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# Gravitational wave lensing beyond General Relativity: geometric optic expansion and dispersive phenomena

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The nature of gravity can be tested by how gravitational waves (GWs) are emitted, detected, and propagate through the universe. Propagation tests are powerful, as small deviations compound over astronomical distances. However, tests of theories beyond Einstein's general relativity (GR) are limited by the high degree of symmetry of the cosmological spacetime. Deviations from homogeneity, such as those caused by gravitational lenses, allow for new interactions to emerge, offering a path toward novel tests of gravity through GW propagation.

In this talk, I will present the theory of GW propagation beyond GR (i.e., GW lensing beyond GR) in the short-wave expansion, including, for the first time, corrections to the leading-order amplitude and phase. I will introduce the formalism valid for a general scalar-tensor theory and subsequently present the computation of the dispersive (i.e., frequency-dependent) corrections to all metric and scalar field perturbations in Brans-Dicke, the simplest modified theory exhibiting GW dispersion. I will discuss in detail the structure of these effects, their potential impact on the phase of the GW signal, and how such lensing scenarios can give rise to non-tensorial polarizations. Although these effects are highly suppressed in Brans-Dicke, our formalism opens the possibility of novel tests of gravity, including dark-energy models and theories with screening mechanisms.

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