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Transverse spherocity dependence of elliptic flow and application of machine learning tools in heavy-ion collisions at the LHC using AMPT model

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Recently, event shape observables such as transverse spherocity (S_0), has been studied successfully in small collision systems at the LHC as a tool to separate jetty and isotropic events. In our work, we have performed an extensive study of charged particles' azimuthal anisotropy in heavy-ion collisions as a function of S_0 for the first time using a multi-phase transport (AMPT) model. We have used the two-particle correlation (2PC) method to estimate the elliptic flow (v_2) for different centrality classes in Pb-Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 5.02$ TeV for high-S_0, S_0-integrated and low-S_0 events. We found that transverse spherocity successfully differentiates heavy-ion collisions' event topology based on their geometrical shapes {\em i.e.} high and low values of spherocity (S_0). The high-S_0 events are found to have nearly zero elliptic flow while the low-S_0 events contribute significantly to elliptic flow of spherocity-integrated events. It was found that the number of constituent quark scaling of elliptic flow is strongly violated in events with low-S_0 compared to S_0-integrated events. In the absence of experimental explorations in this direction, we implement a machine learning based regression method to estimate S_0 distributions in Pb-Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 5.02$ TeV by training the model with experimentally available event properties. This method works well as a good agreement between the simulated true values and the predicted values from the ML-model is observed.

References:
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Preferred track

High-temperature QCD

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