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ASTROPHYSICAL DATA ANALYSIS FOR THE DETECTION OF GRAVITATIONAL WAVES FROM INSPIRAL COMPACT BINARIES INJECTED IN LIGO'S FIFTH AND SIXTH SCIENCE RUNS

Abstract

Gravitational Waves (GW), the ripples in the fabric of the space-time predicted one hundred years ago in the Einstein's General Theory of Relativity, have been finally detected. These gravity waves are emitted by massive astrophysical objects moving with violent accelerations and propagates at the speed of light. The tremendous effort of a great number of scientists has ended with the detection of a GW emitted 1.3 billion years ago by a binary system composed of two merging black holes of masses 36 and 29 the sun's mass possibly located in the Magellanic cloud. Detection of GW required the construction and calibration of a network of very sensible instruments designed to measure distance changes in the order of 1/1000th the diameter of a proton. These instruments are based on the L-shape laser Michelson interferometer. The most representative of these GW detectors is the two 4km-long-arms interferometers named Laser Interferometer Gravitational-wave Observatory (LIGO). This work presents an introduction to the fundamental theory of GW, the nature and characteristics of the different astrophysical sources of GW and describes the scientific and technological efforts developed to detect GWs using LIGO. Subsequently, the work focuses on the mathematical model of GW generated by inspiral compact binaries, a system composed of a pair of neutron stars and/or black holes in their late stage of evolution, and presents a comprehensive data analysis methodology developed to perform detection of the GW emitted by these astrophysical sources that are induced in interferometer-based detector such as LIGO. Results of experiments performed to test and evaluate the detection of GW from inspiral compact binaries injected in LIGO's fifth and sixth science runs are presented and discussed.