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Investigating Radius-Dependent Jet Quenching Dynamics with the JETSCAPE Framework

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In this work, we extend the JETSCAPE framework to investigate the dependence of the jet nuclear modification factor, R_{AA}, on the jet radius parameter (R) for larger jet cones with radii up to $R = 1.0$. The study primarily aims to explore high-p_T inclusive jets, reaching up to 1 TeV, to analyze quenching effects within the quark-gluon plasma created in the most-central (0-10\%) Pb-Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV. To achieve this, we couple the MATTER module, which models the high-virtuality stage of parton evolution, with the LBT module for the low-virtuality phase, as well as with the AdS/CFT and MARTINI modules for enhanced precision across different interaction regimes. The MUSIC (2+1)D model is employed to present the hydrodynamic evolution of the quark-gluon plasma in these Pb-Pb collisions. These calculations are then compared to experimental data collected from ATLAS and CMS detectors, with JETSCAPE predictions showing consistency across high-p_T values and large jet radii, within the deviations of 10-25\%. A major aspect of this work is computing the double ratio ($R^{\mathrm{R}}_{\mathrm{AA}}/R^{\mathrm{R=small}}_{\mathrm{AA}}$), which helps to isolate the effect of jet radius on energy retention within the QGP, providing new insights into its dependence on jet-R and jet-p_T and advancing our understanding of jet quenching dynamics in a strongly interacting QCD medium. The observed trends align well with JETSCAPE's multi-stage hydrodynamic model of parton shower evolution.

Author: Ms PRIYADARSHINI, Manaswini (Tata Institute of Fundamental Research (IN))

Co-authors: Mr SHAHI, Om; PALNI, Prabhakar (Tata Institute of Fundamental Research (IN)); Mrs SATHE, Vaishnavi

Presenter: Ms PRIYADARSHINI, Manaswini (Tata Institute of Fundamental Research (IN))

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