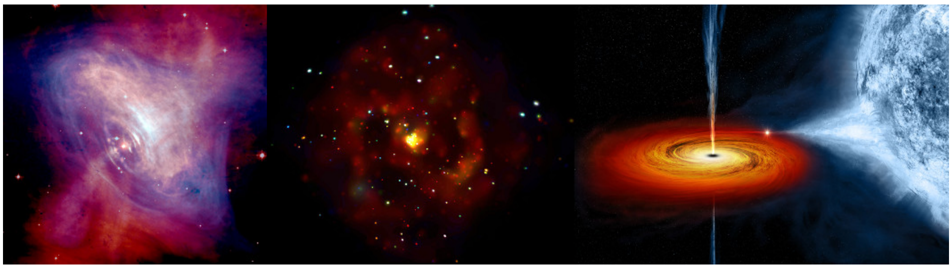
National conference on REcent Trends in the study of Compact Objects (RETCO-V): Theory and Observation



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Detection possibility of continuous gravitational waves from rotating magnetized neutron stars

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In the past decades, several neutron stars (NSs), particularly pulsars, with mass $M > 2M_\odot$ have been observed. On the other hand, the existence of massive white dwarfs (WDs), even violating Chandrasekhar mass-limit, was inferred from the peak luminosities of type Ia supernovae. Hence, there is a generic question of the origin of massive compact objects. Here we explore the existence of massive, magnetized, rotating NSs with soft and steep equation of states (EoSs) by solving axisymmetric stationary stellar equilibria in general relativity. For our purpose, we consider the Einstein equation solver for stellar structure XNS code. Such rotating NSs with magnetic field and rotation axes misaligned, hence with non-zero obliquity angle, can emit continuous gravitational waves (GW), which can be detected by upcoming detectors, e.g., Einstein Telescope, etc. We discuss the decays of magnetic field, angular velocity and obliquity angle with time, due to angular momentum extraction by GW and dipole radiation, which determine the timescales related to the GW emission. Further, in the Alfv\'en timescale, a differentially rotating, massive proto-NS rapidly settles into an uniformly rotating, less massive NS due to magnetic braking and viscosity. These explorations suggest that detecting massive NSs is challenging and sets a timescale for detection. We calculate the signal-to-noise ratio of GW emission, which confirms that any detector cannot detect them immediately, but detectable by Einstein Telescope, Cosmic Explorer over months of integration time, leading to direct detection of NSs.

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