Rydberg blockade in arrays of optical tweezers

S. Ravets[1], D. Barredo[1], H. Labuhn[1], L. Beguin[1], A. Vernier[1], F. Nogrette[1], T. Lahaye[1], and A. Browaeys[1]

[1] *Laboratoire Charles Fabry, Institut d'Optique, CNRS, , Univ Paris Sud, 2 avenue Augustin Fresnel, 91127 Palaiseau cedex, France*

Presenting Author: sylvain.ravets@institutoptique.fr

Controlling individual neutral atoms in arrays of optical tweezers is a promising avenue for quantum science and technology [1–2]. Using a spatial light modulator (SLM), we demonstrate our ability to trap single atoms in arrays of up to 100 traps separated by a few microns with controllable geometry. Using a two-photon excitation scheme, we coherently excite systems of two or three atoms to Rydberg states. The interaction between Rydberg atoms results in the observation of a characteristic Rydberg blockade effect. When the single-atom Rabi frequency for excitation to the Rydberg state is comparable to the interaction, we observe a partial Rydberg blockade where the populations vary in time with different frequency components. Comparing the experimental measurements with a model based on the optical Bloch equations, we are able to extract the van der Waals energy [3]. We measure the evolution of the C6 coefficient for different quantum numbers, distances and angles between the atoms. Despite the anisotropy of the interaction measured between two atoms in a D state, we are able to demonstrate a perfect blockade in arrays of three atoms with linear and triangular configuration. This work extends the potentialities of our system to 2D geometries, ideal for quantum simulation of frustrated quantum magnetism with Rydberg atoms.

References

[1] E. Urban *et al.* Nat. Phys. **5** 110 (2009)
[2] A. Gaetan *et al.* Nat. Phys. **5** 115 (2009)
[3] L. Beguin *et al.* Phys. Rev. Lett. **110** 263201 (2013)