

# SPG(M3)

## EoS Submission Details

EoS name	SPG(M3)
category	Inner crust-core unified EoS
submitted by	Luigi Scurto
affiliation	University of Coimbra
e-mail contact	lscurto@student.uc.pt
sheet creation date	February 26, 2024

## 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  $n_B = 0.79 \times 10^{-1} \text{ fm}^{-3}$ . 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	$\text{fm}^{-3}$	0.161
$E_0$	binding energy per baryon at saturation	MeV	-15.8
$K$	incompressibility	MeV	226
$K'$	skewness	MeV	283
$J$	symmetry energy	MeV	33.7
$L$	symmetry energy slope parameter	MeV	51
$K_{sym}$	symmetry incompressibility	MeV	-231.0

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

	Quantity	Unit	
$M_{max}$	maximum mass	$M_{\text{sun}}$	2.69
$M_{DU}$	mass at DUrca threshold with $\mu^-$	$M_{\text{sun}}$	2.25
$R_{M_{max}}$	radius at maximum NS mass	km	12.42
$R_{1.4}$	radius at 1.4 $M_{\text{sun}}$ NS mass	km	12.65
$\tilde{\Lambda}$	tidal deformability for GW170817 at a mass ratio of $q = 0.8$	-	890.49

## 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 475
```

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	475
$Y_q$	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