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Exploring Longitudinal Observables with 3+1D IP-Glasma

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We present a formulation of the initial state of heavy ion collisions that generalizes the 2+1D boost invariant IP-Glasma [1] to 3+1D through JIMWLK rapidity evolution of the pre-collision Wilson lines. The rapidity dependence introduced by the JIMWLK evolution means that 1) the system no longer trivially satisfies Gauss' law at the initial time and 2) the form of the 2+1D initial gauge fields will give rise to nonphysical energy deposition outside of the interaction region of the colliding nuclei. To address these issues, we enforce Gauss' law locally and modify the form of the initial gauge fields in order to accommodate non-vanishing rapidity derivatives. This makes the initial condition consistent with a non-boost invariant system, and thus allows for temporal evolution on a 3-dimensional lattice.

While the transverse physics of QGP has been studied nearly exhaustively, the effect of longitudinal fluctuations introduced by the JIMWLK evolution has yet to be studied in detail phenomenologically. Hence, we couple our 3+1D IP-Glasma model to MUSIC+UrQMD, for completely 3+1D simulations of heavy ion collisions. Specifically, we consider Pb-Pb collisions at \sqrt{s} = 2.76 TeV and study the rapidity dependence of the charged hadron v_n (η) via the η-dependent flow factorization ratios r_n(ηa,ηb) as measured by CMS [2], as well as the charged hadron multiplicity dN_ch /dη.

REFERENCES
[1] Bjoern Schenke and Soeren Schlichting. "3D glasma initial state for relativistic heavy ion collisions". In: Phys. Rev. C94.4 (2016).
[2] Vardan Khachatryan et al. "Evidence for transverse momentum and pseudorapidity dependent event plane fluctuations in PbPb and pPb collisions". In: Phys. Rev. C92.3 (2015).

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