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Proposal Abstract:

Pulsar systems exhibit complex interplay between magnetic fields and gravitational interactions, which play crucial roles in their evolution and observable phenomena. Unraveling these interactions is essential for understanding the fundamental physics governing these enigmatic objects. In this project, we propose a pioneering investigation of pulsar systems by combining the unparalleled sensitivity of the Five-hundred-meter Aperture Spherical radio Telescope(FAST) with advanced computational techniques, including machine learning and numerical simulations. Our objectives include: 1) the comprehensive study of pulsar timing behavior and its implications for gravitational wave detection, general relativity tests, and galactic dynamics; 2) the investigation of magnetospheric processes governing radio emission and their connection to transient phenomena such as glitches, mode-switching, and nulling events; 3) the characterization of the interplay between magnetic fields and gravitational interactions in binary pulsar systems, with implications for neutron star equation of state and stellar evolution models. Leveraging the unprecedented capabilities of FAST, we will carry out a systematic survey of pulsar systems, targeting both known sources and discovering new ones. Advanced computational techniques will be employed to analyze the rich dataset, enabling the identification of subtle features and correlations that may shed light on the underlying physical processes.