Cesium two-photon transitions with controlled field

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This study describes a pure TPT under a control field to create quantum interference and nonlinear enhancement phenomena [1]. Unlike most papers describing the two-color TPT with control field, the one-color TPT with control configuration yields more control in regards to quantum interference by a destructive coherence effect and enhancing nonlinear optical properties. A numerical simulation based on solving the steady state solution of density matrix can qualitatively fit the experimental data. A model of double-Lorentzian profile is used to fit the observed spectrum and give the information of the TPT (positive Lorentzian), inhibition effect (negative Lorentzian), and power dependence of linewidth and light shift. The control field is from a Cs D2 line transition which has relatively strong oscillator strength. From our previous study [2], controlling the Rabi frequency of Cs D2 line can either create EIT, or electromagnetically induced absorption (EIA), or destroy the coherence process.

The real-time optical switching was demonstrated as the florescence signal of cesium two-photon transitions (TPTs) with the control field. This work explored the optical phenomena of the TPTs and the coupled field sharing the common excited state and analyzed the change of TPT fluorescence spectra with field intensity. New frequency-stabilization scheme based on the atomic transitions between two atomic exited states was also realized here. The frequency of the control laser was locked using the derivation signal generated from a cascade-type electromagnetically induced transparency.

Reference:

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2. R. Y. Chang, Y. C. Lee, W. C. Fang, M. T. Lee, Z. S. He, B. C. Ke, and C. C. Tsai, “A narrow window of Rabi frequency for competition between electromagnetically induced transparency and Raman absorption,” J Opt Soc Am B **27**, 85-91 (2010).