Enhanced Rydberg-EIT spectra in thermal vapors

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Electromagnetically-induced-transparency (EIT) effect involving Rydberg states can dramatically enhance the optical nonlinearity due to the dipole blockade effect. An EIT spectroscopic measurement provides direct and nondissipative optical detections of dipole-dipole interactions among the atoms. The EIT spectral profile with a high contrast and a large signal-to-noise ratio has potential applications in Rydberg-relevant studies. Here, we report the systematic investigation of the Rydberg-EIT spectra with room-temperature ^{87}Rb atoms. The results show that the contrast of EIT peak as a function of the probe intensity is initially increased, reaches a maximum value and then decays gradually. The EIT contrast has 2 to 4-fold enhancement at the optimum probe intensity as compared with that at weak intensity. Qualitatively, such enhancement is irrelative to the laser polarization, the coupling intensity, the Rydberg S-state or D-state orbitals, and the principal quantum number n of Rydberg state. We provide a theoretical model to explain this phenomenon and clarify its underlying mechanism. Our study advances the knowledge for the Rydberg-EIT study in thermal vapors.

[1] B. H. Wu, Y. W. Chuang, Y. H. Chen, J. C. Yu, M. S. Chang, and I. A. Yu, Sci. Rep. **7**, 9726 (2017).