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Creation and characterization of a Rydberg excited superatom TOBIAS WEBER, THOMAS NIEDERPRÜM, TORSTEN MANTHEY, OLIVER THOMAS, VERA GUARRERA, GIOVANNI BARONTINI, MICHAEL FLEISCHHAUER, HERWIG OTT, Technische Universität Kaiserslautern — We have prepared and studied a single superatom consisting of a mesoscopic ultracold atomic sample with several hundred atoms. The sample is excited to a collective Rydberg state and probed by photoionization. For resonant excitation the created blockade results in an anti-bunched ion emission. We determine an effective blockade radius and demonstrate the saturation of the superatom. The rich internal level structure of the superatom can be further exploited to create multiple excitations for an off-resonant driving. The resulting ion signal shows strong bunching with record values up to $g^{(2)}(t = 0) = 60$. Varying the coupling strength and the detuning, we observe a significant change in the excitation dynamics indicating a transition between a regime of saturated single and fluctuating pair excitations. Our experiment represents the first realization of an isolated superatom and opens new possibilities for quantum optical experiments with Rydberg blockaded samples.

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