

# Proper time path integrals for gravitational waves: an improved wave optics framework

*Thursday, 24 October 2024 16:35 (25 minutes)*

When gravitational waves travel from their source to an observer, they interact with matter structures along their path, causing distinct deformations in their waveforms.

In this study we introduce a novel theoretical framework for wave optics effects in gravitational lensing, addressing the limitations of existing approaches. We achieve this by incorporating the proper time technique, typically used in field theory studies, into gravitational lensing.

This approach allows us to extend the standard formalism beyond the eikonal and paraxial approximations, which are traditionally assumed, and to account for polarization effects, which are typically neglected in the literature. We demonstrate that our method provides a robust generalization of conventional approaches, including them as special cases. Our findings enhance our understanding of gravitational wave propagation, which is crucial for accurately interpreting gravitational wave observations and extracting unbiased information about the lenses from the gravitational wave waveforms.

**Primary authors:** Dr GAROFFOLO, Alice (UPenn); RICCIARDONE, Angelo (Istituto Nazionale di Fisica Nucleare); BRAGA, Ginevra (Istituto Nazionale di Fisica Nucleare); BARTOLO, Nicola (Istituto Nazionale di Fisica Nucleare); MATARRESE, Sabino (Istituto Nazionale di Fisica Nucleare)

**Presenter:** BRAGA, Ginevra (Istituto Nazionale di Fisica Nucleare)

**Session Classification:** Cosmology - Talks on specific topics

**Track Classification:** Cosmology