# Gravitational Microlensing and Stellar Polarization

A. Salehi, M. H. Salimi
Supervised by: Prof. P. Sahebsara

Department of Physics, Isfahan University of Technology, Isfahan 84156-8311, Iran.

*themhsalimi@gmail.com*
*alisalehi076@gmail.com*

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Subrahmanyan Chandrasekhar (1910 - 1995)

"Science Is A Place Where What You Find In Nature Pleases You."

# Overview

1. Gravitational Microlensing
   - The Increase In The Brightness Of A Background Star Due To Passing Through The Gravitational Field Of A Foreground Object.

2. Polarization
   - A Property Applying To Transverse Waves That Specifies The Geometrical Orientation Of The Oscillations.

# Lens Structure

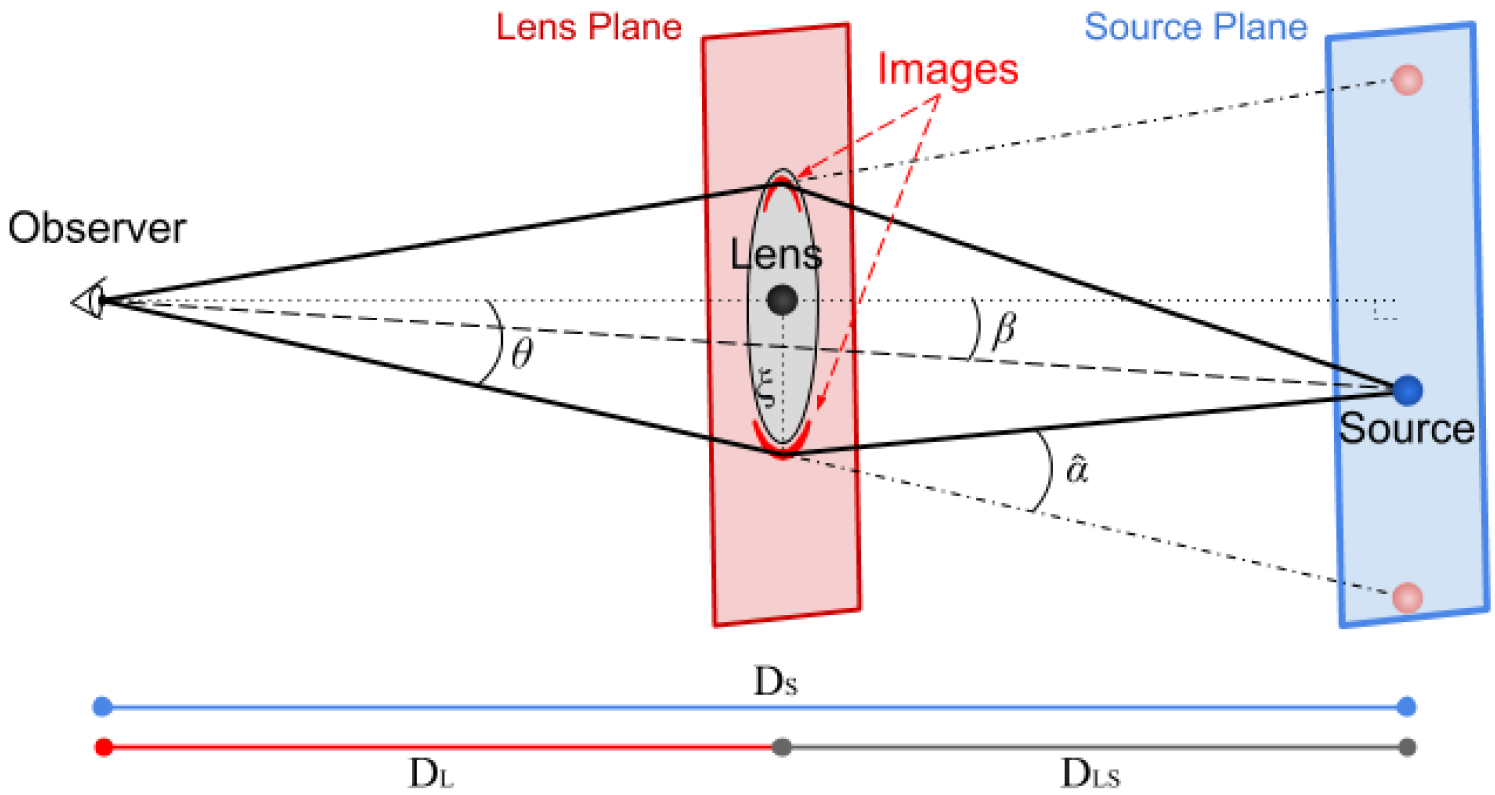


Figure 1: Representation Of Lensing Geometry

# Lens Equation

From General Relativity We Know

$$\alpha = \frac{4GM}{c^2 b}\,. \tag{1}$$

We Define

$$\theta_E = \sqrt{\frac{4GMD_{ls}}{c^2 D_l D_s}}\,. \tag{2}$$

After Some Algebra

$$\theta^2 - \beta\theta = \theta_E^2\,. \tag{3}$$

# Magnification Equation

The Magnification Equation is

$$A = \frac{u^2 + 2}{u\sqrt{u^2 + 4}}\,, \tag{4}$$

where

$$u = \frac{\beta}{\theta_E}\,. \tag{5}$$

# Source Images

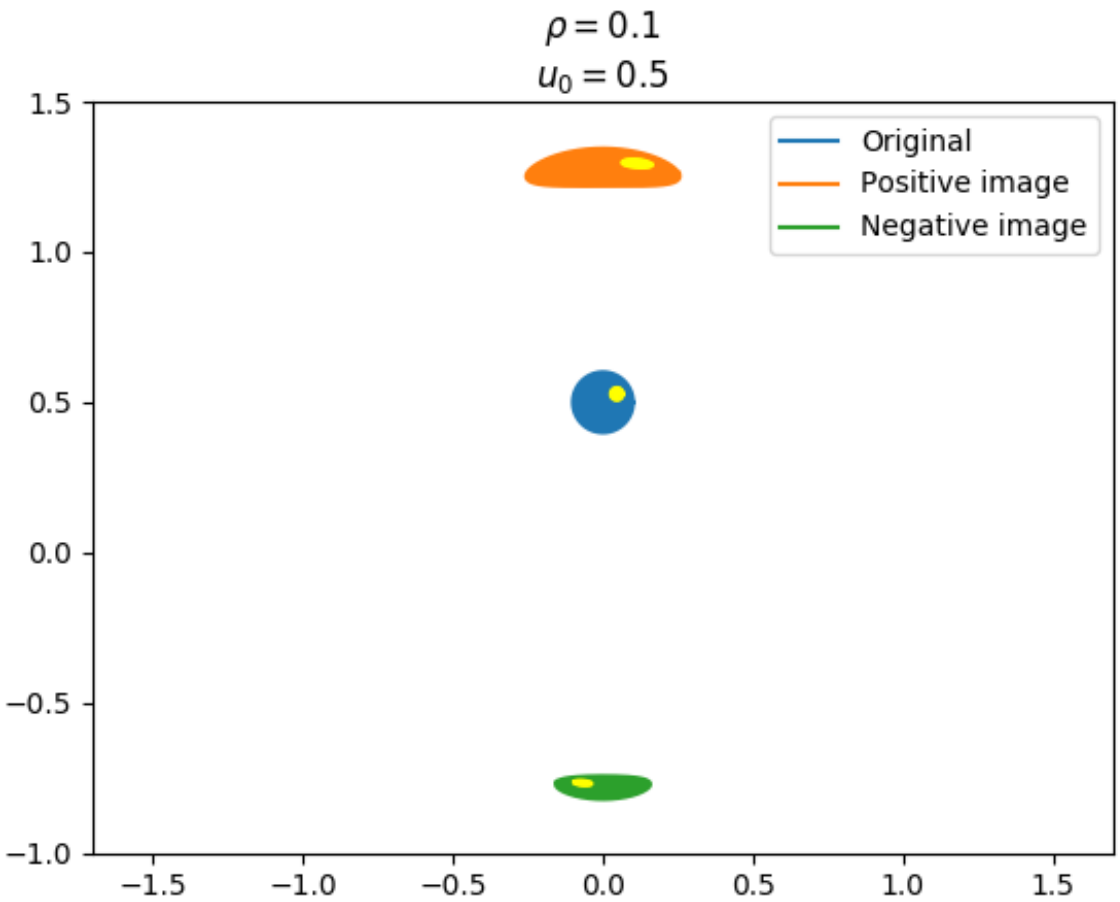


Figure 2: Schematic Of Source Star And It's Images Caused By Microlensing

# Polarization

- Stars Atmosphere Create Polarization.
- Stokes Parameters.
- Due To Microlensing, Symmetry Breaks.
- The Degree Of Polarization

$$P = \frac{\sqrt{Q^2 + U^2}}{I} . \tag{6}$$

# Stars Atmosphere Create Polarization

- Because The Received Light Is Incoherent, There Is No Circular Polarization.
- If There Is Spherical Symmetry, The Linear Polarization Signals Cancel Out.

# Stokes Parameters

Stokes Parameters Denoted by I, Q, U, V Where

- I : The Total Intensity,
- Q : The Difference In Intensity Measured In Two Perpendicular Directions x And y,
- U : The Difference In Intensity Measured In Two Perpendicular Directions At 45° To The x- And y- Axes,
- V : Net Circular Polarization.

# Conclusion

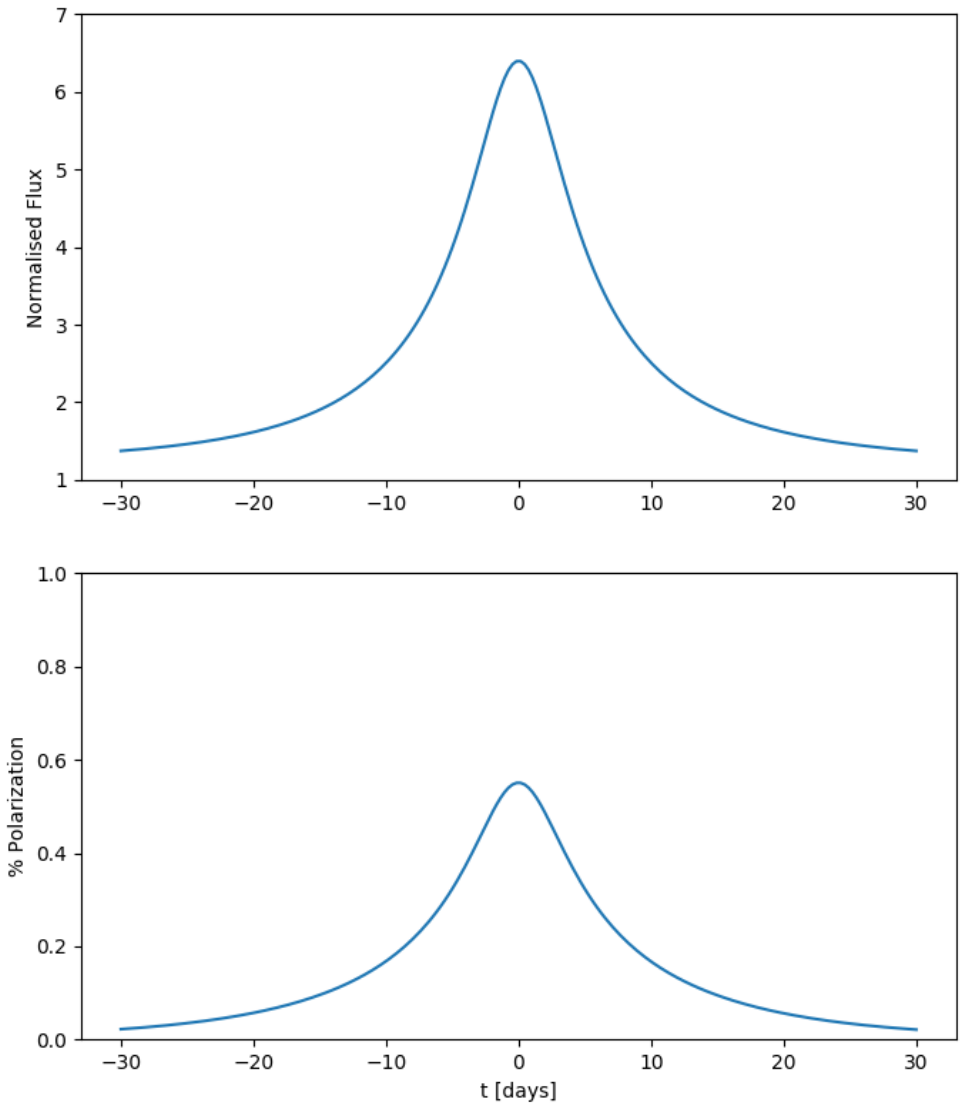


Figure 3: Flux and magnification profiles of a microlensing event with $\rho_\star = 0.1$, $u_0 = 0.2$, and $t_E = 20 days$

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# Thanks For Your Attention :)