Structure of black holes in theories beyond general relativity
LIGO SURF Project

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1 Abstract

So far in scientific history there has not been a single definitive experiment that shows deviations from the predictions of general relativity (GR). However we know from quantum field theory that GR as it stands is not renormalizable, so it cannot be the full story. LIGO is our first shot at probing gravity in the strong field regime. In order to detect agreement with GR or lack thereof more sensitively, we should generate waveform templates from alternative theories of gravity. This has not been done yet, but by and large we need some more insight from numerical relativistic simulations to develop such prescriptions.

For numerous reasons, we expect these more correct alternative theories to be corrections to GR that have to converge with GR in limiting cases. Therefore it is useful to study spacetimes that are perturbations of that of GR. In our case, we study perturbations of Kerr black holes, the unique class of stationary, axisymmetric, charge neutral, regular, and asymptotically-flat spacetime in GR, with corrections to GR in a theory-independent manner. Our scheme is to study these so called "bumpy black holes" in the Weyl-Lewis-Papapetrou gauge, where the four degrees of freedom of the metric are manifest, and numerically solve for the general class of black holes in beyond-GR theories.