

Ast 8110
Fall 2022
Problem Set #5 (due Tuesday Nov 22)

1. Light curve of an extended, uniform surface brightness source.

Write a code to calculate a light curve of a source moving in a straight line past a point lens. All the angular lengths on the sky are in units of the Einstein radius of the point lens. The distance (on the plane of the sky) of the closest approach between the source and lens is b , and the radius of the circular source is r_0 . Assume that the two images of the source are not resolved, so the observer sees only the total flux of the two images. (The third image is infinitely demagnified.)

Plot the light curve of magnification vs. distance along the path, p , for

- (a) $r_0 = 1.0$, $b = 1.5$
- (b) $r_0 = 0.2$, $b = 1.5$
- (c) $r_0 = 1.0$, $b = 0.1$
- (d) $r_0 = 0.2$, $b = 0.1$

Make sure that the magnification at large $|p|$ is 1. Plot all 4 light curves on the same plot, to facilitate comparison.

2. Light curve of an extended source with limb darkening.

Modify your code to include limb darkening of the form

$$I(r) \propto 1 - u(1 - \sqrt{1 - r^2}),$$

which is eq.(6) of Fouque et al., A&A 518, A51 (2010). Let's take parameters of 1(c) and $u = 0.5$. Plot the corresponding light curve.

Plot the light curve from questions 1(c) and 2 on the same plot. Briefly comment on the differences and similarities of these two light curves.