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Initial state fluctuations and their effect on the flow

Substantial collective flow is observed in collisions between Lead nuclei at LHC as evidenced by the azimuthal correlations in the transverse momentum distributions of the produced particles [1].

We perform simulations of the Pb+Pb heavy ion collisions at LHC at 1.38 + 1.38 TeV/nucl within the three module model. Our calculations, in particular, show that the v1-flow, which was rather weak at RHIC and SPS, becomes stronger at LHC. Another even more important change in the v1 behaviour with respect to the similar simulations for RHIC [2] is that the v1 now peaks in the "forward" direction [3], i.e. positive v1 peak appears now at positive rapidity, and correspondingly negative peak at negative rapidity, contrary to what was observed at RHIC.

However, it also appears that v1 flow is extremely sensitive to the initial state fluctuations, due to the sharp change around y=0.
One has to take into account that the Center of Mass (CM) rapidity is not exactly the same for all collisions, due to random fluctuations in the initial state, where the numbers of participant nucleons from projectile and target may not be exactly the same. This leads to considerable y_{CM} fluctuations at large impact parameters, where the flow asymmetry is the strongest, while total number of participants is the smallest.

To analyze the consequences of these fluctuations, we assumed a Gaussian
y_{CM} distribution, centered at y_{CM}=0, with variance of 1 or 2 units of rapidity. Such fluctuations strongly reduce v1(y) at central rapidities, however, it still stays large enough to be observed and to demonstrate the "rotation effect" discussed above [3].

It is also important to take into account experimental rapidity cuts of ALICE detector. These cuts together with initial state CM rapidity fluctuations result also into some increase of the elliptic flow, v2(pt), putting it in better agreement with the ALICE data.

1) K. Aamodt et al. [The ALICE Collaboration], arXiv:1011.3914 [nucl-ex].
2) B. Bauchle et al., J. Phys. G 34 (2007) s1077.
3) L.P. Csernai, V.K. Magas, H. Stocker, D.D. Strottman, arXiv:1101.3451 [nucl-th].

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