

Oferta de Proyecto de Tesis ***(vigente durante el año natural 2024)***

Título orientativo de la Tesis Doctoral

Fluctuation Induced interactions in Superfluids.

Área de Conocimiento* / Línea de Investigación

Ciencias

Resumen de la Tesis Doctoral (máximo 300 palabras)

In this PhD Thesis we will explore and model the interaction of a macroscopic object with a superfluid and compare the theoretical results obtained with an experimental system developed by our group.

An object immersed in a superfluid interacts with at least 3 different continuous physical fields: the electromagnetic field, the velocity field of the superfluid, and the phononic (elasticity) field. Each of the 3 continuous physical fields is subject to fluctuations (quantum thermal for the electromagnetic and phonon fields, and internal in the case of the superfluid velocity field), therefore, these fluctuations can induce a transfer of momentum (Casimir effect) and of energy (heat transfer) between the probe and each one of the continuous fields with which it interacts, both when the probe is at rest with respect to the superfluid and in relative motion.

In this thesis, the PhD student will model and calculate the interactions mediated by fluctuations between the object and the superfluid: heat transfer, momentum transfer (Casimir effect) and quantum friction.

To do this, the PhD student will adapt the theory of the Casimir effect and electromagnetic quantum friction to calculate analytically and numerically the different cases relevant to this study.

¿Está asociado el desarrollo de esta tesis a la ejecución de algún proyecto de investigación? En caso afirmativo, proporcione detalles del proyecto (título, entidad financiadora y plazo de ejecución)

Project title: New quantum probe for the study of superfluids and turbulence - NAUTILUS (PID2022-139524NB-I00).

Funding entity Agencia Estatal de Investigación del Ministerio de Ciencia e Innovación (Spain).

Execution Period: 3 years, from September 1, 2023, to August 31, 2026.

Perfil Académico del Estudiante (máximo 200 palabras)

We are looking for a research and curiosity driven STEM career student with knowledge of Physics, Numerical Calculus and Mathematics, who has interest and curiosity in superfluids and quantum physics. Therefore, students of Physics, Mathematics, Computer Science, Chemistry, and related engineering careers are encouraged to apply for this PhD thesis.

In this PhD thesis we will work on models of Quantum Physics and Fluids, on which the theory will be built, and the results will be calculated. This PhD thesis is an excellent opportunity to learn and use concepts from Physics (Continuum Mechanics, Quantum Physics, Fluid Mechanics, Superfluids and Thermodynamics), Mathematics (Stochastic Calculus, Spectral Theory, Scattering and Variational Calculus) and Programming (Numerical Calculus, Simulations, use of clusters) among others.

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