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Towards understanding the origin of collectivity in small systems: a study of the interplay between initial-state momentum anisotropy and final-state geometry response

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The origin of long-range collective azimuthal correlations in small-system collisions is an area of intense research in the heavy ion community. To disentangle between collectivity associated with initial-state intrinsic momentum anisotropy and the collectivity arising as a final-state response to the collision geometry, we studied the development of collectivity in 5.02 TeV and 0.2 TeV p+Pb collisions with both initial-state and final-state effects included in a transport model AMPT. We find that the initial momentum anisotropy may not be fully isotropized through parton interactions, and the final-state partonic harmonic flow v_n in general are correlated with both the initial momentum anisotropy and the shape of the collision geometry. The initial momentum anisotropy also influences the event by event fluctuation of v_n. Therefore the mere evidence of geometry response of the collective flow does not rule out the presence of large contributions from the initial state[1].

We also compared the results between 5.02 TeV and 0.2 TeV[2], which have the same Glauber geometry but different parton densities (each nucleon produces three times more particles at 5.02 TeV than 0.2 TeV). We found that results are NOT the same for the same N_{part} nor for the same N_{ch}, suggesting a non-trivial influence of different particle production at the two energies. We discuss the prospect of disentangling the non-equilibrium transport or near-equilibrium hydrodynamics in future small system run (p+A and O+O) at RHIC and the LHC.

[1] M. Nie, L. Yi, J. Jia and G. Ma, arXiv:1906.01422.
[2] M. Nie, L. Yi, J. Jia and G. Ma, in preparation.

Primary author: NIE, Maowu (Shandong University (SDU))

Co-authors: YI, Li (ShanDong University); Prof. MA, Guo-Liang (Fudan University); JIA, Jiangyong (Stony brook Universty (US))

Presenter: NIE, Maowu (Shandong University (SDU))

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