Excitation function of elliptic flow in Au+Au collisions

A. Andronic[1], Y.-J. Kim[1], M. Kirejczyk[1], T. Kress[1], P. Koczon[1], Y. Leifels[1], O.N. Hartmann[1], N. Herrmann[2], K.D. Hildenbrand[1], W. Reisdorf[1], A. Schüttauf[1], Z. Tyminski[1], Z.-G. Xiao[1] (for the FOPI Collaboration)
[1]GSI Darmstadt, [2]Universität Heidelberg

We present a complete excitation function of elliptic flow in Au+Au collisions at beam energies from 0.09 to 1.49·A GeV, measured with the FOPI detector. To characterize the elliptic flow we study the second order Fourier coefficient $v_2 = \langle\cos(2\phi)\rangle$, where ϕ is the angle with respect to the reaction plane. The results are for midrapidity ($|y^{(0)}| < 0.1$), which can be covered at all beam energies for particles identified in Z or for light particles selected by mass (A) with the momentum cut $p_t^{(0)} > 0.8$ ($p_t^{(0)} = (p_t/A)/(p_P^{cm}/A_P), y^{(0)} = (y/y_P)^{cm}$, where the subscript P denotes the projectile).

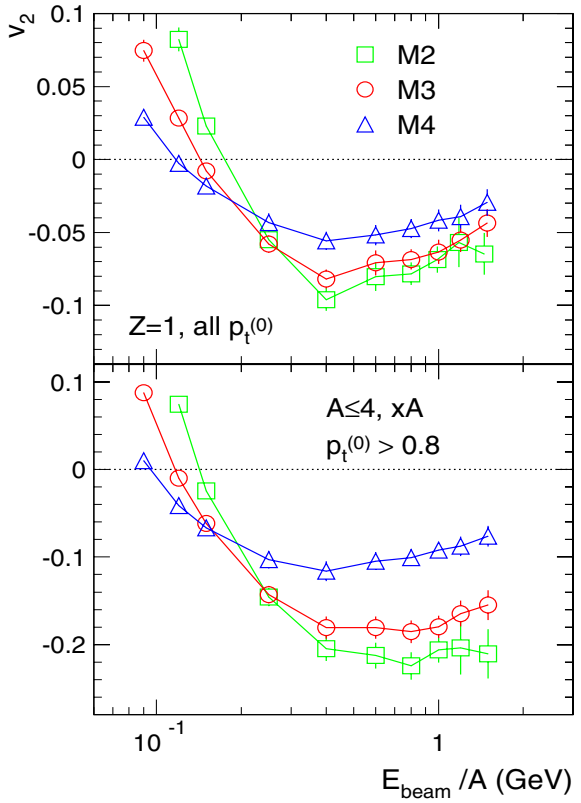

Figure 1: Excitation function of elliptic flow for three centrality bins. Upper panel: Z=1 particles, integrated for all momentum values. Lower panel: particles with A≤4 weighted with their mass, for $p_t^{(0)} > 0.8$.

In Fig. 1 we present the v_2 excitation function for three centrality bins, M2, M3 and M4, corresponding in a geometrical approximation to impact parameter ranges 7.5-10.0, 5.5-7.5, and 2-5.5 fm, respectively. The elliptic flow shows a transition from in-plane ($v_2 > 0$) to out-of-plane ($v_2 < 0$, also called squeeze-out) at low energies, which depends on centrality. This transition was already studied by our collaboration in great detail [1]. For data integrated on $p_t^{(0)}$, a maximum of v_2 is seen around the beam energy of 0.4 AGeV, which is more pronounced towards more peripheral collisions, followed by a decrease towards larger energies. This behaviour is a complex interplay between the magnitude of the fireball expansion (determined in turn by the equation of state, but also by stopping) and spectator shadowing. Comparisons with transport models will establish the importance of these data in the long quest for unraveling the nuclear EoS. The v_2 pattern is very similar to that of observables related to directed flow and stopping in the same energy range, recently completed by our collaboration [2].

The excitation function shows subtle differences in case of high-$p_t^{(0)}$ particles (Fig. 1, lower panel), which may originate from their different participation in the expansion.

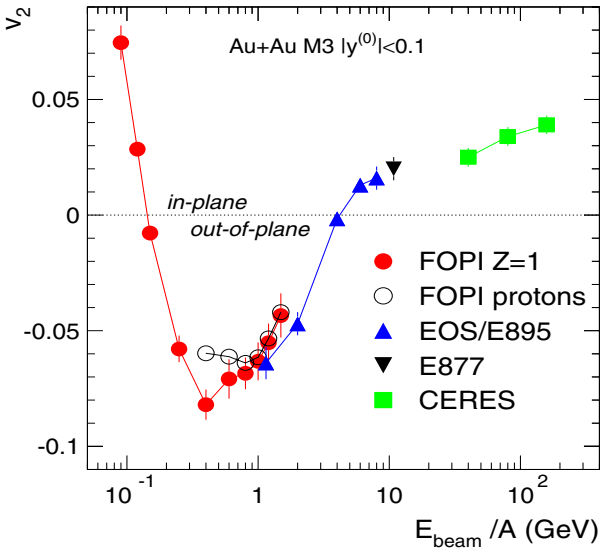

Figure 2: Excitation function of the elliptic flow for the M3 centrality bin. The FOPI data are compared to all existing measurements at fixed target experiments (protons).

In Fig. 2 we present a compilation of the elliptic flow values measured up to SPS energy. FOPI data for Z=1 particles in the M3 centrality bin are compared to values for protons measured by the experiments E895 [3], E877 [4], and CERES [5]. FOPI data for protons integrated on p_t are included for energies above 0.4 AGeV.

References

[1] A. Andronic et al., Nucl. Phys. A 679 (2001) 765.
[2] W. Reisdorf et al., submitted to PRL.
[3] C. Pinkenburg et al., Phys. Rev. Lett. 83 (1999) 1295.
[4] P. Braun-Munzinger and J. Stachel, Nucl. Phys. A6383 (1998) 3c.
[5] K. Filimonov, nucl-ex/0109017.