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Hubble constant estimation via electromagnetic and gravitational-wave joint analyses

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In August 2017, the groundbreaking observation of GW170817 marked the first-ever identification of a binary neutron star merger, accompanied by the detection of a Gravitational Wave (GW) and a gamma-ray burst (GRB). The GRB exhibited prompt gamma-ray emission and an afterglow across radio, optical, and X-ray bands, originating from a relativistic jet formed post-merger at an angle of 20-30 degrees from its axis. In this work, we estimate the Hubble constant H_0 using broad-band afterglow emission and relativistic jet motion from the Very Long Baseline Interferometry and Hubble Space Telescope images of GW170817. Using a simultaneous fit of GW and afterglow, we probe the H_0 measurement robustness depending on the data set used, the assumed jet model, the possible presence of a late time flux excess. Using the sole GW leads to a 20% error (77^{+21}_{-10} km/s/Mpc, medians, 16th-84th percentiles), because of the degeneracy between viewing angle and luminosity distance. Adding the afterglow light curve and centroid motion in the analysis efficiently breaks parameters degeneracies and overcome the late-time deviations, giving $H_0 = 69.0^{+4.4}_{-4.3}$ km/s/Mpc (in agreement with Planck and SH0ES measurements) and a viewing angle of $18.2^{+1.2}_{-1.5}$ deg. This is valid regardless of the jet structure assumption.

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Astrofisica relativistica e particellare

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