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Joint parameter estimation on overlapping gravitational wave signals from coalescing compact binaries with Einstein Telescope and Cosmic Explorer

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Current parameter-estimation techniques for the coalescence of compact binaries assume just one event in the data stream. With the low detection rate of current interferometers, is has not been a problem so far, as overlapping signals are highly improbable. This will change with the next generation (3G) of detectors, like Cosmic Explorer and Einstein Telescope, with hundreds of overlaps per year. Previous work has shown that not accounting for them can lead to biases in the parameter estimation.

In our work we tackle this problem by performing joint parameter estimation – modeling multiple sources in the data at once. Previously, this technique was too computationally expensive to use with long-duration signals expected in 3G detectors, but we have combined it with a likelihood approximation known as relative binning, making the analysis feasible. For comparison, we also perform hierarchical subtraction, where we model one signal at a time, subtract it from data and analyze again.

We consider overlapping signal scenarios of two binary black hole signals and two neutron star signals. Using the joint parameter estimation we are able to accurately estimate the parameters, mitigating the bias observed when we model just one signal at a time.

Primary author: BAKA, Tomek (Utrecht University, Nikhef)

Co-authors: SAMAJDAR, Anuradha; VAN DEN BROECK, Chris; JIMENEZ FORTEZA, Francisco; JANQUART, Justin; DIETRICH, Tim

Presenter: BAKA, Tomek (Utrecht University, Nikhef)

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