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Atoms as electron accelerators

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Resonant positron annihilation on atomic electrons is a powerful technique for searching for light new particles that couple to e^+e^-. Precise estimates of production rates require a detailed characterisation of atomic electron momentum distributions. I will present a general method that leverages the Compton profile of the target material to accurately account for electron velocity effects in resonant annihilation cross-sections. Additionally, I will discuss the implications of this precise computation for new physics searches and explore how high Z atoms can effectively serve as electron accelerators, significantly extending the experimental mass reach. Finally, I will demonstrate that by harnessing the relativistic velocities of electrons in the inner atomic shells, a high-intensity 12 GeV positron beam —such as the one planned at JLab —can enable precise measurements of the hadronic cross section, from the two-pion threshold to a center-of-mass energy exceeding 1 GeV.

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