COOPERATIVE EFFECTS IN A RYDBERG GAS

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Rydberg-Rydberg transitions of Ca atoms are directly detected by chirped-pulse millimeter-wave spectroscopy with broadband, high-resolution spectra with accurate relative intensities. At moderate high number density, the radiation of a Rydberg gas behaves as strong cooperative effects. Compared to a rotational transition, Rydberg-Rydberg transitions have enormous electric dipole transition moments and polarizabilities, which are sensitive to external and self-induced electric fields. In a dense Rydberg gas, a large group of molecules can share an electric field, and absorb and radiate cooperatively. A model with semiclassical method describes several significant cooperative effects in the time-domain and frequency-domain in two-level systems and Λ-type three-level systems. Several experimental evidences which partly support this model will be discussed and a new experiment with buffer gas cooling technique will be proposed.