Simulations of neutron star as sources of gravitational waves

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based on Gaël Servignat's PhD thesis + recent work by Santiago Jaraba

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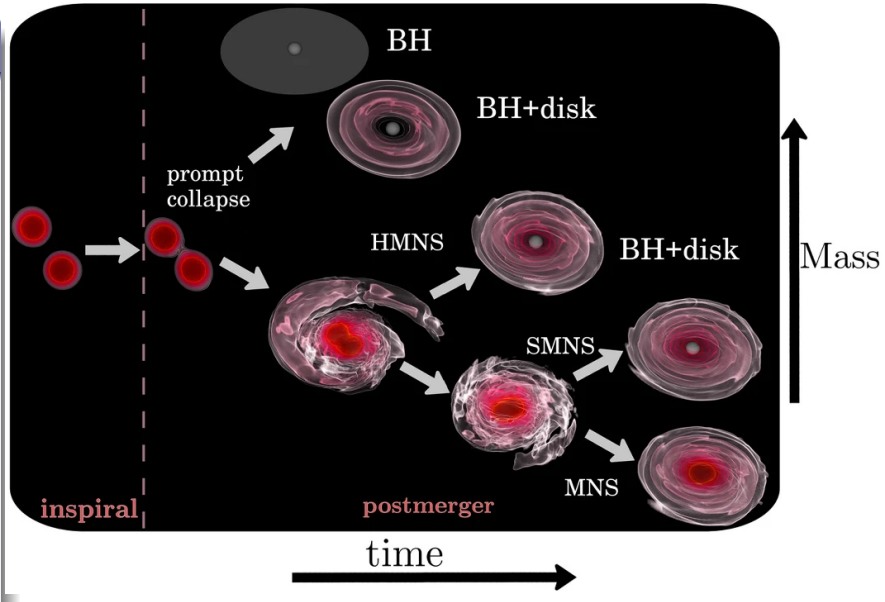
Context

- Gravitational waves from binary neutron star mergers.
- Depending on the total mass, a Super- or Hyper-Massive Neutron Star can exist for many rotation periods.
- It strongly emits gravitational waves.
  $\Rightarrow$ LIGO-Virgo-Kagra & Einstein Telescope.



Aim

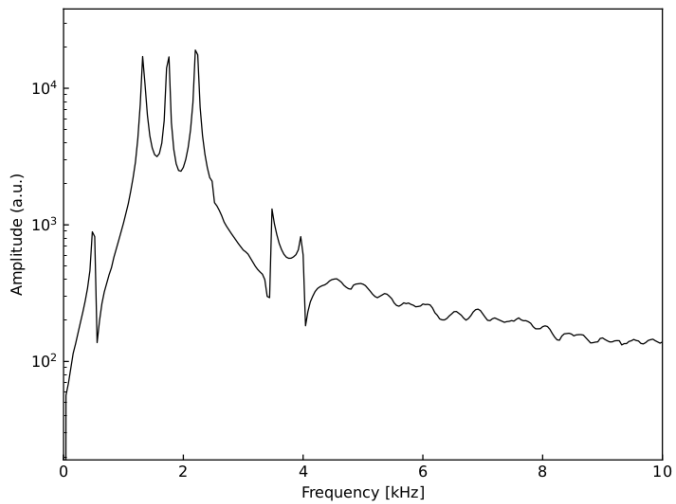
Numerical studies of oscillation modes of a single differentially rotating neutron star.
$\Rightarrow$ link with neutron star (nuclear) matter propeties.

Tool

New 3D (GRHD + Einstein) code "Roxas" based on spectral methods and formulation of hydro equations based on primitive variables [1].
$\Rightarrow$ very fast to explore nuclear physics parameter space.

Results

- Code tested, validated & publicly available.[2]
- Computation of gravitational waves & spectrograms; compared to the literature.[3]
- First 3D modes of a differentially rotating neutron star.[4]



[1]: Servignat+ Class. Quantum Grav. **40** 105002 (2023)
[2]: `https://zenodo.org/records/14849547`
[3]: Servignat & Novak Class. Quantum Grav. **42** 095015 (2025)
[4]: Jaraba+ *in prep.*

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