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报告

不确定度为 2.2×10^{-17} 的钙离子光钟

$^{40}Ca^+$ Ion Optical Clock with Systematic Uncertainty at 2.2×10^{-17}

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高克林 研究员，博导。1982年1月毕业于华中理工大学物理系，1990年于中国科学技术大学获博士学位。曾先后在美国华盛顿大学物理系，香港科技大学，英国国家物理实验室，奥地利 Innsbruck 大学访问和合作研究。主要从事囚禁冷却离子光频标以及精密谱研究。2005年，被科技部聘为“973”计划“原子频标物理与技术基础”项目首席科学家；2011年被科技部聘为“973”计划“光频标关键物理问题与技术实现”项目首席科学家。

报告摘要 Abstract

We recently reported a $^{40}Ca^+$ optical clock with its fractional frequency uncertainty at 3.4×10^{-17}[1], limited by the BBR effect, the servo error, and the excess micromotion. Here we report the improvements made to reduce the systematic uncertainty at 2.2×10^{-17}, limited by the BBR field evaluation. The differential static scalar polarizability $\Delta\alpha_0$ of the $^{40}Ca^+$ ion clock transition is measured by precisely measuring the “magic” rf drive frequency, at which the micromotion-induced scalar Stark shift and 2nd order Doppler shift would cancel each other. Measurement of the trap drive frequency can be used to determine the differential scalar polarizability $\Delta\alpha_0$, which is a key parameter when calculating the blackbody radiation frequency shift. $\Delta\alpha_0$ is measured as $-7.2653(44)\times10^{40}$ Jm^2/V^2 , the blackbody radiation shift is then calculated to be 0.3790(2) Hz at 300 K. The contribution of the blackbody shift coefficient to the uncertainty of the optical clock at room temperature has been reduced to the 10^{-19} level, the excess micromotion induced clock uncertainty is also reduced to the 10^{-19} level by choosing the appropriate trap drive frequency.

1. Y. Huang, H. Guan, P. Liu, W. Bian, L. Ma, K. Liang, T. Li and K. Gao, Phys. Rev. Lett. 116, 013001 (2016).