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Spindown of Isolated Neutron Stars: Gravitational Waves or Magnetic Braking?

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We study the spindown of isolated neutron stars from initially rapid rotation rates, driven by two factors: (i) gravitational wave emission due to r-modes and (ii) magnetic braking. In the context of isolated neutron stars, we present the first study including self-consistently the magnetic damping of r-modes in the spin evolution. We track the spin evolution employing the RNS code, which accounts for the rotating structure of neutron stars for various equations of state. We find that, despite the strong damping due to the magnetic field, r-modes alter the braking rate from pure magnetic braking for B<10^{13}G. For realistic values of the saturation amplitude, the r-mode can also decrease the time to reach the threshold central density for quark deconfinement. Within a phenomenological model, we assess the gravitational waveform that would result from r-mode driven spindown of a magnetized neutron star. To contrast with the persistent signal during the spindown phase, we also present a preliminary estimate of the transient gravitational wave signal from an explosive quark-hadron phase transition, which can be a signal for the deconfinement of quarks inside neutron stars.

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