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# Plausible detection of rotating magnetized neutron stars by their continuous gravitational waves

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In the past decades, several neutron stars (NSs), particularly pulsars, with mass $M > 2M_{\odot}$, have been observed. Hence, there is a generic question of the origin of massive compact objects. Here we explore the existence of massive, magnetized, rotating NSs by solving axisymmetric stationary stellar equilibria in general relativity using 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). We discuss the decay of the magnetic field due to Ohmic, Hall and Ambipolar diffusion, and decay of 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 a 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 and Cosmic Explorer over months of integration time, leading to direct detection of NSs.

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