



ID de la contribución : 58

Tipo : Talk

GWTC-4.0: constraints on the cosmic expansion rate and modified gravitational-wave propagation

lunes, 3 de noviembre de 2025 14:30 (15)

We analyze data from 142 gravitational wave (GW) sources in the fourth LVK Gravitational-Wave Transient Catalog (GWTC-4.0) to estimate the Hubble constant H_0 jointly with the population properties of merging compact binaries. We measure the luminosity distance and redshifted masses of GW sources, and combine this with redshift information obtained by leveraging features in the binary mass spectrum and merger rate evolution, as well as by identifying potential host galaxies in the GW localization volume. Probing the relationship between luminosity distance and redshift in this way yields constraints on cosmological parameters. We also constrain parameterized deviations from general relativity which affect GW propagation, and hence the dependence of GW signals on the luminosity distance to their sources. Assuming a model for the source-frame mass distribution which is able to describe the full spectrum of coalescing compact objects and using GW candidates detected up to the end of the O4a, together with redshift data from the GLADE+ all-sky galaxy catalog and the inclusion of GW170817 with its electromagnetic counterpart, we provide the latest and most precise measurements of H_0 and the GW propagation parameter Ξ_0 to date using GW data.

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Clasificación de la sesión : Gravitational Waves

Clasificación de temáticas : Gravitational waves