ICTS Astrophysical Relativity Seminar

Title : Surrogate model for gravitational wave signals from black hole binaries built on black hole perturbation theory waveforms calibrated to numerical relativity: one model to rule both comparable and extreme mass ratio regime

Speaker : Tousif Islam (University of Massachusetts, Dartmouth, USA)

Date : Thursday, 16th June, 2022

Time : 11:00 am (IST)

Abstract : We present a reduced-order surrogate model of gravitational waveforms from non-spinning binary black hole systems with comparable to large mass-ratio configurations. This surrogate model, BHPTNRSur1dq1e4, is trained on waveform data generated by point-particle black hole perturbation theory (ppBHPT) with mass ratios varying from 2.5 to 10,000. BHPTNRSur1dq1e4 can generate waveforms up to 30,500 $m1$ (where $m1$ is the mass of the primary black hole), includes several more spherical harmonic modes up to $\ell=10$, and calibrates both dominant and subdominant modes to numerical relativity (NR) data. In the comparable mass-ratio regime, including mass ratios as low as 2.5, the gravitational waveforms generated through ppBHPT agree surprisingly well with those from NR after this simple calibration step. We argue that this scaling essentially captures higher order self-force corrections in a much simpler way. We also compare our model to recent SXS and RIT NR simulations at mass ratios ranging from 15 to 32, and find the dominant quadrupolar modes agree to better than $\approx 10-3$. We expect our model to be useful to study intermediate-mass-ratio binary systems in current and future gravitational-wave detectors. Finally, we discuss avenues for improving the model by extending its region of validity.

Venue : Hybrid – Offline: Emmy Noether Seminar Room

Online: Please click on the below link to join the meeting

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