PhD Opportunity: Quantum Nanophotonics for Next-Generation Quantum Technologies

Donostia International Physics Center (DIPC), San Sebastián, Spain
Fully Funded | **Start Date**: Late 2025 – October 2026

The **Theory of Nanophotonics Group** at the Donostia International Physics Center (DIPC) in **San Sebastián (Spain)** offers a **fully funded PhD position** to explore how light-matter interactions at the nanoscale can push the boundaries of **nanophotonic-based quantum technologies**.

This position offers a unique opportunity to dive deep into the theory behind quantum nanophotonic platforms, working in a world-class research environment, and developing realistic models that connect directly with experimental efforts.

Project Overview

The PhD will focus on the theoretical study of **nanoscale photon–matter interactions**, especially the coupling between quantum emitters (such as organic molecules or quantum dots) and their interaction with optical nanoresonators in **advanced quantum nanophotonic architectures.**

These hybrid systems are crucial for generating and manipulating non-classical light, entangled states, and other resources for quantum technologies and molecular spectroscopy. The candidate will employ and develop **cavity quantum electrodynamics (c-QED) models**, enriched when needed by:

- First-principles calculations of excitonic and vibrational responses to feed c-QED Hamiltonians.
- Classical simulations of nano-optical structures to obtain the nanoresonator properties.

The generated states will be characterized through analysis of properties such as quantum correlations (color-blind and frequency-resolved), entanglement, and purity. The ultimate goal is to build increasingly realistic and predictive **theoretical models** of light-matter interactions at the nanoscale to **support and guide experimental research** in rapidly evolving fields such as **molecular quantum optomechanics or nanophotonic-enhanced entangled photon generation**.

The group

The thesis will be supervised by **Javier Aizpurua and Ruben Esteban** in the **Theory of Nanophotonics Group**, which is based at DIPC and the Centro de Física de Materiales (CFM) **in San Sebastián**. The group has pioneered studies of quantum effects in nanoscale optical systems, with current interest in the use of nanophotonics for quantum technologies, field-enhanced spectroscopy, and microscopy.

Google Scholar Profile of Javier Aizpurua

Group Website

Why This PhD?

- Cutting-edge science at the **interface of quantum optics and nanophotonics engineering**
- Work closely with leading international collaborators (both theoretical and experimental)
- Live and work in San Sebastián, one of Europe's most beautiful and livable cities
- Be part of the "**Basque Quantum**" (BasQ) ecosystem, which includes top research centers and the upcoming IBM "System Two" Quantum Computer

What We're Looking For

We're seeking a motivated and curious candidate with:

- A **Master's degree** (or equivalent) in Physics, Materials Science, Electrical Engineering, or a related field
- Background in **quantum optics, cavity QED, or quantum optomechanics** (highly valued)
- Interest or experience in nanophotonics, molecular spectroscopy or computational modeling (appreciated)
- Initiative to participate actively in ongoing collaborations with leading international theoretical and experimental groups.

To Apply

Please send to ruben.esteban@ehu.eus with subject line: "PhD Quantum Nanophotonics":

- **Cover letter** (max. 1 page) explaining your interests and motivation
- **Curriculum Vitae**, including academic transcript
- **Reference letter(s)**

First screening deadline: 15th October 2025 (Applications accepted until the position is filled.)