Magic frequencies in atom-light interaction for precision probing of the density matrix

Y. Margalit, M. Givon, A. Waxman, T. David, D. Groswasser, Y. Japha, and R. Folman
Physics Department
Ben-Gurion University of the Negev
P.O. Box 653, Beer Sheva 84105, Israel
margalya@post.bgu.ac.il

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Abstract

We analyze theoretically and experimentally [1] the existence of a magic frequency for which the absorption of a linearly polarized light beam by a vapor of alkali-metal atoms is independent of the population distribution among the Zeeman sublevels and the angle between the beam and an external magnetic eld, which defines the quantization axis. From a fundamental point of view, the magic frequency represents a unique cancellation of the contributions of higher moments of the atomic density matrix to light absorption, so that light-matter interaction becomes rotationally invariant although the atomic sample as well as the light beam and its polarization all have a well-dened direction. The phenomenon is described using the Wigner-Eckart theorem and inherent properties of Clebsch-Gordan coefcients. One important application is the robust measurement of the hyperne population ρ_0^0. We experimentally demonstrate the magic frequency on an ensemble of rubidium atoms inside a vapor cell.
http://www.bgu.ac.il/atomchip/

Keywords: VAPOR, ALKALI, LIGHT-MATTER INTERACTION

References

[1] M. Givon, Y. Margalit, A. Waxman, T. David, D. Groswasser, Y. Japha, and R. Folman, Phys. Rev. Lett. **111**, 053004 (2013).
See also the APS synopsis.