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【11】Light-matter interaction @ nanoscale

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Light-matter interaction in condensed matter is a fascinating research field, at the intersection between physics and technology. Semiconductor quantum structures have played a very important role in this field and are a clear example of how fundamental physics and technology mutually enrich each other. The advent of epitaxial growth (bottom-up) has allowed the realization of 2-dimensional structures at the nanometer level, opening a wealth of new exploration in fundamental physics and producing highly performing technologies, such information and communication. The continuous progresses of these technologies have stretched the limit of fabrication processing (top-down) also to nanometer precision and today top-down and bottom-up techniques converge at the nanometer world. This allows the conception and realization of structures confining electrons and photons in the 3 dimensions of the space, which are ideal for engineering and exploring new quantum effects. Our interventions at the nanometer level can transform material global properties or produce individual quantum structures sensitive to single photons or single electrons.

This is the context of my research for the past 20 years, which I will briefly review during this presentation. Indeed, most of my carrier has been devoted to investigations of light-matter interaction in low-dimensional structures to conceive and realise high performance light emitters and detectors. I will begin by presenting our work on quantum cascade lasers, subsequently I will show how we got interested on ultra-strong light matter interaction in order to introduce new characteristic times in optoelectronic devices and I will conclude with our research on superradiance.

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