Black hole remnant of Black Hole - Neutron Star mergers

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https://tds.virgo-gw.eu/ql/?c=14116

https://arxiv.org/abs/1903.11622

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Motivation

- BH-NS coalescence is expected to be one of the main sources of GWs for LIGO/Virgo Abbott+ 2018
- The NS might be either tidally disrupted (scenario I) or directly swallowed by the BH (scenario II) Kyutoku+ 2011
- Scenario I leads to an accretion torus around the remnant black hole and associated EM counterparts (SGRBs) Rosswog, Foucart+, Paschalidis..
- Scenario II means BBH-like behaviour
- Remnant BH properties needed for waveform (and counterparts) modeling

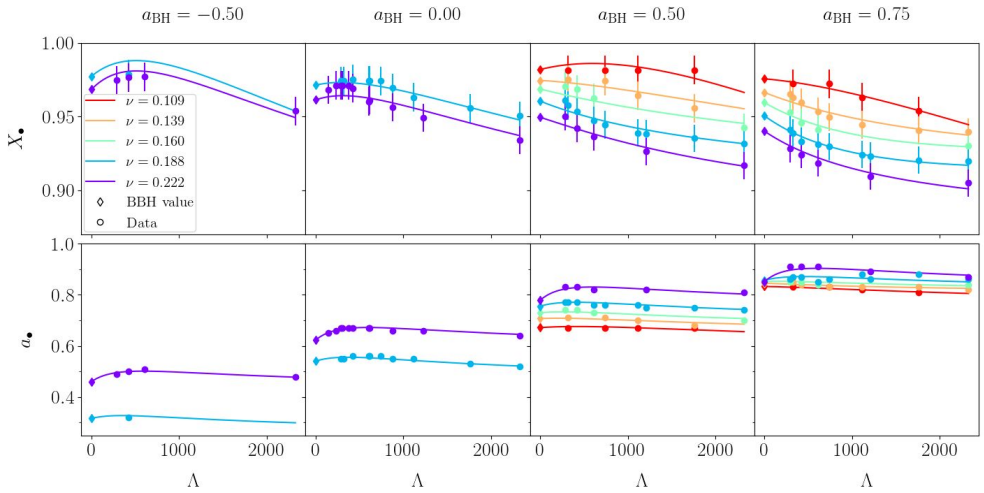
Q: What are the properties of the remnant black hole and which is the most likely merger scenario?

The model

- Using NR data (Kyutoku+ 2010,2011,2015) we construct a map from the initial properties of the binary to the final mass and spin of the remnant black hole

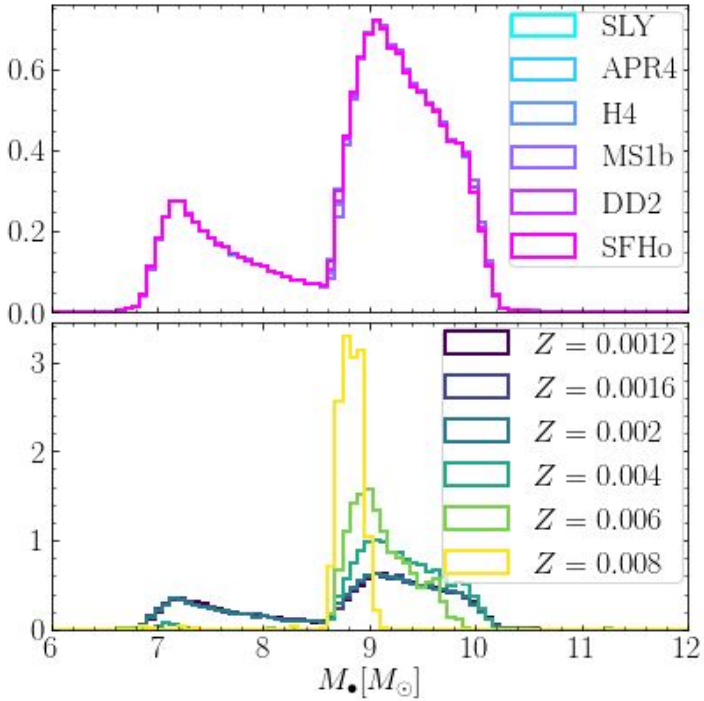
$$F : (\nu, a_{\rm BH}, \Lambda) \rightarrow (M_\bullet, a_\bullet)$$

- The neutron star spin is neglected and the black hole spin is (anti-)aligned to the orbital angular momentum
- Prescription for precessing binaries Barausse+ 2009



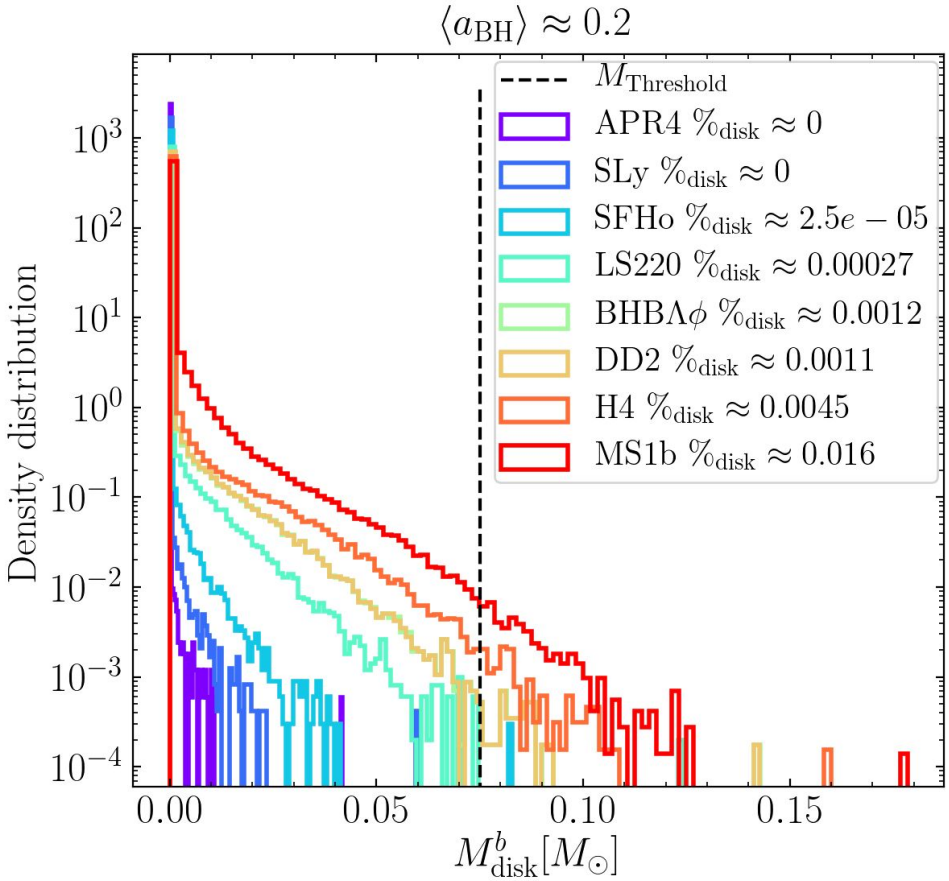
Population synthesis

- We apply our model on recent distributions of BHNS coming from population synthesis simulations Mapelli+ 2018
- Different metallicities of the progenitor stars employed
- Remnant BH masses peaked around $\sim 7 - 9 M_{\odot}$
- Bimodal distribution reflects the initial population of binary masses



Remnant Disk

- We analyze the remnant disk using the fit Foucart+ 2018
- We find values of the baryonic mass of the disk that do not allow EM counterparts for every EOS considered Stone+ 2013



Conclusion

- The distributions of initial and final masses of the BH lead to scenario II as the most likely one
- The analysis of the remnant disk corroborates this finding
- No EM counterparts are expected starting from the considered population
- However, high initial BH spin would lead to high disk masses
- The measurement of EM counterparts from BHNS would mean highly rotating BH spin aligned to the orbital angular momentum

Python code to calculate $(M_\bullet, a_\bullet)$ available at https://git.tpi.uni-jena.de/core/bhnsremnant