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How well can we constrain modified gravitational wave propagation with strong lensing?

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Just like light waves, gravitational waves (GWs) can undergo gravitational lensing. When the characteristic size of the lens is much larger than the wavelength of the GWs, the phenomenon is referred to as strong lensing. Strong lensing produces multiple copies of the same gravitational wave event which arrive at the detector as repeated signals. When the source is quadruply lensed, we can localize it up to sub-arcsecond precision by using simultaneous constraints from gravitational waves and electromagnetic observations. In this work, we show that such precise localization could help us probe theories of gravity beyond General Relativity (GR). In particular, we consider the set of beyond GR theories in which the propagation equation of GW differs from GR by a friction term. Therefore, the luminosity distance measured using GW will also be different from GR. In this work, we show that quadruply lensed gravitational wave events could provide us with competitive against existing bounds on such theories beyond GR.

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