## Abstract Submitted for the DAMOP15 Meeting of The American Physical Society

Ultracold chemistry of a single Rydberg atom in a BEC TARA CUBEL LIEBISCH, MICHAEL SCHLAGMUELLER, KARL MAGNUS WESTPHAL, KATHRIN KLEINBACH, UDO HERMANN, HUAN NGUYEN, BOETTCHER, ROBERT LOEW, SEBASTIAN HOFFERBERTH, FABIAN TILMAN PFAU, Pi5 IQST University of Stuttgart, JESUS PEREZ-RIOS, CHRIS GREENE, Purdue University — A single Rydberg excitation in the high density and low temperature environment of a Bose-Einstein condensate (BEC) leads to a fascinating testbed of low-energy electron-neutral and ion-neutral scattering. For a Rydberg state with a principal quantum number of 100, there are thousands of ground-state atoms with which the Rydberg electron interacts. In a BEC the interparticle spacing is at approximately the same length scale as the Langevin impact parameter, making it possible to study the effect of ion-neutral collisions on time scales much faster than the Rydberg lifetime. Collisions between the Rydberg electron and the ground state atoms cause a mean field density shift of the Rydberg line. We present results on how this effect can be used to monitor phase transitions of the BEC and probe thin density shells of the BEC to monitor density-dependent, ultracold chemical reactions. We report on experimental findings, of Rydberg statechanging collisions on  $\mu$ s timescales, due to collisions of the Rydberg ionic core with neutral ground state atoms. We compare our findings to simulations based on classical trajectory calculations for the motion of the ionic core and neutral atoms, whereas the dynamics of the electron is treated quantum mechanically.

> Tara Liebisch Deutsche Physikalische Gesellschaft

Date submitted: 30 Jan 2015

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