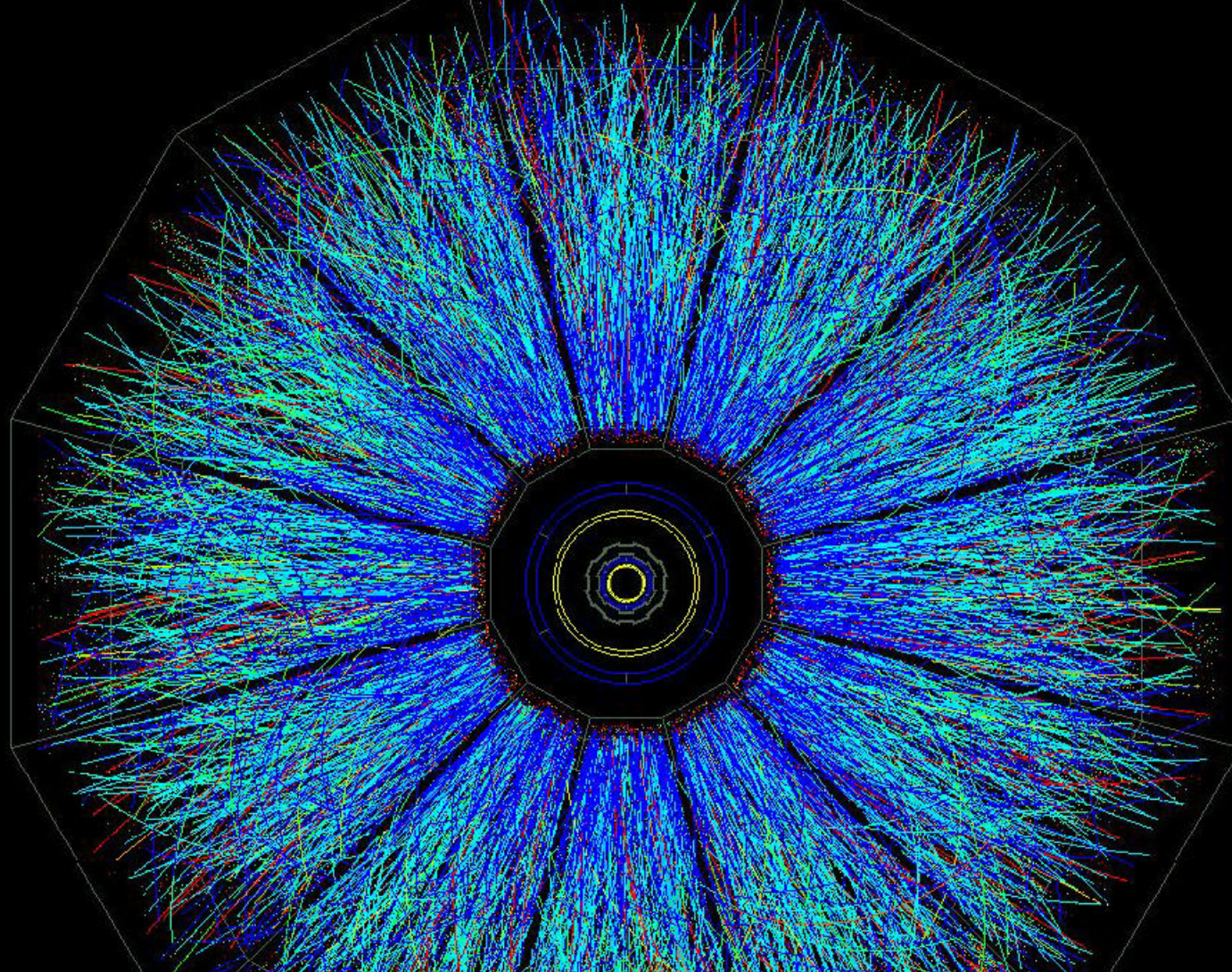


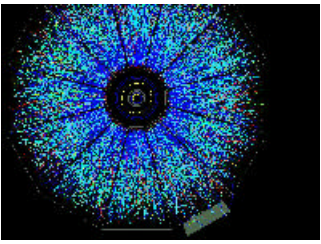
Au-Au collision i.e. two times 79 protons 117 neutrons



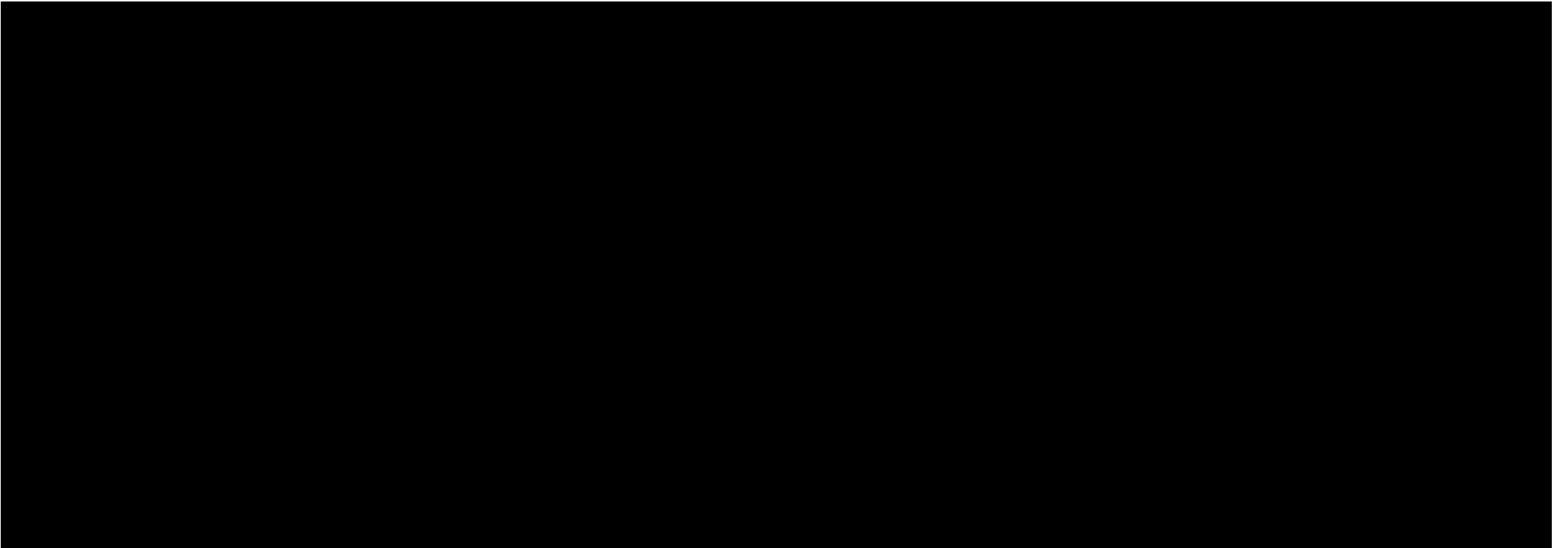
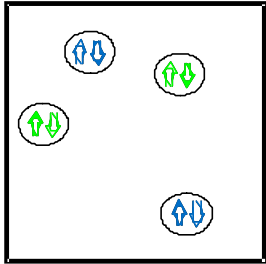
Thermodynamic description
i.e. simplifying the problem to two parameters T , μ

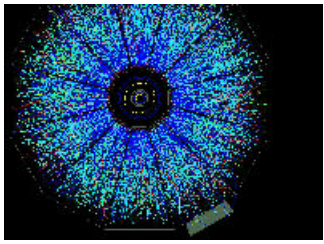


Vacuum - description so far

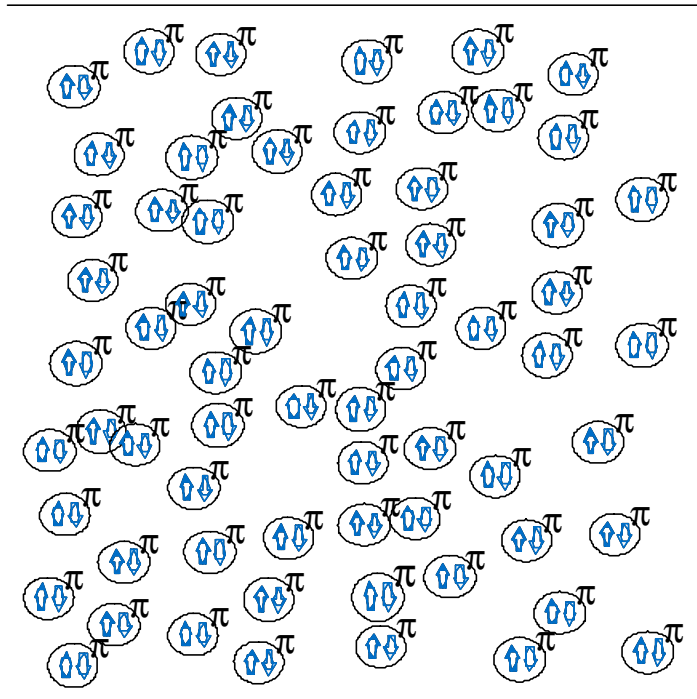
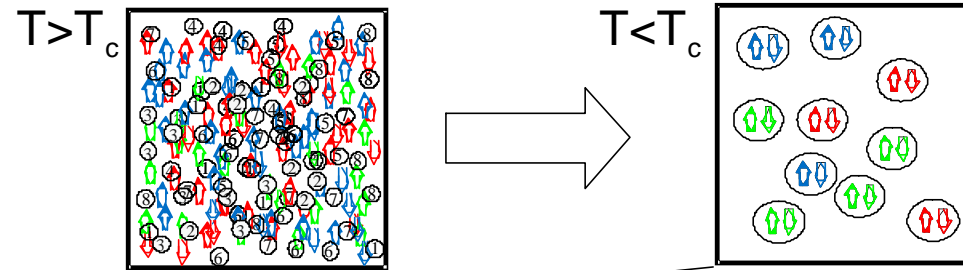


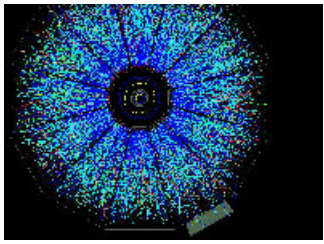
$T \ll$



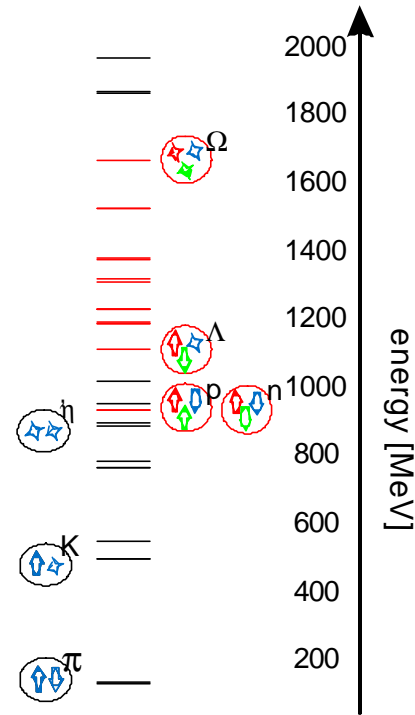
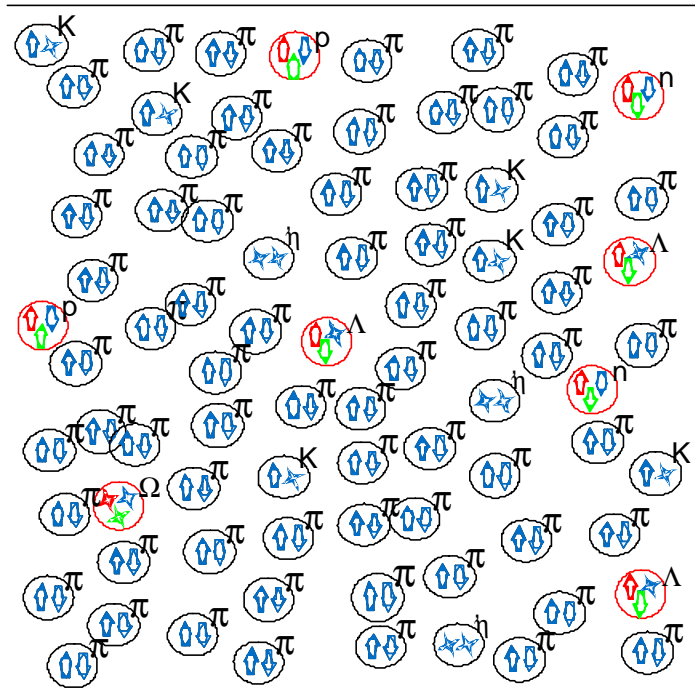
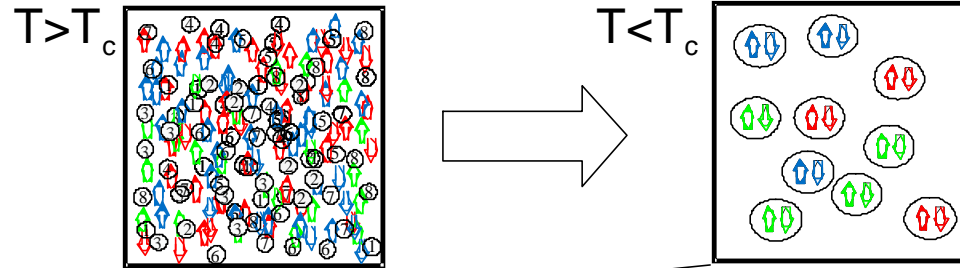


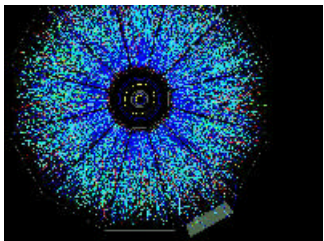
Going from QGP - hadronic gas



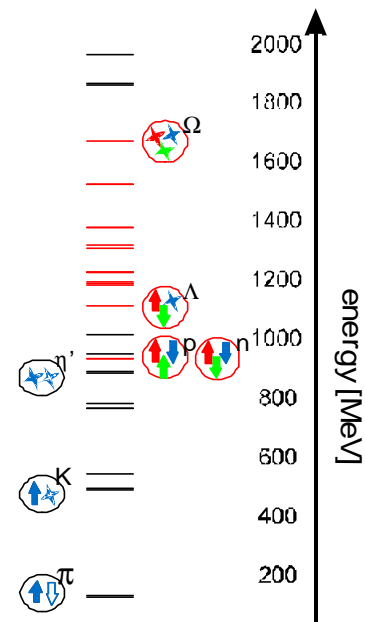
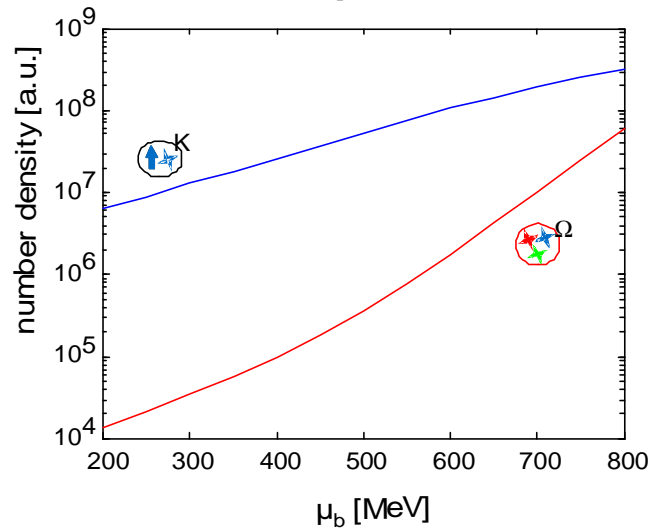
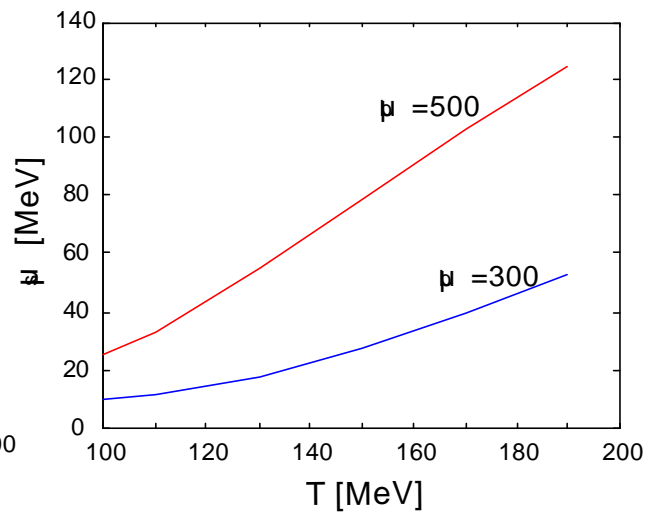
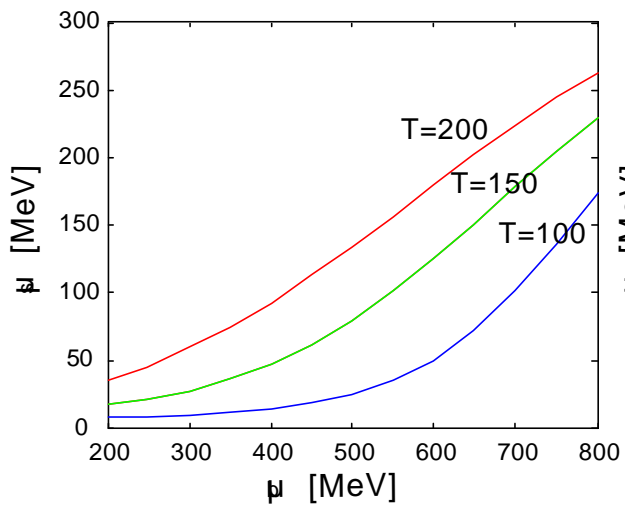
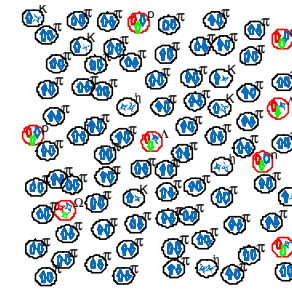


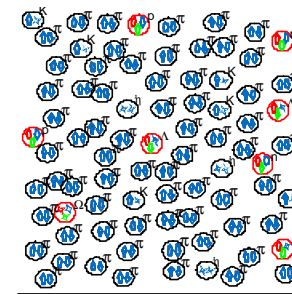
Going from QGP - hadronic gas





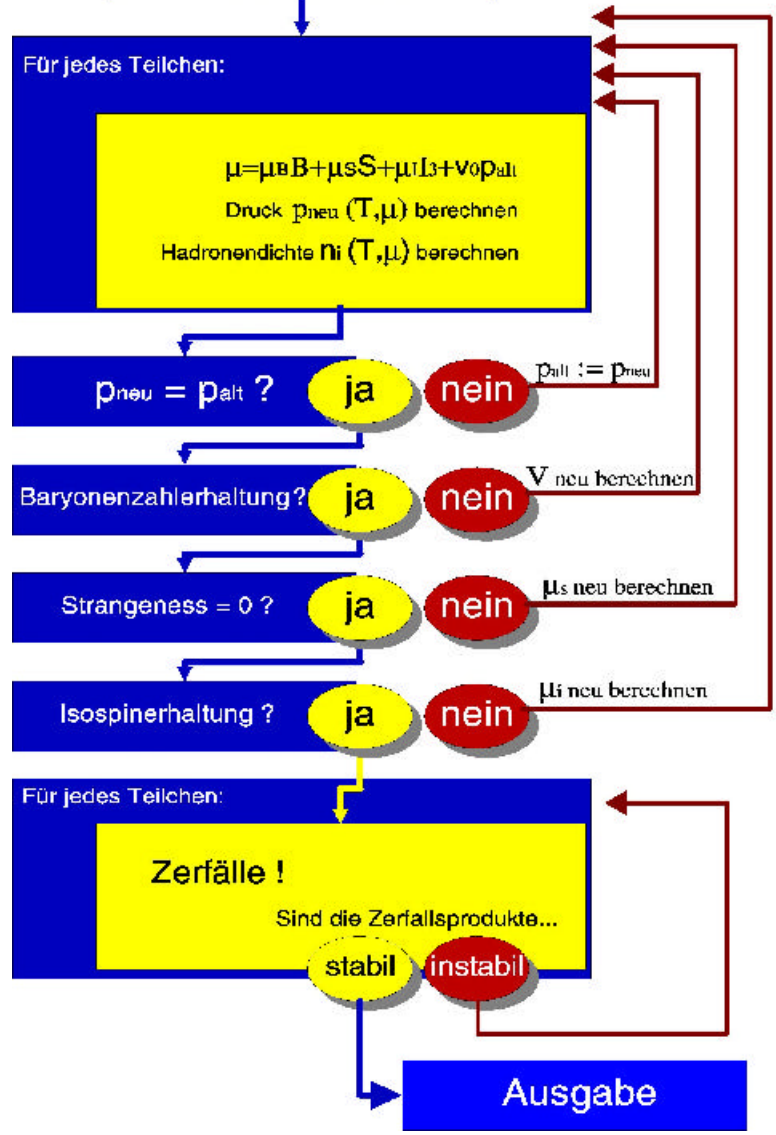
Chemical equilibrium (only S is conserved)



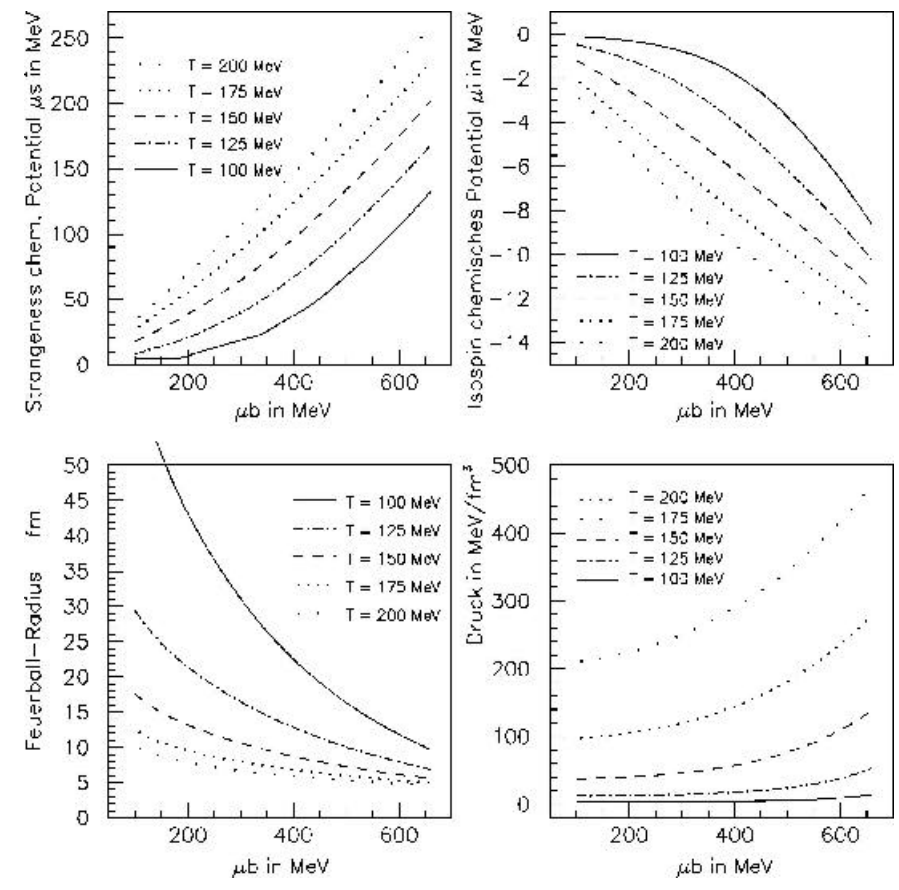


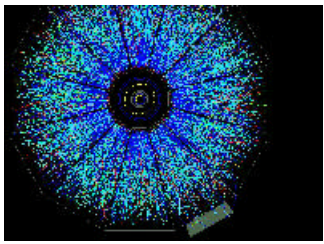
Information, die in das Modell hineingesteckt wird.
 T, μ_B, N, Z, v_0
 reconstruction efficiency
 Startwerte für $\mu_S, \mu_I, p_{alt}=0$

T = Temperatur
 μ_B = baryochemisches Potential
 μ_I = chem. Potential des Isospins
 μ_S = chem. Potential der Strangeness
 N = Neutronenzahl des Kollisionssystems
 Z = Protonenzahl des Kollisionssystems
 v_0 = Eigenvolumen eines Hadrons
 r.e. = Berücksichtigung schwacher Zerfälle

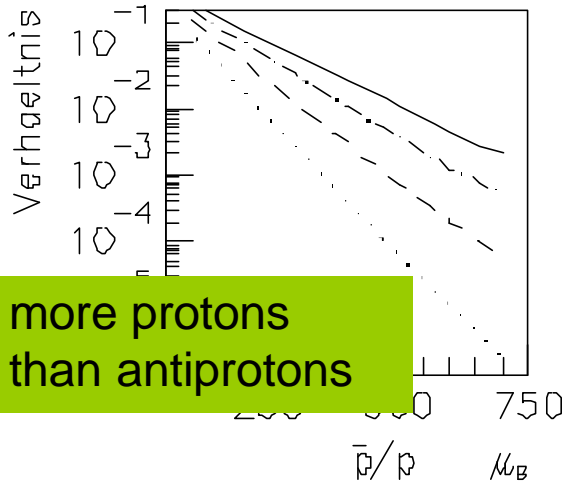
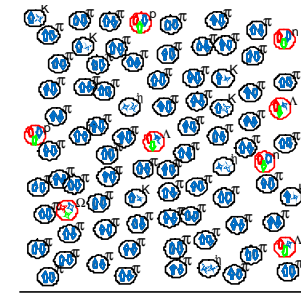


Chemical equilibrium (S, I³, excluded volume) Diplomarbeit Ingrid Heppe 1998



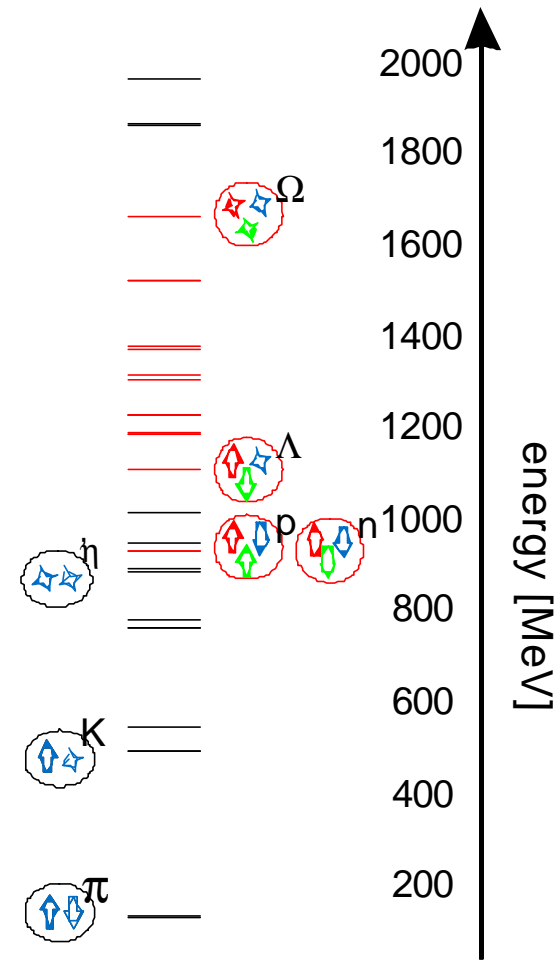


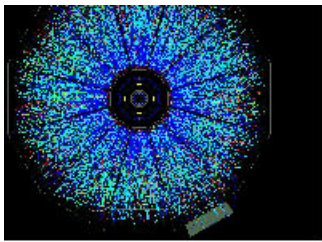
Chemical equilibrium properly done (I. Heppe)



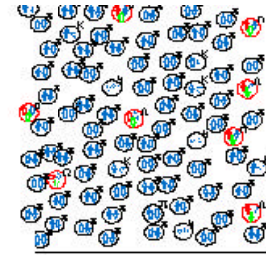
more protons than antiprotons

$$\Omega^+/\Omega^- \sim 1$$





Chemical equilibrium Pb-Pb



	Modellparameter	Exp. Daten
\bar{p}/p		0.055(16) (a) 0.065(4) (b) 0.085(8) (b)
π^+/π^-		1.1(?)
d/\bar{d}		$3.6(?) \cdot 10^{-3}$
$(p - \bar{p})/h$		0.228(29) (a)
K^+/K^-		1.85(9) 1.8(1)
K_S^0/π^-		0.125(25)
$2\phi/(\pi^+ + \pi^-)$		$9.1(10) \cdot 10^{-3}$
K_S^0/ϕ		11.9(23)
$K_S^0/(p - \bar{p})$		0.44(9) (a)
$\phi/(p - \bar{p})$		0.037(7) (a)
$\bar{\Lambda}/\Lambda$		0.152(21) (c) 0.128(12) (c)
Ξ^+/Ξ		0.227(33) (c)
Ξ^-/Λ		0.266(28) (c)
Ξ^0/Λ		0.137(11) (c)
Ξ^+/Λ		0.093(7) (c)
$\bar{\Omega}^-/\Omega$		0.180(39) (c)
$\bar{\Omega}^-/\Xi^-$		0.195 (23) (c)
$\bar{\Omega}^-/\Xi^-$		0.16(15)
Ω^-/Ξ^-		0.195(28) (c)
Ω^-/Ξ^-		0.30(9) (c)
$\bar{u}-\bar{s}$ $\bar{c}-\bar{b}$		0.195(28) (c)

$R(B)=R(M)=0.3 \text{ fm}$, $T=170 \text{ MeV}$, $\mu_B=280 \text{ MeV}$,
 $\mu_S=17.93 \text{ MeV}$, $\mu_B=-5.52 \text{ MeV}$
 (a) : ohne schwache Zerfälle
 (b) : mit allen schwachen Zerfällen
 (c) : schwache Zerfälle der Λ , Ξ und Σ^\pm
 durch entsprechende *cuts* vernachlässigbar.

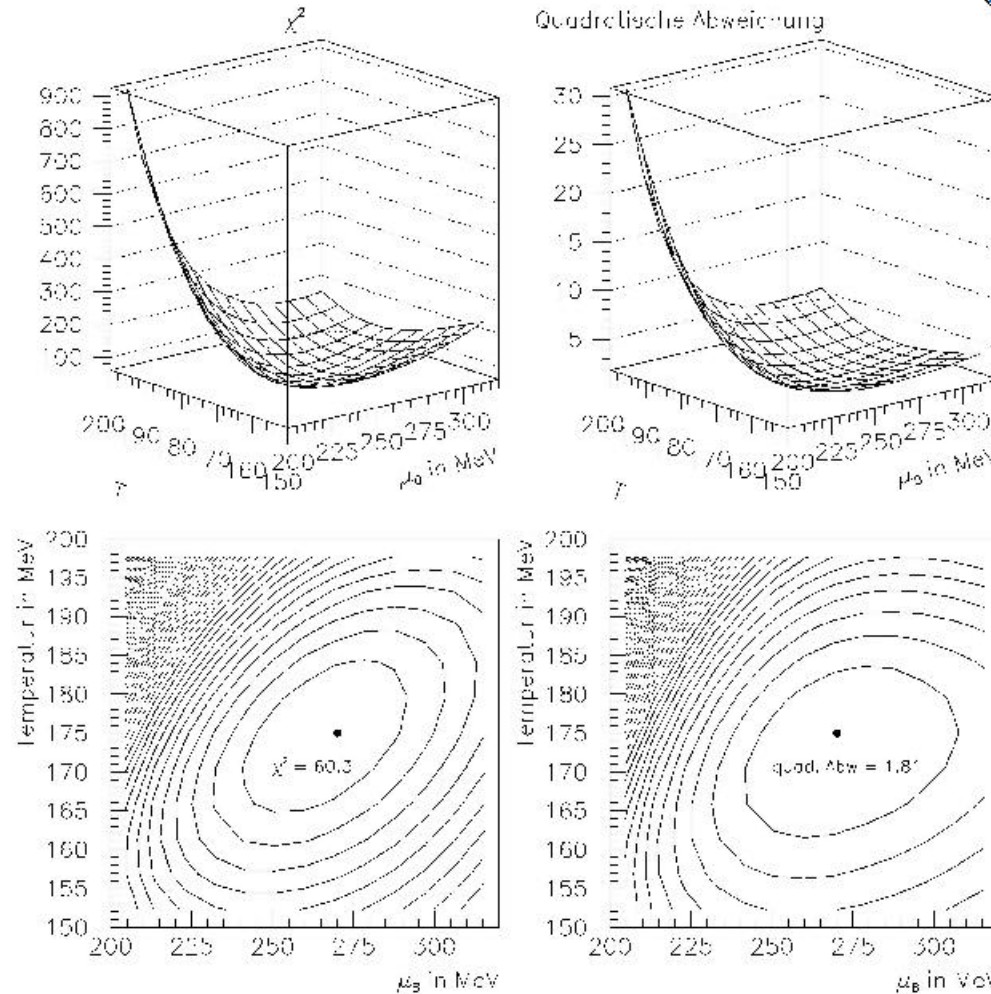
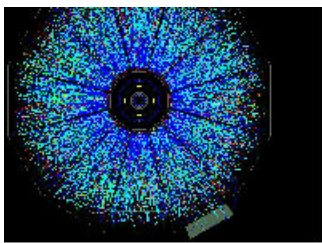
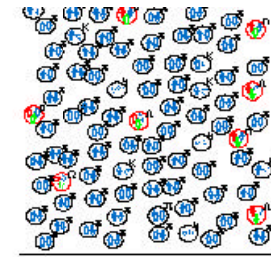


Abbildung 3.17 Quadratische Abweichung und χ^2 für Pb-Pb Daten im Vergleich mit dem erweiterten Modell mit $R(B)=R(M)=0.3 \text{ fm}$. Die innerste "Höhentlinie" liegt ungefähr bei $\chi^2=78.0$. Damit ist hier die $T - \mu_B$ Ebene deutlich flacher, als in den beiden anderen betrachteten Systemen. Die Ausfrieretemperatur läßt sich nur innerhalb eines Bereiches von $\pm 20 \text{ MeV}$ in μ_B und $\pm 10 \text{ MeV}$ in T angeben.

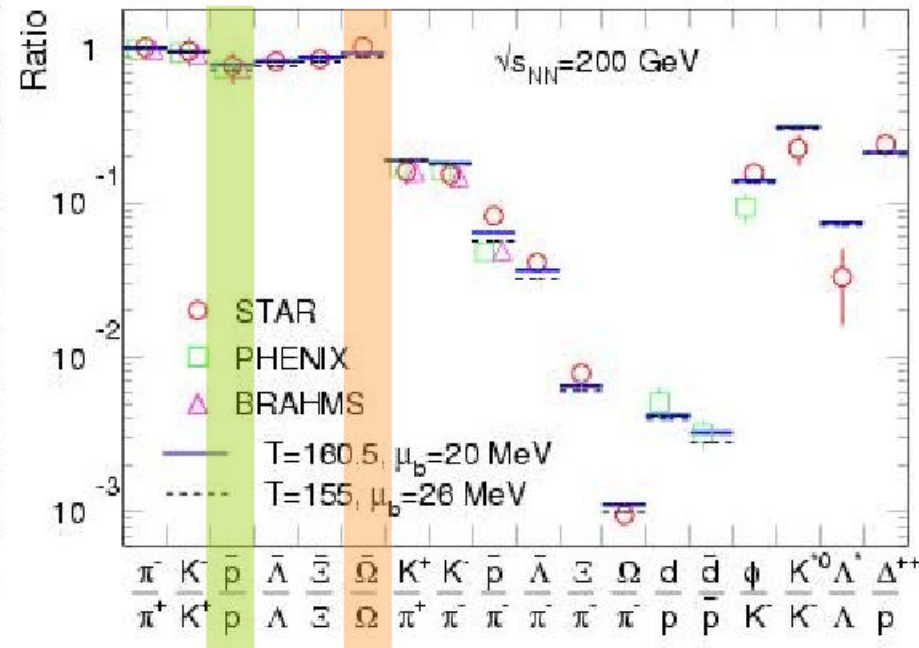
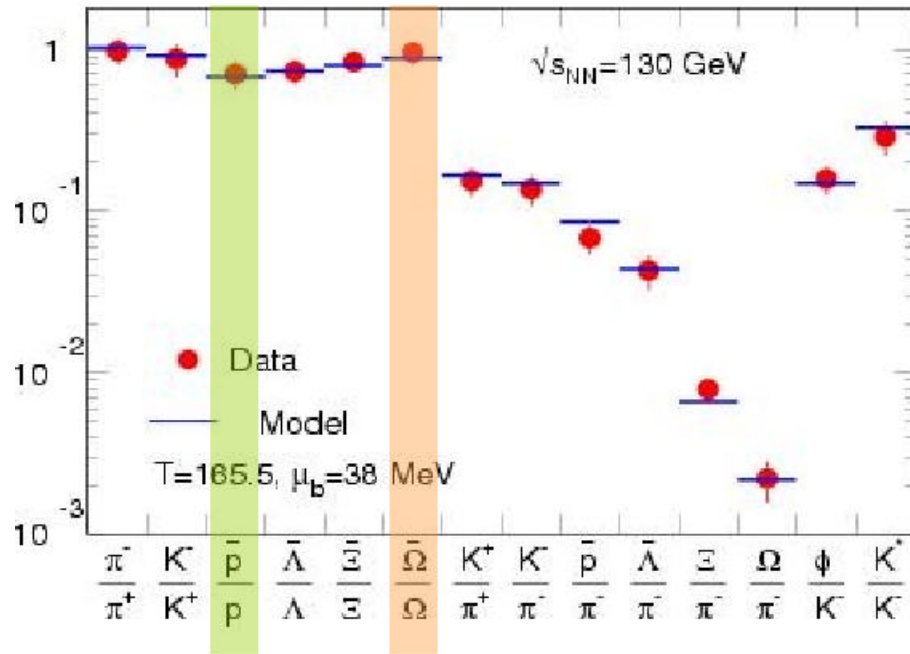


Chemical equilibrium comparison theory/experiment



130 GeV data in excellent agreement
with thermal model **predictions**

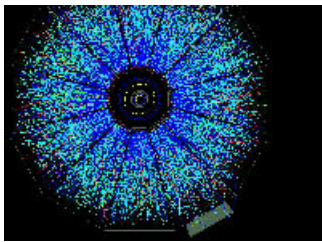
prel. 200 GeV data fully in line
still some experimental discrepancies



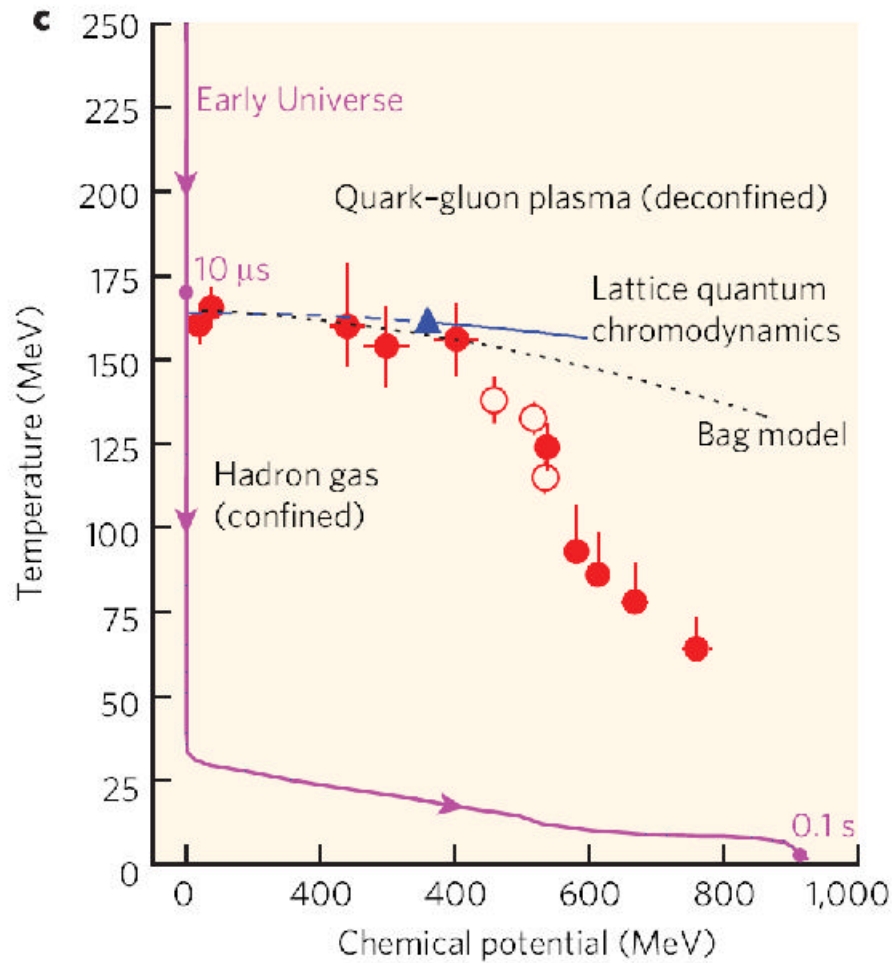
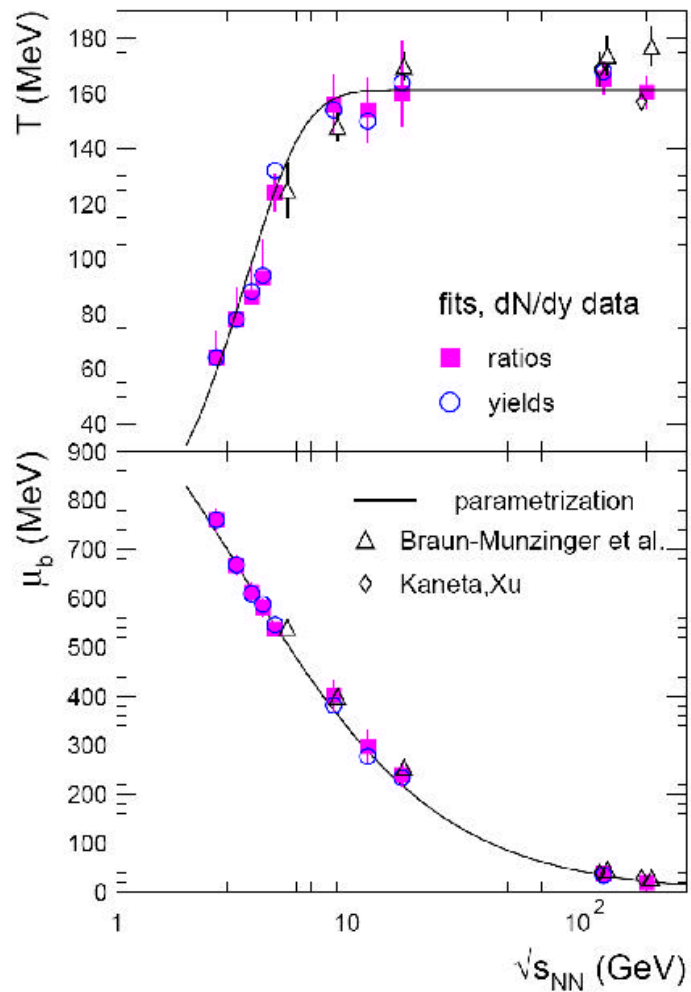
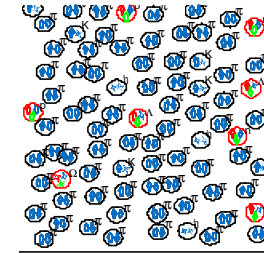
chemical freeze-out at: $T = 165 \pm 5 \text{ MeV}$

P. Braun-Munzinger, D. Magestro, K. Redlich, J. Stachel, Phys. Lett. B518 (2001) 41

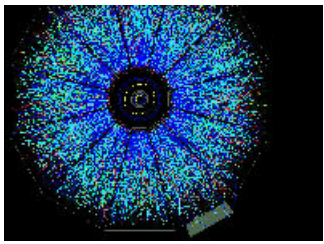
A. Andronic, P. Braun-Munzinger, K. Redlich, J. Stachel, Nucl. Phys. A772 (2006) 167



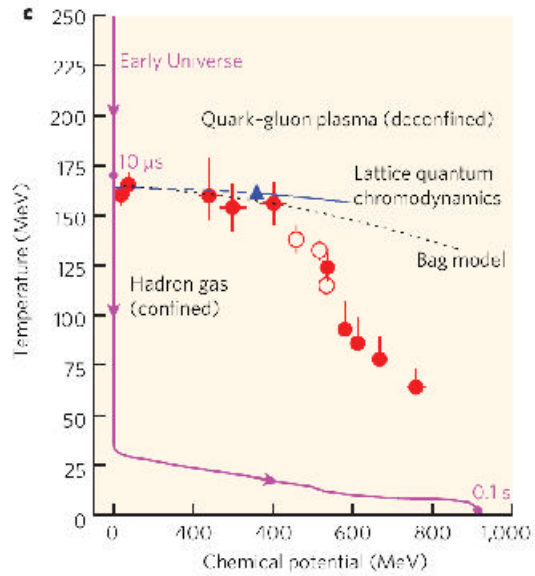
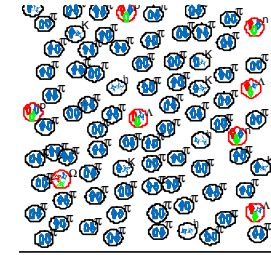
T_{ch} , μ_B in the QGP phase diagram



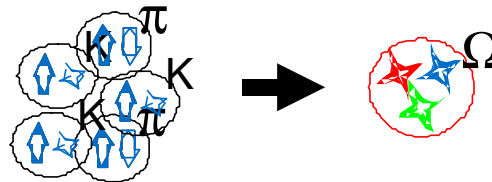
A. Andronic, P. Braun-Munzinger, J. Stachel, Nucl. Phys. A772 (2006) 167
P. Braun-Munzinger, J. Stachel, Nature insight 448, (2007) 302



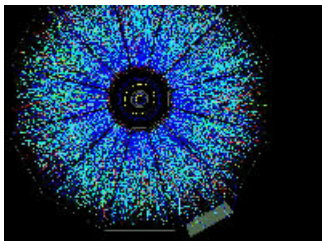
Why is $T_{ch} \sim T_c$?



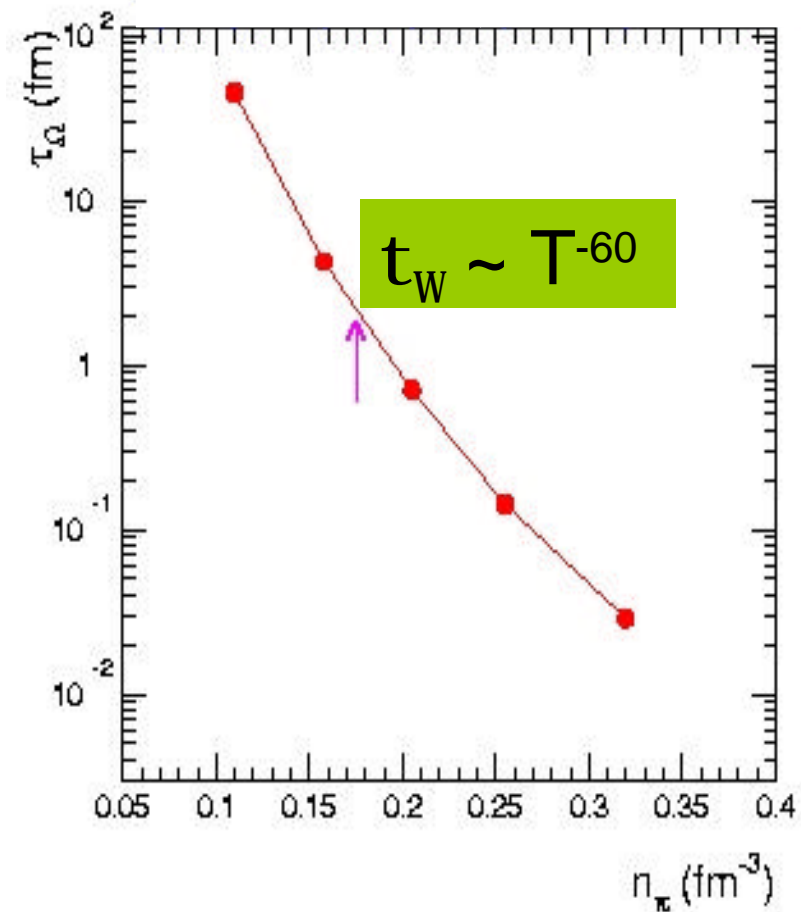
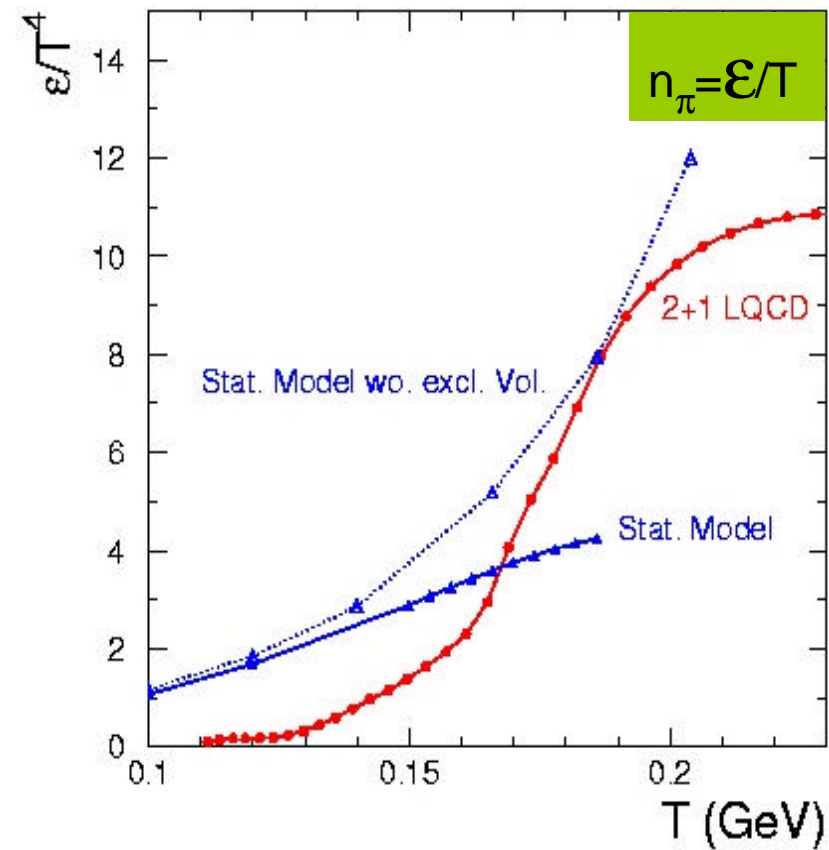
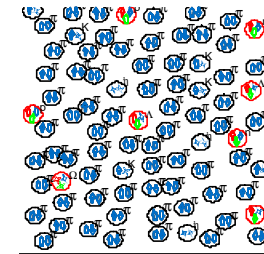
are detected - consistent with chemical freeze out

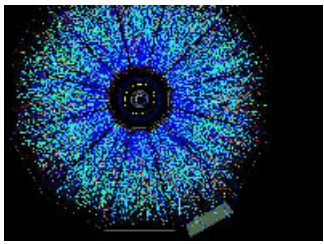


5 particle collision \rightarrow rate is prop. $n_{\pi}^2 n_K^3 \sim n_{\pi}^5 (n_K/n_{\pi})^3$

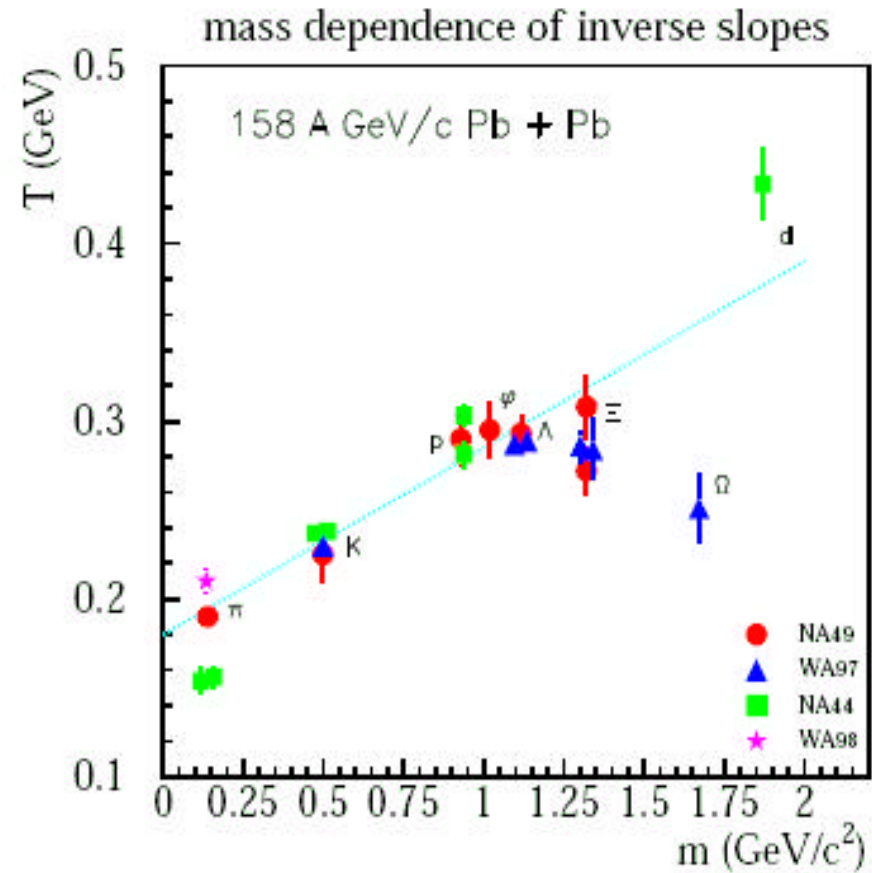
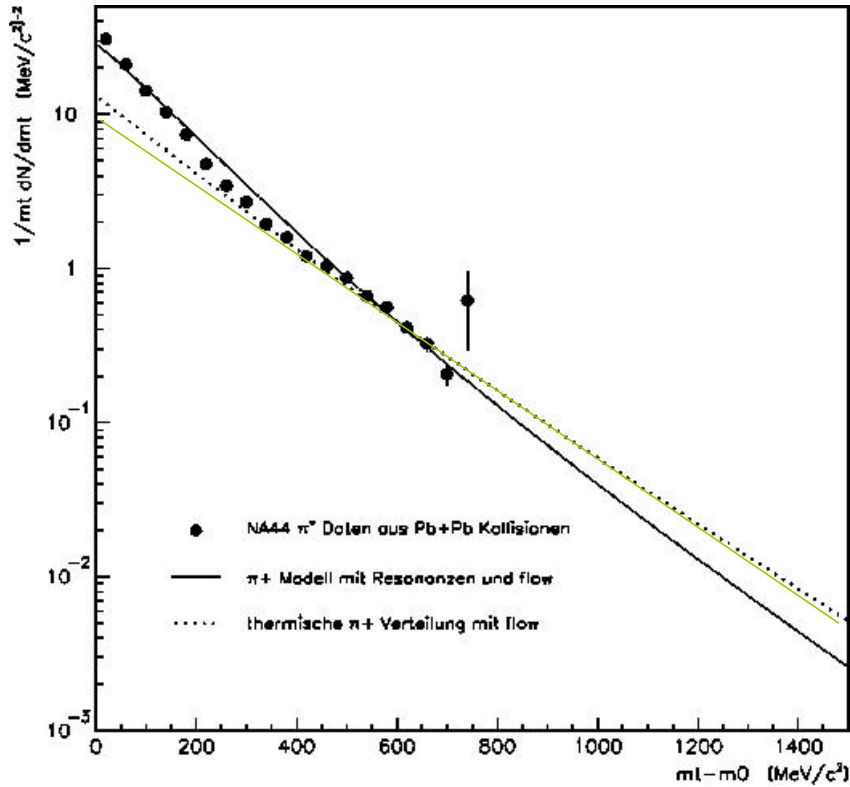
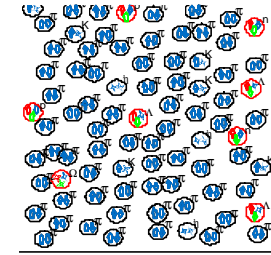


Why is $T_{ch} \sim T_c$?



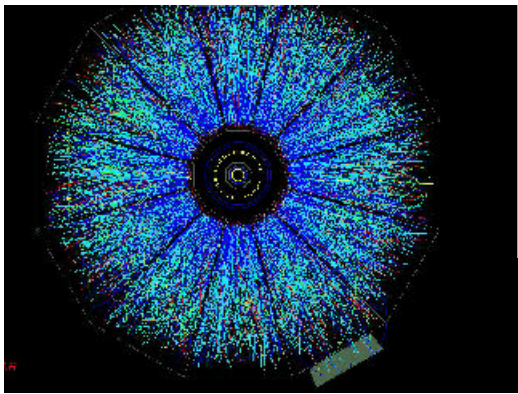


Thermal freeze out ?
Looking at transverse momentum distribution



slope constants grow with mass - much too large to be temperatures!

Hubble Expansion of Nuclear Fireball



T, μ

