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Full Phase Space Resonant Anomaly Detection

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Physics beyond the Standard Model that is resonant in one or more dimensions has been the subject of many anomaly detection studies. This resonant anomaly detection is well-suited for weakly supervised machine learning, where sideband information can be used to generate synthetic datasets representing the Standard Model background. One effective strategy is to learn a conditional generative model that can be interpolated into the signal region to generate synthetic samples. Until now, this approach was only able to accommodate a relatively small number of dimensions, limiting the breath of the search sensitivity. Using recent innovations in point cloud generative models, we show that this strategy can also be applied to the full phase space, using all relevant particles for the anomaly detection. As a proof of principle, we show that the signal from the R&D dataset from the LHC Olympics is findable with this method, opening up the door to future studies that explore the interplay between depth and breadth in the representation of the data for anomaly detection.

Authors: NACHMAN, Ben (Lawrence Berkeley National Lab. (US)); EWEN, Cedric; SHIH, David; BUHMANN, Erik (Hamburg University (DE)); KASIECZKA, Gregor (Hamburg University (DE)); MIKUNI, Vinicius Massami (Lawrence Berkeley National Lab. (US))

Presenter: EWEN, Cedric

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