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Combining galaxy catalogs and gravitational wave data to infer cosmological parameters

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Gravitational waves (GWs) from the coalescence of compact binaries are among the most promising cosmological probes. Their signal can be used to study the late-time cosmic expansion of the Universe independently from other known cosmological probes and without the need for an intermediate calibrator. However, this is only possible if the binary redshift is known.
Different methods have been proposed to include redshift information in the inference process, from the direct detection of electromagnetic counterparts ("bright sirens") to the use of statistical properties inferred either from a catalog of possible hosts or from spectral features in the source-frame mass distribution of the GW population ("dark sirens").
In this talk, I will present CHIMERA, a code that combines the use of spectral features and galaxy catalogs within a hierarchical Bayesian framework to fully exploit multi-messenger information and simultaneously infer cosmological and GW population parameters from dark siren events.
We tested the code on a set of simulated O4 and O5 GW events, along with a complete mock galaxy catalog, to assess its improvements over previous approaches. I will discuss the results obtained, focusing on the importance of an accurate galaxy catalog and providing a new forecast on the precision of the Hubble constant measurement, showing that such a method can achieve a few percent error in H_0 using $\mathcal{O}(100)$ well-localized GW events while correctly marginalizing the population parameters.

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