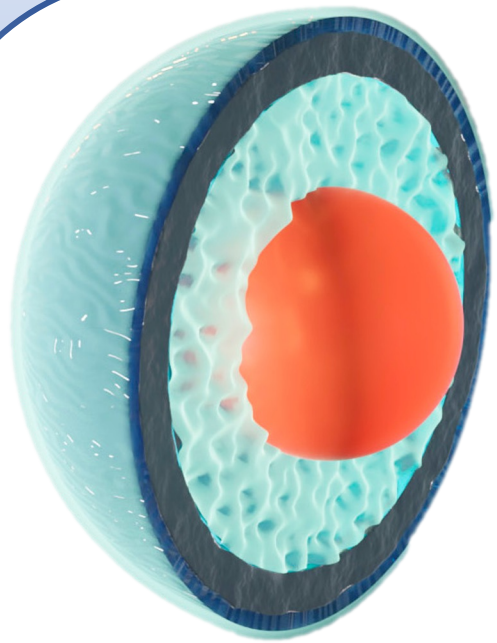
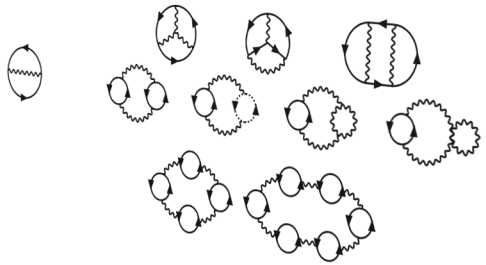
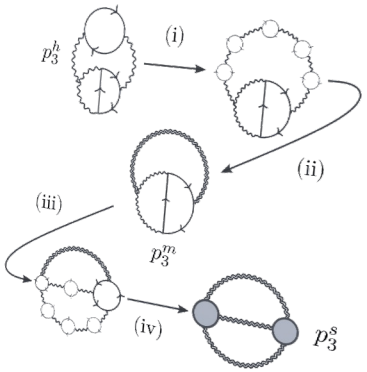






QCD in the cores of neutron stars

Oleg Komoltsev

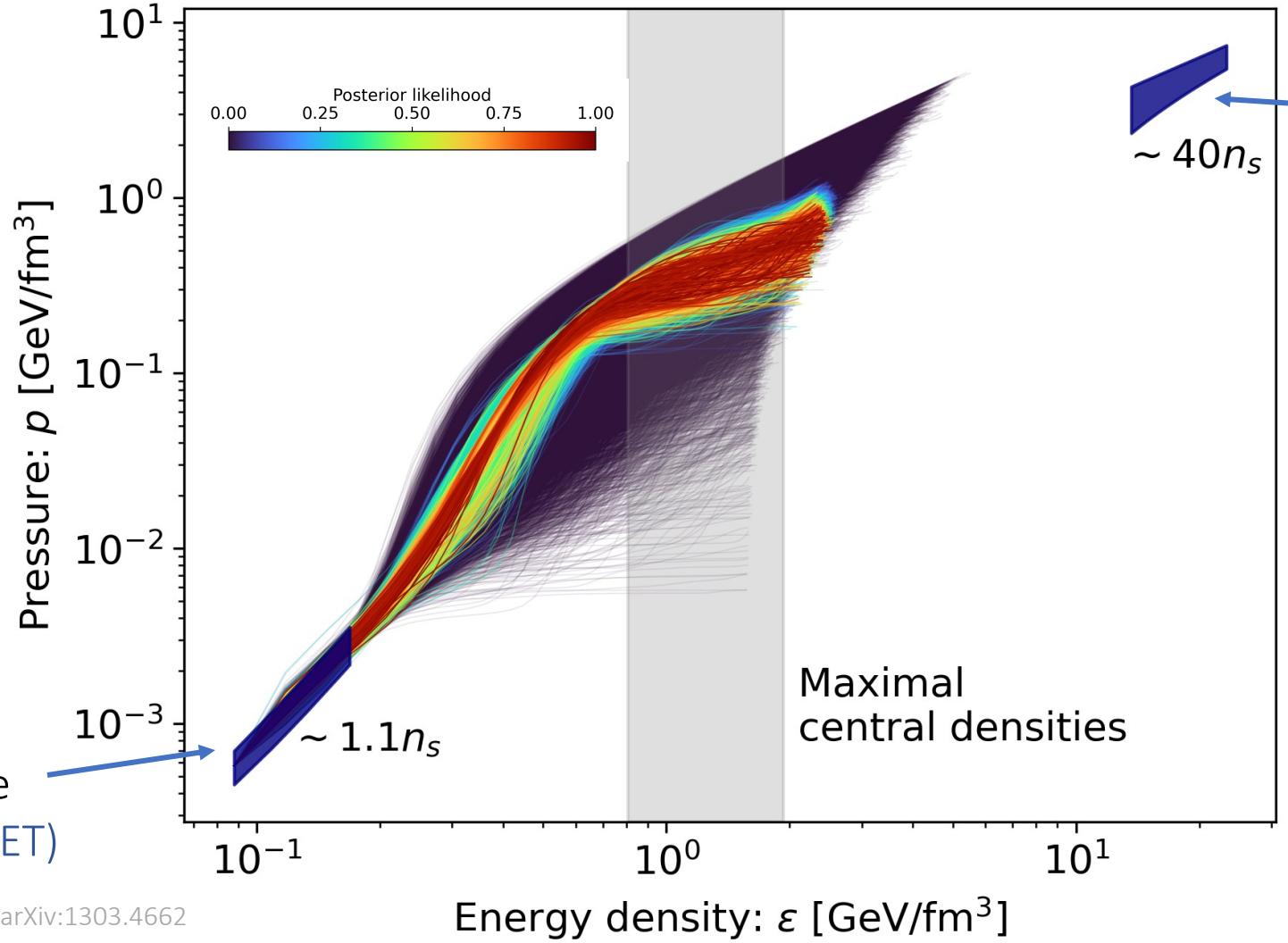
Dark Matter and Stars

May 2023

University of Stavanger

What do we know about EoS, theoretically?

$n_s = 0.16\ fm^{-3}$



Perturbative QCD (pQCD)

Gorda, Kurkela et.al. arXiv:2103.05658

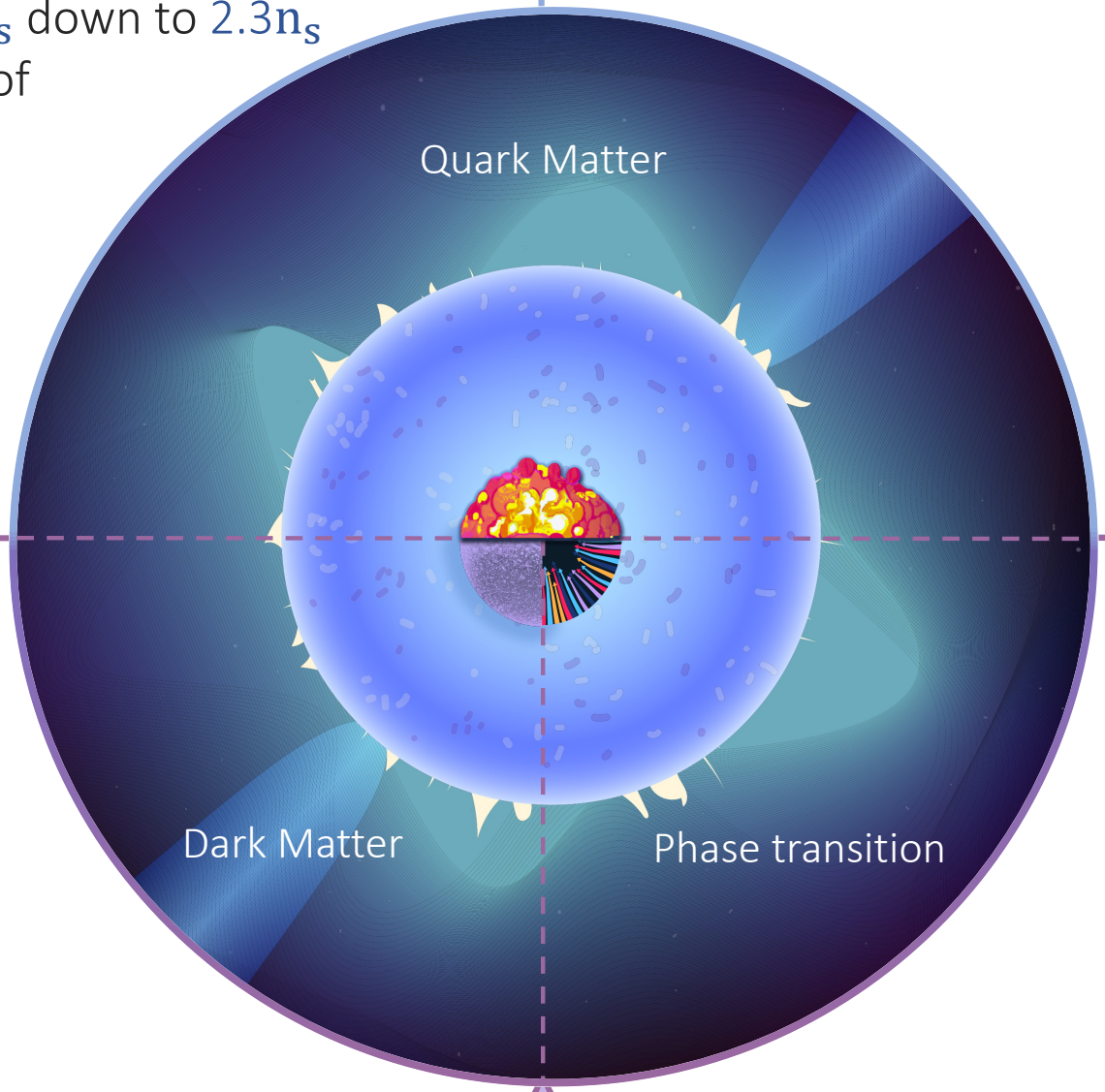
Chiral effective field theory (CET)

Hebeler, Lattimer et.al. arXiv:1303.4662

Pertubative QCD can be used to propagate constraints on EoS from $40n_s$ down to $2.3n_s$ using solely the reqierment of

- Stability
- Causality
- Consistency

O.K, Aleksi Kurkela
Phys. Rev. Lett. 128, 202701 (2022)



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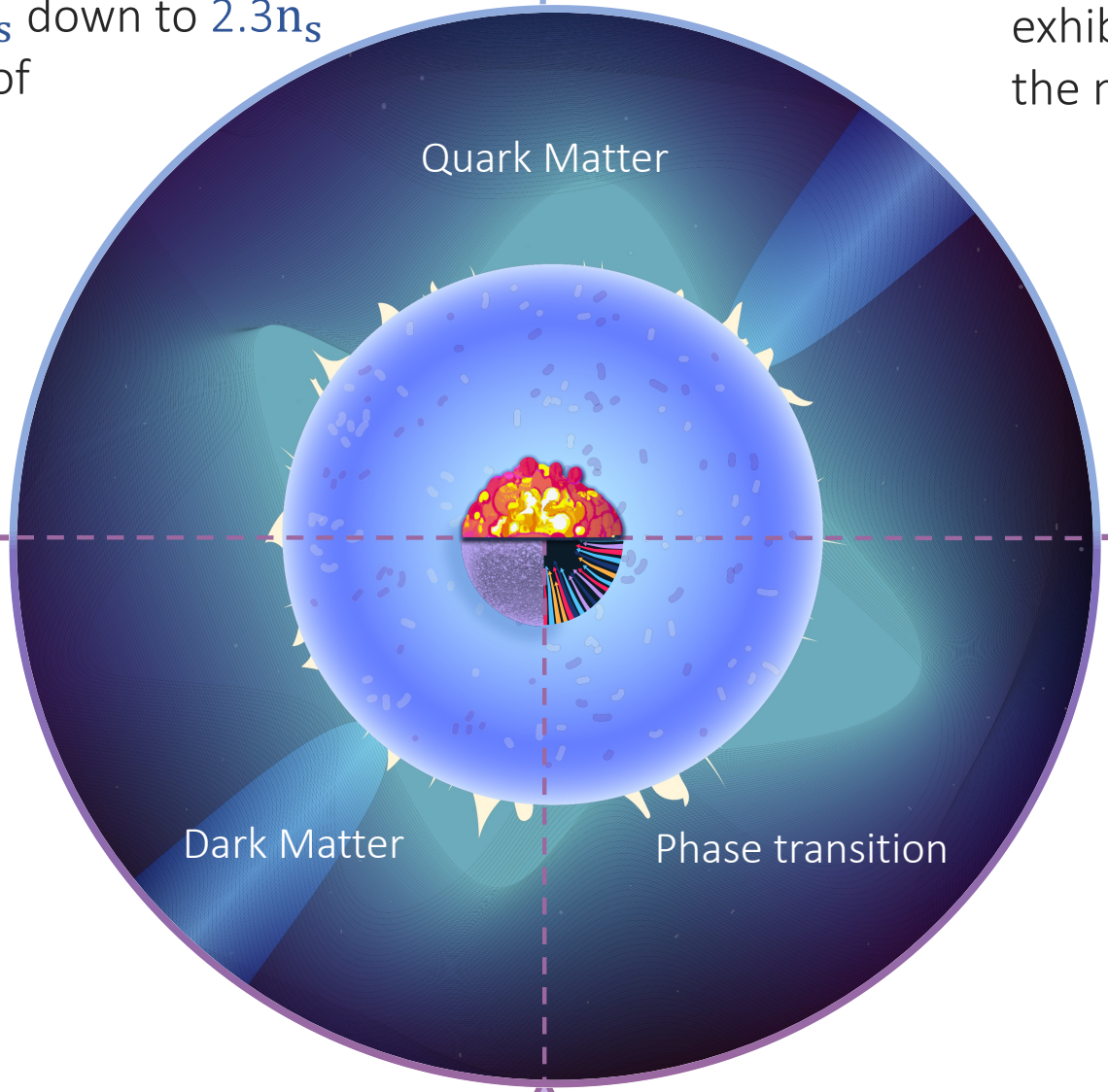

Strongly interacting matter exhibits deconfined behavior in the most massive neutron stars

P(QM) ~ 88%

Annala et.al., arXiv:2303.11356 (2023)

P(FOPT) ~ 10 %

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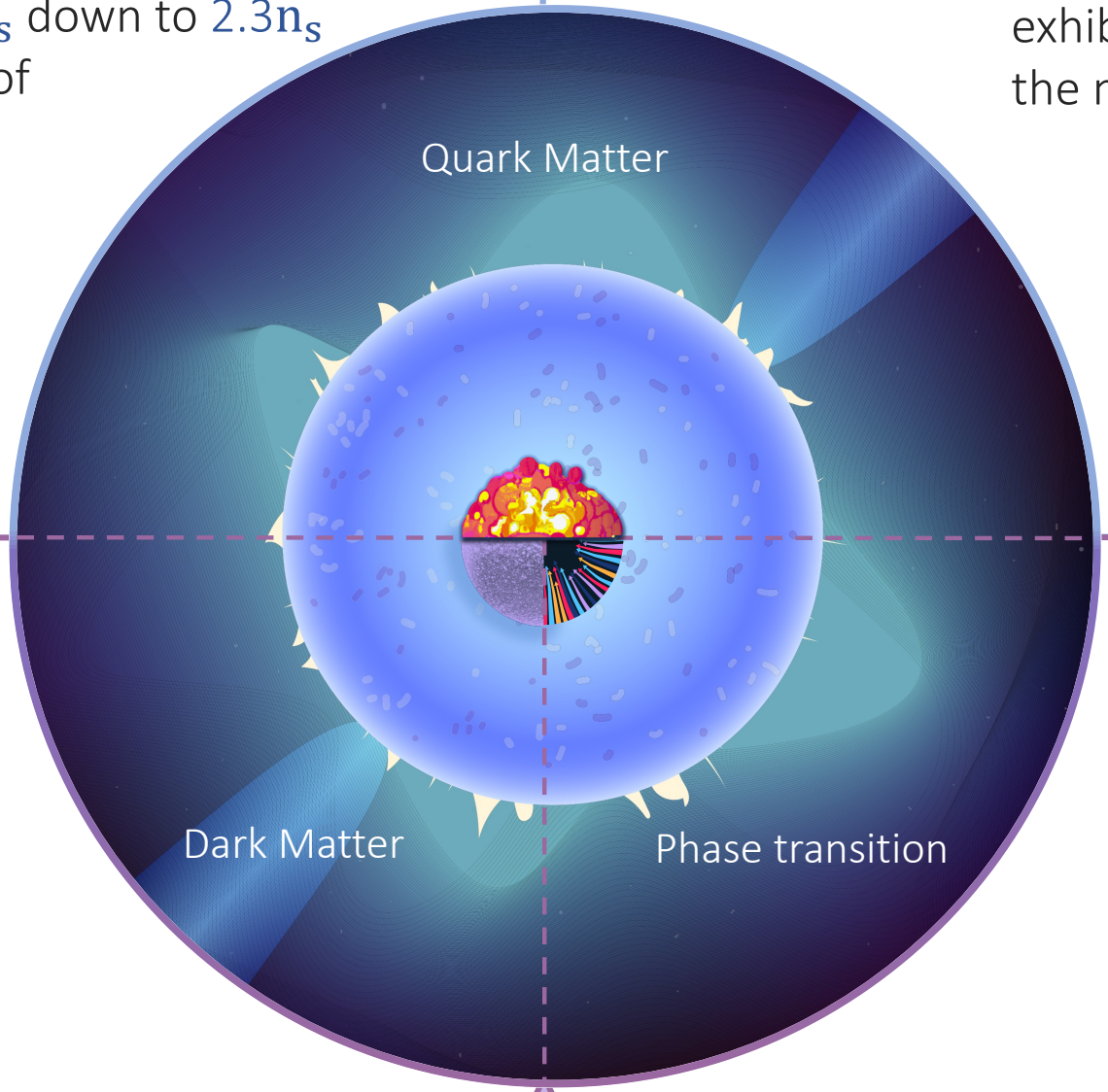


Strongly interacting matter exhibits deconfined behavior in the most massive neutron stars

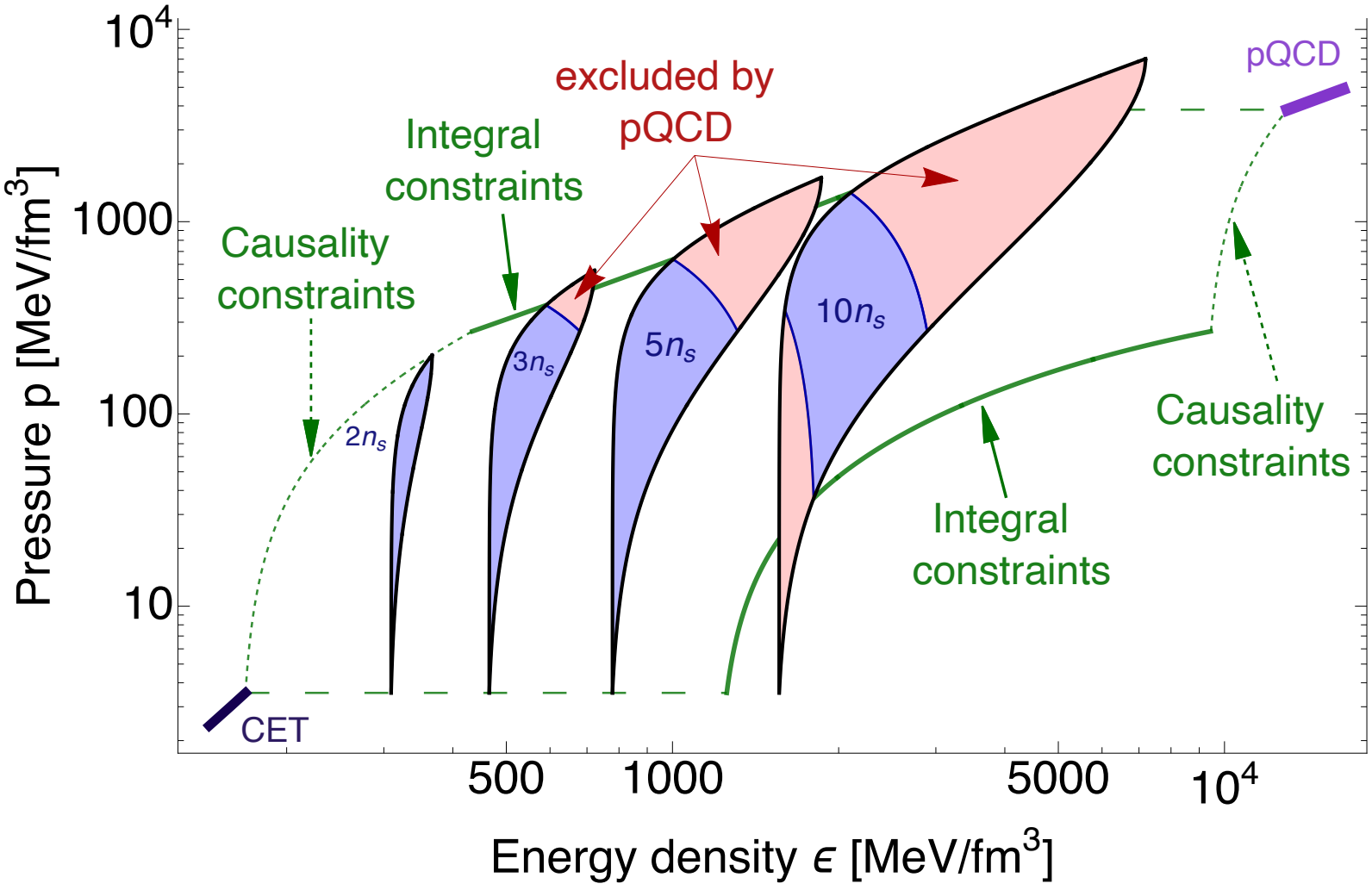
P(QM) ~ 88%

Annala et.al., arXiv:2303.11356 (2023)

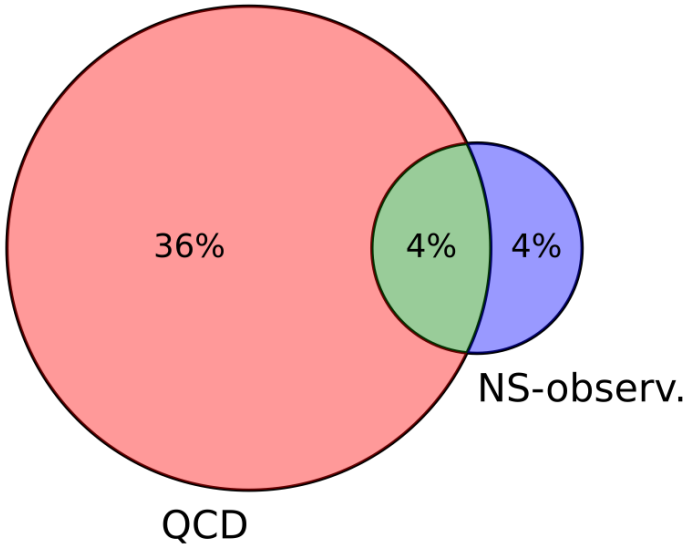
We can use QCD input to test underlying assumptions of General Relativity and Standard model

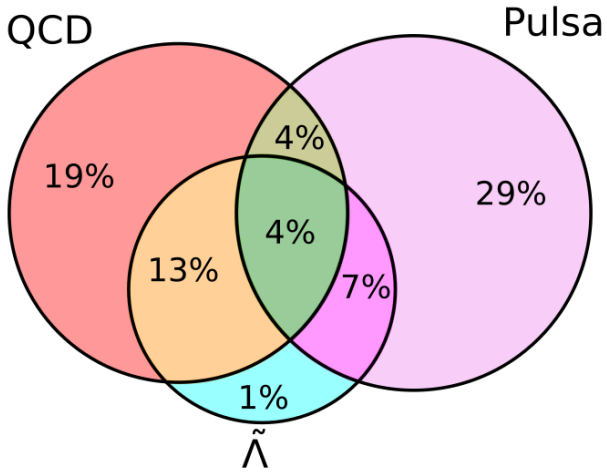
P(FOPT) ~ 10 %

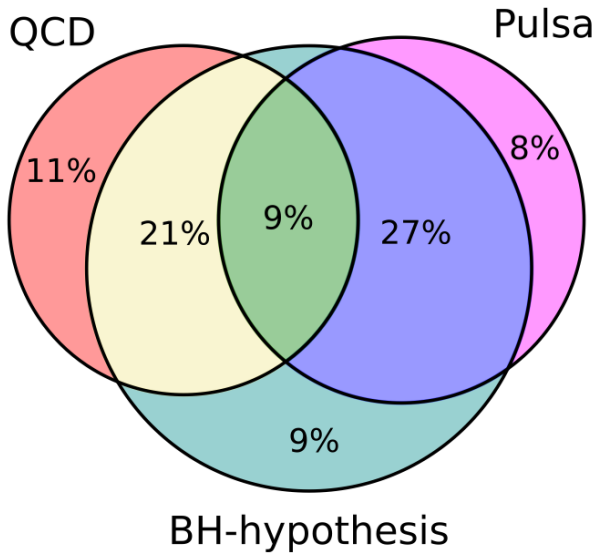
No interpolation function
No model uncertainties
No astrophysical input
No GR



Are neutron stars made of QCD matter?



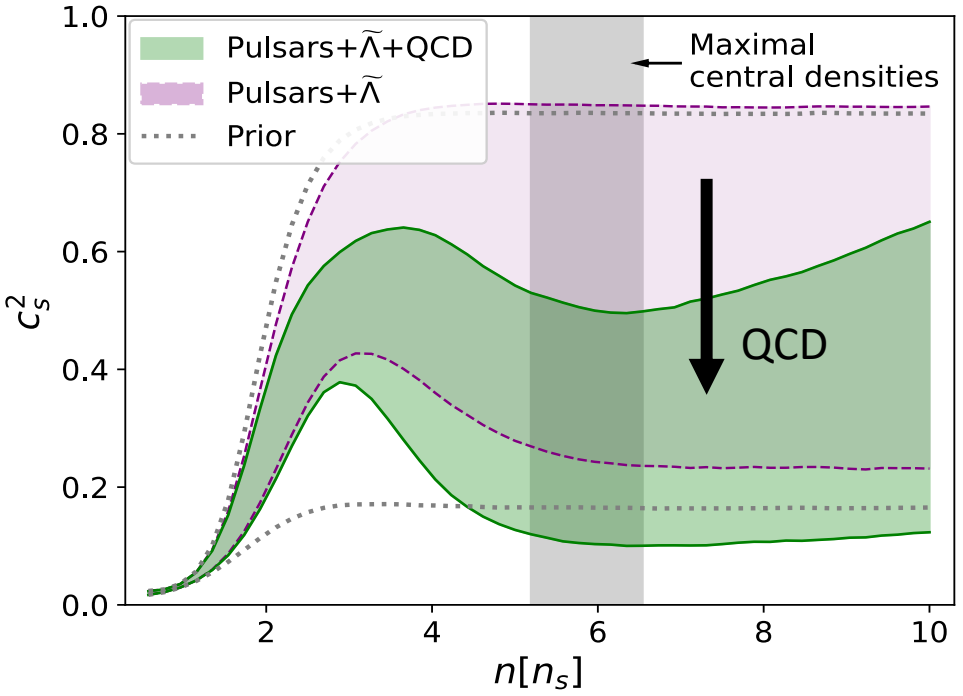


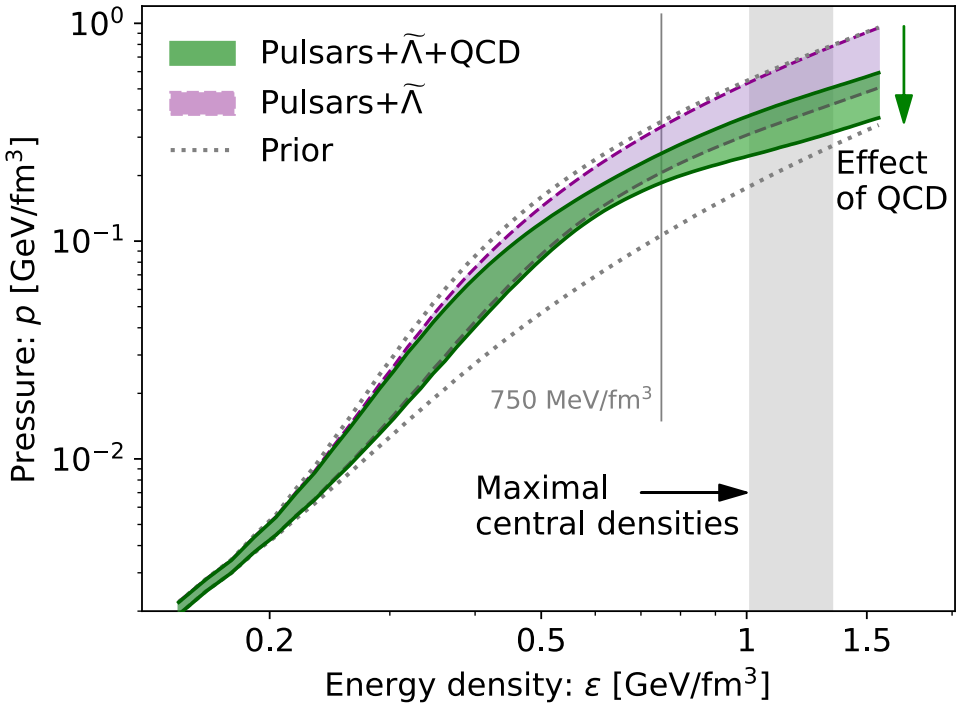


Tyler Gorda, O.K, Aleksi Kurkela.; arXiv: 2204.11877 (accepted in ApJ)

A strategy that encompasses all the possible inputs is the one most likely to find a conflict between them

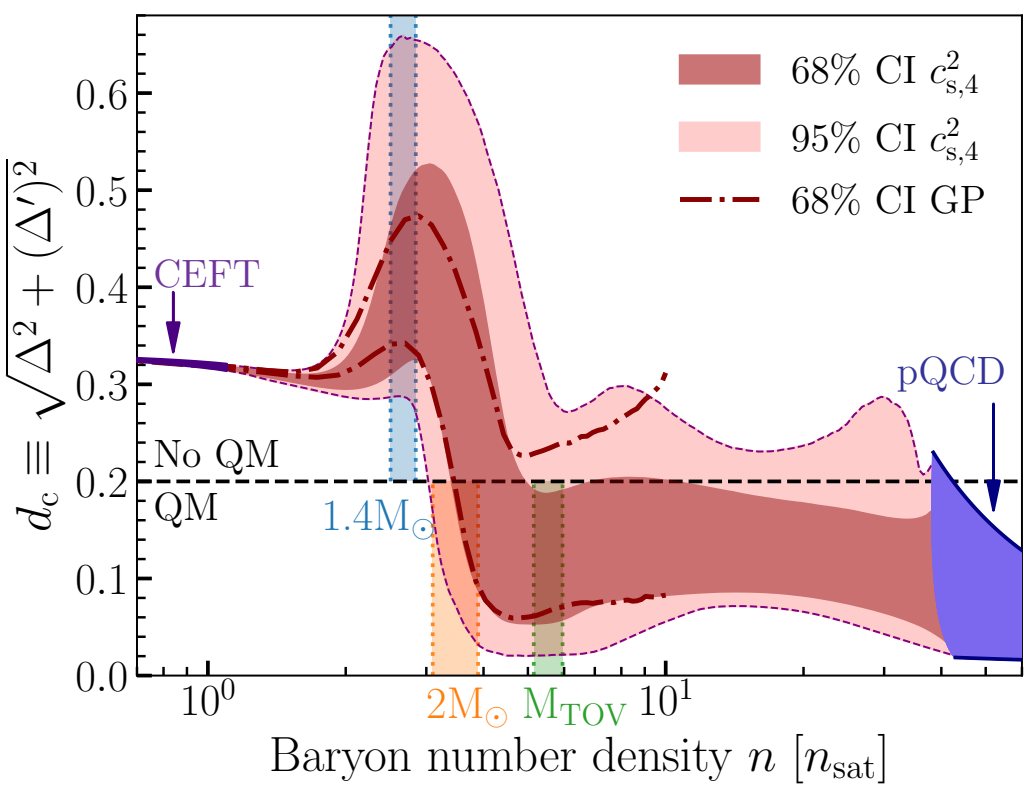
QCD is responsible for the softening

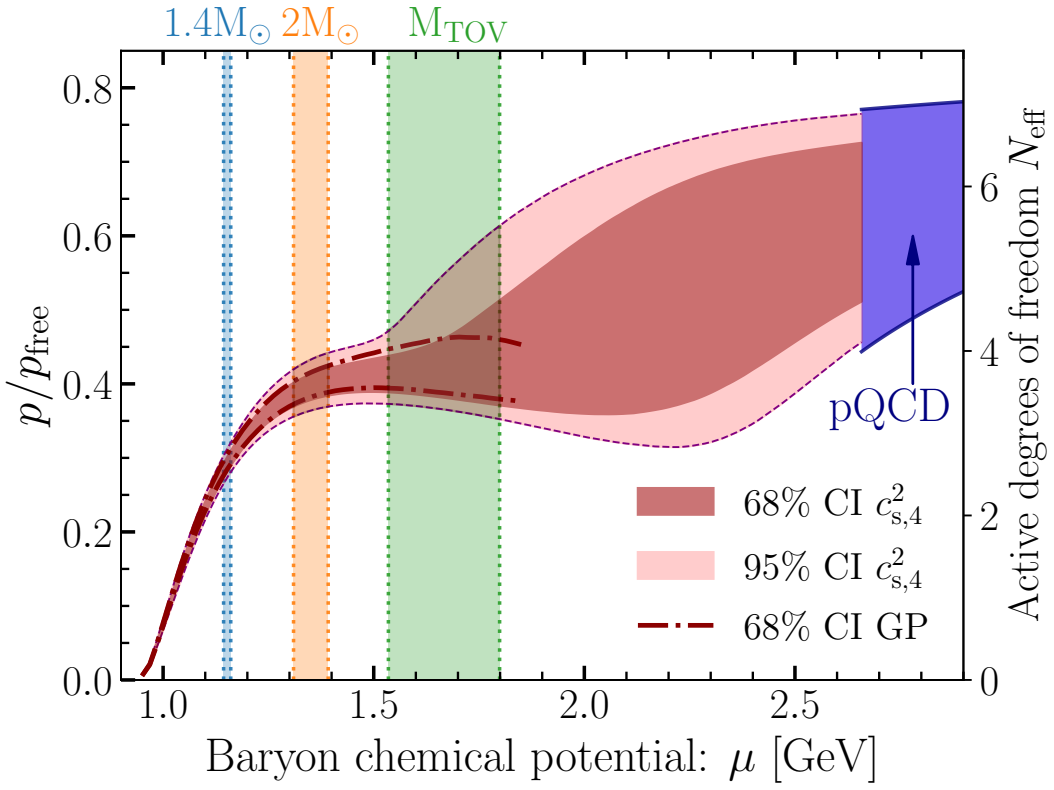




QCD pushes EoS towards conformality, softening at high densities

Quark Matter in the cores of neutron stars





$$\Delta \equiv \frac{1}{3} - \frac{p}{\epsilon} = \frac{1}{3} - \frac{c_s^2}{\gamma},$$

$$\Delta' \equiv \frac{d\Delta}{d\log\epsilon} = c_s^2\left(\frac{1}{\gamma} - 1\right)$$