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Jet or Event? - Physics at Future e^-e^+ Colliders

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Information loss caused by dimension reduction in jet clustering is one of the major limitations for the measurement precision of hadronic events at future e^-e^+ colliders, where the precision frontier of particle physics for next decades is expected to be defined. Such measurements are key for probing, e.g., the nature of Higgs boson, since the hadronic events are dominant in Higgs data. We show that this difficulty could be well-addressed using the machine-learning (ML) techniques at event-level. For this purpose, a comparative ML-based study is pursued between jet-level and event-level analyses, in the benchmark scenarios with two, four, and six expected jets in each event, respectively. We explore how the precision of the benchmark measurements gets improved with the assistance of the information beyond jet level. As an application of this method, we analyze the precision of measuring the Higgs total width at 240 GeV e^-e^+ colliders (which involves analyzing the hadronic events with two, four and six expected jets) and its dependence on the detector resolution, and show that the precision can be significantly improved in comparison to the one presented in literatures and documents. We expect that the proposed method can be broadly applied to many other hadronic-event measurements at future e^-e^+ colliders.

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