Public Abstract
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According to most modern theories of gravity, including general relativity (GR), gravitational fields influence propagation of electromagnetic waves. Among the observable effects predicted by GR, for example, are bending of light rays in a gravitational field, delay in time of propagation of electromagnetic impulses, shift of frequency of electromagnetic radiation, and gravity-induced rotation of the polarization plane. The predictions of GR and other theories regarding propagation of electromagnetic waves are being tested with high-precision astronomical measurements. Rapidly growing accuracy of measurements of positions of astronomical objects using optical and radio interferometers, accumulating pulsar-timing data allow for measurements of very subtle effects. We considered propagation of light rays in the weak time-varying gravitational field of an astronomical system, such as a binary star. In the framework of GR we derived analytical expressions for light-ray trajectory and observable effects of bending of light, gravitational time delay, and gravity-induced rotation of the polarization plane. We considered the effect on propagation of light rays due to the full-structure gravitational field, which consists of pieces dominating at different distances from the light-deflecting system. We generalized the results of previous studies by including into consideration the subtle effects due to higher-order harmonics in distribution of matter within the system. This work furthers understanding of interaction of gravitational and electromagnetic fields within the framework of GR. The expressions derived can be used for calculation of observable effects in propagation of light rays due to localized astronomical sources.