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## Advanced Virgo detector: the path from O2 to O3

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Gravitational Waves discovery has recently been announced by the LIGO and the Virgo collaborations. Due to their weak amplitude, Gravitational Waves are expected to produce a very small effect on free-falling masses, which undergo a displacement of the order of  $10^{-18}$  m for a km-scale mutual distance. This discovery showed that interferometric detectors are suitable to reveal such a feeble effect, and therefore represent a new tool for astronomy, astrophysics and cosmology in the understanding of the Universe. To better reconstruct the position of the Gravitational Wave source and increase the signal-to-noise ratio of the events by means of multiple coincidence, a network of detectors is necessary. In the USA, a couple of twin 4 kilometer-long arms detectors, which are placed in Washington State and Louisiana, constitute the LIGO project. Advanced Virgo (AdV) is a 3 kilometer-long arms second generation interferometer situated in Cascina, near Pisa in Italy. On August 1st 2017, Virgo has joined LIGO in the second observation run (O2) for about one month, during which Virgo has detected for the first time a Gravitational Wave produced by binary black holes and binary neutron stars systems. In view of the next science run which will start in Spring 2019, hardware upgrades have been performed, such as monolithic suspension installation and injection of squeezed light, which have improved the detector performances in the mid-low and high frequency range, respectively. Furthermore, thanks to unceasing noise hunting and commissioning activities addressed towards the noise reduction and fine tuning of the interferometer working point, a broad improvement of the detector sensitivity over the whole frequency range was achieved. Thanks to all of these actions, Advanced Virgo will be able to join the third observation run with a sensitivity two times higher than it was during O2.

### Summary

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