Precision microwave spectroscopy of the *n*=2 positronium fine structure.

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As a purely leptonic system, positronium (Ps) is an ideal system for performing QED tests [1]. QED corrections to Ps energy levels have been calculated up to order $m\alpha^6$, and the theoretical calculations [2] are currently more precise than experimental measurements. The first measurement of the $n = 2$ fine structure was of the $2^3S_1 - 2^3P_2$ transition, conducted in 1975 by Mills, Berko and Canter [3]. This measurement was improved upon by Hatamian, Conti and Rich, in 1987 [4], and then by Hagena and co-workers in 1993 [5]. However, these experiments all relied on generation of Ps atoms in the 2^3S_1 state via positron bombardment into metal targets [6], which is intrinsically inefficient and necessarily results in Ps with energies of several eV. The last fine structure precision measurements are now over 25 years old, with uncertainties of approximately 200 ppm [5]. Here we present the results of a new Ps $n = 2$ fine structure measurement (2^3S_1-2^3P_2) in which 2^3S_1 atoms were produced via laser excitation [7]. This methodology is more efficient and results in the production of much slower atoms, significantly reducing systematic errors.

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