PhD GRANTS 2023

PhD project title: **Turbulence in a fluid of light**

PhD Supervisor: **Alberto Amo**

PhD project summary (max. 20 lines):

Semiconductor microcavities are two-dimensional photonic structures with remarkable nonlinear properties. Their eigenstates are polaritons, half-light/half-matter quasiparticles with giant nonlinearities and they behave as a dense fluid of light. For instance, they show superfluid propagation [1]. With an external laser it is possible create and control the photon fluid properties, and to observe the nucleation of vortices, solitons and other turbulent phenomena.

The goal of this thesis is to experimentally investigate the turbulent properties of a fluid of light. Among other configurations, we will study the emergence of a turbulent flow of light when passing obstacles of different shapes engineered in the microcavity. In particular, **we will address the question of whether a plane can fly in a superfluid**. Indeed, the motion and lift of the wing of an airplane in air is intimately related to the generation of vortices. In a photon superfluid, not only friction is strongly reduced, but vortices have very special properties: their circulation is quantised, and it can only take some integer values. We will use cutting-edge time resolved spectroscopic techniques to observe the emergence of vortices and other turbulent phenomena generated by an obstacle with the form of a wing in a superfluid of light.

The project is part of the European ERC grant EmergenTopo recently awarded to Alberto Amo, and it will be developed in collaboration with the Center for Nanosciences and Nanotechnologies in Palaiseau (where the microcavities are fabricated) and with theory groups in UK and Italy. More information: http://honeypol.eu/.

[1] A. Amo et al., *Polariton Superfluids Reveal Quantum Hydrodynamic Solitons*, Science **332**, 1167 (2011).