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From superradiance to subradiance : exploring the many-body Dicke Ladder

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We are interested in the problem of light scattering by a dense ensemble of two-level atoms in a regime close to the Dicke regime, in which many atoms are trapped in a volume whose dimensions are smaller than the wavelength of the atomic transition. When the medium is dense and the frequency of the light is close to that of an atomic transition, the light-induced dipoles interact with each other. These resonant interactions between the dipoles modify the collective response of the ensemble. Here we report a time-resolved study of collective emission in dense ensembles of two-level atoms.

We compare, on the same sample, the build-up of superradiance and subradiance from the ensemble when driven by a strong laser. This allows us to measure the dynamics of the population of superradiant and subradiant states as a function of time. We demonstrate the buildup in time of subradiant states through the superradiant dynamics. This illustrates the dynamics of the many-body density matrix of superradiant ensembles of two-level atoms when departing from the ideal conditions of Dicke superradiance in which symmetry forbids the population of subradiant states.

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