



**Carlos Rodríguez
García**
ICE-CSIC

Title: Phenomenological exploration of pulsar similarity and artificial intelligence

Time: 21:00-21:30, 20 February (Thursday), Shanghai time

Host: Dong Lai

Location: Online

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Meeting ID: 114984568 (no password)

Abstract:

This talk will present innovative applications of graph theory and time-series analysis to pulsar phenomenology and Fast Radio Bursts (FRBs). It will utilize the Minimum Spanning Tree (MST) and Dynamic Time Warping (DTW) as effective computational tools. The MST framework, applied to the ATNF pulsar catalog, provides a new way to classify and visualize the pulsar population, revealing relationships beyond the traditional P-Pdot diagram. This approach in the millisecond pulsar population is beneficial in identifying candidate black widows, rebacks, and transitional millisecond pulsars by uncovering connections and grouping them based on shared properties. In the case of FRBs, the MST serves as an unsupervised classification methodology, effectively distinguishing repeaters from non-repeaters and identifying potential repeater candidates by highlighting the importance of certain variables concerning what would be the best to describe the repetitive character of a source.

In parallel, DTW is applied to pulsar light curves, allowing for a quantitative comparison of the gamma-ray pulsars reported in the Third Fermi-LAT Pulsar Catalog. Unlike conventional approaches focusing on specific indicators (e.g., number of peaks, separation, width, and height), DTW provides a global similarity measure, revealing striking morphological correspondences between light curves. Notably, some millisecond and young pulsars exhibit highly similar light curves, regardless of other timing, physical, or spectral properties, which could offer new insights into emission mechanisms.

Biography:

It's Carlos Rodríguez García (Charlie). I am a PhD student at the Institute of Space Sciences (ICE-CSIC) in Barcelona, Spain. My research focuses on pulsar phenomenology and Fast Radio Bursts (FRBs). I apply graph theory, machine learning studies, and time-series analysis to uncover new insights into their properties and classifications. My work includes the usage of the Minimum Spanning Tree (MST) for pulsar and FRB classification and Dynamic Time Warping (DTW) for pulsar light curve similarity analysis. I am particularly interested in multi-frequency astrophysics, leveraging large-scale observational datasets to bridge theory and experiment. My approach combines computational astrophysics with novel methodologies through advanced mathematical tools, providing new ways to interpret compact objects and their connections across different energy regimes.