Relativistic mean field, continued

$$(\Box + m_\sigma^2)\sigma = g_\sigma \bar{\psi}\psi$$

$$(\Box + m_\omega^2)\omega_\mu + \partial_\mu(\partial^\nu \omega_\nu) = g_\omega \bar{\psi}\gamma_\mu \psi$$

$$\left[\gamma_\mu(i\partial^\mu - g_\omega \omega^\mu) - (m - g_\sigma \sigma)\right]\psi = 0$$

mean-field approximation

$$\sigma \to \langle \sigma \rangle = \text{constant}$$

$$\omega_\mu \to \langle \omega_\mu \rangle \begin{cases} 0 & \mu = 1,2,3 \\ \text{constant} & \mu = 0 \end{cases}$$

effective $\begin{cases} \text{momentum} & k^\mu - g_\omega \omega_\mu \\ \text{mass} & m^* = m - g_\sigma \sigma \end{cases}$

EOS from energy-momentum tensor

$$T^{\mu\nu} = \frac{\partial \mathcal{L}}{\partial \partial_\mu \psi} \partial^\nu \psi + \frac{\partial \mathcal{L}}{\partial \partial_\mu \bar{\psi}} \partial^\nu \bar{\psi} - g^{\mu\nu} \mathcal{L}$$

$$T^{00} = \epsilon$$

$$\frac{1}{3} T^{ii} = P$$

@ fixed baryon density

Result only depends on

$$\frac{g_\sigma}{m_\sigma} \qquad \frac{g_\rho}{m_\rho}$$

model fully determined from equilibrium properties of isospin-symmetric matter