

# Joint CQSE and CASTS Seminar

Weekly Seminar  
Sep. 18, 2015 (Friday)

TIME Sep. 18, 2015, 14:30 ~ 15:30  
TITLE Superradiant cascade emissions in an atomic ensemble via four-wave mixing  
SPEAKER Dr. Hsiang-Hua Jen  
Institute of Physics, Academia Sinica  
PLACE Rm716, CCMS & New Physics Building, NTU

## Abstract

We investigate superradiant cascade emissions from an atomic ensemble driven by two-color classical fields. The correlated pair of photons (signal and idler) is generated by adiabatically driving the system with large-detuned light fields via four-wave mixing. The signal photon from the upper transition of the diamond-type atomic levels is followed by the idler one which can be superradiant due to light-induced dipole–dipole interactions. We then calculate the cooperative Lamb shift (CLS) of the idler photon, which is a cumulative effect of interaction energy. We study its dependence on a cylindrical geometry, a conventional setup in cold atom experiments, and estimate the maximum CLS which can be significant and observable.

The cascade atomic system provides a source for telecommunication bandwidth in its upper transition. This correlated photon pair can realize long-distance quantum communication enabling a low-loss quantum repeater in the DLCZ (Duan–Lukin–Cirac–Zoller) protocols. In addition, manipulating the CLS of cascade emissions enables frequency qubits that can provide alternative robust elements in quantum network.

