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Scalar Gravitational Waves in the Effective Theory of Gravity

Abstract: As a low energy effective field theory, classical General Relativity receives an infrared relevant modification from the conformal trace anomaly of the energy-momentum tensor of massless, or nearly massless, quantum fields. The local form of the effective action associated with the trace anomaly is expressed in terms of a dynamical scalar conformalon field that couples to the conformal factor of the spacetime metric, allowing it to propagate over macroscopic distances. Linearized around flat spacetime, this semi-classical EFT admits scalar gravitational wave solutions in addition to the transversely polarized tensor waves of the classical Einstein theory. The strongest astrophysical sources for scalar gravitational wave burst signals detectable by LIGO and VIRGO are the excited gluonic condensates in the interiors ofneutron stars as they are formed or merge with other compact objects. Primordial scalar gravitational waves should also have been copiously generated by the hot QCD plasma in the early universe, whose detection likely requires space-based GW antennae.

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