PHY-765 SS18: Gravitational Lensing. Worksheet Week 6

1 Journal Club #1: Paper presentation

Last week (exercise 1) you selected a recent lensing paper based on title and abstract. You have prepared a ∼5 minute overview which will be presented in class this week in a journal club setting.

2 Short Essay on Gravitational Lensing

In the spirit of the 'astronomer skill development', start preparing a written essay on a topic of your own choosing. The goal of this exercise is to train writing and formulating scientific results in your own words in english and in LaTeX. The essay will be used as the starting point for a review/feedback exercise, where we will re-shuffle the essays, and you will provide written feedback and comments to each other. The essay should be in a "journal letter format", i.e., < 4 pages of text and < 4 figures (multiple panels per figure is fine). Examples of scientific letters can be found by browsing the archive of ApJ Letters, e.g., http://iopscience.iop.org/volume/2041-8205/782. As the topic for your essay you can choose one of the following:

1. A lensing theme from the lectures and expand/elaborate on this collecting information from the literature.
2. A lensing topic of you own liking and expand/elaborate on this collecting information from the literature.
3. A lensing-related project that you have been or are working on. Describe the background, motivation and progress of the project.
4. A recent full-length paper from the literature. Re-write it in a letter format, i.e. condense the essentials both in terms of text and figures to fit within the letter format's page and figure limits.

Make sure, that it is clear from the abstract of your essay, what topic/theme you chose, as this will likely influence the feedback you will receive by your peers.

The essay is due on June 6 (Week 9)

3 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

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

4 The Magnification For the Point Mass Lens

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

4.1

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

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

4.2

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