

Using non unified EoS when modelling macroscopic parameters of Neutron Stars

Lami Suleiman

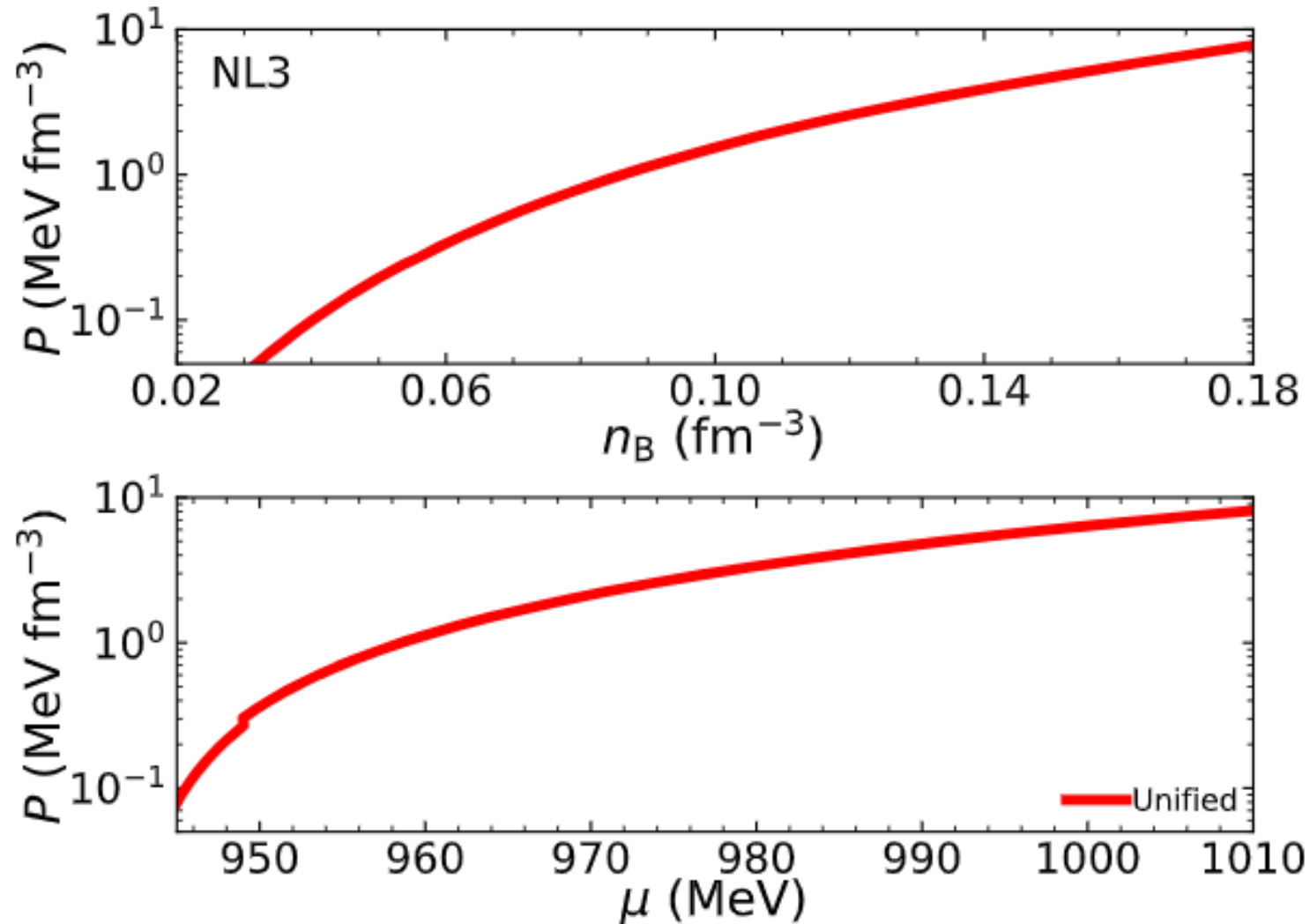
With Morgane Fortin, Leszek Zdunik and Pawel Haensel



Constructing non unified Equations of state

Unified EoS : calculated consistently for the core and the crust

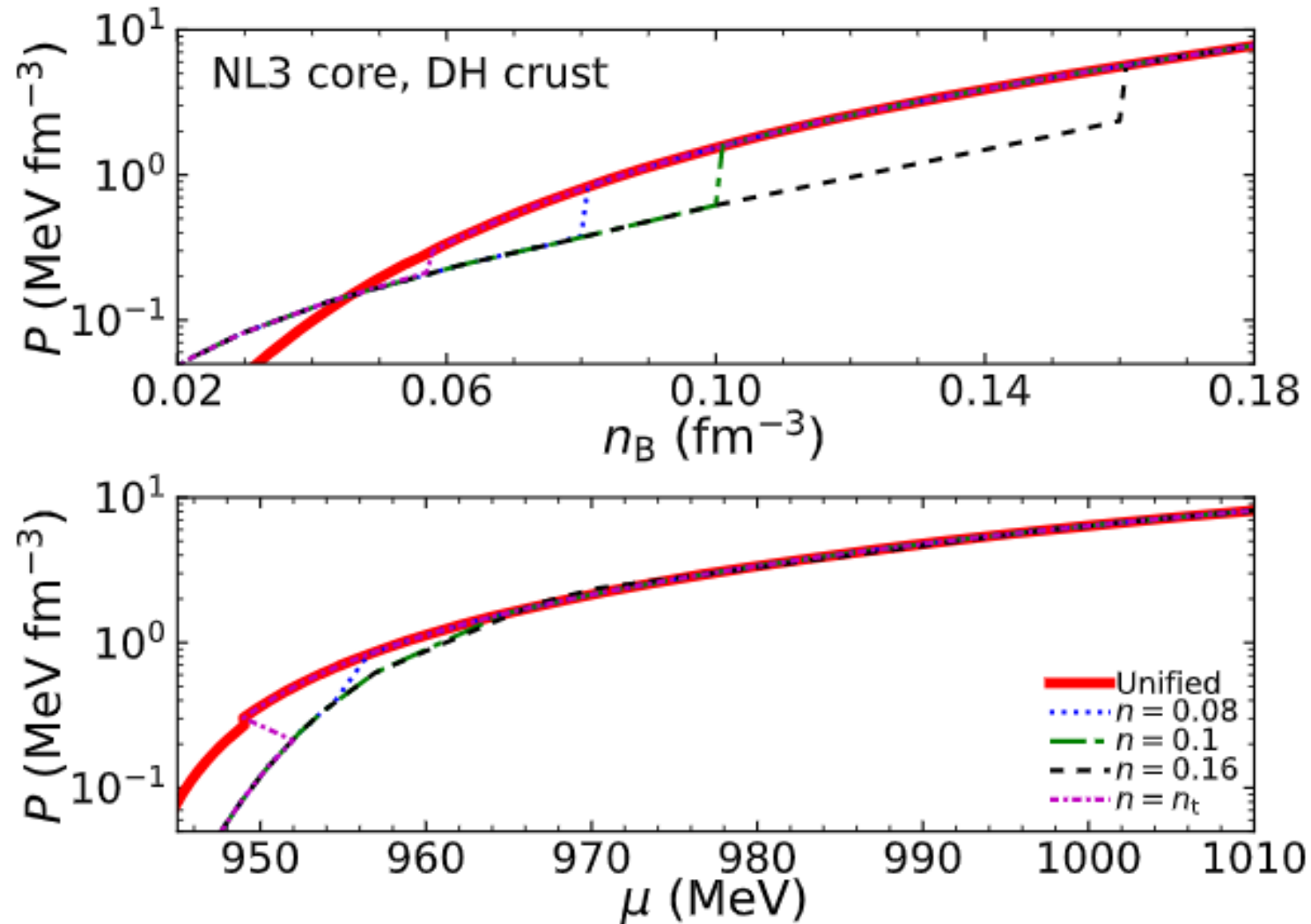
Non unified EoS : glue core to famous crust



Constructing non unified Equations of state

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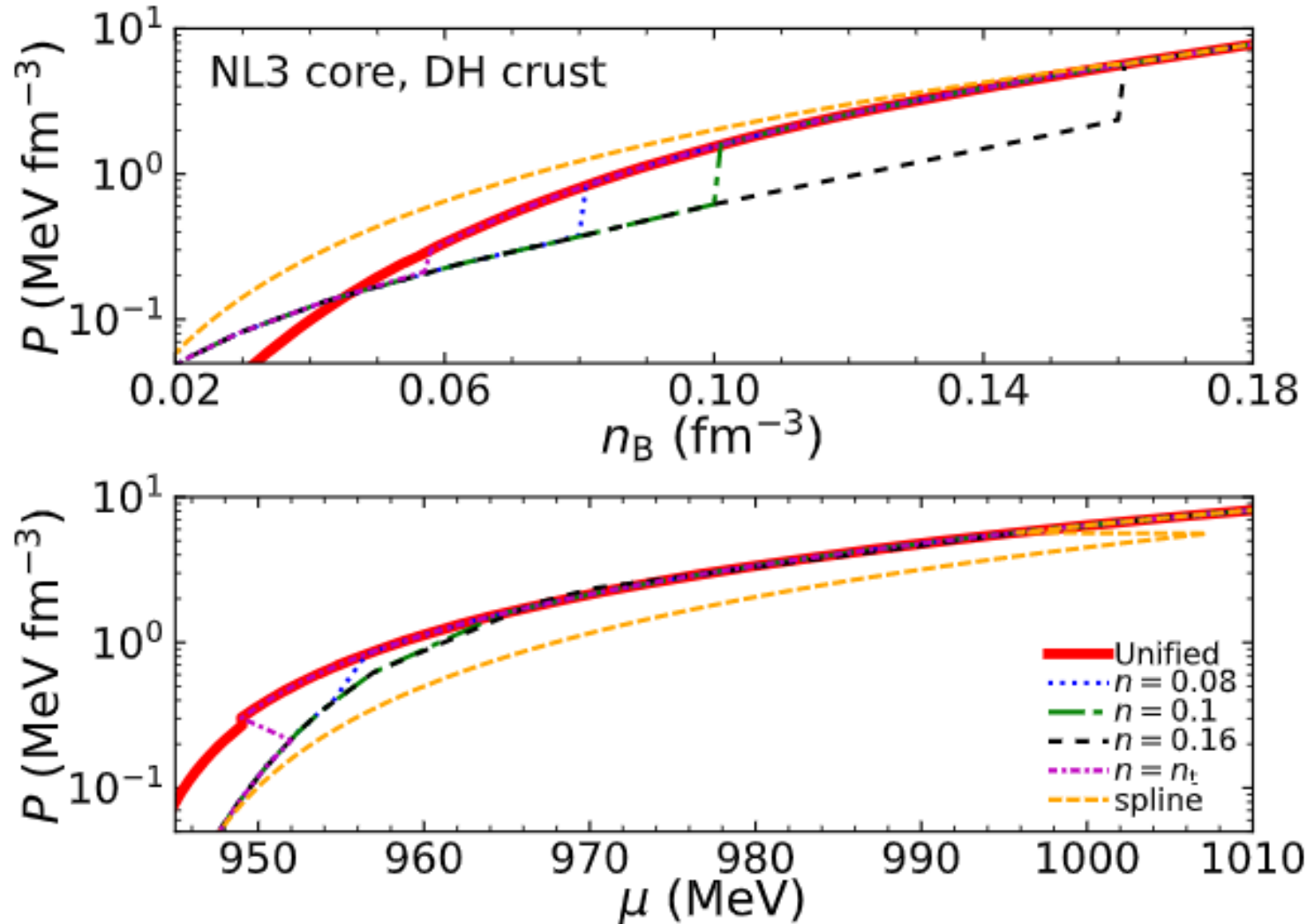
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Constructing non unified Equations of state

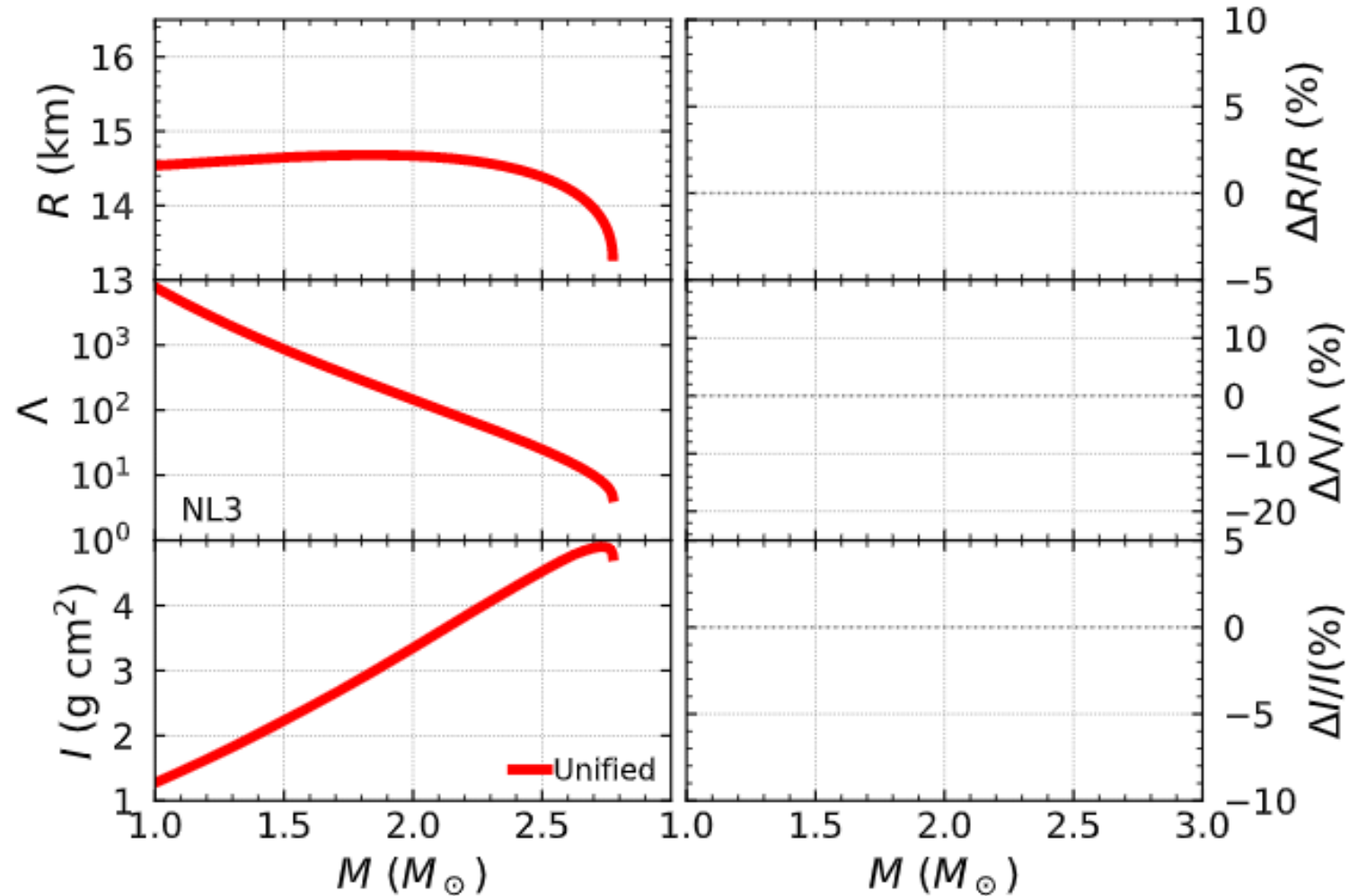
Unified EoS : calculated consistently for the core and the crust

Non unified EoS : glue core to famous crust



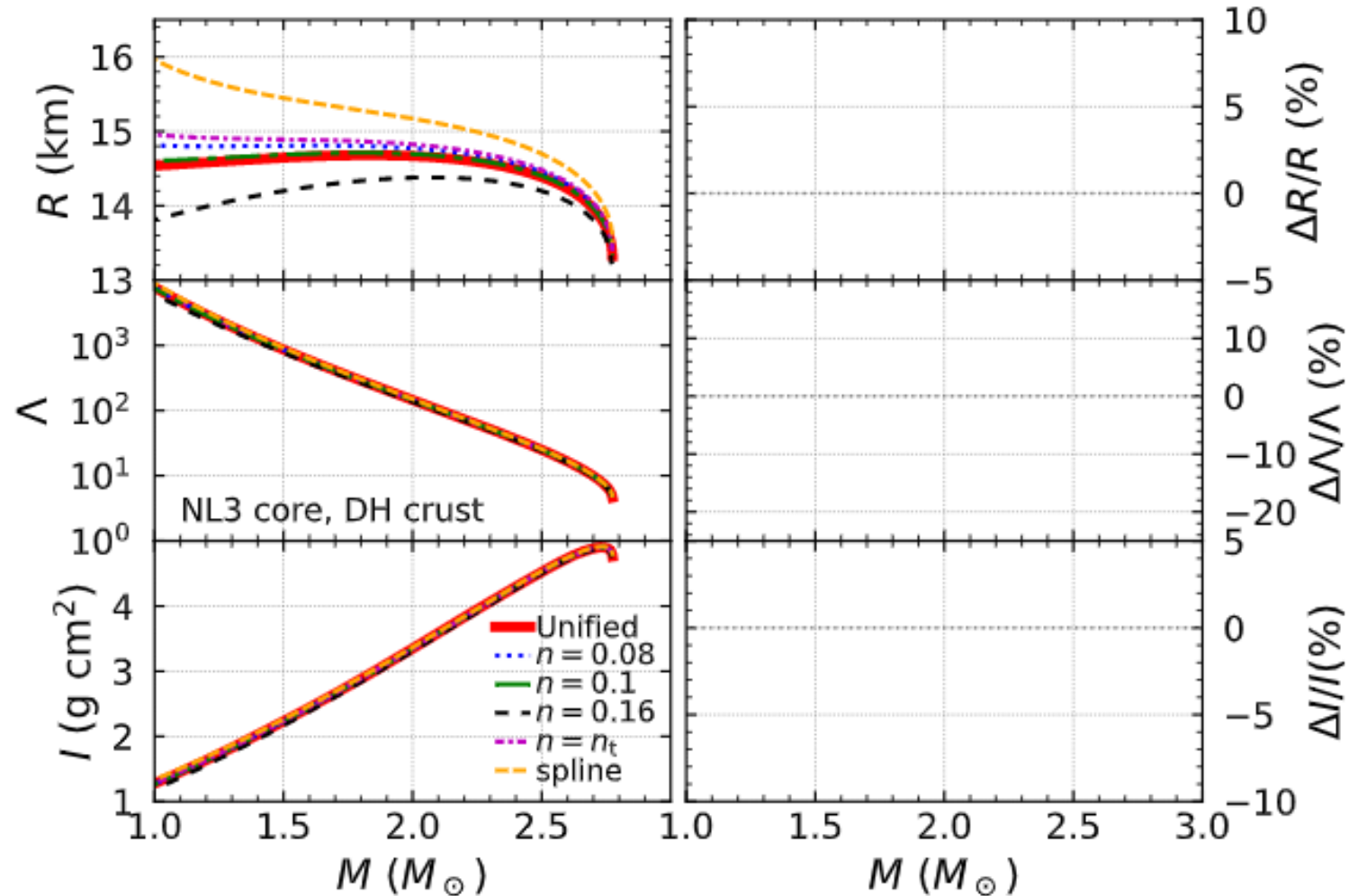
Macroscopic parameters of Neutron stars

Put EoS into relativistic hydrostatic equations -> isolated cold non rotating NS



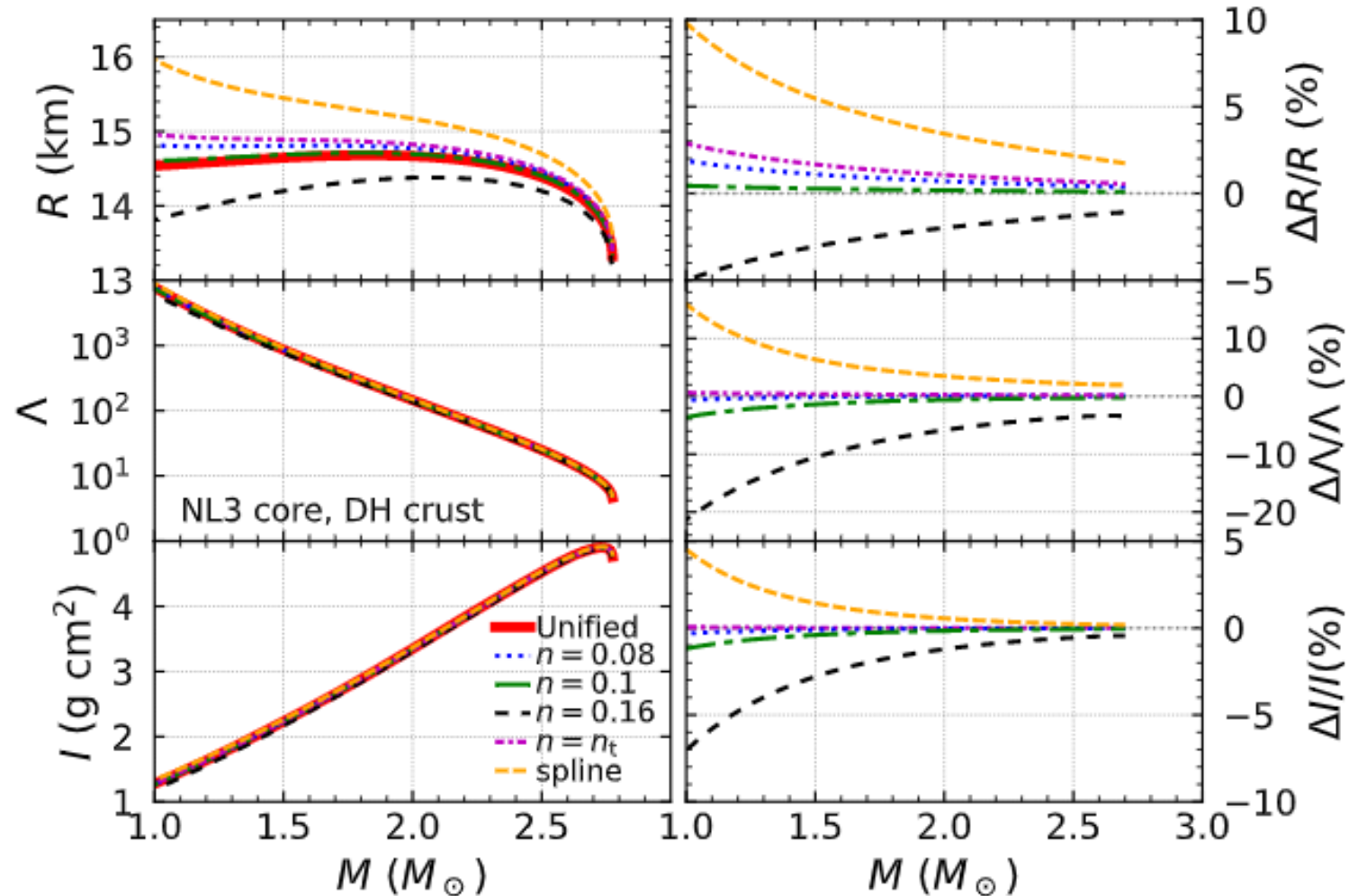
Macroscopic parameters of Neutron stars

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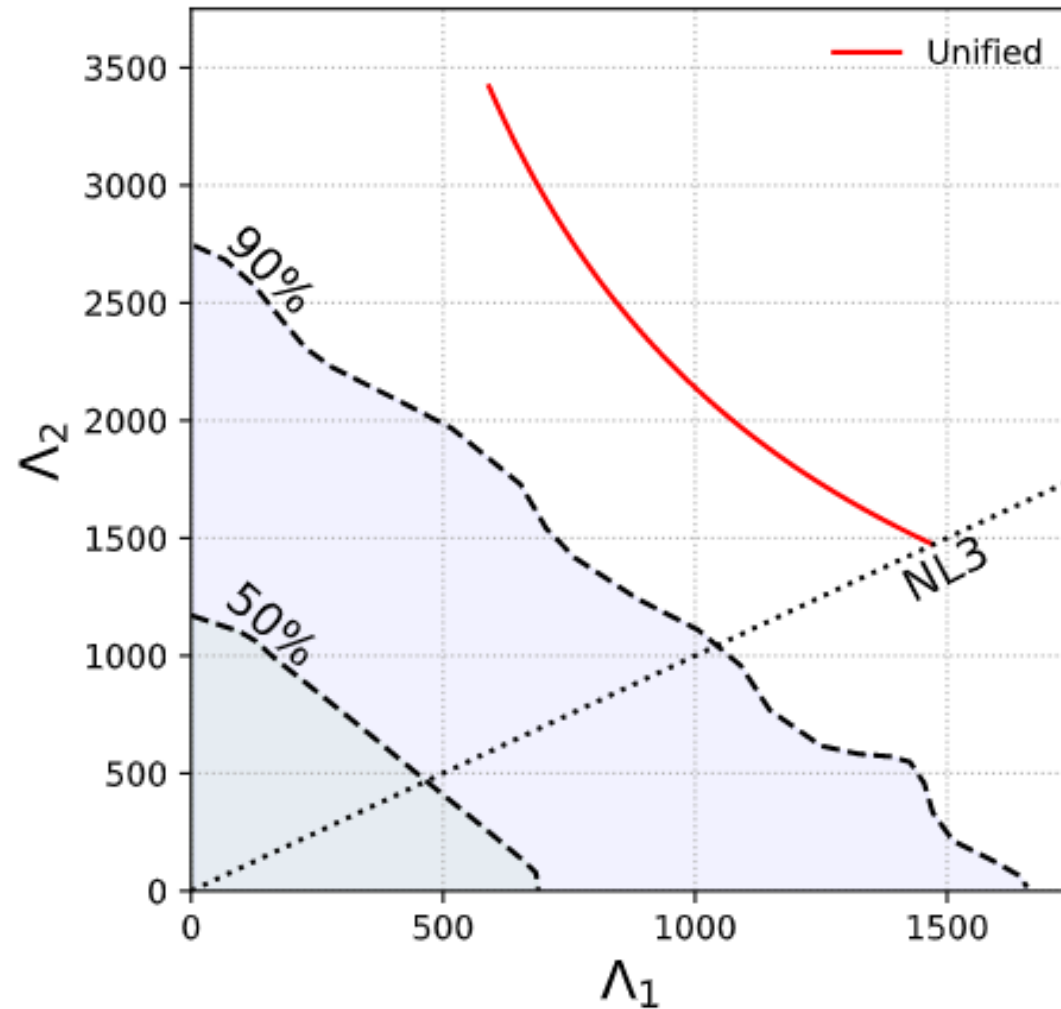
Macroscopic parameters of Neutron stars

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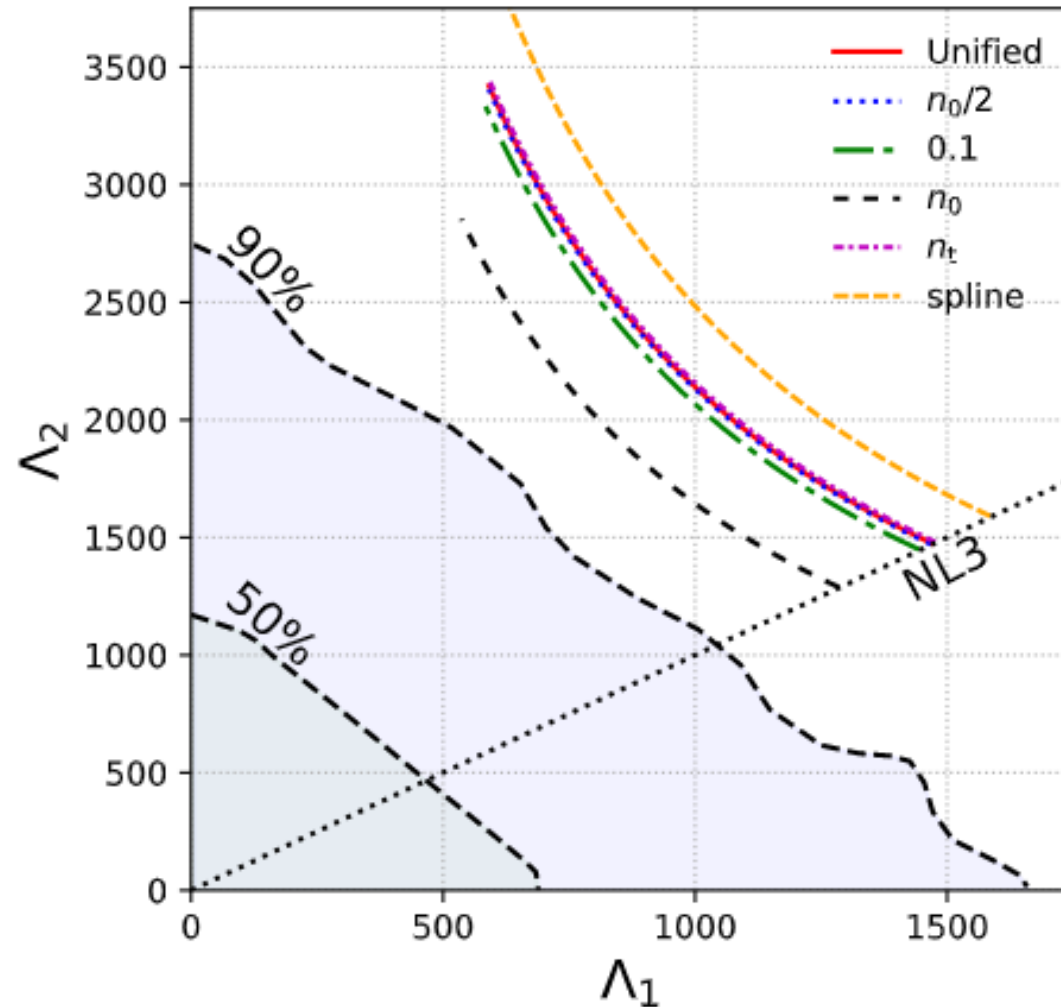
GW170817 Tidal deformability measurement

$1.365 < M_1 < 1.60 M_\odot$
Fixed chirp mass $1.888 M_\odot$



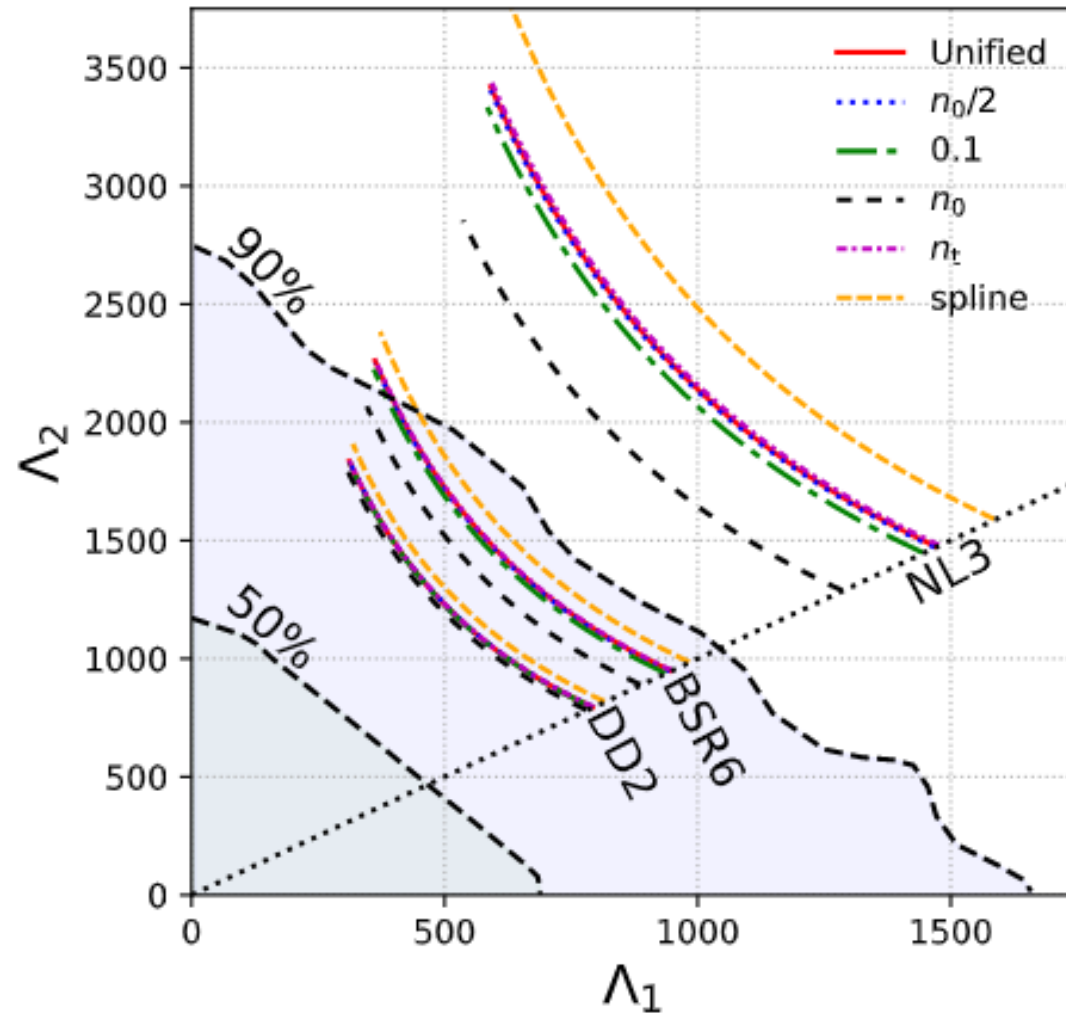
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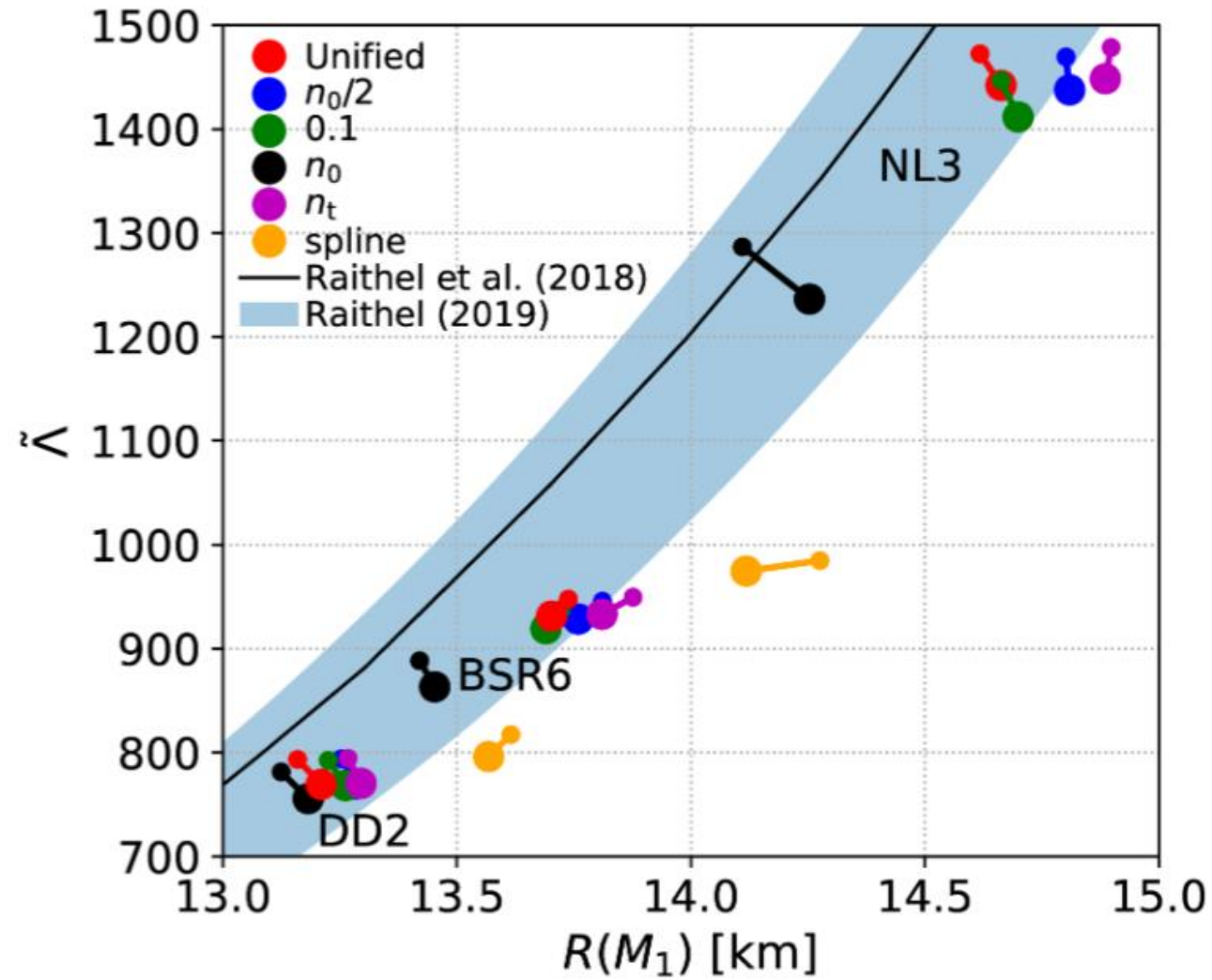


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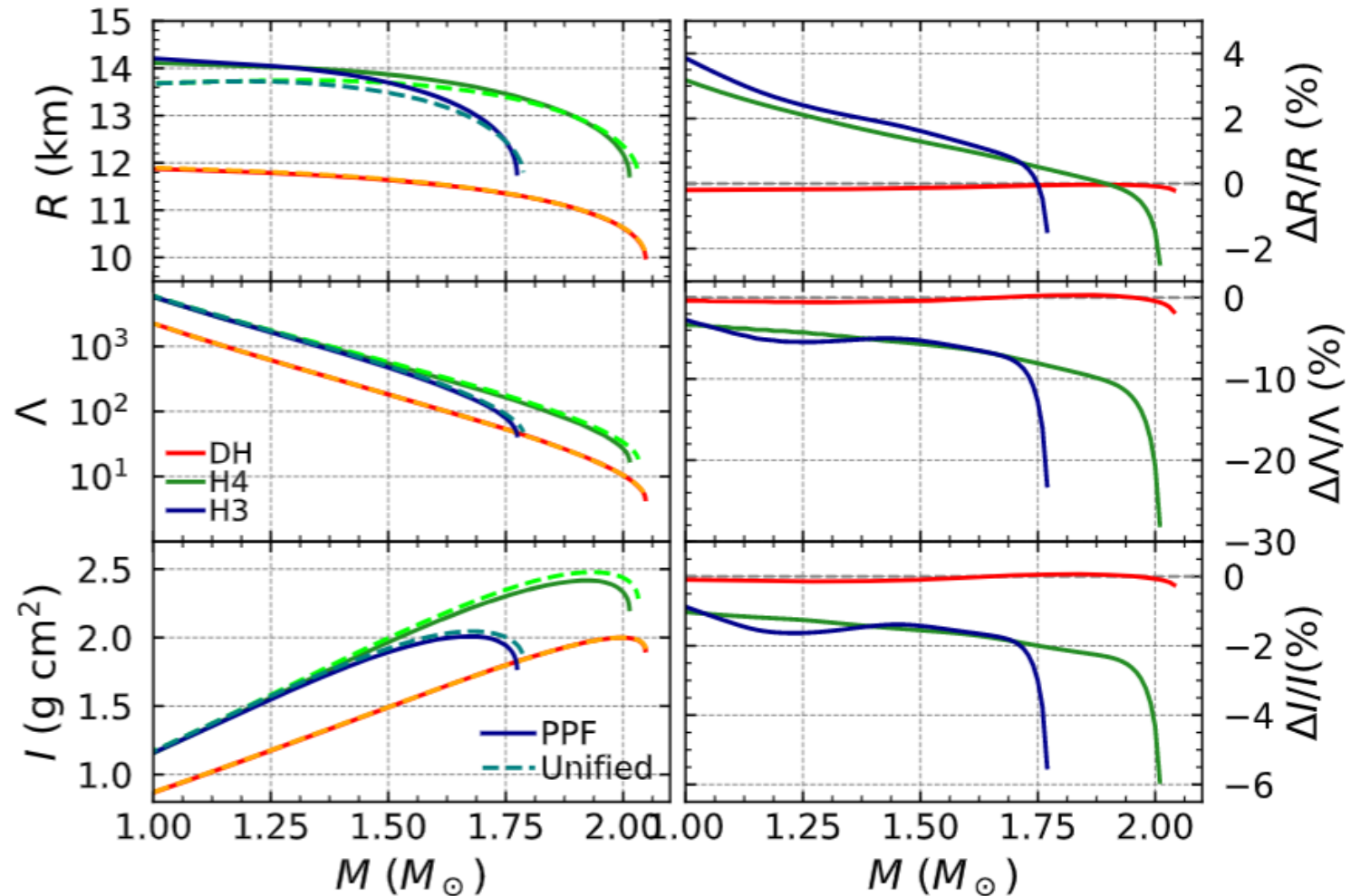
« Universal » relations



Analytical representations of tabulated EoS

Piecewise polytropic fits Read et al. 2009

7 polytropes : $P = \kappa \rho^\Gamma$



Analytical representations of tabulated EoS

Piecewise polytropic fits Read et al. 2009

$$7 \text{ polytropes : } P = \kappa \rho^\Gamma$$

EOS	$\log_{10}(\kappa_0)$	Γ_0	$\log_{10}(\rho_1)$	Γ_1	$\log_{10}(\rho_2)$	Γ_2	$\log_{10}(\rho_3)$	Γ_3	$\log_{10}(\rho_4)$	Γ_4	$\log_{10}(\rho_5)$	Γ_5	$\log_{10}(\rho_6)$	Γ_6
(Nucleonic) Skyrme EOS														
DH	12.7007	1.6021	7.0898	1.3030	11.5622	0.6165	12.4163	1.3397	14.0053	2.1052	14.2804	3.0053	14.9602	2.8605
Nucleonic RMF EOS														
NL3	12.4945	1.6355	6.9470	1.3103	11.4119	0.6234	12.3397	0.9161	13.5283	2.8788	14.5470	3.4771	14.8390	2.5896
H3	12.7365	1.5950	7.1558	1.3021	11.5194	0.4741	12.2298	0.9455	13.7026	3.2473	14.3214	2.9180	14.6654	1.9421
H4	12.7332	1.5958	7.1362	1.3035	11.5018	0.4987	12.2443	0.9454	13.7026	3.2456	14.3267	2.9158	14.7047	2.1990

	M_{\max}	Δ	$n_{M_{\max}}$	Δ	$R_{1.0}$	Δ	$R_{1.4}$	Δ	$R_{M_{\max}}$	Δ	$I_{1.338}$	Δ	$I_{M_{\max}}$	Δ	$L_{1.4}$	Δ	$L_{M_{\max}}$	Δ
(Nucleonic) Skyrme EOS																		
DH	2.049	-0.04	1.207	0.00	11.90	-0.06	11.73	-0.03	9.99	-0.12	1.287	-0.08	1.904	-0.25	304.98	-0.20	4.64	-1.01
Nucleonic RMF EoS																		
H3	1.787	-0.54	0.993	-0.28	13.66	-0.04	13.61	0.04	11.75	-0.76	1.707	-0.03	1.839	-2.39	852.60	0.07	47.43	-3.58
H4	2.032	-0.38	0.964	-0.00	13.66	-0.06	13.72	-0.08	11.71	-0.53	1.730	-0.27	2.268	-1.57	920.95	-0.94	18.32	-2.48
NL3	2.773	-0.16	0.669	0.00	14.52	-0.32	14.61	-0.18	13.29	-0.23	1.898	-0.16	4.744	-0.57	1297.27	-0.48	4.71	-0.80