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Estimation of orbital inclination angle for compact binary mergers through Bayesian Inference

Contributed Talk //

Astro-Particle Physics

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The detection of Gravitational Waves (GWs) allows the study of massive binary systems that may or may not have any electromagnetic (EM) emission. The joint detection of GW 170817 and the Gamma Ray Burst (GRB) GRB 170817A, marked the beginning of GW multi-messenger astronomy. It presented the potential to reveal new insights into the emission mechanisms of GRBs as well as the potential to determine the equation of state (EoS) of neutron stars. In particular this event confirmed that binary neutron star (BNS) mergers are progenitors for at least some short GRBs (sGRB). An estimated joint detection rate of 0.3 - 1.7 per year between the LIGO Hanford, LIGO Livingston and Virgo (HLV) GW network at design sensitivity, and the Fermi Gamma-ray Burst Monitor (GBM) was predicted. However, to date the GW 170817/GRB 170817A joint detection has been the only event of its kind so far. In LIGO's 3rd observing run, BNS merger, GW 190425, and Black Hole Neutron star (BHNS) events, GW 200115_042309 and GW 191219_163120 were detected with no EM counterpart. This study aims to find an explanation for the lack of joint detections after GW170817. In this study, we make the hypothesis that these GW events with no EM counterpart were orientated such that the Earth was not within the viewing angle of the GRB (assuming all BNS and BHNS mergers produces a GRB) and make use of the current Bayesian inference techniques to estimate the inclination angle of these systems to determine the orientation with respect to Earth. This analysis is performed with Bilby, a python based Bayesian inference library.

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