Sexaquark dilemma in compact stars

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S: uuddss
S≡ Λ Λ
(ud, us, ds)

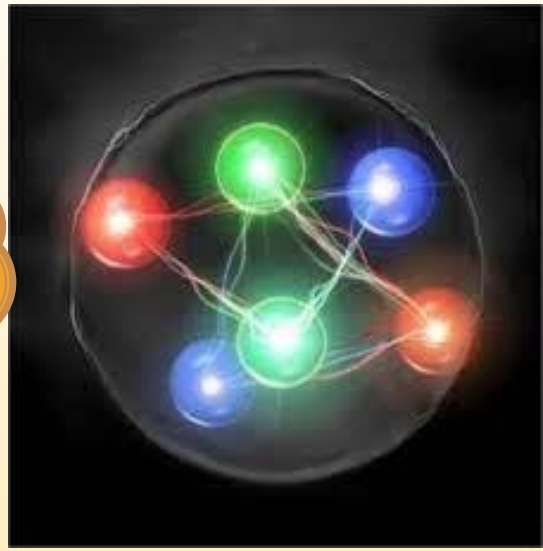
Neutral boson
In spin-color-flavor-singlet state

$m_{\Lambda\Lambda} = 2231$ MeV

$\Lambda \rightarrow p + e + \bar{\nu}$

$\Omega_{DM}/\Omega_b = 5.3 \pm 0.1$

$m_\Lambda + m_p + m_e$= 1115.5+938+0.5= 2054 MeV
$2\,(m_p + m_e) = 2(938 + 0.5) =$1877 MeV
if 2054 MeV $< m_s <$ 2231 MeV it decays
We consider: 1885 MeV < m_s < 2054 MeV



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M. Shahrbaf et al., arXiv:2202.00652 [nucl-th]
G. R. Farrar, 1805.03723 (2018)
F. Buccella, PoS CORFU2019, 024 (2020)

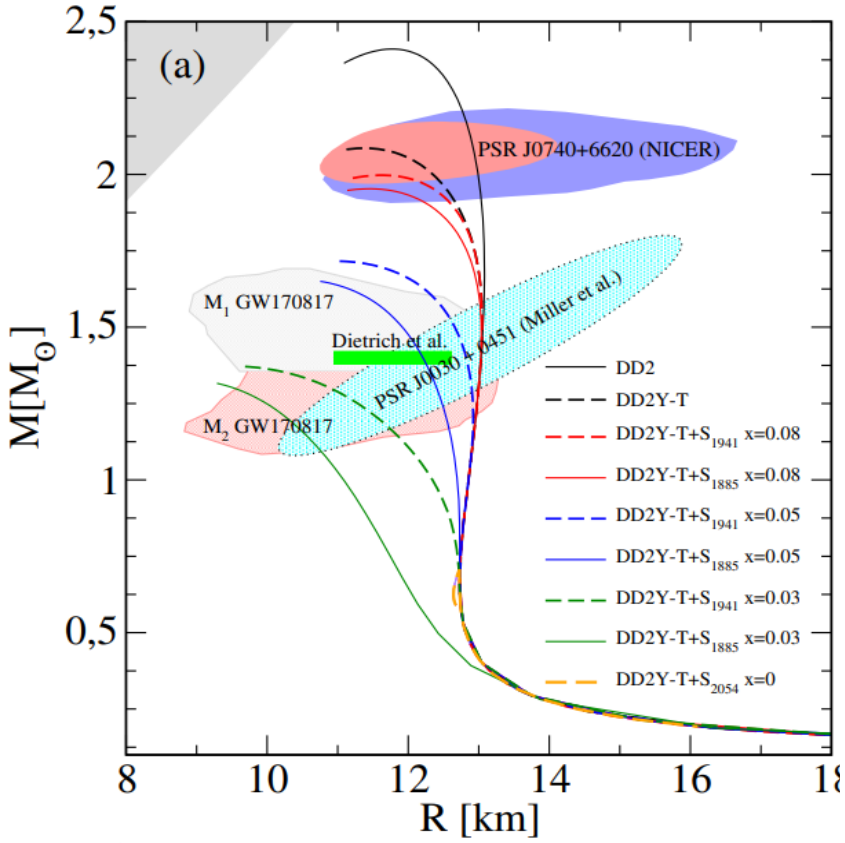
Quark matter 2022, 4-10 April - Krakow

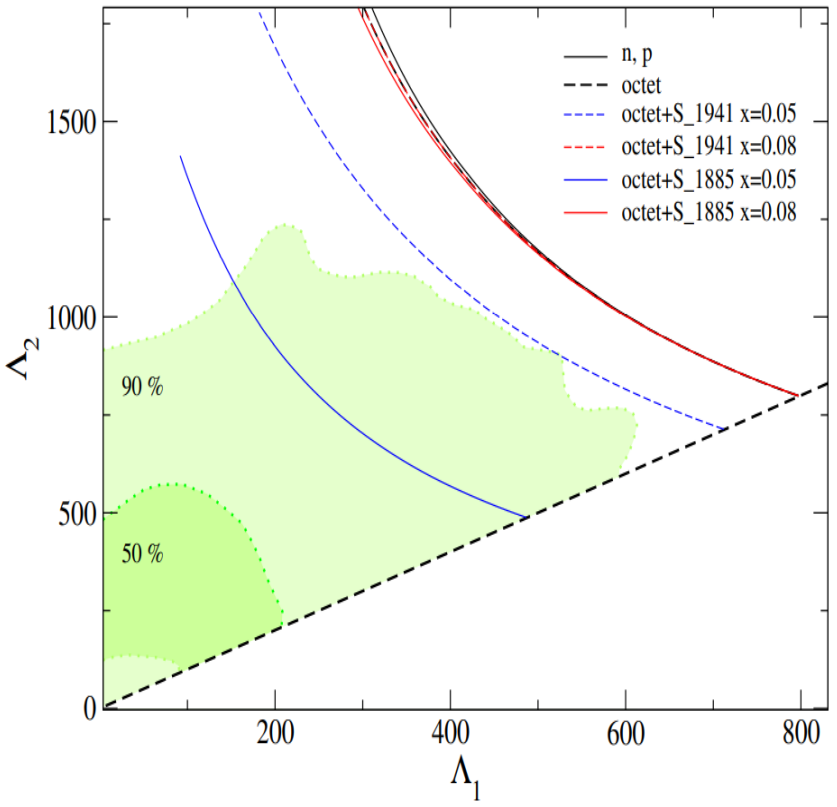
What are the possible scenarios for Neutron Stars including S?

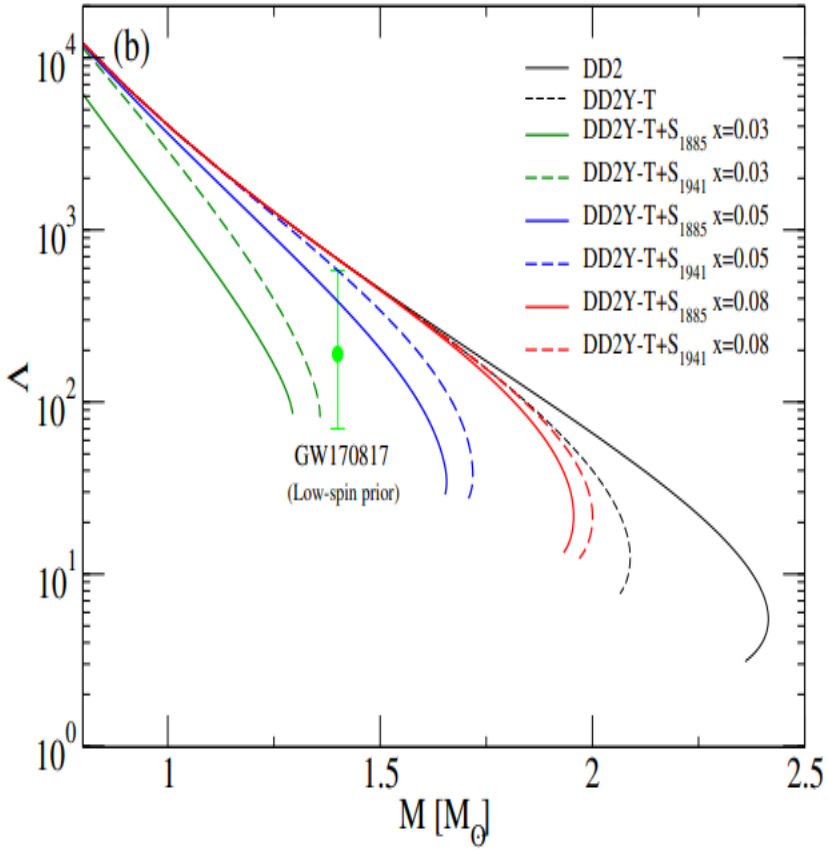
a) Assuming a linear mass shift for S instead of a meson-coupling interaction as all medium effects: $\Delta m_S = m_S(1 + x_S \frac{n_b}{n_0})$

b) Constant mass of S

(a) S in pure hadronic stars when DD2Y-T approach is used for the EoS of hadronic matter







Quark deconfinement as a solution

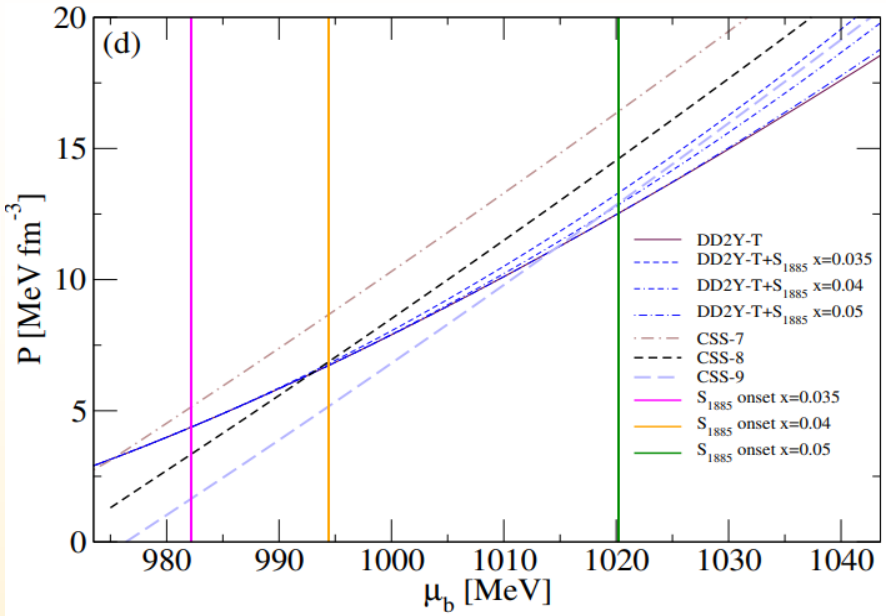
$$P(\mu) = A\left(\frac{\mu}{\mu_x}\right)^{1+\beta} - B$$

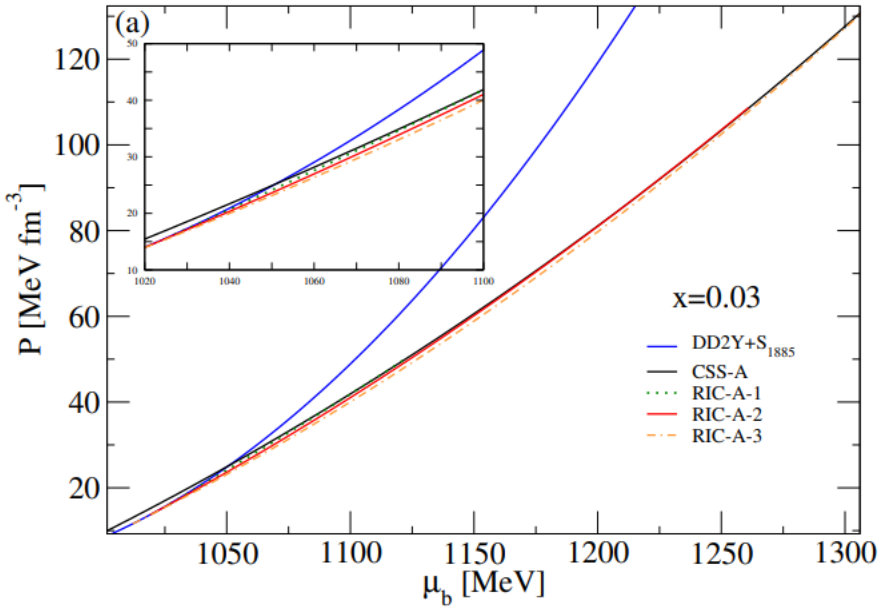
nlNJL model which has been mapped to CSS parameterization, is used for the EoS of quark matter

S. Anti´c, M. Shahrbaf, D. Blaschke, and A. G. Grunfeld (2021), arXiv:2105.00029

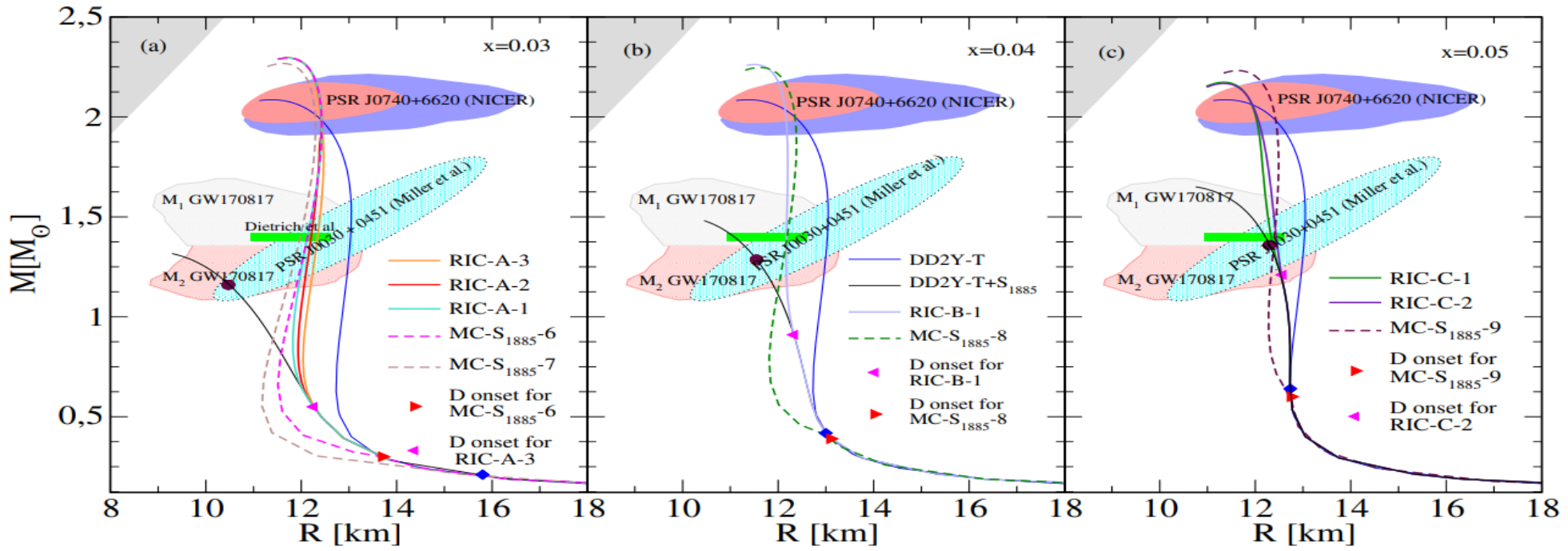
Maxwell construction (MC)

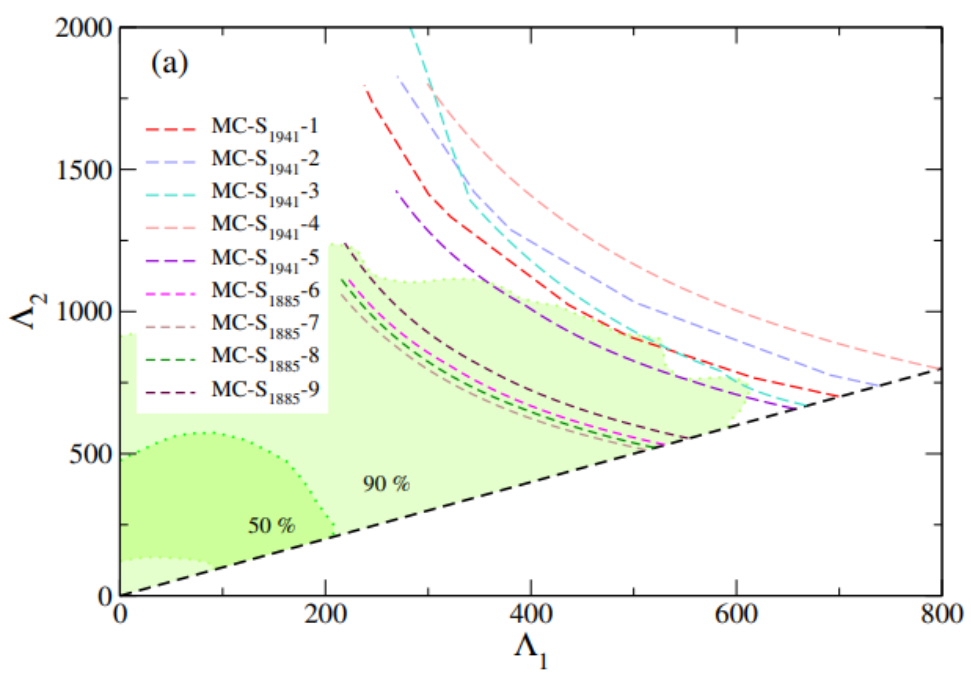
Replacement interpolation construction (RIC)

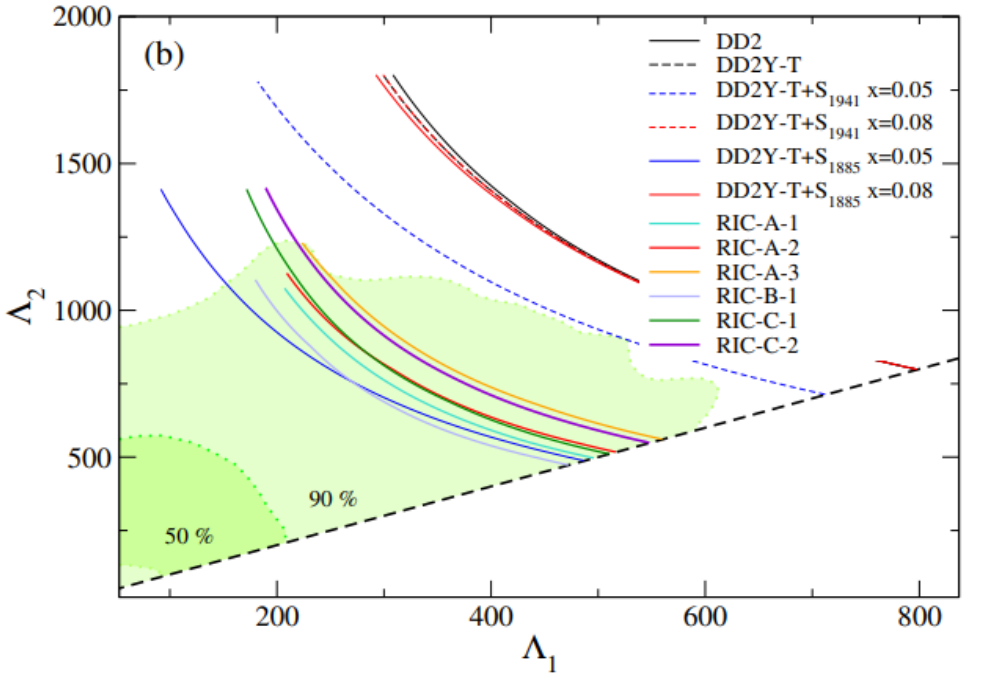




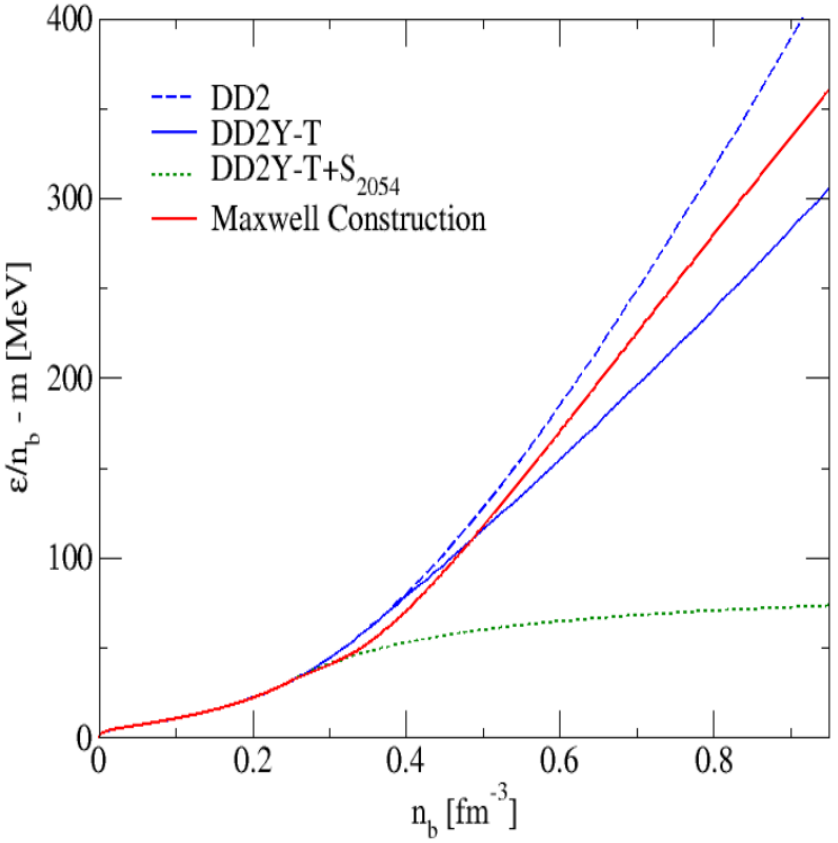
All observational constraints are fulfilled for $m_S = 1885\ MeV$

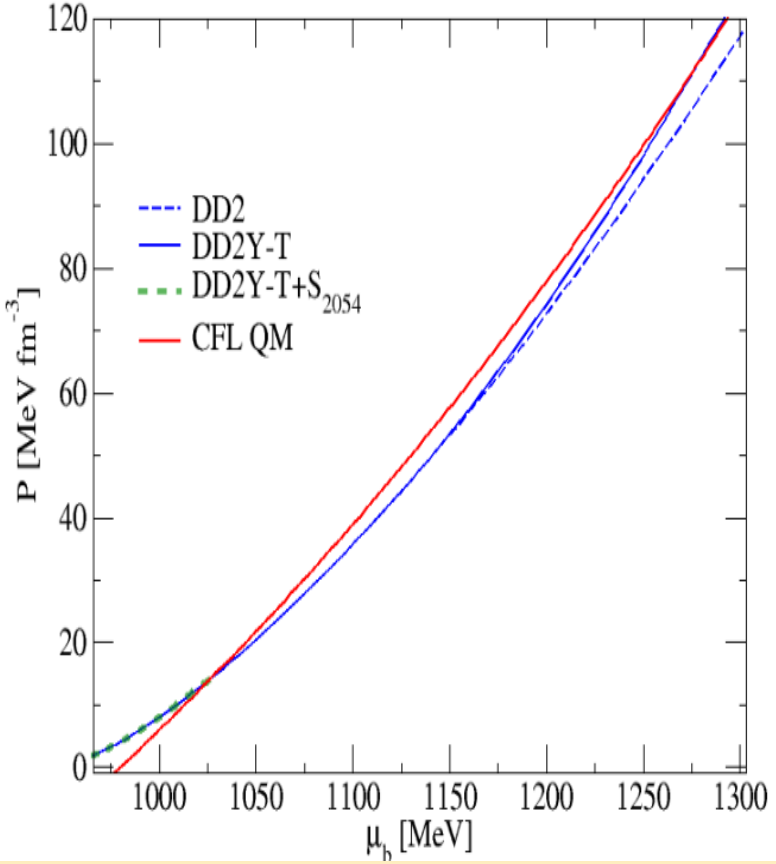


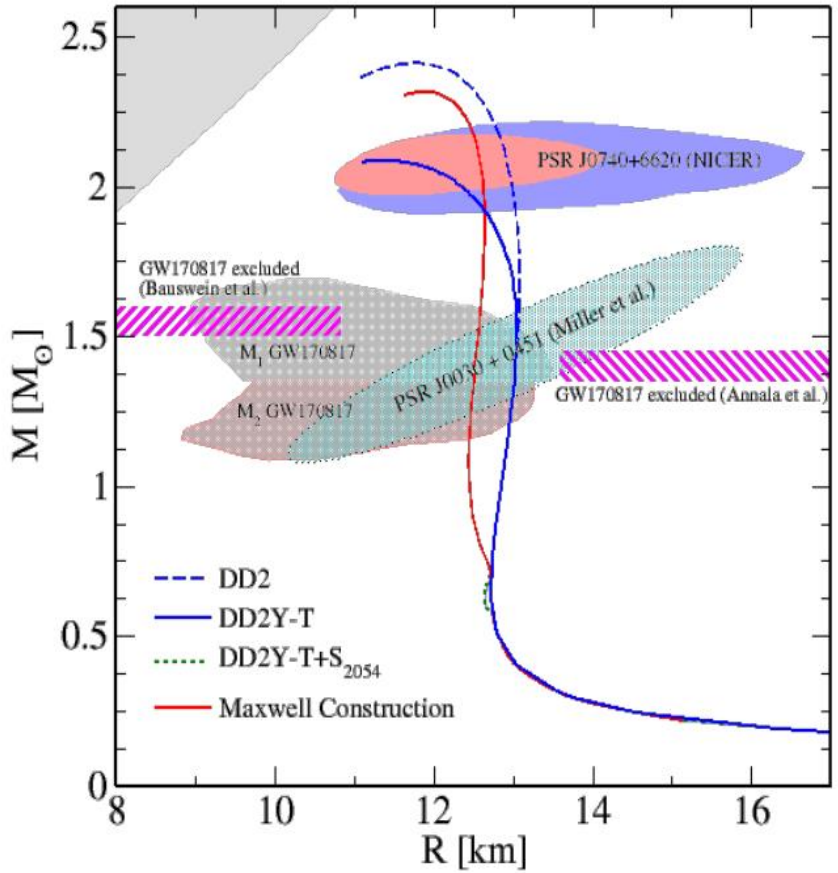




(b) Constant mass of S
This scenario results in BEC of S particles which acts as a trigger for an early deconfinement







The EoS of quark matter in CFL phase

Alford, M., Braby, M., Paris, M. W., and Reddy, S. (2005). Astrophys. J. 629.

$$\Omega_{QM} = -3/4\pi^2 a_4 \mu^4 + 3/4\pi^2 a_2 \mu^2 + B_{\text{eff}}$$