vibrational instabilities in GNR-based nanogaps

Supervisor: Andres Arnau (andres.arnau@ehu.eus). Reference: 2018/28.

Current-induced heating of molecular junctions driven out of equilibrium can promote bond breaking or conformational changes. Although the reaction yield is typically low, recent theoretical works have demonstrated that, under certain conditions, tunneling electrons can induce an extremely effective excitation of specific vibrational modes, a situation known as vibrational instabilities. In this project we will explore by means of first-principles calculations based on density functional theory (DFT) and nonequilibrium Green's function technique the possibility to use current-driven vibrational instabilities for the controllable dissociation of small molecules of particular interest in catalysis or molecular energy storage. Preliminary calculations have shown that molecular junctions formed by parallel graphene nanoribbons (GNR) separated by a vacuum gap represent a particularly interesting system, we will therefore focus on this kind of junctions.

The candidate should have experience in high performance computing using ab-initio methods for electronic structure calculations, as well as elastic and inelastic transport.