Ultrahigh-Precision Measurement of the $n = 2$ Triplet P Fine Structure of Atomic Helium Using Frequency-Offset Separated Oscillatory Fields$^1$ K. KATO, T. D. G. SKINNER, E. A. HESSELS, York University

The $2^3\text{P}_1$-to-$2^3\text{P}_2$ fine structure interval in atomic helium is measured [1] to a precision of 25 Hz using the frequency-offset separated oscillatory fields (FOSOF) technique [2]. A beam of metastable helium atoms is produced in a liquid-nitrogen-cooled DC-discharge source, and is intensified using a two-dimensional magneto-optical trap. Atoms in the $2^3\text{S}$ state are optically pumped into $m=+1$ prior to entering the main experiment region. These atoms are excited to the $2^3\text{P}_1$ ($m=+1$) state by a pulse of linearly polarized 1083-nm laser light. The $2^3\text{P}_1$-to-$2^3\text{P}_2$ transition is driven by two time-separated microwave fields (at slightly offset frequencies). 447-nm and 1532-nm laser pulses excite atoms in the $2^3\text{P}_2$ state up to the $18^\text{P}$ Rydberg state, and the Rydberg atoms are Stark-ionized and counted. This background-free ion detection method is only sensitive to the atoms that experience a complete FOSOF sequence, eliminating the major systematic effects of previous experiments [3]. The excellent signal-to-noise ratio allowed for thorough investigation of systematic effects.


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