

# Hempel–Schaffner-Bielich/TMA

## EoS Submission Details

EoS name	Hempel–Schaffner-Bielich/TMA
category	hadronic
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## Abstract

This is the zero electron fraction EOS table with RMF interactions TMA [1]. Contributions of neutrons, anti-neutrons, protons, and anti-protons are included, whereas the net abundance of protons is always zero. The details of the underlying EOS model at finite  $Y_e$  can be found in Ref. [2]. The manual from the web page

<http://phys-merger.physik.unibas.ch/~hempel/eos.html>  
gives further information about the table. Applications of HS EOS for various different RMF interactions in supernova simulations can be found in Refs. [3,4].

### References to the original work

1. H. Toki, D. Hirata, Y. Sugahara, K. Sumiyoshi, and I. Tanihata, Nucl. Phys. **A** 588 (1995) 357.
2. M. Hempel and J. Schaffner-Bielich, Nucl. Phys. A **837** (2010) 210.

### Further References

3. M. Hempel, T. Fischer, J. Schaffner-Bielich, and M. Liebendörfer, Astrophys. J. **748** (2012) 70.
4. A.W. Steiner, M. Hempel, and T. Fischer (2012), arXiv:1207.2184.

## Nuclear Matter Properties<sup>1</sup>

	Quantity	Unit	
$n_S$	saturation density in symmetric matter	$\text{fm}^{-3}$	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<sup>1</sup>

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

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<sup>1</sup>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                    2  
table type                         4  
total number of grid points    26406

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	$\text{fm}^{-3}$	0.10000000E-11	0.10000000E+02	326
$Y_q$	Charge Fraction		0.00000000E+00	0.00000000E+00	1

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
	- end of table -

The listed particle number fraction of neutrons is the net fraction, i.e., it is given by the difference between the neutron and anti-neutron number density. The net particle number fraction of protons is always zero, and therefore it is not listed. Further particle sets are not defined.

**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 #3:**

pure RMF, i.e., only nucleons