

# SPG(M5)

## EoS Submission Details

|                     |                              |
|---------------------|------------------------------|
| EoS name            | SPG(M5)                      |
| category            | Inner crust-core unified EoS |
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## Abstract

This inner crust-core unified EoS for  $\beta$ -equilibrium matter at zero temperature is constructed with a BSk22 outer crust [1] below  $n_B = 2 \times 10^{-3} \text{ fm}^{-3}$ , an inner crust EoS calculated within a Compressible Liquid Drop approach [2], and a homogeneous  $npe\mu$  core EoS, above  $n_B = 0.71 \times 10^{-1} \text{ fm}^{-3}$ . The EoS parameterisation used was one of the density-dependent RMF models with the GDFM functional for the couplings [3] generated in a Bayesian analysis and that agrees with both astrophysical and nuclear constraints [4].

## References to the original work

1. J. M. Pearson, N. Chamel, A. Y. Potekhin, A. F. Fantina, C. Ducoin, A. K. Dutta, and S. Goriely, MNRAS 481, 2994 (2018); <https://compose.obspm.fr/eos/210> .
2. G. Baym, H. A. Bethe and C. J. Pethick, Nuclear Physics A 175, 225 (1971).
3. P. Gogelein, E. N. E. van Dalen, C. Fuchs and H. Muther, Phys. Rev. C 77, 025802 (2008).
4. L. Scurto, H. Pais and F. Gulminelli in preparation

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

|           | Quantity                                | Unit             |        |
|-----------|---|------------------|--------|
| $n_S$     | saturation density in symmetric matter  | $\text{fm}^{-3}$ | 0.148  |
| $E_0$     | binding energy per baryon at saturation | MeV              | -15.8  |
| $K$       | incompressibility                       | MeV              | 228    |
| $K'$      | skewness                                | MeV              | -45    |
| $J$       | symmetry energy                         | MeV              | 31.4   |
| $L$       | symmetry energy slope parameter         | MeV              | 52     |
| $K_{sym}$ | symmetry incompressibility              | MeV              | -113.5 |

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

|                   | Quantity  | Unit             |         |
|-------------------|---|------------------|---------|
| $M_{max}$         | maximum mass  | $M_{\text{sun}}$ | 2.71    |
| $M_{DU}$          | mass at DUrca threshold with $\mu^-$                          | $M_{\text{sun}}$ | 2.70    |
| $R_{M_{max}}$     | radius at maximum NS mass                                     | km               | 12.70   |
| $R_{1.4}$         | radius at 1.4 $M_{\text{sun}}$ NS mass                        | km               | 13.42   |
| $\tilde{\Lambda}$ | tidal deformability for GW170817 at a mass ratio of $q = 0.8$ | -                | 1317.74 |

## eos.thermo

eos.thermo and the three grid defining files are ComPOSE standard data files and by definition available.

```
table dimension      1
table type          1
total number of grid points 477
```

Range and density (#) of the grid parameters:

|       | Quantity          | Unit             | min                       | max      | #   |
|-------|-------------------|------------------|---------------------------|----------|-----|
| T     | Temperature       | MeV              | 0                         | 0        | 1   |
| $n_b$ | Baryon Nr Density | $\text{fm}^{-3}$ | $0.467962 \times 10^{-9}$ | 0.977237 | 477 |
| $Y_q$ | Charge Fraction   |                  | 0                         | 0        | 1   |

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

<sup>1</sup>0-values indicate that the corresponding data is not provided.

### 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.mr** : This file provides the radius (in km), the gravitational mass (in solar masses), the adimensional tidal deformability and the central baryonic density (in  $fm^{-3}$ ) of a family of stars computed for this unified inner-crust-core RMF EoS model, with the BsK22 outer crust.

**eos.compo** : available

4 particle pairs (neutrons, protons, electrons, muons) and one quadruple for heavy nucleus.

Phase index # 0: outer crust

Phase index # 7: inner crust

Phase index # 6: homogeneous matter

**eos.micro** : not available