Contribution ID: **21** Type: **not specified**

Tidal oscillations of neutron stars in eccentric binary systems

Thursday, July 13, 2023 2:50 PM (20 minutes)

The finite size of neutron stars in binary systems has an observable effect on the binary evolution due to tidal interactions. These tidal interactions in circular binaries result in an adiabatic evolution, where the frequency of tidal excitations coevolves with the orbital frequency. However, in case the orbit is eccentric, there is a periodic sharp pulse of external tidal force, which results in an independent oscillation of the neutron star on its eigenfrequencies, with the energy being drained from the orbit. This provides an opportunity to measure the f-mode frequency independently from the tidal deformability in such systems. We investigate tidal excitations in eccentric binary systems and study whether they have an observable effect on the orbit. We find that gravitational wave signals from tidal oscillations have low signal-to-noise ratio. The observation of the orbital phase shift caused by these tidal oscillations, on the other hand, might be feasible with the current detector network. Since this phase shift highly depends on the f-mode frequency of the neutron stars, the observation of such an effect might be used to constrain the neutron star equation of state through the measurement of the f-mode frequency.

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Session Classification: Neutron stars 2