

${}^3\text{H}/{}^3\text{He}$ Squeeze-Out - A Signature of the Fireball's Isospin Distribution?

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The Phase I FOPI data evidence for highly central Au + Au collisions at 100, 150 and 250 A-MeV systematically larger mean kinetic energies for ${}^3\text{He}$ fragments relative to the ${}^3\text{H}$ values [1]. The EOS Collaboration find the same trend with somewhat larger size [2]. Microscopic transport models [3] and hybrid hydrodynamical models, including pure Coulomb repulsion at the freeze-out moment [4] do not succeed to explain quantitatively this difference. Similar findings are recently reported by the INDRA Collaboration [5] for ${}^{129}\text{Xe} + {}^{119}\text{Sn}$ at 50 A-MeV. At a higher incident energy 1.15 A-GeV it seems that this difference disappears. Both types of fragments have the same mean kinetic energy, following a trend as a function of the fragment mass only, which is specific for the emission from an expanding source.

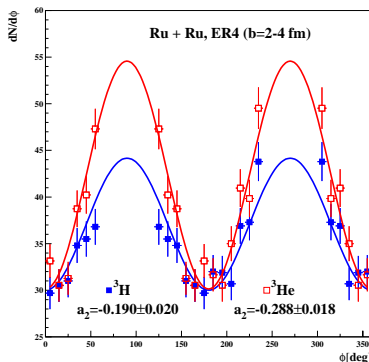


Figure 1: ${}^3\text{He}$ and ${}^3\text{H}$ azimuthal distributions for Ru + Ru collision at $b=2-4$ fm and $p_t^{(0)} = (p_t/A)/(p_P^m/A_P)$ range of 0.8-1.2

Corroborating these facts, based on the dynamics of the expansion suggested by hydrodynamical models, one could imagine that due to the Coulomb repulsion, the outer layers of the initial fireball are to some extent more proton rich than the inner zones. If this is the case, then one expects ${}^3\text{He}$ fragments originating with higher probability from these regions of the fireball and consequently having larger expansion velocities as far as the expansion has an almost linear dependence as a function of the distance from the the center of the fireball [3, 4]. Within such a scenario, the ${}^3\text{He}$ fragments are supposed to be emitted preferentially in earlier phases of the expansion than the ${}^3\text{H}$ fragments, and feel a larger shadowing from the spectators passing by. For mid-central collisions this may lead to a difference in the squeeze-out signal. In order to check this, we analysed data of Ru + Ru collision at 400 A-MeV obtained with the Phase II - FOPI experimental configuration.

The mass and charge identification of $A=3$ fragments is achieved using the combined information from the central drift chamber (CDC) and the time-of-flight Barrel surrounding the CDC. The low momentum range cannot be used due to the geometrical gap between the CDC and

HELITRON. However, the kinetic energy distribution of ${}^3\text{He}$ and ${}^3\text{H}$, for highly central collisions (1% cross section), show similar trends as those observed in Au + Au collision [1]. The selection of the collision geometry and reaction plane determination are explained in a different contribution to this report. The azimuthal distributions are obtained in the reference frame rotated by the side-ward flow angle relative to the collision axis. Due to geometrical cuts the experimental data are analysed in the angular range $0^\circ-60^\circ$ and $300^\circ-360^\circ$. The angular distributions presented in Fig.1 are obtained by symmetrising these results relative to 90° and 270° , respectively. For an impact parameter range of $b = 2-4$ fm one observes a much larger squeeze-out signal for ${}^3\text{He}$ relative to ${}^3\text{H}$. The two azimuthal distributions are normalised at 0° . A second order Fourier expansion ($f(\Phi) = a_0(1 + a_2\cos(2\Phi))$) is used to fit the azimuthal distributions. The resulting a_2 coefficients for all fragments from $A=1$ to $A=4$ are presented in Fig.2. While p,d and ${}^4\text{He}$ show the well known enhancement of the squeeze-out signal as a function of mass, larger a_2 values for ${}^3\text{He}$ relative to ${}^3\text{H}$ can be observed. Different cross-checks and comparisons with microscopic model predictions are in progress. However, this preliminary result seem to indicate that the relative value of the squeeze-out signal of ${}^3\text{H}$ and ${}^3\text{He}$ could be related to the isospin distribution in the fireball at the freeze-out moment. Obviously, other contributions (like Coulomb focusing) to the observed effect are not excluded.

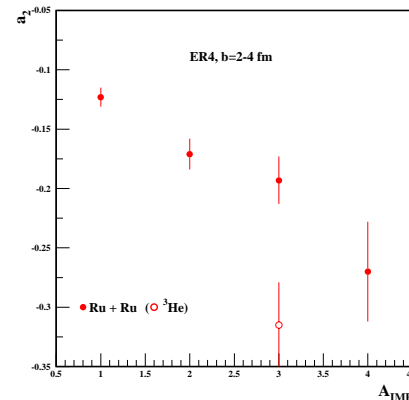


Figure 2: a_2 values as a function of mass of the reaction products for Ru + Ru collision for the same geometry and $p_t^{(0)}$ values as for Fig. 1

References

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