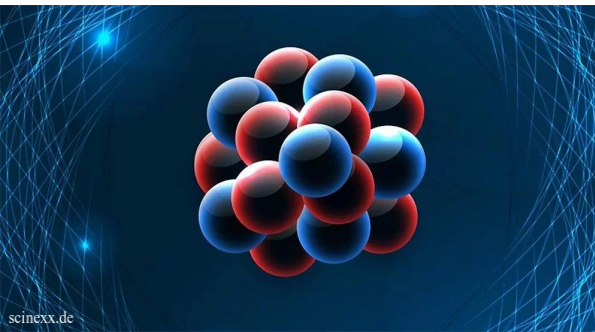


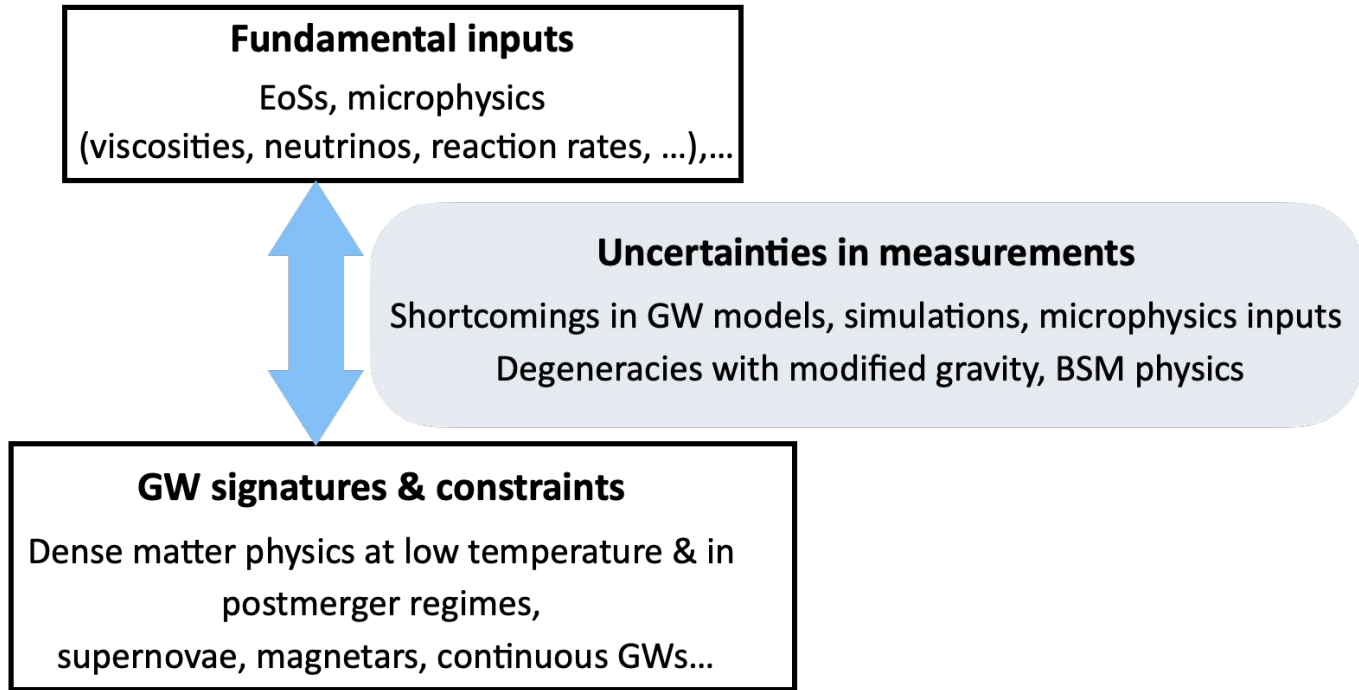
Nuclear Physics

-- Division 6 --

chairs: Tim Dietrich, Tanja Hinderer, Micaela Oertel



Overview of division activities



- Brings together ~ 100 division members from [different fields](#) (subatomic physics, numerical relativity, analytical modeling, data analysis,...)

Overview of division activities

- Contribution to **Blue book** with a dedicated chapter
- **Community building** e.g. through regular meetings
- Collection of **ET specific publications** relevant for Div 6
<https://wiki.et-gw.eu/OSB/NuclearPhysics/Publications>
- Provide **input EoS models** for the **ET community** (e.g. injection and data analysis studies)
 - Two examples also implemented in the MDC generation code [Tania Regimbau]
- Contributions to **CoBA study** (see talk by Anna Puecher)
 - Comparison of triangle & 2L detector configurations for inspiral & post-merger signal
 - No significant difference for nuclear physics outcome, longer arm length slightly preferred (higher sensitivity at high frequencies)

Regular division meetings

- Monthly division meetings, two alternating time slots (Tuesday 4pm, Wednesday 9 am), see <https://wiki.et-gw.eu/OSB/NuclearPhysics/Meetings> and ET calendar
- Attended by ~30-40 members
- Announcements + discussions + 1-2 scientific presentations + report(s) on progress for BlueBook
- In-person division 6 meeting under discussion

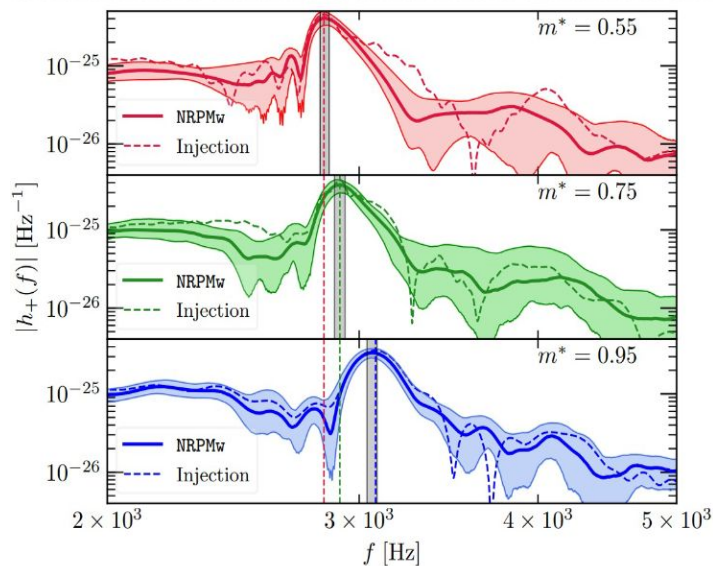
Some selected topics

GW signatures and constraints

- To what extent can we constrain the dense matter EoS from tidal deformability measurements during BNS inspiral?

Coba study + <https://arxiv.org/pdf/2303.11201.pdf> + <https://arxiv.org/pdf/2206.11286> + ...

-> NS EoS and NS properties very well constrained



- Thermal effects in the postmerger -> shift in peak frequency depending on importance of thermal effects detectable for $\text{SNR} > \sim 15$
<https://doi.org/10.48550/arXiv.2302.11359>
- And many others (detectability of a phase transition,)

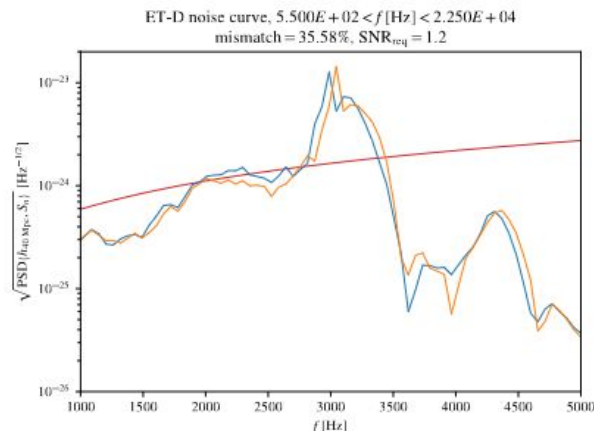
Some selected topics

Microphysics inputs

- Relevance of pQCD constraints for NS EoS (discussion) -> constraints only active at relatively high densities, above central NS density within GR but interesting for Div. 1
- To constrain nuclear EoS/interaction from inspiral additional nuclear physics input desirable

Uncertainties in measurements

- Improvement of measurement accuracy with additional effects
(e.g. resonant r-modes <https://arxiv.org/pdf/2205.01182>)
- Effect of weak reactions on postmerger oscillations frequencies -> careful treatment needed to extract correct frequency <https://arxiv.org/pdf/2205.11377>



Progress on the chapter for the bluebook

Organization, structure, and section leads established, writing underway

1. Microphysics inputs

- 1.1. EoS modeling [text]
- 1.2. Reaction rates, neutrinos, viscosities, nucleosynthesis, nuclear masses [text]

2. Constraints on microphysics with ET

- 2.1. *Low-temperature*: NS-NS inspirals, NS-BH binaries, continuous GWs [outline]
- 2.2. *Finite-temperature*: NS-NS postmergers, supernovae [outline+text]
- 2.3. *Nucleosynthesis* (with multimessenger) [outline]

3. Uncertainties and degeneracies in measurements and interpretations

- 3.1. Impact of waveform systematics [outline]
- 3.2. Uncertainties in simulations and the microphysics included [outline]
- 3.3. Modified gravity and BSM physics impacts on EoS inferences and quasi-universal relations [outline+text]

Progress on the chapter for the bluebook

Organization, structure, and section leads established, writing underway

1. Microphysics inputs

1.1. *Equation of state*

1.2. Work in close coordination with other divisions

2. Core physics

2.1. *Core physics*
➤ focus of Div. 6 material: implications for subatomic-/microphysics interpretations

2.2. *Core physics*

2.3. *Nucleosynthesis* (with multimessenger) [outline]

3. Uncertainties and degeneracies in measurements and interpretations

3.1. Impact of waveform systematics [outline]

3.2. Uncertainties in simulations and the microphysics included [outline]

3.3. Modified gravity and BSM physics impacts on EoS inferences and quasi-universal relations
[outline+text]

Bluebook further planning

- First draft of individual sections should be ready by end of September
- One-month period to share the material with all division members for comments
- Two months for harmonizing and smoothing
- Share with other OSB divisions by end of the year