Abstract Submitted for the DAMOP16 Meeting of The American Physical Society

Anomalous broadening in driven dissipative Rydberg systems THOMAS BOULIER, ELIZABETH GOLDSCHMIDT, ROGER BROWN, SILVIO KOLLER<sup>1</sup>, JEREMY YOUNG, ALEXEY GORSHKOV, STEVEN ROLSTON, JAMES PORTO, Joint Quantum Institute, National Institute of Standards and Technology and the University of Maryland — Due to their strong, long-range, coherently-controllable interactions, Rydberg atoms have been proposed as a basis for quantum information processing and simulation of many-body physics. Using the coherent dynamics of such highly excited atomic states, however, requires addressing challenges posed by the dense spectrum of Rydberg levels, the detrimental effects of spontaneous emission, and strong interactions. We report the observation of interaction-induced broadening of the two-photon 5s-18s Rydberg transition in ultracold 87Rb atoms, trapped in a 3D optical lattice. The measured linewidth increases by nearly two orders of magnitude with increasing atomic density and excitation strength, with corresponding suppression of resonant scattering and enhancement of off-resonant scattering. We attribute the increased linewidth to resonant dipoledipole interactions of 18s atoms with spontaneously created populations of nearby Rydberg p-states. This dephasing mechanism implies that the timescales available for the coherent addressing of such systems are dramatically shortened, hampering many recent proposals to use Rydberg-dressed atoms for quantum simulation.

<sup>1</sup>Now at Physikalisch-Technische Bundesanstalt

Thomas Boulier Univ of Maryland-College Park

Date submitted: 28 Jan 2016

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