GWSim: Python package for creating mock GW samples for different astrophysical populations and cosmological models of binary black holes

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ABSTRACT

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Figure 5 presents the hierarchical inference of cosmological and population parameters using mock gravitational-wave data produced by GWSim. These data were obtained using a Bayesian analysis that relies on parameter estimation (PE) prior assumptions on the parameters of interest. The result shown in the original figure assumed incorrectly that the PE priors were on the detector-frame masses ($m_1, m_2$) of the two black holes when the actual PE priors were on detector-frame chirp mass, $M_c$, and mass-ratio $q = m_2/m_1$. The result shown in the new figure uses the correct PE priors: the difference is the presence of an additional Jacobian, $\mathcal{J}$, such that $|\det \mathcal{J}| = M_c/m_2^2$. The principal effect is visible in the estimation of the hyper-parameter, $\beta$, which is recovered much better with respect to the original results.

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Fig. 5: Population and cosmological parameter posteriors obtained from an O1-, O2-, O3-, and O4-like simulation using the cosmological inference python package IcaroGW. The red lines indicate the injected values of the parameters.