Investigation of the high-contrast saturated-absorption spike observed in a cesium vapor cell under the dual-frequency regime

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Recently, the new bright feature of the saturated-absorption resonance under the two-frequency counterpropagating light waves has been observed [1] (see Fig.1). It consists in observation of a nonlinear resonance with very high contrast. In spite of this effect is becoming very useful tool for laser frequency stabilization in CPT atom clocks [2, 3], it has not been understood and studied well enough. Here we focus on the detailed experimental as well as theoretical study of the new effect. At least three physical reasons have been revealed that can result in observation of enhanced absorption at the center of the resonance. Moreover, simultaneous and constructive action of these reasons can greatly increase an amplitude of the nonlinear resonance, which can be two times bigger than a wide Doppler background. Theory is based on a well-known Λ-scheme of atomic energy levels. The scheme has provided us with very clear physical interpretation of the effect. The real structure of atomic energy levels with taking into account all magnetic sublevels has been also considered.

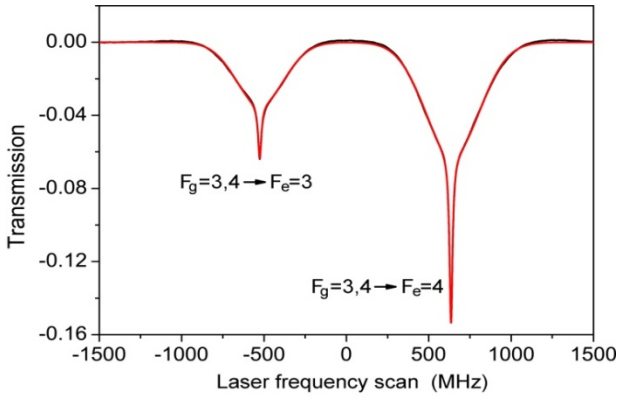

Figure 1. The high-contrast saturated-absorption resonances.

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