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Recent advances in gravitational-wave cosmology

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Standard sirens have been the central paradigm in gravitational-wave (GW) cosmology so far. From the GW signature of compact star binaries, it is possible to directly measure the luminosity distance of the source. Since the source redshift cannot be inferred from the GW signal alone, additional information is required for instance from the observation of an electromagnetic counterpart. One of the lessons learned during the last LIGO-Virgo science run O3 is that it may be more difficult than expected to collect many electromagnetic counterparts of GW events in the coming years. New techniques and ideas have emerged recently to exploit another type of observables to obtain an estimate of the source redshift.
In this talk, I will present an overview of those emerging techniques along with recent results and future prospects associated to their application.

I will first review the standard approach based on electromagnetic observations, either the observation of a counterpart, e.g. a kilonova transient or the use of galaxy surveys.
I will then turn to techniques that do not require electromagnetic observations, such as neutron-star tidal deformability models, features of the source-frame mass spectrum for compact binaries, angular cross-correlation between galaxy and GW sources distributions, and cross-correlation or identification of GWs lensing maps.

Author: MASTROGIOVANNI, Simone (Astroparticule et cosmologie, Paris Diderot university)

Orateur: MASTROGIOVANNI, Simone (Astroparticule et cosmologie, Paris Diderot university)

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