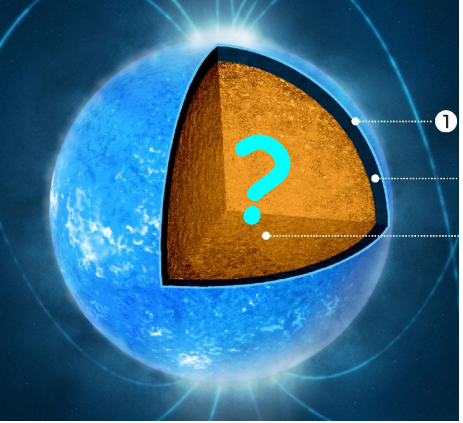
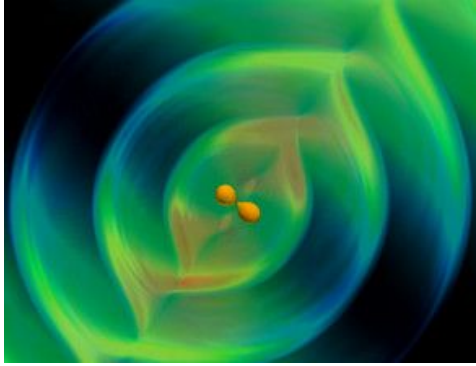
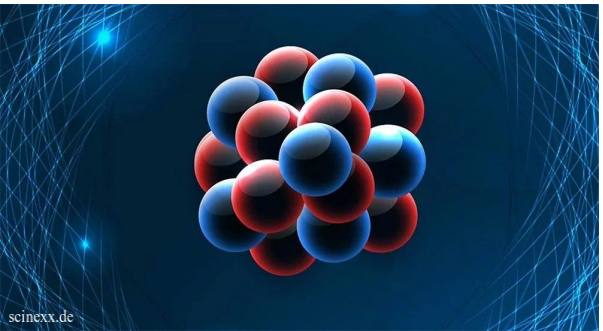


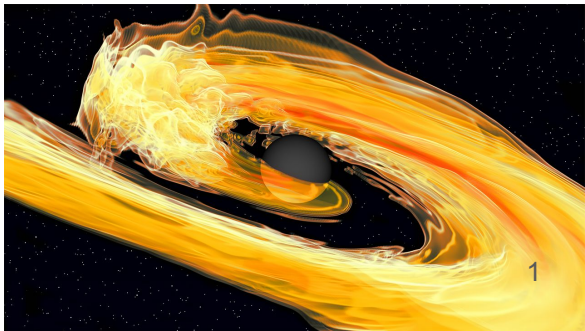


Nuclear Physics

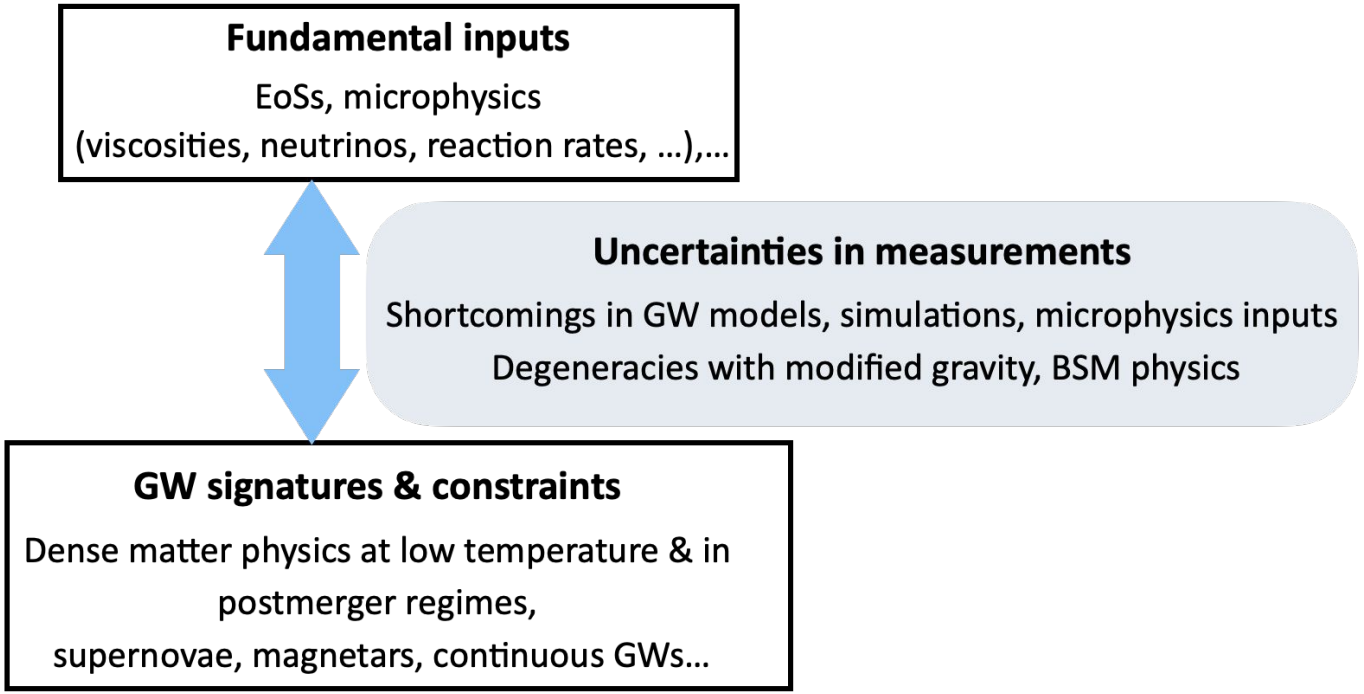
-- Division 6 --

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
- Provide input EoS models for the ET community (e.g. injection and data analysis studies) (-> see Armen's talk)
  - Two examples also implemented in the MDC generation code [Tania Regimbau]
- Contributions to CoBA study (-> see Francesco's talk)
  - 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)

Wiki: https://wiki.et-gw.eu/OSB/NuclearPhysics/WebHome

- monthly division meetings, regularly attended by ~30-40 members (presentations of recent work, discussions)

Nuclear physics division telecons & minutes

Division meetings

- Division meeting, December 8, 2021
- Division meeting, March 9, 2022
- Division meeting, April 12, 2022
- Division meeting, May 25, 2022
- Division meeting, June 21, 2022
- Division meeting, October 25, 2022
- Division meeting, December 7, 2022
- Division meeting, January 31, 2023
- Division meeting, February 22, 2023
- Division meeting, March 28, 2023
- Division meeting, April 26, 2023

Topical presentations and discussions

Many presentations by junior researchers on various topics, e.g.:

- Out of beta-equilibrium effects in BNS merger signals
- Detectability of strong phase transition from GW signals
- Impact and detectability of spin-tidal couplings with ET
- EoS extraction with ET using tidal effects and r-mode excitations
- The dense matter EoS and its compatibility with NS observations
- Bulk viscosity in BNS mergers
- The effect of dark matter on EoS constraints
- The capability of ET to measure postmerger properties
- Constraining nucleon dynamics with astrophysical observations
- EoS constraints from perturbative QCD
- The low density EoS
- Detectability of inertial modes from HMNS with 3G detectors
- Revealing the strength of three-nucleon interactions with ET

ET-specific publications

Please add items in reverse chronological order and use the format: Title, Authors, Journal (DOI)(link to paper on ET-TDS)(arXiv)

2023

- Revealing the strength of three-nucleon interactions with the Einstein Telescope, Henrik Rose, Nina Kunert, Tim Dietrich, Peter Pang, Rory Smith, Chris van den Broeck, Stefano Gandolfi, Ingo Tews, (https://apps.et-gw.eu/tds/?content=3&r=18182)(https://arxiv.org/abs/2303.11201)
- Thermal Effects in Binary Neutron Star Mergers, Jacob Fields, Aviral Prakash, Matteo Breschi, David Radice, Sebastiano Bernuzzi, André da Silva Schneider (https://arxiv.org/abs/2302.11359)
- Prospects for the inference of inertial modes from hypermassive neutron stars with future gravitational-wave detectors. Miquel Miravet-Tenés, Florencia L. Castillo, Roberto De Pietri, Pablo Cerdá-Durán, José A. Font (https://apps.et-gw.eu/tds/?content=3&r=18119)(https://arxiv.org/abs/2302.04553)
- Effect of dynamical gravitomagnetic tides on measurability of tidal parameters for binary neutron stars using gravitational waves, Pawan Kumar Gupta, Jan Steinhoff, Tanja Hinderer (https://apps.et-gw.eu/tds/ql/?c=16523)(https://arxiv.org/abs/2302.11274)
- General Relativistic Simulations of High-Mass Binary Neutron Star Mergers: rapid formation of low-mass stellar black holes, Kutay A. Cokluk, Kadri Yakut, Bruno Giacomazzo (https://apps.et-gw.eu/tds/ql/?c=16511)(https://arxiv.org/abs/2301.09635)
- Pre/post-merger consistency test for gravitational signals from binary neutron star mergers, Matteo Breschi, Gregorio Carullo, Sebastiano Bernuzzi (https://arxiv.org/abs/2301.09672)

2022

- Determining the equation of state of neutron stars with Einstein Telescope using tidal effects and r-mode excitations during binary inspiral, Pawan Kumar Gupta, Anna Puecher, Peter T.H. Pang, Justin Janquart, Gideon Koekoek, Chris Van Den Broeck, (https://apps.et-gw.eu/tds/ql/?c=16259)(https://arxiv.org/abs/2205.01182)
- Impact and detectability of spin-tidal couplings in neutron star inspirals, Goncalo Castro, Leonardo Gualtieri, Andrea Maselli, Paolo Pani, *Phys.Rev.D* 106 (2022) 2, 024011 (https://apps.et-gw.eu/tds/?content=3&r=17837) (https://arxiv.org/abs/2204.12510)
- Detecting the impact of nuclear reactions on neutron star mergers through gravitational waves, Peter Hammond, Nils Andersson, Ian Hawke, *Phys.Rev.D* 107 (2023) 4, 043023 (https://apps.et-gw.eu/tds/ql/?c=16287)(https://arxiv.org/abs/2205.11377)
- Kilohertz Gravitational Waves From Binary Neutron Star Mergers: Numerical-relativity Informed Postmerger Model, Matteo Breschi, Sebastiano Bernuzzi, Kabir Chakravarti, Alessandro Camilletti, Aviral Prakash, Albino Perego (https://arxiv.org/abs/2205.09112)
- Kilohertz Gravitational Waves from Binary Neutron Star Mergers: Inference of Postmerger Signals with the Einstein Telescope, Matteo Breschi, Rossella Gamba, Ssohrab Borhanian, Gregorio Carullo, Sebastiano Bernuzzi (https://arxiv.org/abs/2205.09979)
- Resonant tides in binary neutron star mergers: analytical-numerical relativity study, Rossella Gamba, Sebastiano Bernuzzi (https://arxiv.org/abs/2207.13106)
- Sensitivity of Neutron Star Observations to Three-nucleon Forces, Andrea Sabatucci, Omar Benhar, Andrea Maselli, Costantino Pacilio *Phys.Rev.D* 106 (2022) 8, 083010 (https://apps.et-gw.eu/tds/?content=3&r=17902) (https://arxiv.org/abs/2206.11286)
- Hubble constant and nuclear equation of state from kilonova spectro-photometric light curves, M. A. Pérez-García, L. Izzo, D. Barba-González, M. Bulla, A. Sagués-Carracedo, E. Pérez, C. Albertus et al., A&A (https://doi.org/10.1051/0004-6361/202243749)
- Crystallization in single- and multicomponent neutron star crusts, David Barba-González, Conrado Albertus, M. Ángeles Pérez-García, Phys. Rev. C (https://doi.org/10.1103/PhysRevC.106.065806) (https://apps.et-gw.eu/tds/?content=3&r=18092)
- Gamma rays run on time, by Daniel Beltrán Martínez, Gloria Tejedor García y Felipe J. Llanes-Estrada, *JCAP* 12 (2022) 004 (https://apps.et-gw.eu/tds/?content=3&r=17942)(https://arxiv.org/abs/2208.02247)

2021

- Constraints on the maximum densities of neutron stars from postmerger gravitational waves with third-generation observations, Matteo Breschi, Sebastiano Bernuzzi, Daniel Godzieba, Albino Perego, David Radice (https://arxiv.org/abs/2110.06957)

Progress on the chapter for the bluebook

Organization, structure, and section leads established, writing underway

1. **Microphysics inputs**
   - 1.1. EoS modeling
   - 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
   - 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
   - 3.3. Modified gravity and BSM physics impacts on EoS inferences and quasi-universal relations [outline+text]

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Work in close coordination with other divisions

➢ focus of Div. 6 material: implications for subatomic-/microphysics interpretations