Initial energy density : a unique indicator of the QCD phase transition ?

Sonja Kabana ??

[a]*Laboratory for High Energy Physics, University of Bern, Switzerland*

Presented by: Sonja Kabana

Abstract

We discuss to which extent, the initial energy density ϵ reached in a collision, is 1) a discriminating parameter for the appearance of the QCD phase transition and 2) if so, if it is the only discriminating parameter, or there is e.g. a critical volume above which this transition can occur. These questions are investigated by means of calculations of the ϵ dependence of a) hadron number densities (hep-ph/0004138, hep-ph/0010228), and b) of the temperature and the strangeness suppression factor λ_s extrapolated to zero fugacities at the chemical freeze-out (hep-ph/0010247). We use experimental data of A+A, $e^+ + e^-$, $p+p$ and $p+\overline{p}$ collisions at $\sqrt{s}$=2.6 GeV to 1.8 TeV, including new RHIC data. The results are interpreted as mapping out the QCD phase transition boundary universally in A+A as well as in particle reactions, with $\epsilon_{init,critical} \sim 1$ GeV/fm^3 and $T_{freeze-out,critical}$=155 $\pm$ 20 MeV. Strangeness is enhanced over light quarks in the reactions going through the QGP phase, as compared to the ones which do not cross the boundary. However, no additional strangeness enhancement is observed in nucleus+nucleus collisions with respect to elementary collisions at the same (ϵ_{init}, μ_b, μ_s).

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