SFB/TRR 21 - Seminar

21. Oktober 2014, Tübingen

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Correlations of Rydberg excitations in optically-driven dissipative atomic ensembles

I will discuss resonant optical excitation of Rydberg states of atoms in the presence of relaxations. Atoms in high-lying Rydberg states strongly interact with each other via long-range potentials [1,2]. These interactions translate into the level shifts of multiple Rydberg excitations which are therefore strongly suppressed. Collection of atoms within a certain "blockade" volume can then accommodate at most a single Rydberg excitation [3,4]. Perhaps counterintuitively, dephasing of atomic polarization increases the steady-state excitation probability of such a Rydberg "superatom". Larger atomic ensembles can accommodate more Rydberg excitations which effectively repel each other. The Rydberg superatoms behave as soft spheres resulting in highly sub-Poissonian probability distribution of the number of excitations. In the finite size one- and two-dimensional systems, the boundary effects mediate quasi-crystallization of Rydberg excitations [5], while the density-density correlations exhibit damped spatial oscillations. Similarly to a single superatom, dephasing and larger atom density lead to stronger density-density correlations of Rydberg excitations [6].

[1] T.F. Gallagher, Rydberg Atoms (Cambridge University Press, Cambridge, 1994) [2] M. Saffman, T.G. Walker, K. Molmer, Rev. Mod. Phys. 82, 2313 (2010) [3] M.D. Lukin et al., Phys. Rev. Lett. 87, 037901 (2001) [4] Y.O. Dudin, L. Li, F. Bariani, and A. Kuzmich, Nature Phys. 8, 790 (2012) [5] P. Schauss et al., Nature 491, 87 (2012) [6] D. Petrosyan, J. Phys. B 46, 141001 (2013); Phys. Rev. A 88, 043431 (2013); Phys. Rev. A 87, 053414 (2013).

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