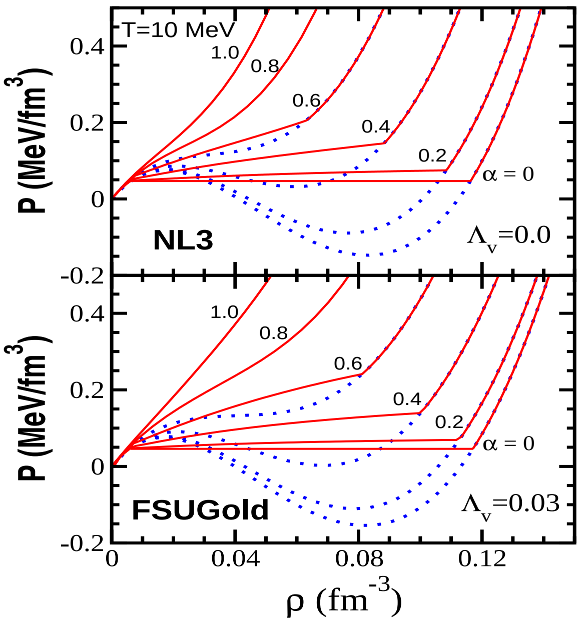

FIG. 2: Pressure as a function of density at temperature $T = 10$ MeV for various isospin asymmetry α in the original NL3 set [27] with $\Lambda_v = 0.0$ (top panel) and the original FSUGold set [28] with $\Lambda_v = 0.03$ (right panel). The dotted curves refer to unstable single phase while the solid curves refer to stable matter; see text for details.

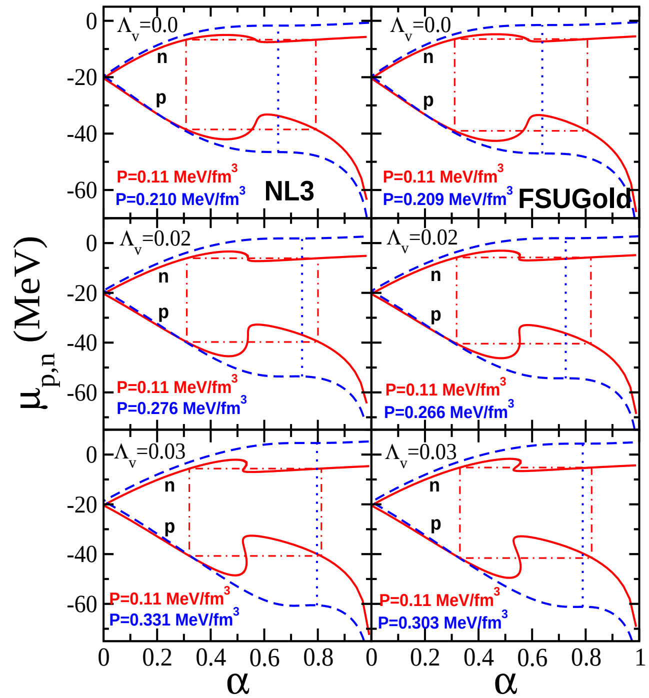

FIG. 3: Chemical potential isobars as a function of isospin asymmetry α at temperature $T = 10$ MeV for NL3 (left panel) and FSUGold (right panel) with different Λ_v couplings. The geometrical construction used to obtain the isospin asymmetries and chemical potentials in the two coexisting phases is also shown.

The first inequality indicates mechanical stability which means a system at positive isothermal compressibility remains stable at all densities. The second inequality stems from chemical instability which shows that energy is required to change the concentration in a stable system while maintaining temperature and pressure fixed. If one of these conditions get violated, a system with two phases is energetically favorable. The two phase coexistence is governed by the Gibbs's criteria for equal chemical potentials and pressures in the two phases with different densities but at the same temperature:

$$\mu_q^L(T, \rho^L) = \mu_q^G(T, \rho^G) \quad (q = n, p), \tag{9}$$
$$P^L(T, \rho^L) = P^G(T, \rho^G). \tag{10}$$

Figure 2 shows the pressure as a function of nucleon density at a fixed temperature $T = 10$ MeV with different values of asymmetry α in the original NL3 and FSUGold sets. Below a critical value of asymmetry α, the pressure is seen (dotted curves) to decrease with density resulting in negative incompressibility and thereby a mechanically unstable system. The stable two-phase (liquid-gas) configuration at each density is obtained from Maxwell construction (solid lines). Analogues to intermediate energy heavy-ion collisions [1, 2] when the hot matter in the high density (liquid) phase expands it enters the coexistence LGP where the pressure decreases at a fixed $\alpha \neq 0$ for the two-component asymmetric matter. Whereas, for symmetric nuclear matter at $\alpha = 0$ the pressure remains constant at all densities. Finally the system leaves the coexistence region and vaporizes into the low density (gas) phase. Of particular interest here is the symmetry energy effects on the isotherms. It is clearly seen that in contrast to the original NL3 with $\Lambda_v = 0$, the softer $E_{\rm sym}(\rho)$ in the original FSUGold with $\Lambda_v = 0.03$ [17] enforces the onset of pure liquid phase to a higher density resulting in a wider coexistence region for each asymmetry α. Moreover, the critical pressure P_c above which the mixed liquid-gas phase vanishes is seen larger for this soft FSUGold set; a detailed discussion of which is presented below.

The details of chemical evolution for the LGP transition is depicted in Fig. 3 where the neutron and proton chemical potentials are shown as a function of isospin asymmetry α at a fixed $T = 10$ MeV and pressure $P = 0.11$ MeV/fm^3 for the NL3 (left panels) and FSUGold (right panels) at various Λ_v values. As usual, the bare nucleon mass has been subtracted from the chemical potentials. At fixed pressure and Λ_v, the solutions of the Gibbs conditions (9) and (10) for phase equilibrium form the edges of a rectangle and can be found by geometrical construction as shown in Fig. 3. At each Λ_v, the two different values of α defines the high density liquid phase boundary (with small $\alpha = \alpha_1(T, P)$) and the low density gas phase boundary (with large $\alpha = \alpha_2(T, P)$). From the figure it is evident that the symmetry energy