NIFTy session

Weak lensing with NIFTy

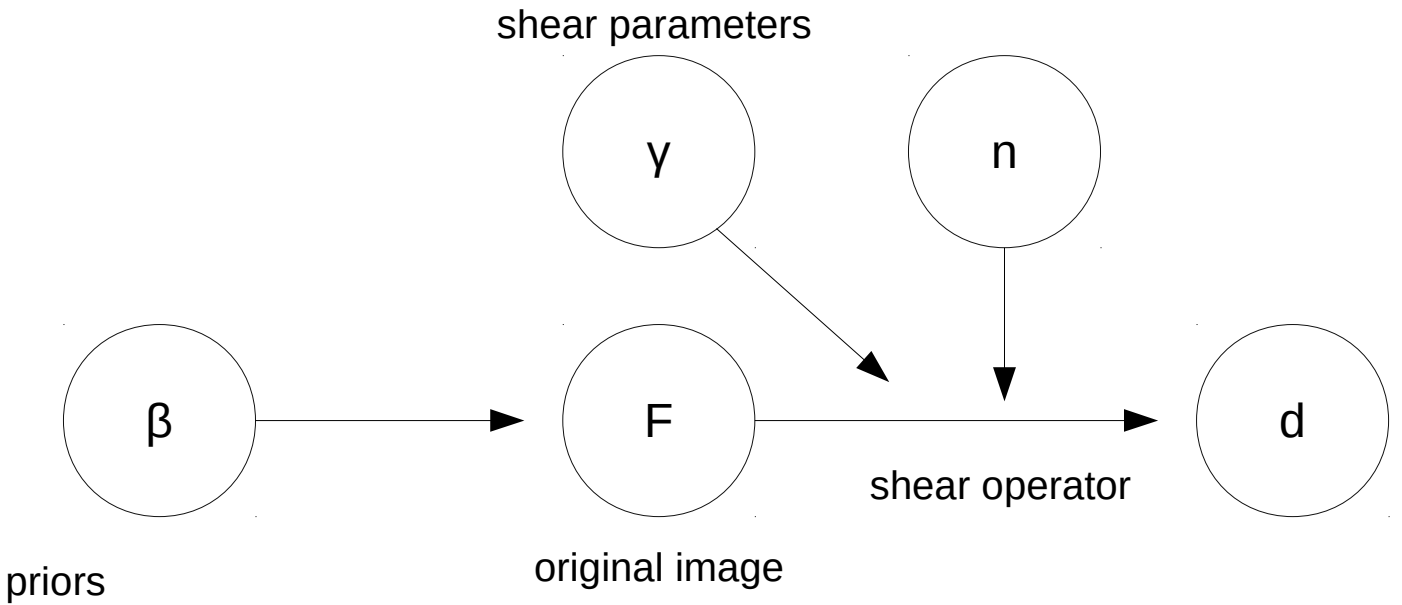
Andrija Kostić
Master Physik

A little bit about lensing

(slides 2 - 8)

Simple problem

- Shearing a galaxy with a given brightness profile: $I(r) \sim \exp(r/r_0)$
- Shear parameters are known: $\gamma_1 = 0.1, \gamma_2 = 0.2$
- Assumed homogeneity and isotropy of the prior



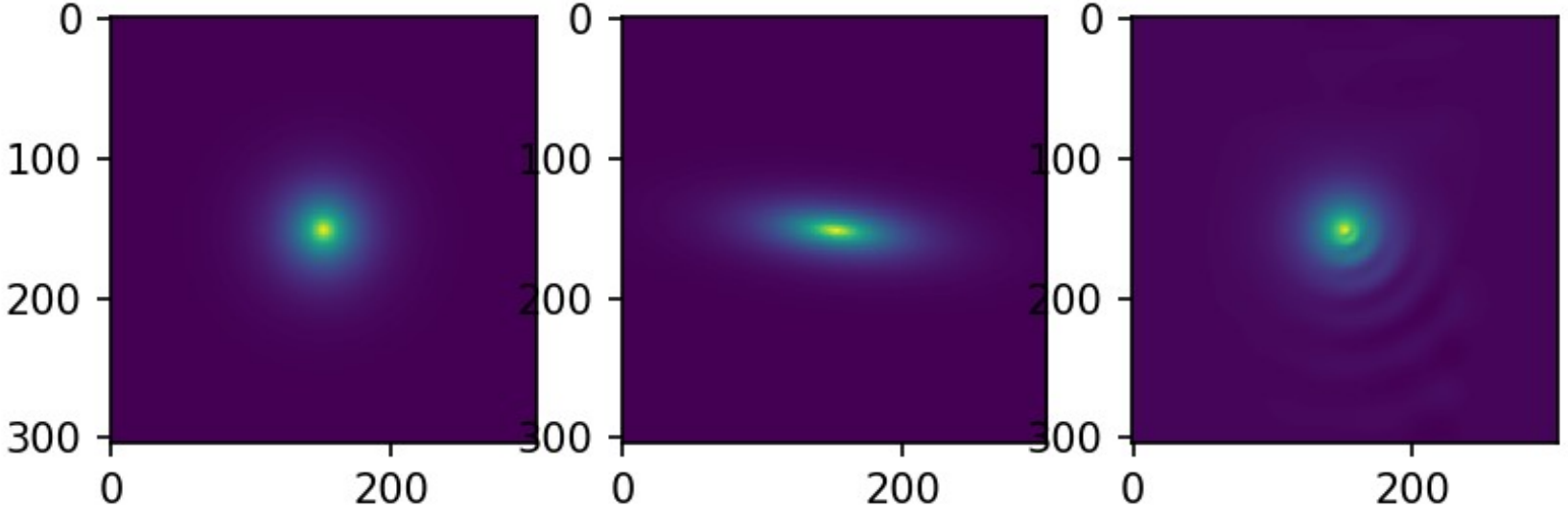
Power spectrum*:

$$\frac{5}{10 + k^2}$$

* Ensuring positivity

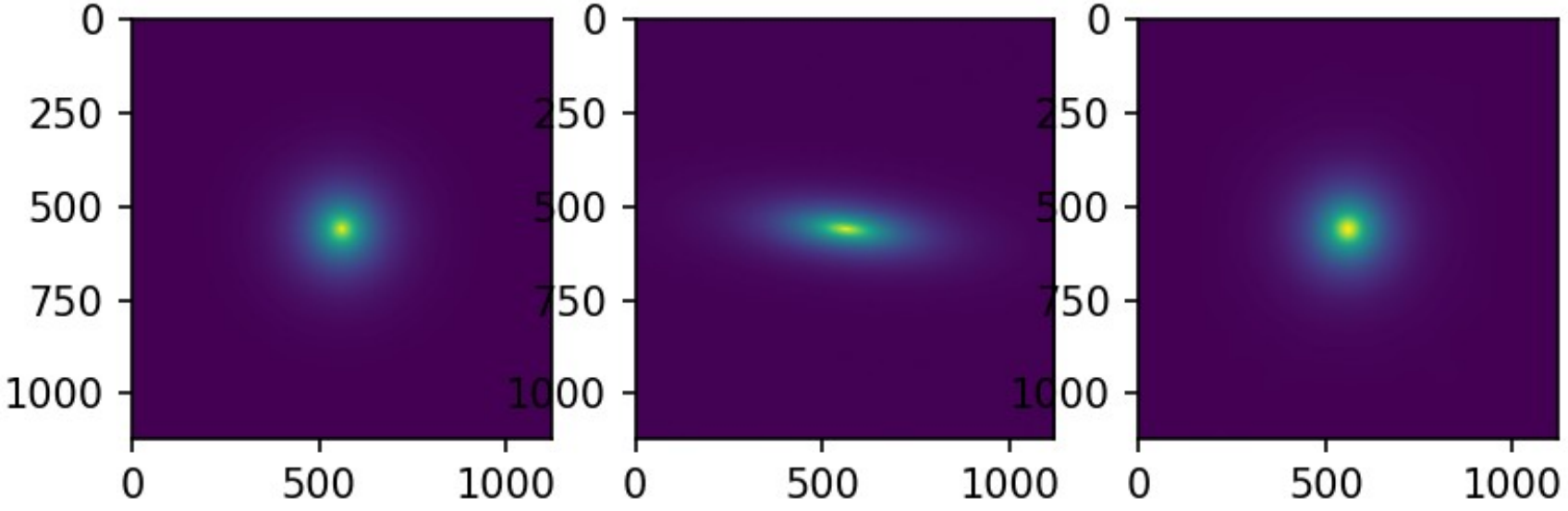
Results - reconstructions

$r_0 = 2.7$ (around 20 pixels)



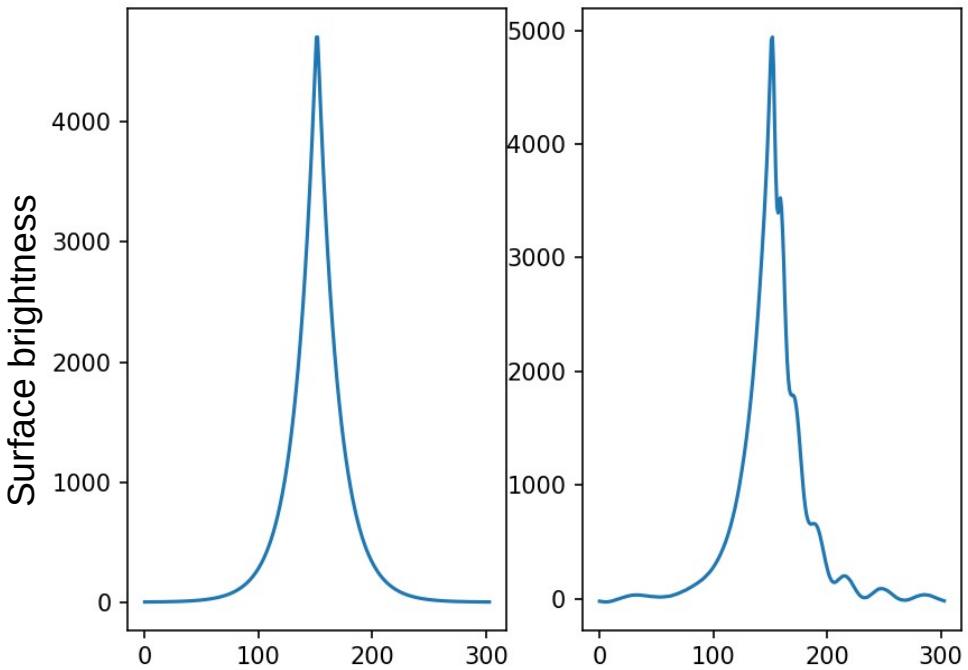
Results - reconstructions

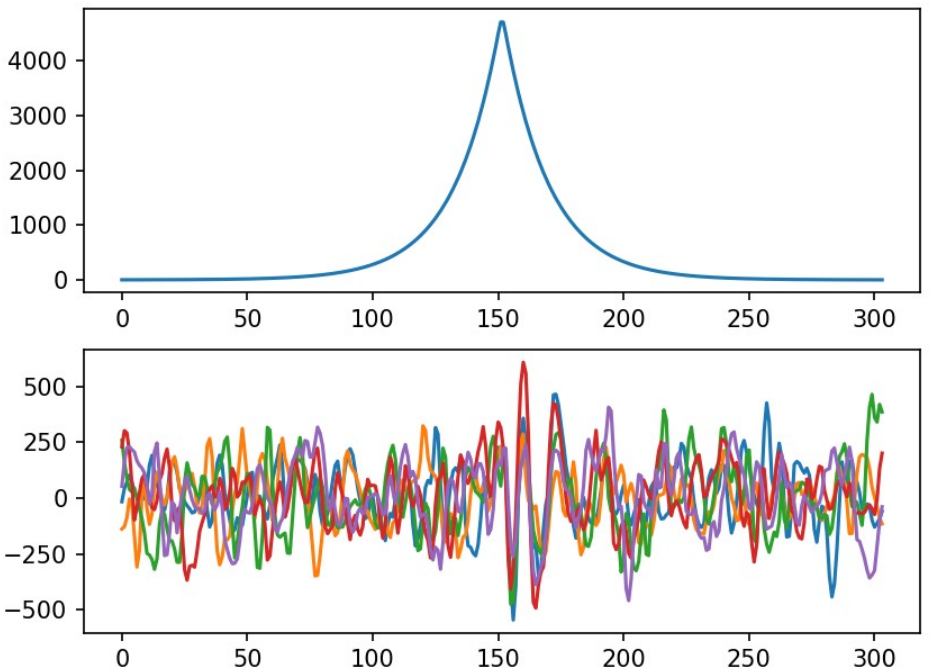
$r_0 = 10.$ (around 70 pixels)



Results - errors

$$r_0 = 2.7$$

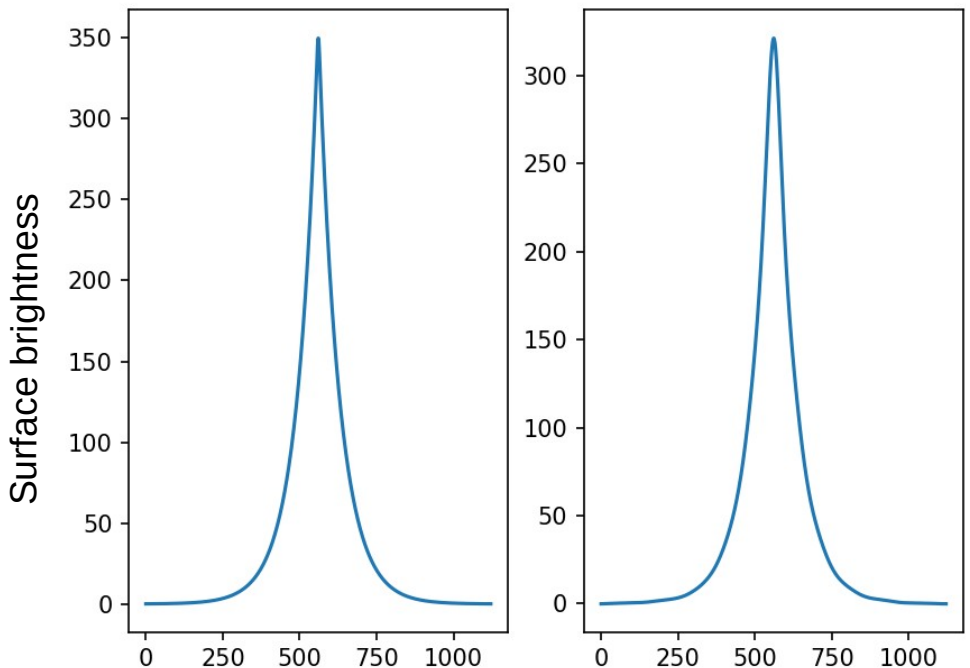


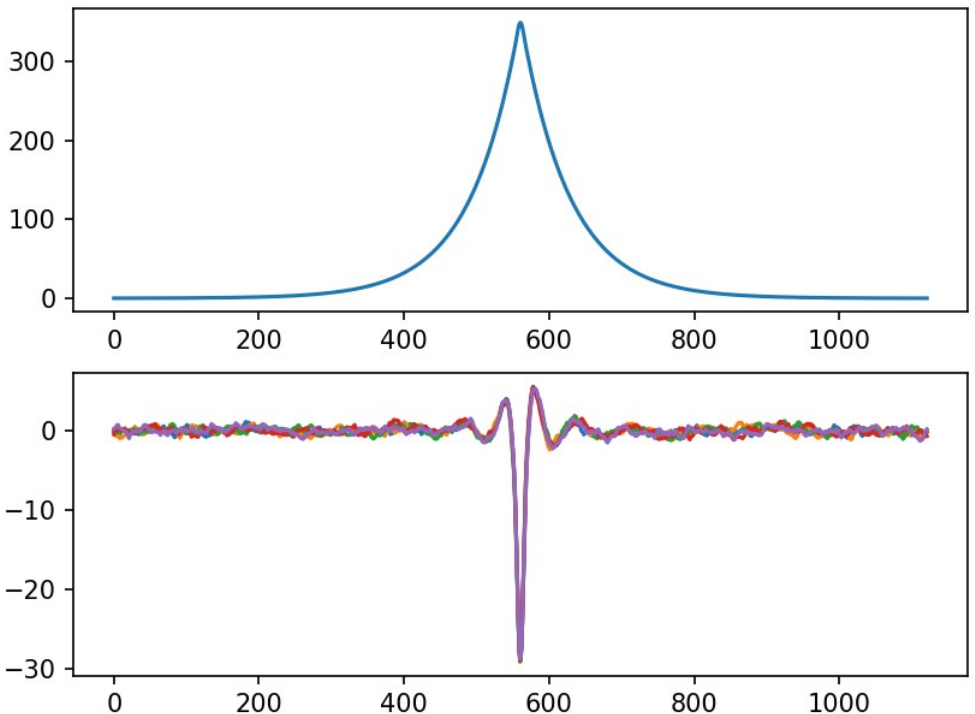


At the peak error ~ 12%

Results - errors

$$r_0 = 10.$$

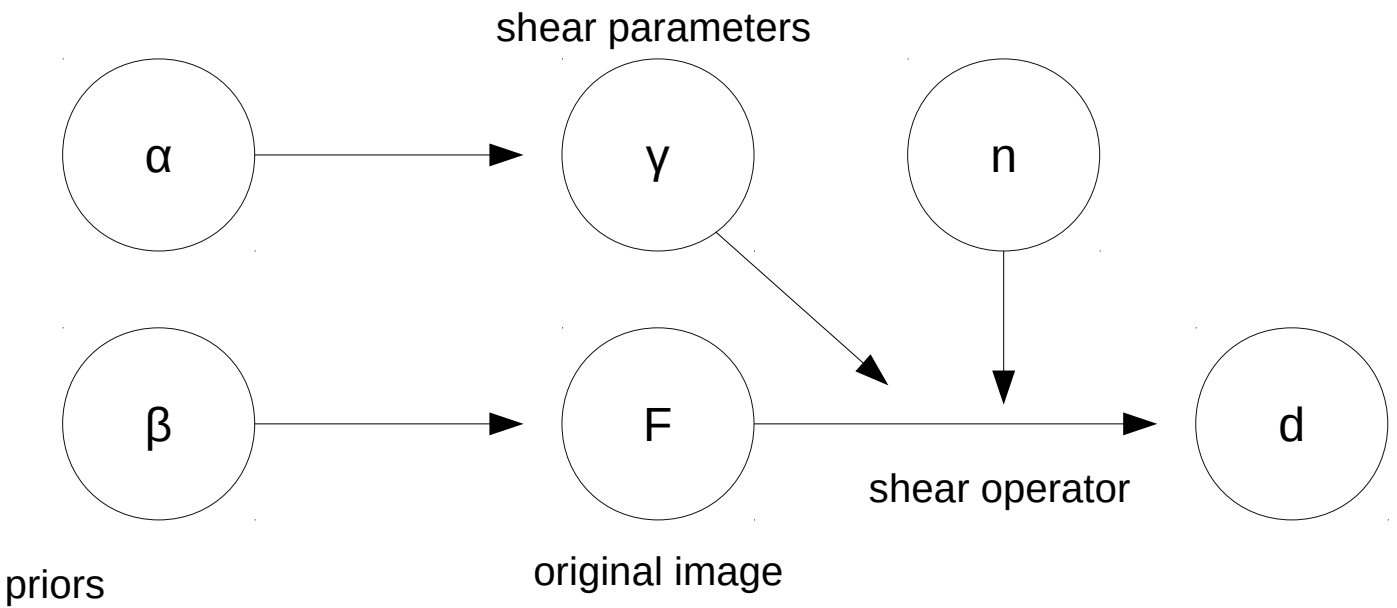




At the peak error ~ 10%

Uknown shear

- We would like to infer also the shear parameters, as well as the initial brightness profile



Uknown shear - problem

- I don’t know how to formulate the response mapping for NIFTy $d = R_\gamma F + n$
- Possible to express locally:

$$F' = (1 + A(\gamma_1, \gamma_2)\nabla_\theta)F, \quad \gamma_1, \gamma_2 \to 0$$

$$A(\gamma_1, \gamma_2) = \begin{pmatrix} -\gamma_1 & \gamma_2 \\ \gamma_2 & \gamma_1 \end{pmatrix}$$

- But for arbitrary gamma? *

* Mapping between F’ and F for very strong field and very weak field is known, but I don’t know the mapping for the intermediate gamma

Potential solutions / improvements

- Maybe do the transformations in the shapelet space, since it is clear how to do. But problem is to see how much is lost in the shapelet decomposition
- We can do better with the prior spectrum to fix the offset in surface brightness *

* since total surface brightness is conserved the brightness close to the center of the sheared image would be very similar to the initial image

Benefits

- Would be useful to map out the matter density throughout the universe, using weak lensing maps, hence testing cosmological models

euclid

Thanks for your attention!