l'Observatoire de Paris | LUTH

Laboratoire Univers et Théories

Investigating dense matter using Neutron Star observations

LAMI SULEIMAN

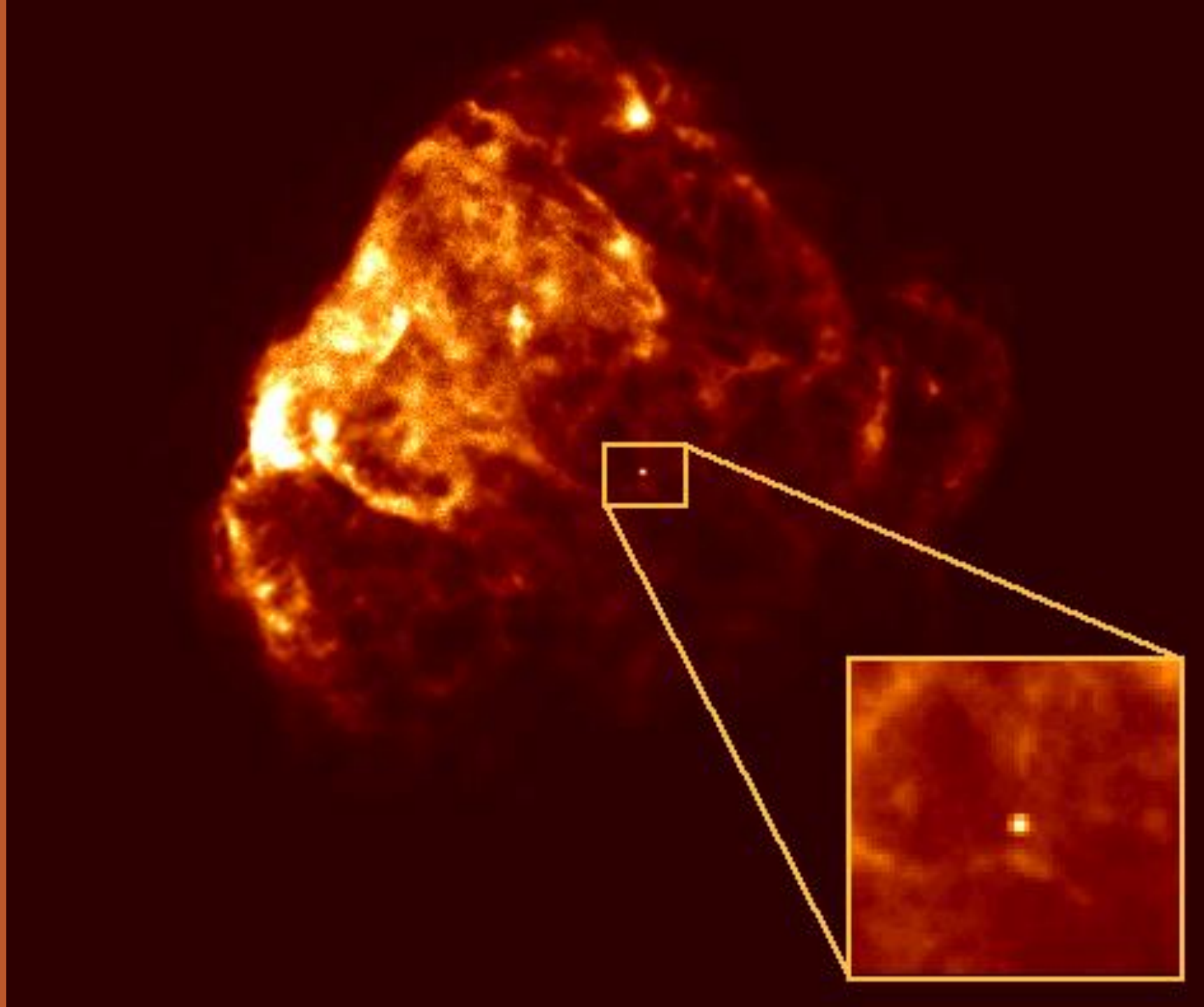
Rencontres Jeunes Physiciens 16th March 2021

Supernova Remnant of Puppis A observed by ROSAT X-ray Observatory

Credits : Nasa website

Focus on Cold Neutron Stars

~~Proto-NS~~



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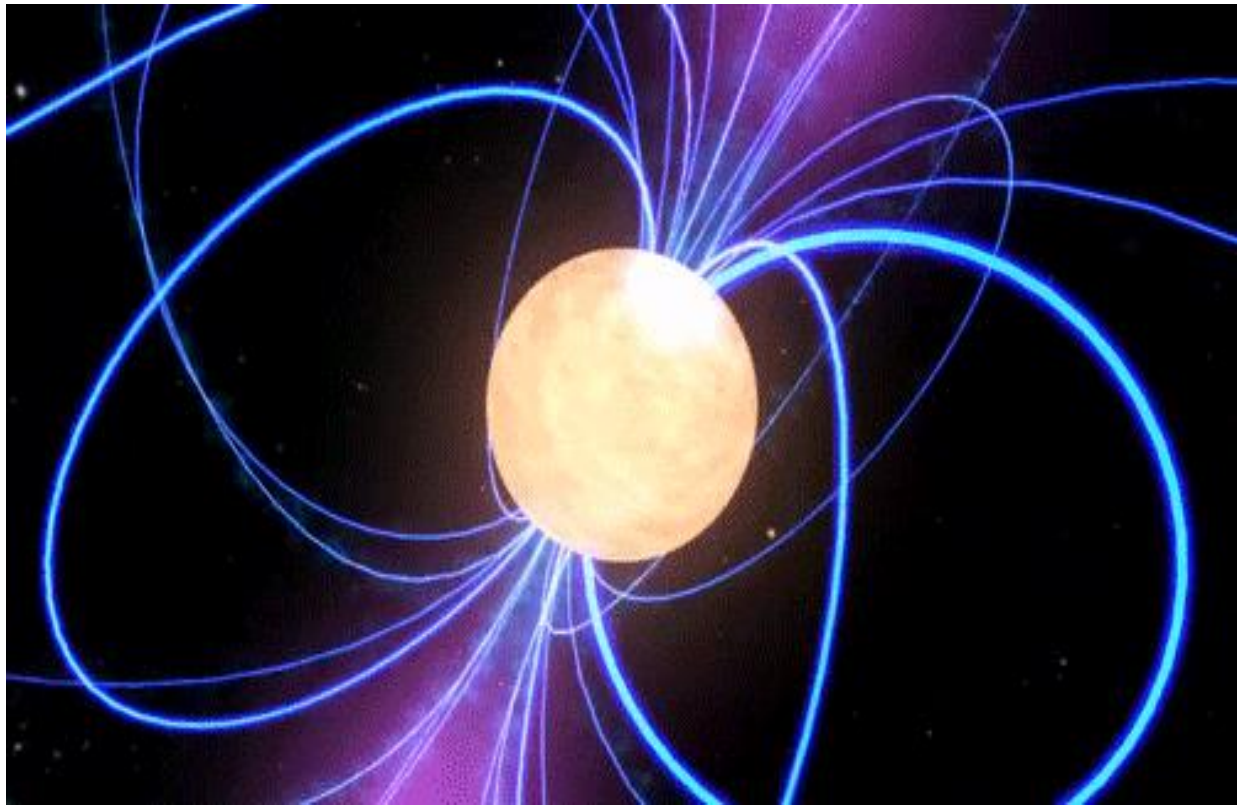
<u>Compact objects:</u>

- Mass ~ $M_{\odot}$
- Radius ~ 10kms

High magnetic field: pulsars



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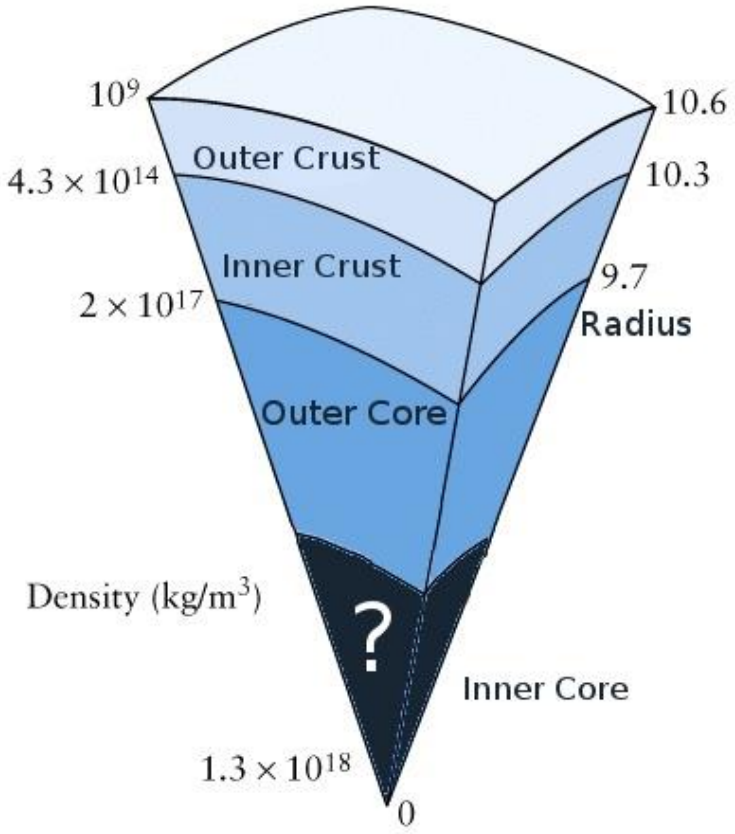

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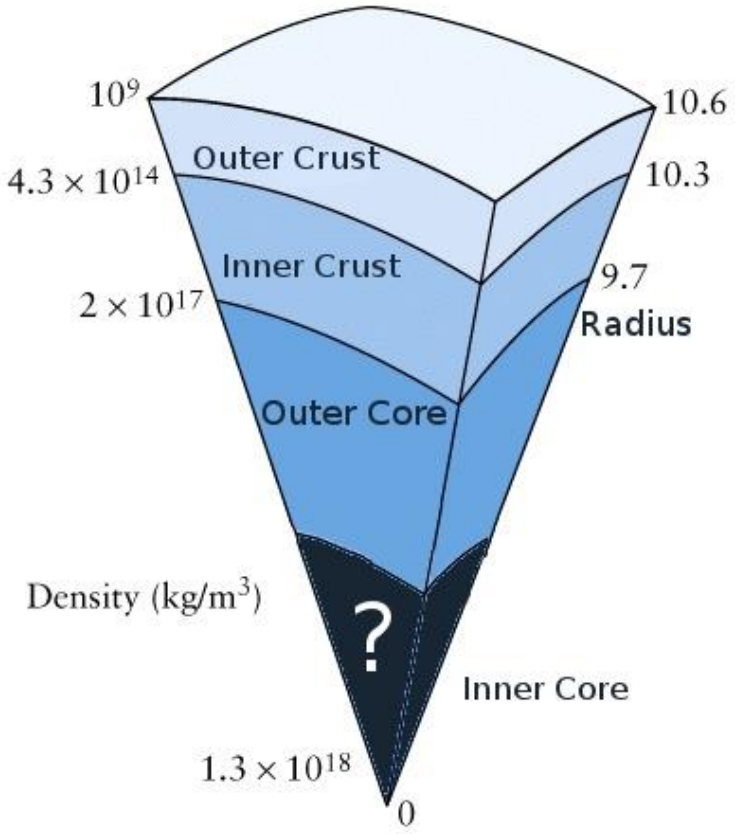

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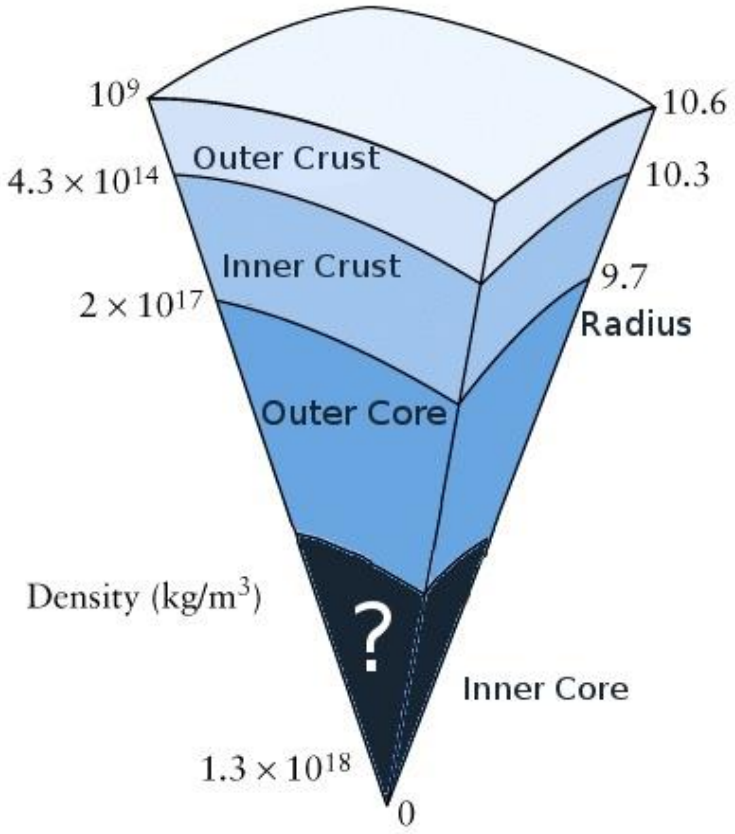

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$P(\rho)$ + composition = nuclear model of NS interior

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So many EoS !!

Multimessenger astronomy vs dense matter exploration

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Modelisation of macroscopic parameters

Input : $P(\rho)$

Output : M, R, Λ, I

$$\frac{dP}{dr} = -\frac{Gm(r)}{r^2}\left(1+\frac{P}{\rho(r)c^2}\right)\left(1+\frac{4\pi r^3 P}{m(r)c^2}\right)\left(1-\frac{2Gm(r)}{rc^2}\right)^{-1}$$

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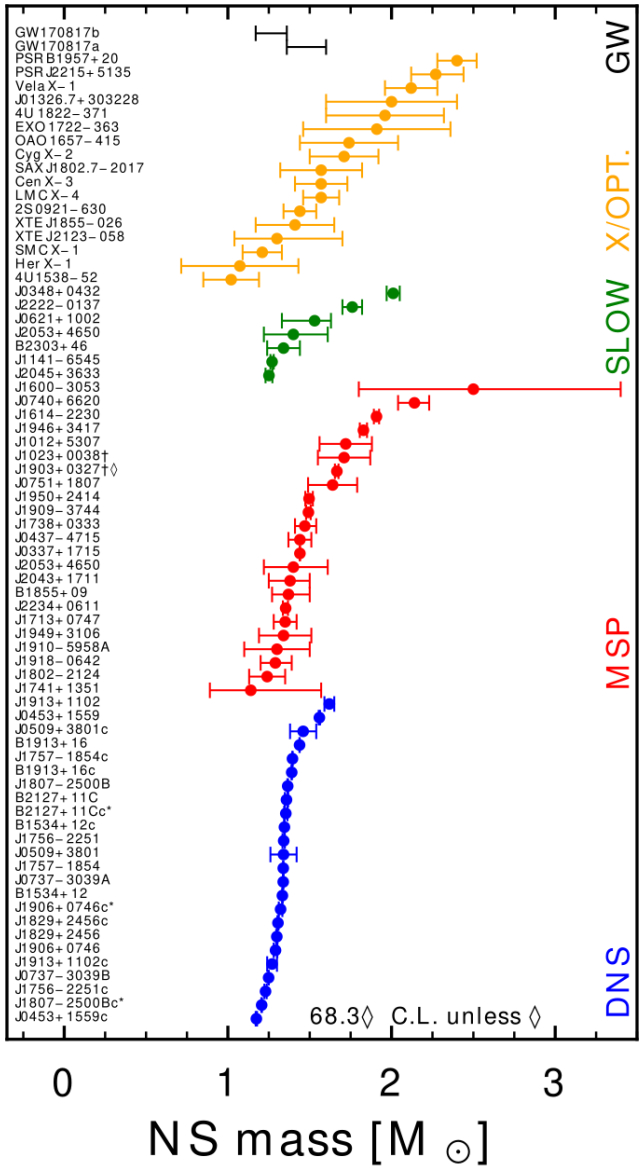

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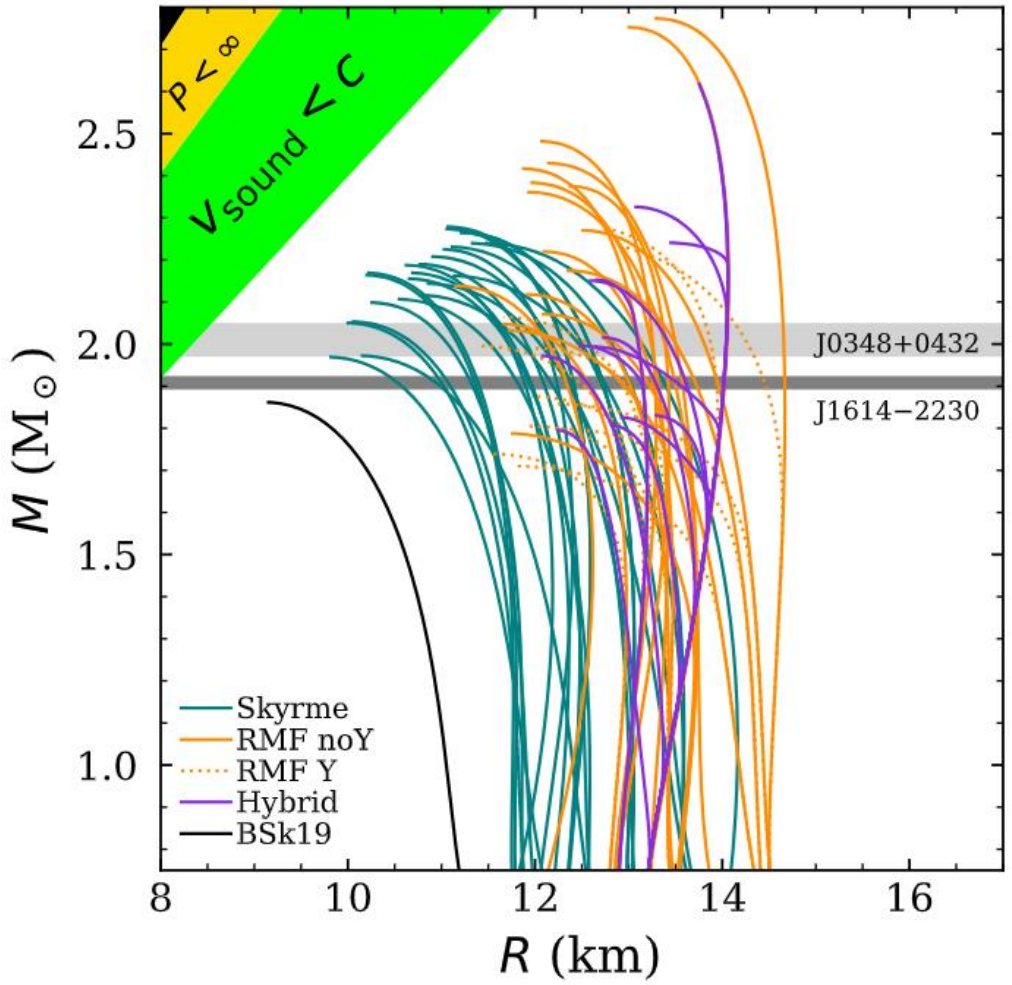

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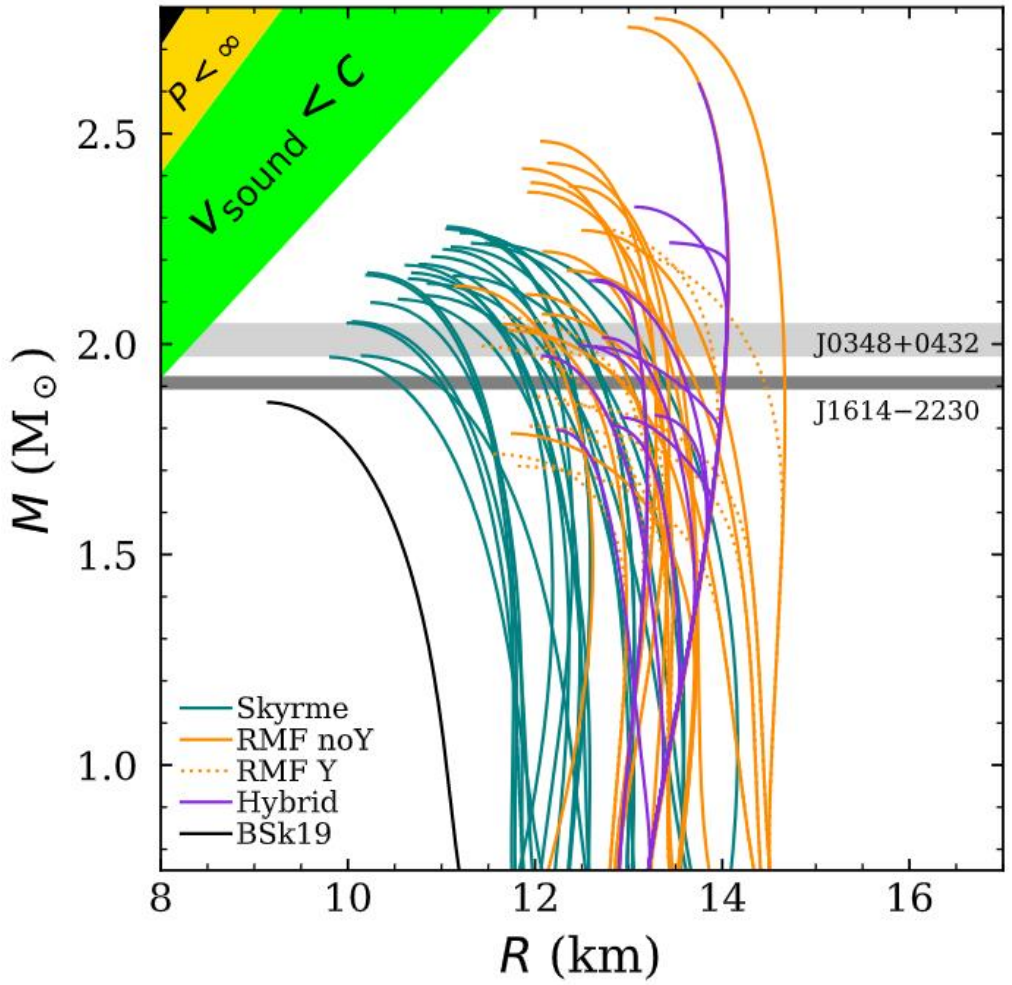

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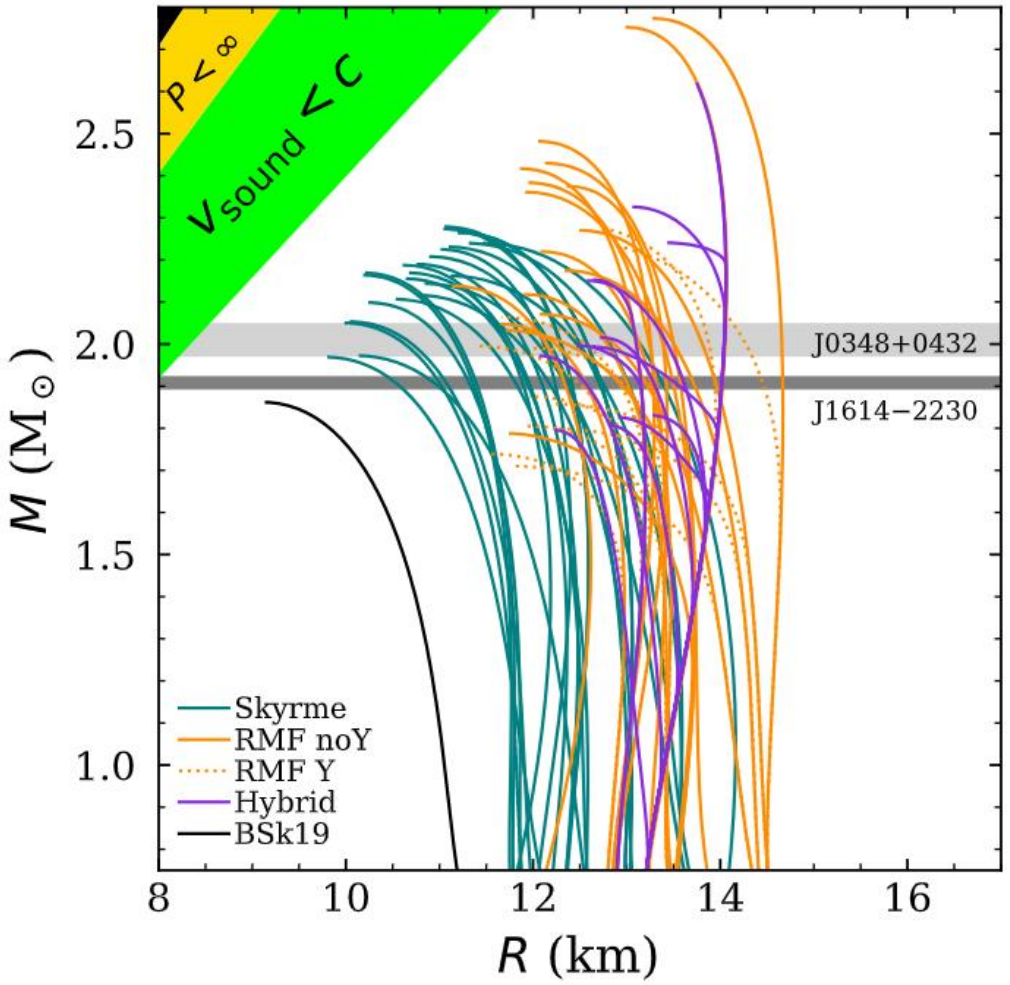

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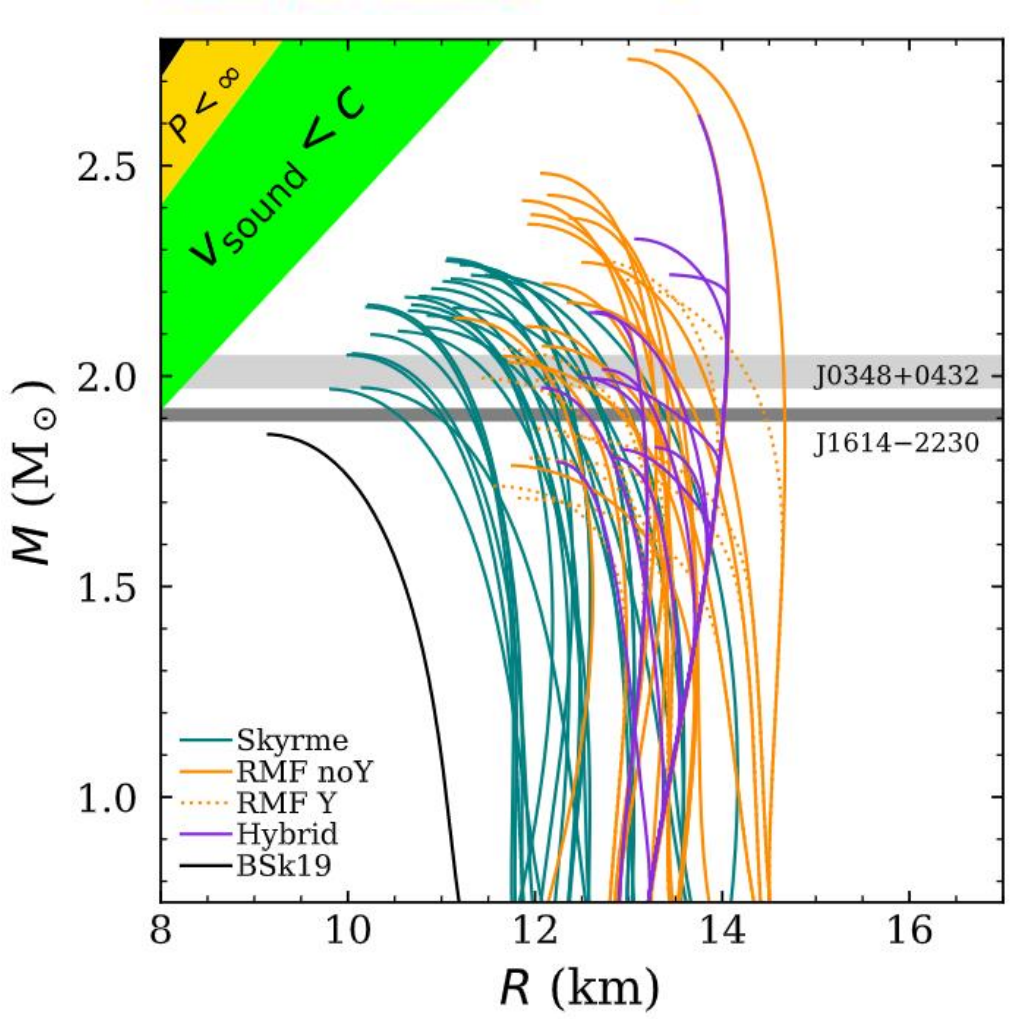
- Moment of inertia I
  - → ☹



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Bind anyway they want …

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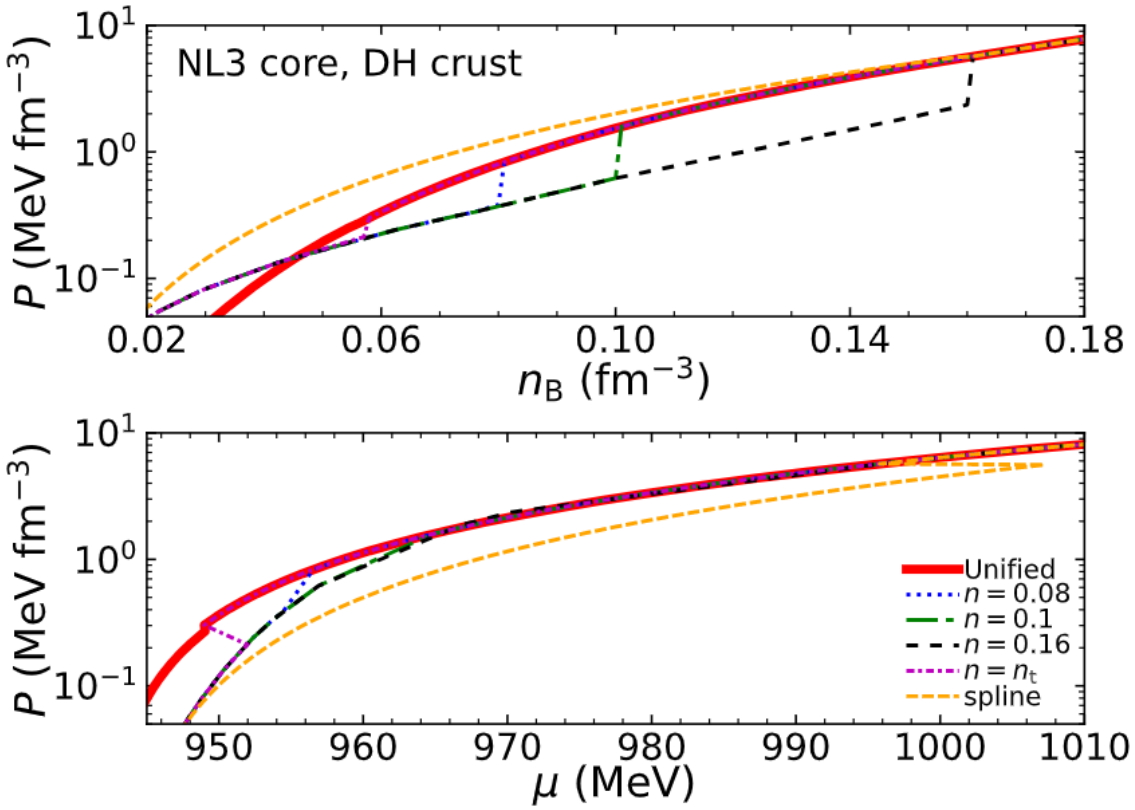

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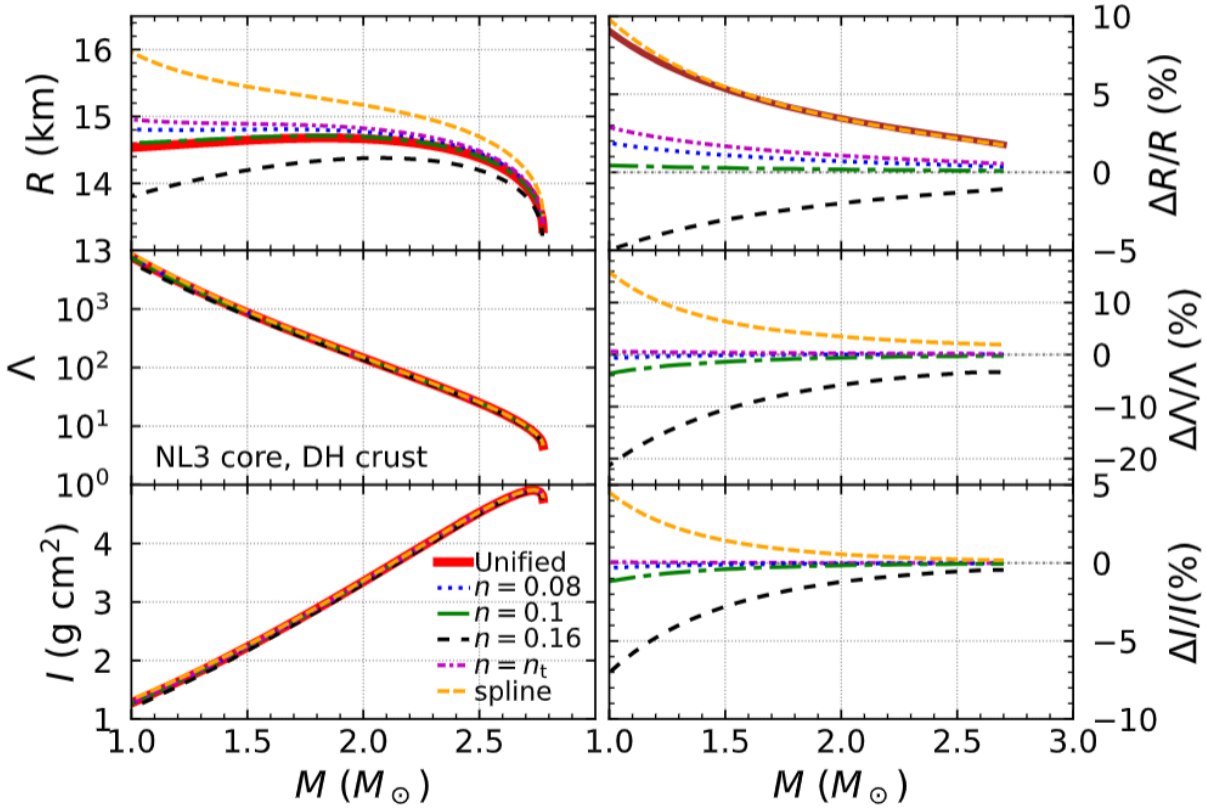

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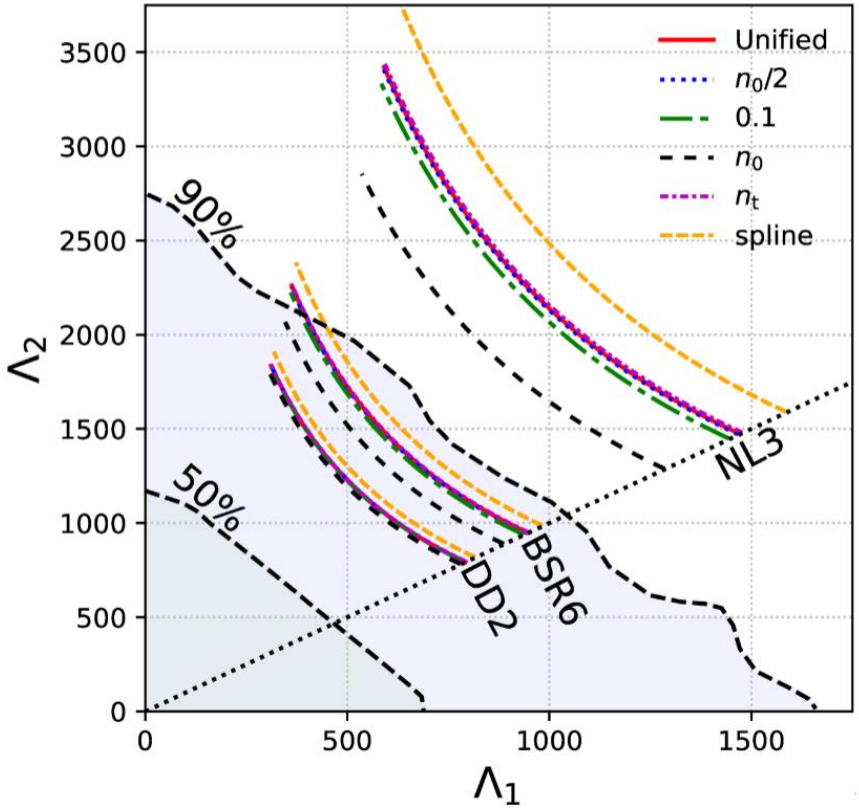

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- « Universal » relations + fits

$$C = \frac{GM}{Rc^2} = \sum_{k=0}^{2} a_k (\ln \Lambda)^k$$

☹ Need to be reevaluated…

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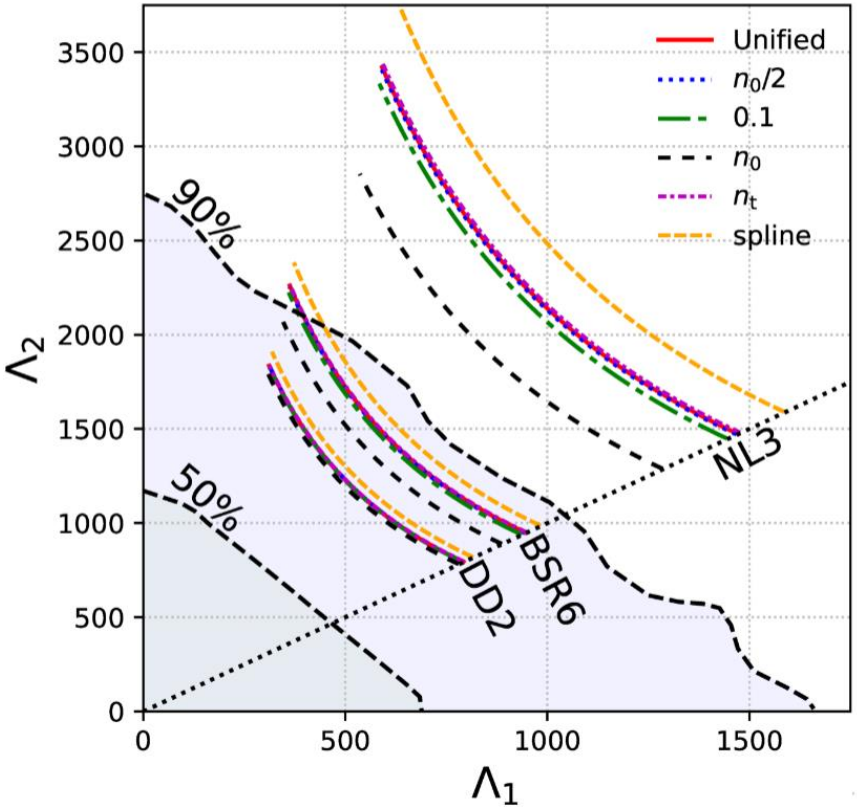

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Thank you for your attention !

Questions ?