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Machine Learning methods for antideuteron identification with the AMS-02 detector

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Cosmic ray antideuterons, although yet to be detected in space, represent a highly sensitive channel for probing new physics, including models related to Dark Matter. Their flux is expected to be approximately 10^{-9} times lower than that of protons posing significant challenges to their detection. The AMS-02 experiment, after 11 years of data collection, holds the potential for cosmic-ray antideuteron identification. However, the accurate characterisation and rejection of multiple backgrounds is crucial to achieve a good isotopic mass separation over a wide range of energies.
Machine Learning methods, particularly Boosted Decision Trees, are well suited for this classification task, but their performance relies on the choice of the features needed for their training phase. I explore both physics-driven feature selection methods and automated feature selection methods, based on Machine Learning algorithms, to optimise the classifier performance. I apply this enhanced feature selection methodology to the analysis of antideuteron identification in AMS-02 data, obtaining high background rejection while preserving 90% signal efficiency.

Collaboration(s)

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