

Abstract Submitted
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Constraining Gravitational-Wave Propagation Speed with Multimessenger Observations¹ ATSUSHI NISHIZAWA, Caltech, TAKASHI NAKAMURA, Kyoto University — Detection of gravitational waves (GW) provides us an opportunity to test general relativity in strong and dynamical regimes of gravity. One of the tests is checking whether GW propagates with the speed of light or not. This test is crucial because the velocity of GW has not ever been directly measured. Propagation speed of a GW can deviate from the speed of light due to the modification of gravity, graviton mass, and the nontrivial spacetime structure such as extra dimensions and quantum gravity effects. Here we report a simple method to measure the propagation speed of a GW by directly comparing arrival times between gravitational waves, and neutrinos from supernovae or photons from short gamma-ray bursts. As a result, we found that the future multimessenger observations of a GW, neutrinos, and photons can test the GW propagation speed with the precision of 10^{-16} , improving the previous suggestions by 8-10 orders of magnitude. We also propose a novel method that distinguishes the true signal due to the deviation of GW propagation speed from the speed of light and the intrinsic time delay of the emission at a source by looking at the redshift dependence.

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