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The search for gravitational waves from LIGO/Virgo/KAGRA detectors to Einstein Telescope: recent results and new frontiers of gravitational wave instruments and astronomy

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Einstein Telescope is the future European Laboratory for gravitational waves. The discovery of gravitational waves (GW), in 2015, 100 years after the publication of Einstein's general theory of relativity, was soon followed, in 2017, by the assignment of the Nobel prize for physics to three scientists of the LIGO-VIRGO collaboration. LIGO in the USA and VIRGO in Italy are, at present, the unique detectors worldwide capable to observe the GW signals. In 2017 with a coordinated effort of LIGO-VIRGO and a network of Telescopes on earth and in the space the gravitational waves signal from a neutron star collision was detected and combined with its electromagnetic counterpart, opening the era of multi messenger astronomy.

This provided the substantial momentum which led to the proposal of a third generation GW detector in Europe. In July 2021 Einstein Telescope was officially approved and inserted in the ESFRI program. The detector will substantially improve the current ones in sensitivity and in background suppression. In the present configuration it is designed as a triangle, underground, of 10 km per side, but a twin L shape system, with same concept of the LIGO detector is under consideration, There are presently two site candidates, one in Italy, in Sardinia, and one in the Netherlands, in the Limburg region.

This presentation will cover both the genesis of the project and the principles of GW detection, its technological challenges and an overview of the present status and future schedule.

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