QMC-RMF1

EoS Submission Details

EoS name	QMC-RMF1
category	Hadrons and Leptons
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Abstract

An EoS in β-equilibrium at $T = 0$. The core is homogeneous n, p, e matter that begins above 0.07 fm^{-3}. It is computed using a relativistic mean-field theory constrained by chiral effective field theory calculations of pure neutron matter (from 0.08 fm^{-3} to 0.32 fm^{-3}) and by properties of isospin-symmetric nuclear matter around saturation density [1]. The outer crust is the Baym-Pethick-Sutherland (BPS) EoS and spans the density range 6.30×10^{-12} fm^{-3} to 2.57×10^{-4} fm^{-3} [2]. The inner crust is the GPPVA(TM1e) EoS, which models nuclear pasta phases calculated within a self-consistent Thomas-Fermi approach from 2.00×10^{-3} fm^{-3} to 6.24×10^{-2} fm^{-3} [3]. A first-order phase transition to the core is imposed at a baryon chemical potential of 952.22 MeV.

References to the original work

1. M. G. Alford, L. Brodie, A. Haber, and I. Tews, arXiv: 2205.10283.

2. G. Baym, C. Pethick, and P. Sutherland, Astrophys. J. **170**, 299 (1971).

3. F. Grill, H. Pais, C. Providência, I. Vidaña, and S. Avancini, Phys. Rev. C **90**, 045803 (2014).

Nuclear Matter Properties[1]

	Quantity	Unit	
n_S	saturation density in symmetric matter	fm^{-3}	0.160
E_0	binding energy per baryon at saturation	MeV	-16.1
K	incompressibility	MeV	260
K'	skewness	MeV	496
J	symmetry energy	MeV	32.9
L	symmetry energy slope parameter	MeV	44.5
K_{sym}	symmetry incompressibility	MeV	-191
U_Λ	Λ-potential at saturation	MeV	0
U_Σ	Σ-potential at saturation	MeV	0
U_Ξ	Ξ-potential at saturation	MeV	0

Neutron Star Properties[1]

	Quantity	Unit	
M_{max}	maximum mass	M_{sun}	1.95
$M_{DU,e}$	mass at DUrca threshold (1/9) w/o μ^-	M_{sun}	0
$R_{M_{max}}$	radius at maximum NS mass	km	10.24
$R_{1.4}$	radius at 1.4 M_{sun} NS mass	km	11.86
$\tilde{\Lambda}$	tidal deformability for GW170817 at a mass ratio of $q = 0.8$		373

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	301

[1] 0-values indicate, that the corresponding data is not provided.

Range and density (#) of the grid parameters:

	Quantity	Unit	min	max	#
T	Temperature	MeV	0	0	1
n_b	Baryon Nr Density	fm^{-3}	0.6295×10^{-11}	1.286	301
Y_q	Charge Fraction		0	0	1

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
	- end of table -

This file contains particle fractions, defined as the individual particle number density divided by the total baryon number density. The phase index '1' within the file indicates the inner and outer crust. Phase index '2' indicates the homogeneous n, p, e core.

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	vector self-energy V_i	n
11051	vector self-energy V_i	p
10052	scalar self-energy S_i	n
11052	scalar self-energy S_i	p
	- end of table -	

eos.mr : available

This file provides the gravitational mass (in solar masses) and the radius (in kilometers) for a family of neutron stars after solving the Tolman-Oppenheimer-Volkoff (TOV) equations using this EoS and different central pressures.