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Enhanced detectability of gravitationally lensed gravitational waves by spinless black holes with aLIGO

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We investigate the detectability of GWs that have been lensed by a spinless stellar-mass BH. By numerically solving the full relativistic linear wave equation in the spacetime of a Schwarzschild BH, we find that the strong gravity can create unique signals in the lensed waveform, particularly during the merger and ringdown stages. The differences in terms of fitting factor between the lensed waveform and best-fitted unlensed GR template with spin-precessing and higher-order multipoles are greater than 5% for the lens BH mass within $70M_{\odot}M_{\rm lens}133M_{\odot}$ under aLIGO's sensitivity. This is up to 5 times more detectable than previous analyses based on the weak field approximation. Based on Bayesian inference, the lensing feature can be distinguished with a signal-to-noise ratio of 12˜19, which is attainable for aLIGO.

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