Gravitational waves detection: principles, status and perspectives

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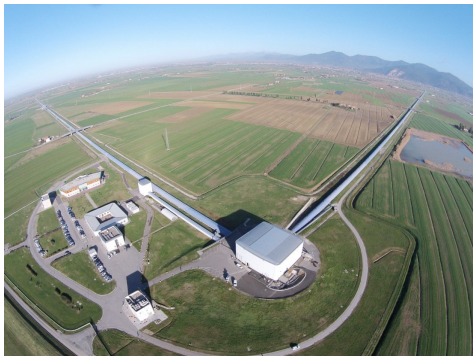
The first observation of gravitational waves from the coalescence of binary black holes [1] has open the field of gravitational wave astronomy and has been recognized with the 2017 Nobel Prize in Physics. More recently the first detection of gravitational waves emitted by the coalescence and merger of two neutron stars [2] and the subsequent observation of the explosion by many astronomical observatories [3] will mark the history of multi-messenger astronomy.



The gravitational wave detector Virgo located near Pisa (Italy)

Gravitational wave detectors are based on Michelson type interferometer with arms several kilometers in length. Two interferometers with arm four kilometers in length are operated by the LIGO project in the USA [4]. A three kilometer long detector, called Virgo [5], is operated in Italy by a collaboration involving scientists from several European countries. The LIGO and Virgo detectors have been operated jointly in 2017. After the implementation of several upgrades will be completed, they should resume operation in early 2019 for a one year long data taking called O3.

In Japan the KAGRA project [6] is building a three kilometers long interferometer located underground in the Kamioka mine. KAGRA is aiming at joining the LIGO-Virgo network before the end of the O3 run. It will be the first interferometer to be operated with the mirrors cooled down to cryogenic temperatures.

In the meantime discussions are starting in Europe and in the USA to prepare the next generation of large infrastructures devoted to gravitational wave astronomy. These will be laser interferometers with arms lengths in the range between 10 km and 40 km and adopting some of the solutions developed for KAGRA.

In this talk the detection principle will be recalled. Then the current status of the detectors and the future perspectives will be described briefly.

References

1) Abbott B. P. et al.: Physical Review Letters 116 6 061102 (2016)

2) Abbott B. P. et al.: Physical Review Letters 119 16 161101 (2017)

3) Abbott B. P. et al.: Astrophysical Journal Letters 848 2 L12 (2017)

4) Aasi J. et al.: Classical and Quantum Gravity 32 7 074001 (2015)

5) Acernese F. et al.: Classical and quantum Gravity 32 2 024001 (2015)
6) Somiya K.: Classical and Quantum Gravity 29 12 124007 (2012)