PhD Position

Tailoring Quantum and Classical Light emission of Nanographenes by coupling to Optical Microresonators

The **PHOTO^{2}N** (https://photo2n.unipa.it/) research group at the Department of Physics and Chemistry of the University of Palermo, Italy, and the Quantum Optics group (https://quantum-optics.inrim.it) at the Istituto Nazionale di Ricerca Metrologica (INRIM) in Torino, Italy, jointly invite applications for a fully funded three-years PhD position in experimental nanophotonics, focused on the study of **quantum and classical emission properties of nanographenes coupled to optical microresonators.**

The Groups

The **PHOTO^{2}N** group at the University of Palermo investigates the fundamental optical properties of emerging nanomaterials using advanced spectroscopic techniques with time resolution ranging from steady-state to the femtosecond regime. The Quantum Optics group at INRIM has been working for 25 years on the study of the properties of quantum optical states and their application to quantum technologies, such as quantum communication, quantum metrology, quantum imaging and sensing.

Project Overview

The PhD student will spend approximately equal periods at the two institutions, gaining access to a broad range of state-of-the-art experimental techniques in nanophotonics. The project aims to **harness the coupling between nanographenes (NGs) and optical microresonators as an effective strategy to tailor their optical response down to the level of single-photon quantum emission**. NGs are an emerging class of carbon-based nanomaterials characterized by intense and tunable optical transitions, made possible by their exceptional atomic-level structural precision. They have recently attracted significant attention as efficient single-photon emitters with strong potential for next-generation quantum technologies. By integrating NGs with optical microresonators, the project seeks to **precisely engineer key emission characteristics — including brightness, spectral response, emission rate, and directionality** — paving the way toward a new generation of highly efficient and fully tailorable quantum light sources.

Research Activities

As a PhD candidate, you will:

- Assemble **NG-microresonator composites with variable architectures**, where NGs with a range of atomic structures are coupled to different types of microresonators.
- Carry out **fundamental optical characterization** of NGs and NG-resonator composites with a broad range of optical techniques, from steady-state spectroscopy to ultrafast femtosecond-resolved measurements.
- Carry out **single-molecule photoluminescence microscopy experiments** to study emission from individual NGs coupled to the microresonators.
- Conduct advanced **photon-correlation and antibunching measurements** to probe the quantum nature of the emitted light.
- Conduct experiments aimed at highlighting the influence of NG-microresonator interactions in **shaping the classical and quantum emission properties of the nanoemitters**.

Candidate Profile

We are looking for a highly motivated candidate with:

- A M.Sc. degree in Physics, Nanotechnology, Materials Science, or related fields.
- Strong interest in nanophotonics, optical spectroscopy, quantum optics.
- Background in optical spectroscopy and photophysics is a plus.
- Ability to work independently and collaboratively in an interdisciplinary research environment.
- Lots of enthusiasm!

Period: **2026 –2029**

For information and application, contact **fabrizio.messina@unipa.it**