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Interface modes in inspiralling neutron stars: A smoking-gun gravitational-wave signature of first-order phase transitions

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Quantum chromodynamics predicts a phase transition from hadronic matter to deconfined quarks at extreme densities, yet its exact nature remains uncertain. Neutron stars offer a unique opportunity to probe this transition, but bulk properties—mass, radius and tidal deformability—provide only indirect signatures, which require many detections to resolve and are ineffective if the discontinuity exists at lower densities. In this talk, I report on a *smoking-gun* gravitational-wave signature of a first-order phase transition, identifiable in a single event: the resonant tidal excitation of an interface mode. I demonstrate the detectability of this resonance using general-relativistic perturbation calculations for an ensemble of nuclear-matter equations of state informed by chiral effective field theory. The results suggest that this signature is within reach of third-generation interferometers and may even be observable with LIGO A+ in sufficiently loud events.

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