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Precision Measurement of the 2^3S_1-2^3P_J Transitions in ^{4}He using an Optical Frequency Comb[1] DANIEL FARKAS, GERALD GABRIELSE, Harvard University Physics Dept — One promising way to measure the fine structure constant α and test Quantum Electrodynamics in an atomic system is to measure the ^{4}He fine structure splitting of the 2^3P level into the J=0,1,2 sublevels. We recently reported the most accurate experimental measurements of these intervals, with uncertainties of 500 Hz and 700 Hz for the small ($2P_1$-$2P_2$, 2.2 GHz) and large ($2P_0$-$2P_1$, 29.6 GHz) intervals, respectively [1]. Our approach uses saturated absorption laser spectroscopy at 1083 nm to excite metastable ^{4}He atoms in a variable-pressure discharge cell to the $2P_J$ states. Several changes to the experiment have improved our resolution by a factor of 5 to less than 100 Hz. Most significant, a new iodine frequency reference at 532 nm is 40 times more stable than an existing ^{3}He reference. The stability of this reference is transferred to 1083 nm using an optical frequency comb. Simultaneously, the comb lets us accurately measure the optical frequencies of the 2S-$2P_J$ transitions with respect to the SI second. We present preliminary measurements of both the improved ^{4}He 2P fine structure splittings and the 2S-$2P_J$ transitions using the iodine-stabilized frequency comb as the frequency reference for the experiment. Systematics and their limitations on accuracy are discussed. [1] T. Zelevinsky, D. Farkas, and G. Gabrielse, *Phys. Rev. Lett.*, **95**, (2005).

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