

## **Parameter inference for binary black holes using deep learning**

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Over the past five years, LIGO and Virgo have published 50 detections of gravitational waves from compact binary coalescences. To infer the system parameters, iterative sampling algorithms such as MCMC are typically used with Bayes' theorem to obtain posterior samples---by repeatedly generating waveforms and comparing to measured strain data. These approaches, while extremely successful, are computationally costly. Faster methods would therefore be desirable to address the growing rate of detections and the need for rapid multimessenger alerts. In this talk, I will describe the use of simulation-based inference with deep neural networks to learn a non-iterative inverse model for the parameters given the strain. The strategy is to use a normalizing flow to define a conditional density estimator, and train it to approximate the Bayesian posterior. Training requires simulated strain data, never any posterior samples or likelihood evaluations. The normalizing flow then enables fast sampling for any strain data consistent with the training distribution. We demonstrate these methods by performing inference in seconds on the first gravitational-wave detection, GW150914, over the full 15D parameter space for quasicircular binary black holes. Finally, I will discuss prospects for simulation-based methods to improve also the accuracy of gravitational-wave inference.