QHC21 C_χ

EoS Submission Details

EoS name	QHC21 C_χ
category	hybrid
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sheet creation date	December 18, 2021

Abstract

This table corresponds to the zero temperature and β-equilibrium unified EoS by Kojo et al. [1]. The EoS are divided into four distinct domains: the crust, nuclear liquid, hadron-quark crossover, and quark matter domains. For each domain we assign an equation of state as

Crust	Togashi [2]	$[10^{-9}n_0 \le n_B \le 0.5n_0]$
Nuclear liquid	N^3LO ChEFT [3]	$[0.5n_0 \le n_B \le 1.5n_0]$
Crossover	QHC21 C_χ [1]	$[1.5n_0 \le n_B \le 3.5n_0]$
Quark matter	QHC21 C_χ [1]	$[3.5n_0 \le n_B \le 10n_0]$

The quark matter EoS (including up-, down-, and strange-quarks) in the QHC21 was calculated using the NJL model within the mean field approximation. As variable parameters, we choose g_V and H which quantify the strength of the repulsive density-density interaction and the attractive paring-interaction between quarks, respectively. For QHC21C_χ, we consider $(g_V, H)/G = (1.20, 1.54)$ [C_χ] which are compatible with the hadron physics. The QHC21 satisfies the empirical constraints from neutron stars as well as the causality and thermodynamic consistency.

References to the original work

1. T. Kojo, G. Baym, and T. Hatsuda,
"*QHC21 equation of state of neutron star matter – in light of 2021 NICER data*,"
arXiv: 2111.11919, `https://arxiv.org/pdf/2111.11919.pdf`

2. H. Togashi, K. Nakazato, Y. Takehara, S. Yamamuro, H. Suzuki, and M. Takano,
"Nuclear equation of state for core-collapse supernova simulations with realistic nuclear forces," Nucl. Phys. A 961, 78 (2017),
`https://doi.org/10.1016/j.nuclphysa.2017.02.010`

3. C. Drischler, S. Han, J.M. Lattimer, M. Prakash, S. Reddy, and T. Zhao,
"Limiting masses and radii of neutron stars and their implications,"
Phys. Rev. C **103**, 045808, `https://doi.org/10.1103/PhysRevC.103.045808`

Nuclear Matter Properties[1]

	Quantity	Unit	
n_S	saturation density in symmetric matter	fm^{-3}	0.17
E_0	binding energy per baryon at saturation	MeV	14.3
K	incompressibility	MeV	260.0
K'	skewness	MeV	0
J	symmetry energy	MeV	31.7
L	symmetry energy slope parameter	MeV	59.8
K_{sym}	symmetry incompressibility	MeV	0
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}	2.31
$M_{DU,e}$	mass at DUrca threshold (1/9) w/o μ^-	M_{sun}	0
$R_{M_{max}}$	radius at maximum NS mass	km	11.4
$R_{1.4}$	radius at 1.4 M_{sun} NS mass	km	12.4
$\tilde{\Lambda}$	tidal deformability for GW170817 at a mass ratio of $q = 0.8$		0

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	795

[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}	7.59E-011	1.35	795
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 : not available

index	particle
0	e
	- end of table -