

Cooperativity in atom light interactions.

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In a cooperative process, such as superradiance, the interaction between light and individual atoms is modified by dipole-dipole interactions. The real part of the dipole-dipole interaction produces a shift in the atomic resonance known as the cooperative Lamb shift.

We present measurements of this shift in an atomic nanolayer. In addition we show that the high dipoles associated with transitions between Rydberg states can be used to switch the optical response of many neighbouring atoms giving rise to strongly enhanced optical non-linearities [Pritchard et al PRL 105, 193603 (2010)], allowing the creation and control of non-classical states of light.