Contribution ID: **687** Type: **Talk in the parallel session**

Probing modified gravitational-wave propagation through tidal measurements of binary neutron star mergers

Monday, 5 July 2021 17:50 (20 minutes)

Gravitational-wave(GW) sources can serve as standard sirens to probe cosmology by measuring their luminosity distance and redshift. Such standard sirens are also useful to probe theories beyond General Relativity with a modified GW propagation. Previous studies on the latter assume multi-messenger observations so that the luminosity distance can be measured with GWs while the redshift is obtained by identifying sources' host galaxies from electromagnetic (EM) counterparts. Given that GW events of binary neutron star(BNS) coalescences with associated EM counterpart detections are expected to be rather rare, it is important to examine the possibility of using standard sirens to probe gravity with GW measurements alone. In this paper, we achieve this by extracting the redshift from the tidal measurement of BNSs(originally proposed within the context of GW cosmology). We also improve previous work by considering multi-band GW observations between ground-based (e.g.Einstein Telescope) and space-based (e.g.DECIGO) interferometers. We find that such multi-band observations with the tidal information can constrain a parametric non-Einsteinian deviation in the luminosity distance more stringently than the case with EM counterparts (due to a larger number of events) by a factor of a few.

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Session Classification: Compact Stars as Laboratories for Testing Strong Gravity

Track Classification: Neutron Stars: Compact stars as laboratories for testing strong gravity