Absolute and ratio measurements of the polarizability of Na, K, and Rb with an atom interferometer

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Abstract

We present absolute and ratio measurements of the ground state electric dipole polarizability of sodium, potassium, and rubidium using a Mach-Zehnder atom interferometer with an electric field gradient (Fig. 1). The uncertainty of each absolute measurement is less than 1.0% and the uncertainty of each ratio measurement is 0.3%. Our measurements (Table 1) serve as improved tests of atomic structure calculations. Please see arXiv:1001.3888 and `www.atomwave.org`

Keywords: polarizability, atom interferometry, sodium, potassium, rubidium

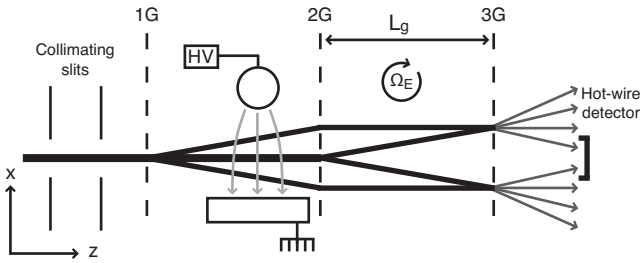

Figure 1: Nanogratings 1G, 2G, and 3G form multiple Mach-Zehnder interferometers (two are shown). An atom passing through the interaction region acquires a phase ϕ_1, ϕ_0, and ϕ_{-1} along each path. The third grating acts as a mask for the 100 nm period interference fringes. The distance between two gratings is $L_g = 940$ mm. The vertical (transverse) scale is exaggerated 10^4 times. The Earth rotation rate Ω_E modifies the measured phase shift.

Table 1: Measured absolute and recommended atomic polarizabilities in units of 10^{-24} cm^3. Recommended polarizability measurements are based on our ratio measurements and the sodium polarizability measurement from reference [1].

	$\alpha_{\rm abs}$(stat.)(sys.)	$\alpha_{\rm rec}$(tot.)
Na	24.11(2)(18)	24.11(8)
K	43.06(14)(33)	43.06(21)
Rb	47.24(12)(42)	47.24(21)

References

[1] C.R. Ekstrom, J. Schmiedmayer, M.S. Chapman, T.D. Hammond, and D.E. Pritchard, Phys. Rev. A **51**, 3883 (1995).