Ast 8110

Fall 2022

Problem Set #4 (due Tuesday November 8)

Please do all the calculations in parts (a)-(c) by hand,

not using Mathematica, or other symbolic-manipulation software.

SISell lensing potential model.

Consider a commonly used elliptical lensing potential that has the form

$$\Psi(R) = bR[1 + \gamma \, \cos(2\theta)],$$

where b and γ are constants, θ is a polar angle in the lens plane, and R is a distance in the lens plane, from the lens center. For this potential

(a) Derive the expression for the deflection angles in x and y directions.

(b) Derive the expressions for κ, γ_1 and γ_2, making sure to simplify these as much as possible. What is the relation between κ and $\gamma = \sqrt{\gamma_1^2 + \gamma_2^2}$?

(c) Find the expression for $\det[A]$, the determinant of the magnification matrix, simplifying it as much as possible.

(d) On the same plot, plot the critical curve and caustic for SISell using the parameter set $(b, \gamma) = (1, \, 0.05)$.

(e) On the same plot, plot the critical curve and caustic for SISell using the parameter set $(b, \gamma) = (1, \, 0.15)$.