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Low magnetic fields behavior of photon echo in LuLiF4:Er3+

Lisin V., Samartsev V., Shegeda A., Zuikov V., Korableva S.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

It is reported about the first observation and studying of the photon echo in LuLiF4:Er3+. The energy transition is 4I15/2 → 4F9/ 2 (λ = 6536 Å). The density of ErF3 is 0.025 wt%. The operation temperature is 1.9 K. Measurements were spent at low (up to 1200 Oe) and even zero external magnetic fields. It was studied a behavior of the photon echo intensity versus the magnetic field mgnitude and direction about the crystal axis C and versus the laser pulse separation t12. It was observed an expotential growth and then, after some plateau, an exponential decreasing of the photon echo intensity as a function of magnetic field with increasing of the magnetic field from zero value. The parameters describing the exponential growth and decreasing are not depended on direction of magnetic field. Value of a magnetic field at which the echo intensity accepts the maximum, and quantity of this maximum decrease with increased the pulse sepatation t12 and the angle θ between the magnetic field and crystals axis. The echo intensity expotentially decreases with increased θ. The parameter describing the exponential decreasing is not depended on the magnitude of the field. The echo intensity as a function of pulse separation shows exponential decay. The phase relaxation time is depended on the magnitude and direction of the magnetic field. T2 is equal to 202±16 ns at zero magnetic field. Phenomenological formula is suggested, which qualitatively presents the mentioned dependencies. Polarization properties of the backward photon echo in this crystal are studied also. A graph is presented. Echo size versus magnetic field directed as along optic axis as at an angle of θ = 5° of different values of t12. The color symbols show experimental points. The solid curves were calculated using experession (1). The Y-scale is logarithmic.

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Keywords

Backward echo, Erbium ion, Low magnetic field, LuLiF4-crystal, Phase relaxation, Photon echo