Temperatures and freeze out radii of expanding nuclear matter in central Au+Au collisions.

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We measured temperatures in Au+Au collisions at beam energies of 50, 100, 150, and 200 AMeV with three hodoscopes consisting of in total 216 Si-CsI(Tl) dE-E detectors and placed at angles at $\theta_{lab.} = 24 - 59^o$. Central collisions where selected by gating on multiplicity of light charged particles measured with an additional forward hodoscope consisting of 36 dE-E detectors and an array of 48 Si-strip detectors. For statistical reasons no impact parameter cut was applied to the 50 AMeV data. The apparent temperatures from excited states for all incident energies are in agreement with an rather constant temperature of T≈4-6 MeV. With increasing beam energy there is a growing disagreement between chemical temperatures and temperatures extracted from particle unbound states. In a blast scenario, which starts to evolve in this energy regime, different types of fragments might freeze out at different reaction stages. Therefore, it is conceivable that quite delicate objects like excited states are formed in a later colder reaction stage compared to quite stable ground states.

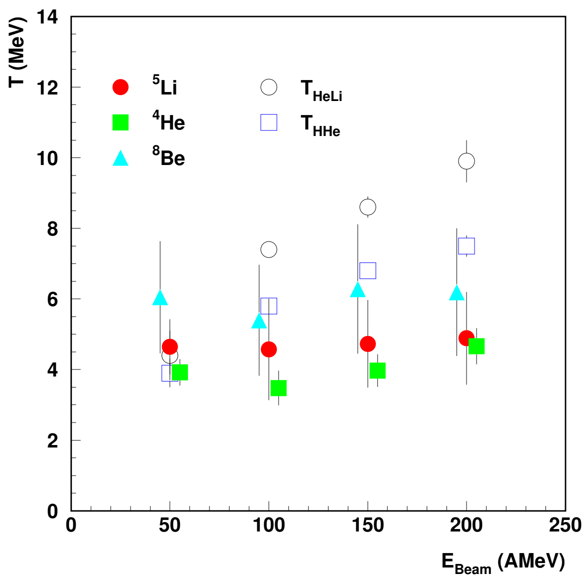

Figure 1: Chemical temperatures (open symbols) and temperatures from excited states (closed symbols) for different incident energies.

The blast scenario that evolves with increasing incident energies also influences the proton-proton correlation function, from which information about the space-time behaviour of the source may be obtained [1]. The correlation functions for proton pairs from reactions at 100, 150, and 200 AMeV incident energies are shown in Fig. 2 (data points). From QSM [3] calculations, with parameters selected to describe measured yields, the fractions of protons emitted from long lived resonances were estimated to be 0.21, 0.29, and 0.31 for 100, 150, and 200 AMeV, respectively. The data were corrected for this effect and source sizes were deduced by comparing these correlation functions with predictions of the Koonin-Pratt formalism (lines in Fig. 2). A Monte Carlo generated source with flow, zero lifetime, and with temperature values taken from Ref. [2] served as input for this theoretical description. The simulated protons have passed through the experimental filter. With increasing incident energy the apparent source size

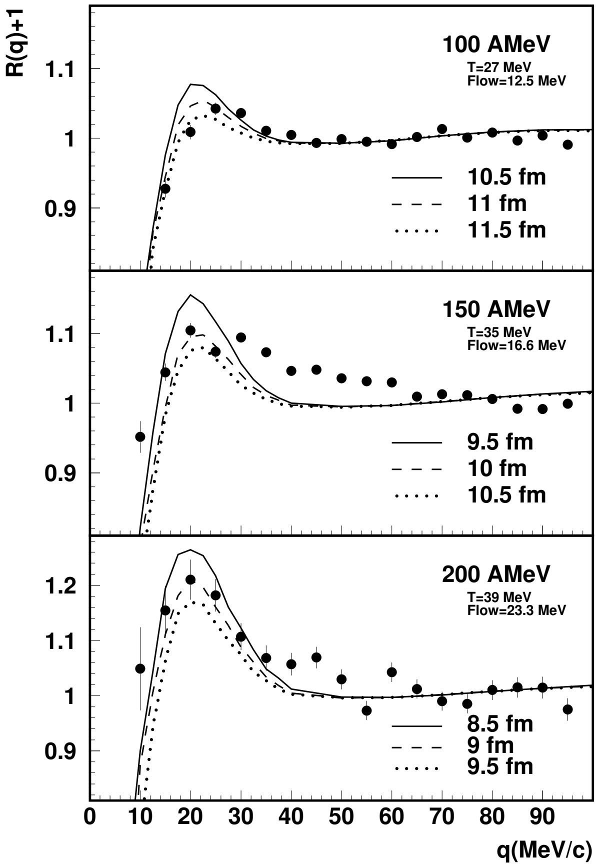

Figure 2: Proton-Proton correlation functions are shown for central collision at the indicated incident energies. Theoretical predictions (lines) indicate a shrinking apparent source size.

decreases from 11 fm to 9 fm. These values are larger than the radius of the combined system of two Au nuclei at groundstate density. The systematical errors resulting from different methods of normalization are estimated to be about 0.5 fm.

References

[1] H. Xi, GSI, Scientific Report 1995, 37

[2] G. Poggi et al., Nucl. Phys. A **586** (1995) 755

[3] D. Hahn and H. Stöcker, Nucl. Phys. A **476** (1988) 718