

PHY-765 SS18: Gravitational Lensing. Worksheet Week 10

1 Written feedback and peer reviews

Being able to provide written feedback to collaborators and peer review journal articles is an important skill to acquire. At the end of [this week's slides](#), you'll find a short introduction and guidelines to the peer review process. Re-distributing the [essays you have written \(week 6, exercise 2\)](#), this exercise will train you in providing such feedback. Therefore, read the essay you received and provide written feedback via email following the guidelines in [this week's slides](#). To give (at least) 24 hours to the author for looking through the feedback, before we'll discuss the process in the seminar of week 12 (June 27),

the feedback is due June 26 @ 08:00 (cc feedback to kbschmidt@aip.de)

2 Modeling Lenses

As discussed in [this week's slides](#), lens modeling is an iterative parametric or non-parametric process, trying to find a model that minimizes the disagreement with the observed data. Setting yourself in "the place of an iterative computer code", use the lens model generator http://virtual-universe.org/ego_cgi.html to match the observed Einstein Ring 0047-2808. You can change source and lens positions, parametric model of lens (SIE or NFW), its size, the size of the critical curve etc. You will quickly realize that modeling includes a lot of 'knobs' to turn to fit the data.

3 The Mass Sheet Degeneracy

The main source of uncertainty of most lens models is introduced by the mass sheet degeneracy described in [this week's slides](#).

3.1

Show that

$$\nabla^2 \psi_\lambda = 2\kappa_\lambda \quad (1)$$

holds for the potential

$$\psi_\lambda(\boldsymbol{\theta}) = \frac{1-\lambda}{2} |\boldsymbol{\theta}|^2 + \lambda \psi(\boldsymbol{\theta}) \quad (2)$$

where the remaining parameters are defined in [this week's slides](#).

3.2

Combine the lens equation for the modified surface mass density, κ_λ , and the expression for the deflection angle resulting from the κ_λ to show that

$$\frac{\boldsymbol{\beta}_\lambda}{\lambda} = \boldsymbol{\theta} - \boldsymbol{\alpha}(\boldsymbol{\theta}) \quad (3)$$

3.3

Show that the convergence and shear for the mass sheet degeneracy is given by

$$\gamma_\lambda(\boldsymbol{\theta}) = \lambda \gamma(\boldsymbol{\theta}) \quad \text{and} \quad (1 - \kappa_\lambda) = \lambda(1 - \kappa) \quad (4)$$

where the κ subscript refers to the model where the surface mass density has been modified.