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Poloidal Field Instability in Magnetized Neutron Stars

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We investigate the instability of purely poloidal magnetic fields in nonrotating neutron stars by means of three-dimensional general-relativistic magnetohydrodynamics simulations. Our aim is to draw a clear picture of the dynamics associated with a hydromagnetic instability in a neutron star and to obtain indications on possible equilibrium configurations from the final state reached by the system. Furthermore, the internal rearrangement of magnetic fields is a highly dynamical process, which has been suggested to be behind magnetar giant flares. Our simulations can provide realistic estimates on the electromagnetic and gravitational-wave emission which should accompany the flare event. In particular, we find that (1) the electromagnetic emission matches the duration of the initial burst in luminosity observed in giant flares, giving support to the internal rearrangement scenario, and that (2) only a small fraction of the energy released during the process is converted into f-mode oscillations and in the consequent GW emission, thus resulting in very low chances of detecting this signal with present and near-future ground-based detectors.

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