#852: Implications from GW170817 for relativistic hybrid stars (HS)

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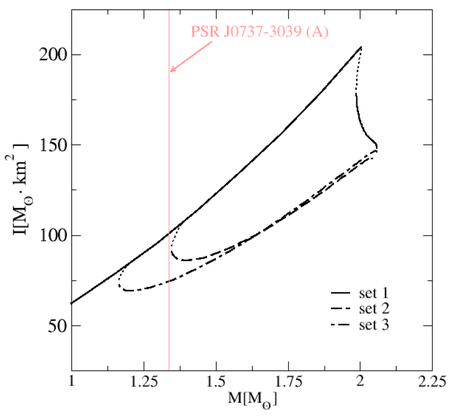
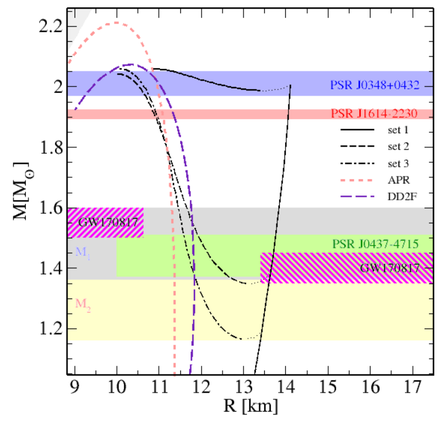
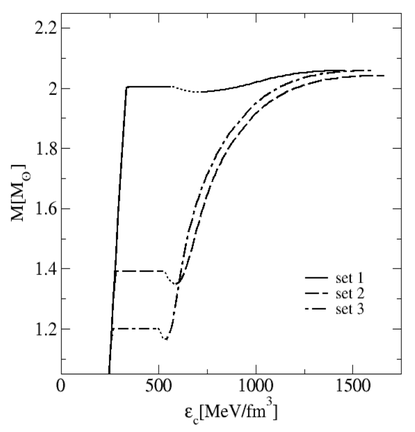
Abstract / Summary:

- Equations of State (EoS) corresponding to a third family of compact stars are characterized by:
  - stiffening of nuclear matter at supranuclear densities (quark Pauli blocking)
  - early phase transition with large latent heat (Δε~εcrit; ncrit ~ n0, pcrit ~ 50-100 MeV fm3)
  - stiff high-density EoS with cs2 > 0.5
- High-mass and low-mass twin stars and corresponding HS branches are described by different EoS: multi-polytrope, multi-css, density-functional and nonlocal chiral quark model with bag and interpolation
- Constraints on tidal deformability from GW170817 (Λ < 800) exclude stiff purely nuclear EoS (like DD2_p40) within a NS-NS merger scenario, while low-mass third family solutions suggest a HS-NS or HS-HS merger
- NICER could confirm low-mass twins if for PSR J0437-4715 a radius R>14 +/- 0.5 km would be measured, otherwise low-mass twins would also not be excluded.

Nonlocal NJL model (with interpolation), D. Alvarez-Castillo et al., arxiv:1805.04105







PRD 97 (2018) 084038; arxiv:1712.00451 [astro-ph.HE]

Implications from GW170817 and I-Love-Q relations for relativistic hybrid stars

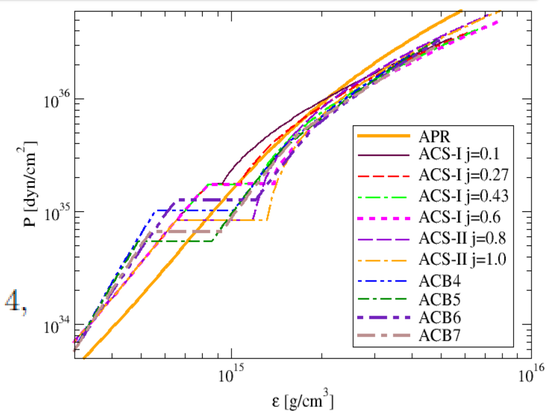
Vasileios Paschalidis,[1] Kent Yagi,[2] David Alvarez-Castillo,[3,4] David B. Blaschke,[3,5,6] and Armen Sedrakian[7]

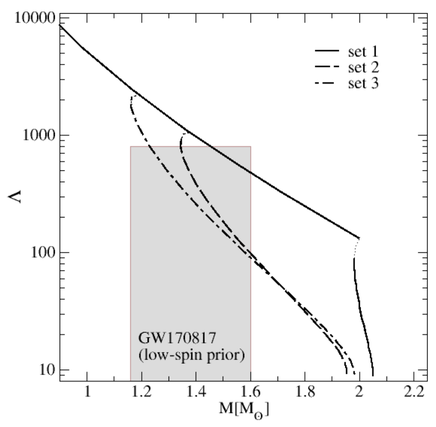
CSS model (ACSX)

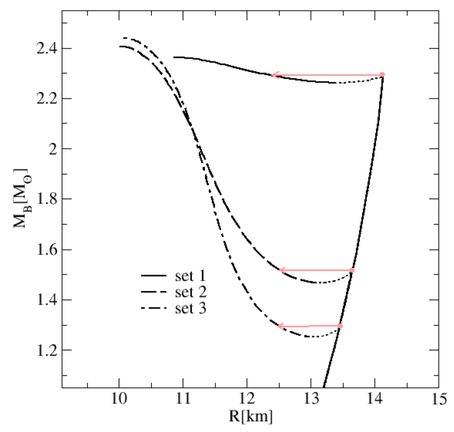
$$P(\varepsilon) = \begin{cases} P_{\rm tr}, & \varepsilon_1 \le \varepsilon \le \varepsilon_2, \\ P_{\rm tr} + c_s^2(\varepsilon - \varepsilon_2), & \varepsilon > \varepsilon_2, \end{cases}$$

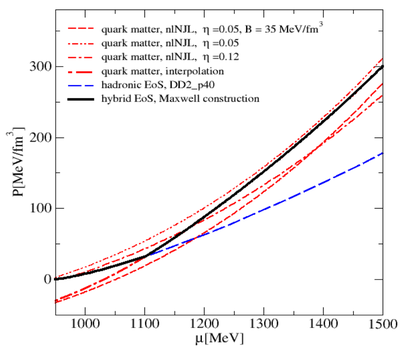
MP model (ACBx)

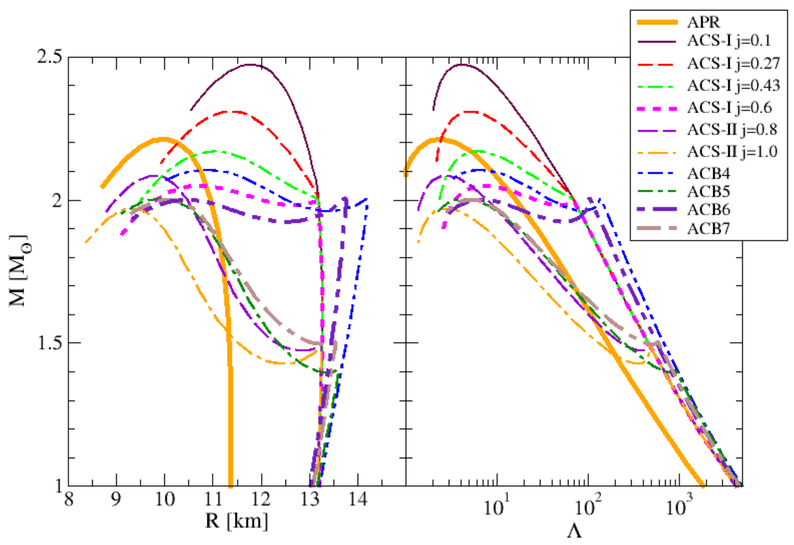
$$P(n) = \kappa_i (n/n_0)^{\Gamma_i}, \; n_i < n < n_{i+1}, \; i = 1 \ldots 4,$$





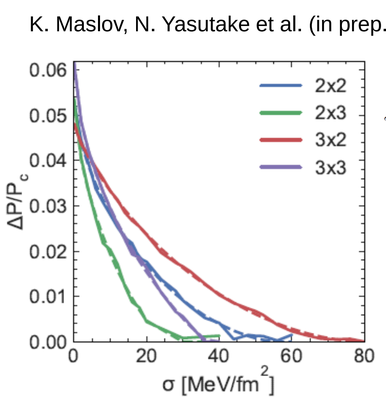


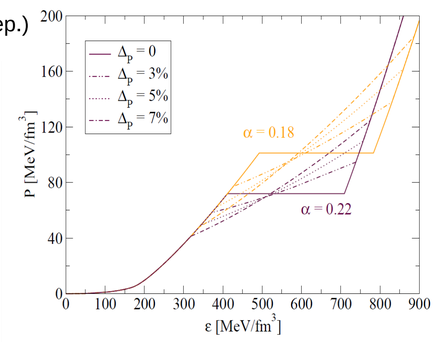




Effect of a mixed phase: KVOR_cut2 – SFM_α=0.3, A. Ayriyan et al., 1711.03926

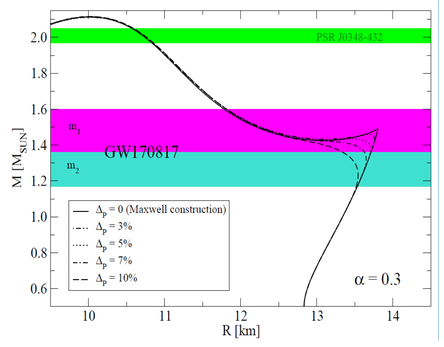
K. Maslov, N. Yasutake et al. (in prep.)

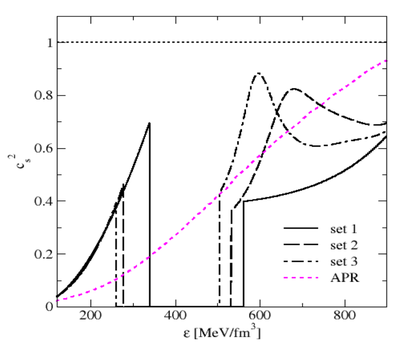




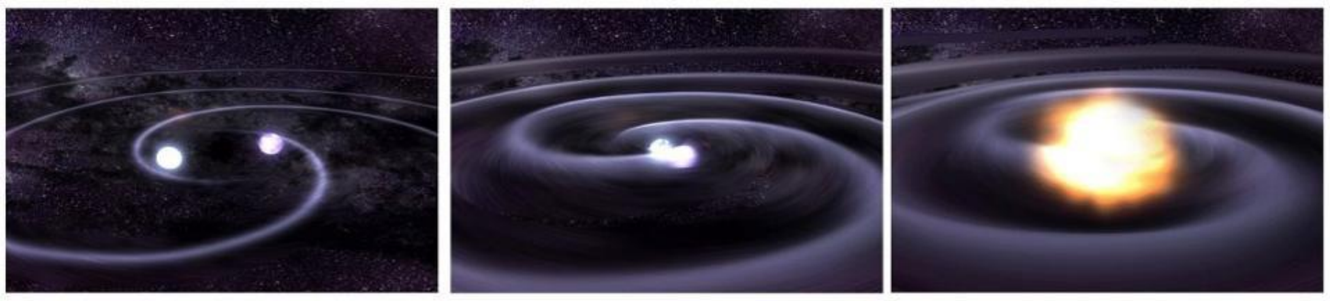
Small surface tension – small structures

Pasta structures
do not destroy the HS-NS merger alternative

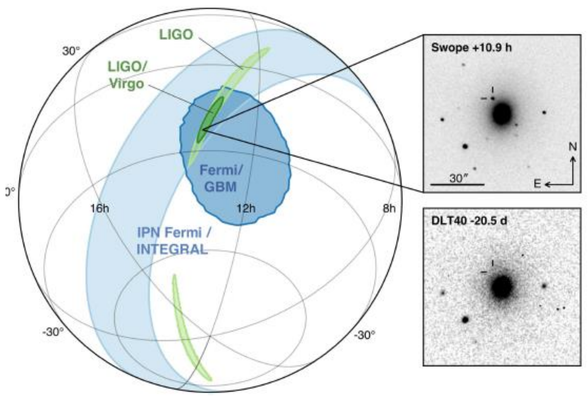


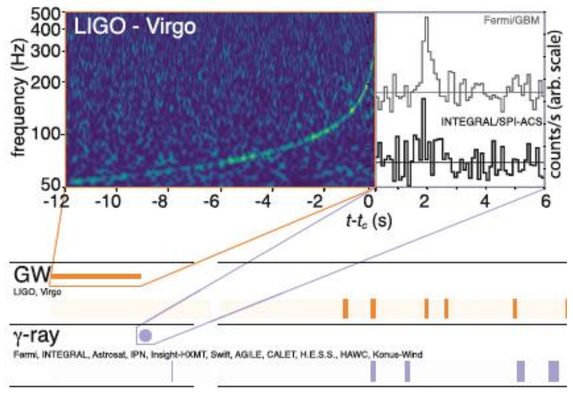


Was GW170817 not a neutron star (NS) merger? Alternative: HS – NS or HS – HS

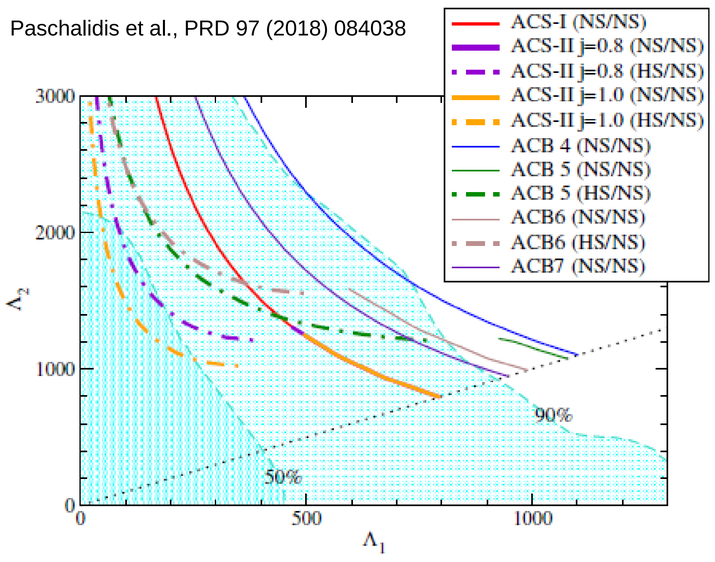


GW170817, announced on 16.10.2017, B.P. Abbott et al. [LIGO/Virgo Collab.], PRL 119, 161101 (2017); ApJLett 848, L12 (2017)

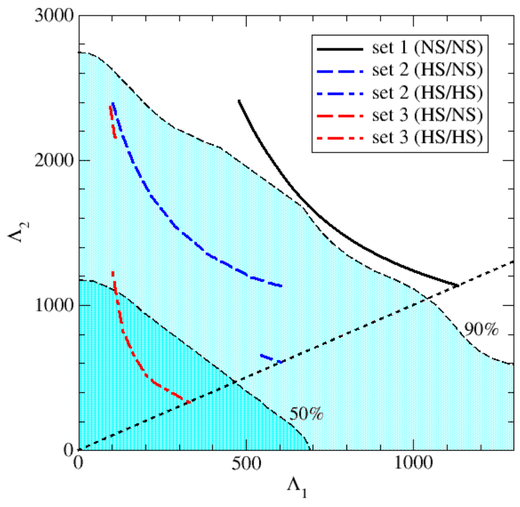


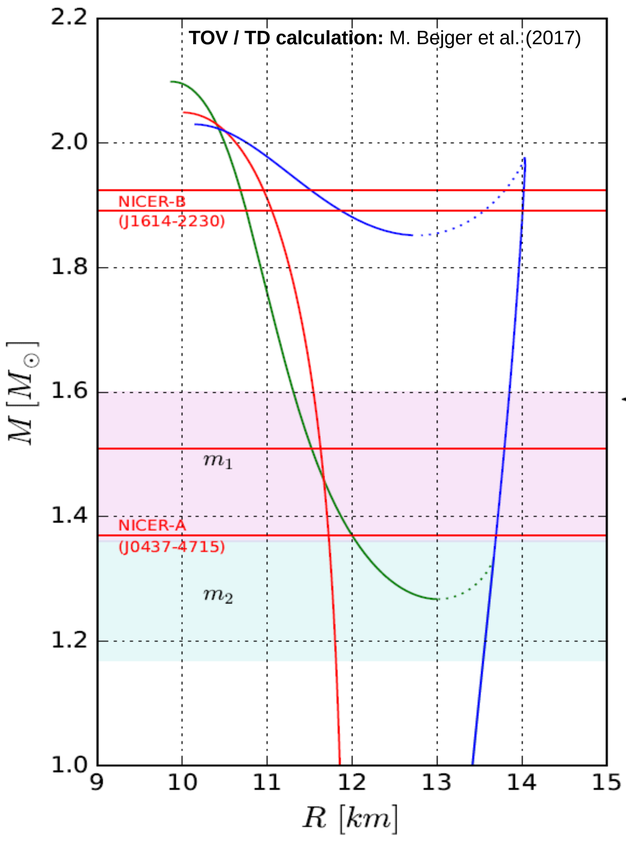


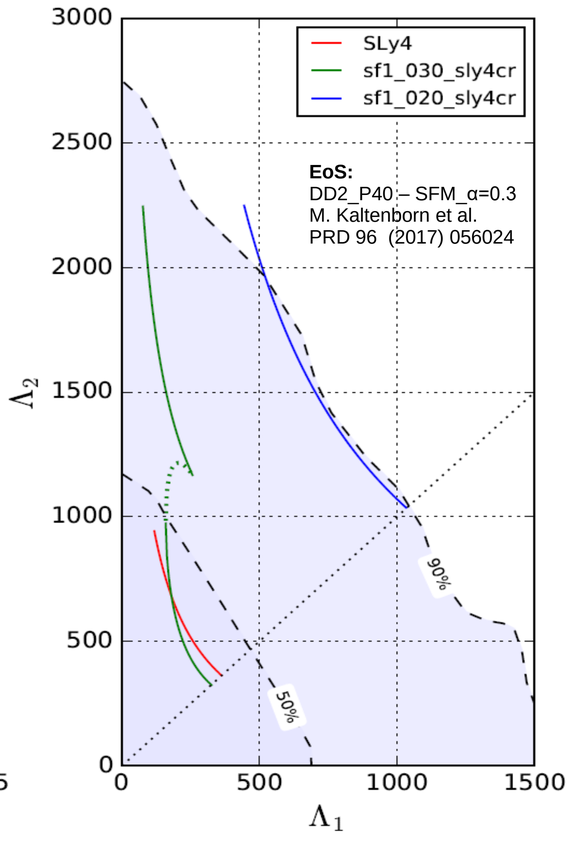
Paschalidis et al., PRD 97 (2018) 084038



Alvarez-Castillo et al., arxiv:1805.04105







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