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Light from a quasar interacting with gravitational waves: a geometrical-optics analysis

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We consider a situation in which a quasar contains a source of gravitational waves (e.g. binary black holes) and electromagnetic waves from the quasar interact with gravitational waves from the source. The effect will be appreciable if the interaction initially takes place close to the source of gravitational waves where the strain amplitude can be large. This situation can be modeled effectively using spherical gravitational waves (rather than plane-fronted gravitational waves); i.e., transverse-traceless radially propagating waves, with the strain amplitude varying by the distance between the source and an observer. Our analysis employs geometrical-optics methods in curved spacetime and a particular focus is placed on the effect of gravitational Faraday rotation (or Skrotskii/Rytov effect) resulting from the interaction between light from a quasar and spherical gravitational waves from binary black holes within the quasar.

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