PT(GRDF2-DD2) cold NS unified crust/core EoS

EoS Submission Details

EoS name	PT(GRDF2-DD2) cold NS unified crust/core EoS
category	hadronic
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Abstract

This unified hadronic EoS table for neutron star matter (charge neutral and in β equilibrium) is calculated with a generalized relativistic density functional (GRDF2) based on a relativistic mean-field model of nuclear matter with density dependent nucleon-meson couplings using the functional dependence introduced in [4.] and the parametrization DD2 [1.]. The dissolution of nuclei is described with medium-dependent mass shifts as defined in [3.]. Phase transitions, e.g., between lattices of different nuclei in the crust or the crust-core transition, are taken into account with Maxwell constructions. See [1.,2.,3.,5.] for details of the EoS model. Besides nucleons, electrons and muons with experimental masses, photons and nuclei are included as degrees of freedom. Masses of nuclei are taken from the 2016 Atomic mass evaluation [6.] if available. For other nuclei the predictions of the DZ31 model [7.] are used.

References to the original work

1. S. Typel, G. Röpke, T. Kläahn, D. Blaschke, and H. H. Wolter,
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   doi:10.1103/PhysRevC.81.015803

2. S. Typel,
   J. Phys. G 45 (2018) 11400.
   doi:10.1088/1361-6471/aadea5

3. H. Pais and S. Typel,
   Comparison of equation of state models with different cluster dissolution mechanisms, in Nuclear Particle Correlations and Cluster Physics, edited by W. U. Schröder (World Scientific, Singapore) 2017, pp. 95-132.
   doi:10.1142/9789813209350 0004

Further References

4. S. Typel and H. H. Wolter,
   Nucl. Phys. A 656 (1999) 331.
   doi:10.1016/S0375-9474(99)00310-3

5. S. Typel S., H. H. Wolter, G. Röpke, and D. Blaschke,
   Eur. Phys. J. A 50 (2014) 17.
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6. Wang Meng, G. Audi, F. G. Kondev, W. J. Huang , S. Naimi and Xu Xing,
   Chinese Physics C 41 (2017) 030003.
   doi:10.1088/1674-1137/41/3/030003

7. J. Duflo and A. P. Zuker,
   Phys. Rev. C 52 (1995) R23.
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Nuclear Matter Properties

	Quantity	Unit	
n_S	saturation density in symmetric matter	fm^{-3}	0.149065
E_0	binding energy per baryon at saturation	MeV	16.02
K	incompressibility	MeV	242.72
K'	skewness	MeV	168.65
J	symmetry energy	MeV	32.67
L	symmetry energy slope parameter	MeV	55.04
K_{sym}	symmetry incompressibility	MeV	-93.23

Neutron Star Properties

	Quantity	Unit	
M_{max}	maximum mass	M$_{sun}$	2.42
$M_{DU,e}$	mass at DUrca threshold (1/9) with μ^-	M$_{sun}$	1.95
$R_{M_{max}}$	radius at maximum NS mass	km	11.87
$R_{1.4}$	radius at 1.4 M$_{sun}$ NS mass	km	13.17
$\tilde{\Lambda}$	tidal deformability for GW170817 at a mass ratio of $q = 0.8$		789

eos.thermo

eos.thermo and the three grid defining files are CompOSE standard data files and by definition available.

No additional quantities are defined in eos.thermo.

table dimension	3
table type	1
total number of grid points	1035

Range and density (#) of the grid parameters:

	Quantity	Unit	min	max	#
T	Temperature	MeV	0	0	1
n_b	Baryon Nr Density	fm^{-3}	10^{-10}	1.000	1035
Y_q	Charge Fraction		0.01	0.80	80

T, n_b, and Y_q are stored in eos.t, eos.nb, and eos.yq, respectively.

Further Available Data Files

Files and quantities listed in the following are provided beyond CompOSE's core requirements as outlined in Sec.4.2. of the CompOSE manual.

eos.compo : available

index	particle
0	e^-
1	μ^-
10	n
11	p
	- end of table -

The tabulated particle number fractions of nucleons and leptons are net quantities, i.e., they are given by the difference of the corresponding particle and anti-particle fractions. A further particle set is defined. One set of quadruples gives the properties of a average heavy nucleus.

index	particle
0	set of all nuclei
	- end of table -