Contribution ID: 6

Enhancing DM searches at the LHC with Machine Learning

Wednesday 23 April 2025 09:44 (22 minutes)

Despite extensive efforts, the fundamental nature of Dark Matter remains unknown. Collider searches provide a unique window into potential Dark Matter interactions, particularly through the "monojet" channel characterized by a small number of energetic jets recoiling against significant missing transverse momentum in a lepton-free final state. Traditional analysis methods often struggle to identify subtle signals of Dark Matter amidst overwhelming Standard Model backgrounds. In this talk, I will present a novel approach based on Graph Neural Networks (GNNs) that integrates high-level kinematic variables with low-level particle information to enhance sensitivity in monojet searches. Using benchmark theoretical scenarios where the Dark Matter candidate is a supersymmetric neutralino, we systematically evaluate the effectiveness of our method, derive implications for the underlying model, and interpret the network's learned features.

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Track Classification: Plenary talk