ICTS Astrophysics & Relativity Seminar

Title : The role of r-modes in pulsar spin-down, pulsar timing, and gravitational waves

Speaker : Sree Ram Valluri (University of Western Ontario, Canada)

Date : Thursday, 18 December 2025

Time : 3:30 PM (IST)

Abstract : I give an overview of the role of r-mode oscillations in pulsar spin-down for gravitational wave (GW) emission and pulsar timing analysis. Using a non-linear differential framework that includes r-mode contributions, we derived time-dependent solutions for rotational frequency and period evolution. These expressions are validated using observational data from the Crab pulsar with high precision. By analytically fitting braking indices and spindown coefficients, we link measurable pulsar properties to GW signatures. We present closed-form expressions for neutron star compactness and tidal deformability using the Lambert W and Lambert--Tsallis functions, enabling model-independent inferences from r-mode GW frequencies. Incorporating r-modes improves the accuracy of spin-down models and GW detectability, through inclusion of high- order frequency terms. This framework supports the modeling of timing residuals, glitch quantification, and GW constraints. Our findings are relevant for data analysis in GW observatories.

Venue : Feynman Lecture Hall
Zoom Link: https://icts-res-in.zoom.us/j/97461949094?pwd=zbmbXEokdHxgJxl1nAaUIfICVRaoS9.1
Meeting ID: 974 6194 9094
Passcode: 000745