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Measurement of the Variation of Electron-to-Proton Mass Ratio Using Ultracold Molecules Produced from Laser-Cooled Atoms

SHIN INOUYE, Osaka City University

A rovibrationally pure sample of ultracold KRb molecules was used to improve the measurement on the stability of electron-to-proton mass ratio ($\mu = \frac{m_e}{M_p}$). The measurement was based upon a large sensitivity coefficient of the molecular spectroscopy, which utilizes a transition between nearly degenerate pair of vibrational levels each associated with a different electronic potential. Observed limit on temporal variation of μ was $\frac{1}{\mu}\frac{d\mu}{dt} = (0.30 \pm 1.0) \times 10^{-14}$/year, which was better by a factor of five compared with the most stringent laboratory molecular limits to date. We also report our effort on trapping ultracold rovibrationally ground state molecules using a cavity-enhanced optical dipole trap.