Abstract: BayeSNova: The First Bayesian-Powered Search Pipeline applied to Gravitational Wave Searches for Core-Collapse Supernovae

After the measurement of gravitational waves (GWs) from merging compact binary stars, one of the next milestones in gravitational wave astronomy will be the detection of signals from core-collapse supernovae (CCSNe). GWs and neutrinos are the only means of directly observing the physical processes taking place in the central region of a collapsing star. In order to extract physical information from the GW of a non-rotating progenitor, the reconstruction of the signal must be sufficient. It is currently believed that reconstructing the gravitational wave signal from the core-collapse of a non-rotating star will only be possible within the neighboring five percent of our galaxy. We report on the detection and reconstruction capabilities of the recently developed algorithm, BayeSNova, as both a search pipeline and follow-up module. By utilizing information from theoretical predictions and preferentially searching for signals with specific characteristic in the time-frequency plane, we show that the detection range can be extended by two orders of magnitude compared to current estimates. The reconstruction techniques rely on Bayesian methods to produce signal components that are imprinted on the gravitational waveforms by quasi-periodic mass motions in the supernova core (for core-collapse supernovae-based searches) and may even reconstruct signal components for the post-merger phase of a binary neutron star merger using current interferometric data. This novel measurement of such features presents the deconstruction of interferometric data in a new light.
We are in the process of developing of an open source pipeline of data sources and tools to analyze GW survey data using the improved BayeSNova signal processing algorithm. This startup allocation will be used to assemble the tools, test parameters for optimal production settings, and build in robustness for the deployment of a continuous analysis of GW data on a production resource.

Once a robust pipeline and optimal parameters are established we intend to deploy production analyses, on appropriate resources, that will run continuously on GW data as it is released.