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STUDYING BINARY COLLISIONS WITH THE ^{40}Ca+^{40}Ca REACTION AT $E_{\rm lab} = 35$ MeV/NUCLEON*

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The ^{40}Ca+^{40}Ca reaction at 35 MeV/nucleon has predominantly a binary character, in agreement with the deep inelastic scattering scenario. It is well described by the stochastic mass and momentum transfer model, both in the primary reaction stage as well as in the secondary evaporation stage.

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The binary reaction scenario has been studied in the ^{40}Ca+^{40}Ca reaction at 35 MeV/nucleon (the Fermi energy domain) using the 4π detector system AMPHORA upgraded with 30 ionization chambers [1]. The 4π detection system enabled us to reconstruct the primary projectile- like fragments for quasi-elastic as well as deep inelastic collisions. The charge, mass and excitation energy distributions of the primary PLF's have been determined. The secondary deexcitation of the PLF source has been also studied [2].

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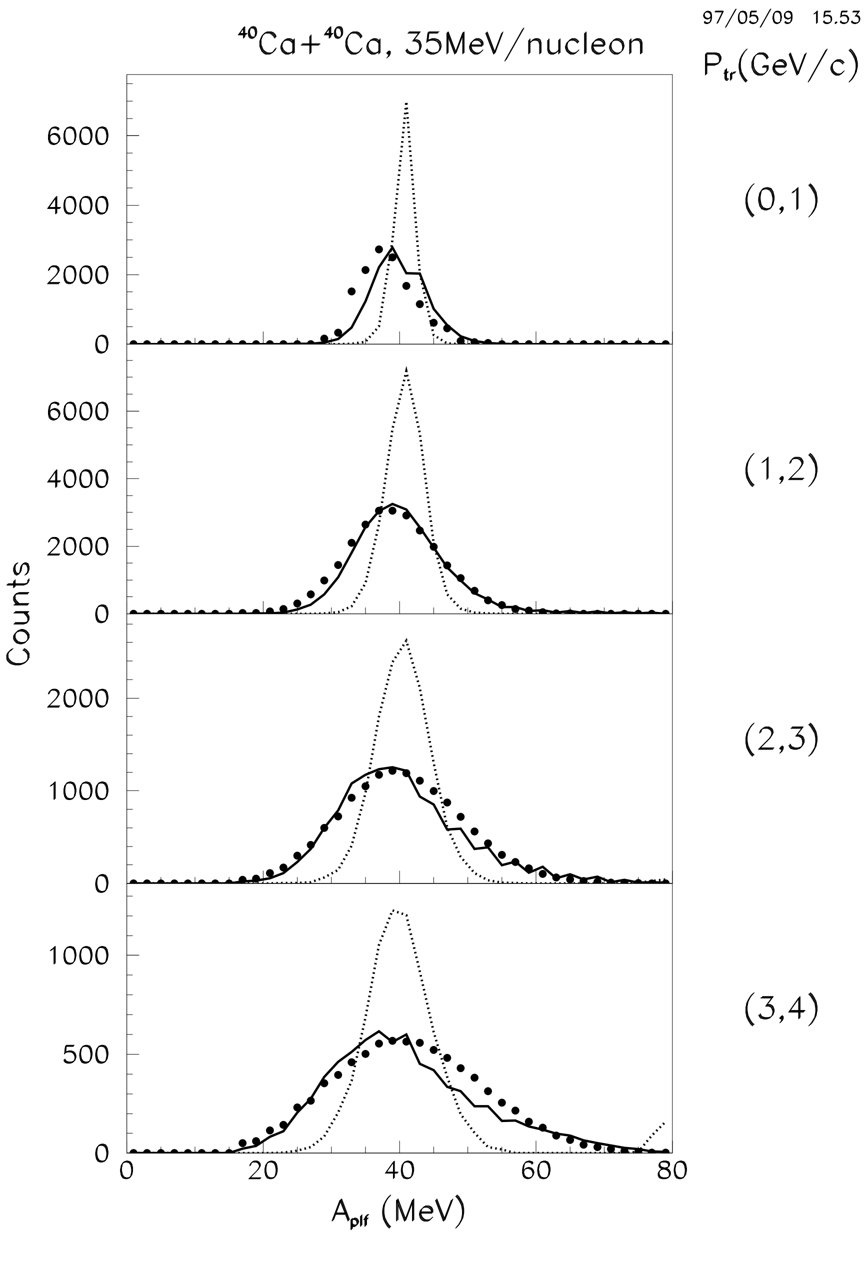

Fig. 1. Mass distributions of reconstructed PLF's for consecutive windows of $p_{\rm tr}$ (solid points). The SMMT model predictions for the primary PLF mass distribution (doted line) and for the reconstructed mass (solid line) are also presented.

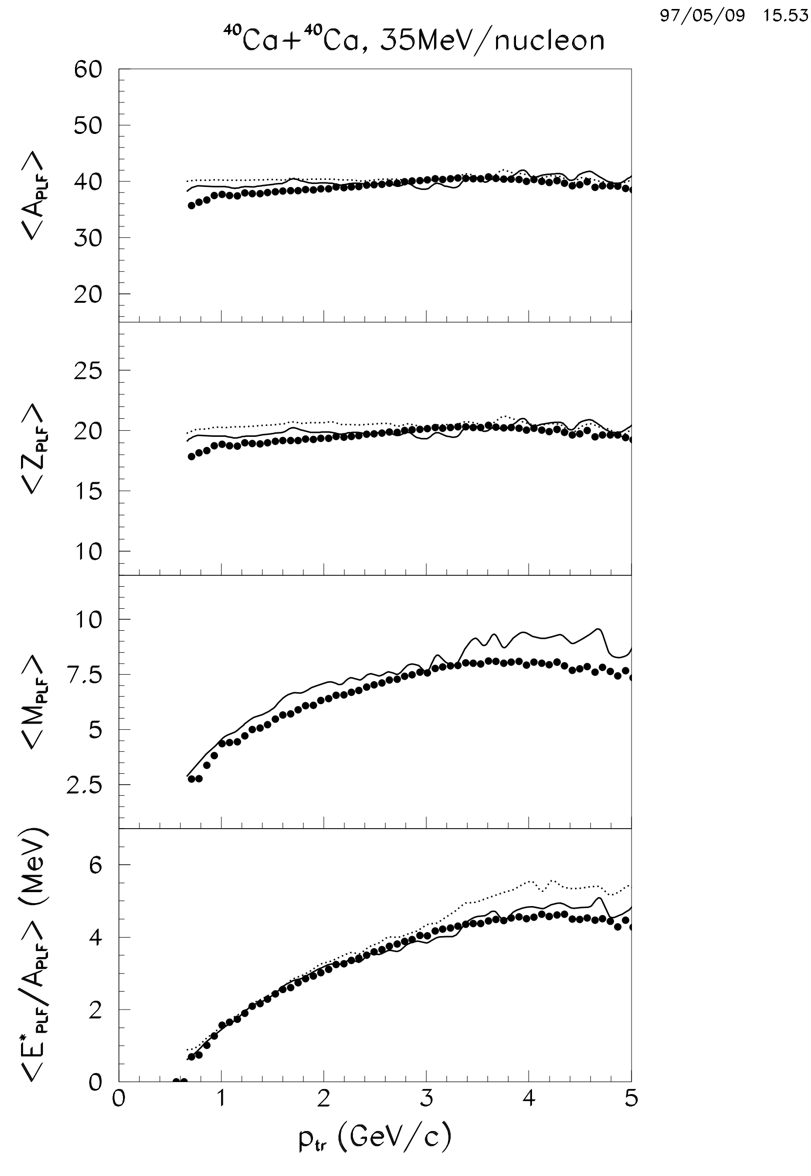

Fig. 2. Average values of mass, charge, decay multiplicity, excitation energy per nucleon of the reconstructed PLF's versus $p_{\rm tr}$ (solid points). The SMMT model predictions for average values of these primary quantities (doted line) and for the reconstructed quantities (solid line) are also presented.

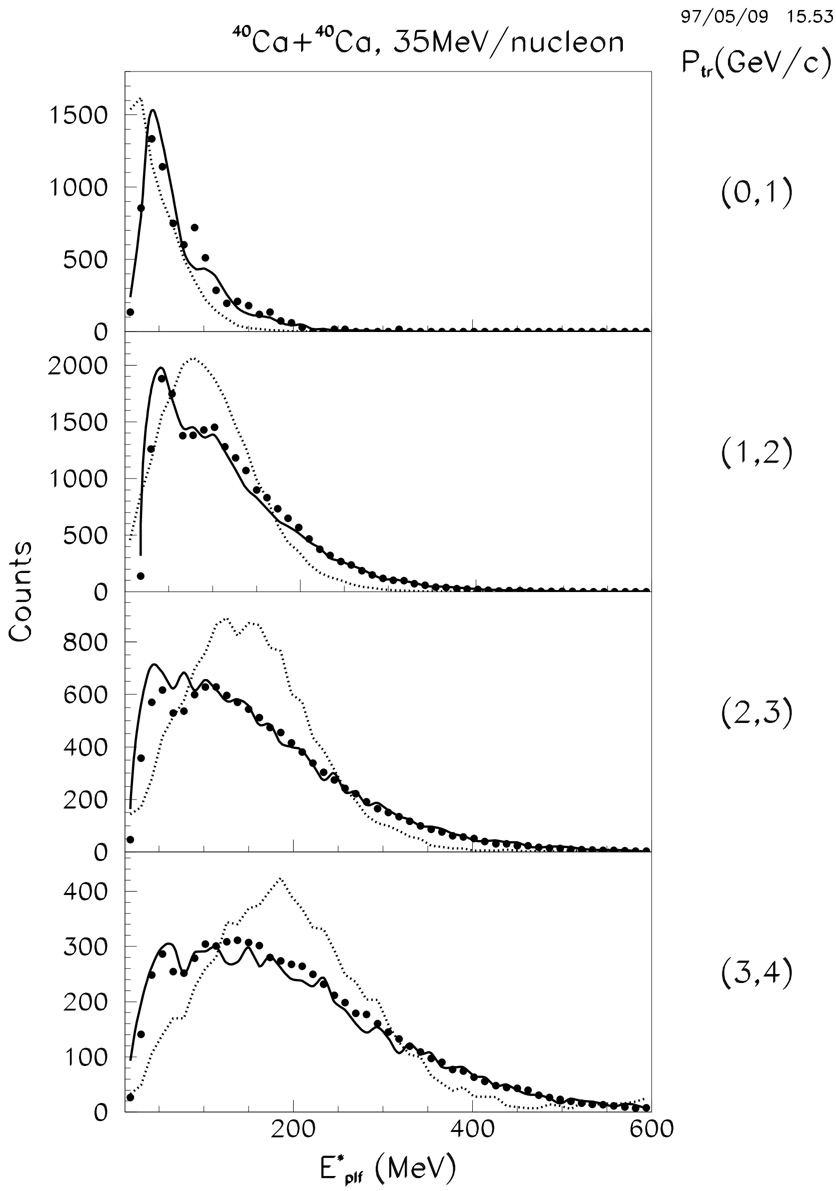

Fig. 3. Excitation energy distributions of reconstructed PLF's for consecutive windows of $p_{\rm tr}$ (solid points). The SMMT model predictions for the primary PLF excitation energy distribution (doted line) and for the reconstructed excitation energy (solid line) are also presented.

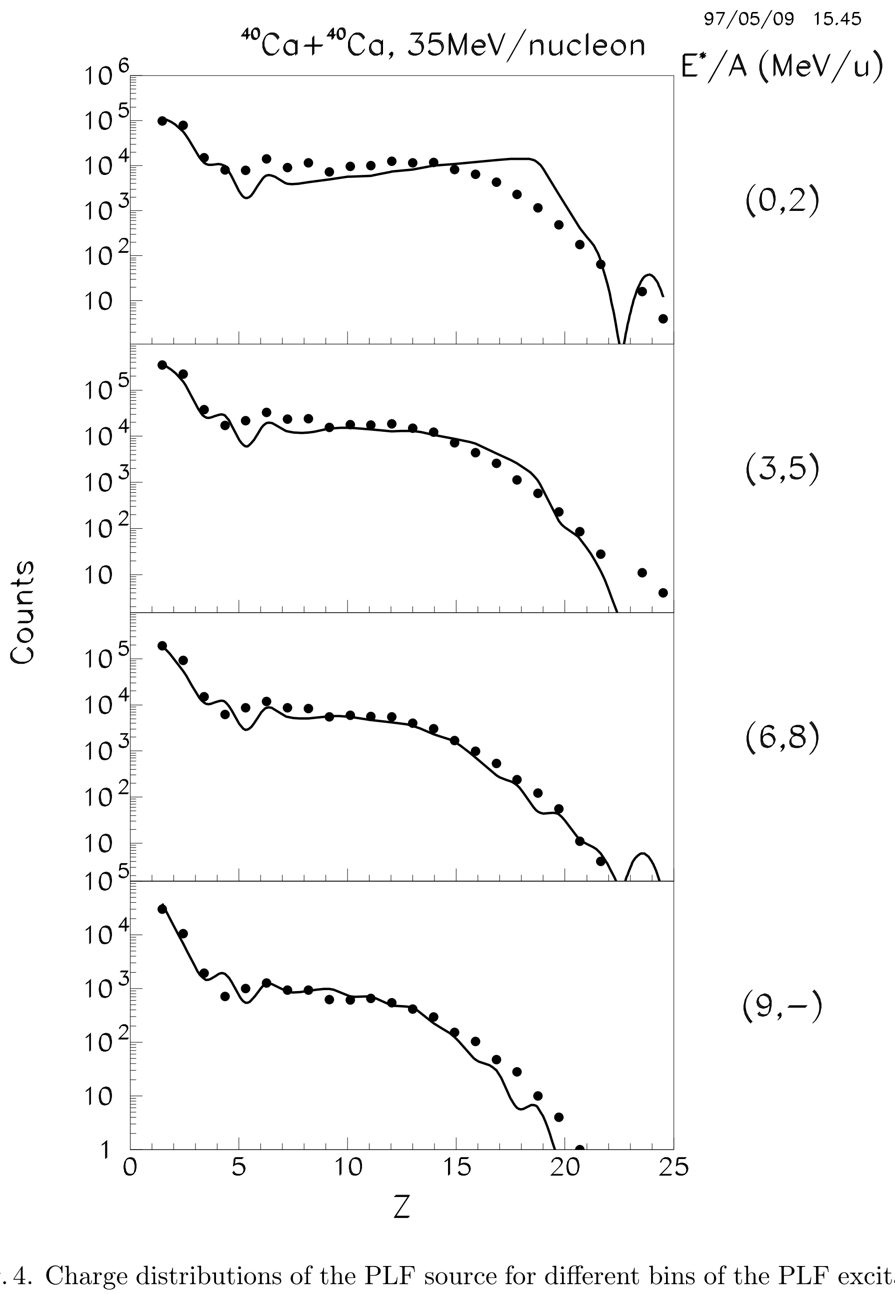

Fig. 4. Charge distributions of the PLF source for different bins of the PLF excitation energy (solid points). The SMMT model predictions are represented by solid lines.

In data analysis the transverse momentum, $p_{\rm tr}$, has been used as a measure of the dissipated energy. The width of the primary projectile like fragment (PLF) mass distribution (Fig.1) increases with the increasing $p_{\rm tr}$ while its centroid (Fig.2) remains fairly constant at a value close to the projectile mass. The primary PLF excitation energy increases with the increasing $p_{\rm tr}$ and its width also increases (Fig.3). Figure 4 shows the final charge distribution of particles emitted by the hot PLF, with respect to its excitation energy.

The experimental results agree with predictions of the stochastic mass and momentum transfer (SMMT) model which describes the heavy ion reaction as a series of nucleon-nucleon collisions in the overlap zone of heavy ions and multiple transfer of the corresponding nucleon masses, momenta and angular momenta. It was possible, for the first time to make detailed comparisons of the SMMT model predictions with data on the primary reaction level (formation of the primary PLF) as well as on the secondary deexcitation level. It is demonstrated in Figs $1 \div 4$ where model predictions for the primary reaction, before evaporation are presented as dotted lines and for the secondary reaction products as solid lines.

Experimental observations and agreement of experimental data with predictions of the SMMT model provide the strong support for the stochastic nature of the DIC reaction scenario. This work also shows that Monte Carlo calculations based on the SMMT model can be used as a convenient event generator. It is worthwhile to mention quite high final excitation energies (up to 4 MeV/u) of Ca nuclei participating in collisions.

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