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Performance and efficiency measurement of a transformer-based quark gluon jet tagger in the ATLAS experiment

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In this talk a deep learning approach based on the transformer architecture is presented to distinguish jets originating from quarks or gluons.
The algorithm is defined to operate on jets with transverse momentum $p_{\mathrm{T}} > 20$ GeV and pseudorapidity $|\eta| < 4.5$ and takes as inputs the jet constituents, using information from the ATLAS detector tracker and calorimeter.
The algorithm performance is evaluated in data analyzing final states with two jets produced in proton-proton collisions at $\sqrt{s} = 13$ TeV and 13.6 TeV recorded by the ATLAS detector during Run 2 and Run 3 of the LHC.
Two methods are employed to define distributions associated to quark- or gluon-initiated jets in data: a matrix method fully based on Monte Carlo simulation and a new approach named jet topics which has a reduced dependence on the assumed modelling of the physics process under study.
The quark/gluon identification efficiency is measured in data and, for the 50\% quark identification efficiency working point, is found to vary with respect to the simulated one from 0.85 to 1.18 for quark-initiated jets and from 0.67 to 1.01 for gluon-initiated jets.
The uncertainties on the measurement estimated with the new jet topics method are found to be smaller than the ones estimated with the matrix method, with up to 20\% reduction in systematic uncertainties in some phase space regions.
This talk reports advances in the identification of jets initiated by quarks or gluons, providing a robust tool for precision Standard Model measurements and searches for new physics at the LHC.

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