Ionization of noble gas atoms in slow antiproton collisions

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In order to improve our understanding of the physics of atomic collisions, accurate experimental data are needed which can be used as benchmarks for the development of advanced calculations of these dynamically developing many-body systems. One of the simplest processes in this field is the single ionization of helium by antiproton impact. Here, there is a strong many-body effect, namely the electron-electron correlation, but on the other hand there is no complication from electron transfer. Furthermore the projectile is heavy which means that it moves in a classical orbit and that we can investigate ionization in collisions where the projectile moves with a speed much slower than that of the target electrons. At CERN's LEAR we measured the total cross sections for single and multiple ionization of a multitude of targets for impact of antiprotons with velocities down to that of the outer electrons in the targets [1,2]. This in turn led to the development of more than a dozen advanced theories. These calculations coalesce at high projectile speed, bur shown great spread a low projectile energies. In order to judge the validity of these models, we therefore need to measure ionization for impact of antiprotons of a few keV.

Using a new technique for the production of intense beams of very slow antiprotons [3] developed by the ASACUSA collaboration at CERN's AD facility, we have been able to obtain accurate cross sections for single ionization of helium and single and double ionization of argon down to impact energies of 3 keV [4]. In this talk, I will present the technique and the results and compare them to the theoretical calculations.

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