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High accuracy measurement of optical atomic clock polarizability JEFF SHERMAN, National Institute of Standards and Technology, NATHAN LEMKE, NATHAN HINKLEY, University of Colorado, Department of Physics, MARCO PIZZOCARO, Politecnico di Torino, Italy, RICHARD FOX, ANDREW LUDLOW, CHRIS OATES, National Institute of Standards and Technology —

The differential static polarizability of ytterbium optical clock states $\alpha_{\mathrm{clock}} \equiv \alpha(^3P_0) - \alpha(^1S_0)$ is known theoretically to $\sim$10%. We report an experimental value of this polarizability, $\alpha_{\mathrm{clock}} = 36.2612(7)$ kHz $(\mathrm{kV/cm})^{-2}$ at 20 parts-per-million (ppm) accuracy [1]. Ultracold ^{171}Yb atoms held in an optical lattice at the ac-Stark balancing "magic" wavelength (759 nm) are surrounded by rigidly spaced transparent conductive planar electrodes. An ultrastable laser (578 nm) is locked to the $^1S_0 \leftrightarrow {}^3P_0$ transition in an interleaved fashion for three electrode conditions: voltage applied, reversed, and grounded. These integrated error signals yield the quadratic Stark shift and a measure of stray fields. The electrode spacing is measured interferometrically *in situ*. The applied electric field at the site of the atoms deviates at the few ppm level from an infinite-planar model. When last evaluated, the ytterbium optical clock frequency uncertainty was dominated by that of the blackbody Stark shift. We show how this measurement reduces this uncertainty contribution an order of magnitude to a fractional level of 3×10^{-17}.

[1] J.A. Sherman et al., arXiv:1112.2766 (2011).

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