Towards a sub-wavelength array of single dysprosium atoms for the study of collective light-scattering phenomena.

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Systems of multiple two-level quantum emitters interacting through the dipole-dipole interaction and in the presence of dissipation give rise to interesting effects such as superradiance and subradiance [1]. These phenomena which respectively result in an enhancement and repression of the spontaneous emission rate, are of great interest for our understanding of ensembles of interacting atoms and also for their potential application in future quantum technologies [2]. In this work, we present an optical tweezers array platform which allows for the preparation of single ^{162}Dy atoms trapped in ordered arrays of optical tweezers with an interatomic spacing ranging from $1.5\,\mu$m to several micrometers [3, 4]. With such superwavelength arrays, first light-scattering experiments have already been performed, probing the collectiveness of this type of system [5], using a method we developed for single-shot state readout of individual atoms, relying on the rich level structure of Dy. We are currently implementing a magic lattice with tunable spacing, aimed at reaching distances shorter than transition wavelengths (down to 315 nm). In this regime we expect to observe strong collective effects and dissipation-induced correlations that we will resolve at the single atom level. This work paves the way towards a better understanding and control of collective light-scattering effects like superradiance and subradiance.

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