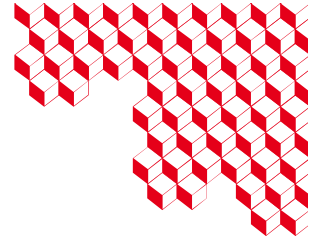




Institute of Research into the
Fundamental laws of the Universe

Nuclear Physics Department



PhD Defense on Friday, December 8th 2023, 10 a.m.

CEA Saclay, Orme des Merisiers, B. 713 Salle de séminaires Galilée

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DPHn LEARN

Interaction of antiprotons with nuclear matter within the INCL++ model

In the wake of renewed experimental interest in antiproton physics and related research, there has emerged a necessity for robust modeling tools to simulate antiproton-nucleus interactions across a broad energy spectrum. This work aims to fill this gap by extending the existing INCL++ (Intra-Nuclear Cascade Liège) model with the capability to set an antiproton projectile and integrating this model into the GEANT4 particle transport code. Antiprotons, as investigative probes, provide a broad spectrum of opportunities for high-precision experiments in nuclear physics. They allow for the generation of exotic antibaryons and facilitate the study of their subsequent interaction with nuclear matter and atomic shells. Additionally, they shed light on the structure and properties of unstable nuclei.

This research is based on extensive data compiled from past antiproton experiments conducted at CERN, Fermilab, and KEK. This historical dataset serves as both the source for extracting input parameters for the model and as a benchmark for validating our results. In doing so, this thesis meets the growing demand for accurate simulation tools essential for the new era of precision measurements in nuclear and particle physics.

The purpose of the present work was to examine if antiprotons could facilitate the study of nuclear surfaces and halos through "at-rest" annihilations with various nuclei. We model such annihilations in INCL by implementing a distinct initialization procedure. This scenario is extensively compared with "in-flight" interactions to understand the interplay between the two and the influence of scenario choice on the resulting output.

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