Elliptic flow in Au-Au collision at 20A GeV

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The Compressed Baryonic Matter (CBM) experiment at the Facility for anti-proton and ion research (FAIR) [1] is being designed to investigate the baryonic matter under extreme thermodynamic conditions. The CBM experiment offers a possibility to discover the most prominent landmarks of the QCD phase diagram expected to exist at high net baryon densities – the first order deconfinement phase transition and the critical end point. When two nuclei collide at high-energy and at a nonzero impact parameter, their overlap area in the transverse plane has a short axis parallel to the impact parameter, and a long axis perpendicular to it. This almond shape of the initial profile is converted by the pressure gradient into a momentum asymmetry, so that more particles are emitted along the short axis. The magnitude of this effect is characterized by an elliptic flow parameter, defined as [2]:

$$v_2 = \langle \cos 2(\phi - \psi) \rangle \,, \qquad (1)$$

where ϕ is the azimuthal angle of an outgoing particle, ψ is the azimuthal angle of the impact parameter, and the angular brackets denote an average over many particles and many events. In this preliminary investigation we report some aspects of the elliptic flow in Au+Au collision at an incident energy of 20A GeV, a typical CBM energy, using the UrQMD model [3]. Elliptic flow results on pions (π) and kaons (K) generated by the UrQMD model are shown as functions of transverse momentum (p_T), pseudorapidity (η) and the centrality (impact parameter b). The results are based on a statistics of 10^5 events. In FIG. 1 and FIG. 2 we see that v_2 as a function of p_T plotted at three different centralities increases gradually respectively, for pions and kaons. We have also found a mass ordering *i.e.*, flow of kaons is less than pions, upto more or less $p_T = 1.5$ GeV/c for

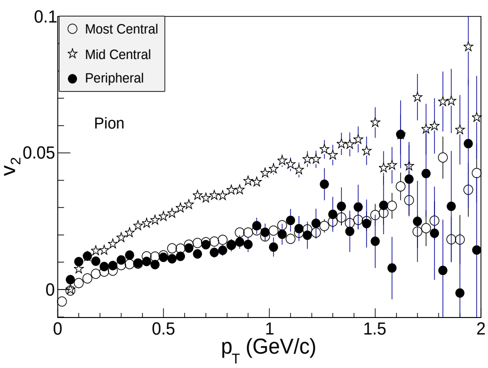

FIG. 1: v_2 versus p_T for π-mesons

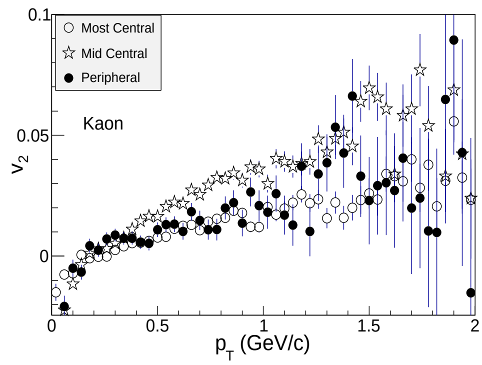

FIG. 2: v_2 versus p_T for K-mesons

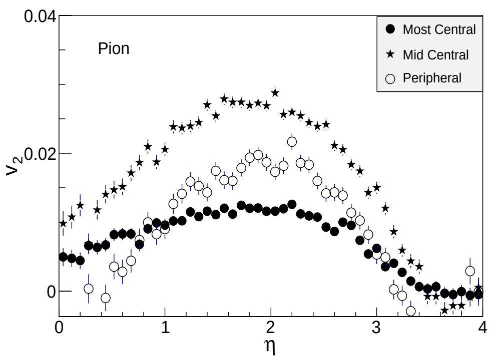

FIG. 3: v_2 versus η for π-mesons

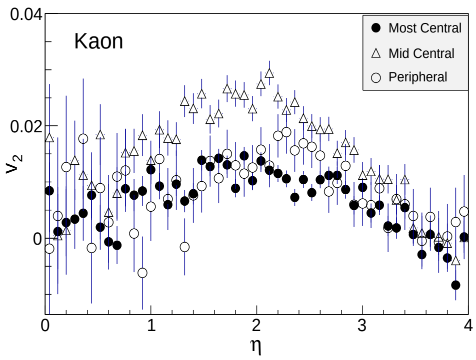

FIG. 4: v_2 versus η for K-mesons

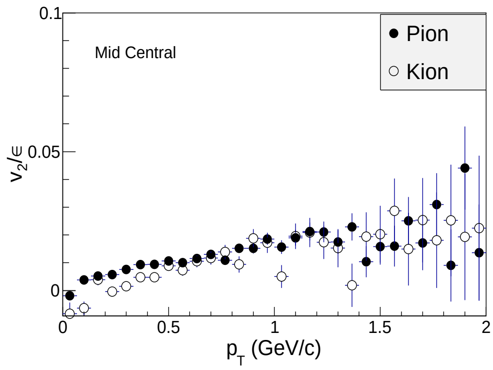

FIG. 6: v_2/ϵ versus p_T for π and K-mesons

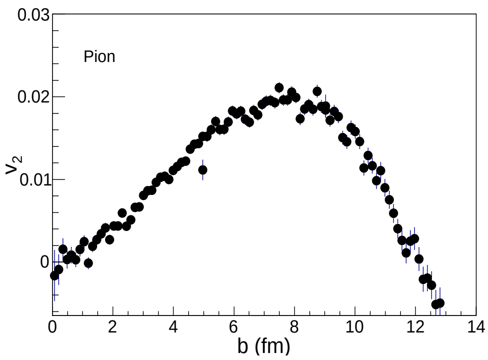

FIG. 5: v_2 against impact parameter for π-mesons

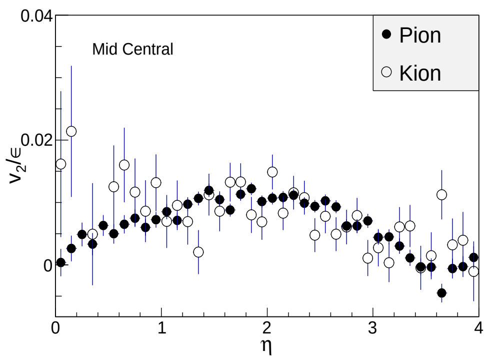

FIG. 7: v_2/ϵ versus η for π and K-mesons

most central and mid-central collisions. However such mass ordering is absent in the peripheral collisions. In FIG. 3 and FIG. 4 the flow parameter v_2 plotted as a function of η shows a peak within $1.5 \leq \eta \leq 2.5$, a region that corresponds to the maximum flow. In all these diagrams it is observed that in the most central collisions the nuclear overlap region is nearly symmetric and therefore, v_2 is less. In the mid-central collisions although the charge particle multiplicity is less, v_2 is large because of the strong asymmetry of the nuclear overlap region (larger impact parameter). In the most peripheral collisions, the asymmetry of the nuclear overlap region is very strong while the multiplicity is too low to generate a pressure gradient, and therefore, v_2 is small. In FIG. 5 v_2 is plotted as a function of b, and as expected we see maximum flow in the mid-central ($b = 6 - 8$ fm.) events. In FIG. 6 and FIG. 7 the ratio of flow and eccentricity ϵ is plotted respectively, as functions of p_T and η for pions and kaons. A scaling behavior of the ratio seems to appear in both cases. However, the exact nature of this scaling can be established only with a larger statistics. To summarize, the overall flow pattern of pions and kaons at a typical CBM experiment as generated by the AMPT model seems to be consistent with other such heavy-ion interactions. Any new or unusual behavior can be established with a larger statistics using more involved analysis of the data.

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