High-Precision Measurements of the n=2 Triplet P States of Helium

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The n=2 triplet P J=1-to-J=2 and J=1-to-J=0 intervals in atomic helium are measured using a thermal beam of metastable helium 2 triplet S atoms which are excited up to the 2 triplet P state using a 1.083-micron diode laser. The J=1-to-J=2 transition is driven by 2.29-GHz microwaves in a coaxial transmission line and our measured result [1] of 2 291 174.0 +/- 1.4 kHz is the most precise measurement of helium 2 triplet P fine structure. In a second experiment, we are measuring the J=1-to-J=0 interval using 29.6-GHz microwave fields in a waveguide resonant cavity. The precision of this measurement is expected to be 1 kHz. When combined with precise theory [2] (which soon will be improved to sub-kHz uncertainty [3]), this measurement will provide a new 15-part-per-billion determination of the fine-structure constant.

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[2] T. Zhang and G. W. F. Drake *Phys. Rev. A* **54**, 4882 (1996).
[3] G. W. F. Drake, private communication.