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Strong lensing of quasars

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Abstract

Quasars are very bright and distant objects. Lensing of quasars by foreground galaxies are significant events in cosmology. By measuring the positions of the images, the time delay between them, and the magnification ratio, one can constrain the mass distribution of the lensing galaxy, find cosmological parameters, and understand the physics of quasars. Based on the redshift distribution of quasars and galaxies, the stellar mass of galaxies, and considering models like the Singular Isothermal Sphere (SIS) and Nonsingular Isothermal Sphere (NIS) for the lens, we calculate the time delay and magnification ratio between images. For the Roman Space Telescope, we find that about 85% of lensed quasars are lensed by one galaxy. Additionally, we find a linear relationship between the ratio of the time delays $\Delta t_{\text{SIS}} / \Delta t_{\text{NIS}}$ and the ratio of angular separations $\Delta \theta_{\text{SIS}} / \Delta \theta_{\text{NIS}}$ as well as between the magnification ratio of the two images, $\mu(\theta_1) / |\mu(\theta_2)|$ and their angular position ratio $|\theta_1 / \theta_2|$ for both models.

Keywords: Strong lensing, quasar, galaxy, time delay, magnification.

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