Theory-agnostic modeling of dynamical scalarization in binary systems

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Abstract

Spontaneous and dynamical scalarization of compact objects are non-perturbative phenomena that arise in several modified theories of gravity and can significantly affect the dynamics of a binary system. We use a strong-field-agnostic (coarse-grained) effective-field-theory approach to derive an effective action that can be used to predict the onset of dynamical scalarization, allowing one to search for deviations from general relativity using gravitational-wave observations. We then argue that dynamical scalarization is as ubiquitous as spontaneous scalarization in modified theories of gravity, exemplifying this for binary black holes with modified electrodynamics. We also connect the energetics of isolated objects to linear mode instabilities and their nonlinear saturation, and discuss critical phenomena around the scalarization phase transition.