The Challenge of Calibrating a Laser Interferometric Gravitational Wave Detector

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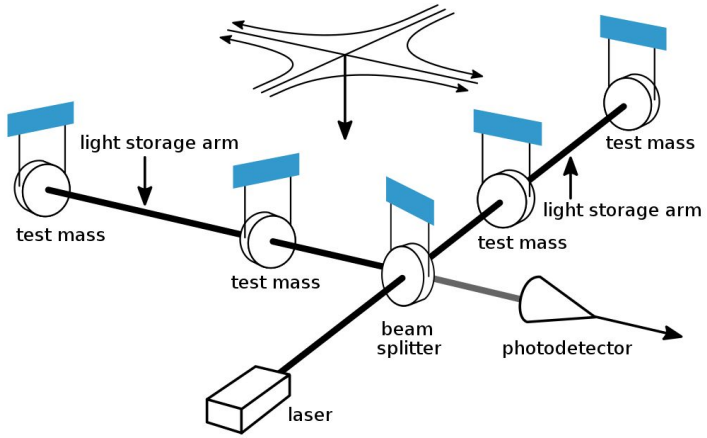
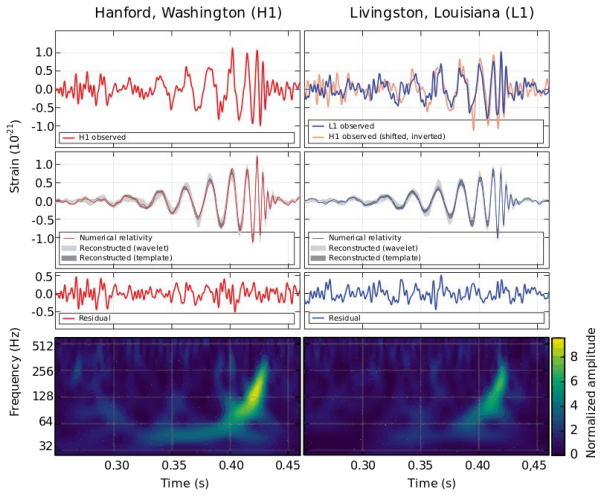
In 2015 the first detection of gravitational waves was made, gravitational waves from the violent collision of two black holes. This collision sent waves through space-time as Einstein predicted. This detection was made possible by many advances in measurement technology, mainly vibration isolation for the detector optics; at 10 Hz, the motion of the laser interferometer detector mirrors is at least on billion times smaller than the seismic motion of the ground and also makes the laser locked-in the detection configuration in a large band of the spectrum very challenging. This was made possible by using many feedback and feedforward control loops. But, to reach such requirements more than 100 of such active systems are included in the detectors to allow lock acquisition, lock stability, and sensitivity of the instrument. In this work, the challenges of reaching these requirements will be addressed and how this makes the calibration of these detectors very challenging, and a solution is proposed.





The proposed solution is to detect the gravitational wave with a resonant-mass detector that is easily calibrated. There was once a network of such detectors around the world but working in a kHz range, the detections made were in the 100 Hz . The new detector has a tuning fork shape with a resonant frequency around 120 Hz and with some state of art parameters reach a sensitivity in strain of **1.31 10^{-21}**. Using the signal detected in that band to calibrate the broader band detectors.