FYSS EoS with full nuclear distribution and realistic nuclear forces

EoS Submission Details

EoS name	FYSS EoS with full nuclear distribution and realistic nuclear forces
category	nuclear
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Abstract

In the present equation of state, nucleons are described within the variational approach of Ref. [1], combined with the quantum approach for d, t, h and α, as well as the liquid drop model for the other nuclei under the assumption of nuclear statistical equilibrium, see Refs. [2-5] for details. Temperature dependences of surface and shell energies of heavy nuclei have been taken into account as well as the possibility of pasta phases for heavy nuclei and the Pauli- and self-energy shifts for d, t, h and α. For the present version of the table contributions from leptons and photons have been added to the original one.

References to the original work

1. *Nuclear equation of state for core-collapse supernova simulations with realistic nuclear forces*, H. Togashi, K. Nakazato, Y. Takehara, S. Yamamuro, H. Suzuki and M. Takano, Nucl. Phys. A 961 (2017) 78, arXiv:1702.05324 [nucl-th]

2. S. Furusawa, H. Togashi, H. Nagakura, K. Sumiyoshi, S. Yamada, H. Suzuki & M. Takano, *A new equation of state for core-collapse supernovae based on realistic nuclear forces and including a full nuclear ensemble*, J. Phys. G 44, 9 (2017).

3. Shun Furusawa, Kohsuke Sumiyoshi, Shoichi Yamada & Hideyuki Suzuki: *Supernova equations of state including full nuclear ensemble with in-medium effects*, Nuclear Physics A 957, 188 (2017)

4. S. Furusawa, K. Sumiyoshi, S. Yamada, and H. Suzuki, Astrophys. J. 772, 95 (2013).

5. S. Furusawa, S. Yamada, K. Sumiyoshi, and H. Suzuki, Astrophys. J. 738, 178 (2011).

Nuclear Matter Properties[1]

	Quantity	Unit	
n_S	saturation density in symmetric matter	fm^{-3}	0.160
E_0	binding energy per baryon at saturation	MeV	16.09
K	incompressibility	MeV	245
K'	skewness	MeV	0
J	symmetry energy	MeV	30.
L	symmetry energy slope parameter	MeV	35.0
K_{sym}	symmetry incompressibility	MeV	0

Neutron Star Properties[1]

	Quantity	Unit	
M_{max}	maximum mass	$\mathrm{M_{sun}}$	2.25
$M_{DU,e}$	mass at DUrca threshold (1/9) w/o μ^-	$\mathrm{M_{sun}}$	0
$R_{M_{max}}$	radius at maximum NS mass	km	10.3
$R_{1.4}$	radius at 1.4 $\mathrm{M_{sun}}$ NS mass	km	11.5

eos.thermo

eos.thermo and the three grid defining files are CompOSE standard data files and by definition available. eos.thermo does <u>not</u> necessarily provide all possible data.

table dimension	3
table type	1
total number of grid points	650650

Range and density (#) of the grid parameters:

	Quantity	Unit	min	max	#
T	Temperature	MeV	0.1	398.1072	91
n_b	Baryon Nr Density	fm^{-3}	7.58E-11	6.02	110
Y_q	Charge Fraction		0.01	0.65	65

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

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

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
10	n
11	p
2001	^{2}H
3001	^{3}H
3002	^{3}He
4002	α-particle
	- end of table -

further particle sets are defined as quadrupels representing an average heavy nucleus ($Z > 5$) and average light nuclei ($Z < 6$).

index	description
1	Average mass number, proton number and fraction for heavy nuclei ($Z > 5$)
2	Average mass number, proton number and fraction for light nuclei ($Z < 6$)
	- end of table -