Hempel–Schaffner-Bielich/TMA

EoS Submission Details

EoS name	Hempel–Schaffner-Bielich/TMA
category	hadronic
submitted by	Matthias Hempel
affiliation	Universität Basel
e-mail contact	matthias.hempel(at)unibas.ch
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Abstract

This hadronic EOS table is calculated with the statistical model with excluded volume and interactions of Hempel and Schaffner-Bielich (HS) [1] with RMF interactions TMA [2]. Contributions of neutrons, anti-neutrons, protons, anti-protons, and nuclei are included. For the masses of nuclei, the table of Geng et al. [3] was used. The details of the underlying EOS model can be found in Ref. [1]. The manual from the web page

`http://phys-merger.physik.unibas.ch/~hempel/eos.html`

gives further information about the EOS table. On this web page, also routines are available which allow to determine the abundances of all nuclei for all conditions. Applications of HS EOS for various different RMF interactions in supernova simulations can be found in Refs. [4,5].

References to the original work

1. M. Hempel and J. Schaffner-Bielich, Nucl. Phys. A **837** (2010) 210.

2. H. Toki, D. Hirata, Y. Sugahara, K. Sumiyoshi, and I. Tanihata, Nucl. Phys. **A** 588 (1995) 357.

3. L. Geng, H. Toki, and J. Meng, Prog. Theor. Phys. **113** (2005) 785.

Further References

4. M. Hempel, T. Fischer, J. Schaffner-Bielich, and M. Liebendörfer, Astrophys. J. **748** (2012) 70.

5. A.W. Steiner, M. Hempel, and T. Fischer (2012), arXiv:1207.2184.

Nuclear Matter Properties[1]

	Quantity	Unit	
n_S	saturation density in symmetric matter	fm^{-3}	0.1472
E_0	binding energy per baryon at saturation	MeV	16.03
K	incompressibility	MeV	318.2
K'	skewness	MeV	-572.2
J	symmetry energy	MeV	30.66
L	symmetry energy slope parameter	MeV	90.14
K_{sym}	symmetry incompressibility	MeV	10.7

Neutron Star Properties[1]

	Quantity	Unit	
M_{max}	maximum mass	$\mathrm{M_{sun}}$	2.02
$M_{DU,e}$	mass at DUrca threshold (1/9) w/o μ^-	$\mathrm{M_{sun}}$	1.2
$R_{M_{max}}$	radius at maximum NS mass	km	12.10
$R_{1.4}$	radius at 1.4 $\mathrm{M_{sun}}$ NS mass	km	13.8

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

eos.thermo

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

table dimension	3
table type	1
total number of grid points	1584360

Range and density (#) of the grid parameters:

	Quantity	Unit	min	max	#
T	Temperature	MeV	0.10000000E+00	0.15848932E+03	81
n_b	Baryon Nr Density	fm^{-3}	0.10000000E-11	0.10000000E+02	326
Y_q	Charge Fraction		0.10000000E-01	0.60000000E+00	60

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

additional quantities in eos.thermo

none defined

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
4002	$^{2}_{4}$He
11	p
3002	$^{2}_{3}$He
3001	$^{1}_{3}$H
2001	$^{1}_{2}$H
	- end of table -

The listed particle number fractions of protons and neutrons are net fractions, i.e., they are given by the difference between the corresponding particle and anti-particle number density.

Further particle sets are defined. One set of quadruples for an average "heavy" nucleus, see Table 7.2 of the manual.

index	description
999	group of all other considered nuclei which are not listed above (averaged)
	- end of table -

eos.micro : available

index	quantity	particle
10041	Dirac effective mass divided by particle mass m_i^D/m_i	n
11041	Dirac effective mass divided by particle mass m_i^D/m_i	p
	- end of table -	

Description of Phases

Fill this part briefly, in particular if several phases occur. In this latter case characterize the transition(s).

PHASE INDEX #1:

NSE phase, i.e., a mixture of nuclei and nucleons

PHASE INDEX #3:

pure RMF, i.e., only nucleons

PHASE INDEX #2:

Maxwell transition region between phase 1 and 3, assuming local charge neutrality and locally fixed Y_e.