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Precision Spectroscopy and Density dependant Frequency Shifts in Ultracold Strontium MARTIN M. BOYD, TETSUYA IDO, ANDREW D. LUDLOW, THOMAS H. LOFTUS, JUN YE, JILA, National Institute of Standards and Technology and the Univeristy of Colorado, Boulder CO 80309 — Cold alkaline earth atoms show great promise as future optical frequency standards and as key components in optical atomic clocks. Atomic strontium is an excellent candidate for a future standard as the level structure allows for both efficient laser cooling to sub-micro Kelvin temperatures and a variety of narrow clock transitions. We report the first high accuracy measurement of the ^{88}Sr $^1S_0 - ^3P_1$ clock transition using an ultracold (1uK) sample, yielding a frequency of (434,829,121,312,334 +/- 20_{stat} +/-33_{sys}) Hz. Detailed descriptions of both the measurement technique and corresponding systematic uncertainties are given. In addition, by varying the density of the ultracold ^{88}Sr sample over a range of three orders of magnitude we obtain the first definitive measurement of a density-related frequency shift and linewidth broadening of an optical clock transition in an ultracold alkaline earth system.

Martin M. Boyd
JILA / University of Colorado

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