Heavy-Ion Collisions & Equation of State: Homework Set 4

1. Combining information from electron scattering and from empirical mass formula, we can conclude that the energy per nucleon, $\frac{E}{A}(n)$, in symmetric nuclear matter, minimizes at the normal density of $n_0 = 0.16\,\mathrm{fm}^{-3}$, with the value of $-16.0\,\mathrm{MeV}$. As nucleonic density approaches zero, $n \to 0$, the energy per nucleon should tend to zero as well, $\frac{E}{A} \to 0$.

   (a) Assume a parabolic shape for $\frac{E}{A}$ and estimate the value of incompressibility K for symmetric nuclear matter from the sole demand that the parabola for $\frac{E}{A}$ passes through the two points mentioned above.

   (b) Extended regions of cold matter become mechanically unstable when pressure drops with density, $\mathrm{d}p/\mathrm{d}n < 0$. The pressure is related to energy per nucleon with $p = n^2\,\mathrm{d}(E/A)/\mathrm{d}n$. Find the region of instability in n for extended cold matter when assuming $\frac{E}{A}(n)$ above.