Abstract

The first observing run of the Advanced LIGO detectors brought us the first detections of gravitational waves. The two signals, originating from binary black hole coalescences, passed through the detectors on September 14, 2015 and December 26, 2015. The two events, labelled GW150914 and GW151225 respectively, provide us with a unique opportunity to perform the first tests of the strong-field dynamical regime of general relativity. Using the combined information of the two events we find no evidence for a deviation from general relativity and place improved and new bounds on several high-order post-Newtonian coefficients.

In addition to presenting in detail the infrastructure used to perform the tests of general relativity, we also introduce reduced order models (ROMs) for the extended parameterized gravitational waveforms that are employed in the testing method. By using ROMs we are capable of significantly reducing the computational cost of Bayesian inference by removing redundant computations. The ROMs presented here are specifically tailored to the test infrastructure for general relativity (TIGER) and use fast reduced order quadrature (ROQ) integration rules to accurately approximate likelihood calculations at a greatly reduced computational cost. We demonstrate that the ROQ can speed up a typical parameterized test of general relativity between a factor of a few and a few hundred depending on the mass of the source.