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Parameter estimation from the core-bounce phase of rotating core collapse supernovae in real interferometer noise

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In this study, we formulate and describe a method for estimating parameters for rotating core-collapse supernovae, using the gravitational wave core bounce phase as a basis.

We introduce an analytical framework for the core bounce component that is determined by the ratio β, which characterizes the relationship between rotational kinetic energy and potential energy, alongside a phenomenological parameter α that pertains to rotational dynamics and the equation of state. We assess the accuracy of our phenomenological model by utilizing 126 numerical waveforms sourced from the Richers catalog.

The fitting factor used in searches for compact coalescing binaries serves as a metric to measure the effectiveness of the analytical model. The error in the frequentist parameter estimation of β using a matched filter is assessed. Results are analyzed based on actual interferometric noise and a waveform situated 10 kpc away with an ideal orientation. These findings are also contrasted with the situation where Gaussian recolored data is utilized.

Moreover, our study indicates that third-generation interferometers such as the Einstein Telescope and Cosmic Explorer could detect rotation at a distance of 0.5 Mpc. In the analysis, we evaluated an optimal alignment and accounted for the actual noise from the interferometers, particularly focusing on the O3L1 data.

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