Phenomenology 2025 Symposium



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Isolating Unisolated Upsilons with Anomaly Detection in CMS Open Data

Tuesday 20 May 2025 14:45 (15 minutes)

We present the first study of anti-isolated Upsilon decays to two muons $(Y \rightarrow \mu + \mu -)$ in proton-proton collisions at the Large Hadron Collider. Using a machine learning (ML)-based anomaly detection strategy, we "rediscover" the Y in 13 TeV CMS Open Data from 2016, despite overwhelming anti-isolated backgrounds. We elevate the signal significance to 6.4σ using these methods, starting from 1.6σ using the dimuon mass spectrum alone. Moreover, we demonstrate improved sensitivity from using an ML-based estimate of the multi-feature likelihood compared to traditional "cut-and-count" methods. Our work demonstrates that it is possible and practical to find real signals in experimental collider data using ML-based anomaly detection, and we distill a readily-accessible benchmark dataset from the CMS Open Data to facilitate future anomaly detection developments.

Mini Symposia (Invited Talks Only)

Plenary (Invited talks only)

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Session Classification: Machine Learning

Track Classification: Machine Learning and Artificial Intelligence in Particle Physics