Binary black hole detections from LIGO-VIRGO KAGRA runs 1 and 2

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Abstract

Introduction and Background

Gravitational waves as first predicted by Albert Einstein in 1915 in his paper on special and general relativity have been notoriously hard to detect. That was until the LIGO Michelson interferometer in Hanford and Livingston was complete in 2015. A Michelson interferometer is a device that uses the interference of two beams of light to detect small changes in the path distance of the two beams. A diagram of one can be seen in Figure 1. By using a michelson interfermoeter in the LIGO experiment the small changes in distance that are required can be detected and measured. These distances can be on the order of 10^{-21}m, caused by the passing of gravitational waves through the interferometer arms. The first detection of a gravitational wave come on the 14th of September 2015, just 100 years after the publicqtion of Einstiens paper. The first detection was of a binary black hole merger, these mergers commonly release a large amount of energy in the form of gravitational waves. This happens because as the two black holes accelerate towards each other they warp the space-time around them, and as the approach the point of coalescence the amplitude of these waves massively increases, thus allowing them to be detected over the Background noise. The run-down after merging is extremely quick and thus leaving a distinct peak at the time of coalescence.

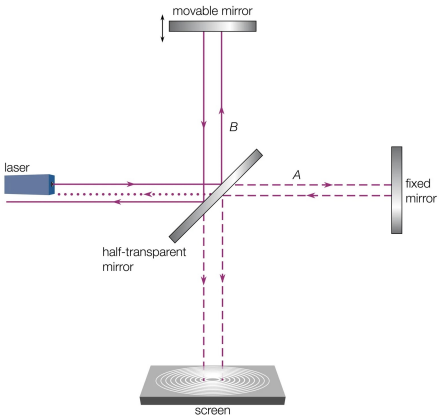

Figure 1: Diagram of a michelson interferometer as used in LIGO.[1]

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