

# DD2F-SF quark-hadron model RDF 1.1 without leptons

## EoS Submission Details

EoS name	DD2F-SF quark-hadron model RDF 1.1 without leptons
category	hybrid
submitted by	Niels-Uwe Friedrich Bastian
affiliation	University of Wroclaw
e-mail contact	niels-uwe.bastian(at)uwr.edu.pl
sheet creation date	March 15, 2021

## Abstract

RDF 1.1 is from a set of equation of state models with a first-order phase transition from hadron to quark matter presented in Ref. [1]. This publication focuses on the super-saturated regime and for the treatment of nuclear clusters below saturation on the nuclear statistical equilibrium with excluded volume approach of Hempel and Schaffner-Bielich [2]. The relativistic density function approach, which is used for the high density regime and in particular the string-flip model for quarks was introduced in Ref. [3] with applications to neutron star configurations. The current extension of this model to finite temperature and arbitrary chargefractions was successfully applied to core-collapse supernova simulations [4] and binary neutron star merger simulations [5-7].

On the website of the author<sup>1</sup> you will find further information about the provided data, and the data in different formats. Please feel free to contact the author, if you run into problems with these tabulations.

---

<sup>1</sup><https://eos.bastian.science>

### References to the original work

1. N.-U. F. Bastian, Phys. Rev. D 103.2, p. 023001 (2021).  
doi: 10.1103/PhysRevD.103.023001.
2. M. Hempel and J. Schaffner-Bielich, Nucl. Phys. A 837 (2010) 210.  
doi: 10.1016/j.nuclphysa.2010.02.010

### Further References

3. M. A. R. Kaltenborn, N.-U. F. Bastian, and D. B. Blaschke, Phys. Rev. D 96, 056024.  
doi: 10.1103/PhysRevD.96.056024.
4. T. Fischer, N.-U. F. Bastian, M.-R. Wu, P. Baklanov, E. Sorokina, S. Blinnikov, S. Typel, T. Klähn, D. B. Blaschke, Nature Astronomy 2, 980–986 (2018),  
doi: 10.1038/s41550-018-0583-0
5. Andreas Bauswein, Niels-Uwe F. Bastian, David B. Blaschke, Katerina Chatziioannou, James A. Clark, Tobias Fischer, and Micaela Oertel, Phys. Rev. Lett. 122, 061102 (2019),  
doi: 10.1103/PhysRevLett.122.061102
6. Andreas Bauswein, Sebastian Blacker, Vimal Vijayan, Nikolaos Stergioulas, Katerina Chatziioannou, James A. Clark, Niels-Uwe F. Bastian, David B. Blaschke, Mateusz Cierniak, and Tobias Fischer, Phys. Rev. Lett. 125, 141103 (2020),  
doi: 10.1103/PhysRevLett.125.141103
7. Sebastian Blacker, Niels-Uwe F. Bastian, Andreas Bauswein, David B. Blaschke, Tobias Fischer, Micaela Oertel, Theodoros Soutanis, and Stefan Typel, Phys. Rev. D 102, 123023 (2020),  
doi: 10.1103/PhysRevD.102.123023

## Nuclear Matter Properties<sup>2</sup>

	Quantity	Unit	
$n_S$	saturation density in symmetric matter	$\text{fm}^{-3}$	0.149
$E_0$	binding energy per baryon at saturation	MeV	16.02
$K$	incompressibility	MeV	242.7
$K'$	skewness	MeV	168.8
$J$	symmetry energy	MeV	31.67
$L$	symmetry energy slope parameter	MeV	55.04
$K_{sym}$	symmetry incompressibility	MeV	-93.23

## Neutron Star Properties<sup>2</sup>

	Quantity	Unit	
$M_{max}$	maximum mass	$M_{sun}$	2.13
$M_{DU,e}$	mass at DUrca threshold (1/9) w/o $\mu^-$	$M_{sun}$	N/A
$R_{M_{max}}$	radius at maximum NS mass	km	N/A
$R_{1.4}$	radius at 1.4 $M_{sun}$ NS mass	km	N/A

## eos.thermo

eos.thermo and the three grid defining files are ComPOSE standard data files and by definition available. eos.thermo does not necessarily provide all possible data.

```
table dimension          3
table type              1
total number of grid points 1142100
```

Range and density (#) of the grid parameters:

	Quantity	Unit	min	max	#
T	Temperature	MeV	0.1E+00	0.15848932E+03	81
$n_b$	Baryon Nr Density	$\text{fm}^{-3}$	0.1E-11	0.1E+02	235
$Y_q$	Charge Fraction		0.10000000E-01	0.60000000E+00	60

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

<sup>2</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.compo** : available

index	particle
10	n
11	p
4002	${}^2_4\text{He}$
3002	${}^2_3\text{He}$
3001	${}^1_3\text{H}$
2001	${}^1_2\text{H}$
500	u
501	d
	- end of table -

The listed particle number fractions are net fractions, i.e., they are given by the difference between the corresponding particle and anti-particle fractions. Further particle sets are defined.

index	description
999	Average fraction, mass and proton number for all nuclei not listed above
	- end of table -

**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
500041	Dirac effective mass divided by particle mass $m_i^D/m_i$	u
501041	Dirac effective mass divided by particle mass $m_i^D/m_i$	d
10051	relativistic vector self-energy $V_i$	n
11051	relativistic vector self-energy $V_i$	p
500051	relativistic vector self-energy $V_i$	u
501051	relativistic vector self-energy $V_i$	d
	- end of table -	