Fourier Expansion of Azimuthal Distribution for Au+Au collisions at AGS

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At AGS energies, collisions of heavy ions provide a unique opportunity for studying nuclear matter far from its normal density. It was predicted that at energy density about 1.5 GeV/fm^3 (10 times that of the nuclear ground state), a new form of matter Quark-Gluon Plasma (QGP) may be formed. One promising way to search for the QGP is to measure the systematics of QGP signatures as a function of beam energy. One such important observable is elliptic flow [1], where the transition from out-of-plane emission to in-plane emission will help us understand the interplay of early pressure buildup and system expansion.

The nucleon azimuthal distribution with respect to the reaction plane in a certain rapidity window can be deconvoluted using the Fourier expansion [2, 3],

$$\frac{dN}{d\phi} \approx v_0(1 + 2v_1\cos(\phi) + 2v_2\cos(2\phi)) \qquad (1)$$

where the angle ϕ is the angle difference between nucleons and the reaction plane ϕ_r. v_0 is a normalization constant, and v_1 and v_2 are a measure of directed flow and elliptic flow, respectively.

The extracted Fourier coefficients v_1 and v_2 at $2A$ GeV as a function of normalized rapidity are shown in Figure 1. The RQMD model calculation from both cascade and mean field mode are also shown in the figure as open circles and stars respectively. In the figures, data points have been reflected around mid-rapidity. We find that, in terms of the magnitude of the v_1 signal, calculations in cascade mode are in better agreement with the data, but it always predict a positive v_2 signal at mid-rapidity at all measured energies: 2, 4, 6 and $8A$ GeV. If we switch on the mean field, the calculations can reproduce the experimentally observed negative v_2 signal at mid-rapidity, but now it over-predicts the strength of v_1.

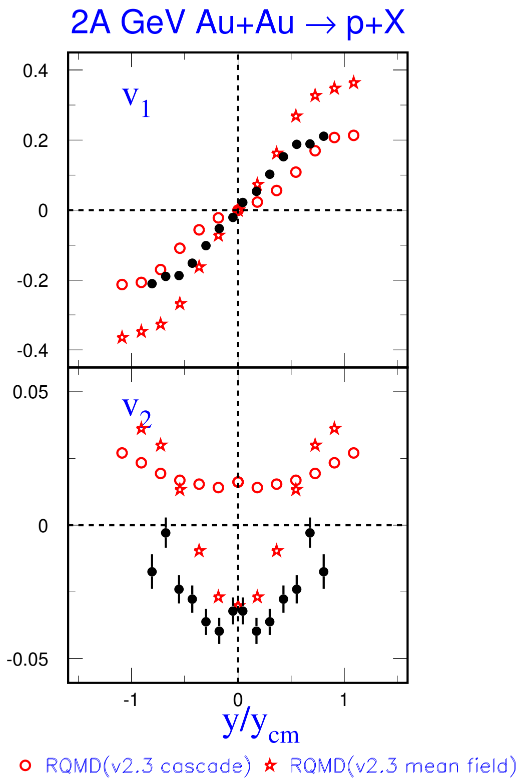

Figure 1: The comparison of v_1 and v_2 expressed as a function of normalized rapidity for protons with predictions from RQMD model. The data, shown in black points, have been reflected about midrapidity. The open symbols are from RQMD calculations. The centrality selection is $5 < b < 7$ fm.

References

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