Detection of bright multiply imaged quasars with GAIA

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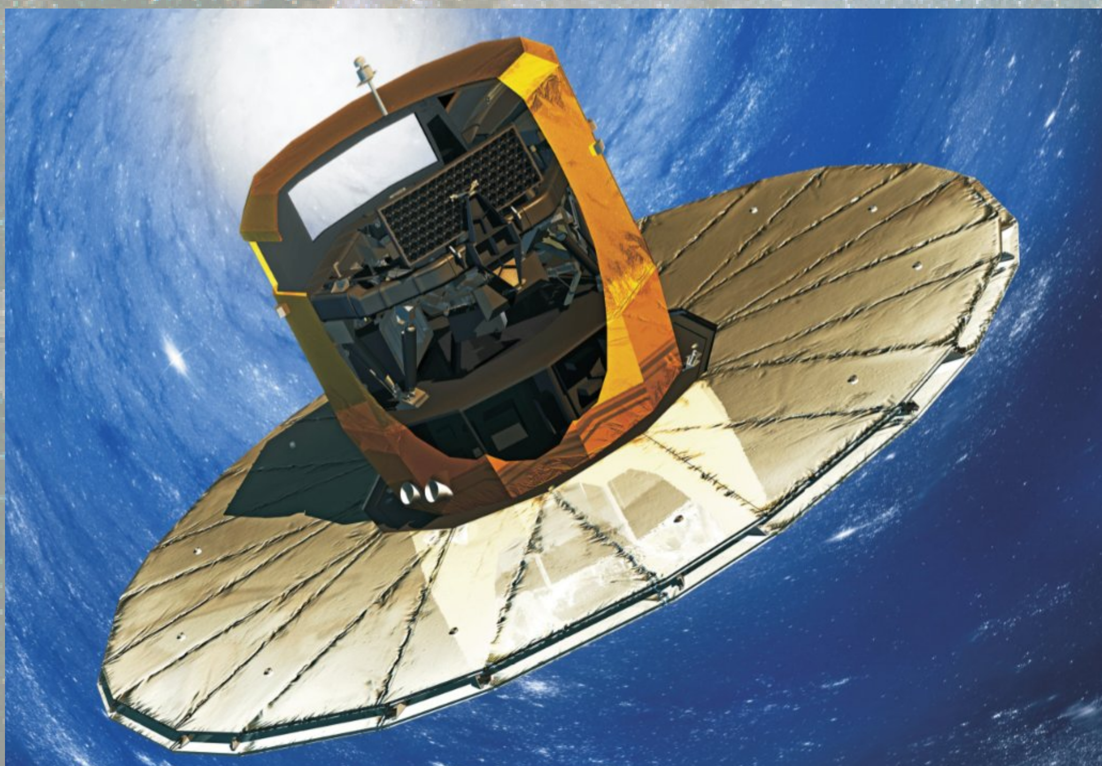
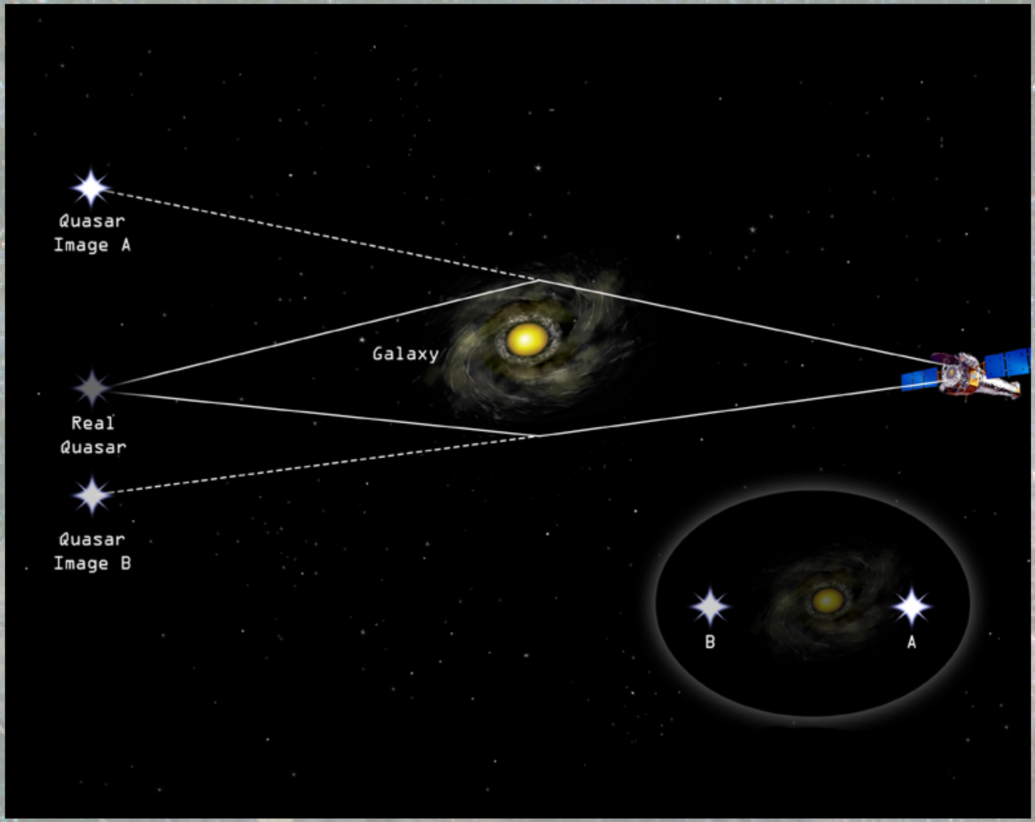
Number of lensed Quasars in the GAIA survey?



- GAIA :
  - ~500 000 Quasars
  - G < 20
- Number of lenses?
  - Probability for a single source ?
  - Simulate catalogs

Gravitational lensing : principle

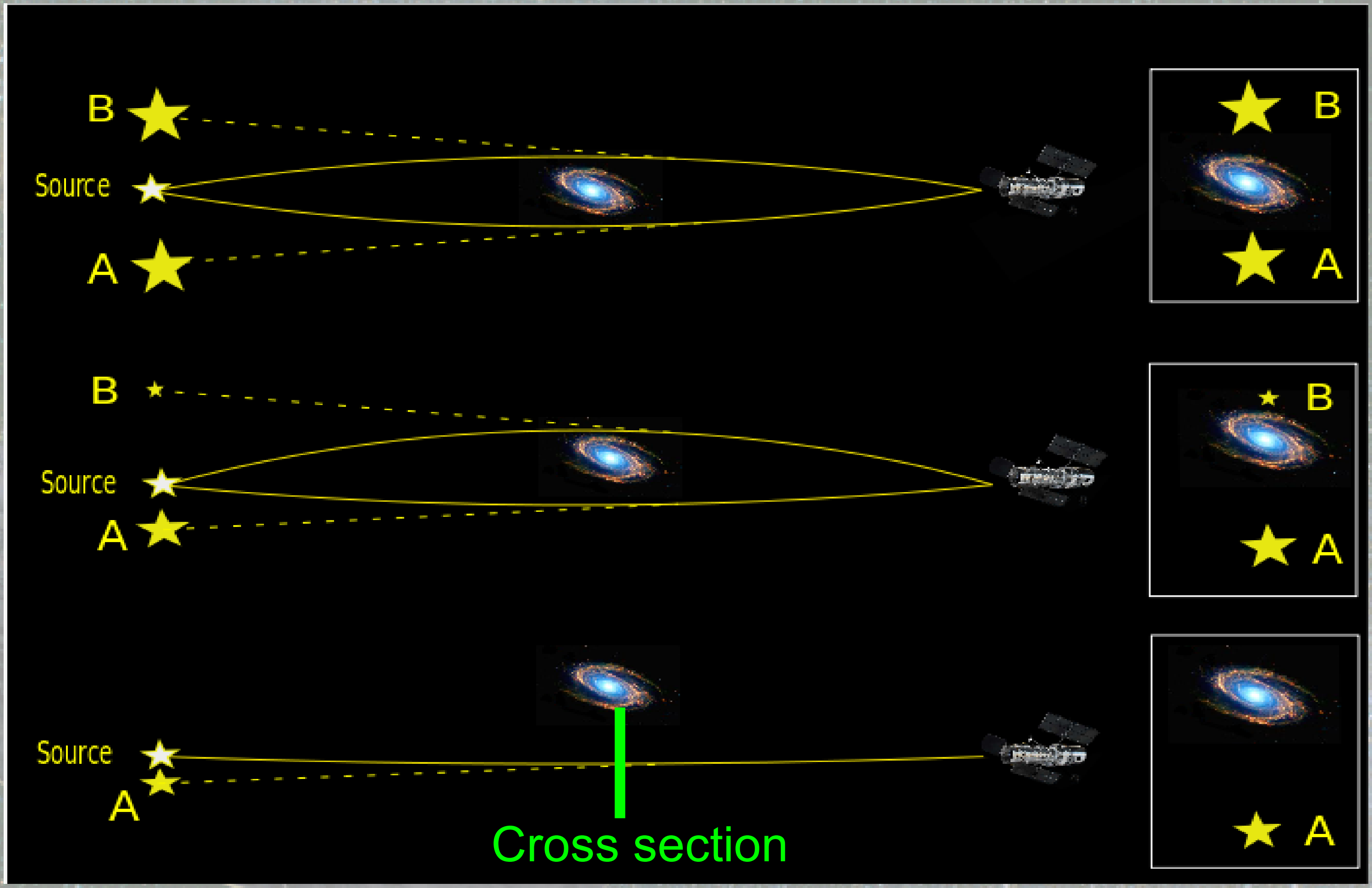


- Light rays emitted by a background source
- Deviation of light rays due to a foreground deflector
- Multiple images, distortion, amplification

- Source with known ***z*** and apparent magnitude:

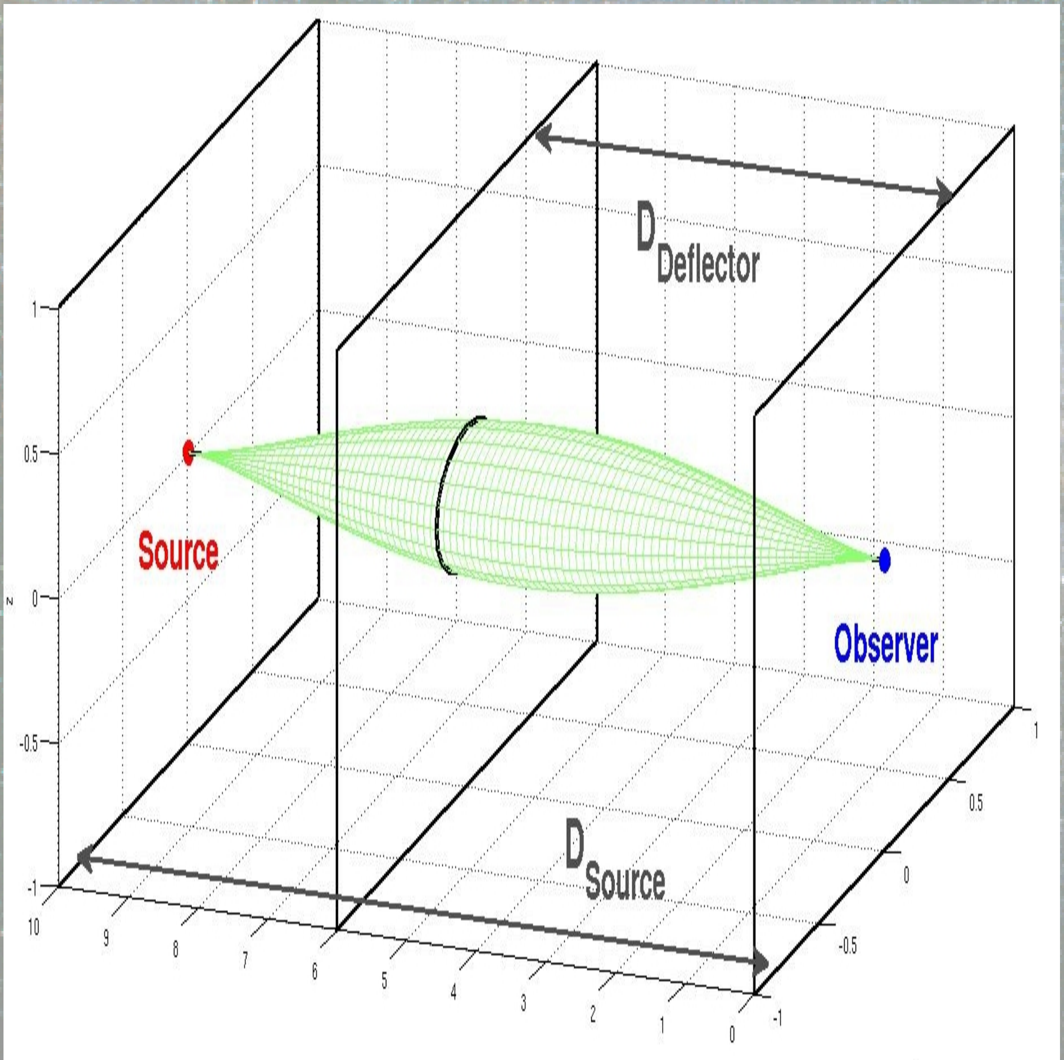
→ Probability of a lensing event?

Lensing geometrical cross section



Function of : deflector type, redshifts

Lensing Volume



- Probability of lensing :
  - Integrating on effective volume
  - Deflector presence probability density function
- We need to know:
  - Deflector model
  - Deflector distribution
  - Cosmological model

Amplification Bias

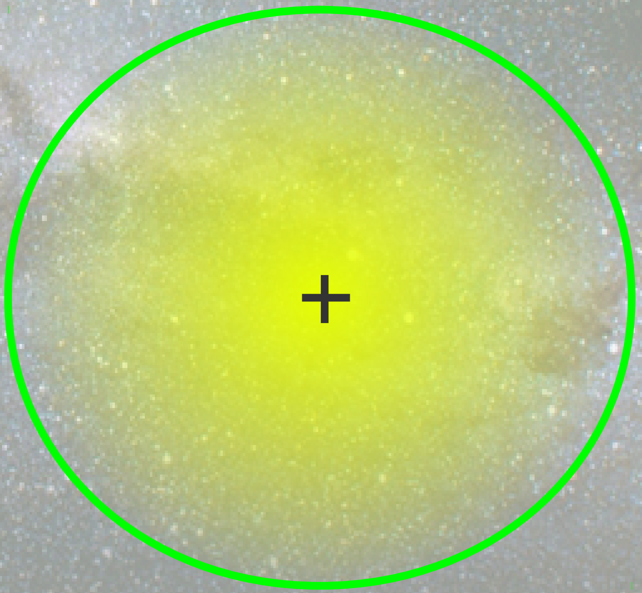
- Probability associated to a source with a given G_{ap}

$$G_{ap} = G_{intr} + Dg_{ampl}$$

- Through Cross section :
  - Amplification changes with the deflector position
  - Different amplification → source with different intrinsic magnitude!
  - During integration : weighing by the fraction of concerned sources

- Correction factor : *Amplification Bias*

→ Need of the QSO Number count function!



Geometrical Cross section

Probability of GL event

Lensing event probability depends on :

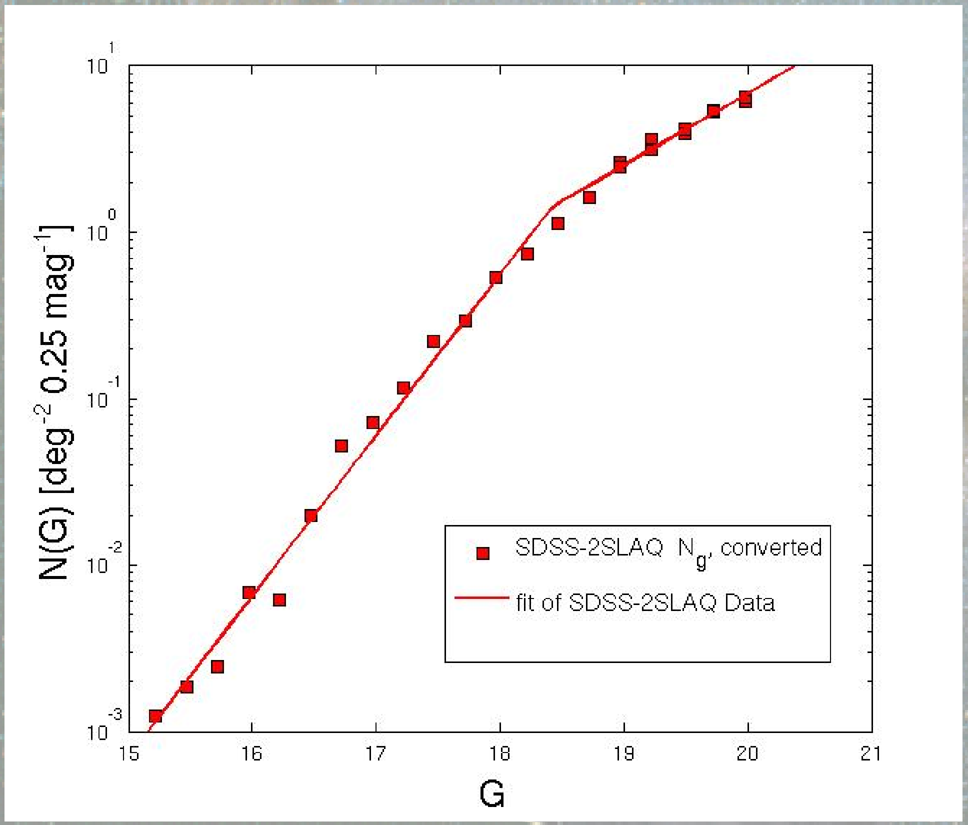
- Deflector model :
  - Singular isothermal Sphere
  - Spherical symmetry

- Deflector distribution :
  - Constant spatial co-moving density
  - Constant deflector luminosity function (with redshift)

- Cosmological model :
  - FLRW flat universe
  - Omega matter = 0.27 , H_0 = 72 (km/s/Mpc)

- Source Number count function (→ *Bias*)

Number Counts Function



- N(g) known by
  - SDSS Dr3 (Richards 2006)
  - 2SLAQ
- Conversion g → G
  - (g-i) → (G-g)
    (Slezak & Mignard 2007)
  - Mean <g-i> from SDSS Dr3
- Fit by 2 power laws
  (break from Narayan 1989)

Catalog Simulation

- Catalogue simulation :
  - Need of the Luminosity function of Quasars
  - ***G*** magnitude : $G = M_G + 25 + 5\log(D_{lum}) + K$
  - Reject sources with ***G >20***
- Luminosity Function from SDSS i band (Richards et al. 2006)
- Using :
  - Mean <g-r> and <g-i> for each z (Slezak&Mignard 2007)
  - <g-G> = P(<g-r> ; <g-i>) (Slezak&Mignard 2007)

  → <g-G>,<g-i> known as a function of z

  → <G-i> known as a function of z

→ LF estimation known for each redshift in G-band

Results

- Mean Probability : P ~ 0.0059

  → 500000 * 0.0059 = 2950 Lenses

- Reconstruction of QSO Statistical sample:
  - From Gaia QSO catalog:
    - Unlensed sources
    - Lensed sources with unresolved images
    - Lensed sources with resolved and separated images
  - From Gaia extended object catalog:
    - Lensed sources with resolved and joined images
    - With QSO-like spectra

Perspectives

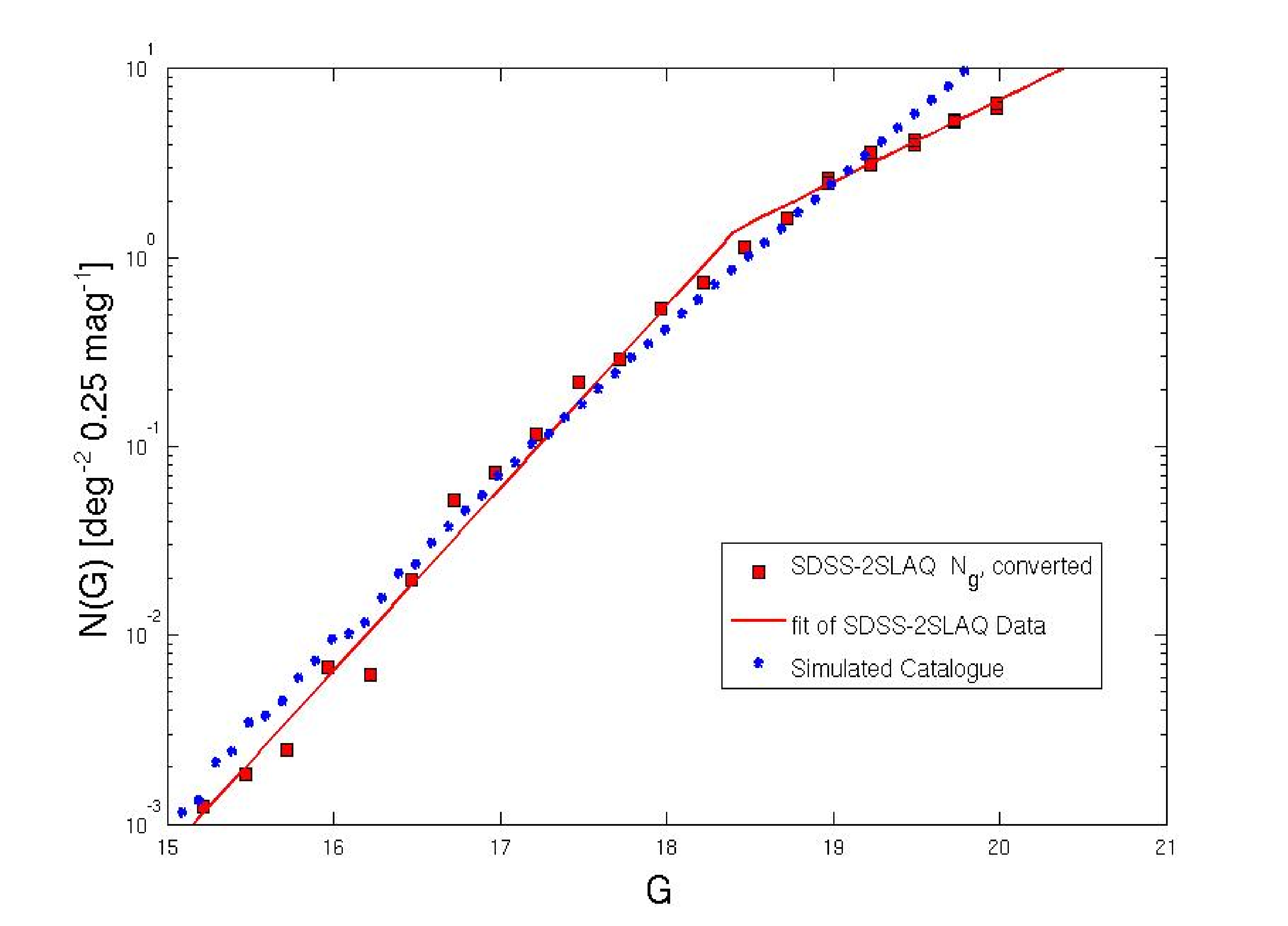
- Use reconstructed QSO statistical sample

- Adjust the model parameters to fit real statistics
  → constrain model parameters!

- Complexify the model
  - Deflector model
  - Deflector distribution

The End

Number count function



Catalog Simulation

- If we know:
  - Redshift distribution
  - Quasar LF (in G-band)

- Generate sources respecting
  - ***M**G* distribution
    (Luminosity Function)
  - ***z*** distribution
    (Richards 2006 – SDSS DR3)

- Calculate ***G*** magnitude:

  $G = M_G + 25 + 5 \log(D_{lum}) + K$

- Reject sources with ***G >20***