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The global geometrical property of jet events in high-energy nuclear collisions

We present the first theoretical study of medium modifications of the global geometrical pattern, i.e., transverse sphericity (S_{\perp }) distribution of jet events with parton energy loss in relativistic heavy-ion collisions. In our investigation, POWHEG + PYTHIA is employed to make an accurate description of transverse sphericity in the p + p baseline, which combines the next-to-leading order (NLO) pQCD calculations with the matched parton shower (PS). The Linear Boltzmann Transport (LBT) model of the parton energy loss is implemented to simulate the in-medium evolution of jets. We calculate the event normalized transverse sphericity distribution in central Pb + Pb collisions at the LHC, and give its medium modifications. An enhancement of transverse sphericity distribution at small S_{\perp } region but a suppression at large S_{\perp } region are observed in A + A collisions as compared to their p + p references, which indicates that in overall the geometry of jet events in Pb + Pb becomes more pencil-like. We demonstrate that for events with 2 jets in the final-state of heavy-ion collisions, the jet quenching makes the geometry more sphere-like with medium-induced gluon radiation. However, for events with n≥3 jets, parton energy loss in the QCD medium leads to the events more pencil-like due to jet number reduction, where less energetic jets may lose their energies and then fall off the jet selection kinematic cut. These two effects offset each other and in the end result in more jetty events in heavy-ion collisions relative to that in p + p.

Primary author: Dr CHEN, shiyong (Huanggang Normal University)

Co-authors: Prof. ZHANG, Ben-Wei (Central China Normal University); Dr DAI, Wei (China University of Geosciences)

Presenter: Dr CHEN, shiyong (Huanggang Normal University)