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High precision spectroscopy of Ps

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Positronium is an excellent test-bed for bound-state QED, owing to its purely leptonic nature. This allows its properties to be calculated very precisely in terms of the fine structure constant, with no contributions from hadronic interactions (weak interactions can also be neglected at the present experimental level). A measurement of the 1S-2S transition frequency of poitronium (at a precision level of less than 1 ppb (an improvement of a factor of five on the current measurement [1]) is sufficient to check the most recent calculations [2]. The limitation on improving the precision of this measurement much beyond this level is the high velocity of positronium at room temperature. Simulations show that Stark deceleration of Rydberg state positronium from room temperature (around 70000 m/s) to below 1000 m/s should be possible with reasonable efficiency. In this case, a measurement of the transition frequency at the level of a few kHz would be feasible, allowing a possible independent determination of the Rydberg constant. Progress towards such a measurement is reported here, including preliminary results, positron beam technology and strategies for reaching the required precision.

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[2] K. Pachucki and S. G. Karshenboim, Phys. Rev. A60, 2792 (1999)

Primary authors: COOKE, David (Eth Zurich); CRIVELLI, Paolo (Eidgenoessische Tech. Hochschule Zuerich (CH))

Presenter: COOKE, David (Eth Zurich)

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