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How to do Cosmology with gravitational waves and afterglow observations from neutron star mergers

A fundamental role in Cosmology is played by the Hubble constant, which measures the current expansion rate of the Universe. A discrepancy exists in the Hubble constant measurements, between the Planck results that use the Cosmic microwave background (CMB) and the supernovae distance ladder. Binary neutron star mergers are promising sources for gravitational waves (GW) accompanied by electromagnetic (EM) counterparts and offer a completely independent Hubble constant estimation. However GW measurements have a degeneracy in the viewing angle determination, which for GW170817 was ~ 0 –60 degrees. GW170817 was the first ever detection of GW from a neutron star merger, and was followed by a well monitored electromagnetic afterglow, produced by a relativistic jet. The afterglow modeling can break the viewing angle degeneracy. We argue that the choice of jet modeling through either hydrodynamic or magneto-hydrodynamic simulations can have a big impact of the Hubble constant estimation. We present a comprehensive analysis of the viewing angle from different assumptions on the jet model and present a way to distinguish between different jet models that can result to a better estimation of the Hubble constant.

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