Digging compact binary population out of the noise

John Veitch[*], Sebastian Gaebel[†], Thomas Dent[‡], Will Farr[§]

March 2019

The recent detections of coalescing binaries have begun to reveal the how the population of sources are distributed in terms of their masses, spins, and throughout space. The characterisation of these populations has so far been performed using only those sources which have a high probability of being of astrophysical origin, effectively imposing a detection threshold, then using them to estimate population parameters in a hierarchical model. This procedure throws away information contained in sub-threshold triggers which individually have only a low probability of being real signals but together yield information about the population.

We present a novel technique which obviates the need for a detection threshold when estimating population parameters, through the use of a mixture model containing both astrophysical and noise transients. This technique allows for uncertainty in the parameters of events actually considered, and is therefore suitable for use with parameter estimates from recent observing runs. Using this model we obtain unbiased estimates of the population parameters even when the data we consider are polluted by a large fraction of noise events. This allows a threshold to be chosen to achieve a desired computational cost rather than to eliminate false alarms.

[*]University of Glasgow
[†]University of Birmingham
[‡]University of Santiago de Compostela
[§]Stony Brook University / Flatiron Institute for Computational Astrophysics