Universality of Projectile Fragmentation at Relativistic Energies

A.Schüttauf for the ALADIN - Collaboration

Univ. Frankfurt, GSI Darmstadt, Univ. Catania, Univ. Milano, FZ Rossendorf, SINS Warszawa

In the most recent experiments at the ALADIN spectrometer the fragmentation of excited projectile spectators was studied with beams of Xe,Au,U at energies from 400 to 1000 MeV per nucleon and with targets ranging from Be to U . These data have allowed us to further test the universality of the fragmentation patterns observed in the fragment distributions as a function of Z_{bound} [1][2]. Z_{bound} is the sum of the charges of all product nuclei with Z $\geq$ 2 and is related to the total charge and the excitation energy of the excited spectator.
The new data show that the universality also holds if the projectile energy or the projectile mass are varied. The dependence on the bombarding energy was studied for Au + Au collisions between 400 to 1000 AMeV. The cuts in the detector acceptance chosen in the analysis compensate for the focussing effect which increases with the bombarding energy [3]. It was required that, at the lower bombarding energies, some of the fragments detected with the Si-CsI hodoscope in front of the ALADIN magnet are included in the projectile spectator source.

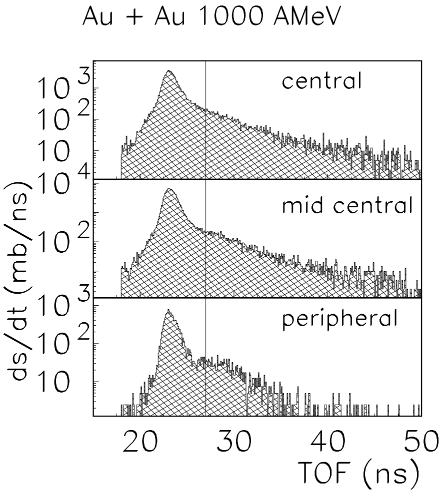

Figure 1: Time-of-flight spectra for Z=2 particles at 1000 AMeV

The contribution of the midrapidity source is illustrated in FIG. 1 for Z = 2 particles. In peripheral reactions it appears as a separate bump at larger flight - times, i.e. lower velocities. In more central collisions the distributions overlap more strongly. However , fits to the measured distributions with Gaussian and Poissonian functions and model calculations suggest that a cut at 75 % of the projectile rapidity (27 ns at 1000 AMeV) yields a satisfactory separation of the projectile and mid-rapidity sources. The mean number $< M_{IMF} >$ of intermiediate mass fragments as a function of Z_{bound} for the so - defined spectator source is shown in FIG. 2. No significant dependence on the bombarding energy is observed. In order to compare the results for the Xe,Au and U projectiles the quantities $< M_{IMF} >$ and Z_{bound} were divided by the atomic number of the projectile Z_{proj}. With this linear scaling the universality of the fragment production is retained for projectiles of different mass (FIG. 3).

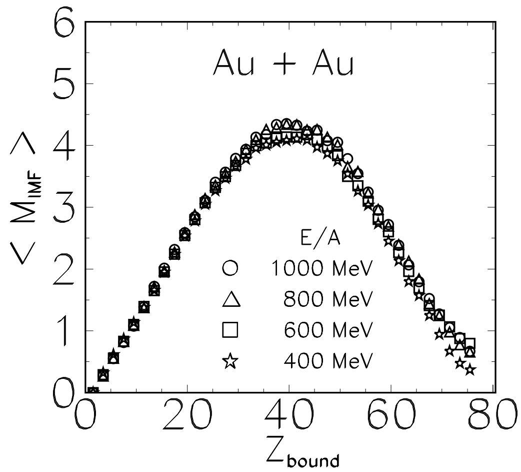

Figure 2: Mean number of intermediate-mass fragments (3$\leq$Z$\leq$30) as a function of Z_{bound}.

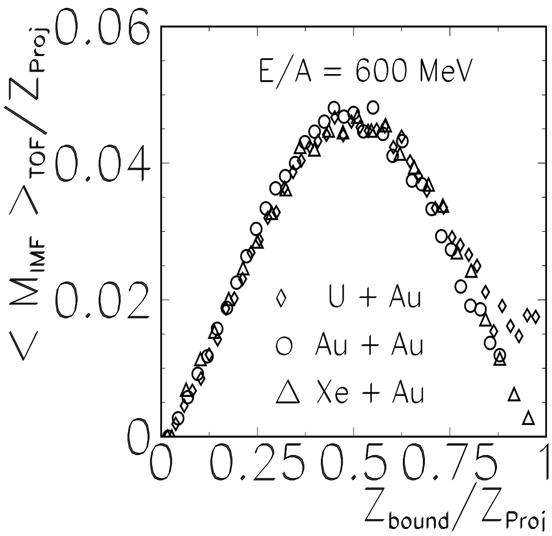

Figure 3: Mean number of intermediate mass fragments (3$\leq$Z$\leq Z_{proj}$/3) for Xe,Au, and U projectiles after collisions with a Au target.

References

[1] J.Hubele et al. Z. Phys. **A 340**, 263 (1991)

[2] P.Kreutz et al. Nucl. Phys. **A 556**, 672 (1993)

[3] GSI Sientific Report S. 19 (1993)