PHY-765 SS19: Gravitational Lensing. Worksheet Week 7

1 Journal Club #1: Paper presentation

Last week you selected a recent lensing paper based on title and abstract. You have prepared a short overview which will be presented in class this week in a journal club setting.

2 The Magnification of a Source in Terms of γ and κ

From the definition of the Jacobian, and by using $\gamma^2 \equiv \gamma_1^2 + \gamma_2^2$, show that

$$\mu = \frac{1}{(1-\kappa)^2 - \gamma^2} \tag{1}$$

3 The Magnification For the Point Mass Lens

For the point mass lens, the convergence vanishes and the source magnification only depends on the shear.

3.1

Using that $\Phi = c^2\psi = \theta_{\rm E}^2 \ln\theta$ and that $\theta = \sqrt{\theta_x^2 + \theta_y^2}$, show that

$$\gamma_1 = -\frac{\theta_{\rm E}^2}{\theta^4}\left(\theta_x^2 - \theta_y^2\right) \qquad\qquad \gamma_2 = -\frac{2\theta_{\rm E}^2\theta_x\theta_y}{\theta^4} \tag{2}$$

3.2

Express the magnification for the point mass lens, μ in therms of $\theta_{\rm E}$ and $\boldsymbol{\theta}$ only.

4 The magnification for a CIS

Consider a CIS lens model with a core radius of $\theta_c = \theta_0/4$. Assume that a background source is positioned such that the apparent positions of the 3 observed images are

$$\theta_1/\theta_0 = -0.54 \qquad \theta_2/\theta_0 = -0.11 \qquad \theta_3/\theta_0 = +0.85 \tag{3}$$

4.1

Calculate the magnification for each of the three images.

4.2

What happens with the magnification if the core radius is made larger/smaller?