

Graphical Neural Network for Tagging Merged b-jets Resulting From Exotic Higgs Boson Decays to Low Mass Pseudoscalars

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In our search using CMS data for low mass, boosted pseudoscalar ($M_a < 15\text{GeV}$) decays to b-jet pairs and τ pairs predicted by the Two Higgs Doublet Model + Singlet (2HDM+S), we find that the b-jets tend to merge when run through the anti-kT jet reconstruction algorithm with R parameter of 0.4 (AK4). Standard CMS b taggers are not optimized for this signal. We look to discriminate this topology by training a specialized Graphical Neural Net based on the ParticleNet framework. We use the standard particle network flow, stacking multiple blocks of the EdgeConv algorithm, but carefully tailor the network size, input parameters, and training our signal against our dominant backgrounds (tt and QCD). In doing this, we find significant improvement over the DeepFlavour and DeepCSV algorithms. This innovative approach provides excellent opportunities to exploit B meson triggered data and expand the scope of new physics searches.

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