Selective Reflection on Rb D$_2$ Line Using Cell with the Thickness of Order of Light Wavelength

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Selective reflection (SR) of a resonant laser radiation from the interface of a cell window (dielectric) and atomic vapor is known to be an efficient tool for laser spectroscopy because of the ability to form Doppler-free spectra and high reflection coefficient [1]. A special Rb nano-cell (NC) with a large area of $L \sim \lambda/2$ and $\lambda/4$ ($\lambda = 780$ nm being the laser wavelength tuned to the $^{85}$Rb D$_2$ line) has been fabricated and implemented in these experiments in order to study SR spectra from a Rb vapor NC. In Fig. 1 the upper curve shows the SR spectrum for the thickness $L = \lambda/2 - 30$ nm = 360 nm, the middle curve labeled D shows the obtained in situ derivative on $^{85}$Rb $F_g = 3 \rightarrow F_e = 2',3',4'$ atomic transitions (see the diagram in the inset). The lower curve is the Saturation Absorption (SA) spectrum and is used as a reference.

The possible applications of SR are 1) magnetic-field controlled tunable locking of laser frequency to atomic resonance line [1], 2) 35 MHz-resonances can be served as a frequency references for Rb D$_2$ transitions, 3) in strong external magnetic fields these D-peaks resonances are strongly shifted [2], thus they can serve as a tunable frequency references for laser atomic spectroscopy.

The presented features of SR signal will also be observed in a nano-cells filled with vapor of other alkali metals (Cs, K, Na, etc.).

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References