Contribution ID: **68** Type: **not specified**

Left-right splitting of elliptic flow in heavy ion collisions: TRENTo-3D initialization and CLVisc hydrodynamic simulations

Thursday, 27 November 2025 15:40 (15 minutes)

Using the TRENTo-3D initial condition model coupled with (3+1)-dimensional CLVisc hydrodynamic simulations, we systematically investigate the left-right splitting of elliptic flow (Δv_2) for soft particles in relativistic heavy-ion collisions. Our study reveals that the final distribution characteristics of Δv_2 are primarily depend on the odd flow harmonics and v_2 itself. We find that the parton transverse momentum scale k_{T} not only determines the geometric tilt of the QGP fireball but also significantly affects the rapidity dependence of both v_1 and Δv_2, providing new insights into the splitting mechanism of Δv_2.
Furthermore, our results demonstrate that $\Delta v_2(p_{\mathrm{T}})$ exhibits significant sensitivity to influences such as the sub-nucleonic degrees of freedom (or ‘hotspots’), transverse momentum scale, and fragmentation region profile. By analyzing the Δv_2 and $\Delta v_2/v_2$ ratio, our findings provide new constraints on the uncertainties of the QGP initial state and provide additional constraints for refining model parameters.

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Session Classification: Thursday Afternoon Second Session