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DATA ANALYSIS IN HIGH ENERGY PHYSICS USING MACHINE LEARNING METHODS

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This scientific initiation project involved the analysis of a Monte Carlo (MC) dataset of relativistic heavy-ion collisions using Machine Learning (ML) methods. The dataset was provided by the Experimental Hadronic Physics Group (HadrEx) in direct collaboration with the ALICE experiment at the Large Hadron Collider (LHC). The research focused specifically on multi-strange baryons—such as Ξ^-, Ξ^+ , and others —and their subsequent decays, a process known as "Cascade Decay." The primary objective was reconstructing these particles through their secondary decays using generative Machine Learning models. By synthesizing realistic data that harmonizes with experimental observations, the project aimed to optimize conventional high-energy physics analyses and enhance data analysis algorithms for the search for rare observables. To address this challenge, the Conditional Tabular Generative Adversarial Network (CTGAN) model was employed. The results demonstrated that CTGAN effectively preserved the physical and intrinsic correlations of the original data while reproducing the variable distributions, reinforcing its potential for improving data-driven studies in high-energy physics.

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