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Experiments with atomic and molecular positronium

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Positronium (or Ps) is a hydrogen-like metastable bound state between an electron and its antiparticle, the positron. This was first produced experimentally by Martin Deutsch in 1951 [1], and since that time Ps has been the subject of numerous experimental studies [2]. However, since antimatter is relatively hard to come by in the lab, and because Ps has a short lifetime against self-annihilation, it is difficult to produce large numbers Ps atoms at the same time, and so experimental work was restricted measurements using one atom at a time. This situation is now starting to change because of developments in positron trapping technology [3] that make it possible to generate intense bursts of positrons and thereby create a "gas" of positronium; this can easily be probed with pulsed lasers making spectroscopic measurements feasible. Moreover, if a high positron beam density is used the resulting Ps atoms may be able to interact with each other, allowing us to observe spin exchanging collisions, Ps-Ps scattering, and the formation of Ps2 molecules. In this talk I will give an overview of some recent experiments performed using a positron trap, including the formation of molecular positronium [4] and a spin polarized Ps gas [5], spectroscopy [6] and scattering [7] of confined Ps, some optical measurements of the Ps hyperfine interval [8] and the production of Rydberg states of Ps [9].

[1] Martin Deutsch "Evidence for the Formation of Positronium in Gases" Phys. Rev. 82, 455 (1951).
[2] A. Rich, "Recent experimental advances in positronium research" Rev. Mod. Phys. 53, 127 (1981).
[3] C.M. Surko and R.G. Greaves, "Emerging science and technology of antimatter plasmas and trap-based beams" Phys. Plasmas 11, 2333 (2004).
[4] D.B. Cassidy and A.P. Mills, Jr., "The production of molecular positronium" Nature (London) 449, 195 (2007).
[5] D. B. Cassidy, V. E. Meligne, and A. P. Mills, Jr., "Production of a Fully Spin-Polarized Ensemble of Positronium Atoms" Phys. Rev. Lett. 104, 173401 (2010).
[6] D. B. Cassidy, M. W. J. Bromley, L. C. Cota, T. H. Hisakado, H. W. K. Tom, and A. P. Mills, Jr., "Cavity Induced Shift and Narrowing of the Positronium Lyman-α Transition" Phys. Rev. Lett. 106, 023401 (2011).
[7] D. B. Cassidy and A. P. Mills, Jr., "Enhanced Ps-Ps Interactions due to Quantum Confinement" Phys. Rev. Lett. 107, 213401 (2011).
[8] D. B. Cassidy, T. H. Hisakado, H. W. K. Tom, and A. P. Mills, Jr. "Positronium Hyperfine Interval Measured via Saturated Absorption Spectroscopy" Phys. Rev. Lett. 109, 073401 (2012).
[9] D. B. Cassidy, T. H. Hisakado, H. W. K. Tom, and A. P. Mills, Jr. Efficient Production of Rydberg Positronium" Phys. Rev. Lett. 108, 043401 (2012).

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