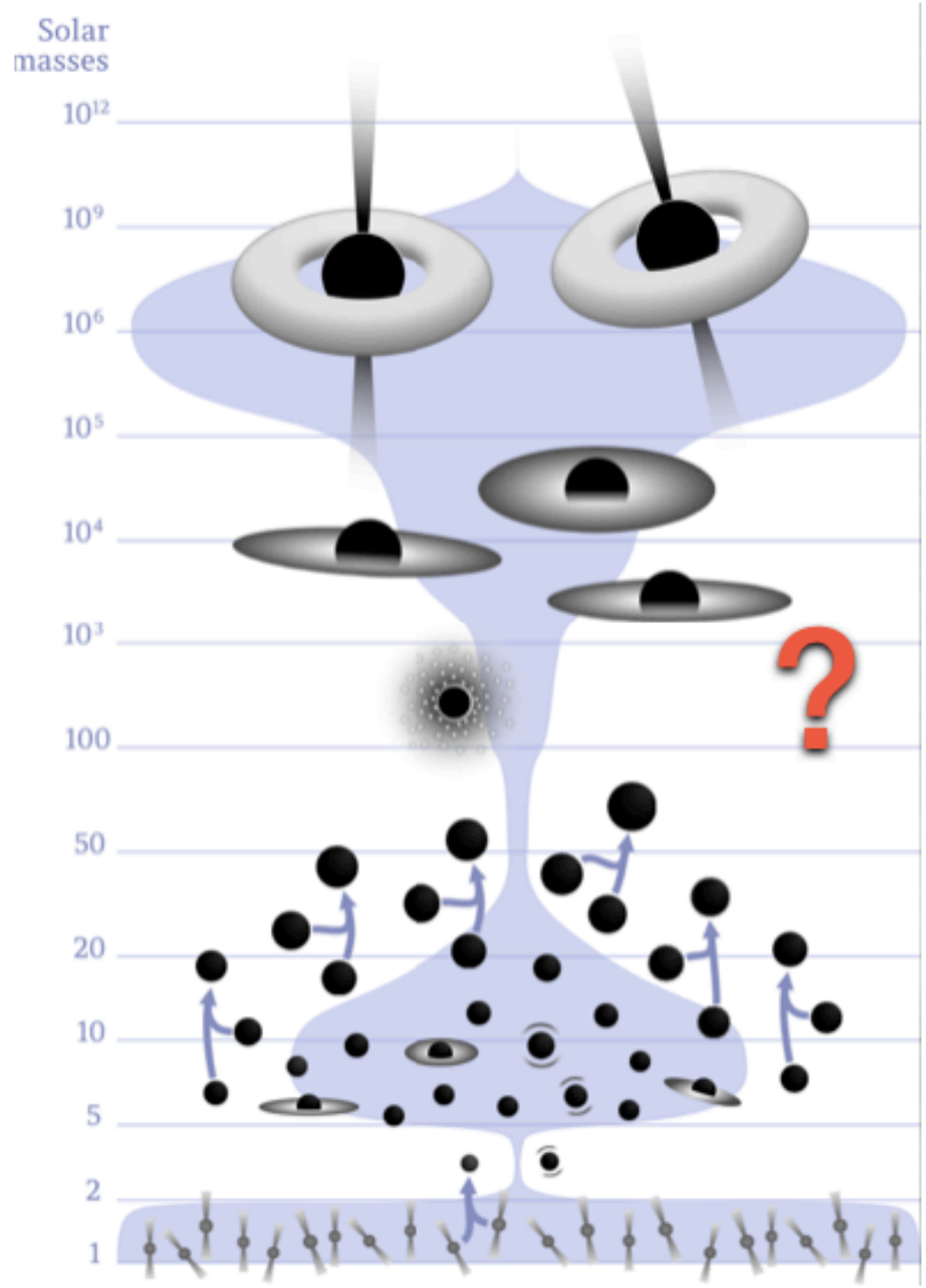
Astrometric lensing signatures of IMBHs with the *Gaia* space mission

Zofia Kaczmarek

Time-Domain Cosmology
with Strong Gravitational Lensing
25 January - 2 February 2021

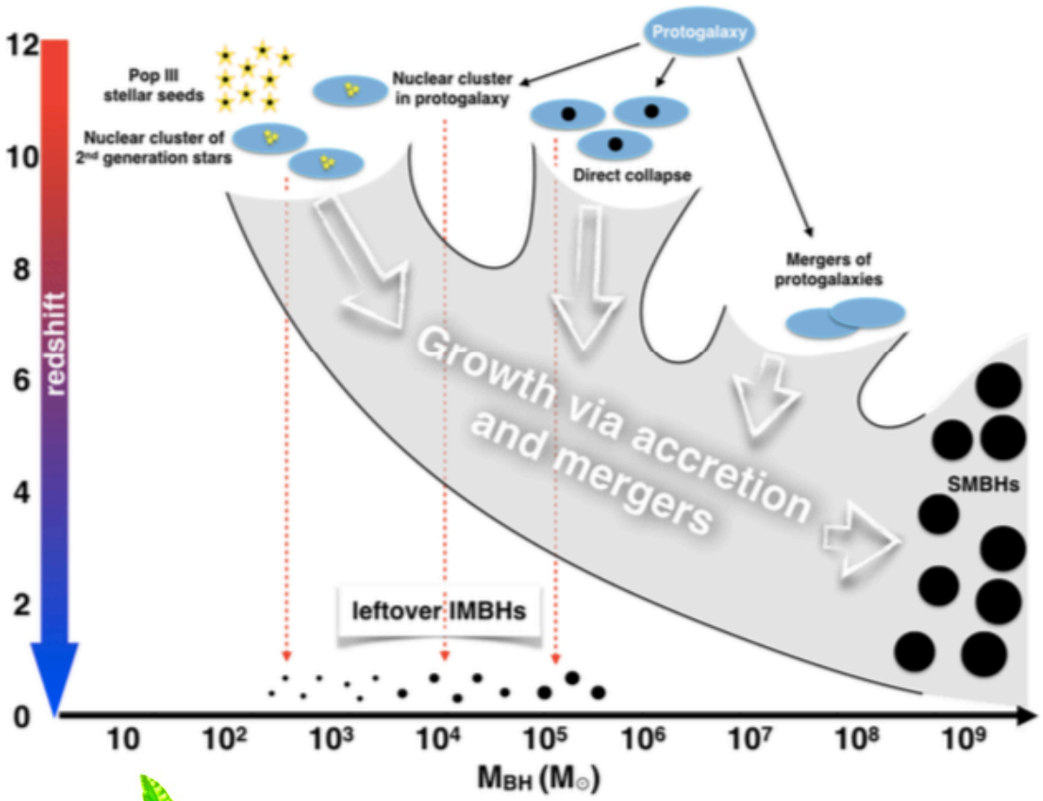
The mystery of IMBHs

- mass range: 10^2 - 10^5 $M_\odot$
- 'the missing link' between the known populations of *stellar-mass* and *supermassive* black holes
- very few known candidates



The mystery of IMBHs

- galaxy evolution

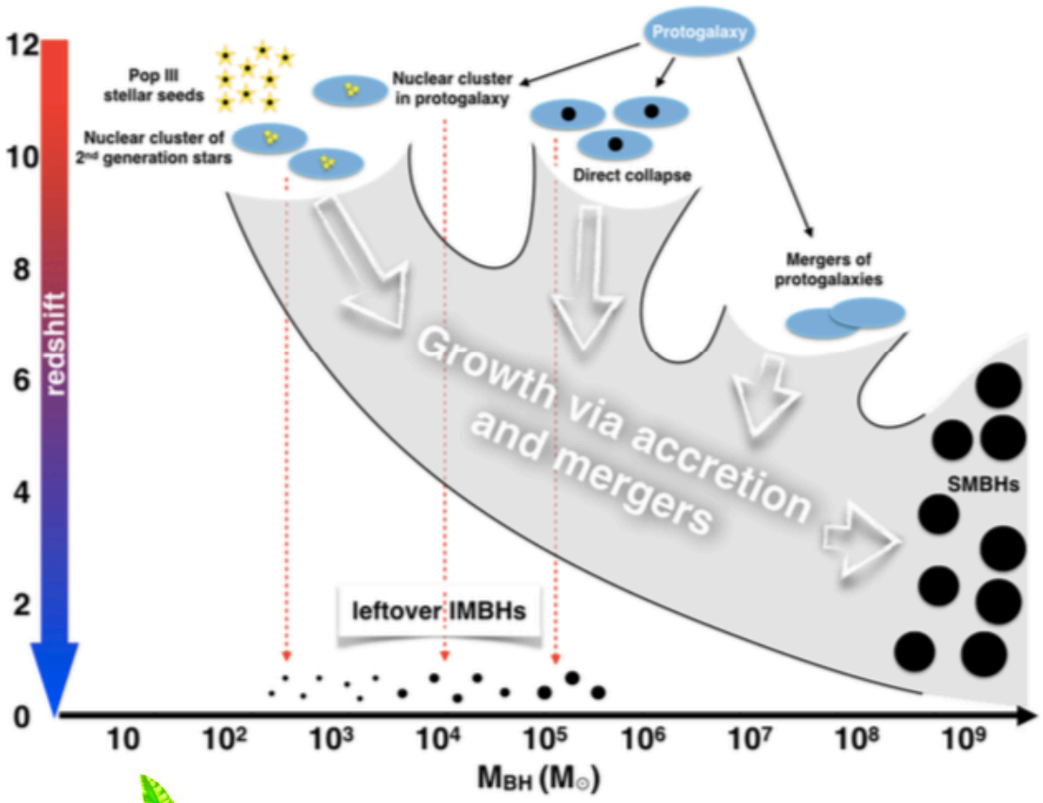


Mezcua 2017

'SMBH seeds'

The mystery of IMBHs

- ✦ galaxy evolution

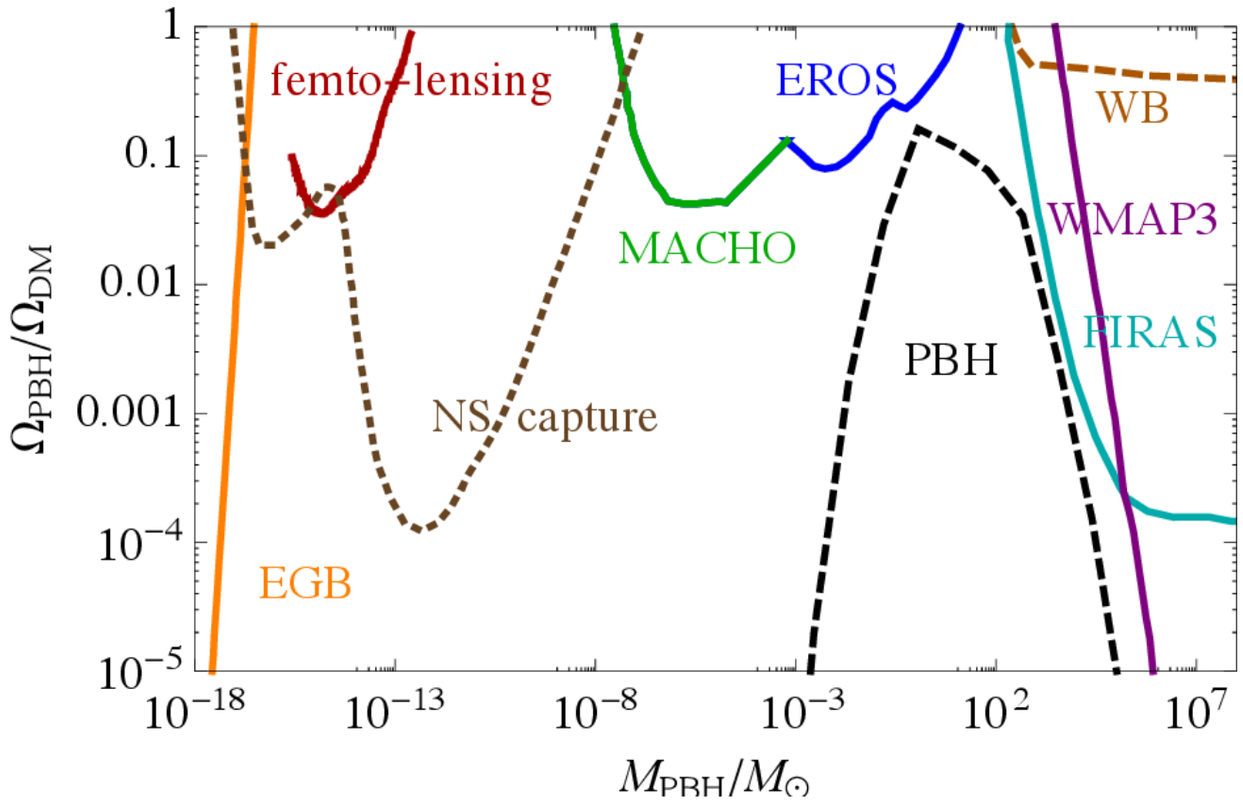


Mezcua 2017

'SMBH seeds'

- ✦ primordial black holes (PBH) candidates

(dark matter?)



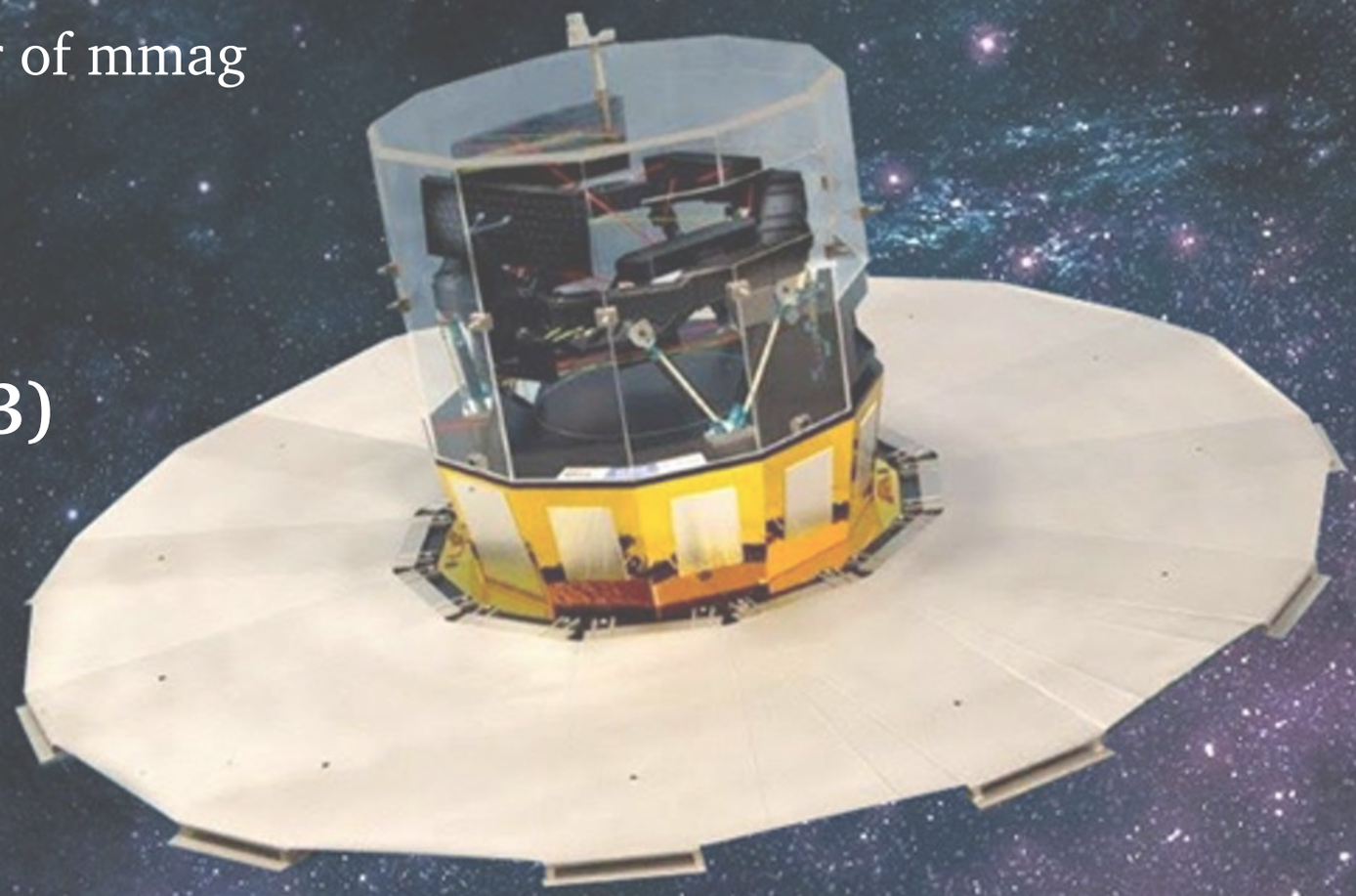
García-Bellido 2017

How can *Gaia* help?

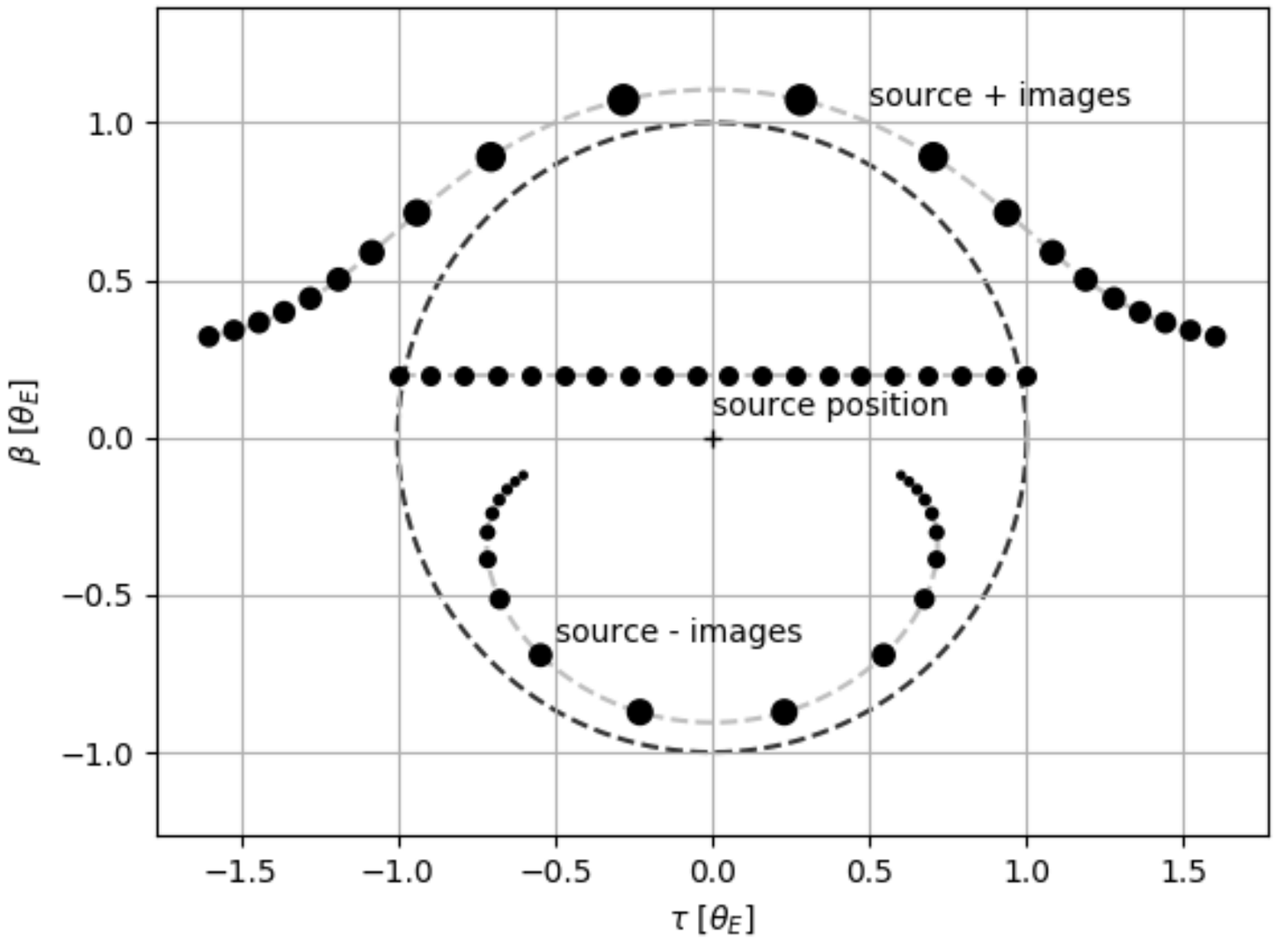
Astrometric mission: „measuring a billion stars”

- ✦ precise astrometry
- ✦ photometry precision: order of mmag
- ✦ all-sky scans

Data Release 2: 2018
Data Release 3: 2020 (EDR3) - 2021



Lensing by IMBHs

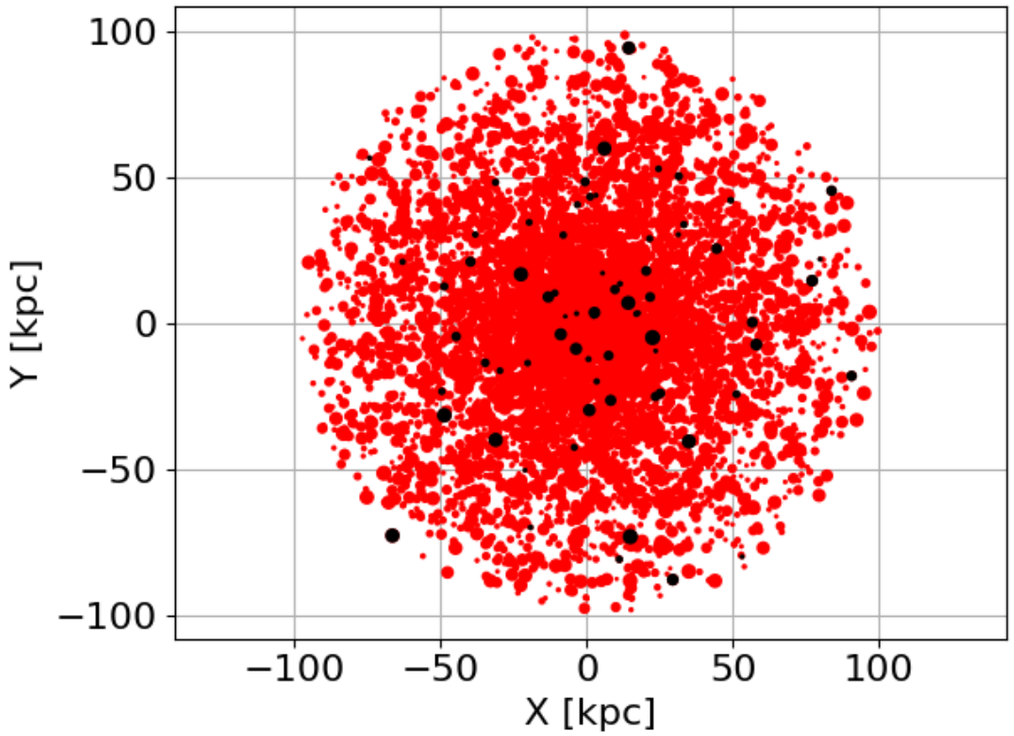


two resolved images, visible in *Gaia* data

Application to a mock population

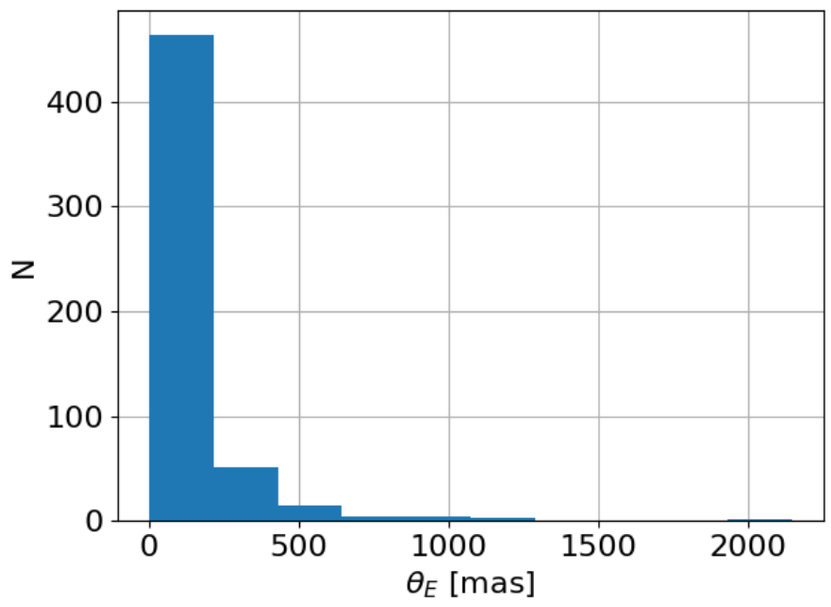
Population:

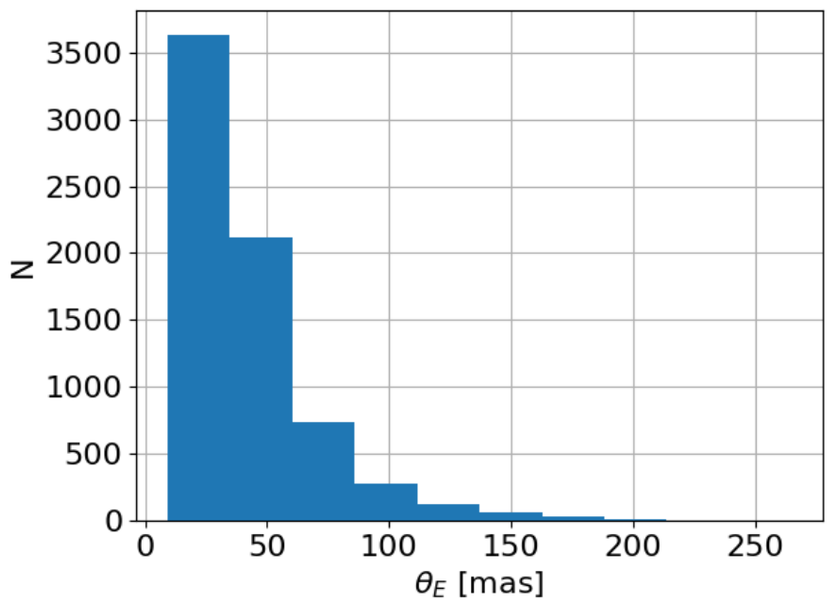
(mass and distance distribution - adapted from Rashkov & Madau, 2014)



Results:

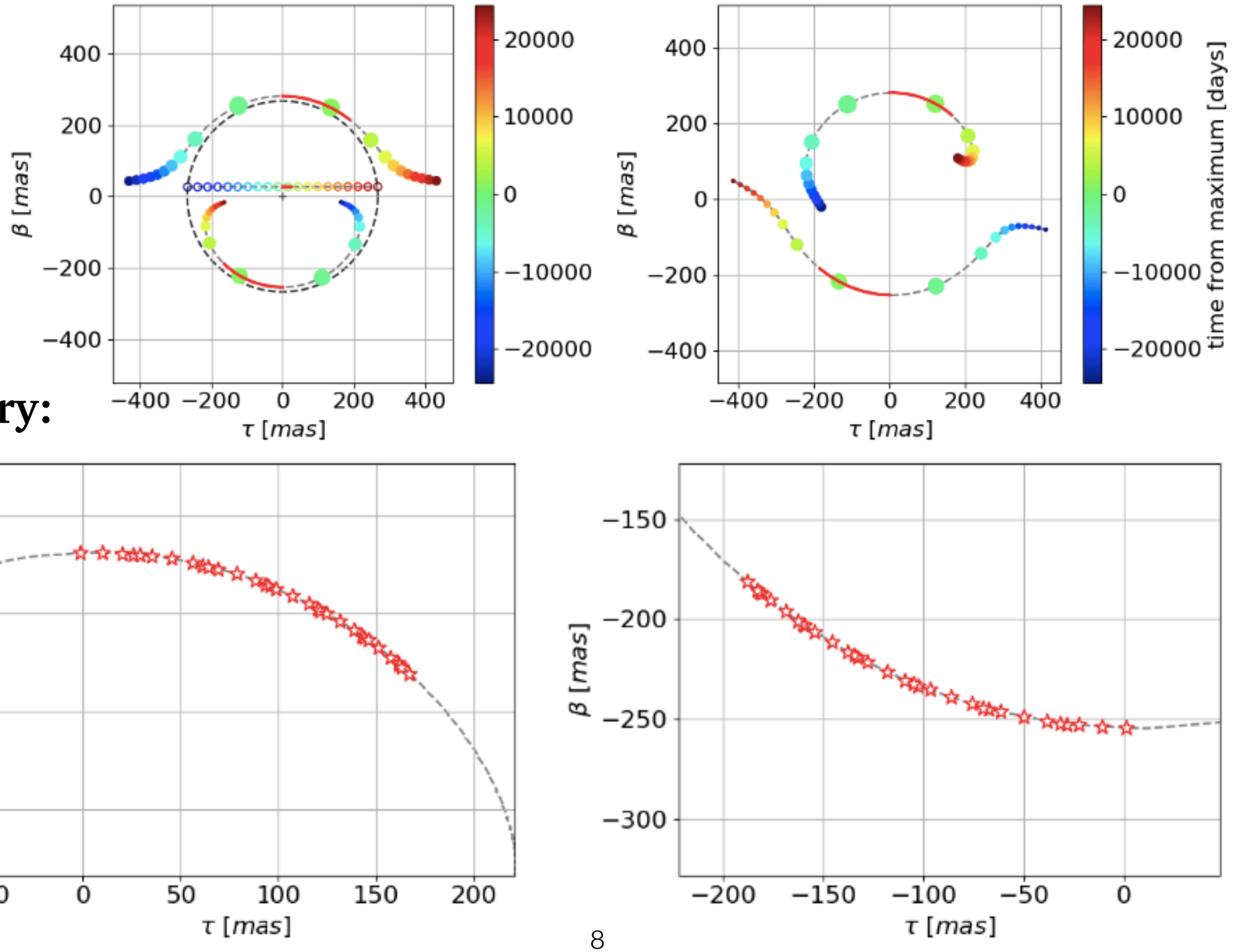
(distribution of Einstein radii for lensing of stars and quasars)



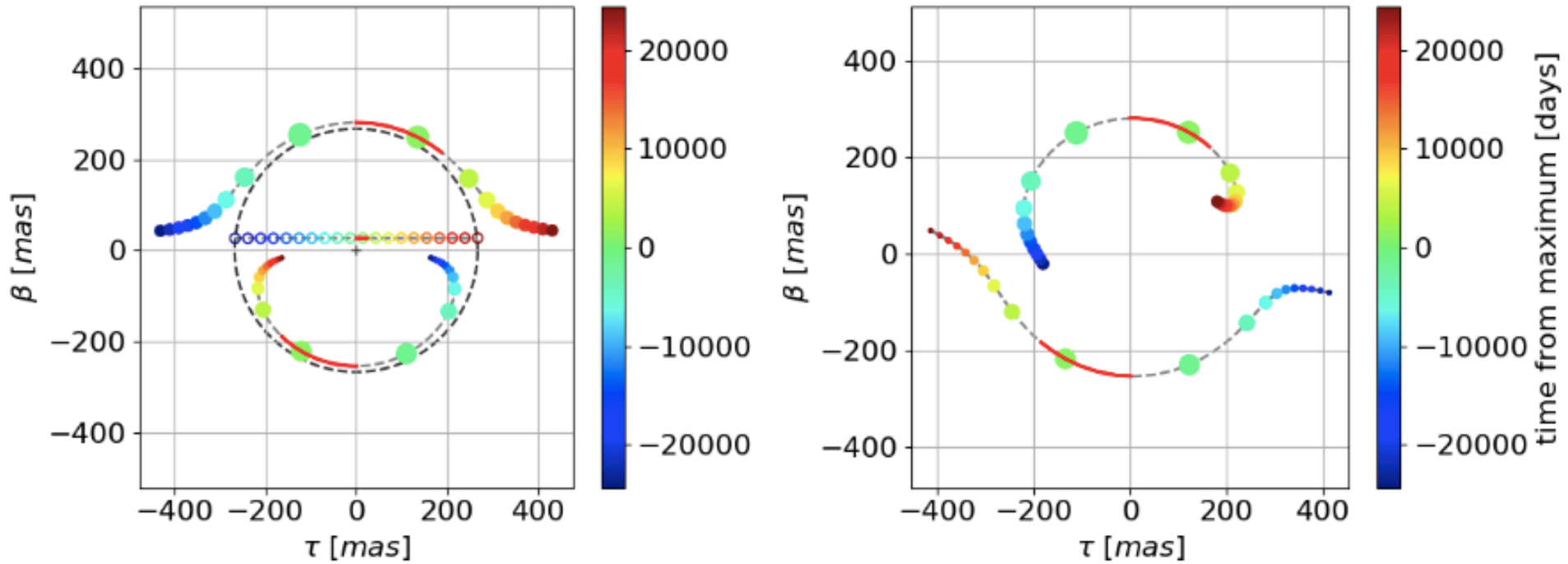


How will *Gaia* see the events?

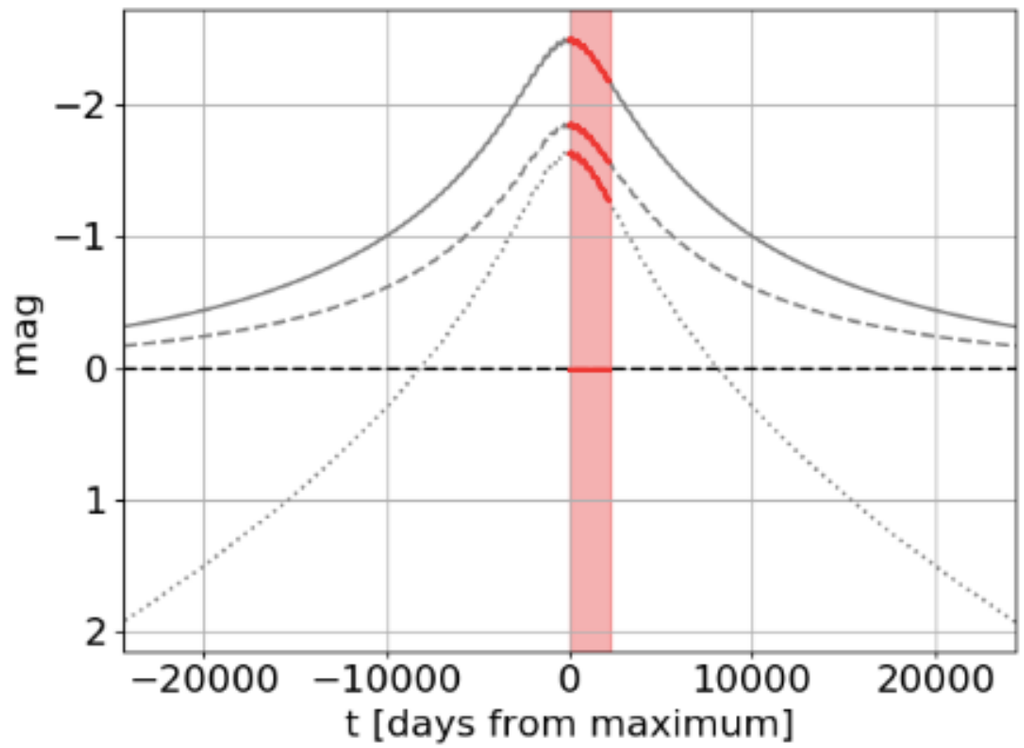
Astrometry:



How will *Gaia* see the events?

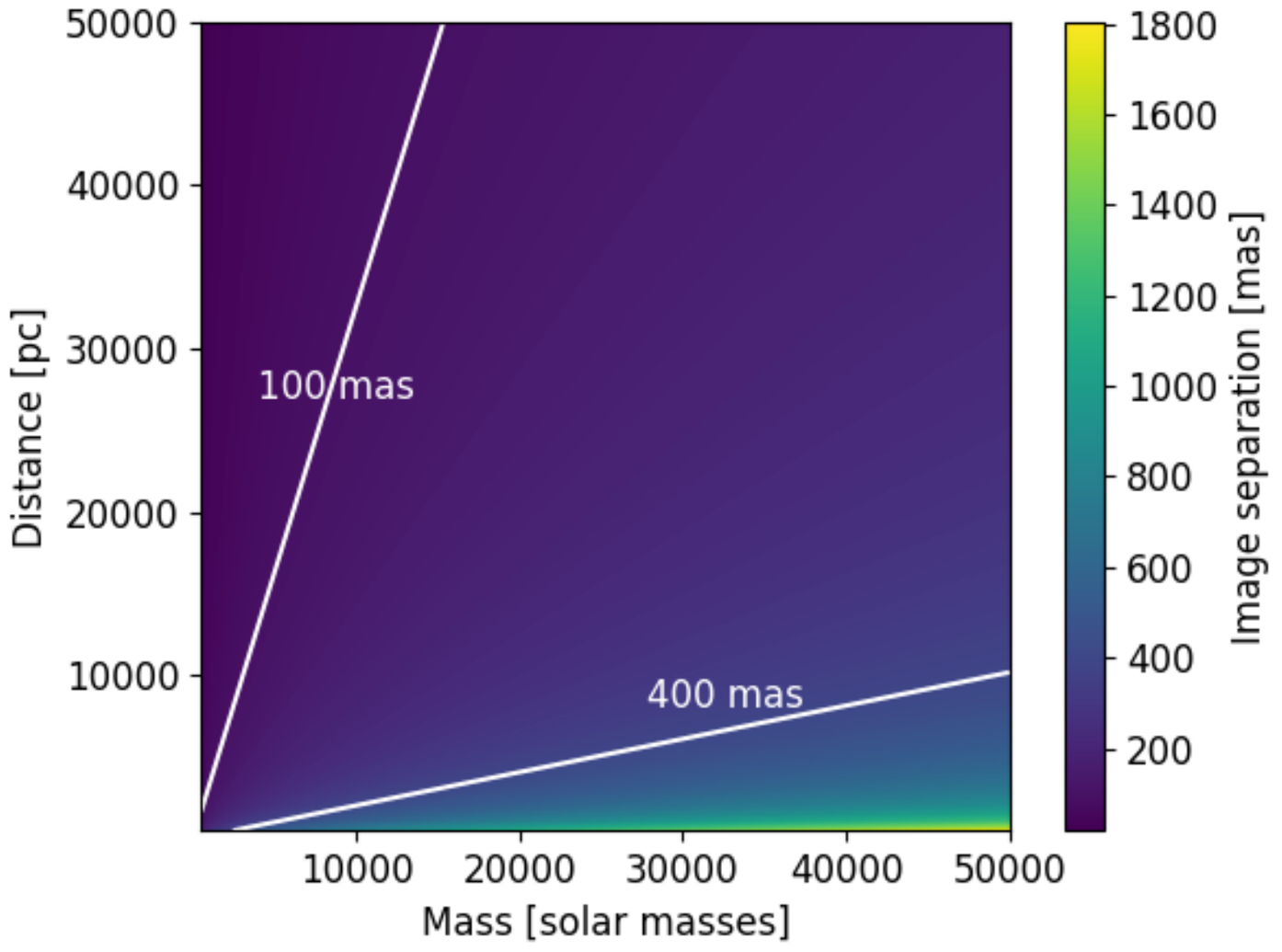


Photometry:



Detectability

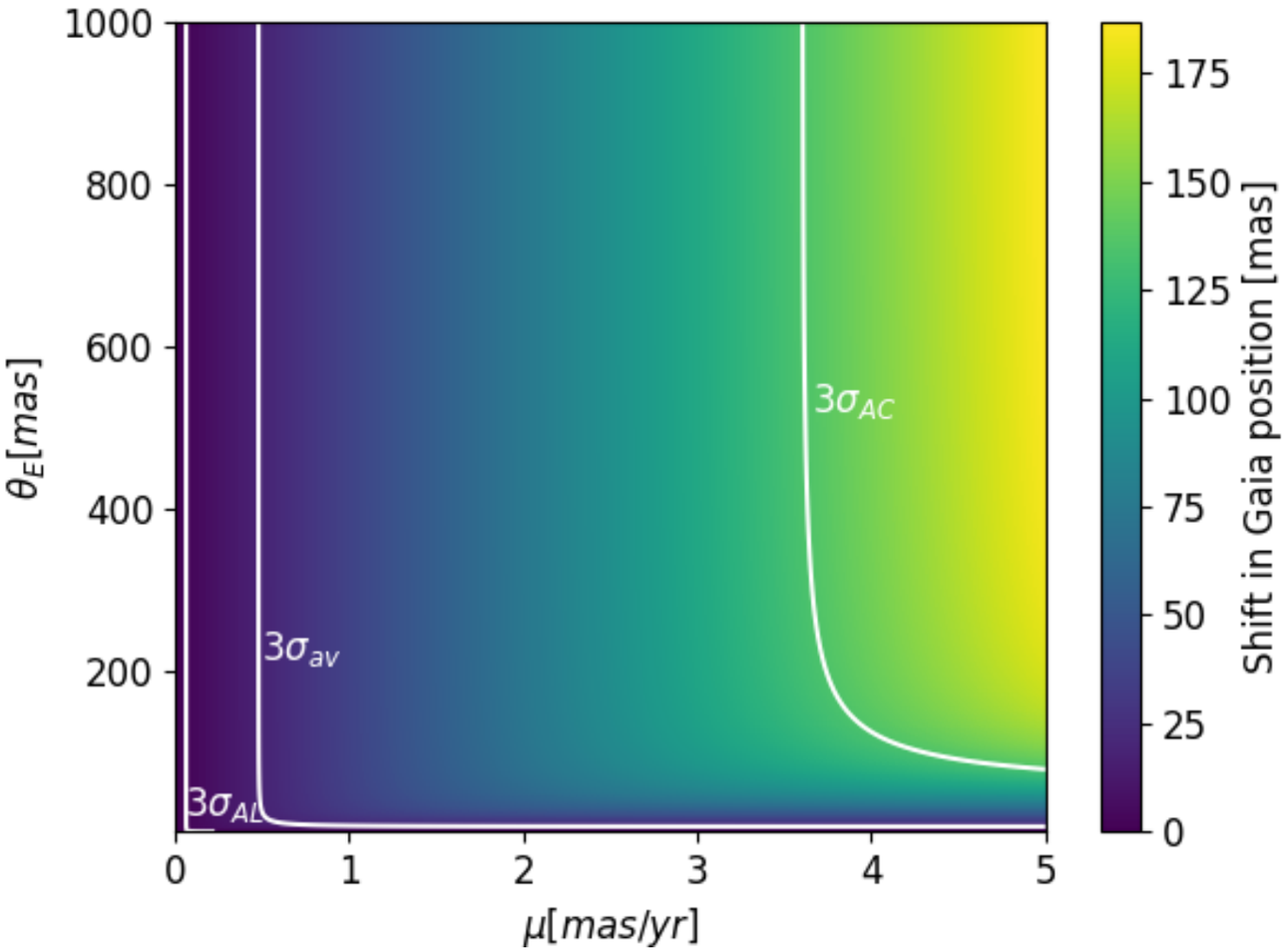
Resolved images:

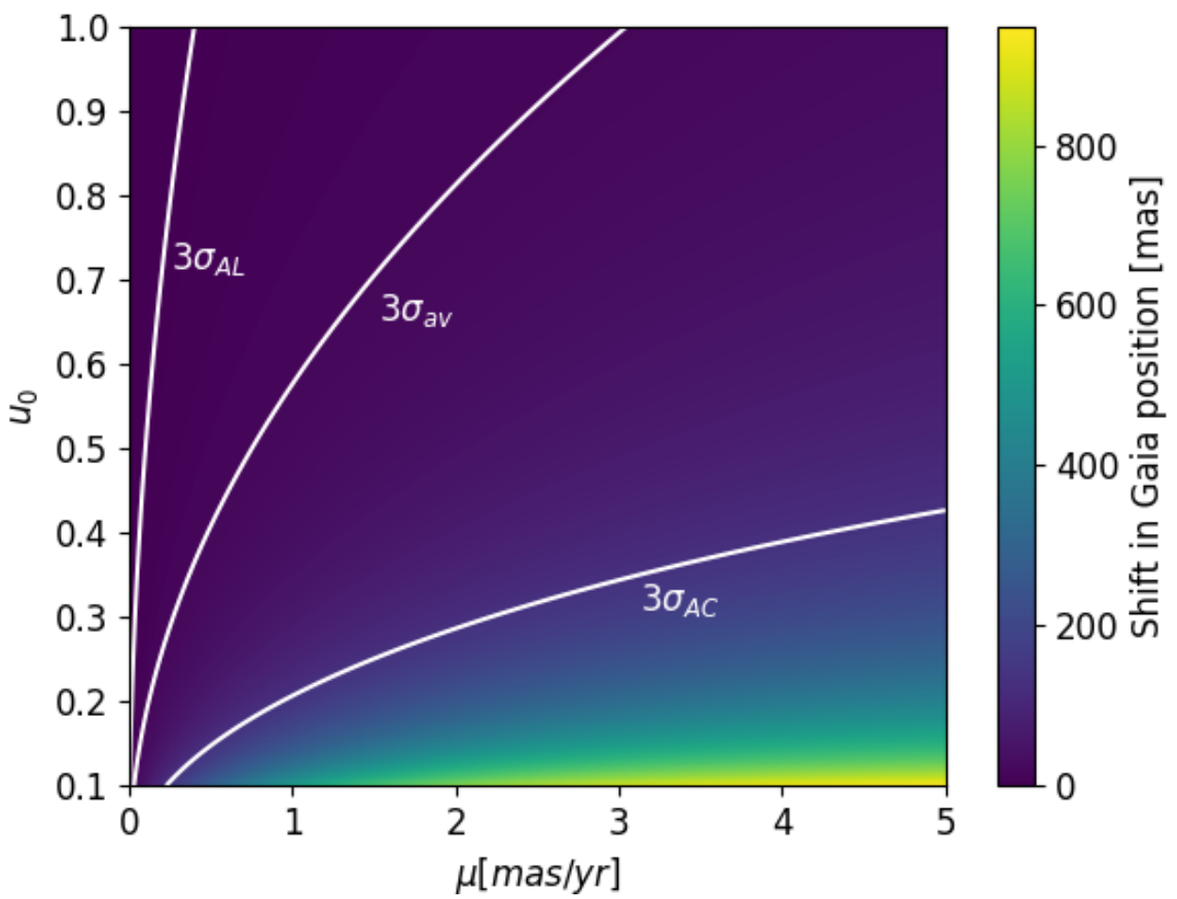


Currently *Gaia* is able to detect only the nearest and most massive IMBHs acting as lenses. Detectability will improve with new data releases!

Detectability

Unresolved images - light center motion:





In *Gaia* data, the light center shift should be detectable in case of most IMBHs acting as lenses.

Thank you for your attention!