

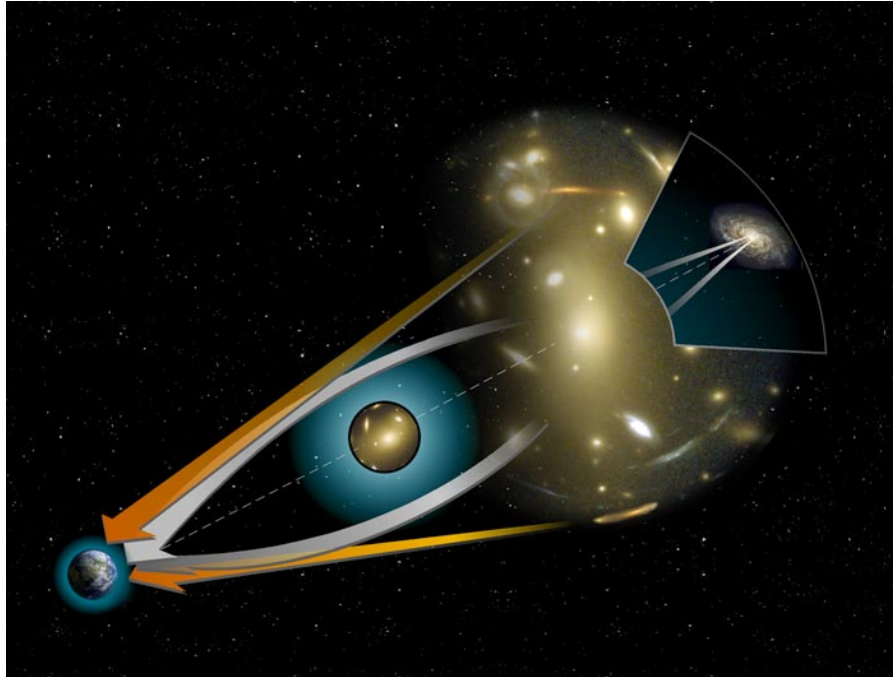
Constrain Point Spread function by using Galaxy Images

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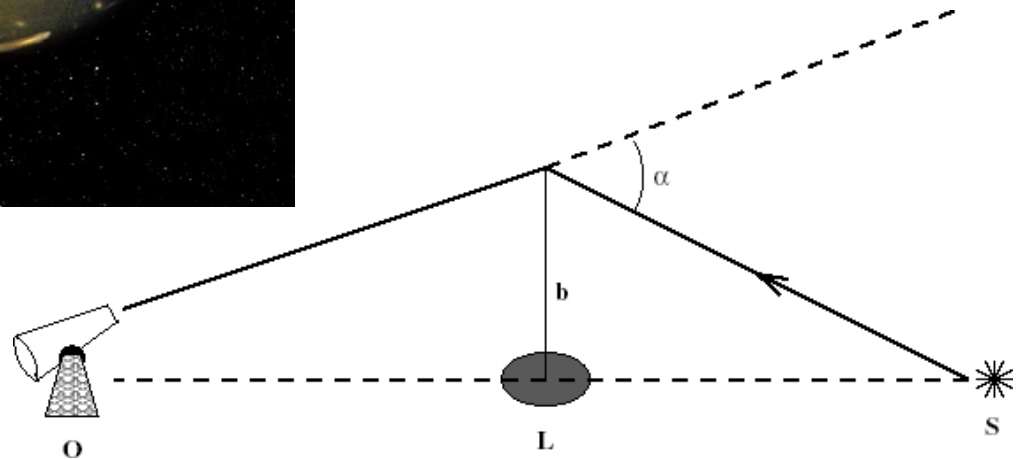
Outlines

- Quick view on cosmic shear measurement.
- Why we need galaxy images to constrain point spread function(PSF).
- How we do it.
- Some test results.

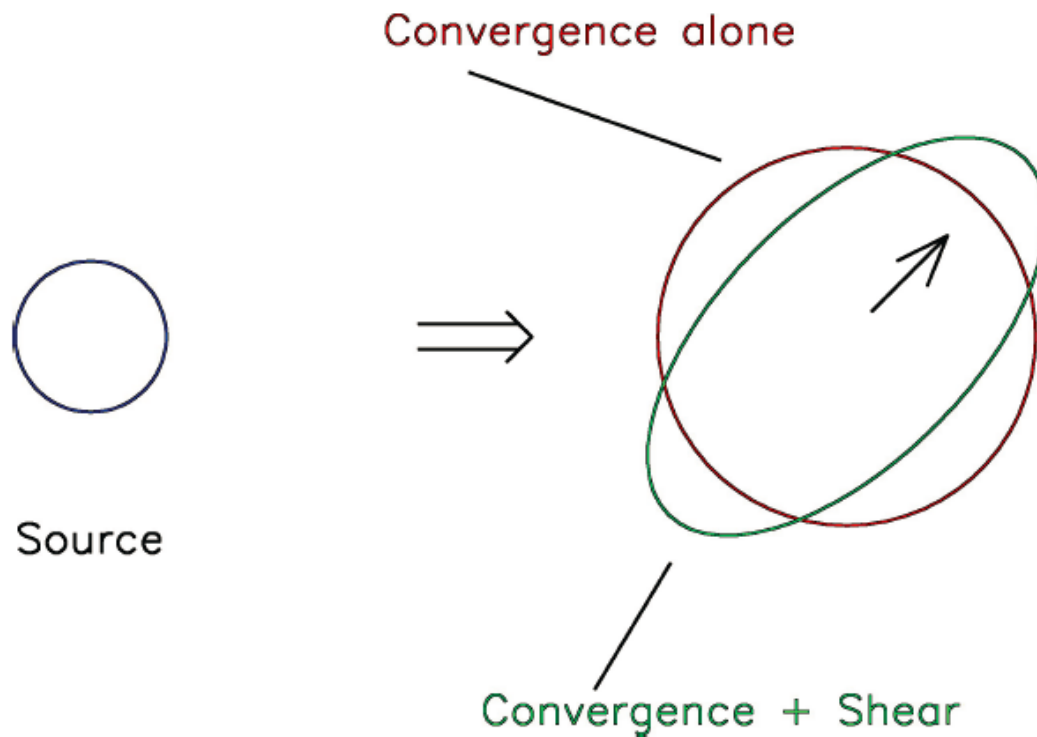
What is gravitational lensing?



$$\alpha = \frac{4GM}{bc^2}$$



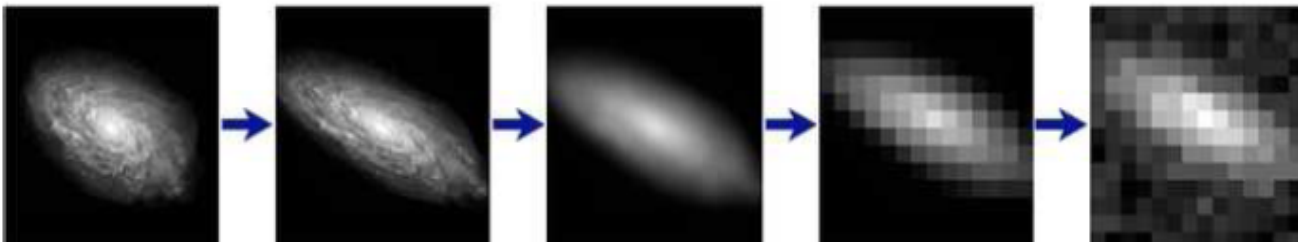
Weak lensing effects



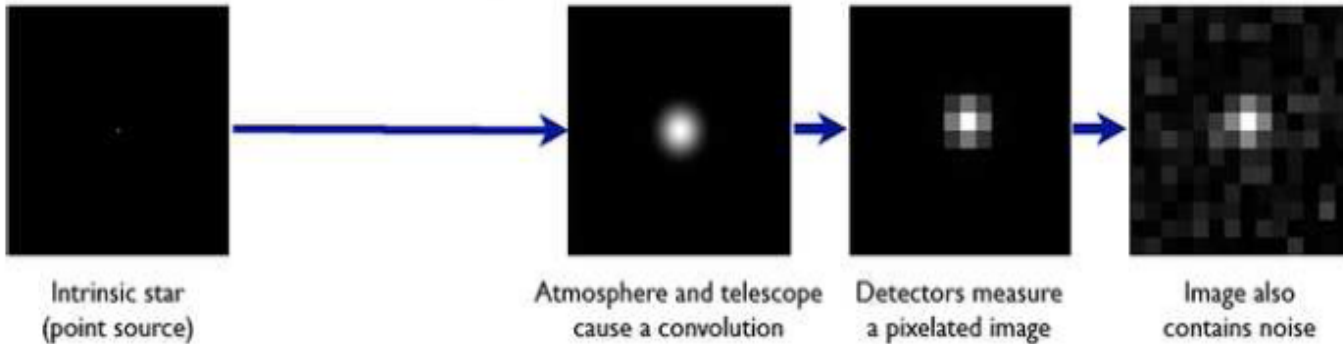
Point Spread Function

The Forward Process.

Galaxies: Intrinsic galaxy shapes to measured image:



Stars: Point sources to star images:



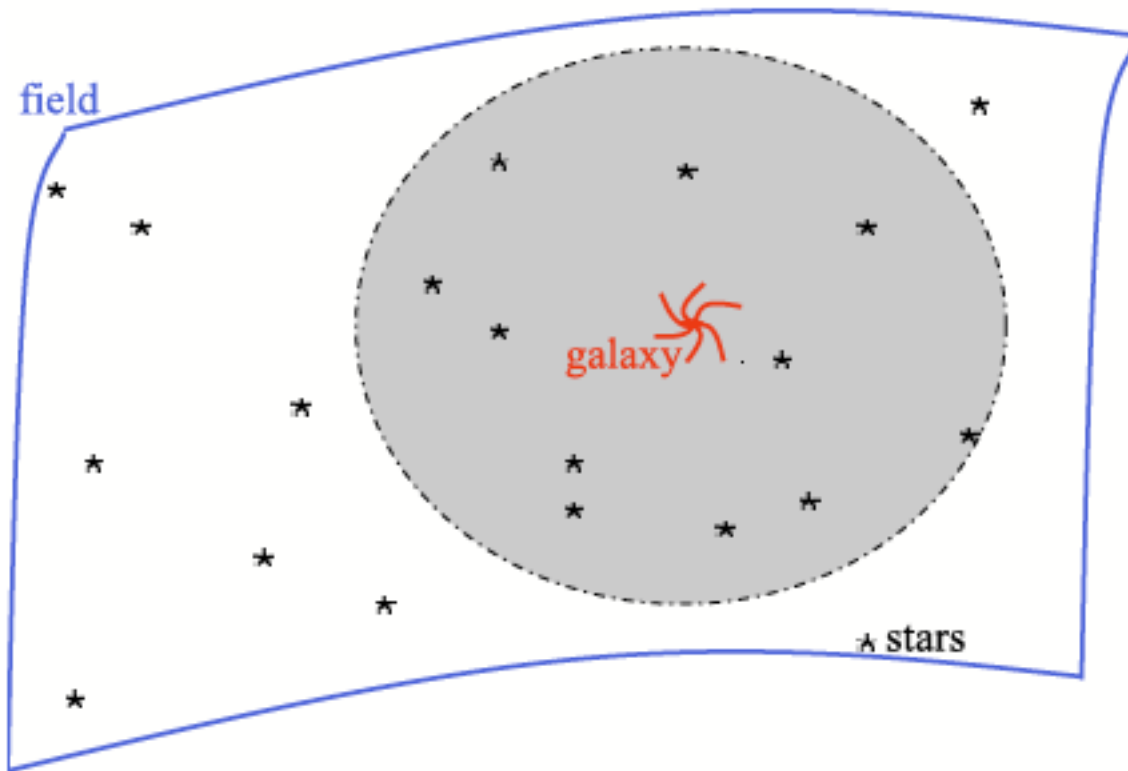
Usually, the distortion introduced by PSF is larger than that caused by cosmic shear!

How do we do the reconstruction?

- A) Star identification.
- B) Parameterized image of stars.
- C) Interpolate the parameters in the field of view.
- D) Create the expected PSF at the position of galaxies.



Motivation



Paulin-Henriksson et al. 2008

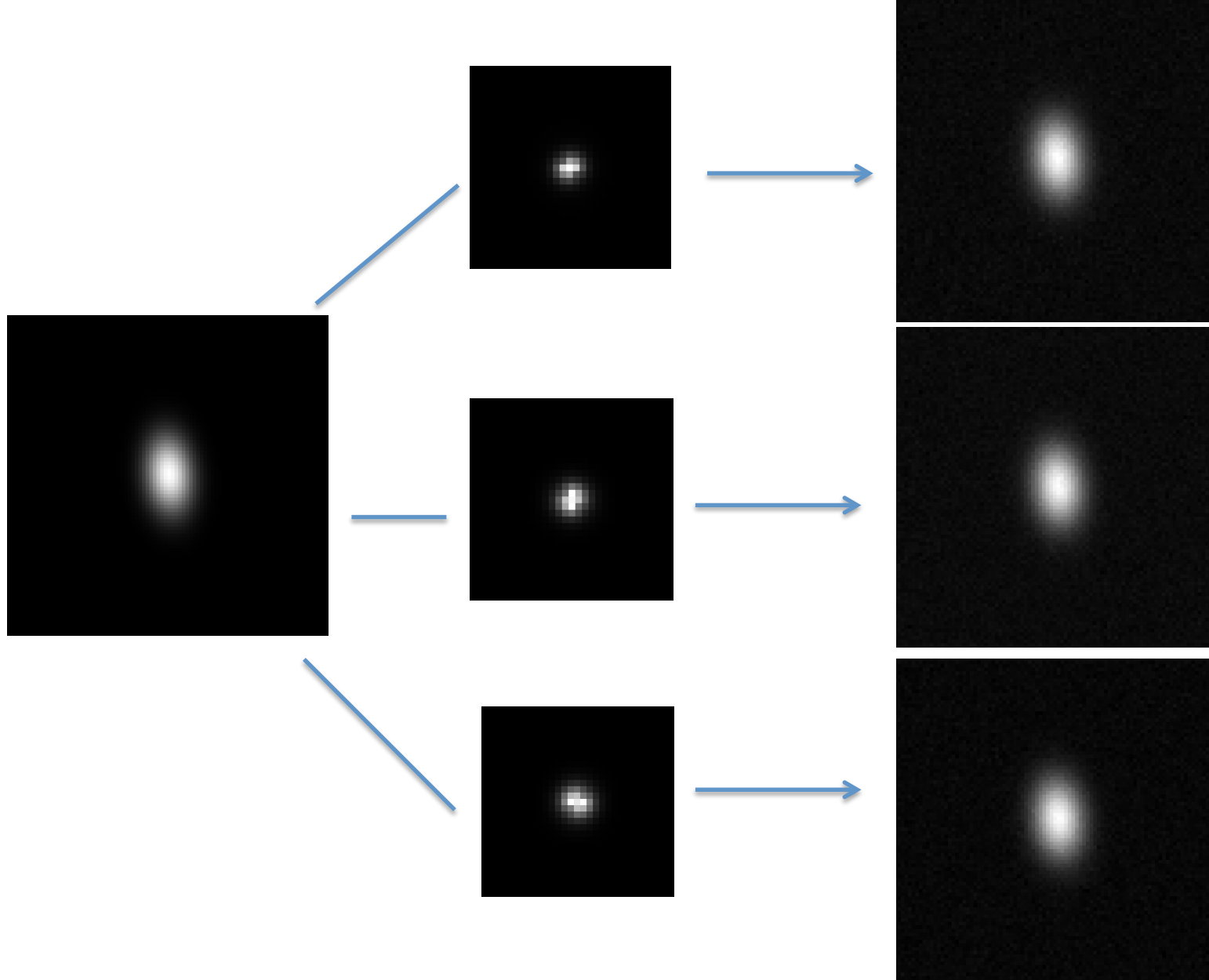
$$\sigma_{\text{sys}}^2 \lesssim 10^{-7}$$



$$\frac{\sigma[R_{\text{PSF}}^2]}{R_{\text{PSF}}^2} \lesssim 10^{-3},$$

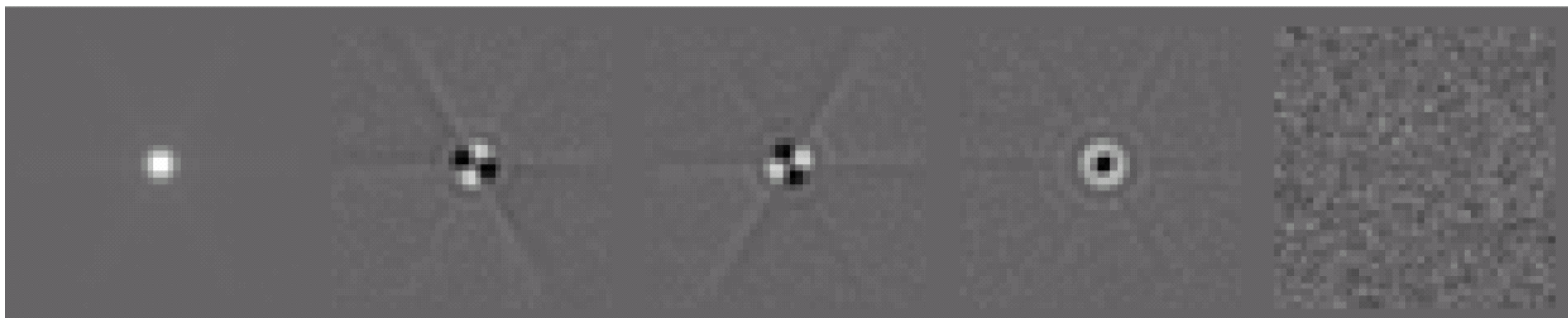
$$\sigma[\epsilon_{\text{PSF}}] \lesssim 10^{-3}.$$

$$\delta\epsilon^{\text{sys}} \simeq (\epsilon_{\text{gal}} - \epsilon_{\text{PSF}}) \frac{\delta(R_{\text{PSF}}^2)}{R_{\text{gal}}^2} - \left(\frac{R_{\text{PSF}}}{R_{\text{gal}}}\right)^2 \delta\epsilon_{\text{PSF}}$$



Unknowns: $N \times N$ + $n \times N \times p \times N \times p$

Knows: $n \times N \times N$

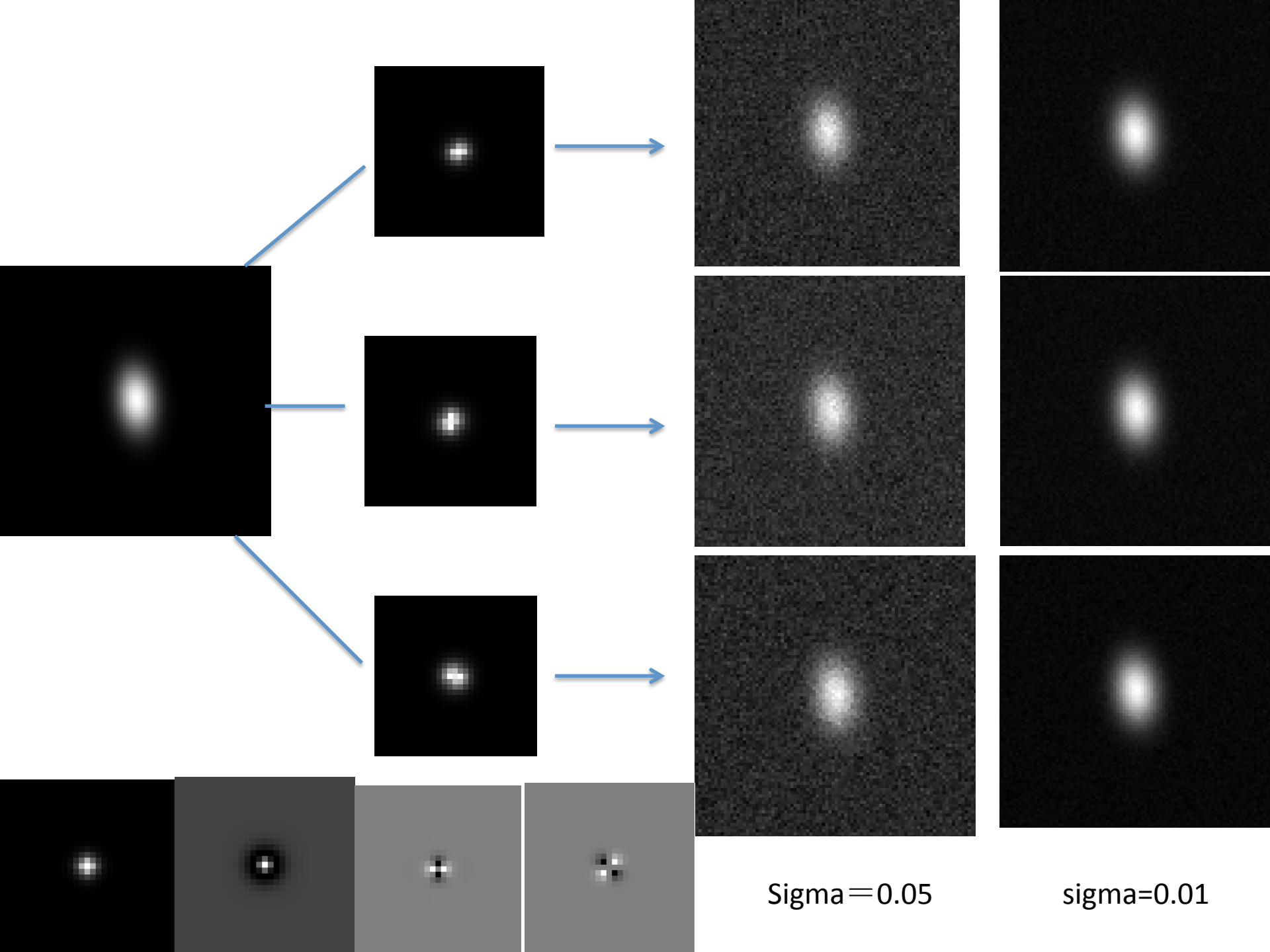


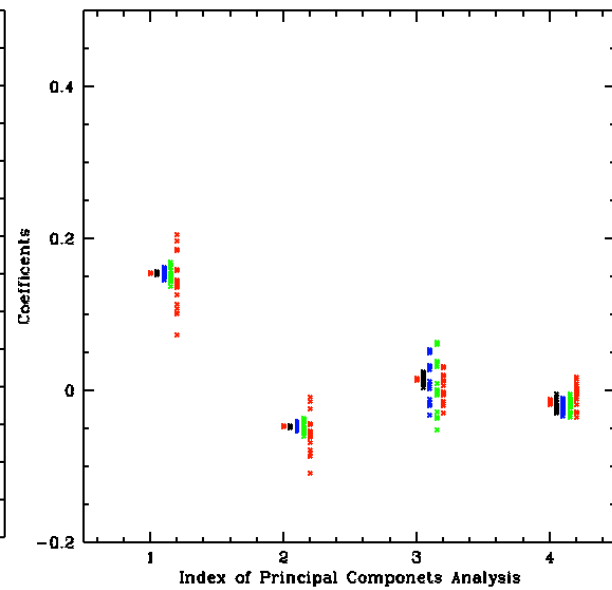
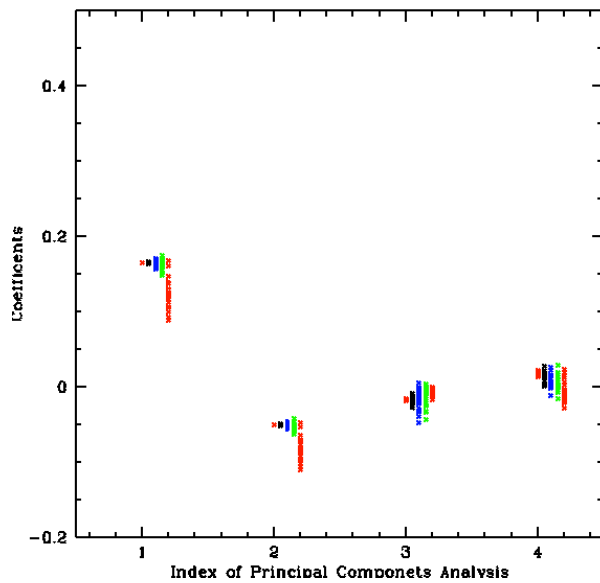
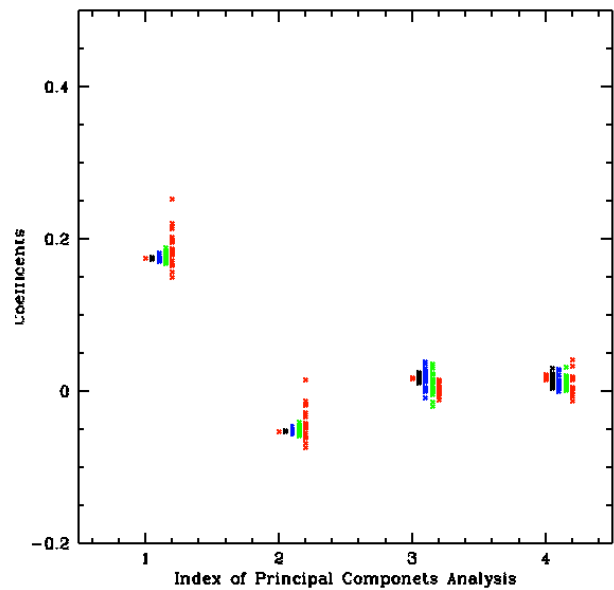
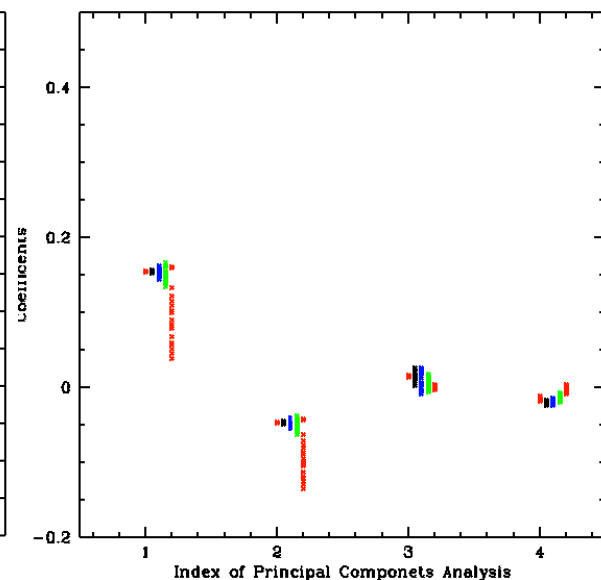
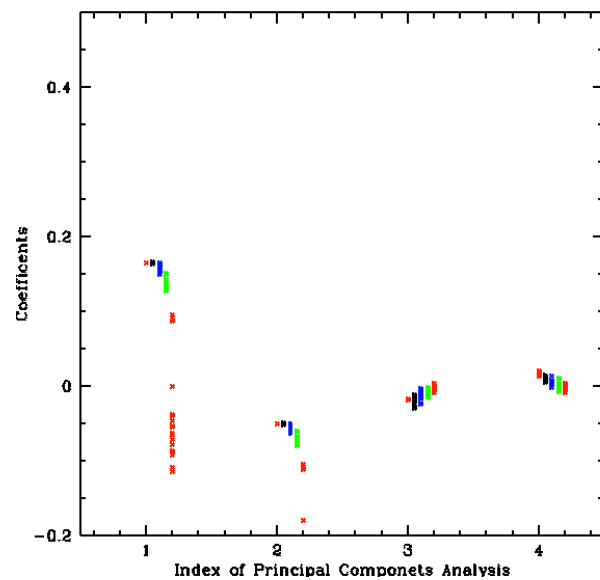
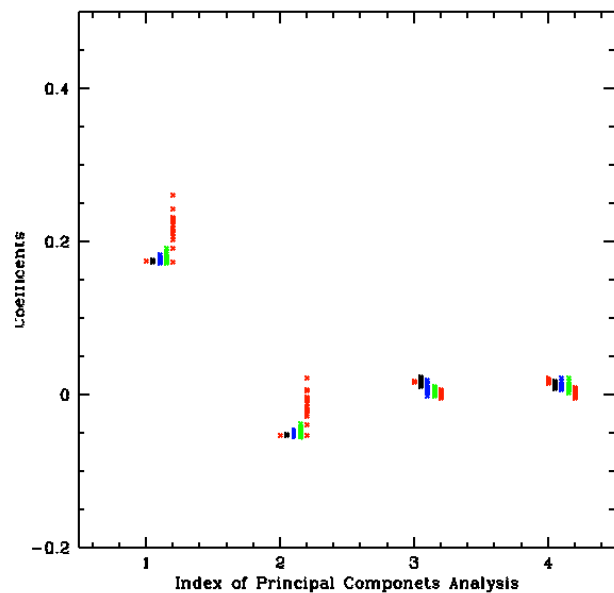
假设由其他星导出的PSF可以完备地描述星系所属的PSF

PSF的 $N_g \times N_g$ 个变量还可以用几个主成分的系数来表示, $PSF_i = \sum_l^{NPC} c_{il} PC_{il}$

$$G_0 \otimes PSF_i \otimes PSF_j = G_i \otimes PSF_j = G_j \otimes PSF_i = G_0 \otimes PSF_j \otimes PSF_i$$

$$\chi_{ij}^2 = \sum_k^{N_{pixel}} \frac{(G_i \otimes PSF_j - G_j \otimes PSF_i)_k^2}{\sigma_{ijk}^2}$$





Summary

- We constructed an algorithm to constrain PSF by using the galaxy images.
- Noise can bias the results but can be corrected with a simple filter.
- Apply to the real data soon.

Thank you!