QGP physics – from fixed target to LHC (SS 2011): Homework asssignments

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Problem 1: Spectrometer Acceptance

The CERES/NA45 spectrometer was covering an acceptance of $\theta = 8 - 14$ degrees. What pseudorapidity coverage does this correspond to? Indicate in a transverse momentrum p_T vs rapidity y diagram the acceptance for protons and pions.

Problem 2: Phase diagram

Use the bag model to draw a phase boundary between nuclear matter and quark-gluon matter and add in this phase diagram as well the region of the interior of neutron stars assuming that the central density is between 5 and 10 times nuclear matter density. In the phase diagram, use the axes temperature and baryon chemical potential.

Problem 3: Glauber Monte Carlo

Download the macro glauber_mc.C from the lecture website and run it under root. Modify it to answer the following questions

a) What is the total inelastic Pb+Pb cross section for a nucleon-nucleon cross section of $\sigma_{\mathrm{NN}}^{\mathrm{inel}} = 64\,\mathrm{mb}$?

b) What is the total inelastic S+S cross section for $\sigma_{\mathrm{NN}}^{\mathrm{inel}} = 64\,\mathrm{mb}$?

c) What is the total inelastic cross section and the average number of nucleon-nucleon collisions in p+Pb collisions for $\sigma_{\mathrm{NN}}^{\mathrm{inel}} = 64\,\mathrm{mb}$?

Problem 4: Average transverse momentum

The invariant cross section of a certain particle species can be parameterized as $E\frac{d^3\sigma}{d^3p} = A\exp(-p_T/T)$. Calculate the average transverse momentum of these particles.