

What Gravitational Waves Tell Us about the Universe

Prof. Dr. Alessandra Buonanno

Max-Planck-Institut für Gravitationsphysik (Albert-Einstein-Institut), Potsdam

In 2015 the LIGO detectors observed, for the first time, a gravitational wave passing through the Earth produced by the collision of two black holes. Such an event was a milestone for astrophysics and it provided a remarkable confirmation of the general theory of relativity. Since then, as many as ninety gravitational waves have been observed by the LIGO and Virgo experiments, including signals from binary neutron stars and neutron-star - black-hole binaries. These observations rely on precise theoretical predictions of the two-body dynamics and gravitational radiation. After reviewing the synergetic approach that successfully combines analytical and numerical relativity to produce highly accurate waveform models, I will discuss the most compelling and challenging findings from the most recent LIGO-Virgo observing run regarding astrophysics, gravity and fundamental physics.