# Hempel–Schaffner-Bielich/TMA

## EoS Submission Details

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

This is the zero electron faction EOS table with RMF interactions TMA [1]. Contributions of neutrons, anti-neutrons, protons, anti-protons, electrons, positrons, and photons are included, whereas the net abundances of electrons and protons are 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[1]

|  | 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[1]

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

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[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 <u>not</u> 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 | 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 fractions of electrons and protons are always zero, and therefore they are 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