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Energy-based graph autoencoders for semivisible jet tagging in the Lund representation

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Semivisible jets are are a novel signature arising in Hidden Valley (HV) extensions of the SM with a confining interaction [1]. Originating from a double shower and hadronization process and containing undetectable dark bound states, semivisible jets are expected to have a substantially different radiation pattern compared to SM jets.

Unsupervised machine learning allows to learn the showering pattern of SM jets from data and successfully tag semivisible jets without relying on assumptions on the showering dynamics of the HV interaction [2]. Lund trees [3] are a natural representation of hadronic jets, encoding the full showering history. We show how a graph autoencoder can succesfully learn the Lund tree structure of SM jets and tag semivisible jets as anomalies. We furthermore propose a novel training workflow that extends the normalized autoencoder architecture [4, 5] to graph networks, allowing to suppress out-of-distribution reconstruction in a fully signal-agnostic fashion by constraining the low-reconstruction-error phase space to match the support of the training data.

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