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Gravitational Lensing in Plasmic Medium
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Аннотация
The influence of plasma on different effects of gravitational lensing is reviewed. Using the Hamiltonian approach for geometrical optics in a medium in the presence of gravity, an exact formula for the photon deflection angle by a black hole (or another body with a Schwarzschild metric) embedded in plasma with a spherically symmetric density distribution is derived. The deflection angle in this case is determined by the mutual combination of different factors: gravity, dispersion, and refraction. While the effects of deflection by the gravity in vacuum and the refractive deflection in a nonhomogeneous medium are well known, the new effect is that, in the case of a homogeneous plasma, in the absence of refractive deflection, the gravitational deflection differs from the vacuum deflection and depends on the photon frequency. In the presence of a plasma nonhomogeneity, the chromatic refractive deflection also occurs, so the presence of plasma always makes gravitational lensing chromatic. In particular, the presence of plasma leads to different angular positions of the same image if it is observed at different wavelengths. It is discussed in detail how to apply the presented formulas for the calculation of the deflection angle in different situations. Gravitational lensing in plasma beyond the weak deflection approximation is also considered.