THE SEARCH FOR IMBHs IN GAIA

new simulations and results

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THE 10TH OPTICON GAIA SCIENCE ALERTS WORKSHOP
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The search for IMBHs - a quick reminder

Intermediate-mass black holes

searches: ***dense stellar clusters***

- **10^2 - 10^5 $M_\odot$**
- apparent mass gap between stellar-mass and supermassive

visualisation: CfA/M.Weiss

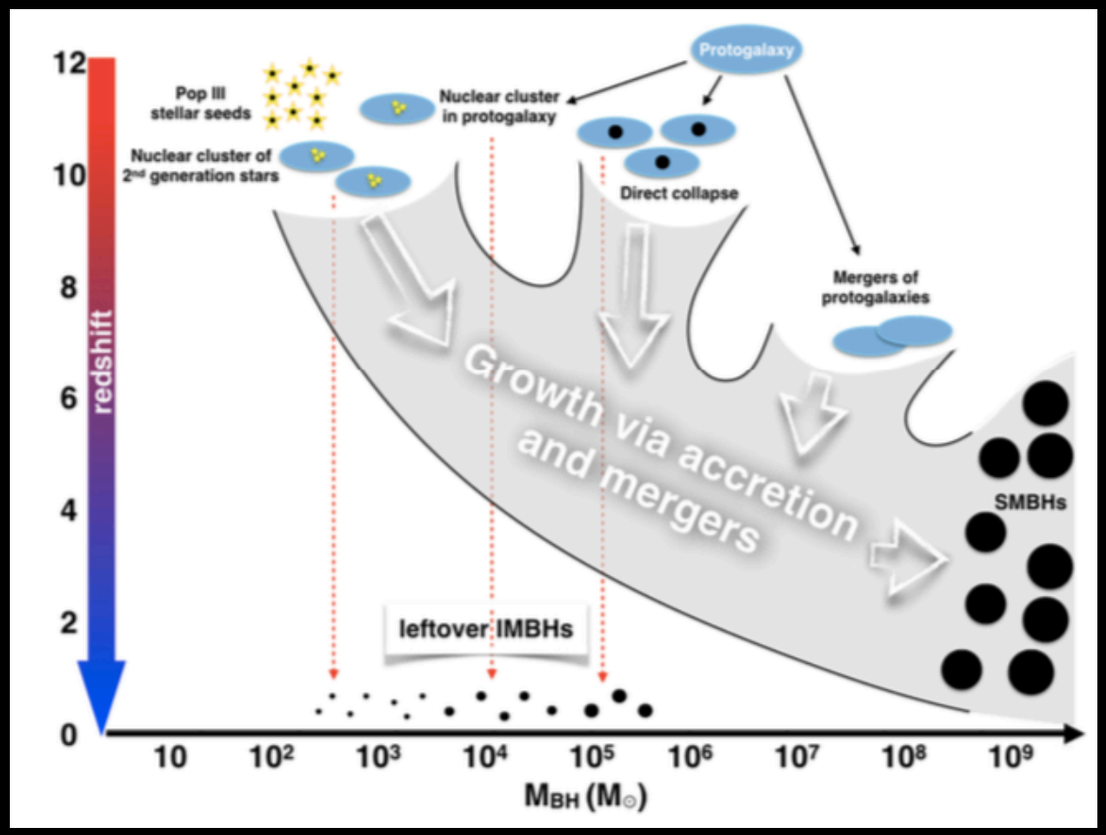
Intermediate-mass black holes

Why are they interesting?

Intermediate-mass black holes

Why are they interesting?

✳ evolution of galaxies



Mezcua 2017

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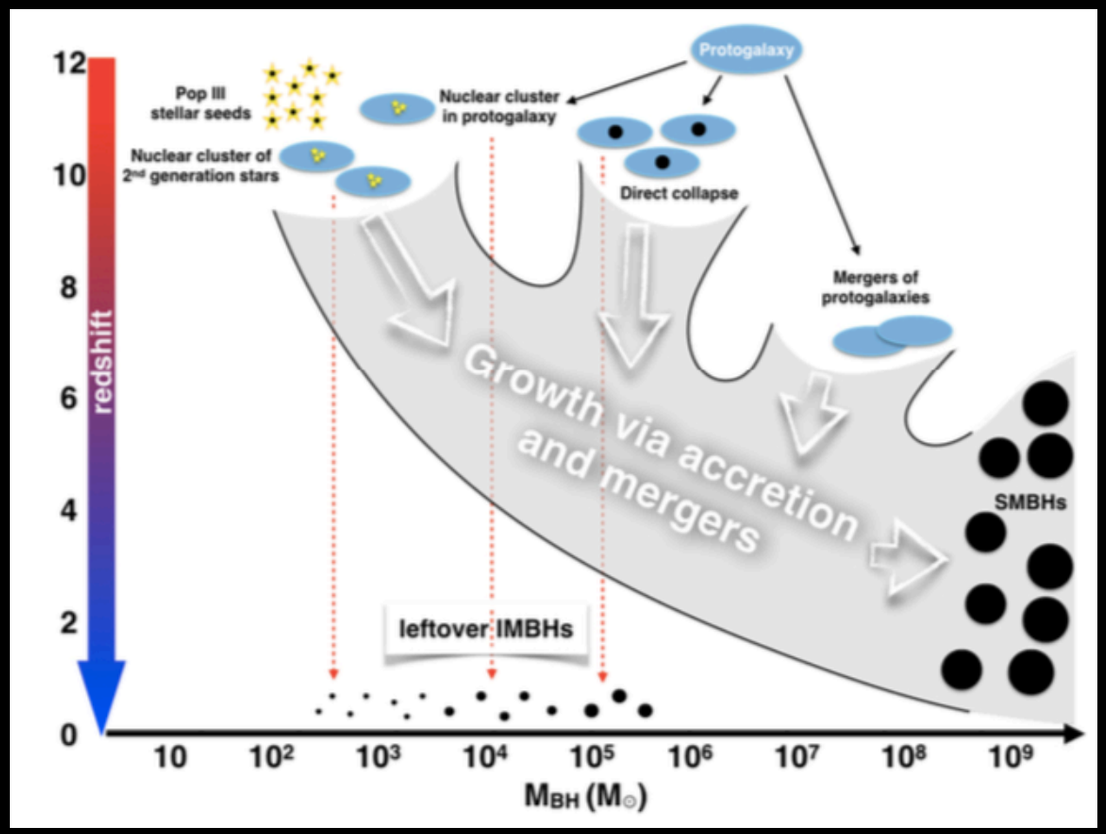

Mezcua 2017

'SMBH seeds'

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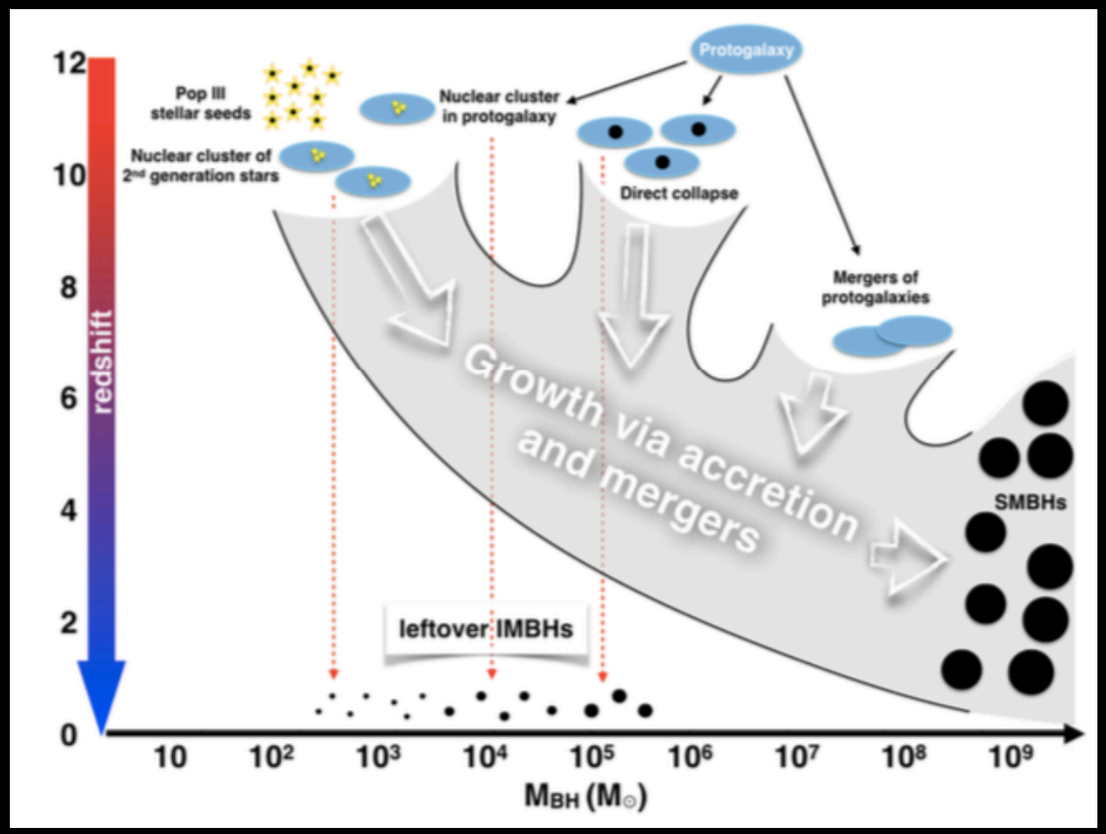
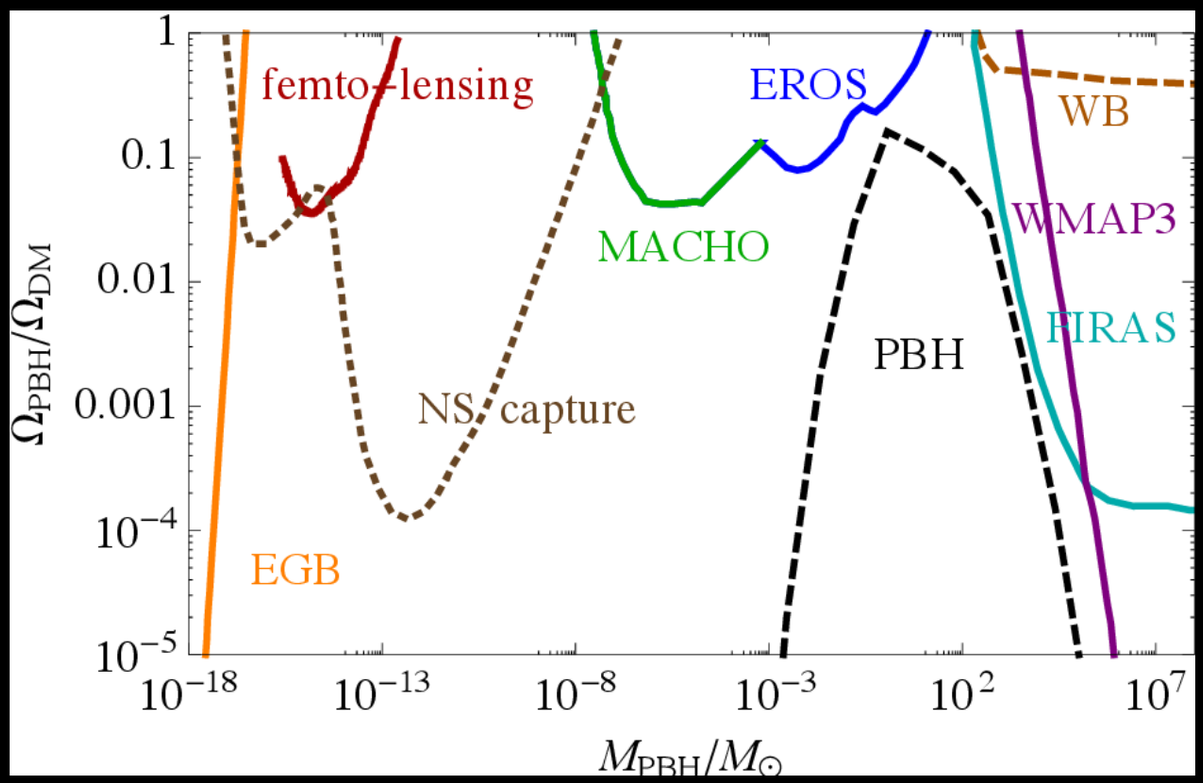


Mezcua 2017

'SMBH seeds'

✳primordial black hole (PBH) candidates



García-Bellido 2017

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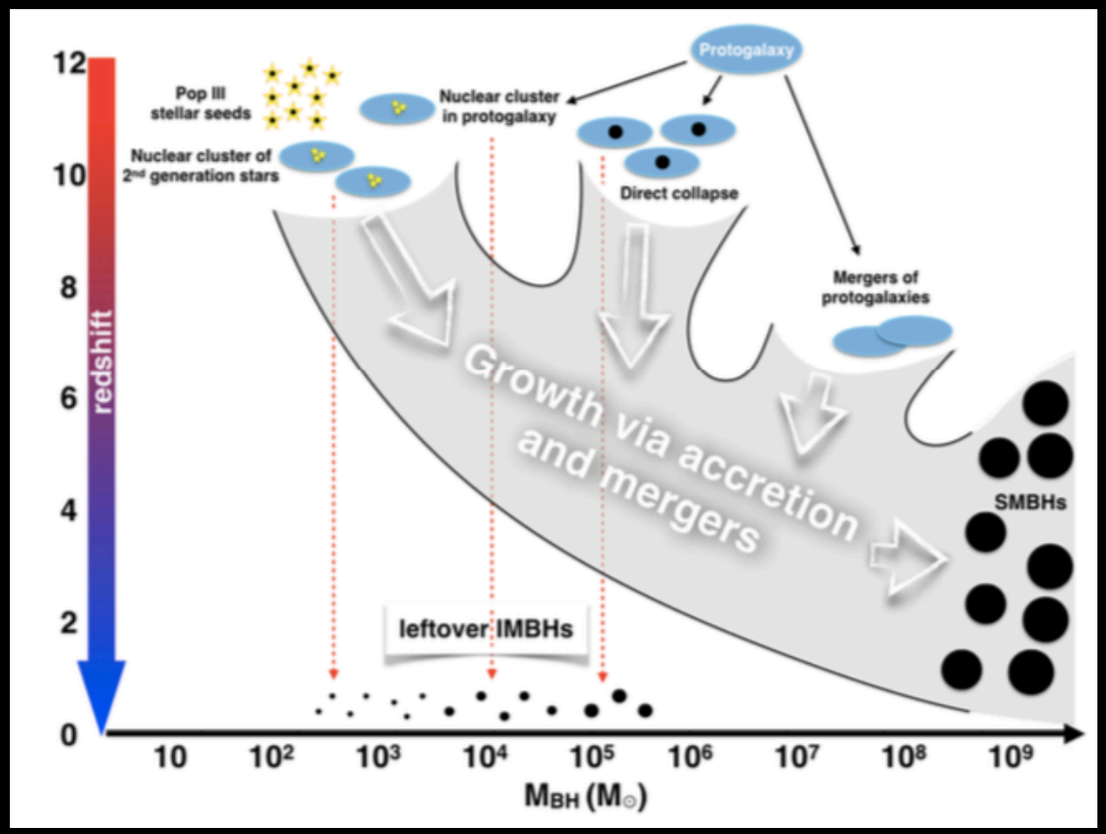

Mezcua 2017

'SMBH seeds'

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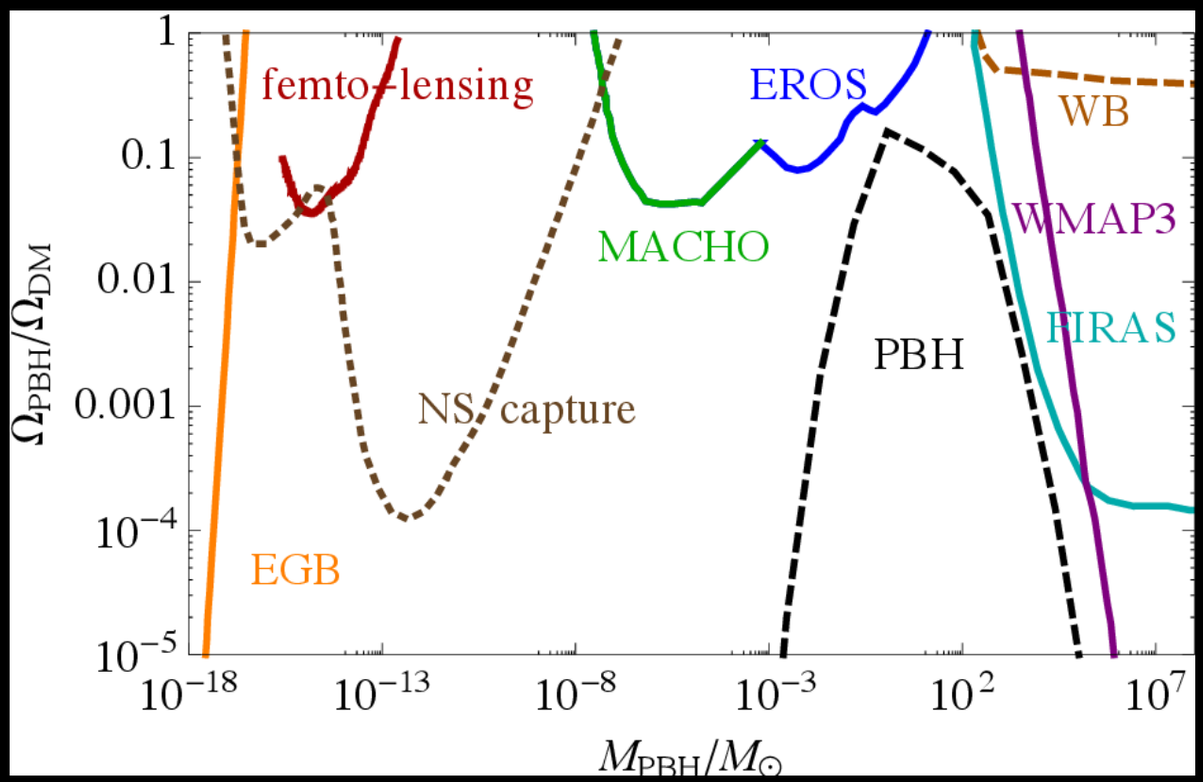
✳dark matter?



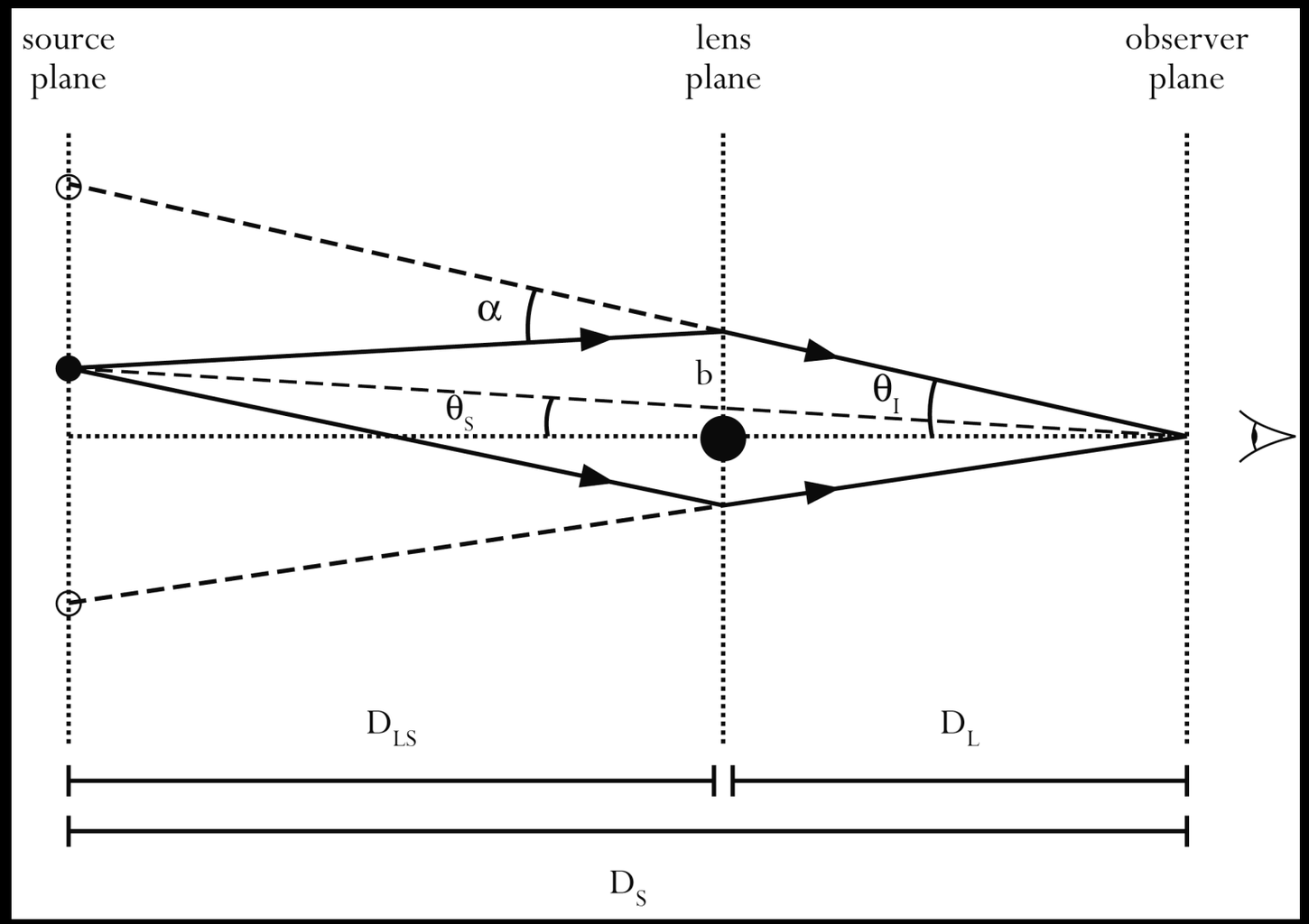
García-Bellido 2017

Intermediate-mass black holes

Why are they interesting?

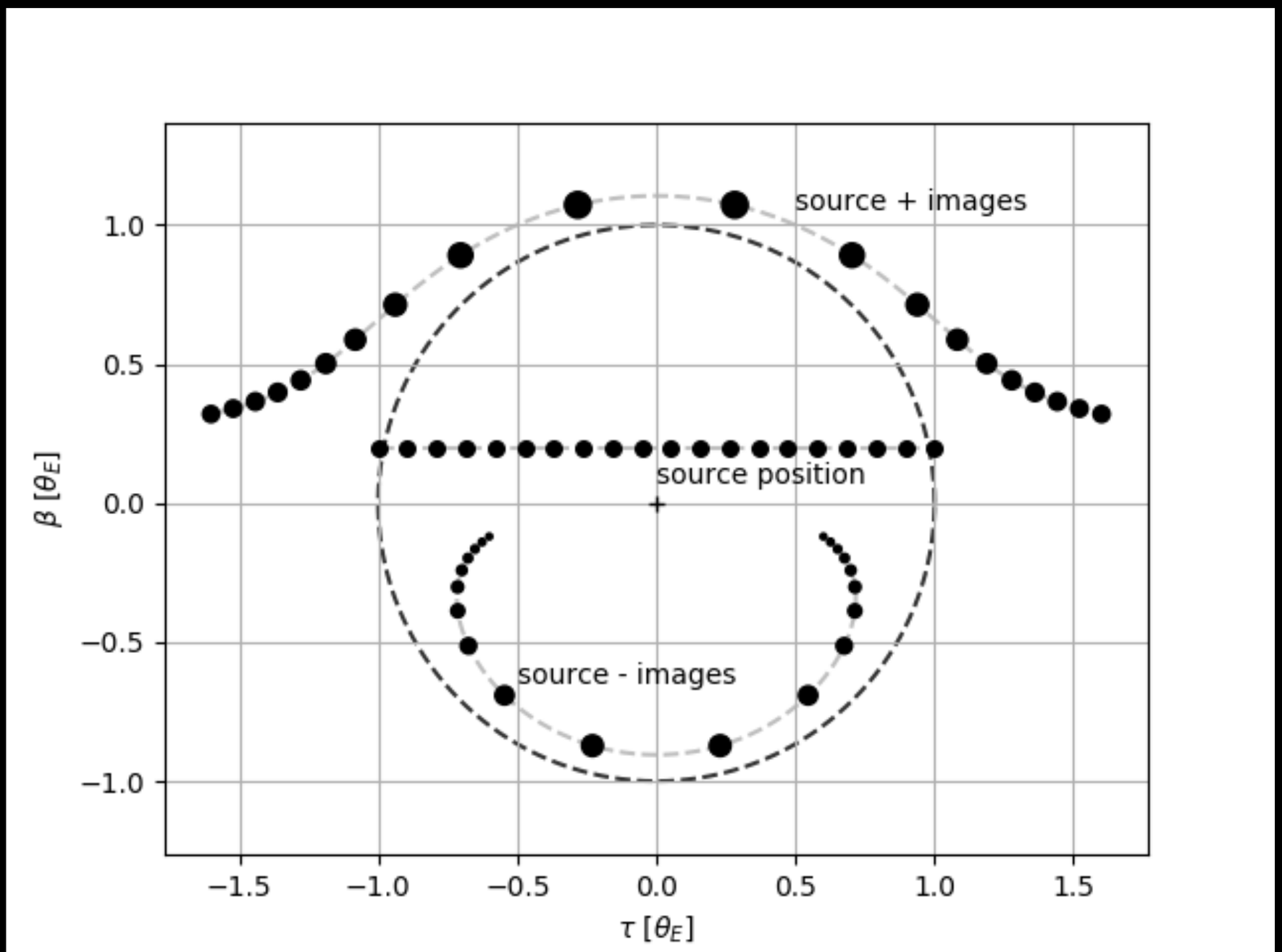
✳ astrometric lensing!

resolvable images



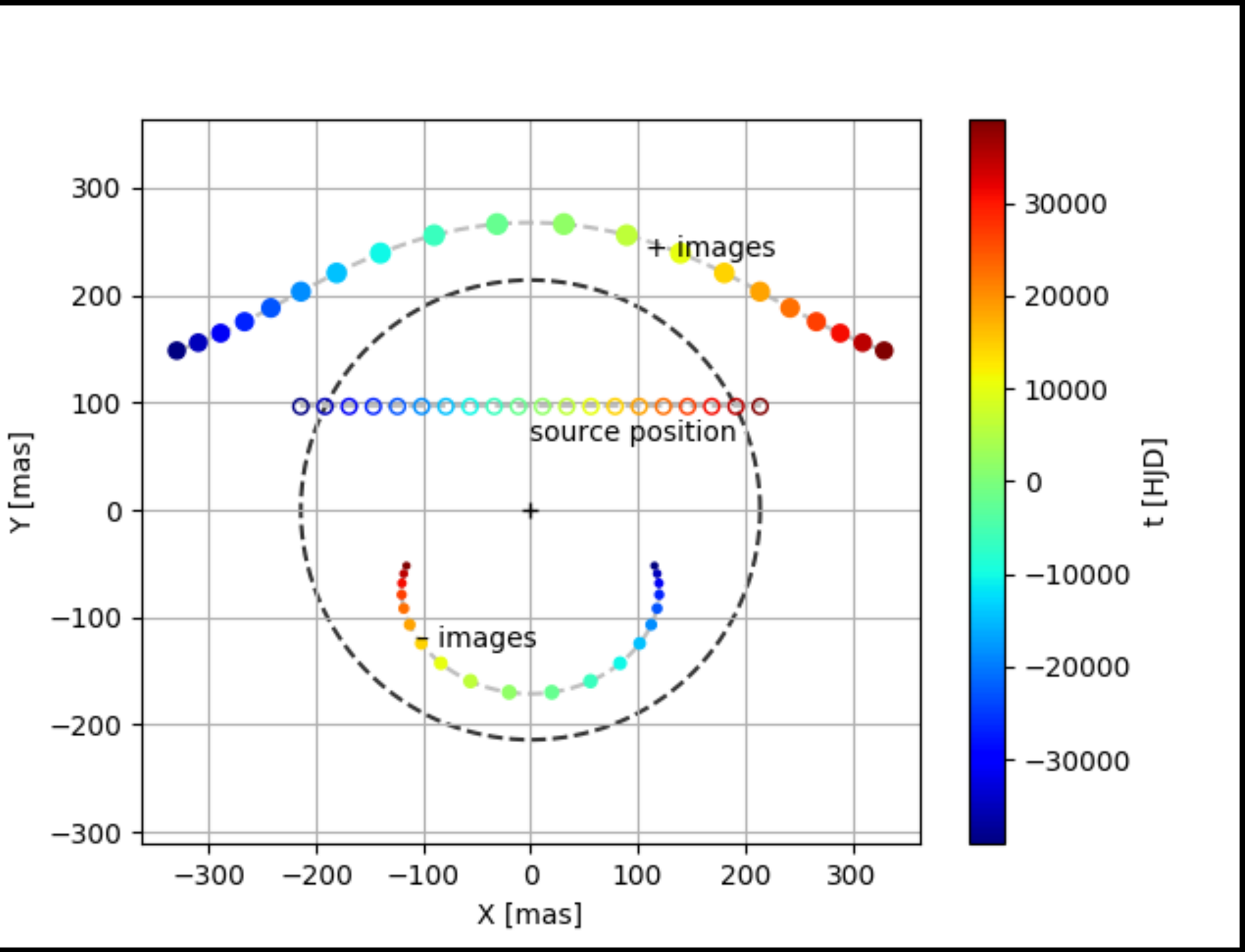
Lensing by IMBHs

Geometry of a centi-lensing event



$$\theta_E = \sqrt{\kappa M \left(\pi_L - \pi_S\right)}$$

Resolved events

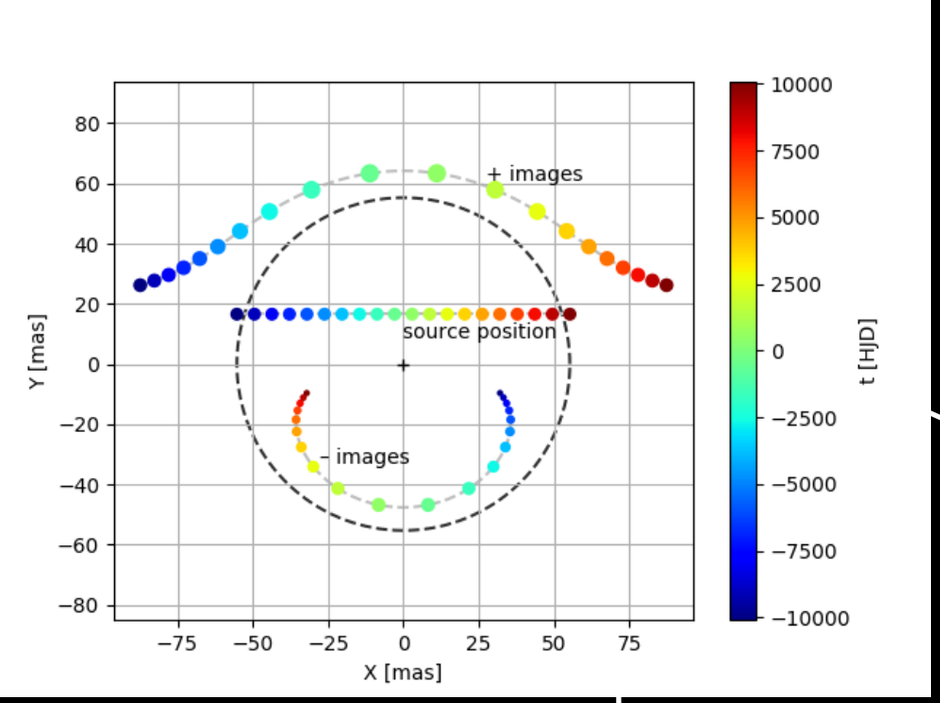


M_{Lens} = 15000 $M_\odot$

D_{Lens} = 2000 pc

D_{Source} = 8000 pc

u_0 = 0.45



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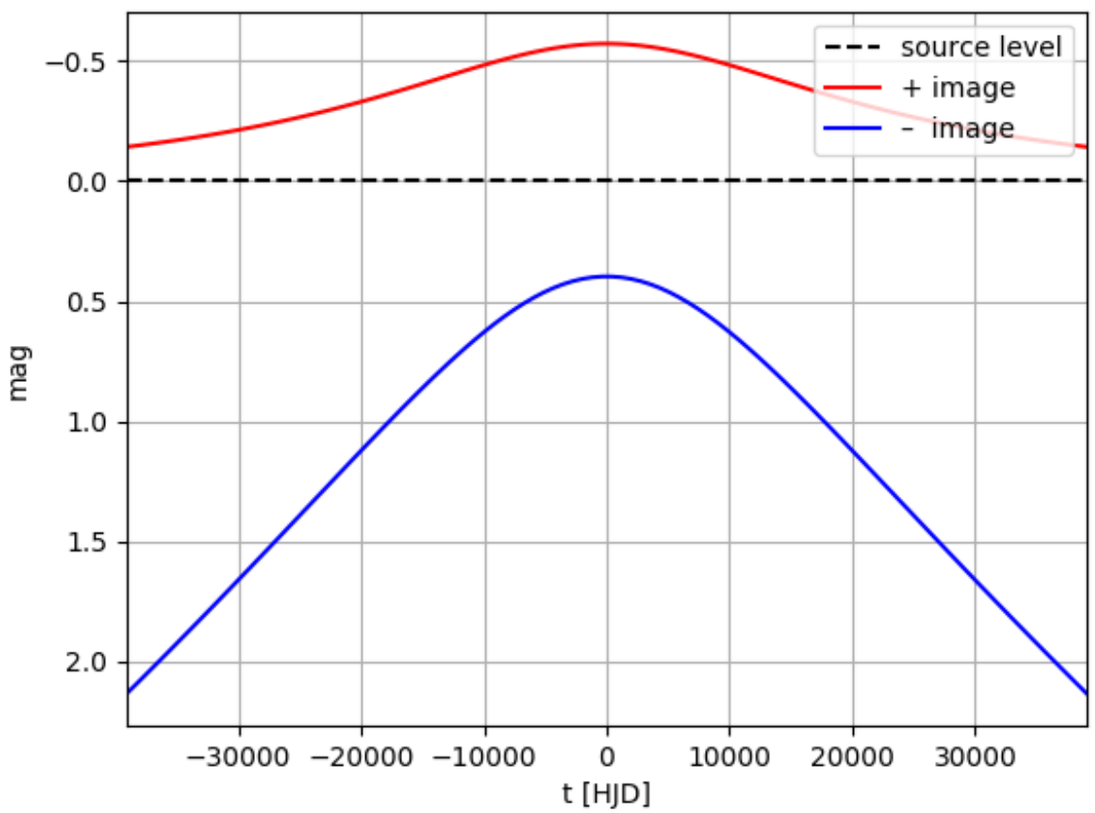
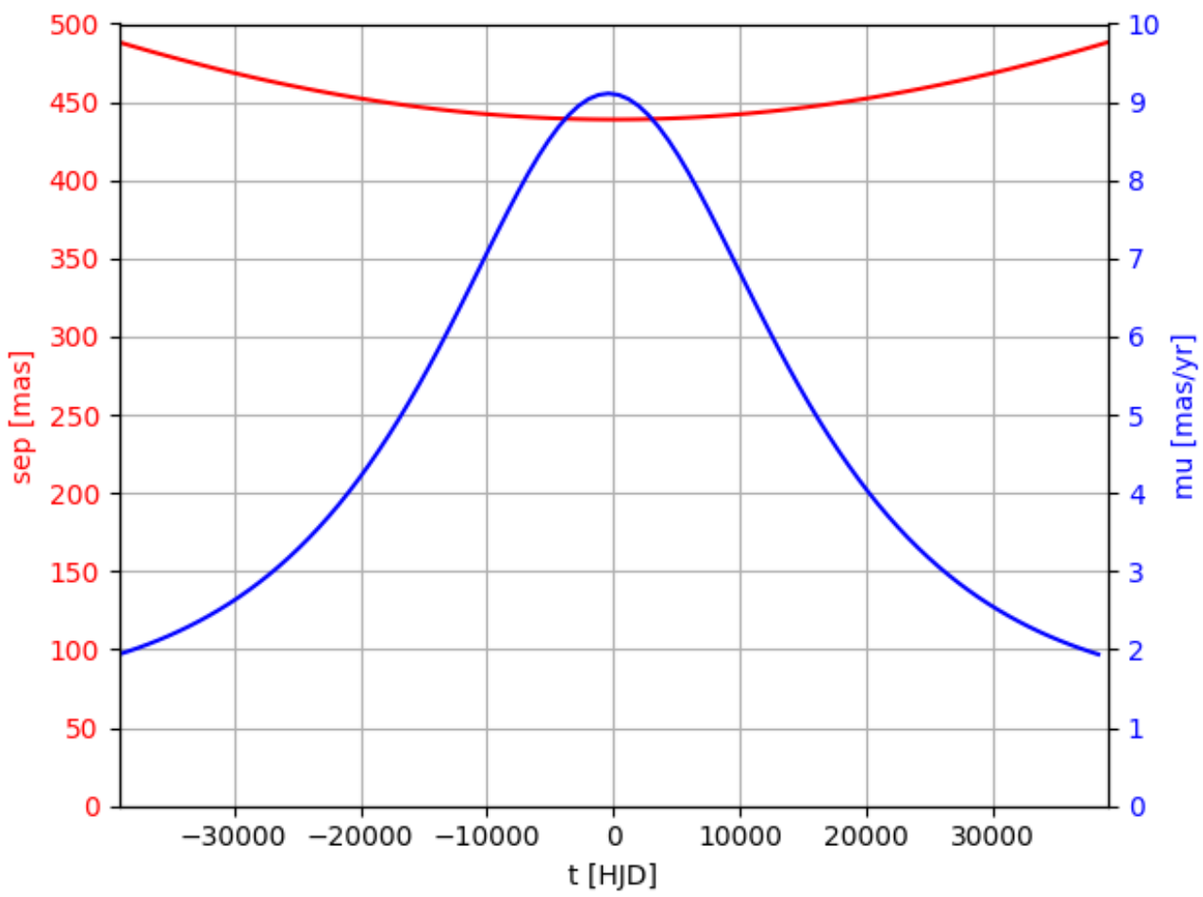
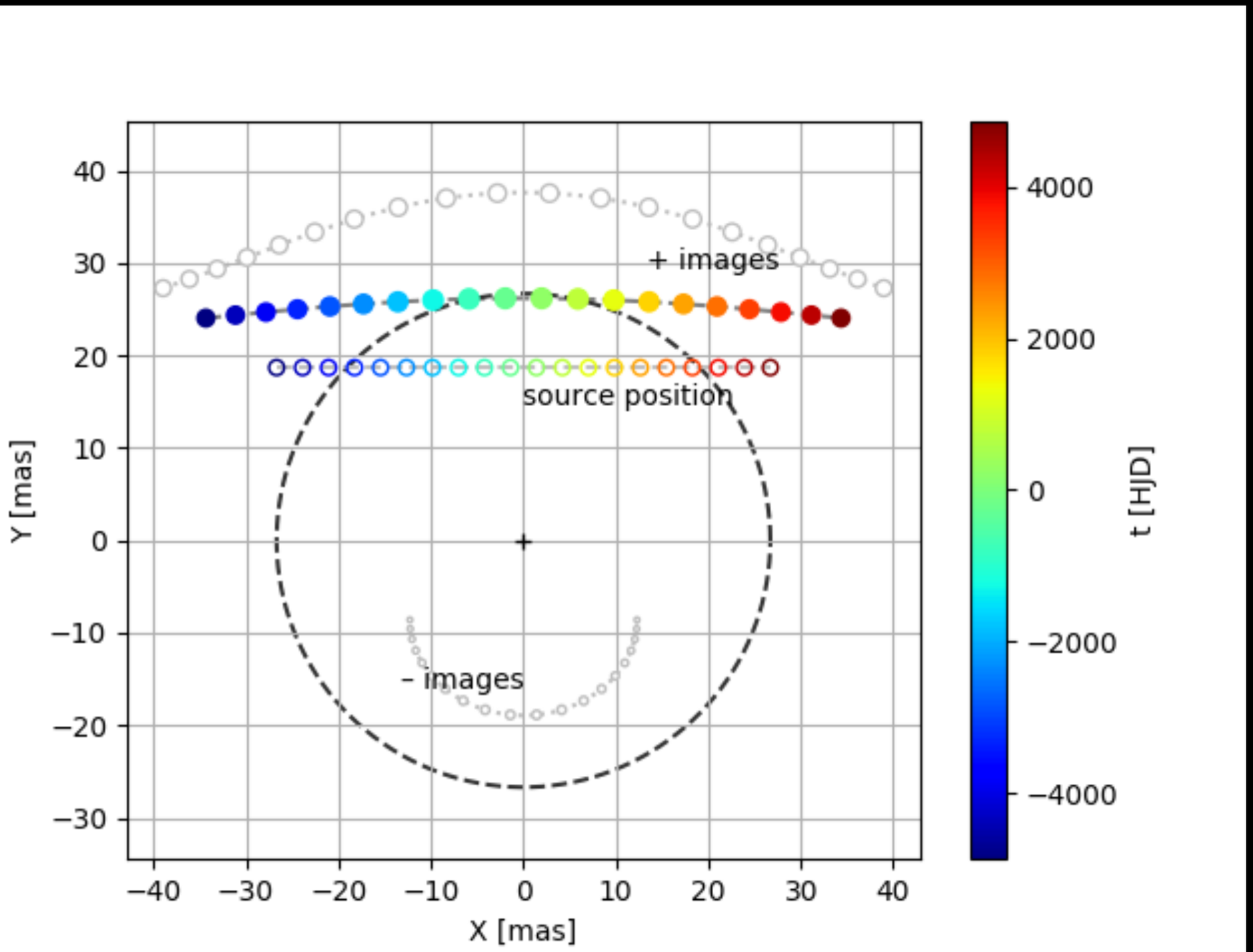
photometry



astrometry



Centroid events



M_{Lens} = 100 $M_{\odot}$
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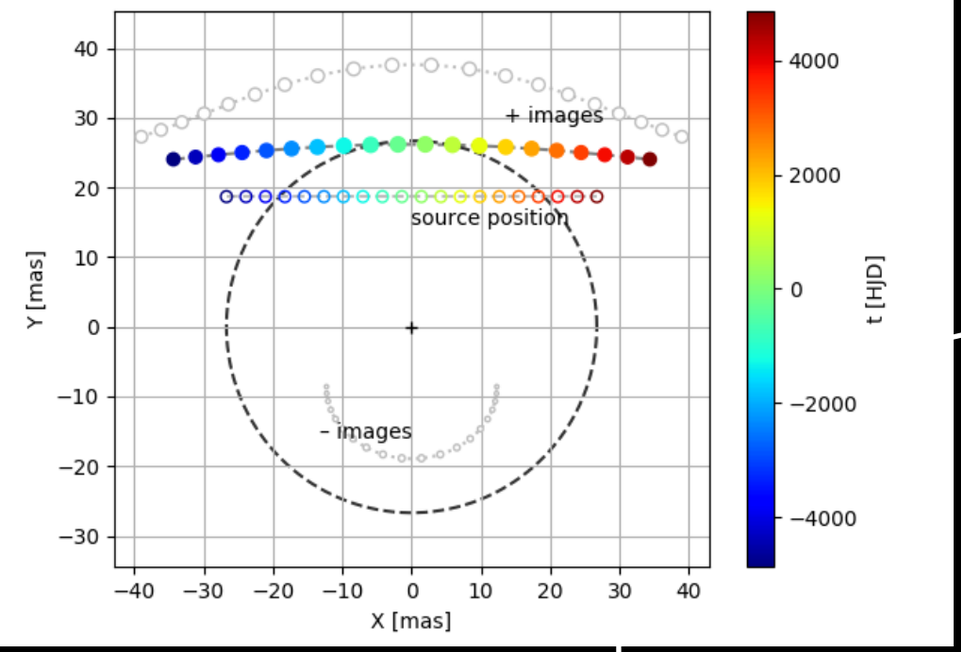

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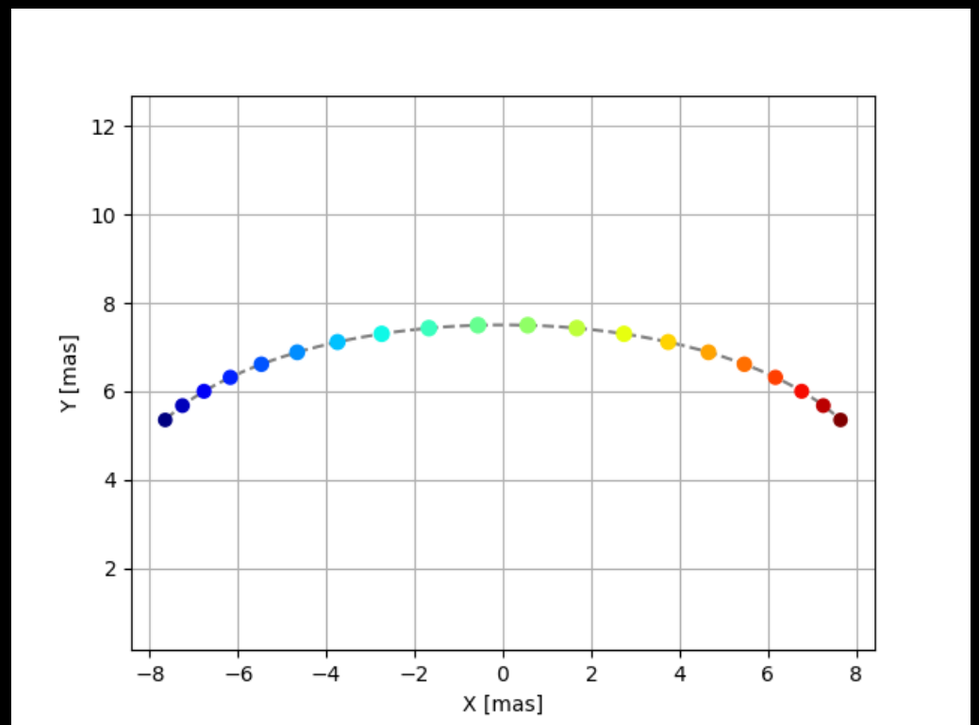
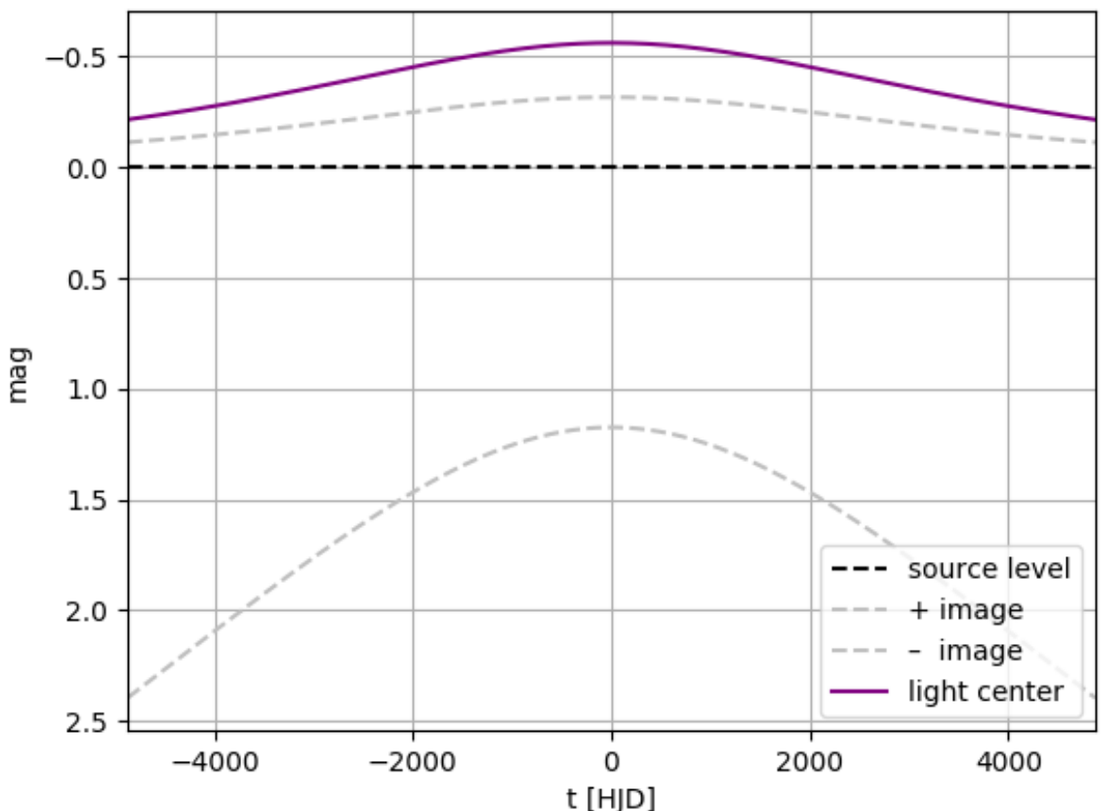
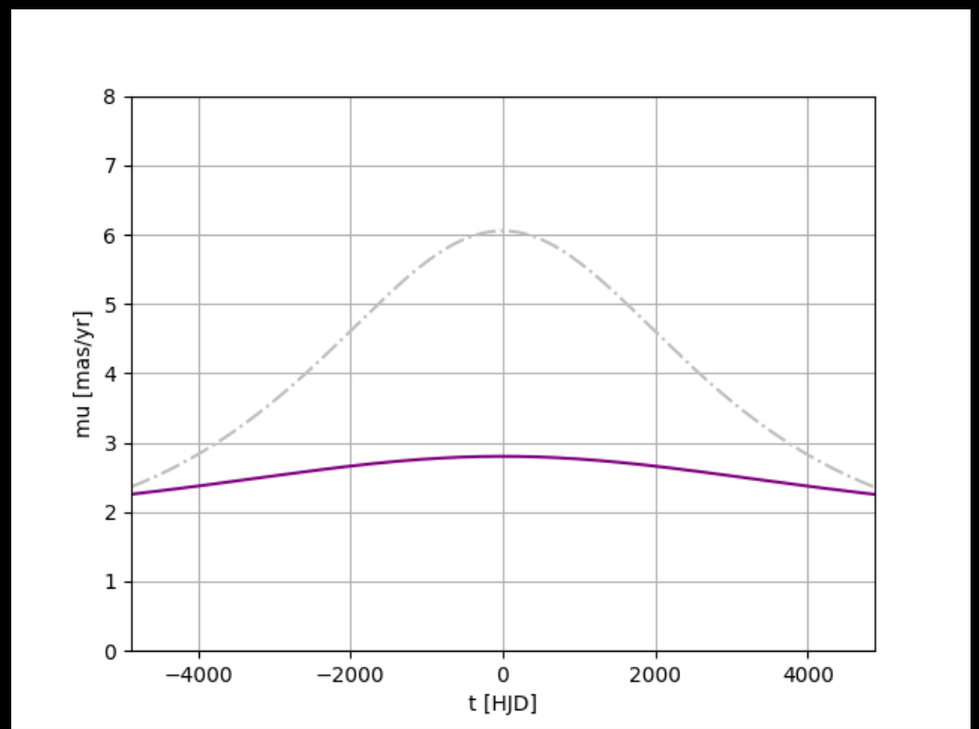
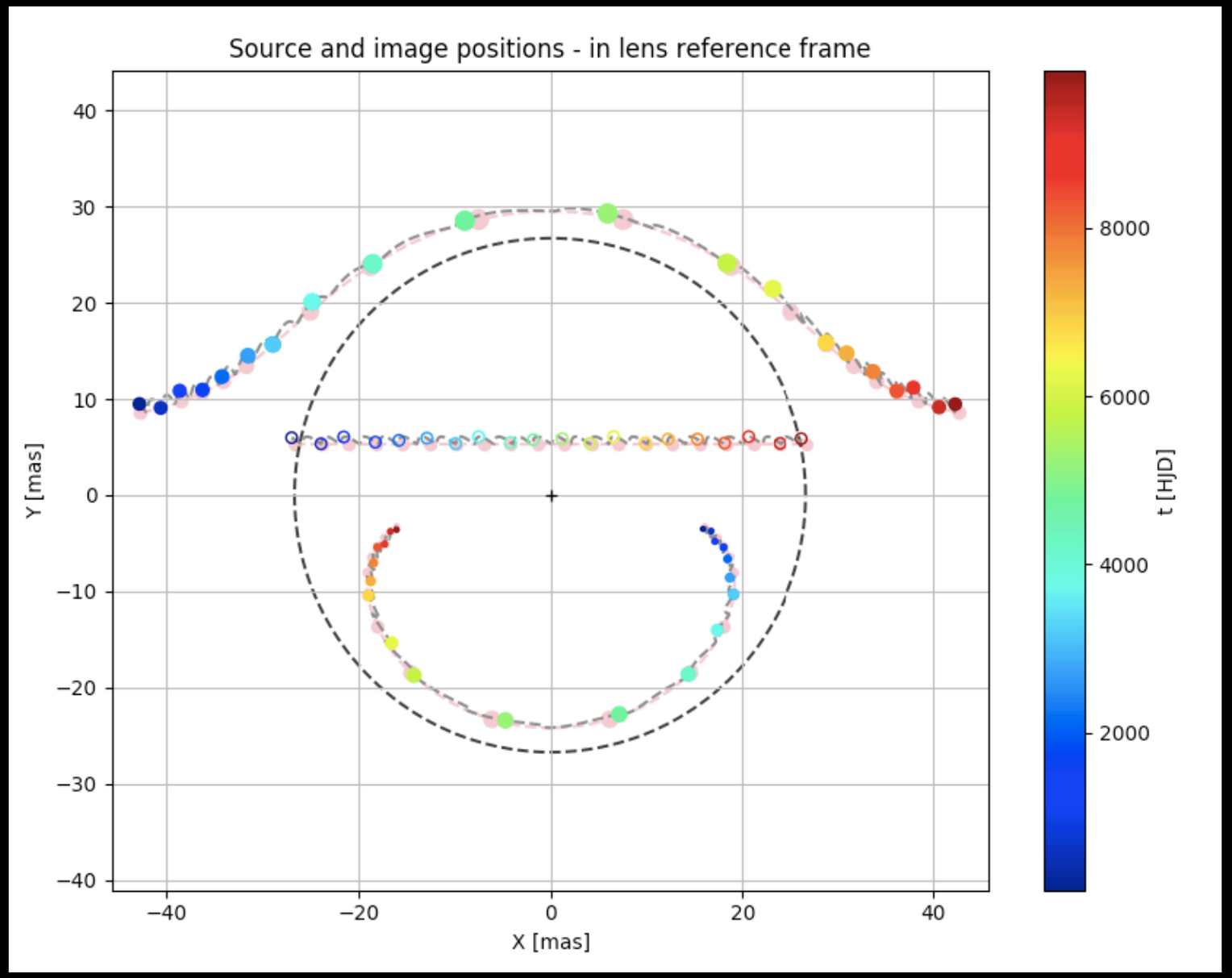


photometry





Parallax effects



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⟶ the missing ingredient for mass measurement!

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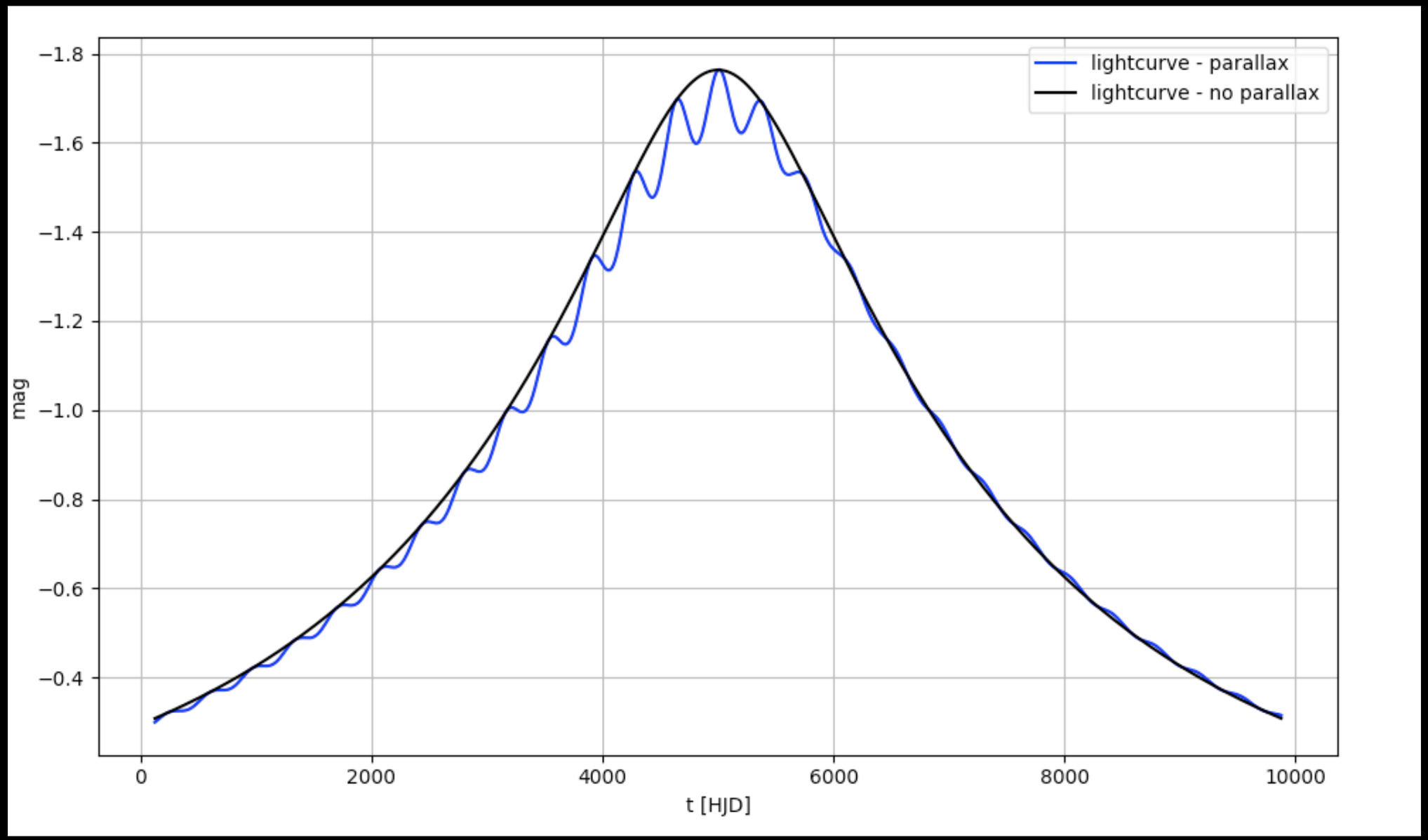

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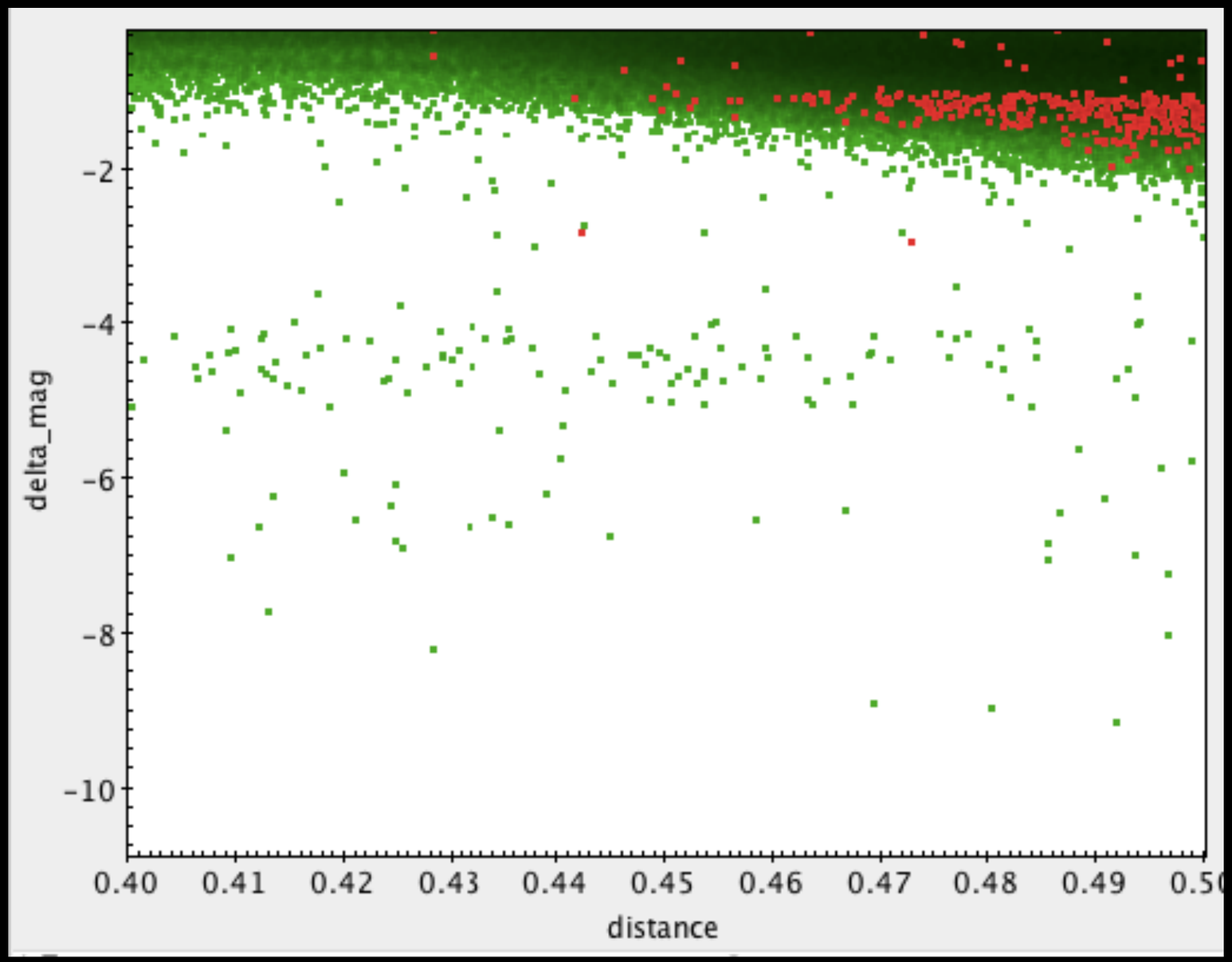
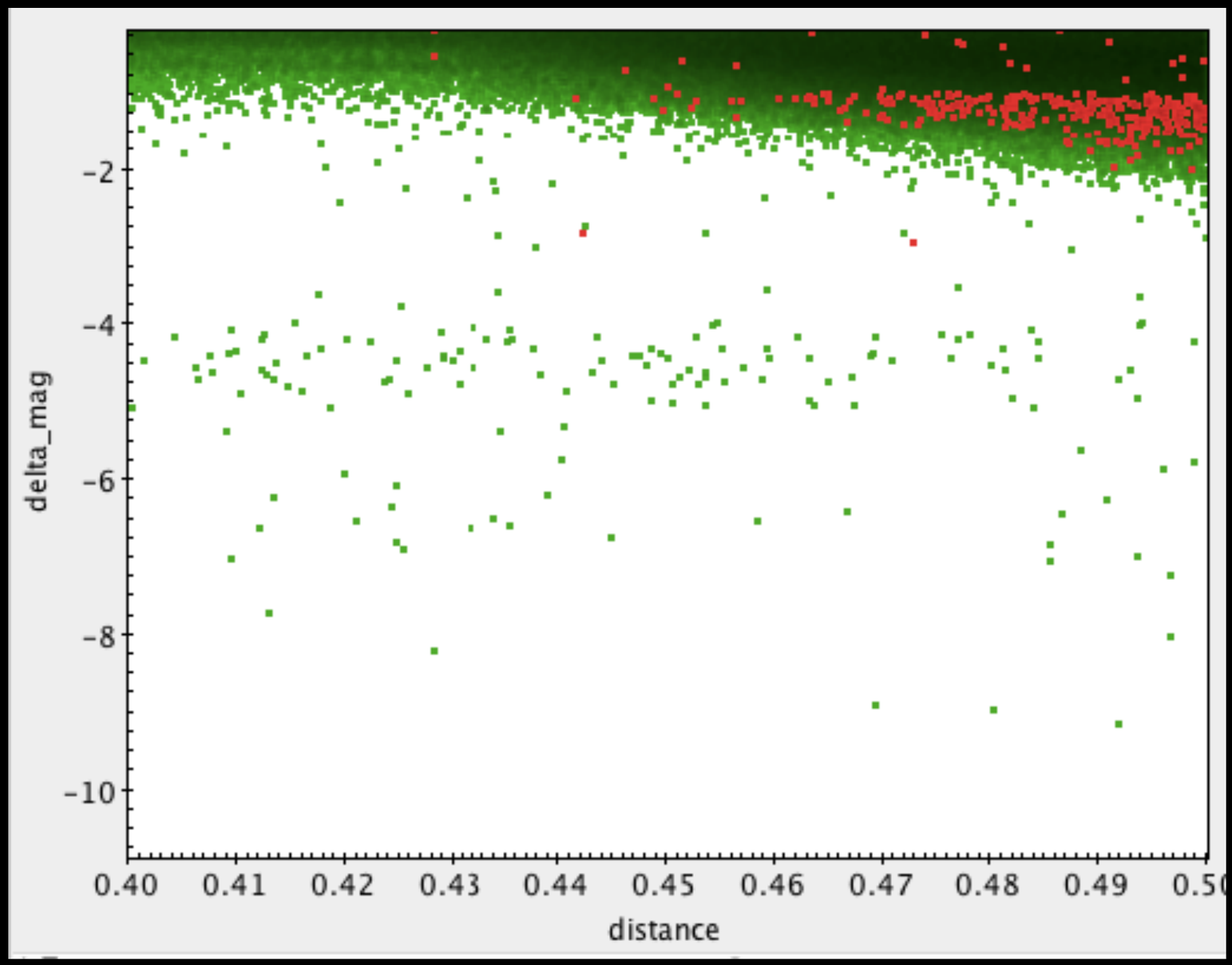
Gaia DR2 database search…



Gaia DR2 database search…



…inconclusive :(

Plans for the future

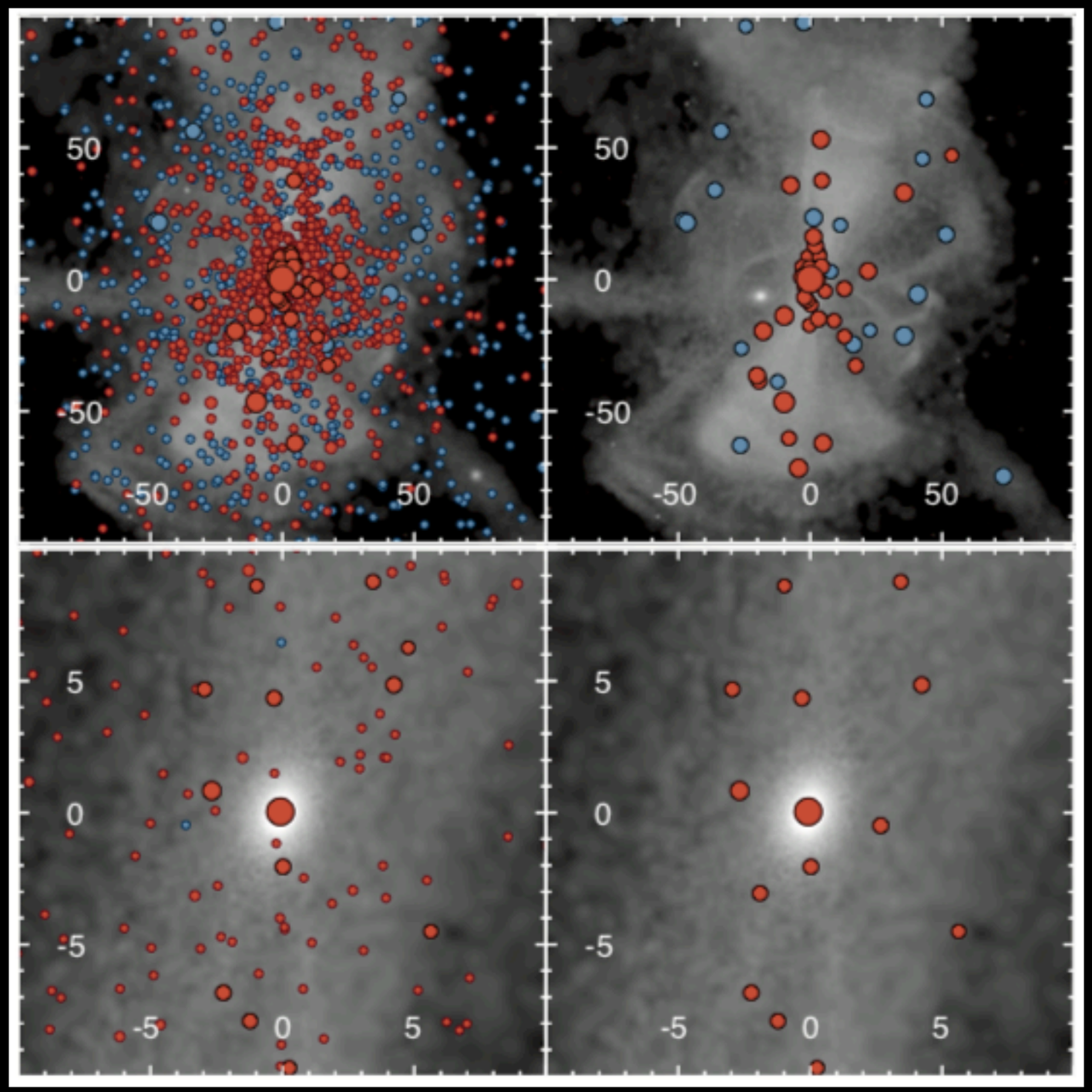
Searching in Gaia data

Gaia EDR3 - Q3 2020

improved astrometry

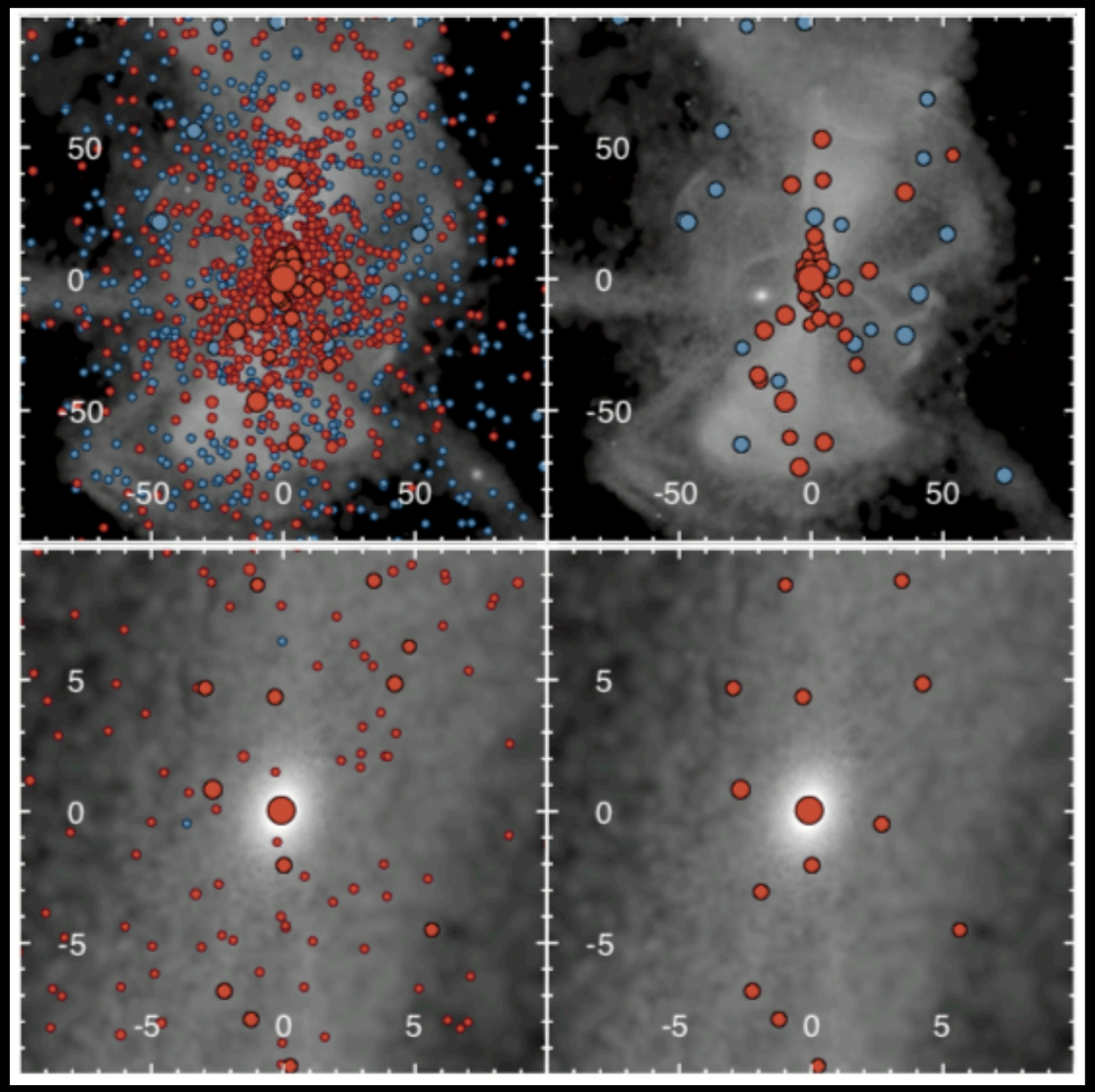
ideas to involve other surveys

IMBH distribution in the Milky Way



Rashkov & Madau 2014

IMBH distribution in the Milky Way



Rashkov & Madau 2014

scales of events
and astrometric parameters
(*what we will observe*):

- angular scale: Einstein radius (θ_E)
- timescale: Einstein time (t_E)
- relative proper motion of images (μ_{im})

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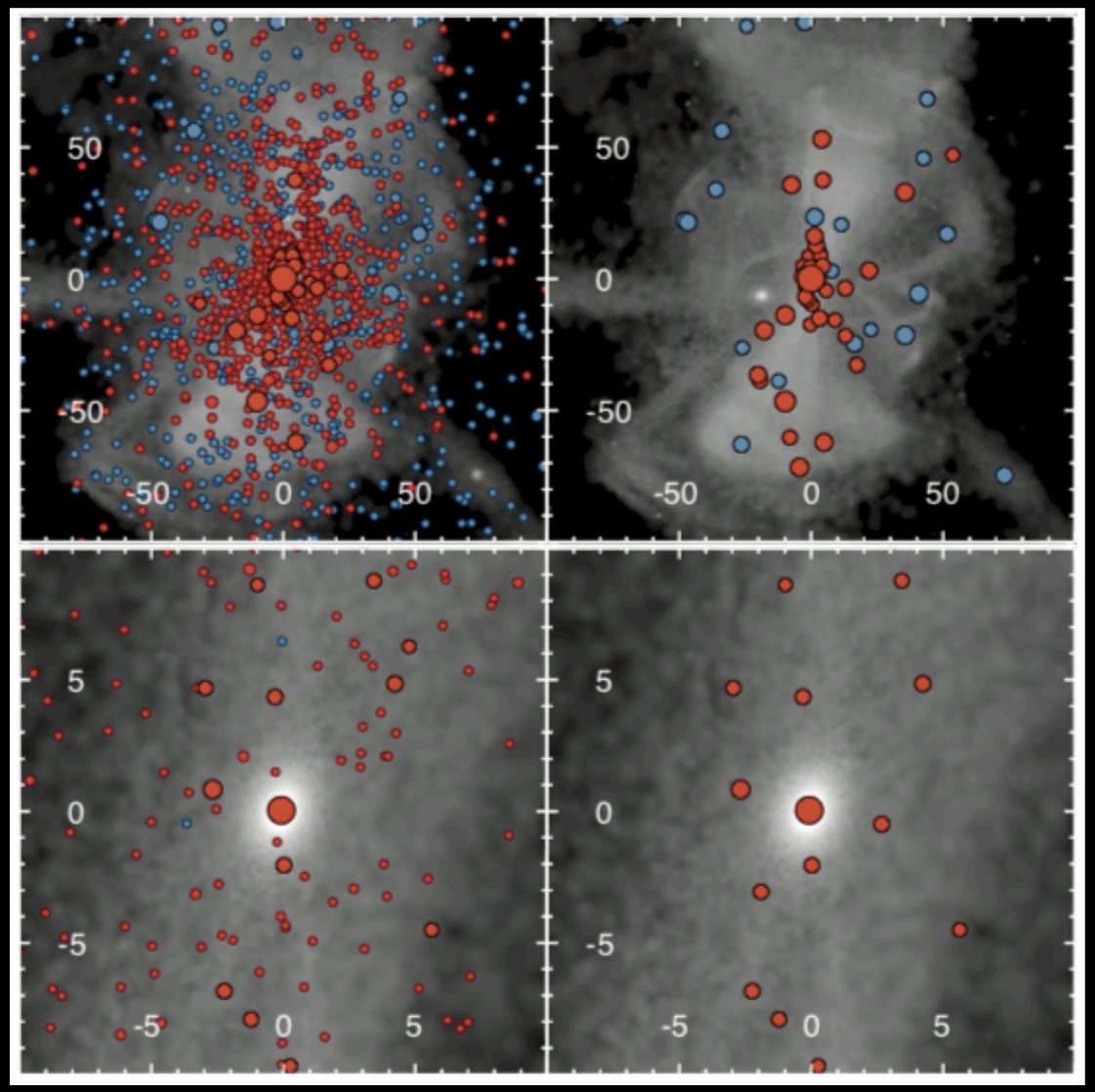

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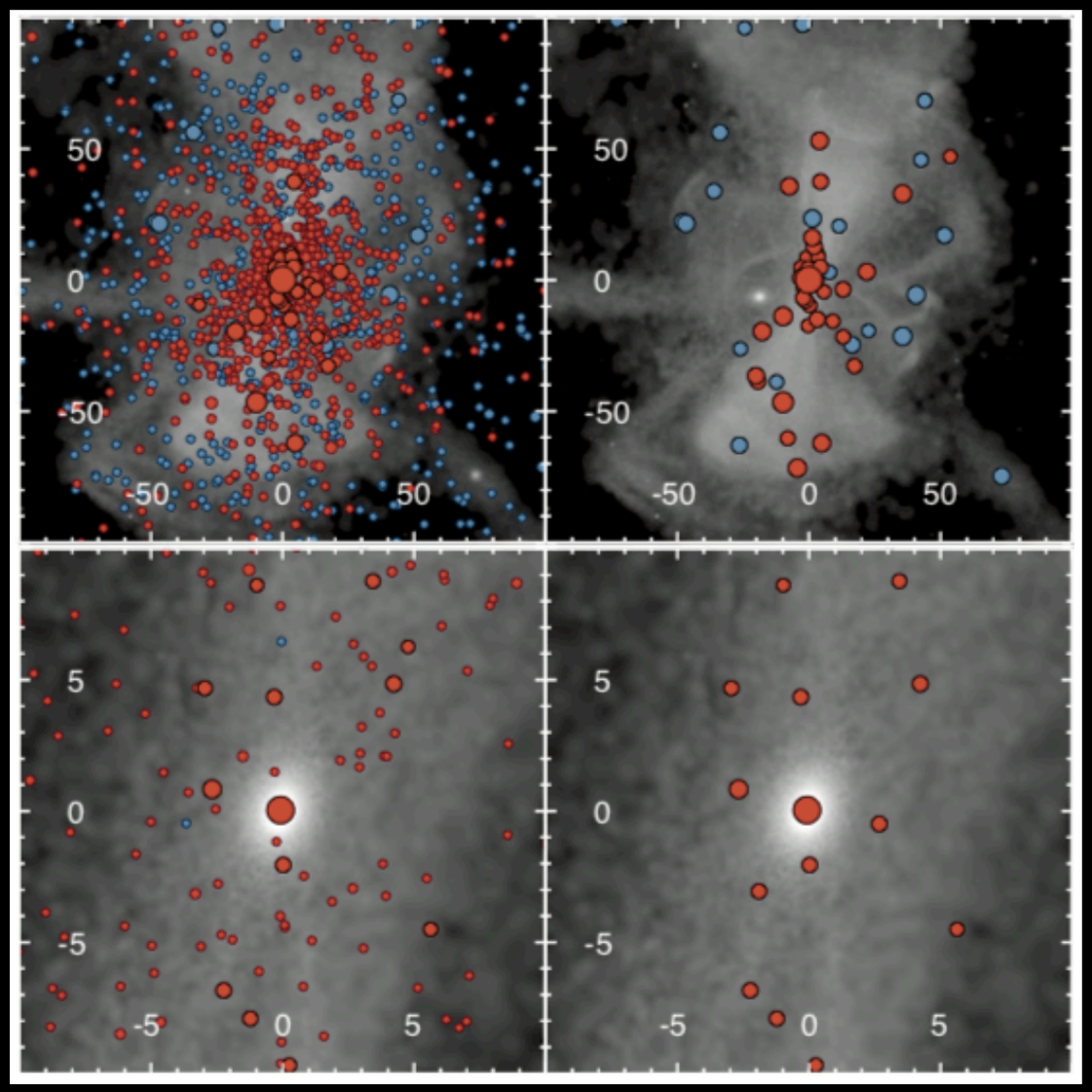
parallax corrections
(what we will look for
***to measure mass)*:**

- lensing parallax (π_{rel})
- lensing parallax
  in Einstein radius units (π_{rel}/θ_E)

IMBH distribution in the Milky Way



Rashkov & Madau 2014

We will know what to look for in Gaia EDR3!

Take-home messages

- The search for astrometric lensing events can help find IMBHs

- Gaia measurements are crucial for this search!

- Cooperation and experience from Gaia Alerts will be valuable

Thank you for your attention!