Source reconstruction and caloric curves in $^{70}Zn + ^{70}Zn$ at E/A = 35MeV

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Preliminary caloric curves have been extracted for reconstructed quasi-projectile sources in collisions of $^{70}Zn+^{70}Zn$ at E/A = 35MeV.

Charged particles and free neutrons were measured in the NIMROD-ISiS 4π detector array. Charged particles were isotopically identified up to Z=17. A series of constraints are placed on the events to select events with a well-measured, equilibrated quasi-projectile source. This is done using the method developed by S. Wuenschel et al. [1]. First, non-equilibrium particle production is suppressed by considering the parallel velocity of charged particles relative to the projectile-like fragment (the heaviest charged particle in the event). Only those within a specific tolerance of this velocity are included in the reconstruction. Second, the charge of the reconstructed quasi-projectile is required to be between 25 and 30 inclusive to ensure near-complete measurement of the quasi-projectile. Third and finally, since we seek an equilibrated source, which should be spherical on average, the quadrupole deformation is restricted to be $-1 \leq \log Q \leq 1$ where $Q = \Sigma p_z^2 / 2\Sigma p_t^2$. The excitation energy of this reconstructed quasi-projectile source is calculated as the sum of three things: the measured charged particle transverse kinetic energy, an average neutron kinetic energy (time the number of free neutrons), and the negative of the Q-value of the breakup. This reconstruction (series of “source cuts”) was implemented in a transparent and modular fashion, allowing easy adaptation to other data-sets and inclusion in future analysis routines.

The temperature of the quasi-projectiles has been extracted from the momentum quadrupole fluctuations as described by Zheng and Bonasera both in the classical approximation, and considering the fermionic nature of the nuclei [2]. Preliminary caloric curves are shown in Figure 1 for selected charged particles. As expected, the classical and quantum temperatures are in agreement at low excitation energy. As the excitation energy increases, both the quantum and classical temperatures increase monotonically, with the quantum temperature rising less rapidly than the classical as expected.

In the near future, the caloric curves will be investigated to understand how they depend on reaction mechanism and isotopic composition. The reaction mechanism evolution has been shown to influence the caloric curve [3]. In this data, we can select on the reaction mechanism both through collision violence [4], and through the size of the projectile-like fragment. Moreover, the impact of the isotopic composition of the emitting source on the caloric curves will be investigated. It is possible that by selecting on the composition of isotopically-resolved reconstructed quasi-projectiles rather than the composition of the initial system, an isospin dependence of the caloric curves may be observed.

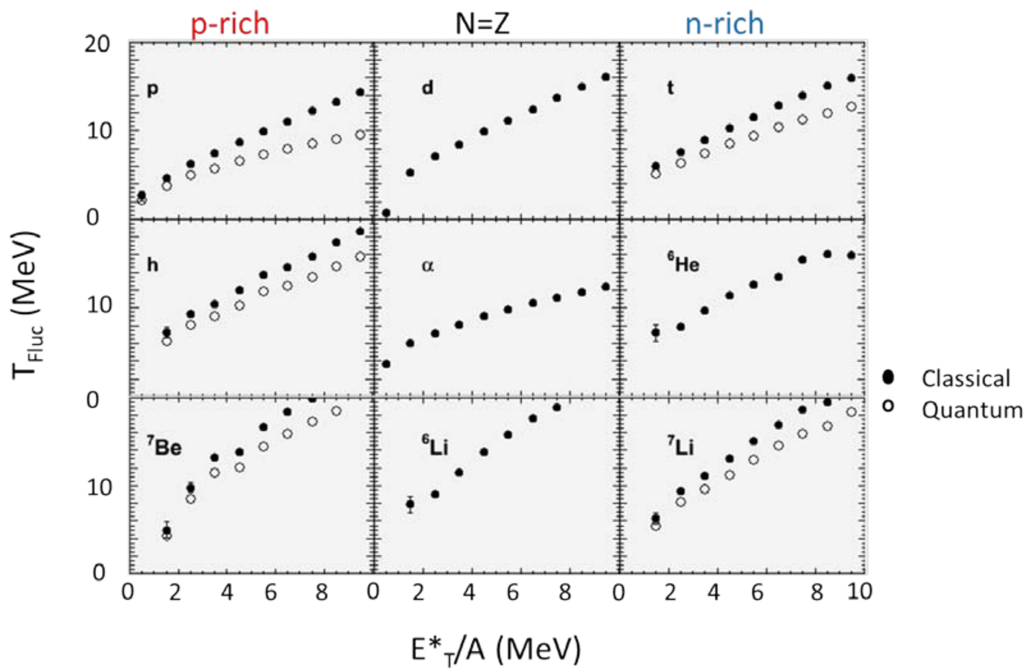

FIG. 1. Caloric curves for light charged particles and intermediate mass fragments produced in $^{70}Zn + ^{70}Zn$ collisions at E/A = 35MeV.

[1] S. Wuenschel *et al.*, Nucl.Phys. **A843**, 1 (2010).

[2] H. Zheng and A. Bonasera, Phys. Lett. B **696**, 178 (2011).

[3] R. Tripathi *et al.*, Phys. Rev. C **83**, 054609 (2011).

[4] Z. Kohley, Ph.D. Thesis, Texas A&M University, 2010