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Exploring Radial and Directed Flow as Probes of QGP Properties Across Energies

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Over the past 15 years, elliptic and triangular flow coefficients (v_2, v_3) have been extensively studied in heavy-ion collisions to gain insight into the collective behavior and transport properties of the quark-gluon plasma (QGP). However, in recent years, increasing attention has been directed toward the radial and directed flow coefficients (v_0, v_1), which have emerged as valuable probes of the QGP medium. In this talk, I will present our recent work on the study of v_0 and v_1 across a wide range of collision energies, from the LHC to RHIC. The radial flow coefficient v_0, now measured in several experiments, is currently a topic of active discussion as a probe of the collective behaviour of the medium. In addition, directed flow v_1—especially for identified particles—along with the observed splitting between baryons and antibaryons, and between positively and negatively charged hadrons, serves as a sensitive probe of conserved charge dynamics, their diffusion, electromagnetic fields, and the medium's electrical conductivity. I will discuss our hydrodynamic model results for v_0 and its significance as well as the detailed investigation of v_1 for identified hadrons, emphasizing its relevance in the Beam Energy Scan (BES) program phenomenology. In particular, I will highlight the role of baryon diffusion in shaping directed flow and present our recent findings on how baryon diffusion and electrical conductivity influence the splitting of v_1 among hadron species with identical mass but different conserved charges.

Author: Mr PARIDA, Tribhuban (IISER Berhampur)

Presenter: Mr PARIDA, Tribhuban (IISER Berhampur)

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