

Rydberg-induced optical nonlinearities from a cold atomic ensemble trapped inside a cavity

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We experimentally characterize the optical nonlinear response of a cold atomic medium placed inside an optical cavity, and excited to Rydberg states. The excitation to S and D Rydberg levels is carried out via a two-photon transition in an electromagnetically induced transparency configuration, with a weak (red) probe beam on the lower transition, and a strong (blue) coupling beam on the upper transition. The observed optical nonlinearities induced by S states for the probe beam can be explained using a semi-classical model with van der Waals' interactions. For the D states, it appears necessary to take into account a dynamical decay of Rydberg excitations into a long-lived dark state. We show that the measured nonlinearities can be explained by using a Rydberg bubble model with a dynamical decay.

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