CESQ Colloquium

Tuesday November 26 @ 3 PM

Seminar Room, Centre Européen de Sciences Quantiques, Campus de Cronenbourg

Angela Vasanelli and Carlo Sirtori

Ecole Normale Supérieure

Superradiance and ultra-strong coupling with quantum plasmons

Quantum plasmons arise from many-body excitations in semiconductor quantum wells, where Coulomb interaction ties together all the single electronic excitations and gives rise to a bright collective mode [1]. Their optical properties can thus be engineered by manipulating single-particle electronic states through artificial potentials [2].

In this seminar, we will show that quantum plasmons are a valuable platform to probe some of the most fundamental phenomena of quantum electrodynamics. Indeed, when they couple to a microcavity mode, the ultra-strong light-matter coupling regime [3] is achieved up to room temperature [4]. Furthermore, quantum plasmons have a superradiant behavior [5], characterized by a lifetime depending on 1/N, where N is the number of carriers involved in the interaction with light. This superradiant spontaneous emission becomes the dominant decay mechanism for excited carriers.

All these fundamental quantum effects have been investigated in optoelectronic devices and theoretically described through a full quantum model [6]. In this model, the confined plasmon states are constructed starting from the single electron wavefunctions, therefore the quantum properties of the electronic states are directly reflected in the collective response [7,8,9]. This approach opens the way towards the application of band engineering techniques for developing a new generation of semiconductor devices based on quantum plasmons, like cold emitters at thermal wavelengths.

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Contact: Jérôme Dubail (j.dubail@unistra.fr)

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Université de Strasbourg