

# CompOSE2021

## **PHAROS WG1+WG2 workshop Neutron star equation of state and transport properties**

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**Thank you to all speakers and all discussion leaders  
for their contributions!!**

Uploaded talks are available under  
the name of the contributor

Several **ideas and tasks** have been proposed

## Why CompOSE?

- what do I gain?
  - will be my paper more cited?
  - what credit will I get?
  - questions from users: EoS equally good? consistent with current knowledge? uncertainty bands fit chiral EFT? how can I know if the EoS fits my needs?
  - how to quote/reference CompOSE repository?
  - how to quote paper of the EoS model?
- contributors to provide only 1 reference (often not possible), export citation in BibTeX format, standard/conventional name for EoS,...

## To improve CompOSE:

- need of human(man/woman) power to improve CompOSE
- need to define a list of tasks in CompOSE so researchers can join
- need to determine the priority and the list of tasks
- need at least one researcher from simulations to join the core team of CompOSE
- set up SLAC+GitHub channel to communicate with the community, one has been set up in PHAROS
- hands-on session next PHAROS school (planned at the Karpacz school)
- video on how to use CompOSE (Adriana Raduta?)

## Physics needs:

- need of a large set of EoS with consistent temperature dependence
- need of consistent of EoS and transport properties
- need good physics for hybrid EoS with deconfinement and color superconductivity
- comparison between different EoS models
- making an informed choice (overview of various nuclear EoS..)
- EoS: systematic change of nuclear matter parameters that cover the experimental predictions
- EoS: ab-initio calculations (important to constrain metamodels, phenomenological EoS)
- curated tables in a wide range of densities, temperatures, electron fractions.
- consistent zero temperature neutrino-less beta equilibrium
- different elements in NSE: consistent electron/photon EoS, pointed to networks..
- consistent reaction rates for coupling to neutrinos, superfluid pairing gaps...
- constraints on finite temperature EoS: liquid-gas phase transition
- $Y_Q$ ,  $Y_I$ ,  $Y_S$  needed at finite temperature

## Physics needs:

- magnetic fields on EoS only if strong (problems with large tables), more important effects on the transport properties
- provide EoS for heavy-ion collisions?
- beyond EoS: gaps, viscosity parameters, transport coefficients, neutrino emissivities, entrainment..
- transport coefficients: there are subroutines for practical use (A.Y. Potekhin, [www.ioffe.ru/astro/conduct/index.html](http://www.ioffe.ru/astro/conduct/index.html)) and practical expressions (Harutyunyan & Sedrakian 2016). Mirror in CompOSE?
- transport on phases beyond nuclear phase? not so much information
- consistency of EoS and transport properties
- to compute transport properties: need of more parameters to compute them, such as effective masses, Landau parameters
- need of EoS/composition for high- $\rho$ /high- $T$  for GWs and much lower- $\rho$ /lower- $T$  for EM
- some old EoS and ab-initio EoS are missing

## Format:

- extended CompOSE manual/quick guide on CompOSE
- include new categories: unified EoS
- include uncertainty band, code to introduce that band?
- get universal relations
- ensure quality (isolated faulty points, violation of causality,..)
- users to gain more control over the parameters of the EoS (difficult since parameters might be linked)
- introduce filters in searching for EoS (example, ATNF pulsar, <https://www.atnf.csiro.au/research/pulsar/psrcat/>)
- additional information on the models (minimal list of mandated quantities, domain of validity, main assumptions, indicate if EoS is obsolete or state-of-the-art?) and have feedback from users to developers
- scores of usage of different EoS? Nuclear & GW-constraints (providers score), download count (users score)→refine/improve the ones which are more used.  
Add moderation

## Format:

- a table not the best thing: parametrizations, spectral representation, alternative interpolations (non-uniform grids, more sophisticated interpolations to detect discontinuities..)
- .nb files mixed with mathematica files
- remove  $1/n_B$  from tables: problematic for lattice data, heavy-ion collisions at  $n_B=0$
- add transport section: collections of subroutines/references to relevant subroutines
- have a common framework to compute transport properties (high densities problematic), additional transport part of CompOSE with a collection of existing results in form of codes, formulae, using as input the (extended) EoS data?
- connection with numerical codes: status in Einstein toolkit? Whisky?
- provide online tools to superimpose on the mass-radius curve further observational information/constraints from nuclear physics
- feedback from simulation community: add information from large simulations
- other programming languages (python..)



## Web site:

- list of parameters/constraints
- search function on EoS name
- wiki: add feedback of users

## Set up of Working Teams for CompOSE tasks

- **CompOSE core team for coordination:**

Micaela Oertel, Stefan Typel + somebody performing simulations

- **CompOSE editor team for manual revision:**

CompOSE core team + ???

- **CompOSE code development team:**

CompOSE core team + ???

- **CompOSE web development team:**

CompOSE core team, Marco Mancini, Mathieu Servillat + ???

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After the meeting **we will send an email to all participants to get volunteers for the specific tasks with a clear explanation**

In particular, we encourage **to apply for a STSM** to work on CompOSE. Discussing the possibility of a **focused CompOSE meeting after Karpacz school (June2021)?**

Feel free to distribute this email to anybody interested in working on CompOSE

The more, the better!

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## **Special Issue** on

The European Physical Journal A (Hadrons and Nuclei)

- Reviews or original works, with (some) focus on CompOSE
- All invited/contributed speakers/discussion leaders of this meeting are welcome to submit a contribution
- Instructions will follow next week

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**Keep tuned!!**