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Adventures in Gaseous Positronics - An Ultra-High-Energy-Resolution Cryogenic Beam[1]

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While positron interactions with matter are important in a variety of contexts, many important experiments have been inhibited due to the difficulties encountered in creating beams with narrow energy spreads. This talk focuses on the development of a pulsed positron beam with a total energy spread of 7 meV FWHM; this represents a factor of five improvement over the previous state-of-the-art. Current positron atomic physics experiments rely on high quality beams from buffer gas traps. Although widely used, the physical phenomena operative in beam formation had not previously been fully investigated, and understanding these processes proved crucial to improving beam quality. Experimental measurements and simulation results of positron cooling and beam formation are discussed, with an emphasis on beam energy resolution.[3,4,5] Using these results, a new cryogenic, trap-based beam system was built. Positrons are cooled to 50 K using a CO buffer gas, resulting in beams with total energy spreads as low as 6.9 meV FWHM, sub-microsecond temporal spreads and beam diameters as small as 1 mm.[6] Details of this beam system, as well as new experiments that will be enabled by it, will be discussed.

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[2]In collaboration with J. R. Danielson and C. M. Surko

[3]M. R. Natisin, *et al.*, Phys. Plasmas **22**, 033501 (2015)

[4]M. R. Natisin, *et al.*, Phys. Plasmas in press (2016)

[5]M. R. Natisin, *et al.*, J. Phys. B **47**, 225209 (2014)

[6]M. R. Natisin, *et al.*, App. Phys. Lett **108**, 024102 (2016)