1

$$P = \frac{1}{3}(\rho - 4B) - \alpha\sqrt{\rho - B} + \beta\left[1 + \kappa \ln\left(\gamma\sqrt{\rho - B}\right)\right]$$

$$\alpha = \frac{m_s^2}{3\pi\sqrt{a_4}} \qquad \beta = \frac{m_s^4}{12\pi^2}\left(1 - \frac{1}{a_4}\right) \qquad \gamma = \frac{8\pi}{3m_s^2\sqrt{a_4}}$$

$$\kappa = 3\left(1 - \frac{1}{a_4}\right)^{-1}$$, m_s quark mass

saat $m_s \to 0$, $P \sim \frac{1}{3}(\rho - 4B) \Rightarrow$ ~~speed~~ of sound $= \frac{1}{\sqrt{3}}$

Tebakan u/ mengubah speed of sound $= \left(\frac{dP}{d\rho}\right)^{1/2}$ jadi umum V_s.

u/ sementara $V_s^2 \equiv w$. Kita tebak

$$\boxed{P = w(\rho - 4B) - \alpha\sqrt{\rho - B} + \beta\left[1 + \kappa \ln\left(\gamma\sqrt{\rho - B}\right)\right].}$$

Definisikan $\tilde{P} \equiv P - \beta\left[1 + \kappa \ln\left(\gamma\sqrt{\rho - B}\right)\right]$

Maka $\tilde{P} = w(\rho - 4B) - \alpha\sqrt{\rho - B}$

atau $\tilde{P} - w(\rho - 4B) = -\alpha\sqrt{\rho - B}$

Kuadratkan kedua ruas

$$\tilde{P}^2 - 2w\tilde{P}(\rho - 4B) + w^2(\rho - 4B)^2 = \alpha^2(\rho - B)$$
$$= \alpha^2(\rho - 4B) + 3\alpha^2 B$$

$$w^2(\rho - 4B)^2 - (2w\tilde{P} + \alpha^2)(\rho - 4B) + (\tilde{P}^2 - 3\alpha^2 B) = 0$$

akar²nya adalah

$$(\rho - 4B)_{\pm} = \frac{2w\tilde{P} + \alpha^2}{2w^2} \pm \sqrt{\left(\frac{2w\tilde{P} + \alpha^2}{2w^2}\right)^2 - \frac{\tilde{P}^2 - 3\alpha^2 B}{w^2}}$$

$$\rho = \frac{\tilde{P}}{w} + 4B + \frac{\alpha^2}{2w^2} \pm \sqrt{\frac{4w^2\tilde{P}^2 + \alpha^4 + 4w\alpha^2\tilde{P}}{4w^4} + \frac{-\tilde{P}^2 + 3\alpha^2 B}{w^2}}$$

$$\sqrt{\frac{\cancel{4w^2\tilde{P}^2} + \alpha^4 + 4w\alpha^2\tilde{P} \cancel{- 4w^2\tilde{P}^2} + 12w^2\alpha^2 B}{4w^4}}$$

$$\cancel{\frac{4w^2\tilde{P}^4 + \alpha^4 - 4w(\alpha^2 + w)\tilde{P}^2 + 12w^2B\alpha^2}{2w^2}}$$

$$\frac{\alpha\sqrt{\alpha^2 + 4w\tilde{P} + 12w^2B}}{2w^2} \Leftarrow \frac{\sqrt{\alpha^4 + 4w\alpha^2\tilde{P} + 12w^2\alpha^2 B}}{2w^2}$$

hasilnya (jika diambil tanda + dari $\pm$):

$$\boxed{\begin{aligned} \rho &= \frac{\tilde{P}}{w} + 4B + \Delta\rho \\ \Delta\rho &= \frac{\alpha^2}{2w^2} + \frac{\alpha}{2w^2}\sqrt{\alpha^2 + 4w\tilde{P} + 12w^2B} \end{aligned}}$$

cek: $$\Delta\rho\Big|_{w=\frac{1}{3}} = \frac{9\alpha^2}{2} + \frac{9\alpha}{2}\sqrt{\alpha^2 + \frac{4\tilde{P}}{3} + \frac{4}{3}B}$$

$$= \frac{9}{2}\alpha^2 + \frac{3\sqrt{3}}{2}\alpha\sqrt{3\alpha^2 + 4\tilde{P} + 4B}$$

Kemudian $\tilde{P}$ butuh input P dan ρ. Kita definisikan

$$\boxed{\tilde{P} = P - \beta\left[1 + \kappa \ln\left(\gamma\sqrt{\rho_0 - B}\right)\right]}$$ dengan $\rho_0 = \rho$ saat $\mathcal{O}(m_s^4)$ di abaikan. Berarti

$$\boxed{\rho_0 - B = \frac{\tilde{P}}{w} + 3B + \Delta_0\rho\,, \quad \Delta_0\rho = \frac{\alpha^2}{2w^2} + \frac{\alpha}{2w^2}\sqrt{\alpha^2 + 4wP + 12w^2B}}$$

Jadi, secara urut kita hitung

$$\Delta_0 \rho = \frac{\alpha^2}{2w^2} + \frac{\alpha\sqrt{w}}{2w^2}\sqrt{\frac{\alpha^2}{w} + 4(P + 3wB)}$$

kemudian substitusi ke dalam

$$\tilde{P} = P - \beta\left[1 + K\ln\left(\gamma\sqrt{\frac{P}{w} + 3B + \Delta_0\rho}\right)\right]$$

kemudian $\tilde{P}$ substitusi ke dalam

$$\Delta\rho = \frac{\alpha^2}{2w^2} + \frac{\alpha\sqrt{w}}{2w^2}\sqrt{\frac{\alpha^2}{w} + 4(\tilde{P} + 3wB)}$$

dan terakhir $\tilde{P}$ dan $\Delta\rho$ dimasukkan ke

$$\rho = \frac{\tilde{P}}{w} + 4B + \Delta\rho$$

$$\frac{\sqrt{w}}{w^2} = w^{\frac{1}{2}-2} = w^{\frac{1-4}{2}} = w^{-3/2} = 3^{3/2} = 3\sqrt{3}$$

Di code, $\Delta\rho$ dan ρ diubah jadi:

$$\tilde{\alpha} = \alpha\sqrt{\frac{\alpha^2}{w} + 4(\tilde{P} + 3wB)}$$

$$\rho = \frac{2\tilde{P}}{2w} + \frac{6Bw}{2w} + \frac{\alpha^2}{2w^2} + \frac{\tilde{\alpha}\sqrt{w}}{2w^2} + B - B\frac{2w}{2w}$$

$$= \frac{1}{2w}\left(2\tilde{P} + 6wB\right) + B + \frac{1}{2w}\left(\frac{\alpha^2}{w} + \frac{\tilde{\alpha}}{\sqrt{w}}\right)$$

Salah codenya : $\frac{\tilde{\alpha}}{\sqrt{2w}}$ mestinya $\frac{\tilde{\alpha}}{\sqrt{w}}$

Pressure tangensialnya menjadi

$$\boxed{\begin{aligned}P_t = P_c + w(\rho + 4B_\perp) - \alpha_\perp\sqrt{\rho - B_\perp} + \beta_\perp\left[1 + K_\perp \ln\left(\gamma_\perp\sqrt{\rho - B_\perp}\right)\right] \\ - w(\rho_c + 4B_\perp) + \alpha_\perp\sqrt{\rho_c - B_\perp} - \beta_\perp\left[1 + K_\perp \ln\left(\gamma_\perp\sqrt{\rho_c - B_\perp}\right)\right]\end{aligned}}$$

dengan

$$\alpha_\perp = \frac{m_s^2}{3\pi\sqrt{a_{4\perp}}} \qquad \beta_\perp = \frac{m_s^4}{12\pi^2}\left(1 - \frac{1}{a_{4\perp}}\right)$$

$$\gamma_\perp = \frac{8\pi}{3m_s^2\sqrt{a_{4\perp}}} \qquad K_\perp = \frac{3}{\left(1 - \frac{1}{a_{4\perp}}\right)}$$

$$\boxed{\frac{dP_t}{d\rho} = w - \frac{\alpha_\perp}{2\sqrt{\rho - B_\perp}} + \frac{\beta_\perp K_\perp}{2(\rho - B_\perp)}}$$

Anisotropi : $\boxed{\sigma = P - P_t}$ $\boxed{\frac{d\sigma}{d\rho} = \frac{dP}{d\rho} - \frac{dP_t}{d\rho}}$ $\boxed{\sigma' = \frac{d\sigma}{dP}P' + \frac{d\sigma}{d\rho}\frac{d\rho}{dP}P'}$

Jangan lupa di section SL, $K = 8\pi G$ ganti simbol dari K ke $K_N = 8\pi G$ (!!!)

$B = B_\perp$	a_4	$a_{4\perp}$	w	$\tilde{C}$
57	0.7	0.07	1/3	10^6
92			1	10^7

u/ non TOV: variasinya ada $2\times1\times2\times2 = 8$
w/ TOV : variasinya ada $2\times1\times2 = 4$

Nilai² parameter

$B \in \{57, 92\}$ MeV

$a_4 = 0.7$

$w = \{\frac{1}{3}, 1\}$

$\boxed{a_4 = 0.7 \cong M = 2.0\,M_\odot}$

• $\frac{B_\perp}{\text{MeV}} = \begin{cases} \{57, 67, 77\}, & B = 57\text{ MeV} \\ \{92, 82, 72\}, & B = 92\text{ MeV}\end{cases}$

$a_{4\perp} = \{0.07, 0.1, 0.7, 1.0\}$

$m_s = 100$ MeV

dikatakan bahwa $57 < \frac{B}{\text{MeV}} < 92$ u/ stabilitas thd Fe 2 & 3 flavor

$B > 57$ $B < 92$