CLDM-NRMM-H5-FS4

EoS Submission Details

EoS name	GMSR(H5)
category	nucleonic/unified
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Abstract

This table corresponds to the unified EoS of cold catalyzed nuclear matter at β- equilibrium by G. Grams, J. Margueron, R. Somosundaram and S. Reddy [1]. The crust is model with a compressible liquid drop model (CLDM) with Coulomb, surface and curvature terms, the crust model is named finite size 4 (FS4). The considered effective interaction is given by the non-relativistic (NR) meta-model (MM) adjusted to reproduce the Chiral EFT Hamilatonian H5. The lowest order nuclear empirical parameters (E, L/n, K) are defined from a fit of symmetric matter (SM) and neutron matter (NM) to the original model, while the higher order ones (K', Z) are fixed to reach a $2M_\odot$ neutron star. See Ref. [1].

References to the original work

1. G. Grams, J. Margueron, R. Somasundaram and S. Reddy. Submitted to EPJA Special Issue on "CompOSE: a repository for Neutron Star Equations of State and Transport Properties" (2021)

Nuclear Matter Properties[1]

	Quantity	Unit	
n_S	saturation density in symmetric matter	fm^{-3}	0.159
E_0	binding energy per baryon at saturation	MeV	-13.9
K	incompressibility	MeV	207.0
K'	skewness	MeV	220.0
J	symmetry energy	MeV	29.4
L	symmetry energy slope parameter	MeV	40.2
K_{sym}	symmetry incompressibility	MeV	-128.0

Neutron Star Properties[1]

	Quantity	Unit	
M_{max}	maximum mass	M_{sun}	2.37
$M_{DU,e}$	mass at DUrca threshold (1/9) w/o μ^-	M_{sun}	0
$R_{M_{max}}$	radius at maximum NS mass	km	10.82
$R_{1.4}$	radius at 1.4 M_{sun} NS mass	km	12.24
$\tilde{\Lambda}$	tidal deformability for GW170817 at a mass ratio of $q = 1.0$		427

eos.thermo

eos.thermo and the three grid defining files are CompOSE standard data files and by definition available. We provide all standard quantities of eos.thermo in CompOSE, i.e., pressure, internal energy, baryon, charge and electron chemical potentials. We provide tree additional quantities: (i) the sound speed, (ii) the symmetry energy defined as the difference between pure neutron matter (NM) and symmetric matter (SM) $e_{sym} = e_{NM} - e_{SM}$ and (iii) the symmetry energy defined as the second derivative of the energy per particle with respect to the asymmetry $e_{sym,2} = (1/2)(\partial^2 e/\partial\delta^2)$ where $\delta = (n_n - n_p)/(n_n + n_p)$. The sound speed is computed in the crust and core consistently. The symmetry energies e_{sym} and $e_{sym,2}$ are computed at infinity nuclear matter. The purpose of the sound speed is to check causality, which is not guarantied in non-relativistic models while the purpose of the symmetry energy is to check a possible bending down to negative values at high densities ($> 4\ n_{\rm sat}$), a common feature of Skyrme models. When $e_{sym} < 0$ the electron fraction goes to zero. More details of quantities can be found in Ref. [1].

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

table dimension	1
table type	1
total number of grid points	385

Range and density (#) of the grid parameters:

	Quantity	Unit	min	max	#
T	Temperature	MeV	0	0	1
n_b	Baryon Nr Density	fm^{-3}	1.0×10^{-7}	1.0	number of grid points in density
Y_q	Charge Fraction		0.0271	0.459	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
10	n
11	p
0	e^-
1	μ^-
	- end of table -

One set of quadruple for an unique heavy nucleus. See section of 4.2.3 CompOSE manual.

Description of phases

PHASE INDEX #4: heavy nucleus present

PHASE INDEX #3: homogeneous matter