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# Gravitational-wave and multi-messenger astronomy

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Ground-breaking discoveries happened during the first observing runs of the Advanced gravitational-wave detectors, LIGO and Virgo. On September 14 2015 the gravitational waves from the coalescence of a binary system of black holes marked the beginning of a new exploration of the Universe through gravitational waves [1]. This detection was followed by other detections of binary black-hole systems [2, 3, 4, 5]. Another epochal discovery happened on August 17, 2017 with the detection of the first gravitational waves from the inspiral and merger of a binary neutron-star system [6] and its electromagnetic signatures in all the bands from the high-energy to the radio [7]. The talk will give an overview of the astrophysical implications of the first gravitational-wave detections, which span from relativistic and nuclear astrophysics to fundamental physics and cosmology. I will describe the gravitational-wave and multi-messenger observations and the major results about our knowledge of the physics governing neutron stars, black holes, and the most energetic transients in the sky. Challenges and perspectives for the next years will be discussed.

## References

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