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Investigation of short-time many-body dynamics in multilevel Rydberg systems. CARLOS BRACAMONTES, JEREMY YOUNG, ELIZABETH GOLDSCHMIDT, THOMAS BOULIER, ALEXEY GORSHKOV, STEVE ROLSTON, JAMES PORTO, Joint Quantum Institute — We present follow-up work to previous results in which we observe anomalous broadening in a driven-dissipative system of Rydberg atoms. We address rubidium atoms in a 3D optical lattice on 5s-18s transition and see substantial broadening of this line with increasing excitation strength and atomic density. We attribute the broadening mechanism to dipole-dipole interactions with spontaneously populated nearby Rydberg states. This mechanism implies complex dynamics at early times as the contaminant population is built up. A full microscopic model of this many-body multilevel system has proved elusive, but initial experiments to study these dynamics using single photon counting provided qualitative information that was consistent with simple theoretical estimates. We implement optical heterodyne detection for short probe pulses to study this dynamics in depth and gain further understanding of the system.

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