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Antiproton-nucleus annihilation studies with thin targets and comparison to Monte Carlo simulations

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Antiproton-nucleus annihilation at rest is a process that is not well understood, despite previous experimental and theoretical work on its different aspects. One of the main reasons for its complexity are final-state interactions (FSIs), i.e. the interactions between the primary mesons and the residual nucleus. No existing model is able to describe all observables of the annihilation process, and measurements at ultra-low energies are scarce. The antiproton-nucleus reactions at rest have a notable application in experiments at the Antiproton Decelerator (AD) at CERN, the purpose of which are atomic-physics and high-precision tests of fundamental symmetries. They rely on Monte Carlo simulations that were developed for high energy physics, but these simulations perform unsatisfactorily when applied to energies relevant for these experiments.

In this talk, we will present recent experimental work on antiproton-nucleus annihilation at the ASACUSA experiment at CERN using slow extracted antiprotons and thin targets, showing results from measurements with carbon, molybdenum and gold. Additionally, we will introduce a new project aimed at measuring the multiplicity of the annihilation prongs, along with their angular and energy distribution, covering almost 4π solid angle. The results of this study, which involves approximately 15 different nuclei, will provide a necessary benchmark for current and future models, serving as a foundation for more accurate Monte Carlo simulations. At the same time, the obtained data will offer quantitative and qualitative insights into the final state interactions and their evolution with atomic number, potentially identifying novel nuclear physics processes not yet included in existing models.

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