Sexaquark dilemma in compact stars
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S: uuddss
$S \equiv \Lambda \Lambda$
(ud, us, ds)

Neutral boson
In spin-color-flavor-
singlet state

$m_{\Lambda\Lambda} = 2231 \text{ MeV}
\Lambda \rightarrow p + e + \bar{\nu}$

$m_A + m_p + m_e = 1115.5 + 938 + 0.5 = 2054 \text{ MeV}
2 (m_p + m_e) = 2(938 + 0.5) = 1877 \text{ MeV}
if 2054 \text{ MeV} < m_s < 2231 \text{ MeV} \text{ it decays}
We consider: 1885 \text{ MeV} < m_s < 2054 \text{ MeV}

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

M. Shahrbaf et al., arXiv:2202.00652 [nucl-th]
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

\[ P(\mu) = A \left( \frac{\mu}{\mu_c} \right)^{1+\beta} - B \]

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


Maxwell construction (MC)

Replacement interpolation construction (RIC)
All observational constraints are fulfilled for $m_S = 1885 \text{ MeV}$
(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

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