# Status of the AsyEOS S394 experiment: first preliminary results

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The AsyEOS Collaboration aims at improving the knowledge of the asymmetry part of the nuclear equation of state. The purpose of the recent experiment S394, performed at GSI in May 2011, is to determine the behaviour of the asymmetry potential at supra-saturation density, using the ratio of the strengths of the elliptic flow of neutrons with respect to that of protons in heavy-ion reactions at relativistic energy. The method, the motivations and the experimental set-up have been described in [1, 2, 3, 4, 5].

For the first time, the FAIRRoot software framework – which is presently dedicated to the simulations of the future FAIR detectors – has been applied for the analysis of experimental data. The discriminating power of the method relies on the measurement accuracy of several observables. The first one is the centrality of the collisions. For this, we mainly use the information delivered by the ALADiN Time-Of-Flight Wall which collects the spectator residues at very forward angles. One of the observables giving a centrality scaling is the total charge of fragments with $Z > 1$, called $Z_{bound}$. Fig. 1 shows the evolution of the biggest fragment charge $Z_{max}$ measured in an event as a function of $Z_{bound}$, very similar to the "universality" curve obtained in the past for the same system with the ALADiN set-up [6], although the acceptance for the projectile spectator is slightly smaller in S394.

Another key ingredient of the study of the elliptic flow is the precision of the reaction plane determination, done here by coupling the informations provided at various polar angles with the $\mu$-Ball (backward), CHIMERA and ToF-Wall detector arrays (forward). Fig. 2 shows a preliminary example of the good agreement obtained for the azimuthal orientation of the reaction plane between these detectors.

The remaining crucial point for measuring the neutron and proton elliptic flows is the precise determination of their momenta with a high detection efficiency, provided by the LAND array at mid-forward angles. Fig. 3 shows the angular distributions of neutrons with respect to the reaction plane for two rapidity intervals, as obtained after subtracting the background contribution.

The preliminary results are promising. The data analysis is still on the way, towards the determination of accurate elliptic flow parameters with high statistics.

## References

[1] P. Russotto et al., GSI Scientific Report 2010, p.68.

[2] P. Russotto et al., Phys. Lett. B697 (2011) 471.

[3] P. Russotto et al., GSI Scientific Report 2012, p.90.

[4] J. Łukasik et al., GSI Scientific Report 2010, p. 69.

[5] J. Łukasik et al., GSI Scientific Report 2011, p. 91.

[6] A. Schüttauf et al., Nucl. Phys. A607 (1996) 457-486.

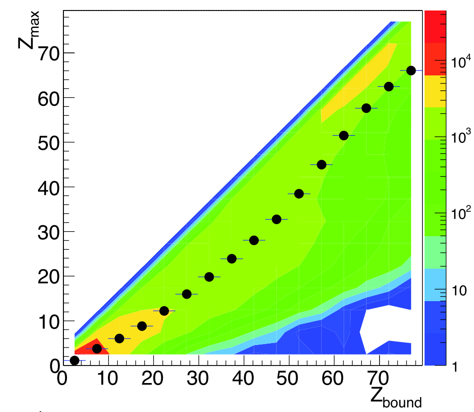


Figure 1: Biggest fragment charge in an event (symbols = mean values) as a function of $Z_{bound}$ (see text) measured in the ToF-Wall and CHIMERA for the reaction $^{197}Au + ^{197}Au$ at 400 A.MeV incident energy.

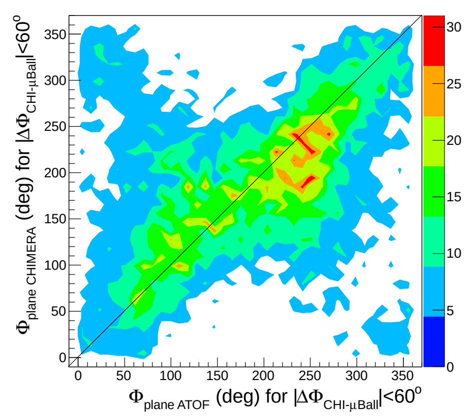


Figure 2: For the same reaction, bi-dimensionnal representations of azimuthal angles of the reaction plane as measured by CHIMERA and the ToF-Wall, under the condition of consistency between CHIMERA and $\mu$-Ball.

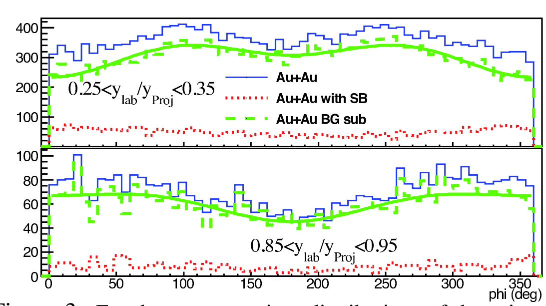


Figure 3: For the same reaction, distributions of the azimuthal angle of neutrons measured in LAND with respect to the reaction plane determined by CHIMERA, for different intervals of neutron rapidity. "SB" and "BG sub" mean respectively "shadow bar" and "background subtracted" (i.e. "no SB" minus "with SB"). The smooth curve is the Fourier decomposition of the elliptic flow.