The Caloric Curve from 8 GeV/c Negative Pion, Anti-Proton + Gold

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The experiment E900a was performed at Brookhaven National Laboratory to study the reaction of 8 GeV/c negative pion, anti-proton + gold. In this system, the target nucleus is rapidly heated with little compression via collisions induced by a GeV hadron beam. It provided an excellent system for studying the thermodynamic properties of hot nuclei. The light charged particles and intermediate mass fragments from the reaction were detected using the Indiana Silicon Sphere (ISiS) 4π detector array [1].

Last year, the caloric curve for hot nuclei formed in 8 GeV/c negative pion, anti-proton + gold was investigated using double isotope ratio thermometers. Now, the investigation focuses on the caloric curves using temperature derived from the slope parameter.

A moving source analysis has been performed on the kinetic energy spectra for Z = 6, 8, and 10. The temperature is one of the parameters to fit the energy spectra. The fit can be done by assuming that there are two sources responsible for the major features of the data [2]. The fast source is dominated by pre-equilibrium emission. The slow source represents the source that emitted later at low density when the system was equilibrated.

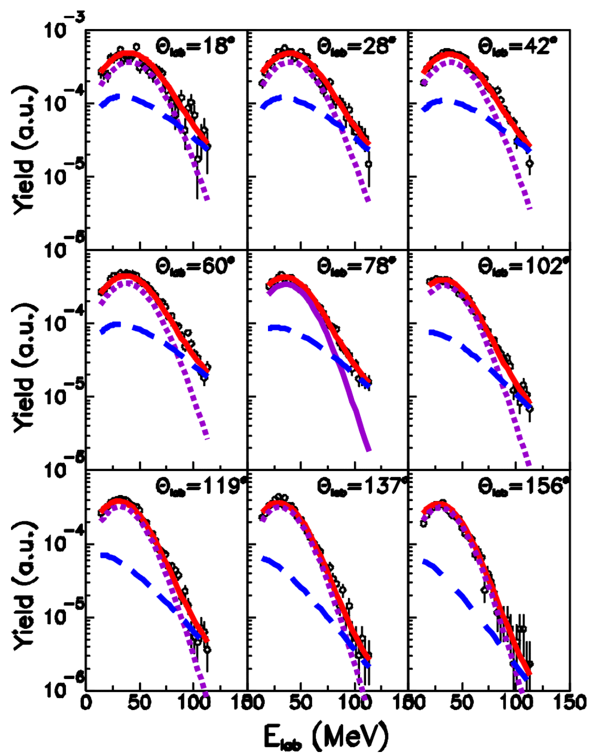

Figure 1: The kinetic energy spectra for Z = 6. The fits from fast source, slow source and the sum are represented by dash line, dot line and solid line respectively.

The kinetic energy spectra of Z = 6 up to 114 MeV is shown in figure 1. The dotted line and dashed line represent the fits from the fast source and slow source respectively. The solid line is the sum for the fast source and the slow source. For intermediate mass fragments, the contribution from the fast source is small. The slow source fit nearly reproduces the energy spectra of the fragments. Therefore, the temperature can be extracted fairly well from the slow source fit.

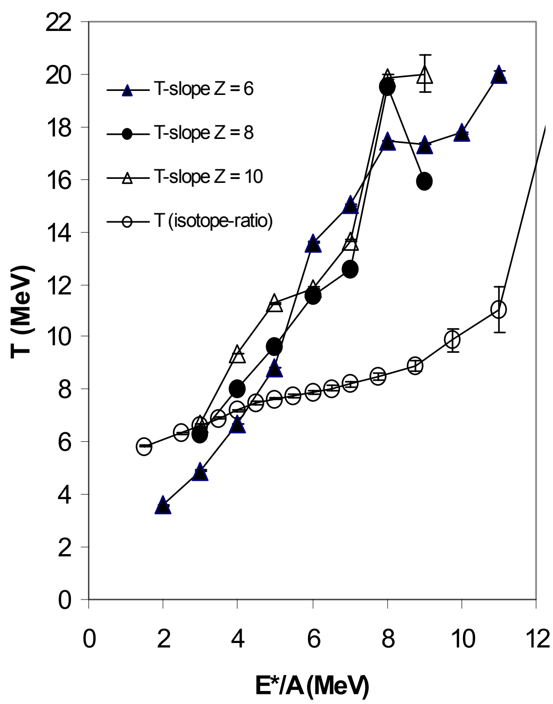

Figure 2: The caloric curves from slope temperatures and double isotope ratio temperature.

The preliminary caloric curves from the slope temperature using 3 different charges (Z = 6, 8, and 10) are compared with the caloric curve from double-isotope-ratio [3] thermometer ($T_{d/t*4/3He}$) in figure 3. The caloric curves from the slope temperature yield higher temperatures than the double-isotope-ratio caloric curve. The double-isotope ratio caloric curve shows an increase in temperature at low excitation energy follows by a plateau at E*/A between 4-8 MeV and then an increase in temperature at high excitation energy. The caloric curves from the slope temperature show a monotonic increase in temperature with excitation energy. The differences in the caloric curves extracted from slope temperature and double-isotope-ratio temperature will be investigated in the near future.

References.

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