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An embedding technique to determine tau tau backgrounds in proton-proton collision data

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Abstract

An embedding technique is presented to estimate standard model tau tau backgrounds from data with minimal simulation input. In the data, the muons are removed from reconstructed mu mu events and replaced with simulated tau leptons with the same kinematic properties. In this way, a set of hybrid events is obtained that does not rely on simulation except for the decay of the tau leptons. The challenges in describing the underlying event or the production of associated jets in the simulation are avoided. The technique described in this paper was developed for CMS. Its validation and the inherent uncertainties are also discussed. The demonstration of the performance of the technique is based on a sample of proton-proton collisions collected by CMS in 2017 at $\sqrt{s} = 13$ TeV corresponding to an integrated luminosity of 41.5 fb⁻¹.

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