Seminar at FEMTO-ST, March, Monday 7th 2016, 14:00.

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Detection of Gravitational Waves with laser interferometers: focus on Virgo Laser and Optics.

Abstract:

In 1916, Albert Einstein predicted the existence of gravitational waves. Einstein understood that gravitational-wave amplitudes would be remarkably small.

Experiments to detect gravitational waves (GWs) began in the 1960s with resonant mass detectors. A Michelson-based laser interferometer with kilometric length arms has been proposed in the 1980s in the US, in Europe and in Japan as a new kind of broadband GW detector. The infrastructure has been built in the late 1990s. Since their installation, these detectors have experienced several periods of commissioning, data-taking and upgrade until mid 2015 where the first two Laser interferometers of the second generation were fully commissioned and ready for data taking.

On September 14, 2015, two signals which could be attributed to gravitational waves were seen on LIGO (Laser Interferometer Gravitational-Wave Observatory) detectors. Indeed, very similar waveforms have been detected in the LIGO Hanford (WA) and Livingston (LA) detectors. Exhaustive investigations of instrumental and environmental disturbances were performed, giving no evidence that this event is an instrumental artifact.

It is the first direct measurement of gravitational waves. The waveform has been attributed to the merger of a pair of black holes.

The detected distortion of space time was very small. The distance changes we measured in LIGO's arms correspond to 4 parts in a thousandth of a proton diameter.

In this talk, the first direct detection of GW will be briefly presented. Then, the principle of the laser interferometers used to measure gravitational waves will be explained. Finally, we will give some details about the laser and optical components needed to achieve the required detector sensitivity.