The effects of mass distribution assumptions on BBH population inference.

Virginia d'Emilio, Irina Dvorkin, Michael Pürrer, Vivien Raymond

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During the next few years, the LIGO-Virgo collaboration is expected to detect hundreds of gravitational-wave signals coming from compact binary coalescences. Determining the distribution and characteristics of this population of sources is crucial to understand their formation history, their environment and to study the evolution processes of their progenitors [1]. As the third observing run of the LIGO-Virgo detectors quickly approaches, it is important to have a well explored and detailed framework to investigate the distributional properties of the observed sources. Various studies have been conducted on the application of hierarchical Bayesian modelling techniques to infer the global parameters of gravitational-waves events. Both using model-independent inference techniques [2] and employing specific models from the canonical binary black hole (BBH) formation scenarios [3]; working with synthetic data from LIGO/Virgo O3 predictions [4], adopting astrophysically motivated parametrisations [5] and accounting for uncertainties in each binary's individual parameters [6].

In this work we aim to extend these investigations by determining whether it's possible to distinguish BBH events coming from different mass distributions and what is the impact of the assumed distribution on the population predictions. Unlike previous work, this study will be conducted on actual parameter estimation simulations generated with SEOBNRv4ROM ROQ waveforms. The observed events are not entirely representative of the true underlying population, as subthreshold events are a known source of bias. In order to recover the true distribution of sources, this work will take into account selection biases, such as the Malmquist bias, as suggested in [7], [8] and will determine the number of detections needed to constrain the mass distributions. The limiting distance to which BBH can be detected depends on their masses, hence the BBH redshift distribution relies on the mass distribution [9]. In this work we assume the BBH rate density to be constant through the observable volume.

References

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