

Physics 3002, Problem Set 10, due 4/22/09

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1. Ryden problem 8.3. Express your results in arcseconds.
2. In class, we derived an expression for the magnification of the two images of a point mass lens using:

$$\mathcal{M} = \left| \frac{\theta_I}{\theta_S} \frac{d\theta_I}{d\theta_S} \right| \quad (1)$$

Complete the derivation to show that the magnification of the two images are:

$$\mathcal{M}_+ = \frac{1}{2} + \frac{\frac{1}{2} + \frac{\theta_E^2}{\theta_S^2}}{\sqrt{1 + 4\frac{\theta_E^2}{\theta_S^2}}} \quad (2)$$
$$\mathcal{M}_- = \frac{\frac{1}{2} + \frac{\theta_E^2}{\theta_S^2}}{\sqrt{1 + 4\frac{\theta_E^2}{\theta_S^2}}} - \frac{1}{2}$$

Show that the above expression for \mathcal{M}_- is correct in the sense that it is always non-negative. Show also that $\mathcal{M}_- + \mathcal{M}_+ \geq 1$ always - this is known as the magnification theorem, and can be proven for any gravitational lens, that the sum of magnification of images always exceeds one.