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Precise measurements of hyperfine structure and atomic polarizability in indium and thallium using two-color diode laser spectroscopy
MEVAN GUNAWARDENA, P.W. HESS, P.K. MAJUMDER, Williams College —
We are pursuing a series of precise atomic structure measurements in atomic thallium and indium designed to test new *ab initio* theory calculations in these three-valence-electron systems [Phys. Rev. A 74, 022504 (2006); Phys. Rev. A 76, 022501 (2007)]. For thallium, independent atomic theory calculations are essential for atomic tests of symmetry violation. In one experiment, using two-color laser excitation, the hyperfine constants of the $6P_{3/2}$ excited state of indium(I=9/2) have been measured for the first time. We excite ground-state atoms to the $6S_{1/2}$ state using a stabilized 410 nm diode laser system. A second laser beam at 1291 nm overlaps the blue beam in a heated indium vapor cell, driving Doppler-narrowed hyperfine transitions to the $6P_{3/2}$ excited state. By modulating the blue laser beam and using lock-in detection, we obtain background-free, low-noise IR spectra. Current statistical precision is at the MHz level, and preliminary results agree well with theory predictions for the hyperfine constants. Using a similar excitation scheme in our thallium atomic beam apparatus, we are undertaking to measure the Stark shift of the thallium 1301 nm $7S_{1/2}$- 7 $P_{1/2}$ transition by first driving the 378 nm $6P_{1/2}$ - $7S_{1/2}$ transition using a stabilized UV laser diode system.

Mevan Gunawardena
Williams College

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