Abstract Submitted
for the DAMOP19 Meeting of
The American Physical Society

Rydberg blockade induced by a single ion TILMAN PFAU, FELIX ENGEL, THOMAS DIETERLE, CHRISTIAN TOMSCHITZ, CHRISTIAN VEIT, NIKOLAS ZUBER, THOMAS SCHMID, ROBERT LW, FLORIAN MEINERT, 5. Physikalisches Institut and Center for Integrated Quantum Science and Technology, Universitt Stuttgart, Pfaffenwaldring 57, 70569 Stuttgart, Germa — Ultracold Rydberg atoms with their strong mutual interactions provide an interesting platform for e.g. quantum simulation or quantum information exploiting the so-called Rydberg blockade. A similar concept applies to hybrid systems of Rydberg atoms and ions leading to single charge-induced blockade phenomena over macroscopic distances. We demonstrate the excitation blockade of a single Rydberg atom by a single low-energy ion. The ion is produced from a single Rydberg excitation in an ultracold sample exploiting a novel optical two-photon ionization scheme, especially suited for the creation of very low-energy ions. We precisely control the ion's motion by applying small electric fields to analyze the blockade mechanism for a range of principal quantum numbers. Finally, we demonstrate the applicability of the ion as a high-sensitivity single-atom based electric field sensor. We use this method to determine the mobility of a cold ionic charge in a BEC. Our method may in the future also be used for controlling cold collisions, chemistry or charge mobilities in ion-atom mixtures. [1] Engel, F., Dieterle, T., Schmid, T., Tomschitz, C., Veit, C., Zuber, N., Low, R., Pfau, T., Meinert, F.: Observation of Rydberg Blockade Induced by a Single Ion. Phys. Rev. Lett. 121, 193401 (2018).

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Date submitted: 29 Jan 2019 Electronic form version 1.4