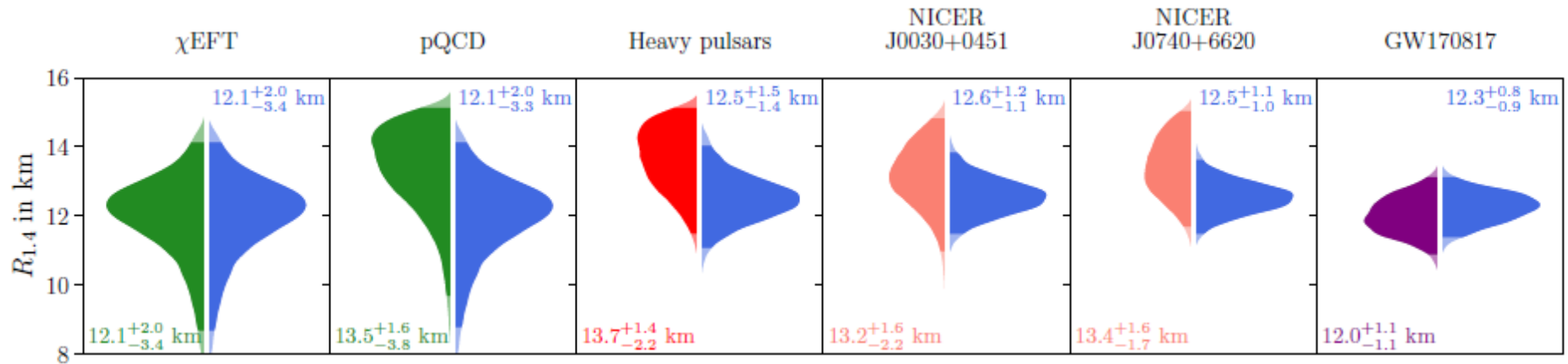


EoS with INDRA/FAZIA: status of the art and perspectives

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Static observables of compact stars

H.Koehn et al, PRX 2025



$$P\left(O(EoS)|\vec{\theta}\right) \propto P(EoS) \prod_i P(\theta_i|EoS)$$

θ_1 . max.mass (radio)

θ_2 . tidal polarisability (GW)

θ_3 . radius (X-ray)

θ_4 . ab-initio theory (chiral+pQCD)



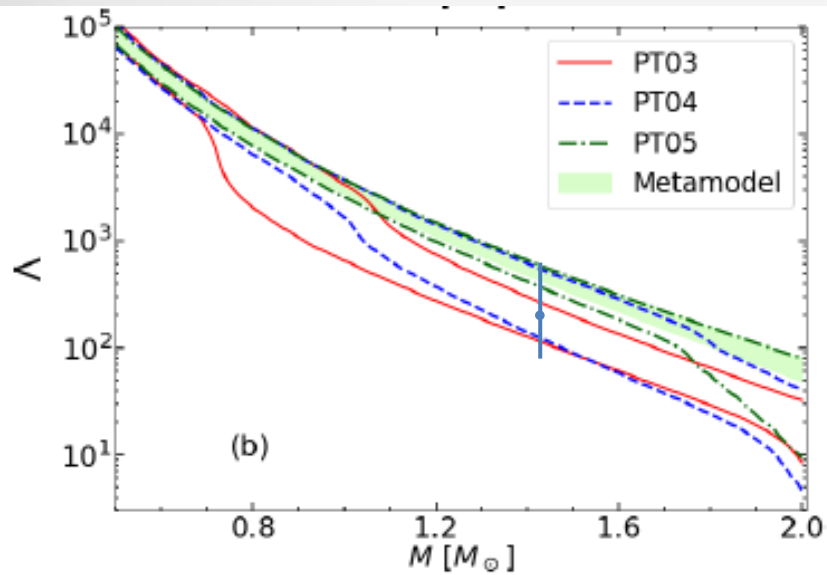
Astrophysics



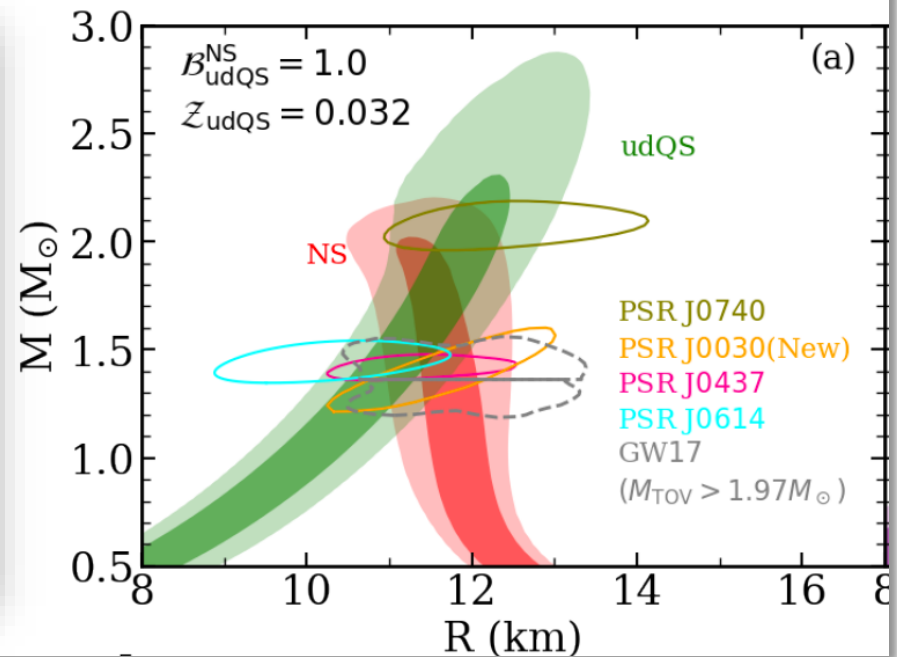
Nuclear physics

Static observables of compact stars

Mondal et al MNRAS 2023



Cao&Li-Wen PRD 2026

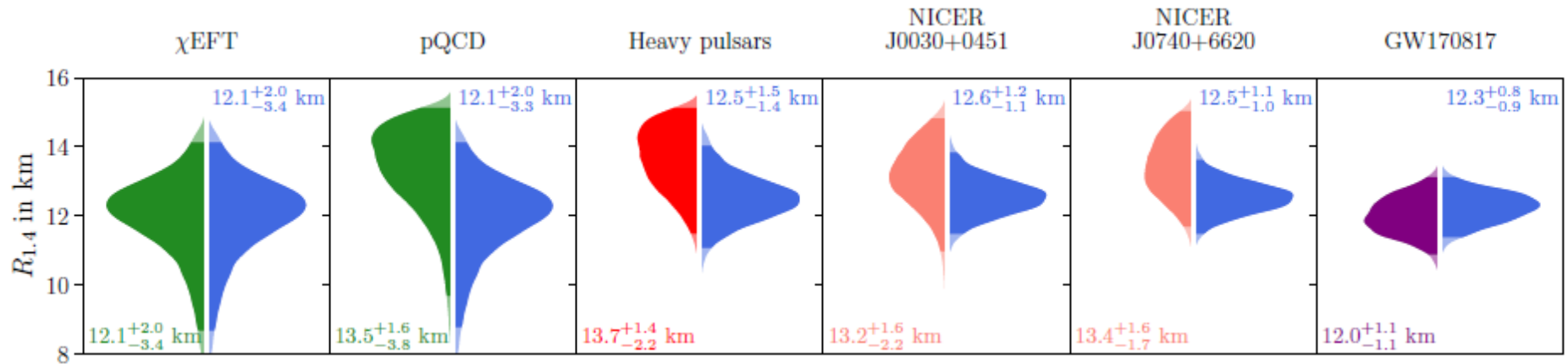


- *Is matter deconfined in the core of NS?*

- *Is quark matter the absolute GS of dense matter?*

Static observables of compact stars

H.Koehn et al, PRX 2025



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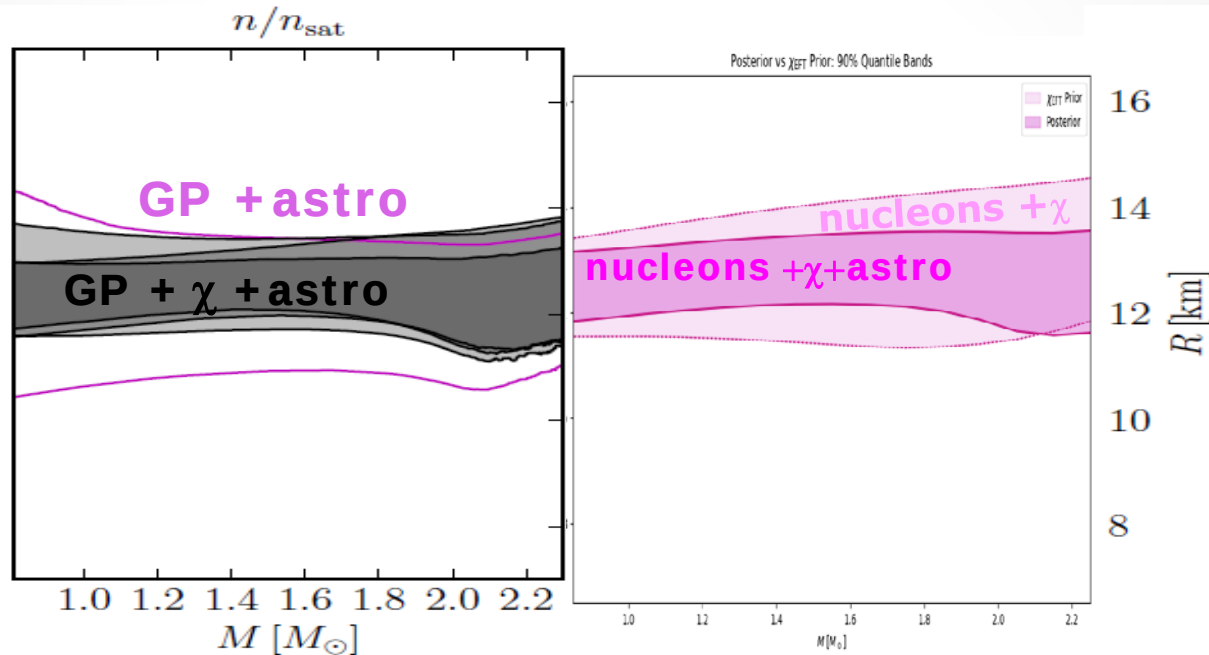
θ_5 . experimental nuclear data ?



Nuclear physics

The status of the art

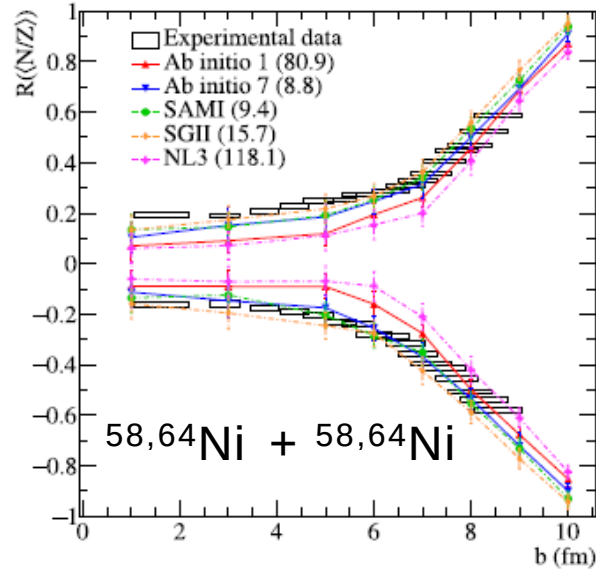
R.Essick et al, PRC 2020 G.Montefusco et al, PRD 2026



- Posterior distributions with chiral (χ)+astro are $\sim$ the same supposing a nucleonic composition wrt an agnostic (GP) model
 - $\Rightarrow$ the observations are compatible with a pure nucleonic composition
 - $\Rightarrow$ the nucleonic models cover all the parameter space compatible with the observations !
 - $\Rightarrow$ Laboratory constraints can be further included in the EoS information

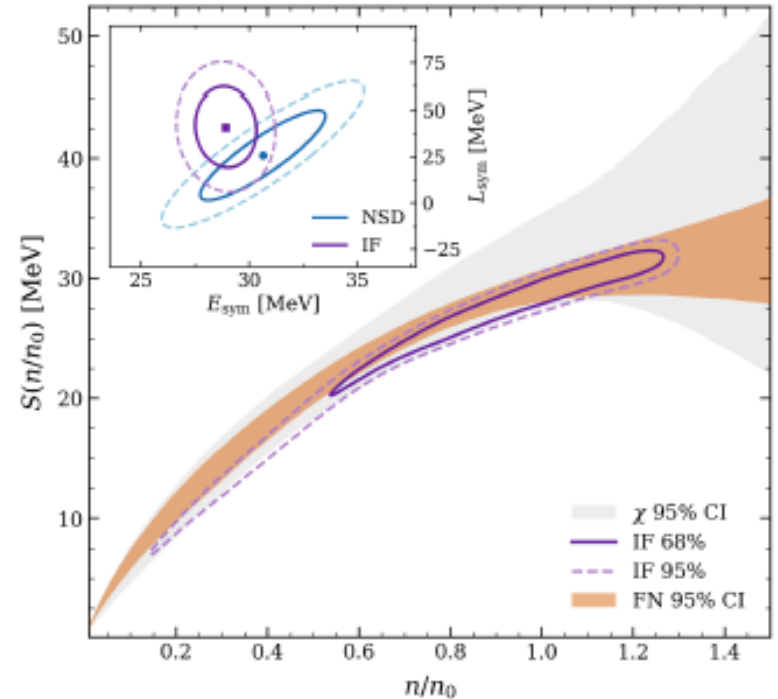
The status of the art

C.Ciampi et al, PLB 2025



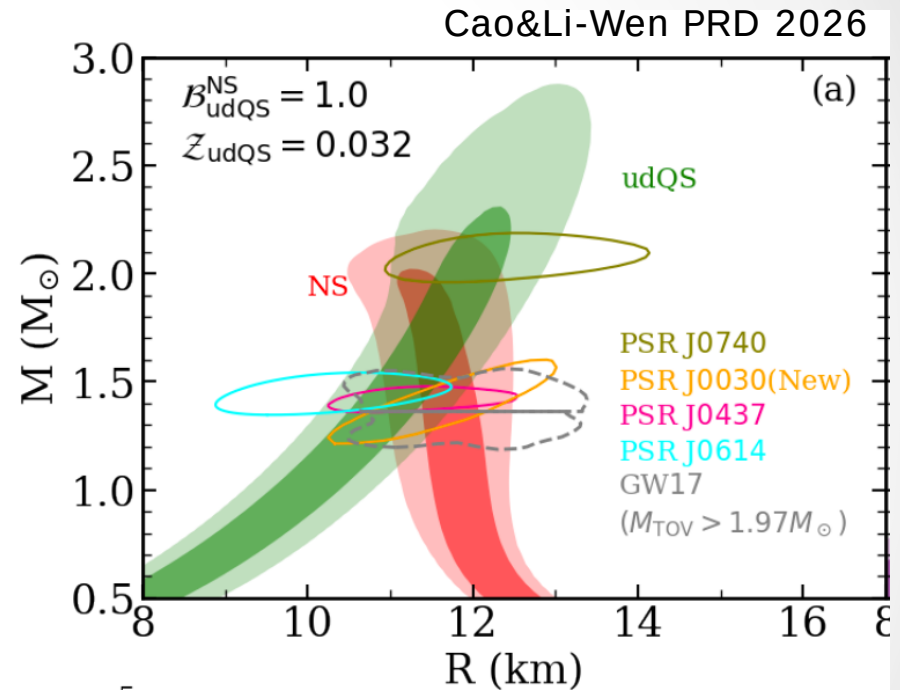
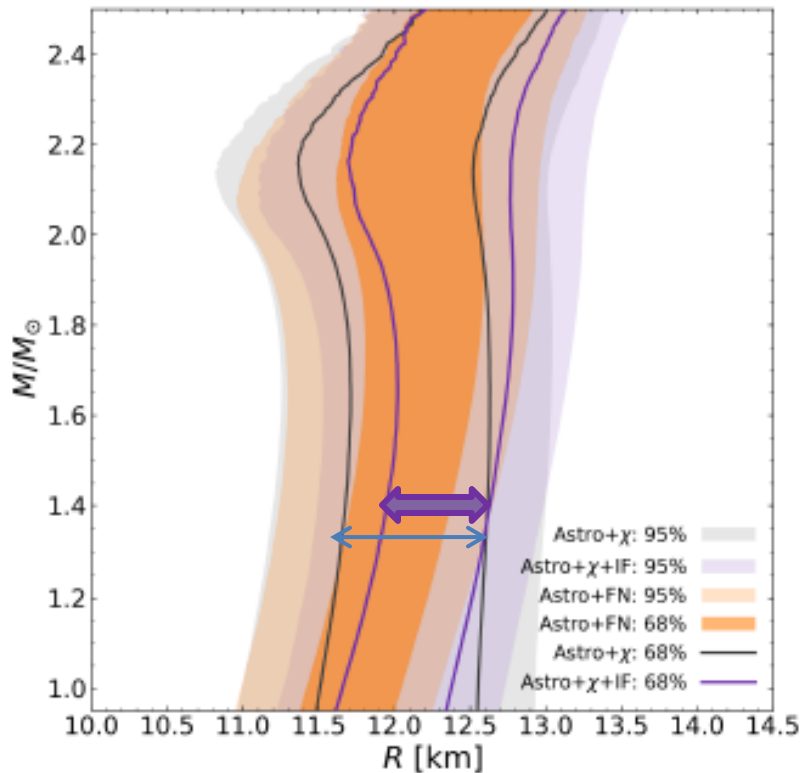
	$B.E.$ [MeV]	R_{ch} [fm]	ΔE_{SO} [MeV]	E_{GMR}^{IS} [MeV]
Pb208	1636.4 ± 2.0	5.50 ± 0.05	2.02 ± 0.50	13.5 ± 0.5
Ca48	416.0 ± 2.0	3.48 ± 0.05	1.72 ± 0.50	
Ca40	342.1 ± 2.0	3.49 ± 0.05		
Ni56	484.0 ± 2.0			
Ni68	590.4 ± 2.0			
Sn100	825.2 ± 2.0			
Sn132	1102.8 ± 2.0	4.65 ± 0.05		
Zr90	783.9 ± 2.0	4.27 ± 0.05		17.7 ± 0.5
	α_D [fm ³]	$m(1)$ [MeV fm ²]	A_{PV} (p.p.b.)	E_{GQR}^{IS} [MeV]
Pb208	19.60 ± 0.60	961 ± 22	550 ± 18	10.9 ± 0.5
Ca48	2.07 ± 0.22		2668 ± 113	

P.Klausner et al, PRC 2024



G.Montefusco et al, arXiv:2609.24940

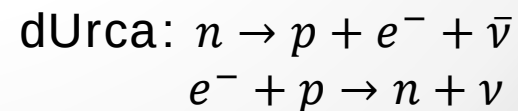
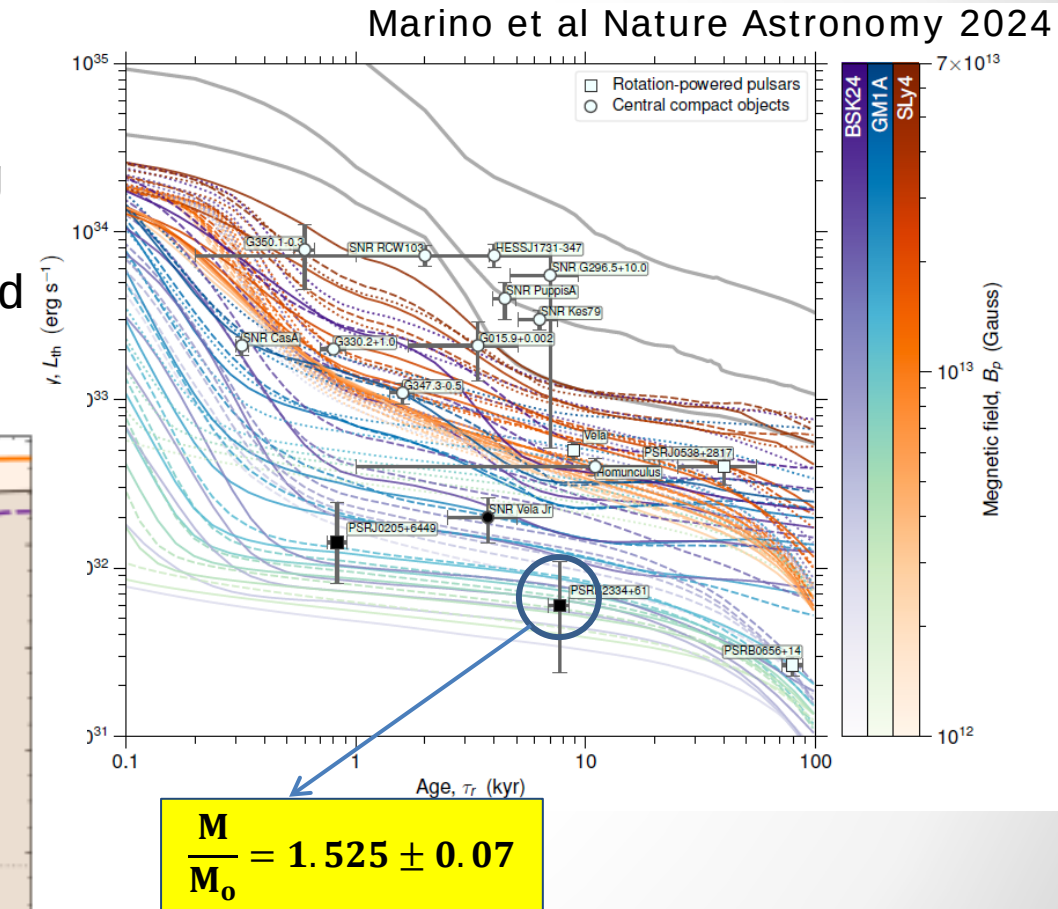
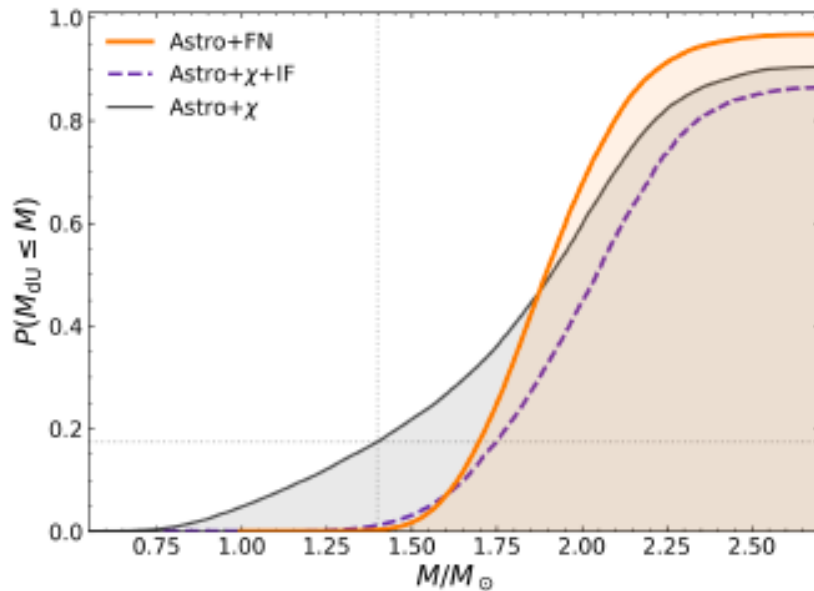
Static observables informed by Indra/FAZIA data



- *Is quark matter the absolute GS of dense matter?*
- Confirming the result/reducing the uncertainties
=> ITR with different systems and higher energy

NS cooling informed by Indra/FAZIA data

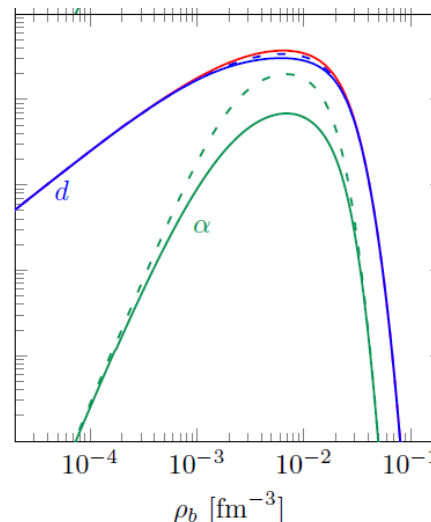
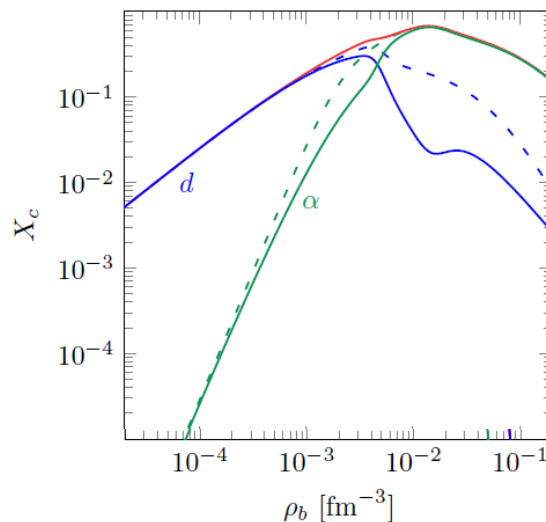
- Are there exotic components in the NS core?
- Confirming the result/ reducing the uncertainties
=> ITR with different systems and higher energy



Supernova and mergers

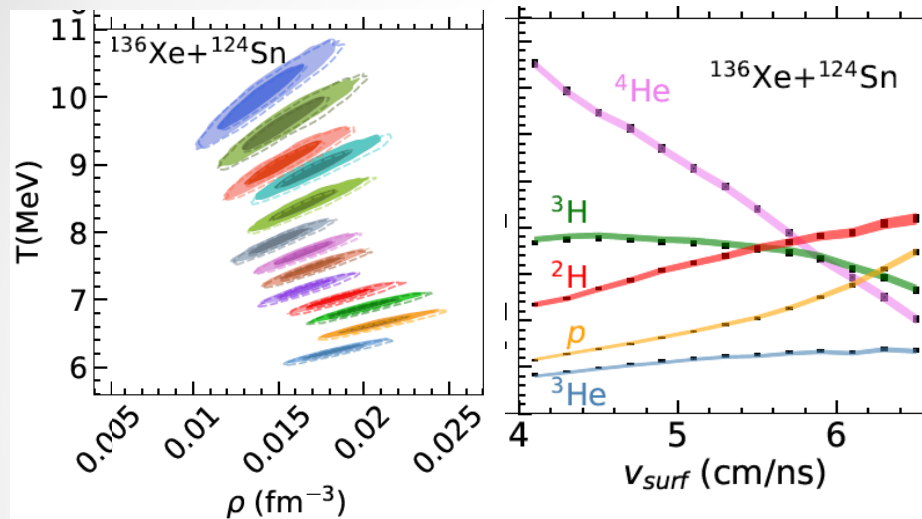
- Describing multi-messenger signals from supernova and mergers requires following the matter+neutrino dynamics
- ⇒ General purpose EoS including composition of « low » density n-p-e matter $\equiv$ cluster abundancies (n, T, y_e)

- $$n_{AZ} = \frac{g_{AZ}}{2\pi^2 \hbar^3} \int_{\mathbf{P}_{Mott}(\mathbf{n}, T)}^{\infty} dP \left[1 \pm \exp \beta \left(\frac{P^2}{2M_{AZ}} - \mathbf{B}_{AZ}(\mathbf{P}, \mathbf{n}, T) - A\mu - Z\mu_p \right) \right]^{-1}$$
- Input required: in-medium modified nuclear energies
- Model dependence: need to calibrate on HI data

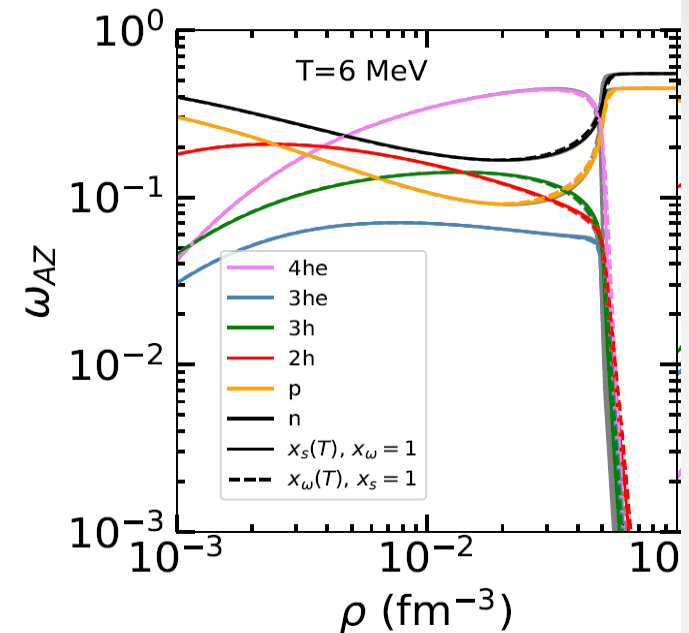


S.Burrello et al,
PRC113(2026)064617

Supernova composition informed by INDRA/FAZIA data



T.Custodio et al,
PRL 134 (2025)082304



- Lower temperatures and higher density benchmarks are needed
- The statistical hypothesis has to be (in)validated
=> new controlled statistical data sets
=> dynamical production: Bayesian analysis with transport models: emulators needed

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