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Dipole-Dipole Excitation and Ionization in a Frozen Rydberg Gas

PAUL TANNER, WENHUI LI, THOMAS GALLAGHER — In cold dense Rydberg atom samples, the dipole-dipole interaction strength is effectively resonant at the typical interatomic spacing in the sample, and the interaction has a $1/R^3$ dependence on interatomic spacing R. The dipole-dipole attraction leads to ionizing collisions of initially stationary atoms, which produces hot atoms and ions and initiates the evolution of initially cold samples of neutral Rydberg atoms into plasmas. More generally, the strong dipole-dipole forces lead to motion, which must be considered in proposed applications.

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