Gravgård

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Alt som ikke kom med.. .

0.1 Tree level pion star

We introduce the new dimensionless variable $1 + x^2 = \mu_I^2/\bar{m}^2$. This is reminicent of the dimensionless Fermi momentum $x_f = p_f/m$ in {section: cold fermi star}. By an argument using a right triangle, we can vertify that $\cos a = b$ implies $\sin a = \sqrt{1 - b^2}$. Substituting the dimensionless variable into the free energy density, we get

$$\mathcal{F} = -\frac{u_0}{2}\left(1 + x^2 + \frac{1}{1 + x^2}\right). \tag{1}$$

We have introduced the characteristic energy density $u_0 = \bar{m}^2 f^2$. As we found in **??**, pressure is given by negative the free energy density, normalized to $\mu_I = \bar{m}$, or $x = 0$. We choose $p_0 = u_0$, so the dimensionless pressure can be written

$$\tilde{p} = -\frac{1}{u_0}(\mathcal{F} - \mathcal{F}_{x=0}) = \frac{1}{2}\frac{x^4}{1 + x^2}. \tag{2}$$

The charge density corresponding to a chemical potential is given by minus the derivative of the free energy with respect to that chemical potential. We must, however, not assume any dependence of α on μ_I. The isospin density therefore is

$$n_I = -\frac{\partial \mathcal{F}}{\partial \mu_I} = f^2 \mu_I \sin^2 \alpha = \frac{u_0}{\mu_I}\frac{2x^2 + x^4}{1 + x^2}., \tag{3}$$

With this, the dimensionless energy density

$$\tilde{u} = -\tilde{p} + \frac{1}{u_0} n_I \mu_I = \frac{1}{2}\frac{4x^2 + x^4}{1 + x^4} \tag{4}$$