PCSB0

EoS Submission Details

EoS name	PCSB0
category	Hadronic
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Abstract

Equation of state for cold neutron star matter in $\beta-$equilibrium containing nucleons, electrons, and muons derived using the relativistic mean field approximation. The description of the Lagrangian density and the EoS model can be found in [1,2]. The EoS model 'PCSB0' results after switching off the vector self-interaction in the RMF Langrangian density given in [1,2] (i.e, setting $\zeta = 0$, see therein). For the crust, we have attached the crust from [3] below a baryon density $(n_b) < 0.0697$ fm^{-3} such that the EoS satisfies the required conditions for thermodynamic stability. The composition data is available for the core EoS only.

References to the original work

1. B. K. Pradhan, D. Chatterjee, R. Gandhi, J. Schaffner-Bielich. Role of vector self interaction in Neutron Star properties. arXiv:2209.12657, September 2022.

2. N. Hornick, L. Tolos, A. Zacchi, J.-E. Christian, and J. Schaffner-Bielich. Relativistic parameterizations of neutron matter and implications for neutron stars. Phys. Rev. C, 98:065804, Dec 2018.

3. M. Hempel and J. Schaffner-Bielich. A statistical model for a complete supernova equation of state. Nuclear Physics A, 837(3):210-254, 2010. ISSN 0375-9474.

Nuclear Matter Properties[1]

	Quantity	Unit	
n_S	saturation density in symmetric matter	fm^{-3}	0.150
E_0	binding energy per baryon at saturation	MeV	-16.0
K	incompressibility	MeV	240
K'	skewness	MeV	0
J	symmetry energy	MeV	32
L	symmetry energy slope parameter	MeV	60
K_{sym}	symmetry incompressibility	MeV	0
U_Λ	Λ-potential at saturation	MeV	0
U_Σ	Σ-potential at saturation	MeV	0
U_Ξ	Ξ-potential at saturation	MeV	0

Neutron Star Properties[1]

	Quantity	Unit	
M_{max}	maximum mass	M$_{sun}$	2.53
$M_{DU,e}$	mass at DUrca threshold (1/9) w/o μ^-	M$_{sun}$	0
$R_{M_{max}}$	radius at maximum NS mass	km	12.13
$R_{1.4}$	radius at 1.4 M$_{sun}$ NS mass	km	13.3
$\tilde{\Lambda}$	tidal deformability for GW170817 at a mass ratio of $q = 0.8$		808

eos.thermo

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

table dimension	1
table type	1
total number of grid points	2085

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[1]0-values indicate, that the corresponding data is not provided.

Range and density (#) of the grid parameters:

	Quantity	Unit	min	max	#
T	Temperature	MeV	0	0	1
n_b	Baryon Nr Density	fm^{-3}	8.93×10^{-11}	1.79	2085
Y_q	Charge Fraction		0	0	1

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 -

eos.micro: Not Available

eos.mr: Available

- table dimension: 707 x 4

- total number of lines: 707

- the 4 columns contain stellar radii (in km), stellar masses (in units of solar mass), quadrupolar dimensionless tidal deformability, and central density (fm^{-3}) of a family of stars.

Description of Phases:

The transitions in the crust and from the core to the crust are treated by simple matching of the different EoS at a given density.

1. The first phase presents the crust ($n_b < 0.0697$ fm^{-3})

2. Homogeneous core with nucleons and leptons.