

Elliptic Event Shapes at the CERN SPS

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The azimuthal asymmetry of hadron emission and transverse energy production in non-central Pb + Pb collisions at SPS energies was studied. The transverse energy was measured by the NA49 Ring Calorimeter in a special run without magnetic field to ensure azimuthally symmetric acceptance in momentum space. This calorimeter is segmented into 240 modules, configured in 10 radial rings and 24 azimuthal sectors. To search for azimuthal correlations we construct a two dimensional tensor as suggested in [1]. We define:

$$\vec{E}_{T,k} = (E_{T,k} * \cos\phi_k, E_{T,k} * \sin\phi_k) \quad (1)$$

and the tensor

$$F_{xy} = \sum_k E_{T,k}(x) * E_{T,k}(y) \quad (2)$$

with $E_{T,k}(x), E_{T,k}(y)$ being the components of the hadronic part of the transverse energy vector $\vec{E}_{T,k}$ for a given cell k centered at ϕ_k .

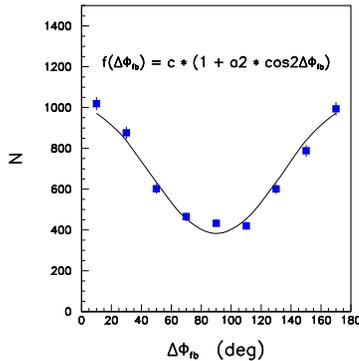


Figure 1: Forward-backward angular correlation of the major transverse energy flow axes.

This tensor is then evaluated to give the oval shape of the event separately in regions forward ($2.9 < \eta < 3.8$) and backward ($2.1 < \eta < 2.9$) of mid-pseudo rapidity for each event as a function of E_{VETO} , which is directly related to the impact

parameter. Fig. 1 demonstrates a strong angular correlation of the major axes between the two hemispheres in an event sample, corresponding to an impact parameter range of approximately 7-8 fm. The orientations of the forward and backward ellipses describing the azimuthal E_T distribution are shown to be aligned. This observation cannot be explained as a detector bias since the individual angular distributions of the major axes are uniform. To quantify the correlation strength of the orientation of the shape we fit the angular distribution in Fig. 1 with the function shown in the figure where c is a normalization constant. The centrality dependence is

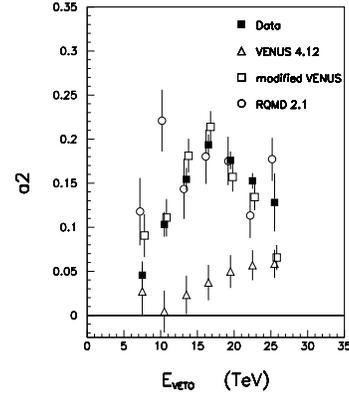


Figure 2: Centrality dependence of the a_2 correlation strength.

displayed in Fig. 2. We used the pseudo rapidity intervals $2.1 < \eta < 2.6$ and $3.3 < \eta < 3.8$ to reduce the influence of shower leakage to our analysis. The correlation strength a_2 exhibits a strong impact parameter dependence and is largest at roughly half overlap collisions. Filtered VENUS events fail to reproduce the data whereas RQMD (in mean field mode) agrees roughly within the statistical errors.

References

- [1] J.-Y. Ollitrault, Phys. Rev. D48 (1993) 1132