

# Hempel–Schaffner-Bielich/NL3

## EoS Submission Details

|                     |                              |
|---------------------|------------------------------|
| EoS name            | Hempel–Schaffner-Bielich/NL3 |
| category            | hadronic                     |
| submitted by        | Matthias Hempel              |
| affiliation         | Universität Basel            |
| e-mail contact      | matthias.hempel(at)unibas.ch |
| sheet creation date | July 10, 2013                |

## Abstract

This is the zero electron fraction EOS table with RMF interactions NL3 [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], where the TMA interactions were used. 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. G.A. Lalazissis, J. König, and P. Ring, Phys. Rev. C **55** (1997) 540.
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  | $\text{fm}^{-3}$ | 0.1482 |
| $E_0$     | binding energy per baryon at saturation | MeV              | 16.24  |
| $K$       | incompressibility                       | MeV              | 271.5  |
| $K'$      | skewness                                | MeV              | 202.6  |
| $J$       | symmetry energy                         | MeV              | 37.39  |
| $L$       | symmetry energy slope parameter         | MeV              | 118.49 |
| $K_{sym}$ | symmetry incompressibility              | MeV              | 100.8  |

## Neutron Star Properties<sup>1</sup>

|               | Quantity                                  | Unit             |       |
|---------------|---|------------------|-------|
| $M_{max}$     | maximum mass                              | $M_{\text{sun}}$ | 2.79  |
| $M_{DU,e}$    | mass at DUrca threshold (1/9) w/o $\mu^-$ | $M_{\text{sun}}$ | 0.9   |
| $R_{M_{max}}$ | radius at maximum NS mass                 | km               | 13.40 |
| $R_{1.4}$     | radius at 1.4 $M_{\text{sun}}$ NS mass    | km               | 14.8  |

---

<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 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