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A Poisson Log-Normal Framework for Cosmological Parameter Inference Using Dark Sirens

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We present a novel statistical framework to infer cosmological parameters from cosmological surveys, based on a Bayesian forward modelling of correlated Poisson processes. In particular, given catalogs of galaxies and standard sirens, we compute the posterior distributions for cosmological parameters by assuming that the detection of standard sirens follow a spatial Poisson process that samples an underlying random log-normal density field. This framework has several computational and mathematical advantages when compared to the usual Gaussian scenario, such as eliminating the need for the inverse of very large matrices. We validate the accuracy of this method using mock catalogs, and show that it is in reasonable agreement with recent forecasts that use Gaussian approximations to the likelihood functions, while providing a more realistic description of the non-Gaussian tails of the posterior probability distributions for inferred cosmological parameters.

Collaboration name

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