Gravitational wave detection: a fully Bayesian approach

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Abstract

The era of gravitational wave astronomy is upon us bringing the exciting prospect of regular detections of binary coalescence events and multimessenger counterparts. A longtime challenge in gravitational-wave astronomy is reliably establishing detection significance. This challenge is highlighted by the marginal event GW151012, which was initially listed as an unconfirmed marginal event, but which was recently upgraded to a detection. To date, significance has been calculated using a false alarm rate approach, necessitated by the fact that we do not fully understand the background. With the number of detectors set to increase, the difficulties inherent in this approach will require new ways to think about significance. In this talk, I will present an inference-based approach, demonstrating how to assign significance in a fully-Bayesian context. Building on ideas of coherence, I will present a framework that allows the background to be conservatively modelled and introduce the *hierarchical coherent odds*: a Bayesian answer to the questions of "How probable is this a signal given all of the relevant data?". Finally, I'll go on to describe how Bilby, a new parameter estimation software suite, aids this effort and how the framework can be naturally extended to multi-messenger scenarios.