

Hempel–Schaffner-Bielich/SFHo

EoS Submission Details

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

This is the SFHo EOS table [1] which is based on the statistical model with excluded volume and interactions of Hempel and Schaffner-Bielich (HS) [2] with RMF interactions SFHo [1]. Contributions of neutrons, anti-neutrons, protons, anti-protons, electrons, positrons, photons, and nuclei are included. For the masses of nuclei, FRDM [3] was used. The details of the underlying EOS model 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 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. [2,4].

References to the original work

1. M. Hempel and J. Schaffner-Bielich, Nucl. Phys. A 837 (2010) 210.
2. A.W. Steiner, M. Hempel, and T. Fischer, Astrophys.J. 774 (2013) 17.
3. P. Möller, J.R. Nix, and K.-L. Kratz, Atomic Data and Nuclear Data Tables 66 (1997) 131.

Further References

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

Updated parameter values for the SFHo interaction

Please refer to Ref. [2] for the notations. Values as communicated by M. Hempel.

| Quantity | Unit | |
|------------|------------------|--------------------------------|
| c_σ | fm | 3.1791606374 |
| c_ω | fm | 2.2752188529 |
| c_ρ | fm | 2.4062374629 |
| b | | $7.3536466626 \times 10^{-3}$ |
| c | | $-3.8202821956 \times 10^{-3}$ |
| ζ | | $-1.6155896062 \times 10^{-3}$ |
| ξ | | $4.1286242877 \times 10^{-3}$ |
| a_1 | fm ⁻¹ | $-1.9308602647 \times 10^{-1}$ |
| a_2 | | $5.6150318121 \times 10^{-1}$ |
| a_3 | fm | $2.8617603774 \times 10^{-1}$ |
| a_4 | fm ² | 2.7717729776 |
| a_5 | fm ³ | 1.2307286924 |
| a_6 | fm ⁴ | $6.1480060734 \times 10^{-1}$ |
| b_1 | | 5.5118461115 |
| b_2 | fm ² | -1.8007283681 |
| b_3 | fm ⁴ | 4.2610479708×10^2 |
| m_σ | fm ⁻¹ | 2.3689528914 |
| m_ω | fm ⁻¹ | 3.9655047020 |
| m_ρ | fm ⁻¹ | 3.8666788766 |

Nuclear Matter Properties¹

| | Quantity | Unit | |
|-----------|---|------------------|--------|
| n_S | saturation density in symmetric matter | fm ⁻³ | 0.1583 |
| E_0 | binding energy per baryon at saturation | MeV | 16.19 |
| K | incompressibility | MeV | 245.4 |
| K' | skewness | MeV | -467.8 |
| J | symmetry energy | MeV | 31.57 |
| L | symmetry energy slope parameter | MeV | 47.10 |
| K_{sym} | symmetry incompressibility | MeV | -205.4 |

Neutron Star Properties¹

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.

¹0-values indicate, that the corresponding data is not provided.

| | Quantity | Unit |
|---------------|---|----------------|
| M_{max} | maximum mass | M_{sun} 2.06 |
| $M_{DU,e}$ | mass at DUrca threshold (1/9) w/o μ^- | M_{sun} 0 |
| $R_{M_{max}}$ | radius at maximum NS mass | km 10.3 |
| $R_{1.4}$ | radius at 1.4 M_{sun} NS mass | km 11.9 |

table dimension 3
table type 1
total number of grid points 1496880

Range and density (#) of the grid parameters:

| | Quantity | Unit | min | max | # |
|-------|-------------------|------------------|----------------|----------------|-----|
| T | Temperature | MeV | 0.1E+00 | 0.15848932E+03 | 81 |
| n_b | Baryon Nr Density | fm^{-3} | 0.1E-11 | 0.19054607E+01 | 308 |
| 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.

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 |
|-------|-------------------|
| 0 | e^- |
| 10 | n |
| 11 | p |
| 4002 | ${}^2_4\text{He}$ |
| 3002 | ${}^2_3\text{He}$ |
| 3001 | ${}^1_3\text{H}$ |
| 2001 | ${}^1_2\text{H}$ |
| | - end of table - |

The listed particle number fractions are net fractions, i.e., they are given by the difference between the corresponding particle and anti-particle fractions. Further particle sets are defined.

| index | description |
|-------|--|
| 999 | Average fraction, mass and proton number for all nuclei not listed above |
| | - 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 |
| 10051 | relativistic vector self-energy V_i | n |
| 11051 | relativistic vector self-energy V_i | p |
| | - end of table - | |