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Probing the intrinsic properties of short gamma-ray bursts using joint gravitational wave observations

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The observation of gravitational waves (GWs) from binary neutron star mergers coincident with short gamma-ray bursts (sGRBs) is a likely scenario for the Advanced detector era. Such observations will allow us to enhance the determination of parameters governing the signals of both emission channels. When a population of such observations are accumulated it is possible to also infer parameters
governing that population. We present a general hierarchical Bayesian procedure for this purpose and provide an example analysis whereby the gamma-ray luminosity distribution of sGRBs can be measured. When modelling the sGRB luminosity distribution as a power-law we are able show that after O(10) joint detections we will be able to constrain the sGRB power-law index to +/- 0.2 and after O(100) to +/- 0.05 at 95% confidence. For the latter result the required number of joint observations requires a 3rd generation GW detector network. For the former it is feasible that the Advanced network at design sensitivity will provide enough jointly observed events.

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