

## Many-body ionization in a frozen Rydberg gas

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In a dense gas of  $300 \mu\text{K}$   $^{85}\text{Rb}$  atoms of  $n \sim 50$  ionization occurs on a 100 ns timescale, far too fast to be explained by motion of the atoms or photoionization by 300 K blackbody radiation. Rapid ionization is accompanied by spectral broadening, with the spectrum becoming continuous at  $n = 88$  at a density of  $5 \times 10^{10} \text{cm}^{-3}$ . The atomic transitions broaden both smoothly and by the emergence of new features, which we attribute to multiple atom absorptions. We attribute the rapid ionization to a sequence of near resonant dipole-dipole transitions through virtual states in this intrinsically many-body system, culminating in ionization of some of the atoms.