



FRONTIERS IN OPTICAL COHERENT AND ULTRAFAST SCIENCE

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A nugget from FOCUS:

Title: Förster resonance-induced dipole blockade in systems of few Rydberg atoms

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Neutral Rydberg atoms, or atoms in very high energy states, interact strongly over relatively large distances. These interactions lead to an effect called the “dipole blockade” where the energy levels of the collective atomic system are shifted from the energies they would have with no interactions. In this work we show that these energy level shifts result in narrowed distributions of the total number of Rydberg atoms created. We have utilized an applied electric field to control the strength of the interactions and the resultant narrowing of the excitation number distributions. This represents the first observation of the dipole blockade in systems with few (~ 15) excitations.

Much interest in the dipole blockade has stemmed from proposed applications in neutral atom quantum computation schemes. These schemes could one day result in computers that are able to perform certain tasks exponentially faster than current computers. Since the building blocks of such computers are groups of only a few atoms, it is necessary to have a technique which allows one to measure the effectiveness of the dipole blockade in systems with few Rydberg atoms. The technique we demonstrate here is ideally suited for such systems.

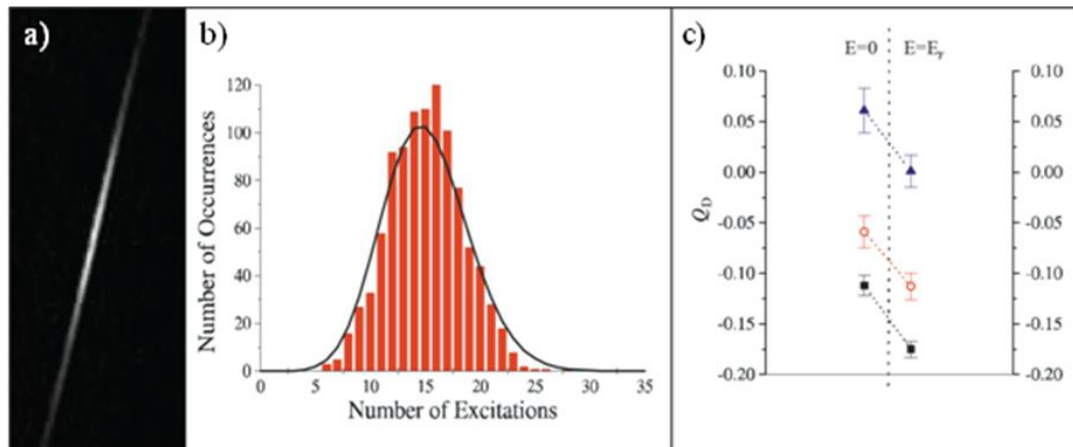


Figure: **a)** Image of trapped atoms **b)** Distribution of the number of $45D_{5/2}$ excitations along with a Poissonian of the same mean **c)** Mandel Q-parameter (or distribution width) of distributions of the number of $45D_{5/2}$ excitations for no applied electric field and a nonzero applied electric field (E_F) for high (triangles), medium (circles) and low (squares) atom densities. The distributions become narrower (lower Q) in an appropriate electric field because of the effect of the dipole blockade.