Speaker: **Olesia DMYTRUK (Ecole Polytechnique, France)**

Title **Majorana bound states in Kitaev chains coupled to light**

Embedding quantum materials into photonic cavities provides a platform for the investigation of new phenomena induced by strong light-matter coupling. The Kitaev chain - a prototype model for Majorana bound states in topological superconductors - is a promising platform for realizing topological qubits. In this talk, I will discuss a finite-length Kitaev chain that hosts Majorana bound states coupled to photons and demonstrate that light could be used to probe and to engineer Majorana bound states.

Abstract: The many-body energy spectrum of the electron-photon Hamiltonian of the finite-length Kitaev chain coupled to light has two distinct types of ground states, one with a well-defined parity and another with an alternating parity. In the latter case, a doubly degenerate ground state is at parityswitching points. The photon number and the photonic field quadratures peak at values of the chemical potential corresponding to parity switching points revealing a property associated with the topological phase of the finite-length Kitaev chain Hamiltonian [1]. Furthermore, I will present a new way to realize Majorana bound states in an interacting two-site Kitaev chain with coupling to light. Adiabatic elimination of photons induces an effective electron-electroninteraction term and renormalizes other parameters in the Hamiltonian giving rise to isolated Majorana bound states. Moreover, I will show that the photonic propagator of the electron-photon Hamiltonian contains signatures of the ground state degeneracy between even and odd parity sectors [2].

[1] V. F. Becerra, O. Dmytruk, arXiv:2506.06237.

[2] Á. Gómez-León, M. Schirò, O. Dmytruk, Physical Review B 111 (15), 155410 (2025)