# Generalized theory of magneto-optical resonances in a periodically modulated light field

Valeriy Yudin[1,2,3], Maxim Basalaev[1,2,3], Dmitriy Kovalenko[1,2], Alexey Taichenachev[1,2]

[1] Institute of Laser Physics SB RAS, Russia
[2] Novosibirsk State University, Russia
[3] Novosibirsk State Technical University, Russia

We develop a generalized theory of magneto-optical resonances (MOR), considering the resonant interaction of atoms with degenerate energy levels with elliptically polarized quasimonochromatic laser field in the presence of a static magnetic field. The laser field parameters (phase, frequency, polarization and amplitude) are periodically modulated at frequency $f$ scanned around Larmor frequency. The theory is formulated and numerical calculations are curried out quite generally based on our method [1], e.g. beyond perturbation theory, beyond Floquet theory, and without the use of Fourier series. Calculations are performed for various types of optical transitions $F_g \to F_e$ ($F_g, F_e$ are the total angular momenta in the ground and excited states) and for different models of relaxation (pure radiative relaxation as well as with account for depolarizing collisions). In particular, we show that in the case of harmonic frequency modulation $B\sin(ft)$ there exists an optimum of spectroscopy signal (e.g. light absorption in the medium) with respect to the modulation depth $B$. This optimum approximately corresponds to the halfwidth of optical transitions $\gamma_D$ (Doppler or collisional broadening). This work was supported by the Ministry Science and Higher Education of the Russian Federation (Grant No. 3.1326.2017/4.6), and the Russian Foundation for Basic Research (Grant Nos. 17-02-00570 and 18-02-00822).

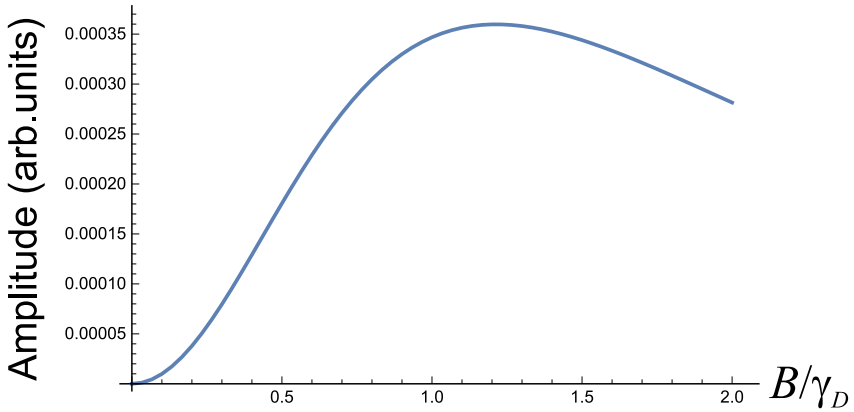


**Figure 1.** MOR amplitude versus modulation depth $B$ for $F_g = 1 \to F_e = 1$ transition.

[1] V.I. Yudin, A.V. Taichenachev, M.Yu. Basalaev, Dynamic steady-state of periodically-driven quantum systems, Phys. Rev. A **93**, 013820 (2016).