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Robust parameter estimation on gravitational wave signals from binary neutron star inspirals within minutes

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The gravitational waves emitted by binary neutron star mergers contain information on nuclear matter above saturation density. However, extracting this information and conducting parameter estimation remains computationally challenging and expensive. Wong et al. introduced Jim, a parameter estimation pipeline that combines relative binning and JAX features, such as hardware acceleration and automatic differentiation, into a normalizing flow-enhanced sampler for gravitational waves from BBH mergers. In this work, we extend the Jim framework to analyze gravitational wave signals from BNS mergers. We demonstrate that Jim can be used for full Bayesian parameter estimation of gravitational waves from BNS mergers within a few minutes, which includes the training of the normalizing flow. For instance, Jim can analyze GW170817 in 26 minutes (33 minutes) of total wall time using the TaylorF2 (IMRPhenomD_NRTidalv2) waveform, and GW190425 in around 21 minutes for both waveforms. We highlight the importance of such an efficient parameter estimation pipeline for several science cases and advocate for its ecologically friendly implementation of gravitational wave parameter estimation.

Primary author: Mr WOUTERS, Thibeau (GRASP, Utrecht University / Nikhef)

Co-authors: Prof. VAN DEN BROECK, Chris (GRASP, Utrecht University / Nikhef); Prof. DIETRICH, Tim (University of Potsdam); PANG, Tsun Ho

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