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Detection capabilities of 3G interferometers: prospects for cosmology

Cosmological parameters can be constrained if simultaneous access to distance and redshift measurements is achieved. Gravitational waves from compact binaries represent the so-called standard sirens, as their waveform provides direct information about the luminosity distance to the source. However, we do need some non gravitational information to break the degeneracy between source mass and redshift and get access to the redshift of the source. In this work, in particular, we focus on dark sirens, where gravitational data comes from binary black hole systems.

Dark sirens approach relies on statistical methods to estimate the redshift. A host galaxy is probabilistically associated to the gravitatinal wave event within the localization volume provided by the detectors. Therefore, an important part of this work is the analysis of distance estimates and detection capabilitites of the future ground based interferometers, especially Einstein Telescope. Large number of binary back hole events are simulated with ET alone and in network with other observatories thanks to a Fisher matrix approach. In particular, we developed a Fiher matrix code in our own group, led by Jan Harms, called GWFish, which has been recently released. It allows us to investigate the parameter estimation capabilitites of future observatories. It has also been tested against a posterior sampling approach, like Bilby, to check the reliability of the Gaussian approximation of the likelihood, with promising results.

As a result, we want to stress the robustness of a Fisher matrix approach and show the encouraging results for distance estimates even for ET alone. Above all, observations by future gravitational waves interferometers could be of great benefit for cosmology.

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