

The detection of gravitational waves by Advanced LIGO and Advanced Virgo provides an opportunity to test the predictions of general relativity in a regime that is inaccessible to traditional astronomical observations and laboratory tests. We present four tests of general relativity on highly significant binary black hole detections in the catalog GWTC-1. One test subtracts the best-fit waveform from the data and checks the consistency of the residual with detector noise. The second test checks the consistency of the low- and high-frequency parts of the observed signals. The third test checks that phenomenological deviations introduced in the waveform model (including in the post-Newtonian coefficients) are consistent with zero. The fourth test constrains modifications to the propagation of gravitational waves due to a modified dispersion relation, including that from a massive graviton. We also provide constraints on non-tensorial gravitational wave polarizations using strong events observed by all three detectors. In addition to presenting results for individual events, we also provide combined results using the most significant events.