The Asymmetry Enthalpy– H_{asy}

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Recent work has sought to extract the asymmetry energy E_{asy} at low density from observables in heavy-ion collisions. The logic employed starts from the assumption that the fragment yields are determined by a minimization of the Helmholtz free energy. As the real world realization do not fix the volume (or for that matter, the pressure), it is not clear this assumption is valid. If, for example, the identical logic was used, but the Gibbs free energy was the more relevant quantity to minimize, it would be the asymmetry enthalpy H_{asy} that would be extracted. While it is clear what the extremalized quantity is in the real world realization, we can determine how much H_{asy} and E_{asy} differ in thermodynamically consistent models. Such differences can be used as illustrations of the possible uncertainties in the extraction of E_{asy} from heavy-ion reaction observables. This has been done using the so called “canonical model” of Subal das Gupta and collaborators. The result is that while H_{asy} is indistinguishable from E_{asy} below the liquid-gas phase transition, H_{asy} can greatly exceed H_{asy} above the transition. This calculation is an eye-opening heuristic exercise for students and MATHEMATICA templates are available on request.