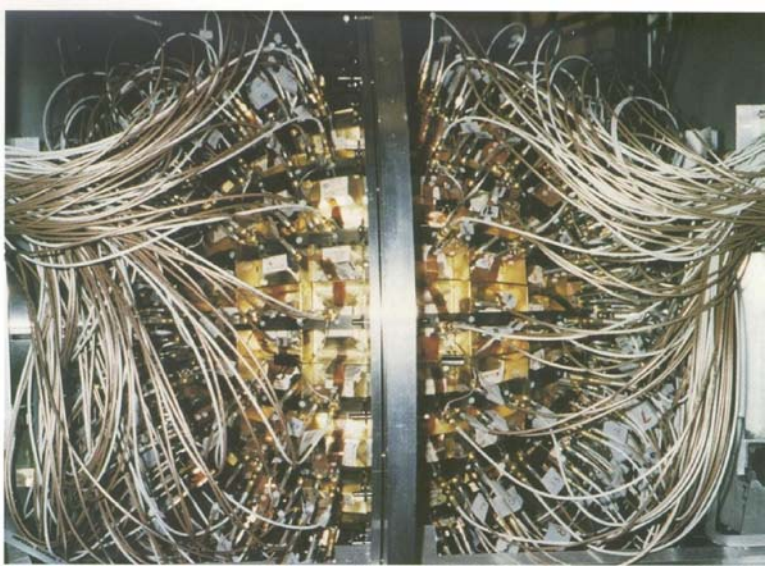
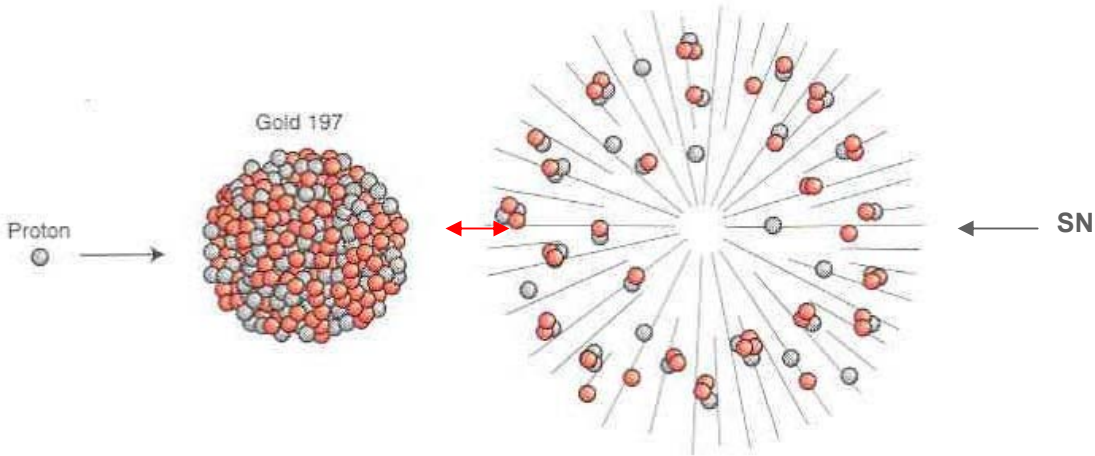


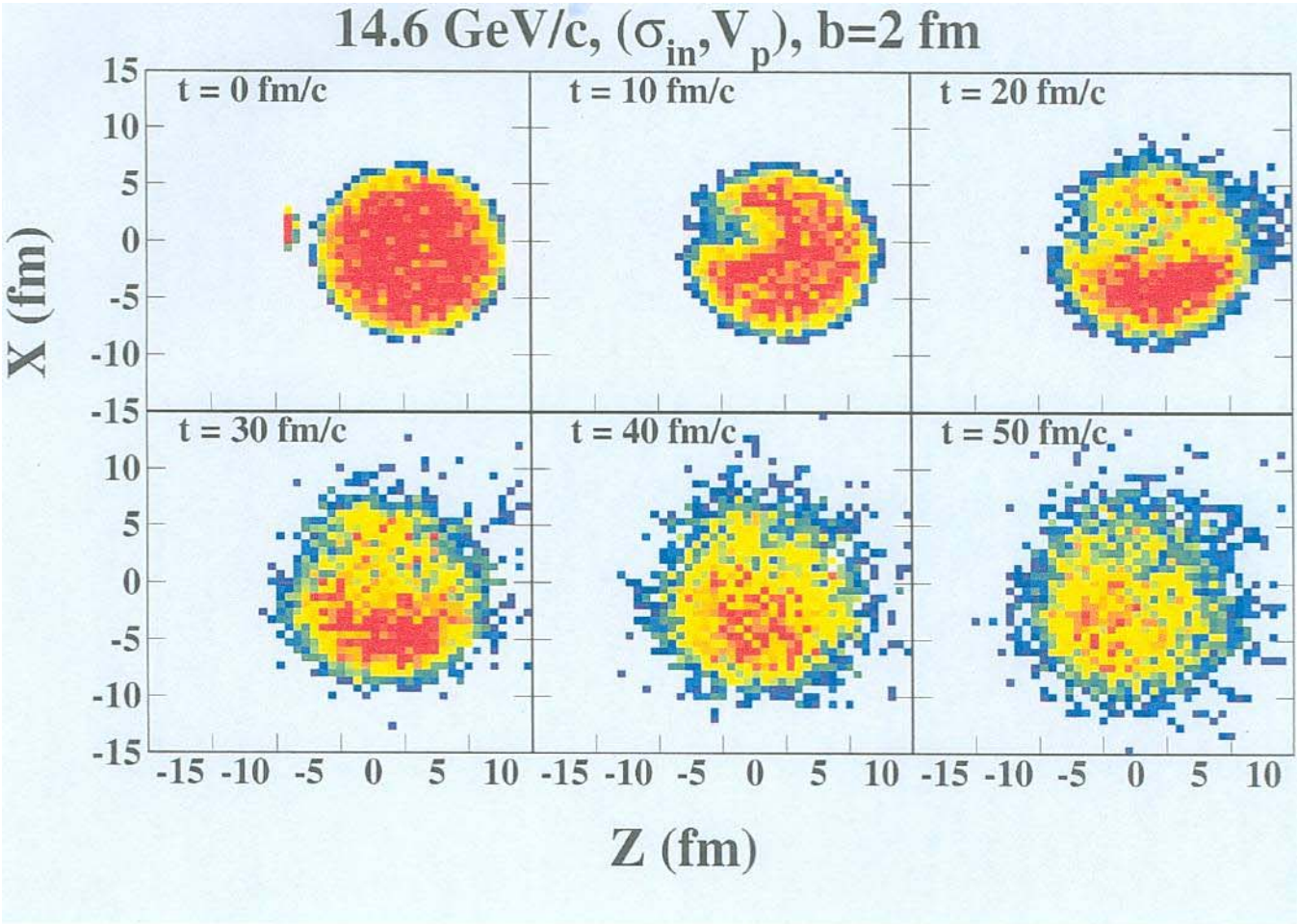
?

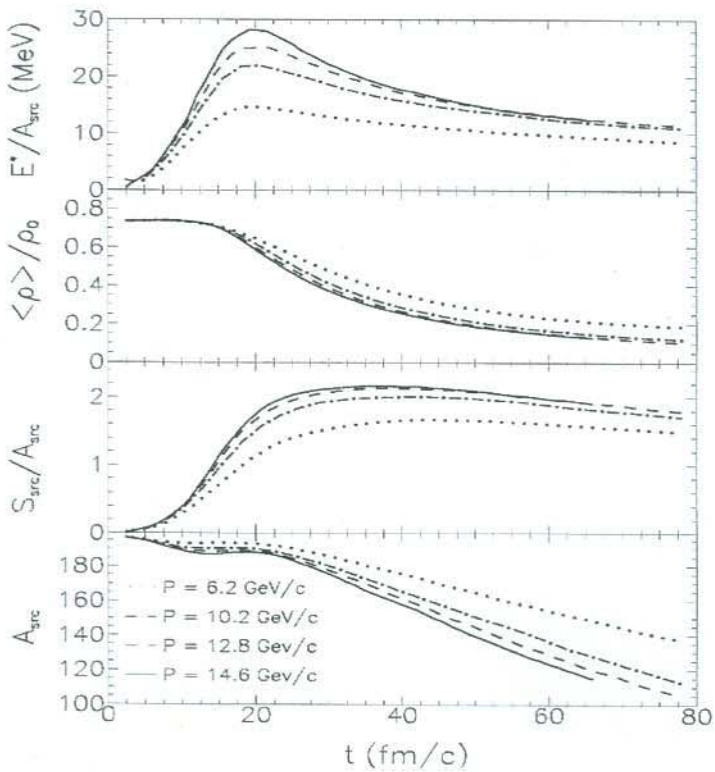
Multifragmentation

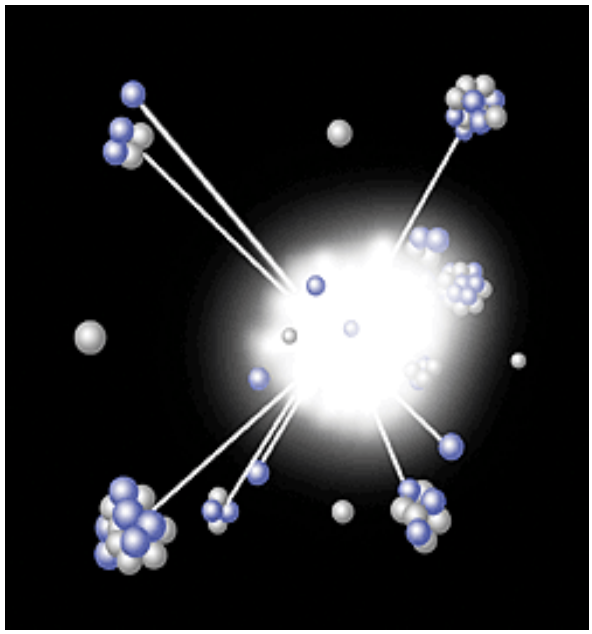


Supernova

?


14.6 GeV/c, (σin,Vp), b=2 fm
t = 0 fm/c
t = 10 fm/c
t = 20 fm/c
t = 30 fm/c
t = 40 fm/c
t = 50 fm/c
X (fm)
Z (fm)


E*/Asrc (MeV)
<ρ>/ρ0
Ssrc/Asrc
Asrc
P = 6.2 GeV/c
P = 10.2 GeV/c
P = 12.8 Gev/c
P = 14.6 Gev/c
t (fm/c)



Phenomenology

Angular Distributions
Spectral Shapes
Multiplicity Distributions
Binomial Scaling
Breakup Density
Time Scale
Charge Distributions

Thermodynamics

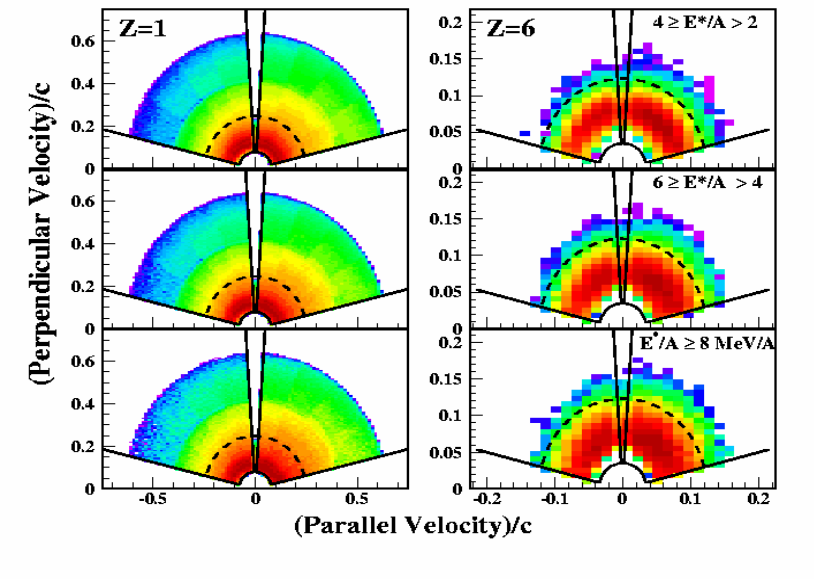
Caloric Curve (Negative Heat Capacity)

Scaling Laws

Percolation
Fisher Droplet Model

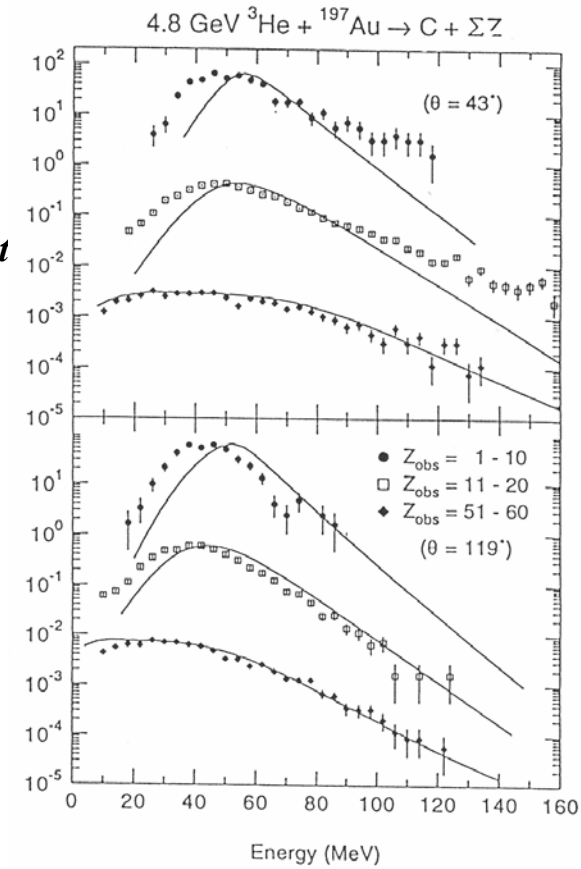
L. Beaulieu *et al.*, PRC 64, 064604 (2001)

LABORATORY INVARIANT CROSS SECTION

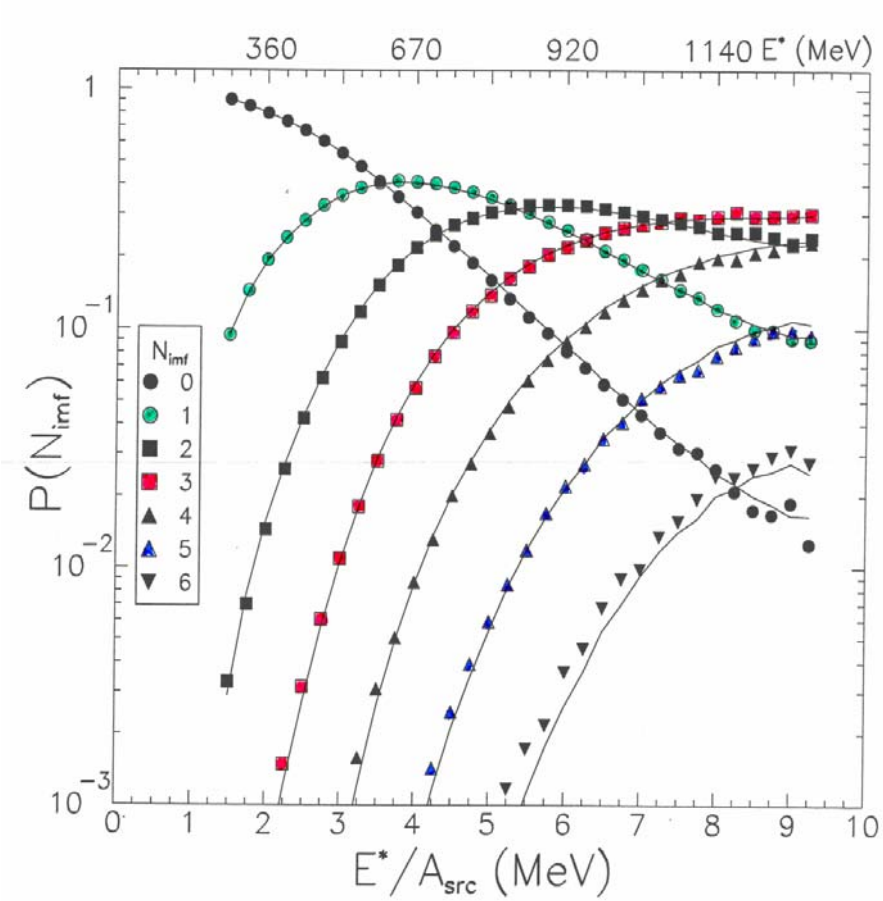


E. Renshaw Foxford, K.B. Morley, *et al.*, PRC 54, 749 (1996).

- ● <E*/A> = 1.8 MeV
- □ <E*/A> = 3.5 MeV
- ■ <E*/A> = 8.0 MeV
- —— INC + EES



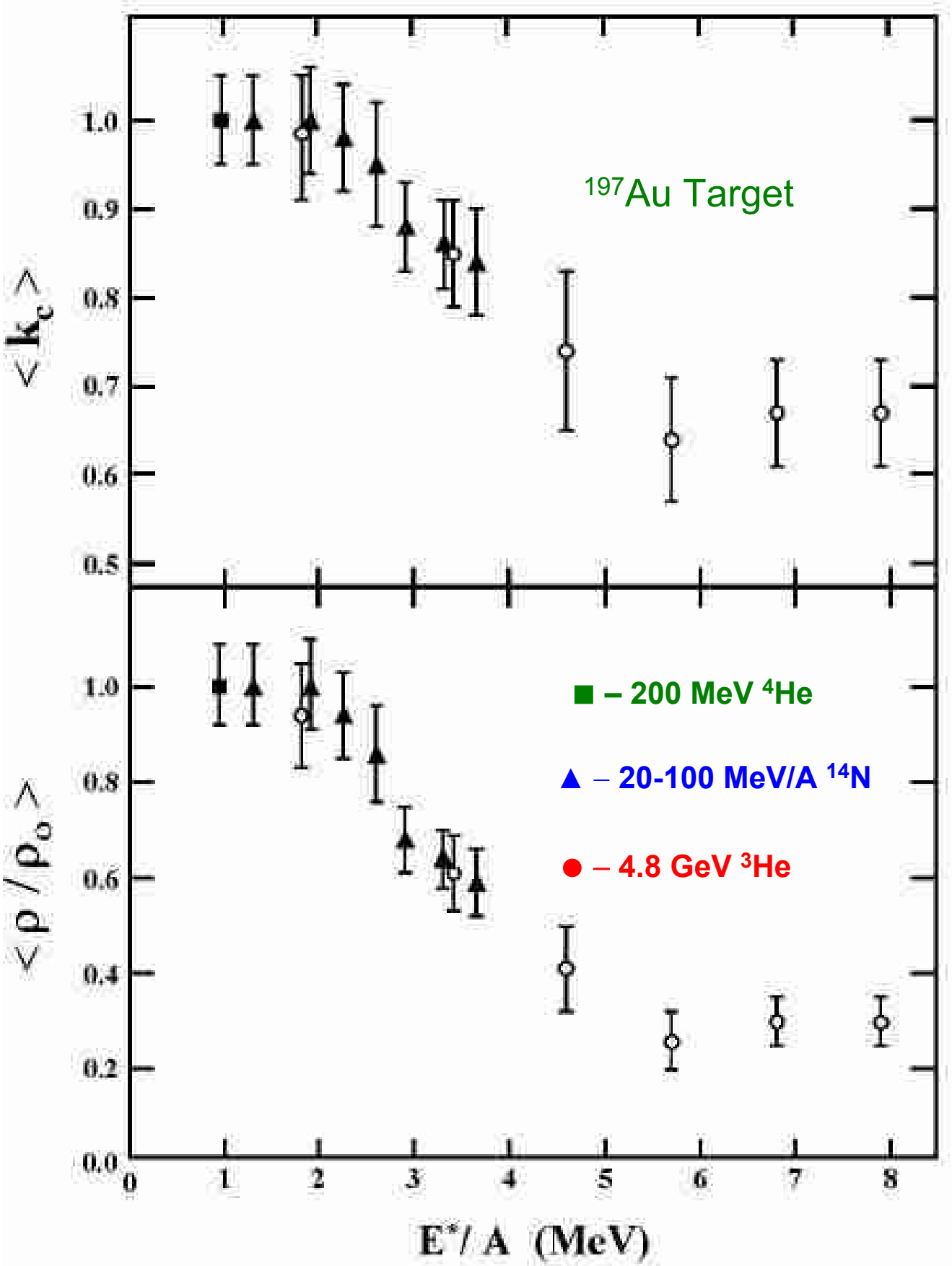
L. Beaulieu *et al.*, PRC, **63,** 031302 (2001)

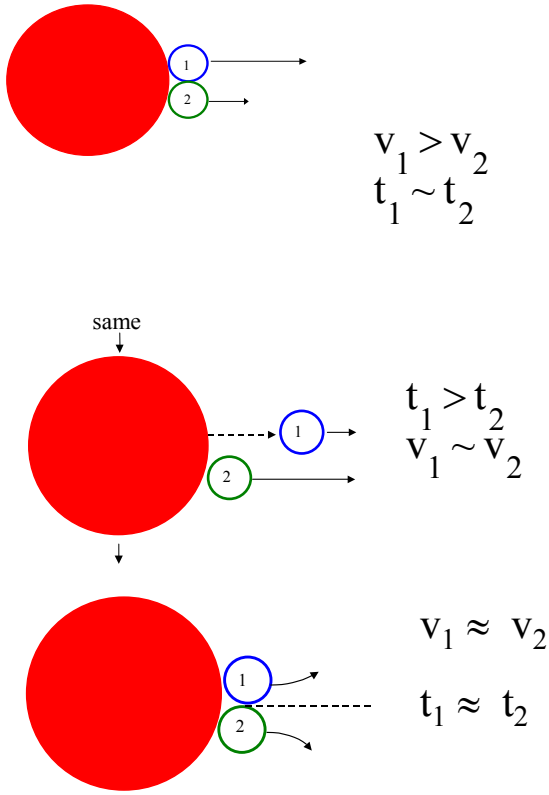


$$P_n^m(E^*) = \frac{m!}{n!(m-n)!} p^n (1-p)^{m-n}.$$

$$\langle n \rangle = mp \quad \text{and} \quad \sigma_n^2 = \langle n \rangle (1-p).$$

E*/A =	2	3	4	5	6	7	8	9	MeV
Z_{src} =	74.3	71.2	68.4	65.8	63.5	61.1	59.0	57.1	
m =	3.4	4.8	5.6	6.3	7	7.7	8.3	7.8	
Q =	-160	-204	-249	-295	-341	-383	-420	-451	

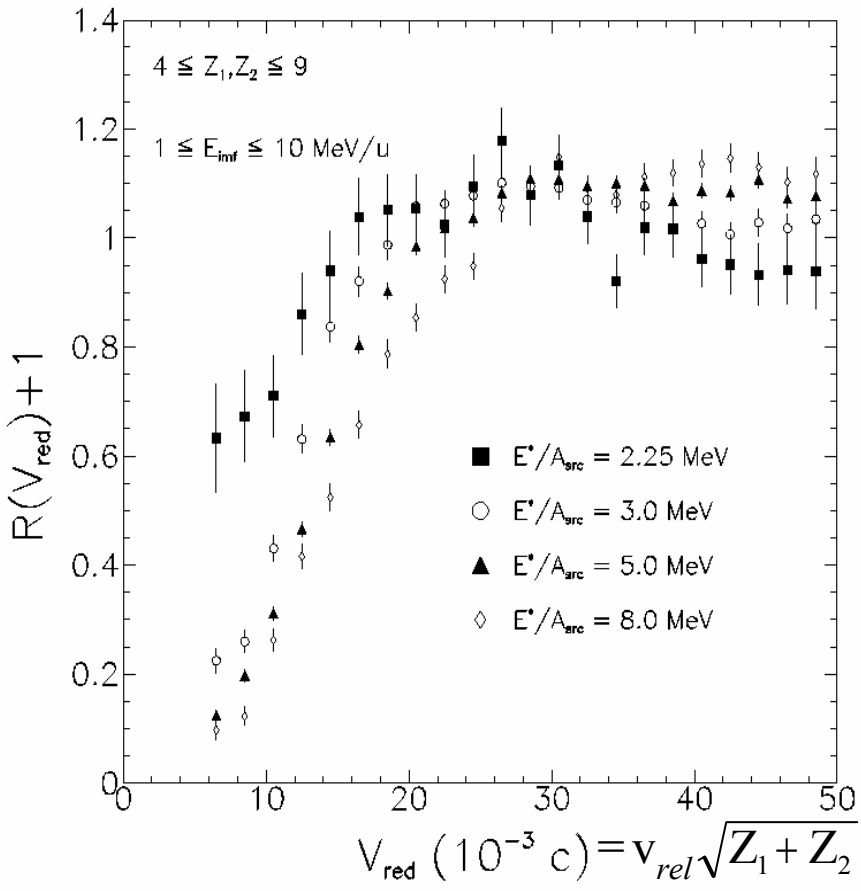

^{197}Au Target
■ – 200 MeV ^{4}He
▲ – 20-100 MeV/A ^{14}N
● – 4.8 GeV ^{3}He
< k_c >
< ρ / $ρ_o$ >
E*/ A (MeV)
0.0
0.2
0.4
0.6
0.8
1.0
0
1
2
3
4
5
6
7
8

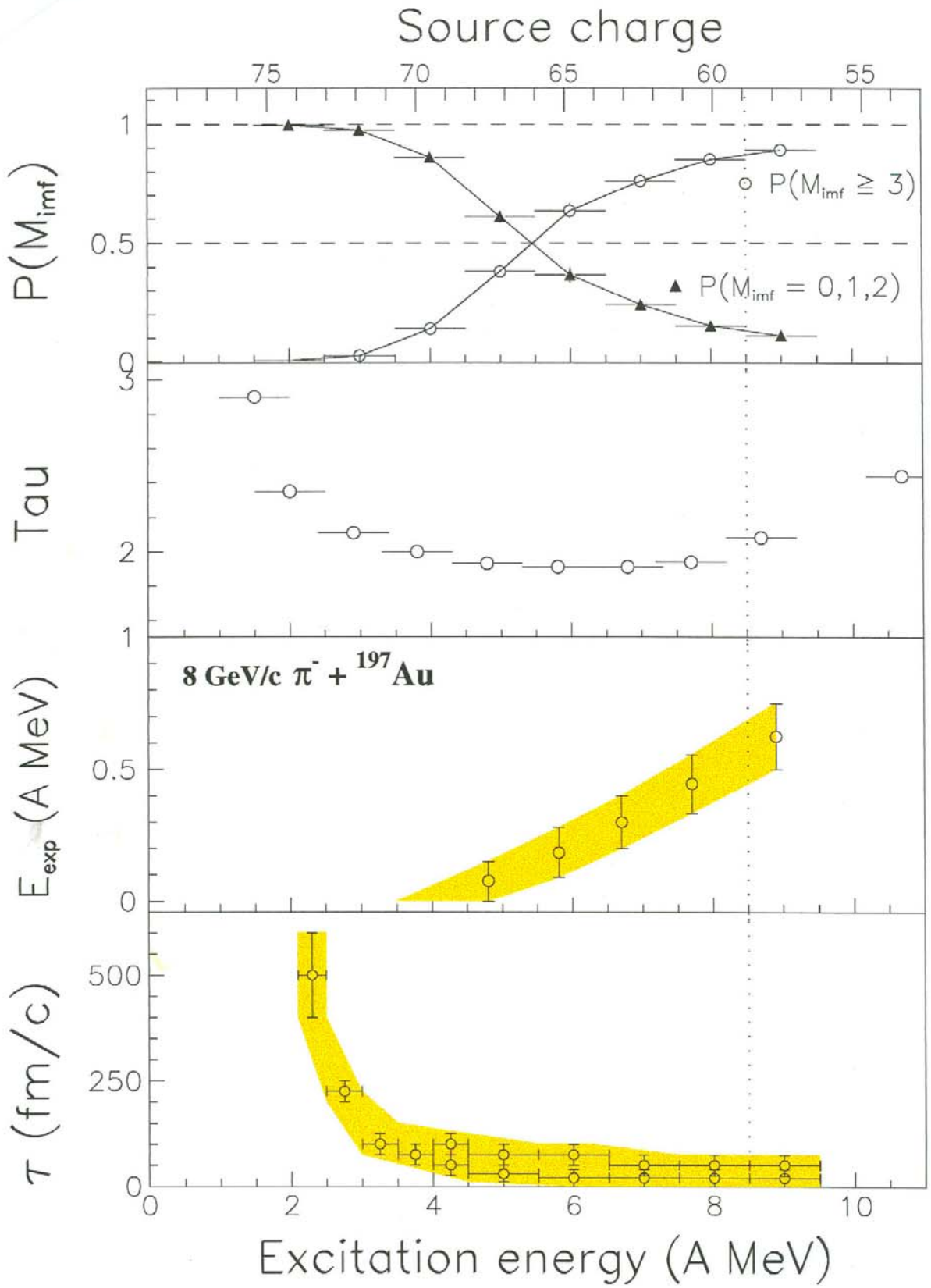


Boal, Gelbke and Jennings, Rev. Mod. Phys. **62**, 553 (1990).

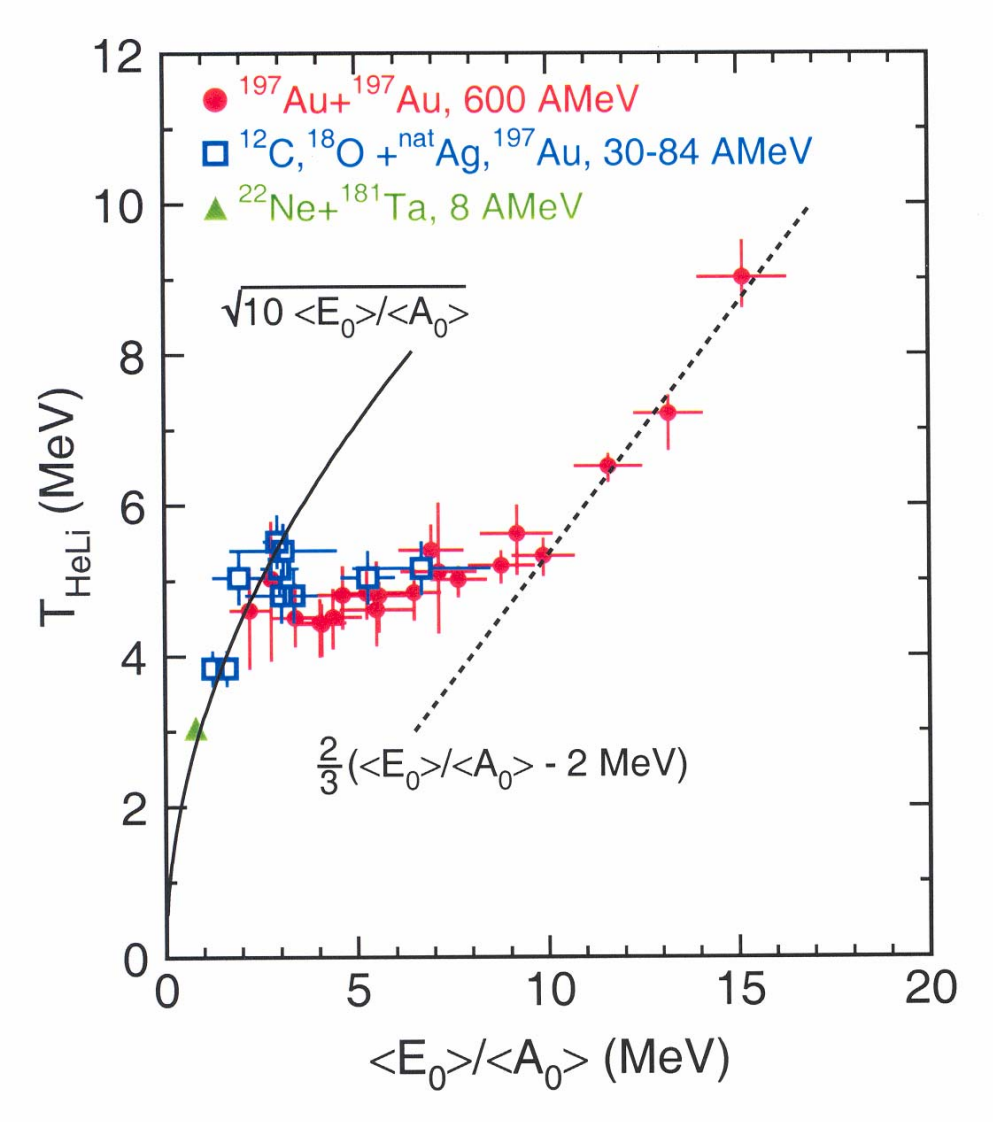
Y.O. Kim *et al.*, PRL **67**, 14 (1991).

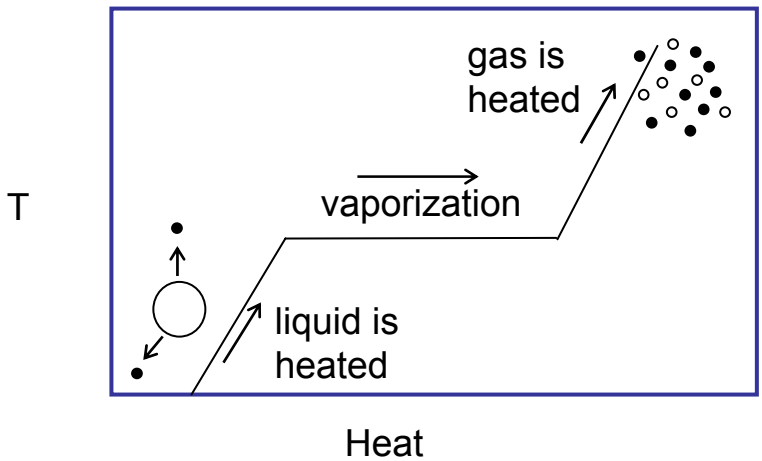
L. Beaulieu, R.T. de Souza, *et al.*, PRL **84** 5971 (2000)



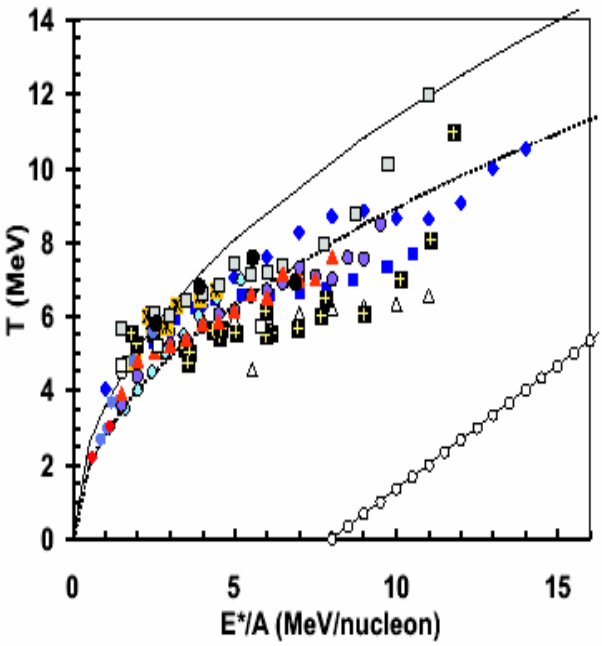

Source charge
75
70
65
60
55
P(M_imf)
1
0.5
0
P(M_imf ≥ 3)
P(M_imf = 0,1,2)
Tau
3
2
1
8 GeV/c π⁻ + ¹⁹⁷Au
E_exp (A MeV)
0.5
0
τ (fm/c)
500
250
0
0
2
4
6
8
10
Excitation energy (A MeV)

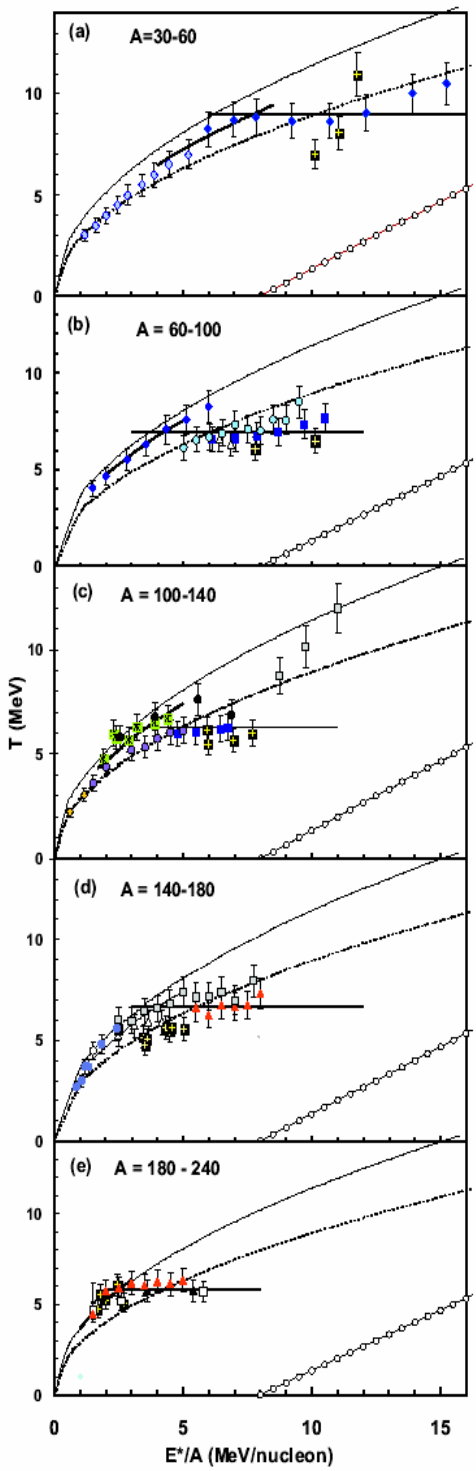
J. Pochodzalla et al., PRL 75, 1040 (1995)

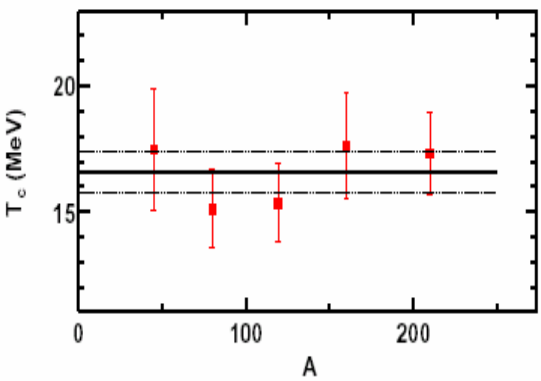




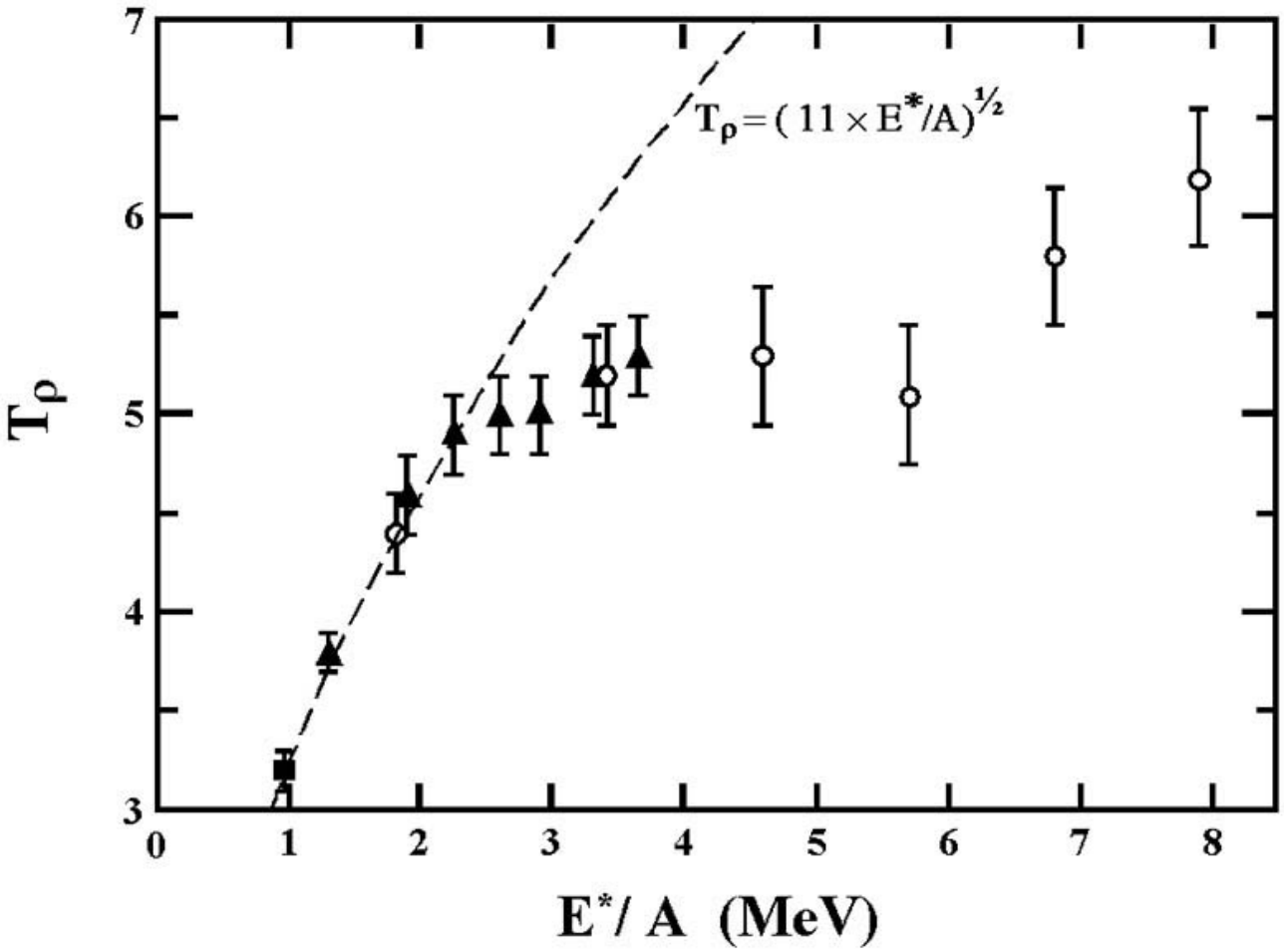
J.B. Natowitz *et al.*, PRC 65, 034618 (2002)







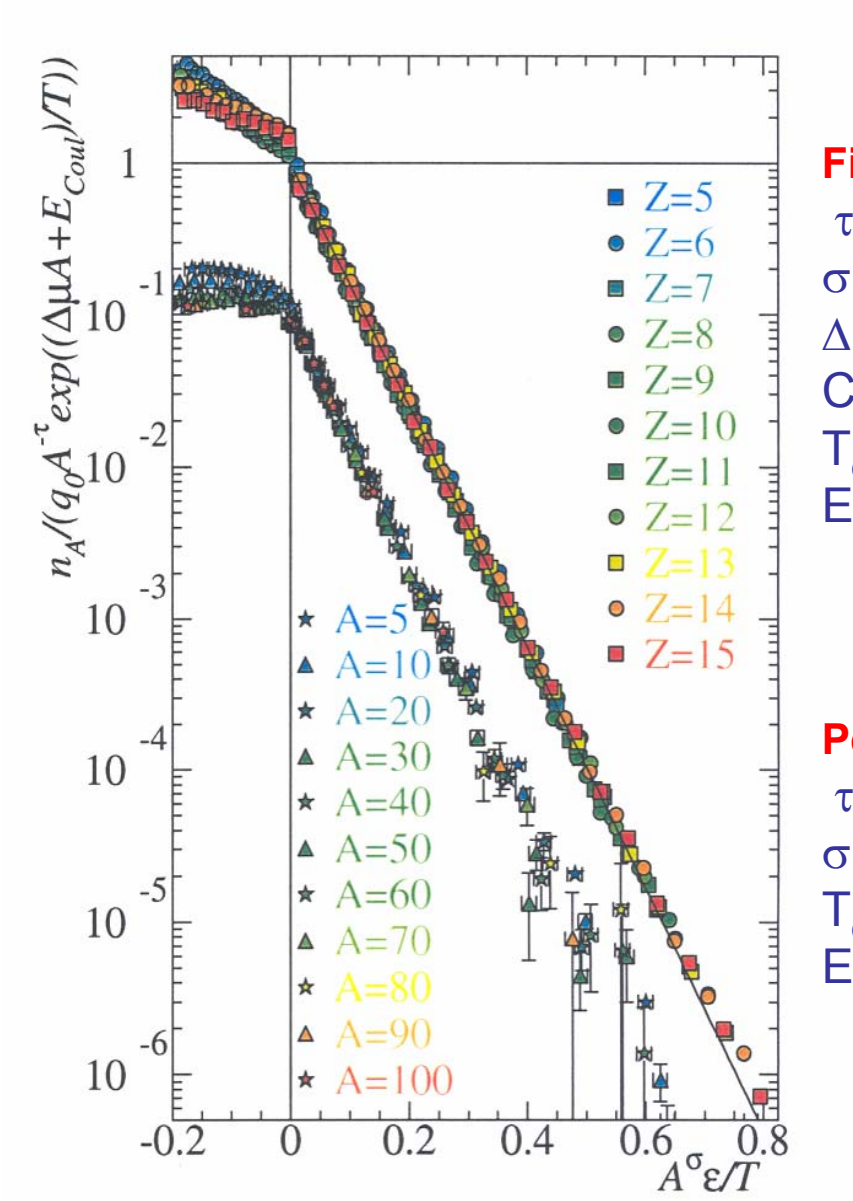
K = 232 ± 30 MeV



$$T = [K_0(\rho/\rho_0)^{2/3}(E^*/A)]^{1/2}$$

PRL (in press)

$$\left(\frac{A\Delta\mu}{T} - \frac{C_0 \in A^{\sigma}}{T}\right) \exp\left(\frac{E_{coul}}{T}\right)$$

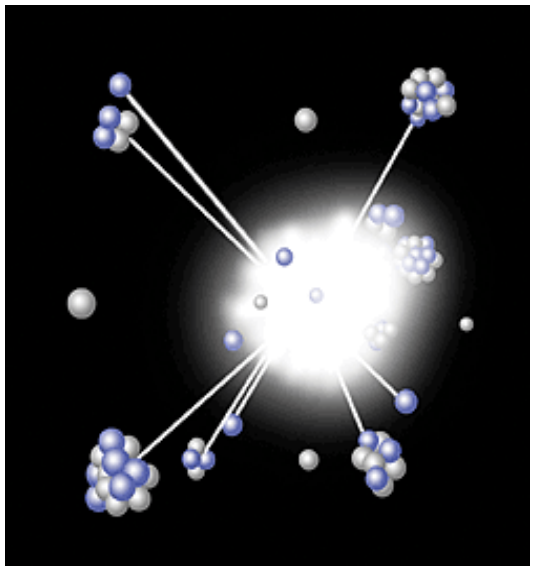


Fisher

τ = 2.18 ± 0.14
σ = 0.54 ± 0.01
$\Delta\mu$ = 0.06 ± 0.03
C_0 = 18.3 ± 0.5 MeV
T_c = 6.7 ± 0.2 MeV
E^*_c = 3.8 ± 0.3 MeV

Percolation

τ = 2,35 ± 0.05
σ = 0.50 ± 0.10
T_c = 8.3 ± 0.2 MeV
E^*_c = 5.3 ± 0.2 MeV



WHERE WE ARE

Liquid-gas phase transition Ubehavior in a strongly interacting, near symmetric two-component system has been characterized

WHERE WE NEED TO GO

- Determine self-consistent (critical parameters
- Explore the neutron-proton degree of freedom
- Define EOS for nuclear matter/supernova behavior