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Gravitational-wave cosmology with large-scale structure correlations

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The standard sirens in the gravitational wave (GW) astronomy provide us with a direct measure of the cosmological distances independent of the cosmic distance ladder. When accompanied by an electromagnetic counterpart, it can also provide a redshift measurement, thus offering a new avenue to probe the cosmic expansion rate today, also known as the Hubble constant H0. However, the majority of the detected GW events, which are binary black hole mergers, are observed without any electromagnetic counterpart. Such sources with unknown redshifts, known as the 'dark sirens', can also be used to infer H0, by making use of the clustering properties of these sources with respect to the observed galaxies and the underlying dark matter distribution. In this talk, I will discuss how the angular clustering between gravitational-wave standard sirens and galaxies allows an inference of H0, regardless of whether the true host galaxies of any of these sirens are present in the galaxy catalog. Moreover, the constraints are not biased by the galaxy catalog incompleteness which has been one of the concerning issues of the current state-of-the art methods in gravitational wave cosmology with dark sirens. With a realistic mock galaxy catalog and a set of GW events distributed within 1 Gpc simulated with coloured Gaussian noise of the Advanced LIGO and Advanced Virgo detectors operating at O4 sensitivity, we show that our method is able to reliably extract the cosmological expansion rate. As the expected number of binary black holes grows with the current and future observing runs, this technique will be imperative for any unbiased cosmological inference using GWs

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