

Talk Prof. Darrick Chang, ICFO, Spain, 14. Aug. 2014

Title: Cold atoms coupled to photonic crystals: a platform for tunable long-range interactions

Abstract:

Significant efforts have been made to interface cold atoms with micro- and nano-photonic systems in recent years. Originally, it was envisioned that the migration to these systems from free-space atomic ensemble or macroscopic cavity QED experiments could dramatically improve figures of merit and facilitate scalability. However, a more interesting question is whether nanophotonic systems can yield intrinsically new capabilities to manipulate quantum light-matter interactions, which cannot be realized in their macroscopic counterparts even in principle.

Here, we describe an example of a fundamentally new possibility, involving the investigation of quantum systems with long-range interactions. In particular, we show that atoms trapped near photonic crystals can become dressed by localized photonic "clouds" of tunable size. This cloud behaves much like an external cavity, but one which follows the position of the atom. We describe how this dynamically induced cavity allows one to mediate and control long-range interactions between atoms, providing a powerful new tool for quantum simulation with cold atoms.