ICTS Astrophysics & Relativity Seminar

Title : Nonlinear Tides in Coalescing Neutron Star Binaries

Speaker : Kyubin Kwon (University of California, Santa Barbara, USA)

Date : Wednesday, 21st August 2024

Time : 3:30 PM (IST)

Abstract : Neutron stars in coalescing binaries deform due to the tidal gravitational fields generated by their companions. During the inspiral phase, this deformation is dominated by the fundamental oscillation~(f-) mode. The tide also has sub-dominant gravity~(g-) modes that are resonantly excited when the linear tidal forcing sweeps through their eigenfrequencies. Beyond the linear order in perturbed fluid displacement, the g-modes are anharmonic, i.e., their oscillation frequencies depend on the mode energy. For the lowest-order g-mode, we show that when the tidal forcing reaches its linear eigenfrequency, the mode dynamically adjusts its energy so that its nonlinearly shifted oscillation frequency always matches that of the driving field, and the mode stays resonantly locked with the drive. Consequently, the locked g-mode grows to substantially larger energy than in the linear theory. Using a 1.4--$1.4\, M_{\odot}$ binary neutron star system with the SLy4 equation of state, we find this results in an extra correction to the frequency-domain gravitational wave (GW) phase of $|\Delta \Psi|\approx 2.3\,{\rm rad}$ accumulated from the onset of resonance locking at the GW frequency of $94\,{\rm Hz}$ to the merger at $1.1\,{\rm kHz}$.

Venue : Feynman Lecture Hall

Zoom Link: https://icts-res-in.zoom.us/j/96185094263?pwd=ScpGJlK0ZxuGc0o5jfbVQDOITfRHeN.1
Meeting ID: 961 8509 4263
Passcode: 303020