Offre de Thèse

Semiconductor Rydberg physics for nonlinear quantum optics

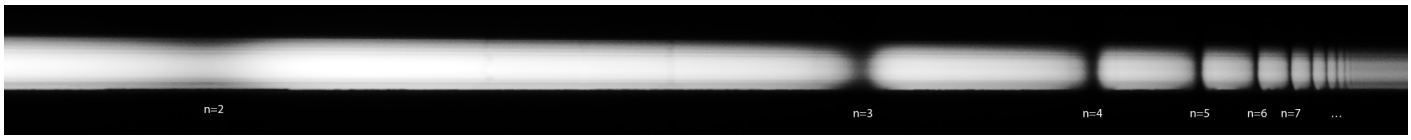

Fig 1 : Example of absorption spectrum of white light through a 50µm slab of Cu2O at 4K. Each absorption line is an excited excion level, showing the Rydberg series up to n>10. This rich level manifold is of great interest for coherent optical control, both in the visible and THz region.

The Nano-THz team at LPENS is starting a new experimental activity aimed at exploring exotic states (large orbitals, known as “Rydberg states”) of electron-hole pairs (excitons) in the wide-gap semiconductor Cu2O [1-2]. Rydberg states have remarkable properties such as mesoscopic wave functions and giant long-range interactions, which make them prime candidates for quantum technologies. Exploiting Rydberg excitons is an exciting new frontier that would have major advantages for integrated, nonlinear quantum optics.

The team possesses advanced laser systems ranging from visible light to terahertz (THz) radiation, in order to probe the excitonic Rydberg states with great precision and study inter-state coupling. We aim to use several spectrally narrow and strongly interacting Rydberg states to explore innovative multi-state optical manipulation protocols. To do so, we will combine visible and medium / far infrared (MIR / THz) light. During this thesis, the MIR and THz excitations will be set up and used along with the visible light for two-photon spectroscopy and coherent optical control experiments.

The candidate must have an experimentation-oriented profile with a solid fundamental physics background, and be fluent in at least French or English. A condensed matter and / or atomic physics specialty will be appreciated. Applicants should send a CV accompanied by a cover letter to the contacts below. A letter of recommendation will be a plus.

Location: Department of Physics of the École Normale Supérieure (LPENS), 24 rue Lhomond, Paris

Start: October at the earliest (a later starting date is possible within 2021)

Duration: 3 years

Funding source: ANR

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[1] T. Kazimierczuk, et al. "Giant Rydberg excitons in the copper oxide Cu2O." *Nature* 514.7522 (2014): 343-347.

[2] M. Aßmann, and M. Bayer. "Semiconductor Rydberg Physics." *Advanced Quantum Technologies* 3.11 (2020): 1900134.