Microwave spectroscopy of the positronium n = 2 fine structure

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Recent measurements of the positronium (Ps) $2^3S_1 \rightarrow 2^3P_J$ fine-structure intervals, for ν_J (J = 0, 1, 2), are presented. This experiment used slow Ps atoms, which were optically excited to the metastable 2^3S_1 level. This metastable beam then passed through a microwave guide, which produced a radiation field tuned to drive the transition to the short-lived 2^3P_J levels. These short-lived Ps atoms were then detected via their subsequent annihilation radiation. For the ν_0 transition, a discrepancy of 4.5 σ from QED theory was measured [1]. While the ν_1, and ν_2 transitions exhibited asymmetric lineshapes [2]. Simulations seem to suggest that this asymmetry was due to reflections of the RF field in the chamber [3]. Recent improvements have been made to the experiment, with asymmetry no longer observed.

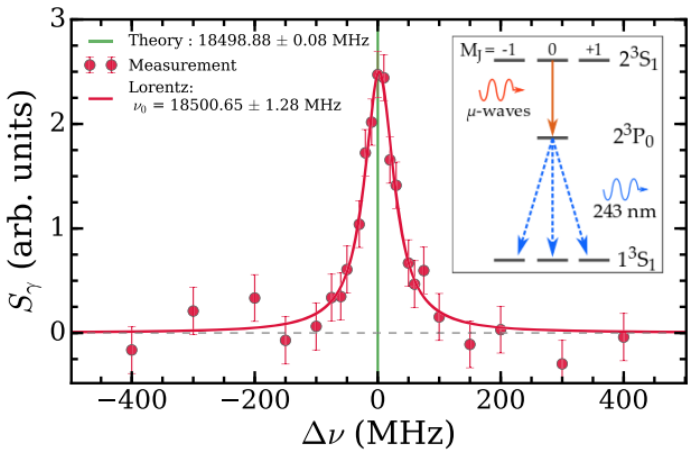

Figure 1: Line shape with a Lorentzian fit for the ν_0 transition [1].

[1] L. Gurung, T. J. Babij, S. D. Hogan, and D. B. Cassidy.Precision microwave spectroscopy of the positronium n = 2 fine structure. Phys. Rev. Lett, **125**, 073002 (2020).

[2] L. Gurung, T. J. Babij, J. Pérez-Ríos, S. D. Hogan, and D. B. Cassidy. Observation of asymmetric line shapes in precision microwave spectroscopy of the positronium $2^3S_1 \rightarrow 2^3P_J$ (J = 1, 2) fine-structure intervals. Phys. Rev. A, **103**, 02805 (2021).

[3]L. A. Akopyan, T. J. Babij, K. Lakhmanskiy, D. B. Cassidy, and A. Matveev. Line-shape modeling in microwave spectroscopy of the positronium n = 2 fine-structure intervals. Phys. Rev. A., **104**, 062810 (2021).