Bestimmung von Aufbruchtempteraturen und –radien aus Leichtteilchenkorrelationen in ^{197}Au + ^{197}Au Kollisionen bei 1 A·GeV

Einleitung

Experimentelles

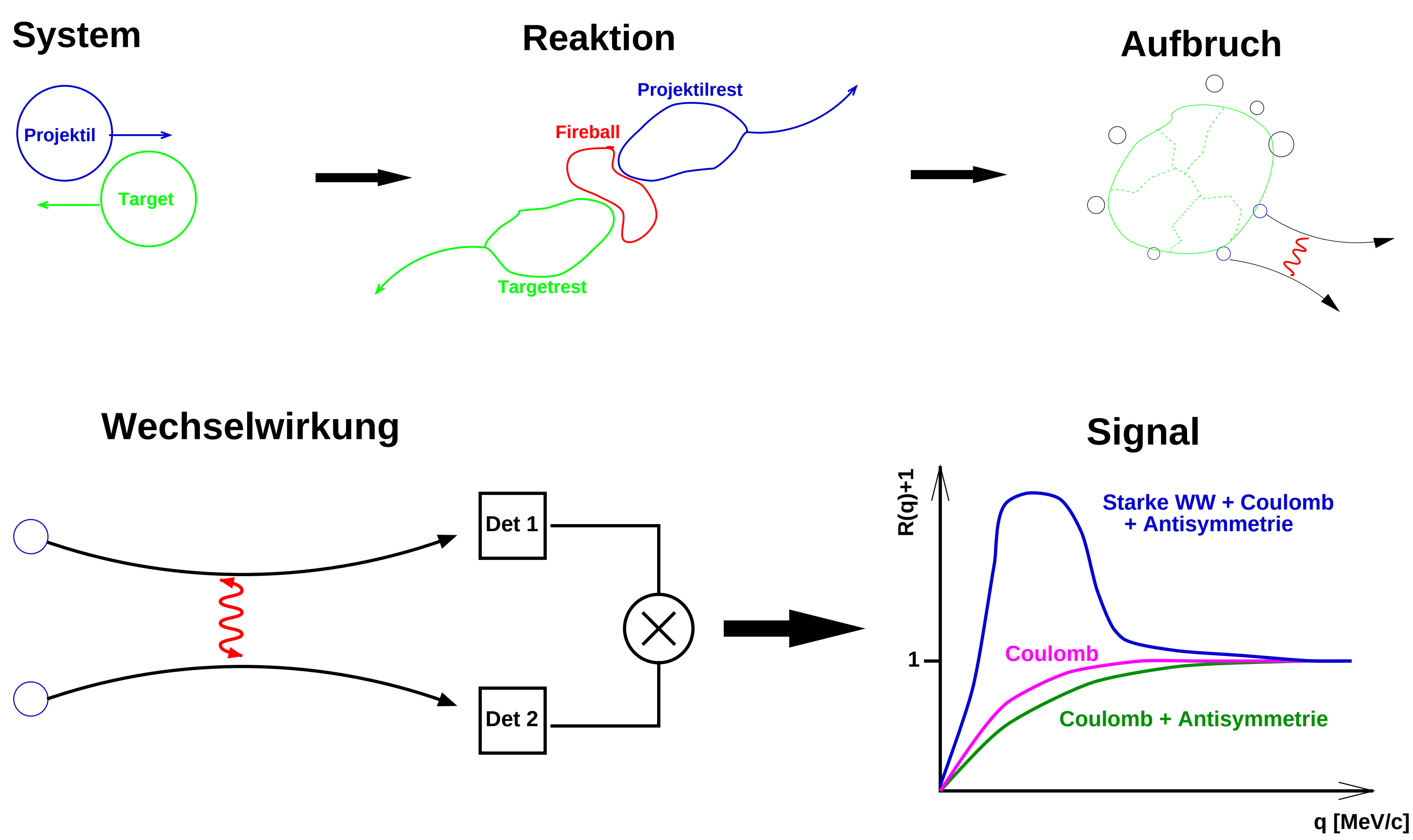
Temperaturmessung aus angeregten Kernzuständen

Leichtteilchenkorrelationen ⇒ Radienbestimmung

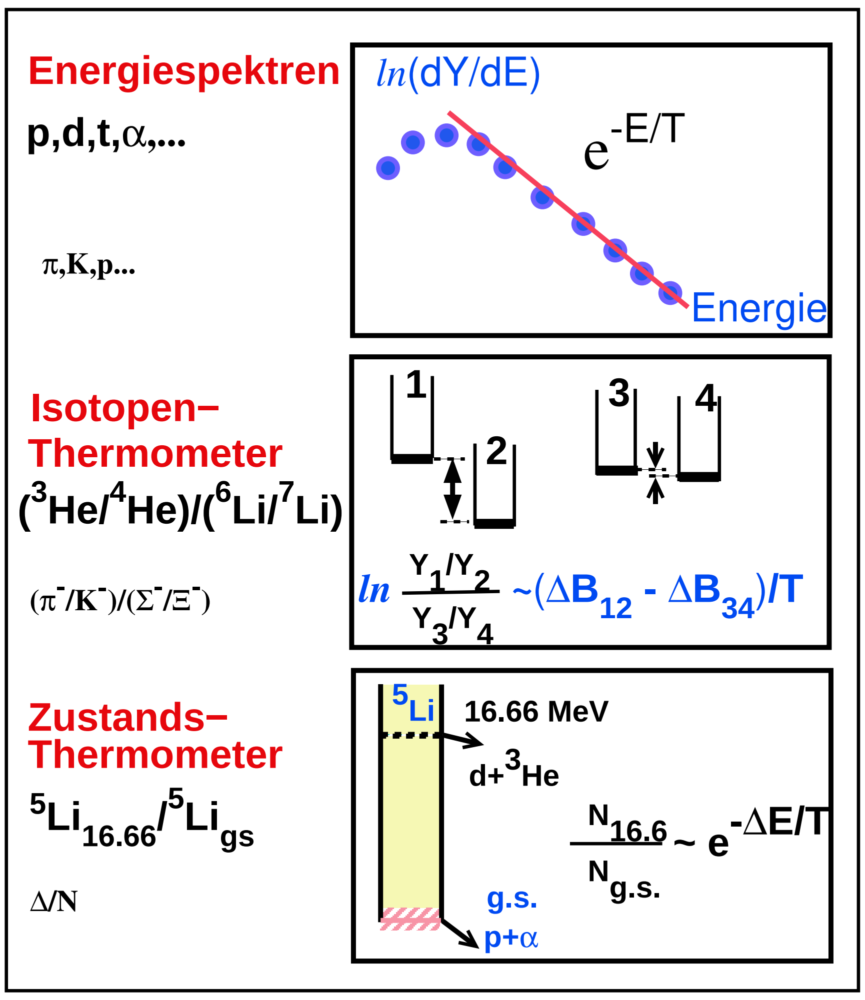
QSM-Korrektur

Zusammenfassung und Ausblick

Physikalisches Szenario I



Physikalisches Szenario II



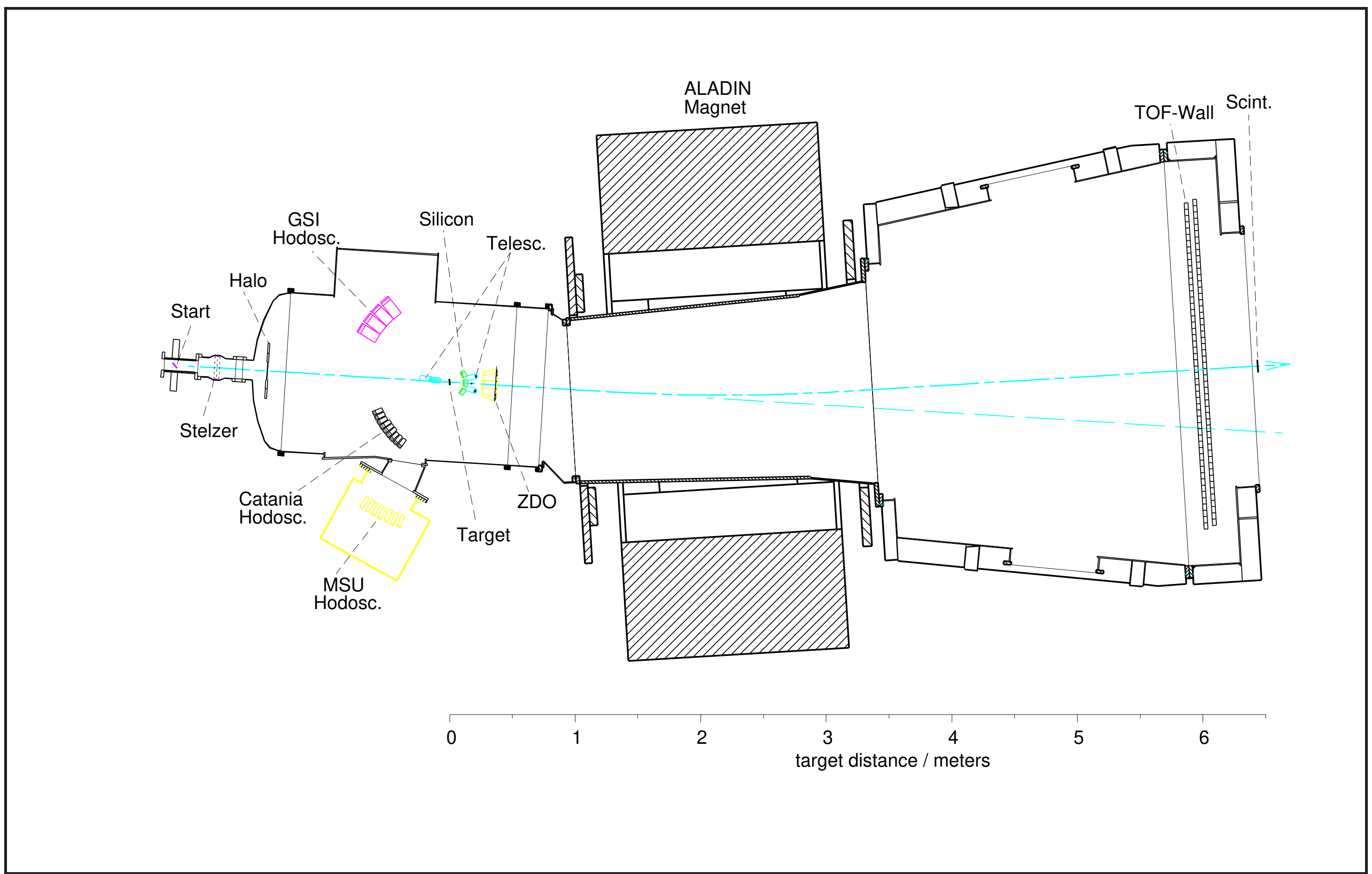
- System Au+Au 1 A·GeV
  Targetspektator

- Zustandsthermometer
- Isotopenthermometer

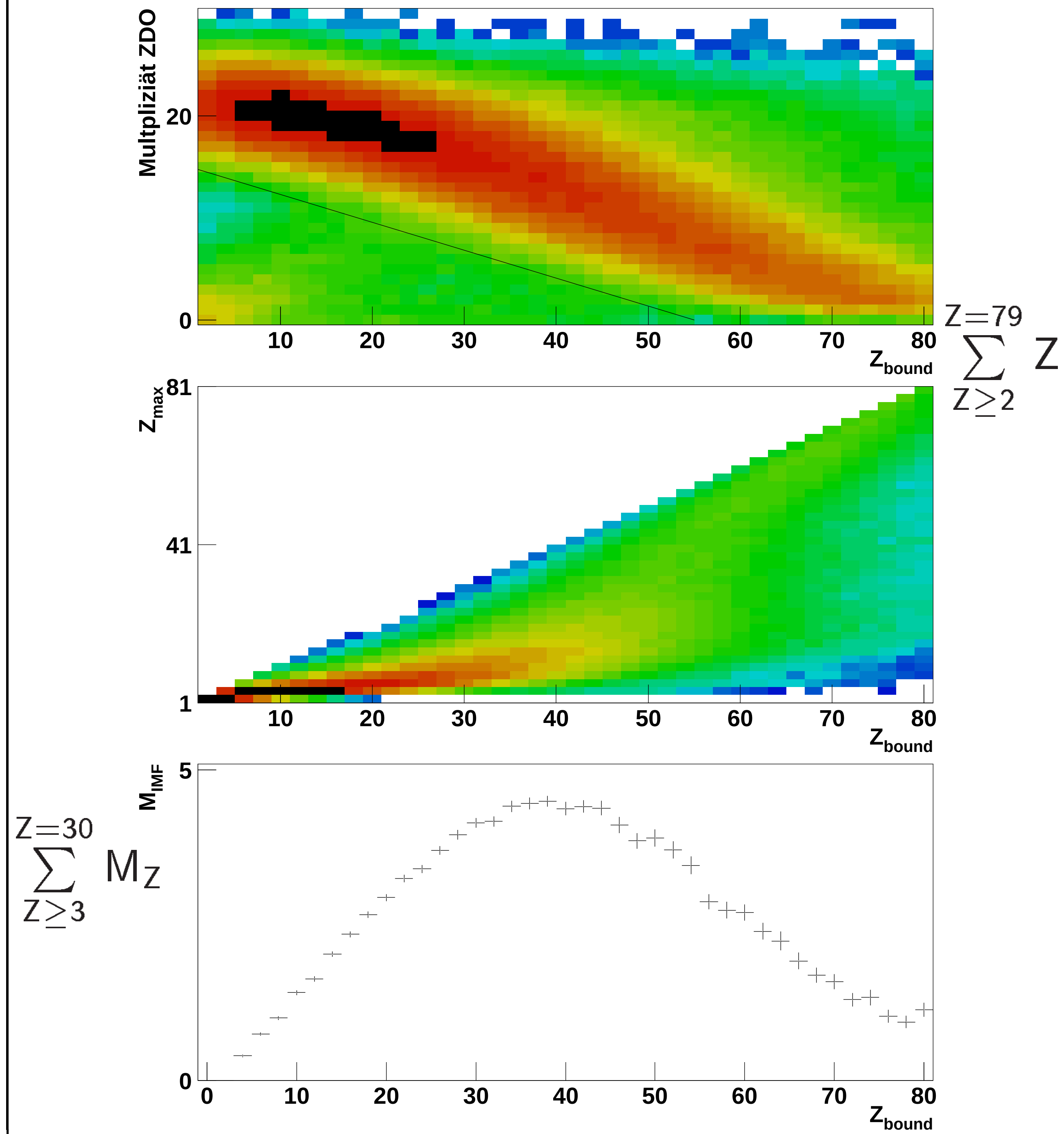
- Abhängigkeit von ...

... Anregungsenergie
... Dichte
... N/Z–Verhältnis
... ??

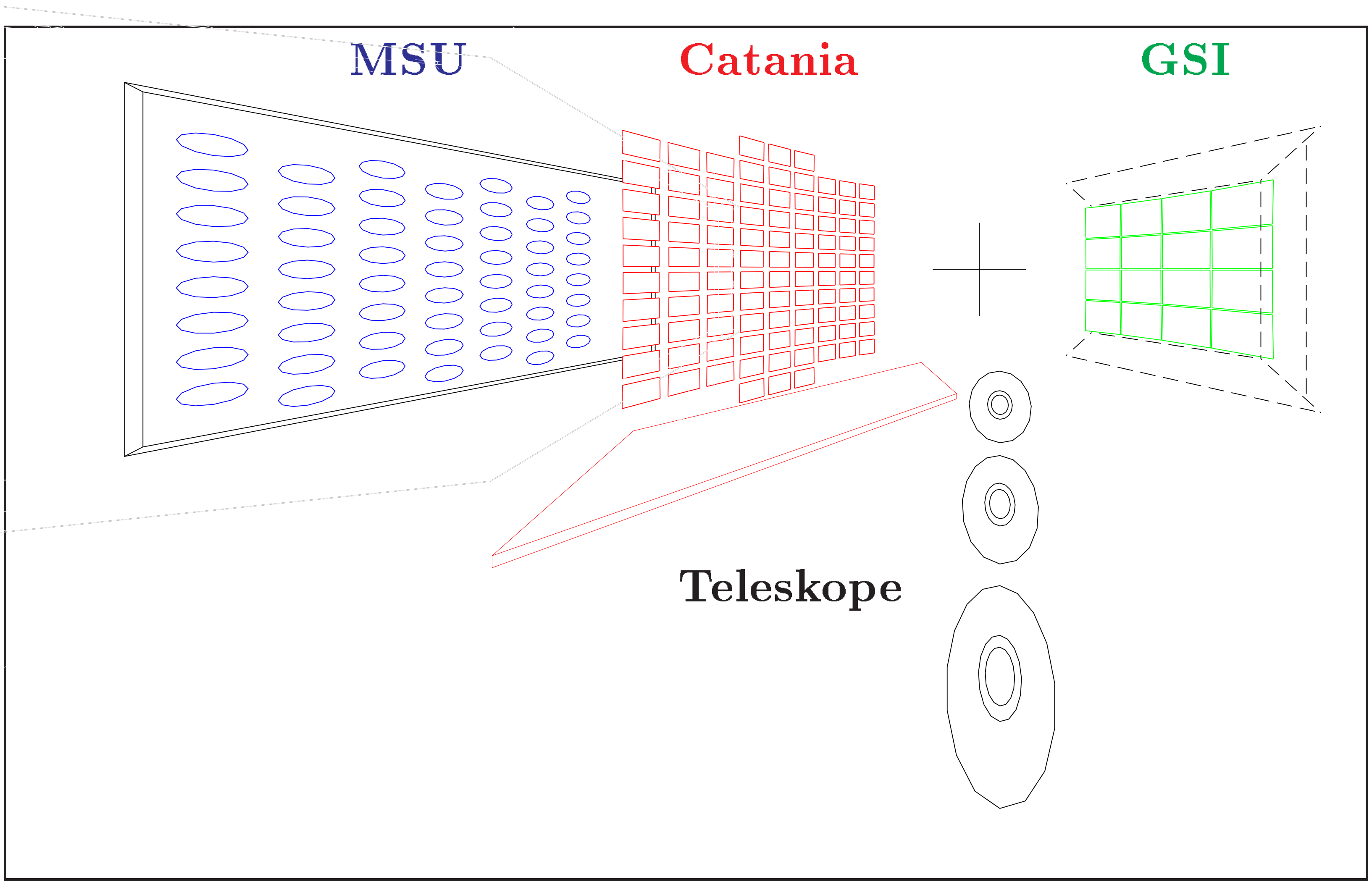
Experimentaufbau



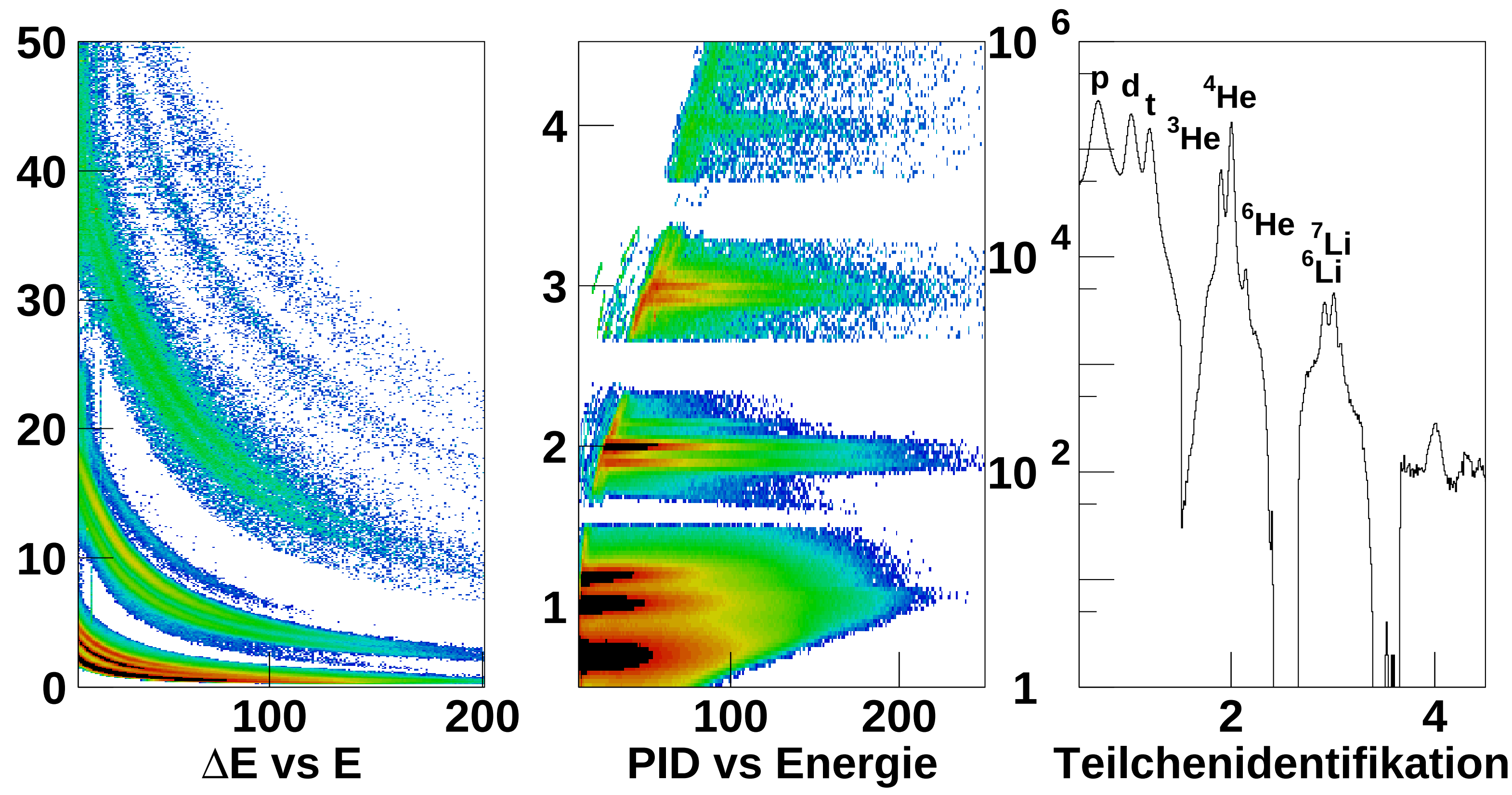
Ereignis–Charakterisierung



Experimentaufbau - aus Targetrichtung

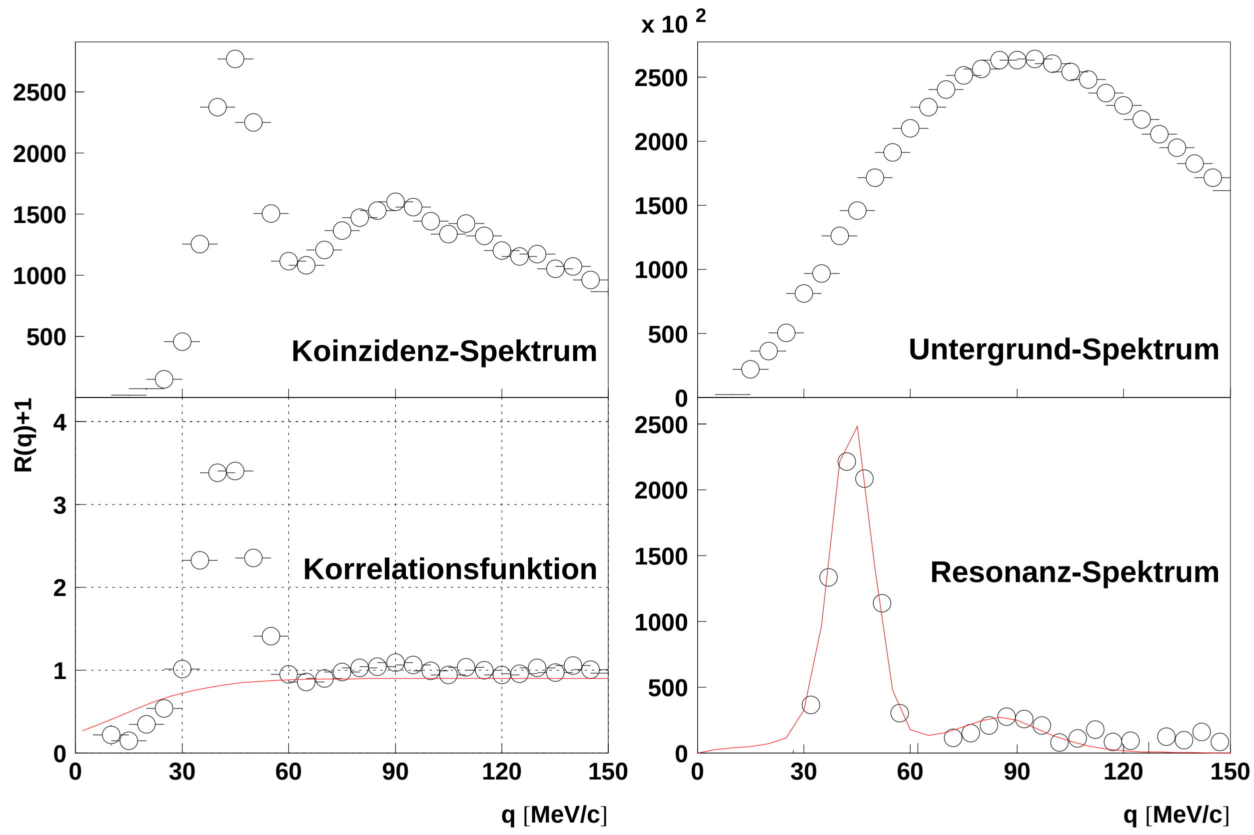


Energie- und Teilchenidentifikation

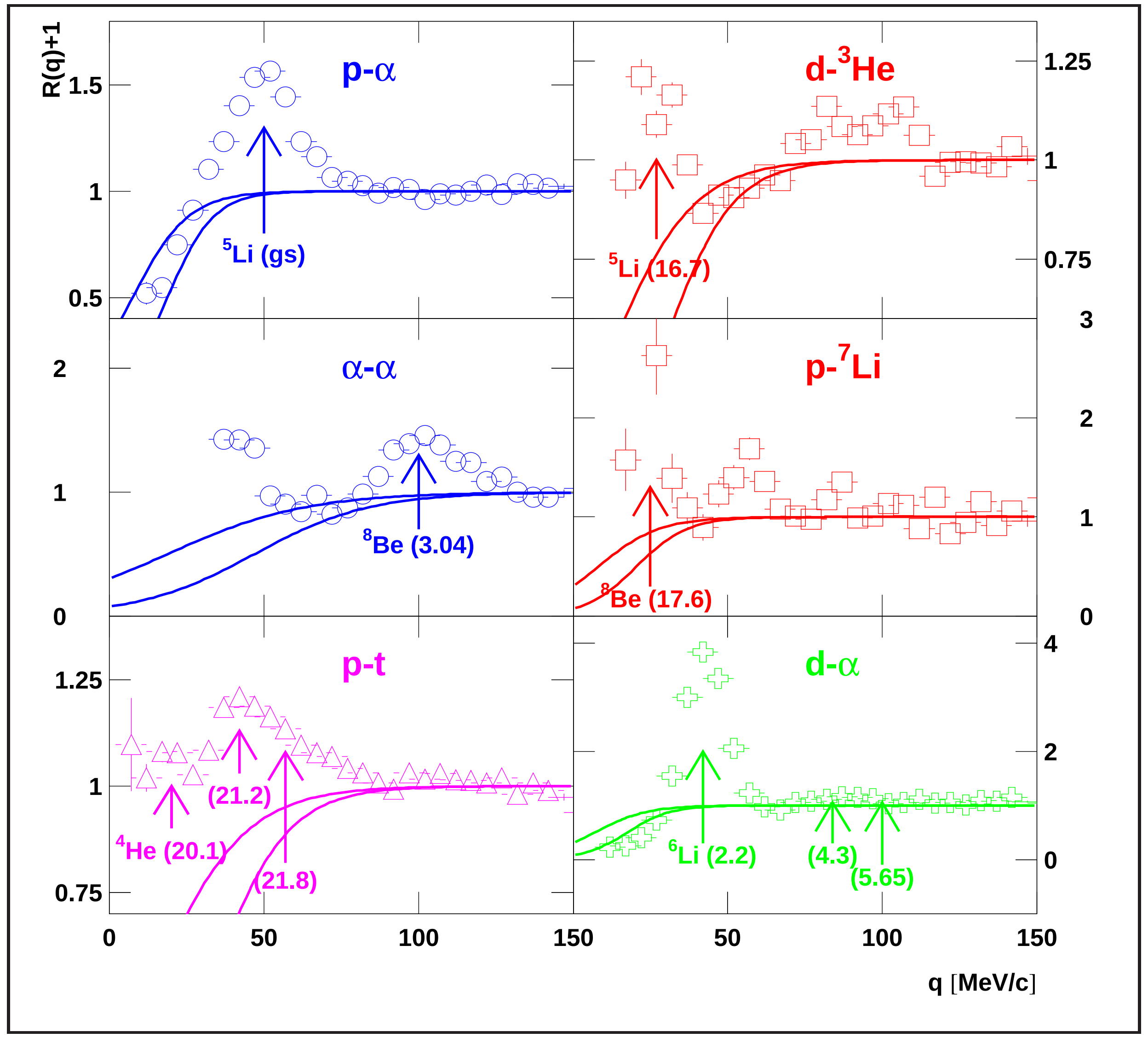


Temperaturbestimmung

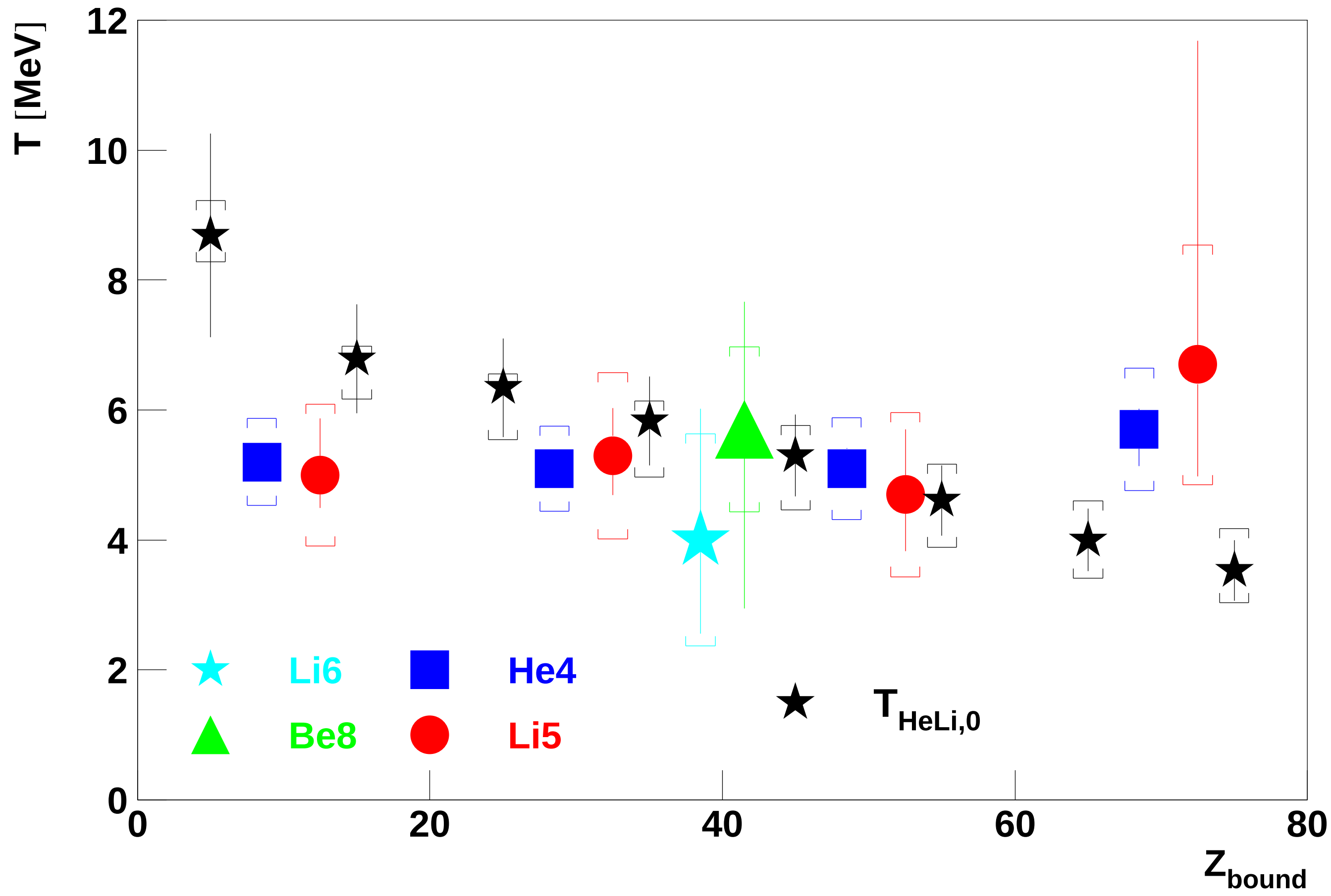
$$\frac{\left(\frac{dn(E)}{dE}\right)_1}{\left(\frac{dn(E)}{dE}\right)_2} \approx \frac{e^{-E_1/T_{Em}}}{e^{-E_2/T_{Em}}} \cdot \frac{2J_1+1}{2J_2+1} \propto e^{\Delta E/T_{Em}}$$



Korrelationsfunktionen
$\Longrightarrow$ Populationsverhältnisse



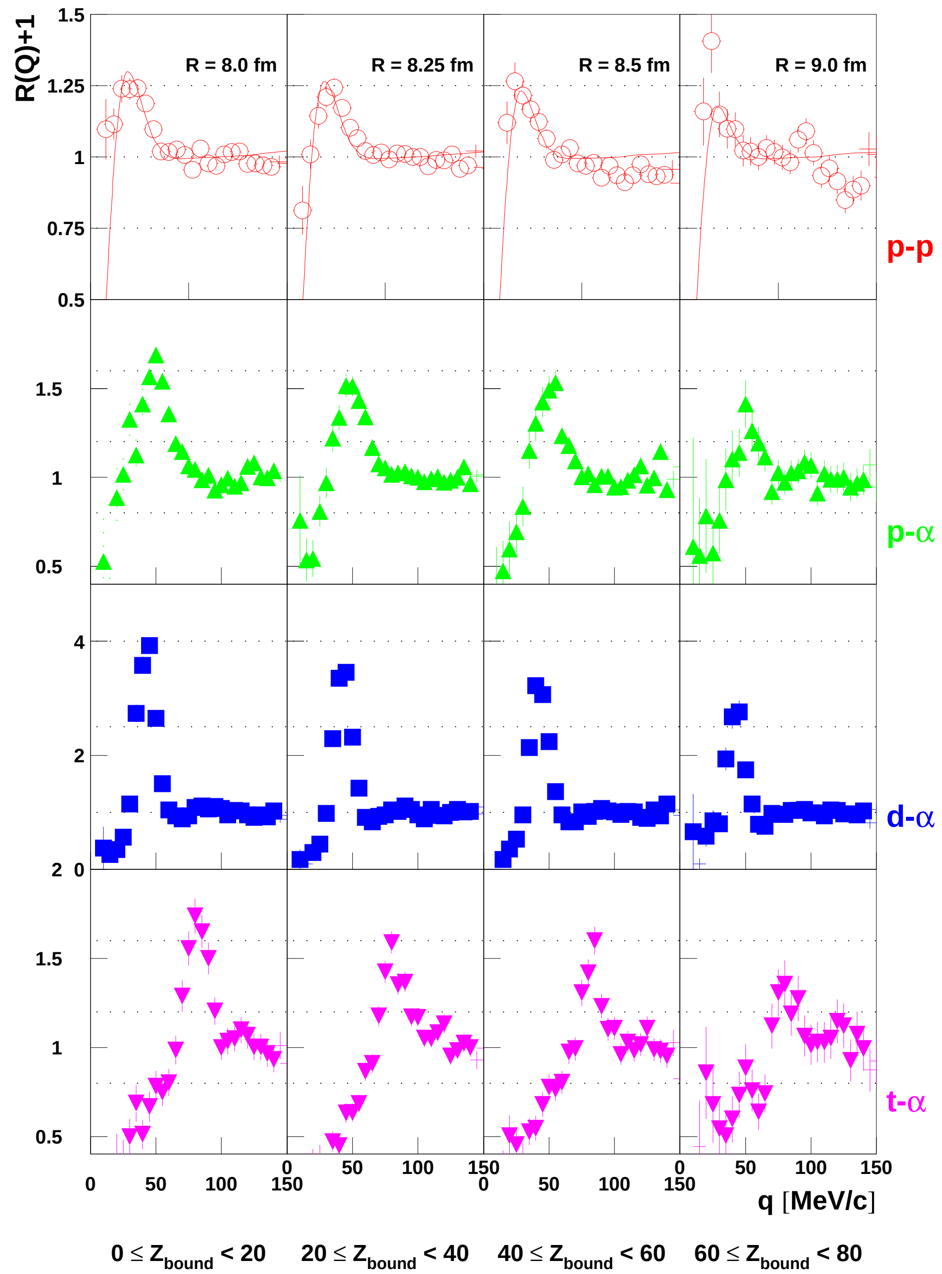
Temperatur in Abhängigkeit von der Zentralität



kleines System $\Leftarrow$ $\Rightarrow$ großes System

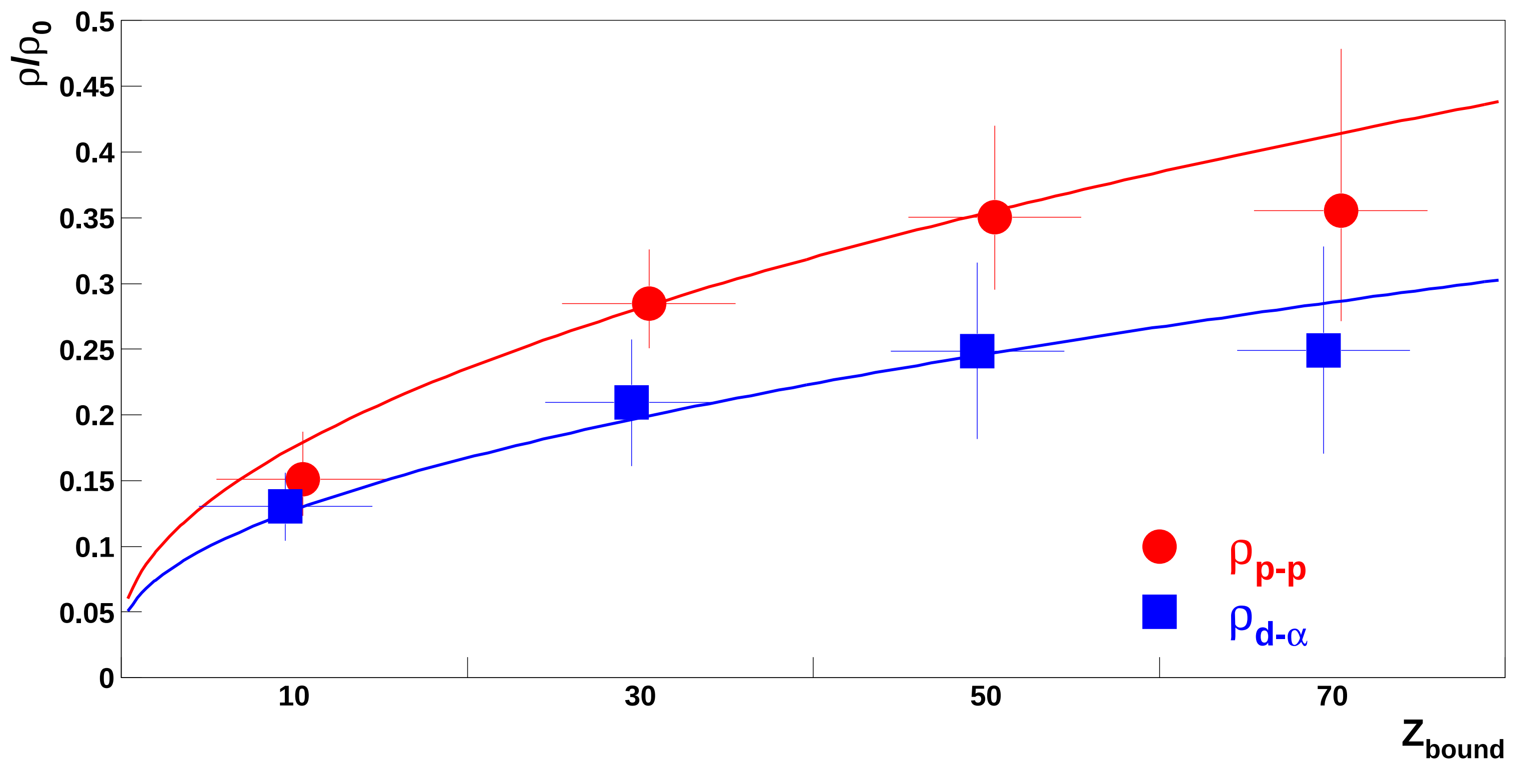
große Anregungsenergie kleine Anregungsenergie

Korrelationsfunktionen
Abhängigkeit von der Zentralität

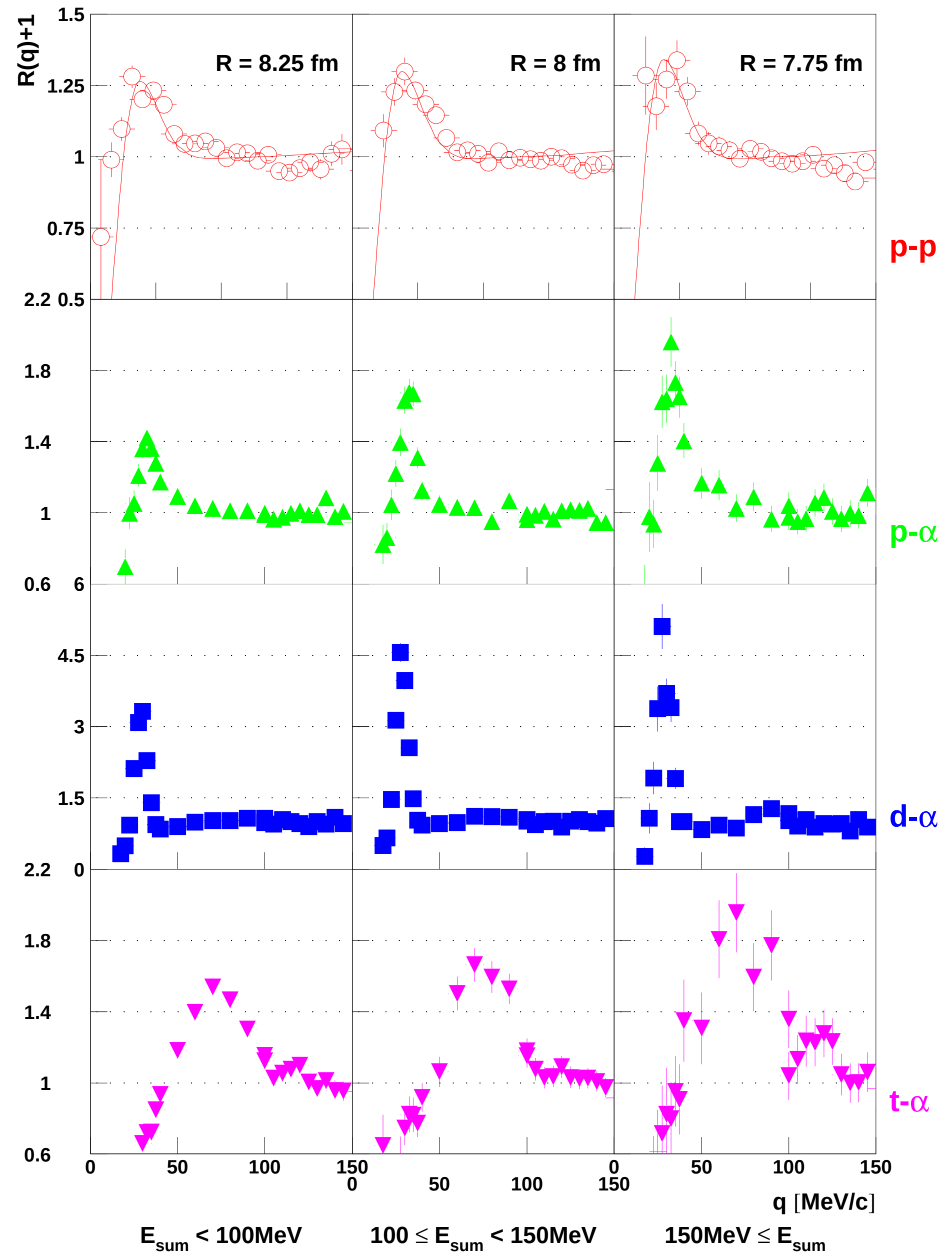


Ermittlung der Dichte

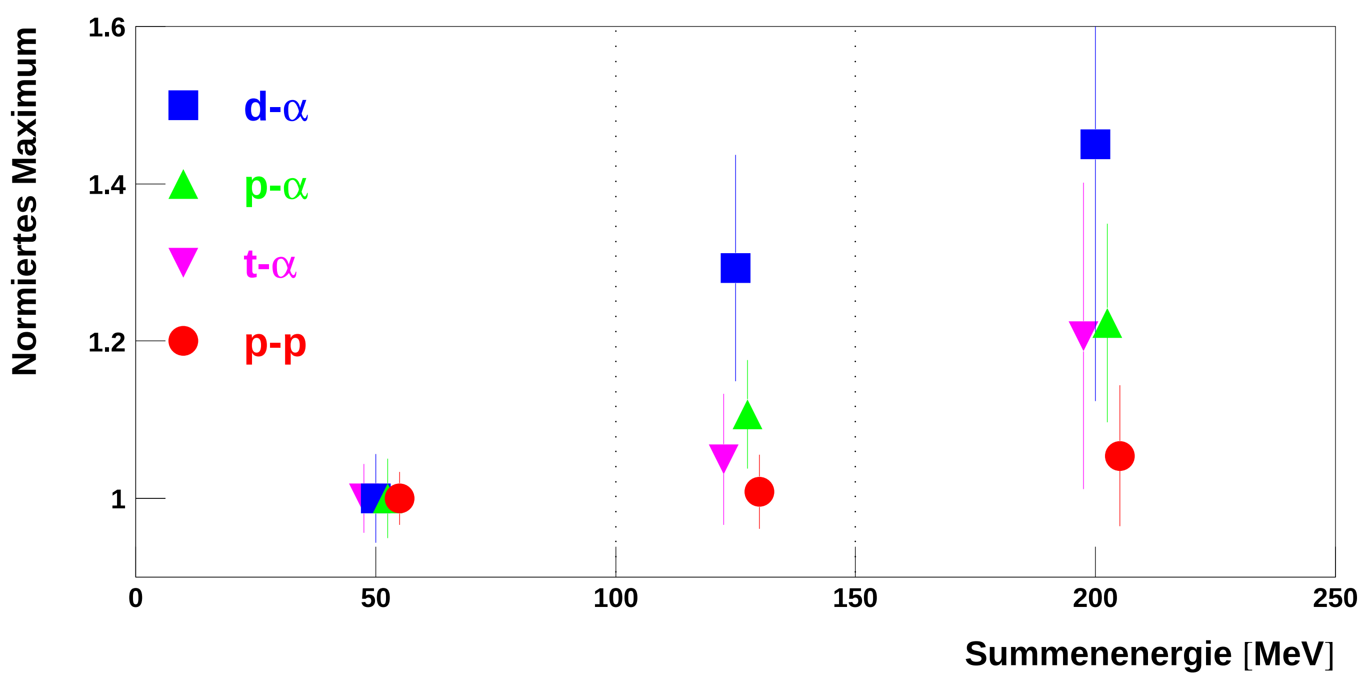
$$\frac{\rho}{\rho_0} = \left(\frac{R_{G_0}}{R_G}\right)^3 = \left(\frac{r_0 \cdot \sqrt[3]{A_0}}{R_G}\right)^3$$



Korrelationsfunktionen
Abhängigkeit von der Energie

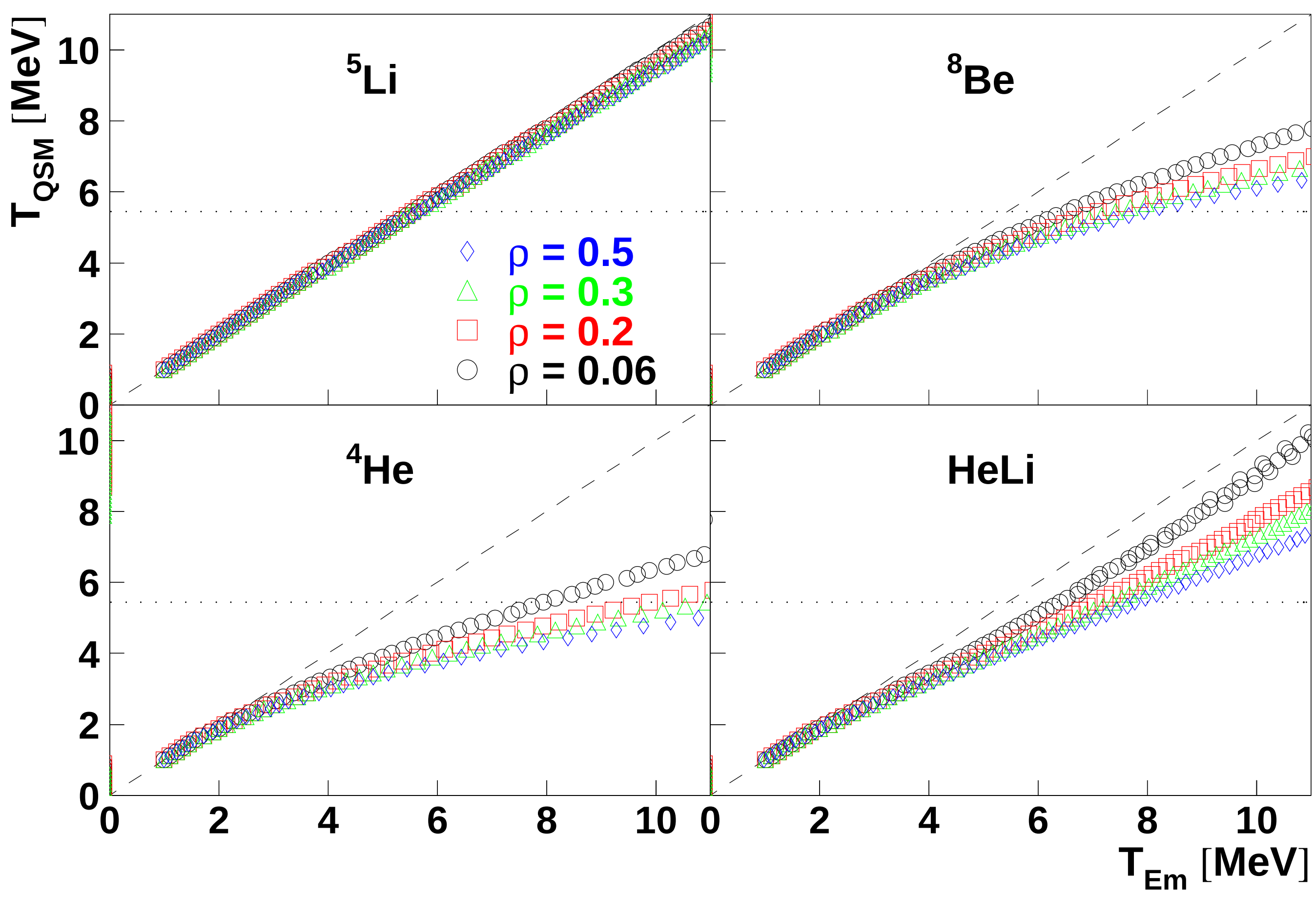


Expansionssignal ?



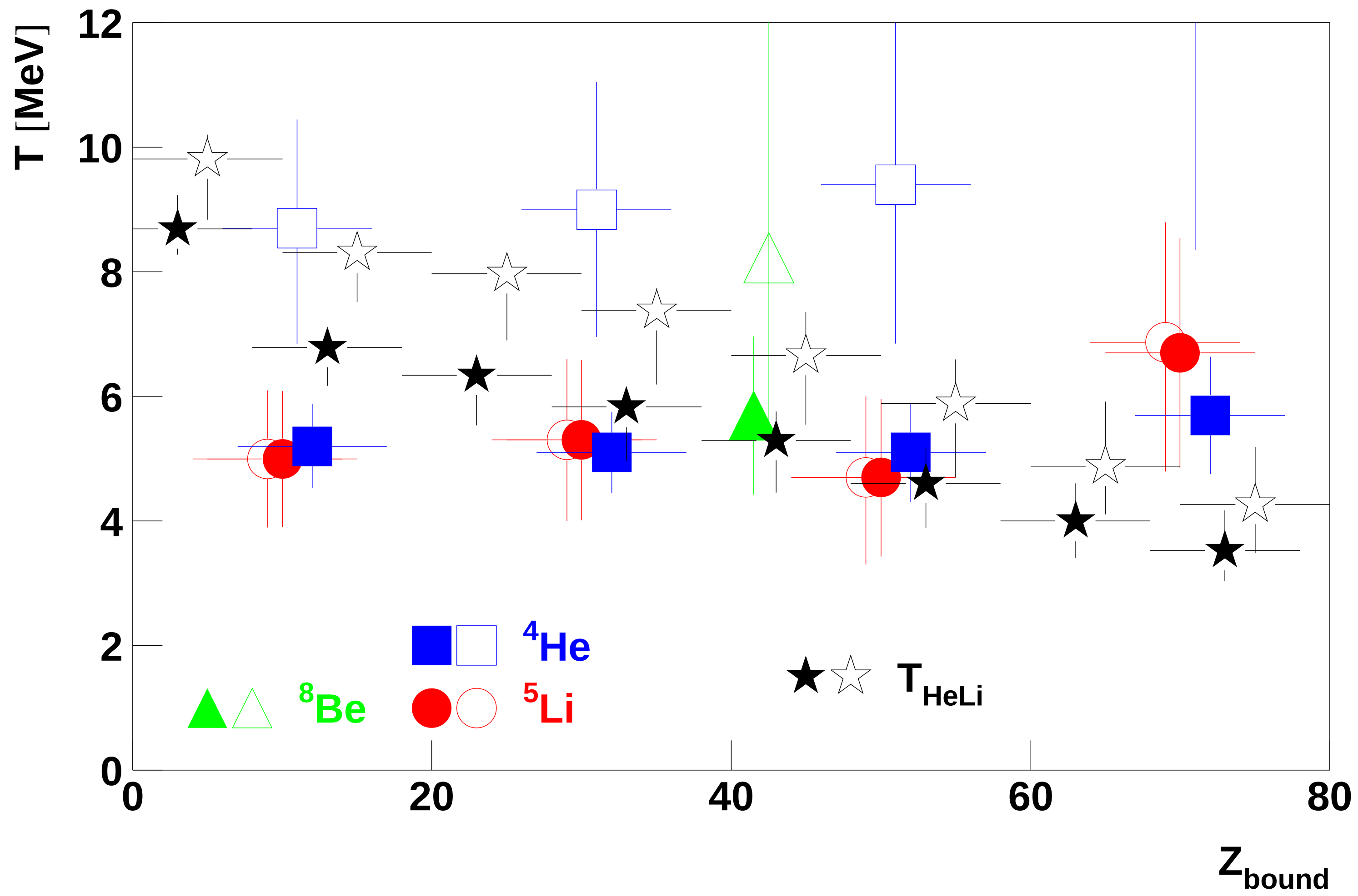
- Widerspruch zu thermisch äquilibrierter Quelle mit einem Freeze out
- Anzeichen für eine geschwindigkeitsselektierte Emission

QSM - Abhängigkeit der Temperatur von ρ

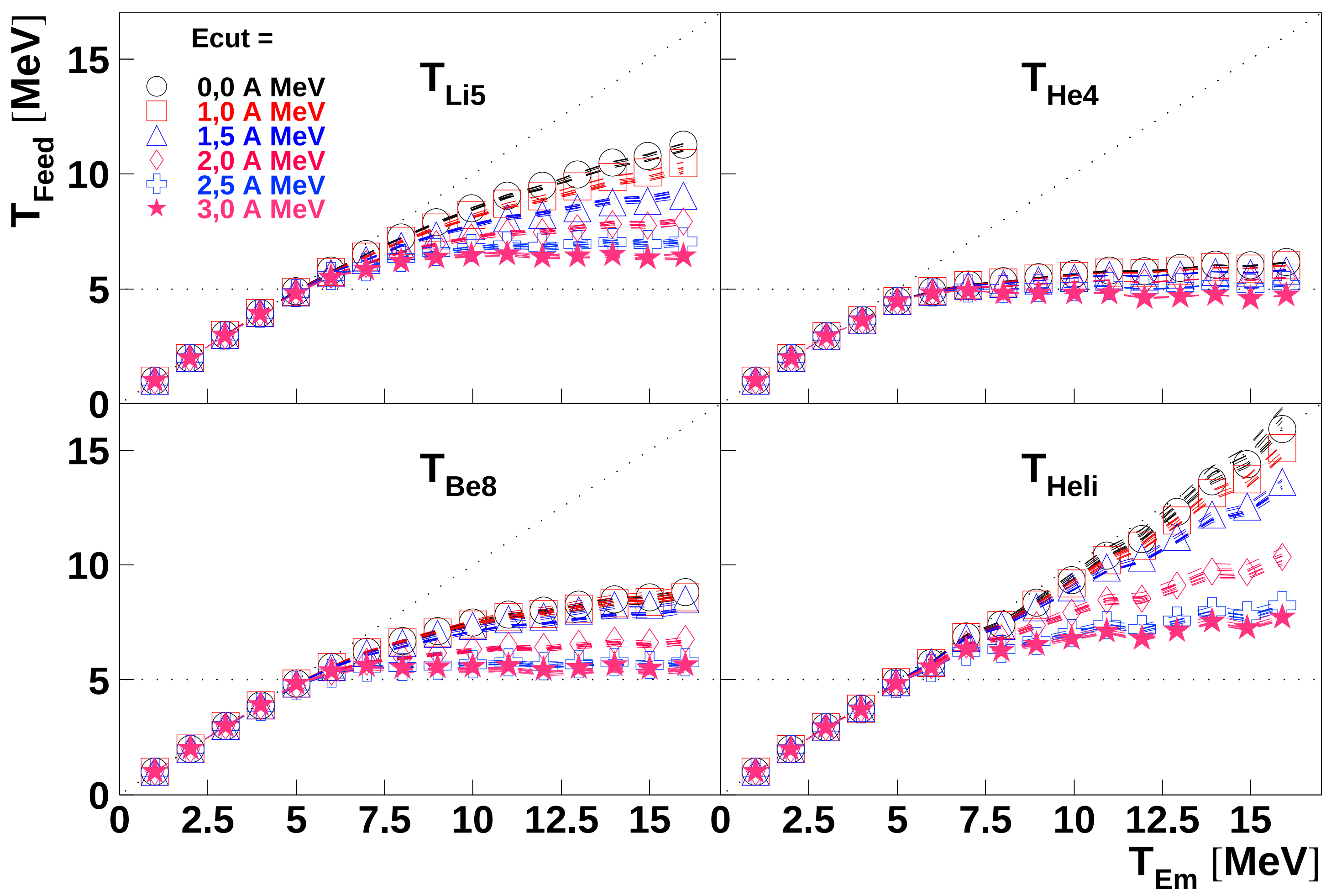


D. Hahn and H. Stöcker, Nucl. Phys. A476:718ff, 1988

Temperatur nach QSM-Korrektur

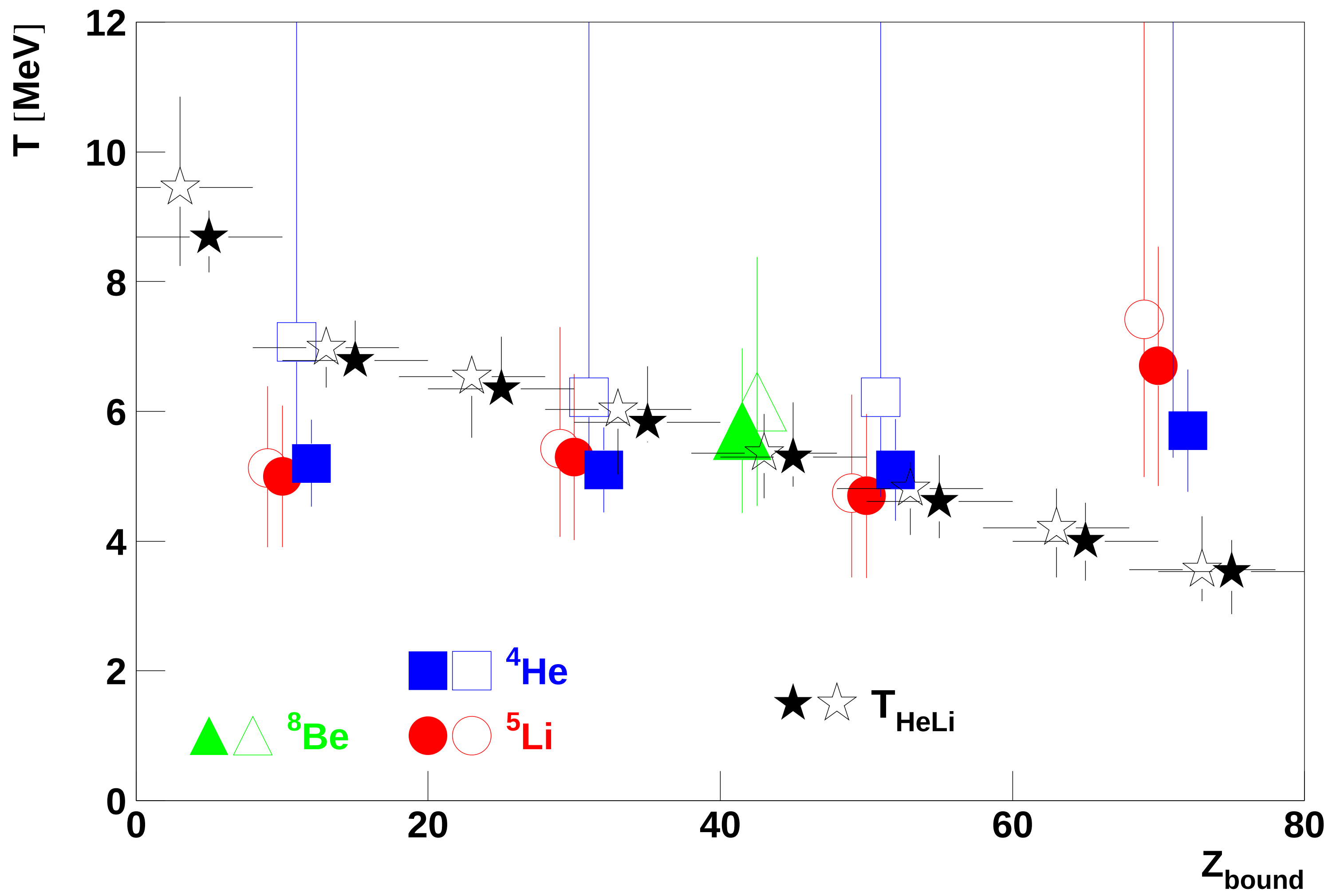


MSU-Code Kontinuumszustände



X. Hongfei, W.G. Lynch, M.B. Tsang, W.A. Friedmann, MSUCL-1040, 1996

Temperatur nach MSU–Feeding–Korrektur



Zusammenfassung und Ausblick

- Radien aus $p-p$ or $d-\alpha$: 8 – 10 fm in Abhängigkeit von Z_{bound}

  $\overset{A_0}{\overbrace{\Longrightarrow}}$ Dichte $\rho = \begin{array}{ll} 0{,}1 - 0{,}15 \cdot\rho_0 & \text{Zentrale Reaktionen} \\ 0{,}2 - 0{,}3 \cdot\rho_0 & \text{Periphere Reaktionen} \end{array}$

- Isotopenthermometer T_{HeLi} steigt zu zentralen Reaktionen an

- Zustandsthermometer $T_{ex} \approx 5 - 6$ MeV unabhängig von Z_{bound}

- Quantenstatistische Modelle können Isotopen– und Zustandsthermometer nicht konsistent beschreiben

- ??? Ideales Model muß enthalten ???

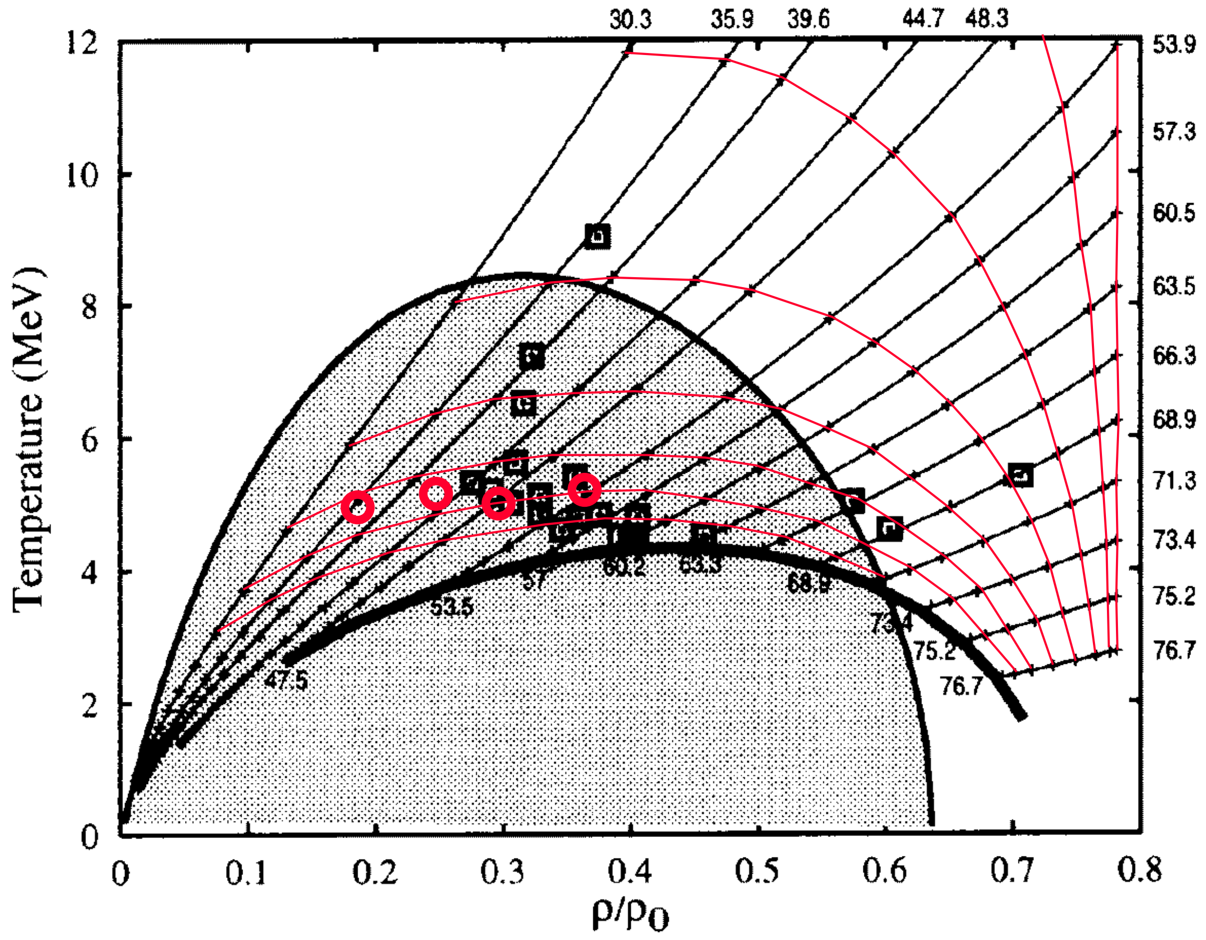
  1. Kontinuum 2. Dichte

  3. Dynamik 4. ???

Quasiadiabatische Expansion im T–ρ–Diagramm

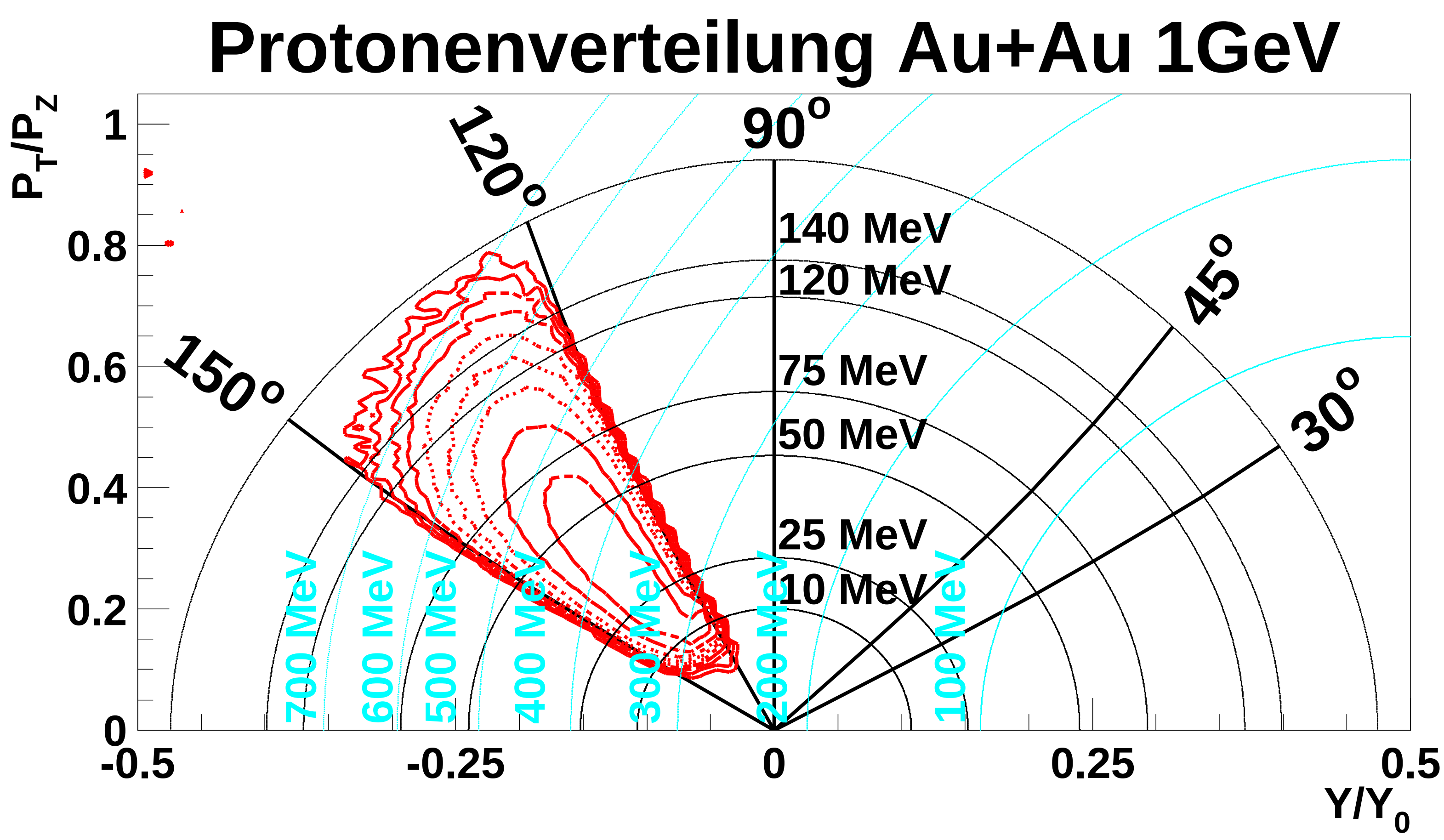
○ ^{5}Li

HeLi

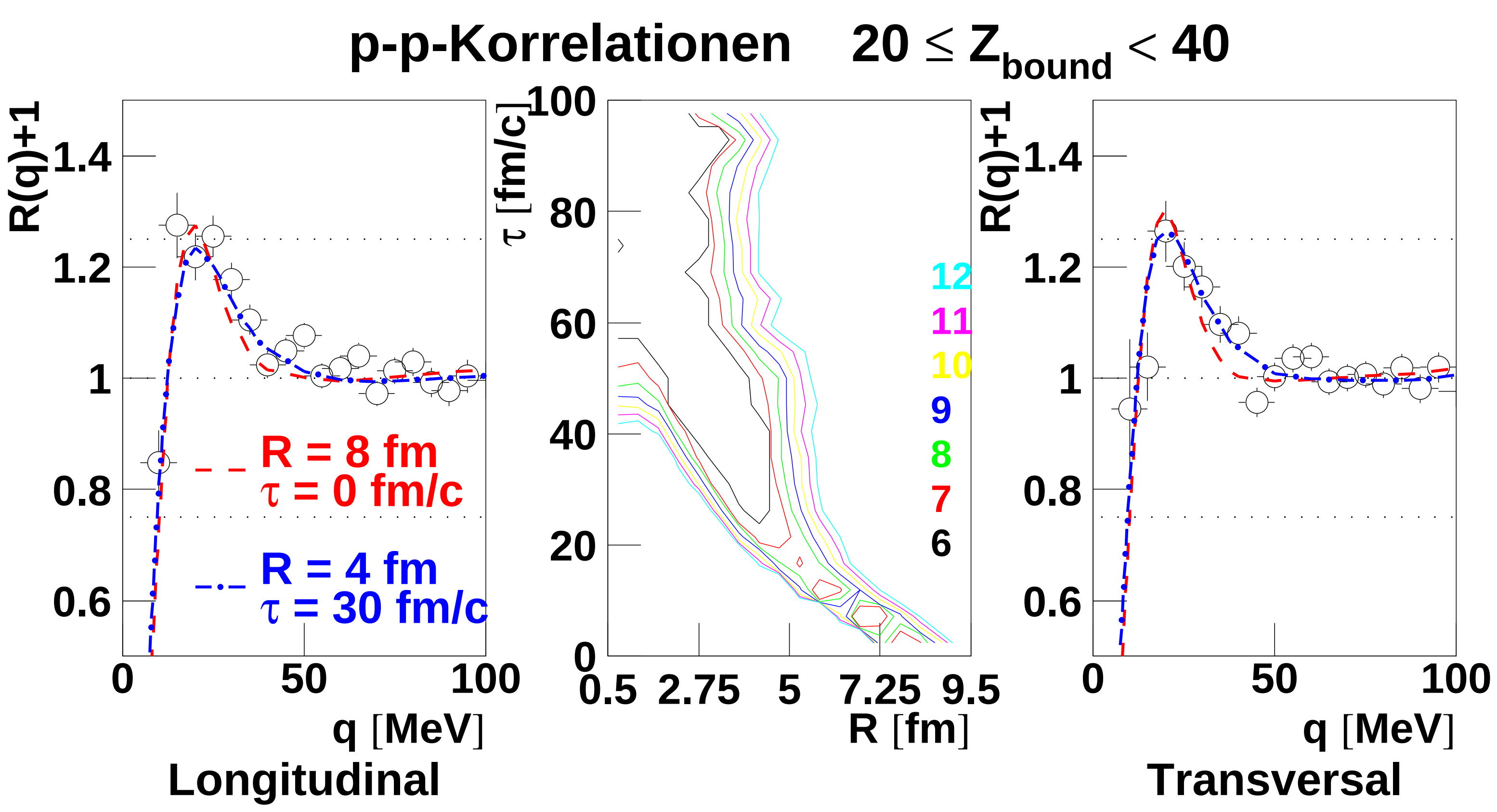


G. Papp, W. Nörenberg, GSI-95-30, Nucl-Th/9612054

p_T–Y–Plot — Hodoskop–Akzeptanz



pp–Korrelationen - χ^2-Fits



Papp und Nörenberg: Kalorische Kurve

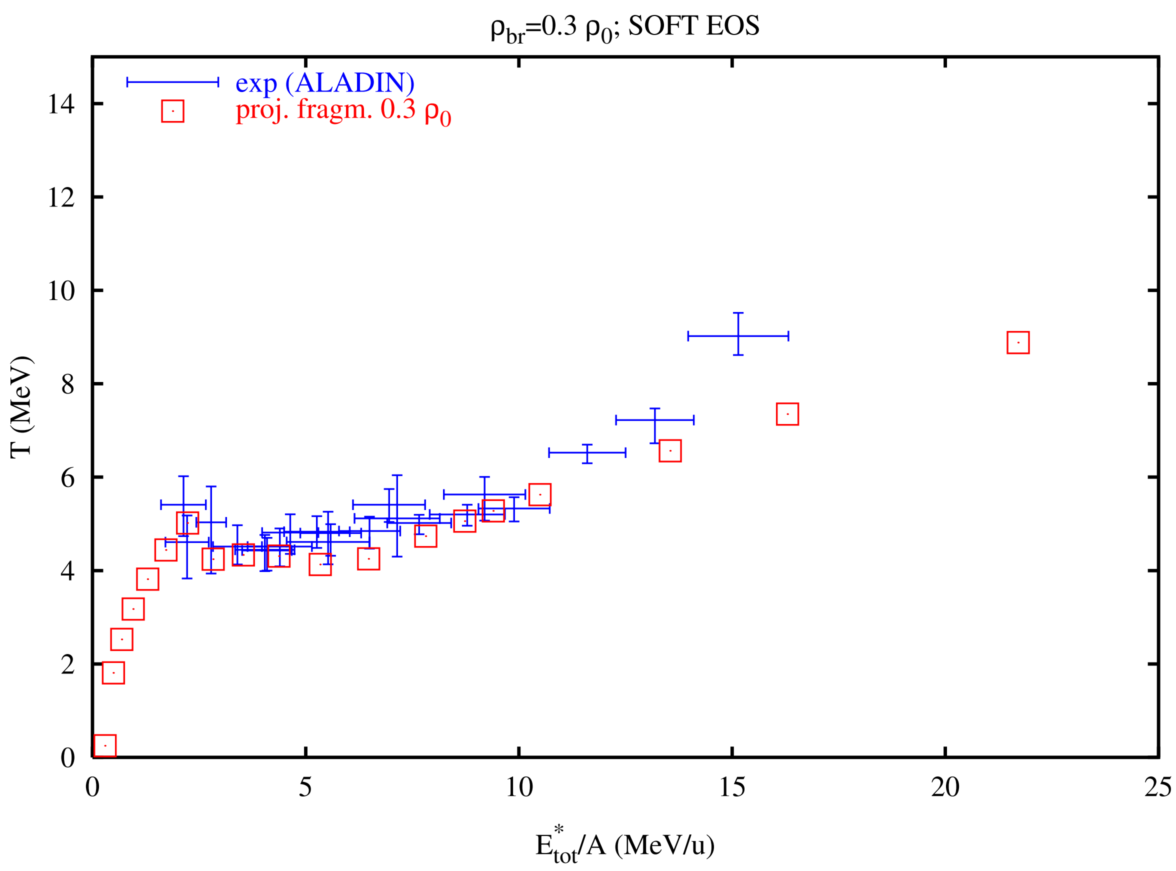


Figure 2: The caloric curve as deduced by the ALADIN collaboration [6] (crosses) compared with the pre-cluster condition. The total excitation energy includes flow energy which is significant in the isentropic dynamics for $E^*/A > 15$ MeV. The discrepancy at large excitation energies may therefore indicate that dissipation is not negligible during the expansion process.

derivative of the pressure with respect to the density along an adiabat becomes negative. Since the system is closed we consider the adiabatic process to be the relevant one. In Fig. 1 the region of instability is shadowed and bounded by the spinodal. To enter the spinodal region and stay there for more than 30 fm/c one needs initial temperatures of about 8 MeV and 11 MeV for the soft and hard EOS, respectively.

Because of the occurrence of turning points in the expansion, the multifragmentation process of the projectile residue has a unique feature: the subsequent decay into fragments is expected to be rather free from collective flow. This is different from the fragmentation of compressed compound systems which are formed in central collisions. As our calculations show already for a small initial compression ($1.5\ \varrho_0$) no turning points occur for realistic initial excitation energies. Thus the fragmentation process becomes qualitatively different and looks more like an explosion [24].

In Fig. 2 we compare our results for the temperature and the total excitation energy in the remnant with experimental data from the ALADIN experiment. Our points are determined at the turning points if the corresponding