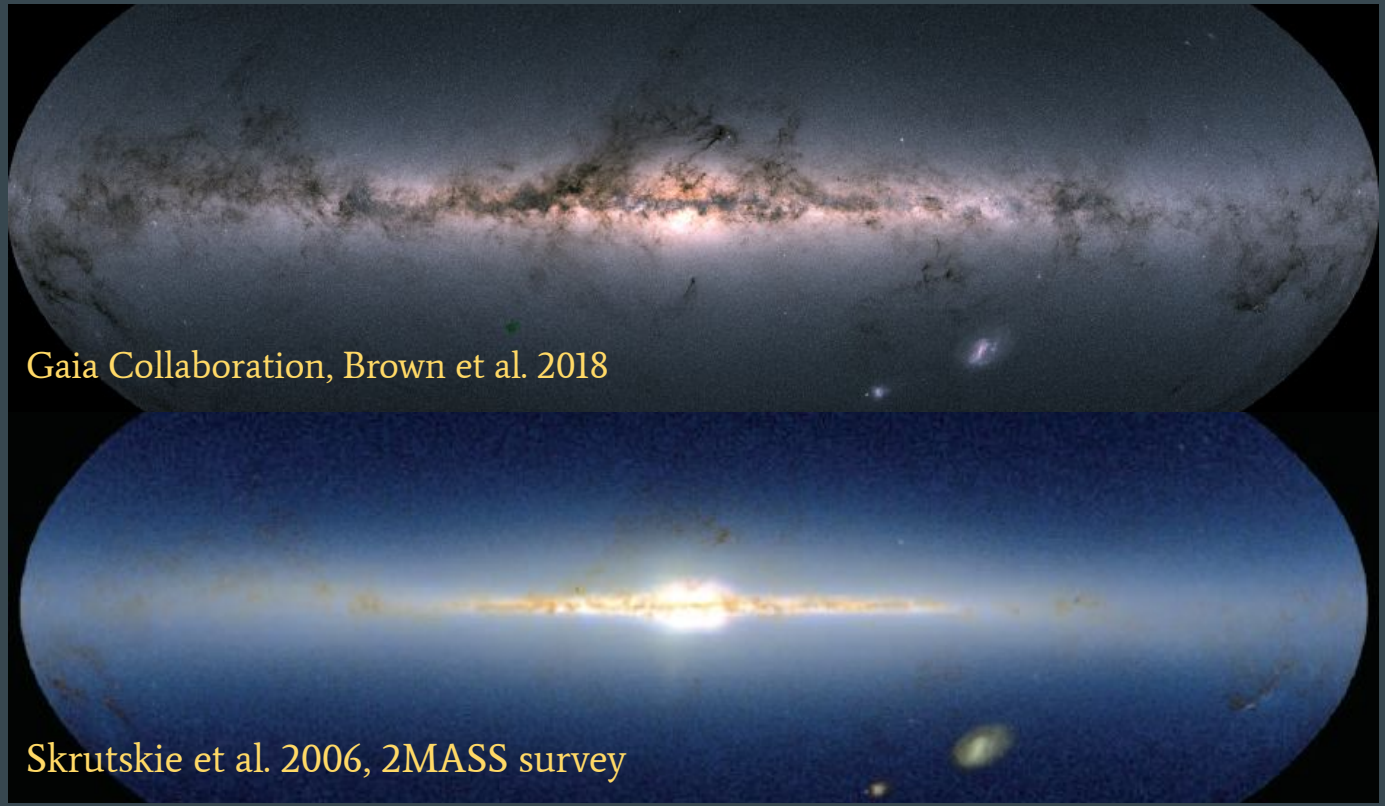
Revealing the disc of the Milky Way with GaiaNIR

In collaboration with Shourya Khanna and Eloisa Poggio

Our limited view of the disk



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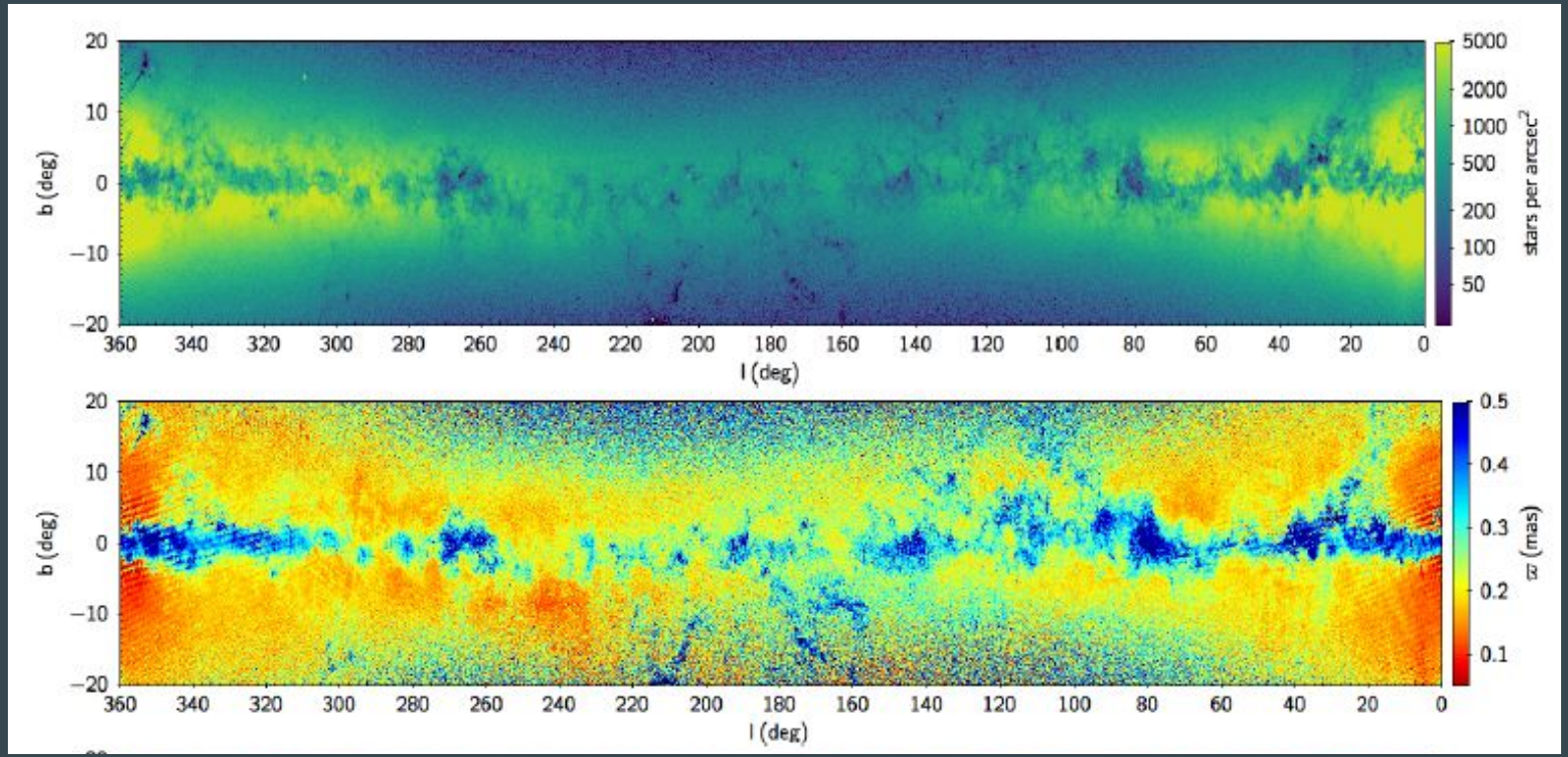
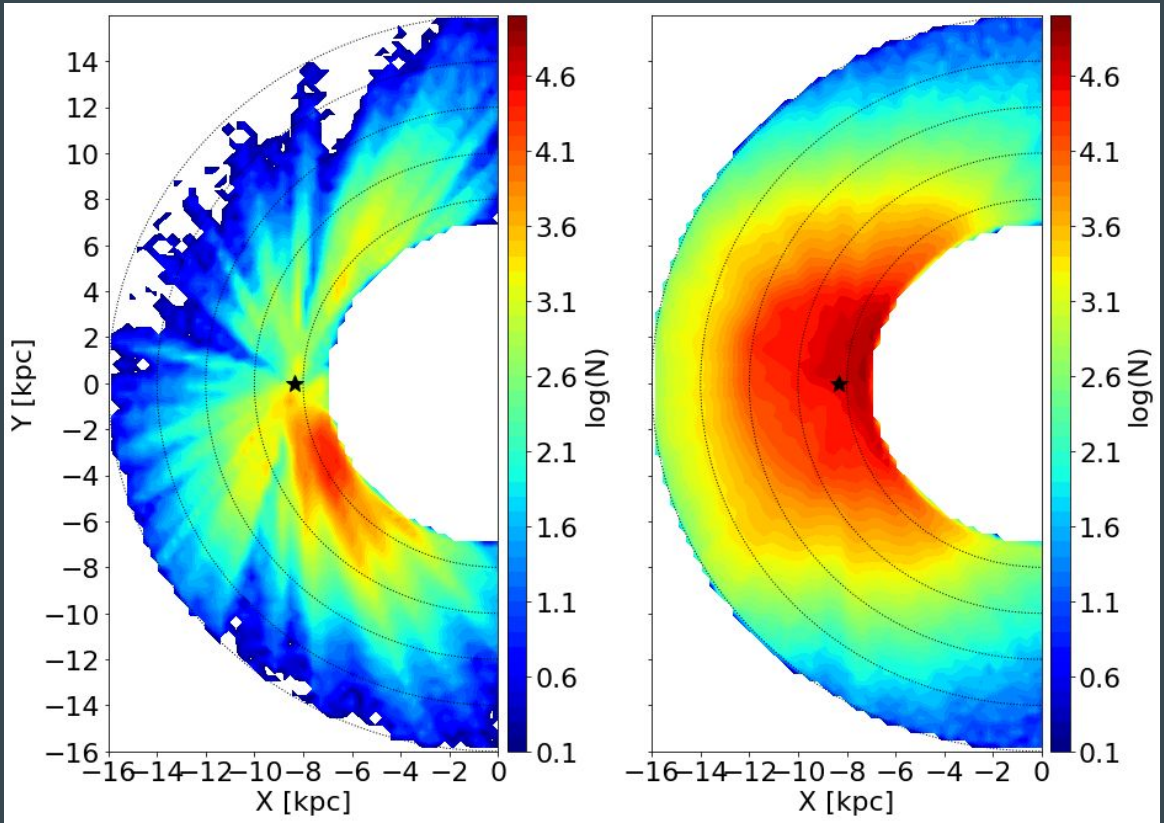


Poggio, Drimmel et al. 2020

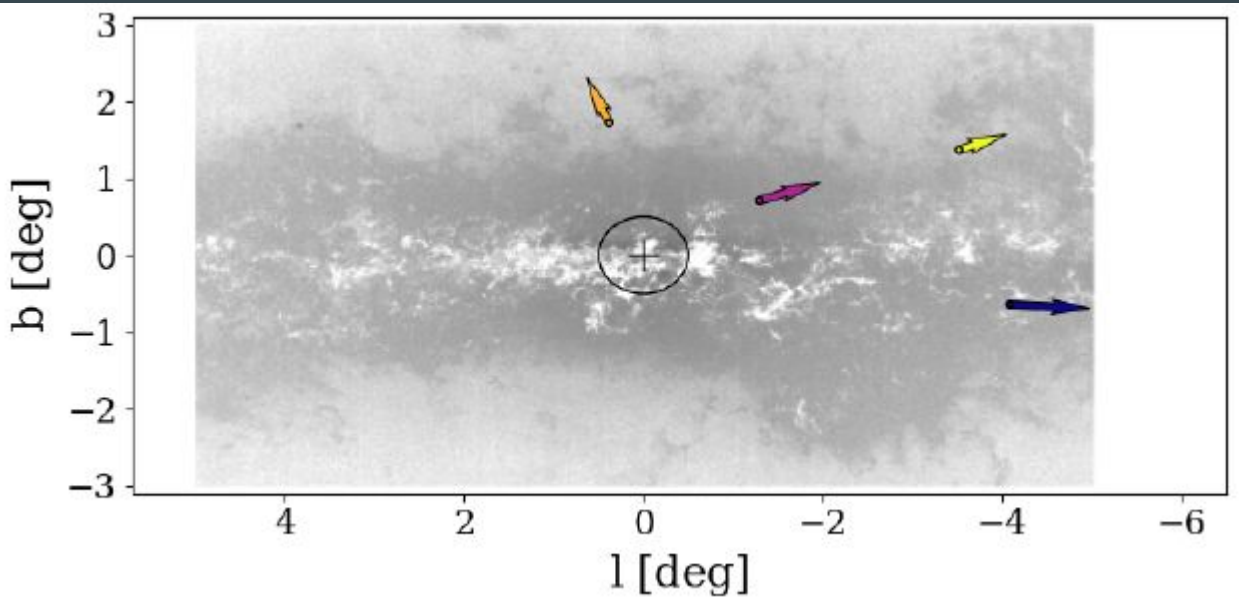
Our limited view of the disk



OB vs giant distribution

From M. Romero-Gomez et al 2019

Lifting the veil of extinction



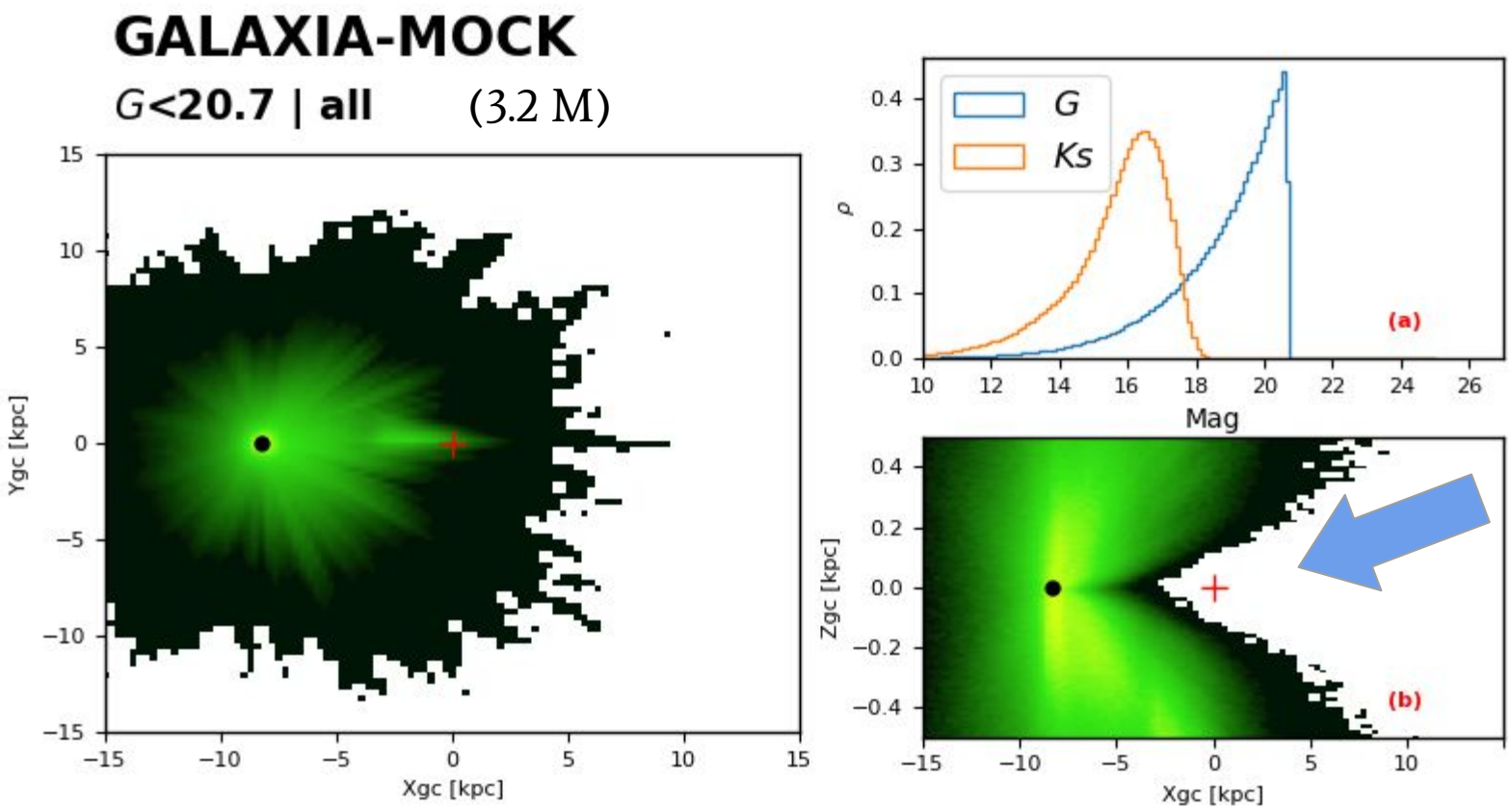
From Luna et al 2023

VIRAC = VVV Infrared Astrometric Catalogue

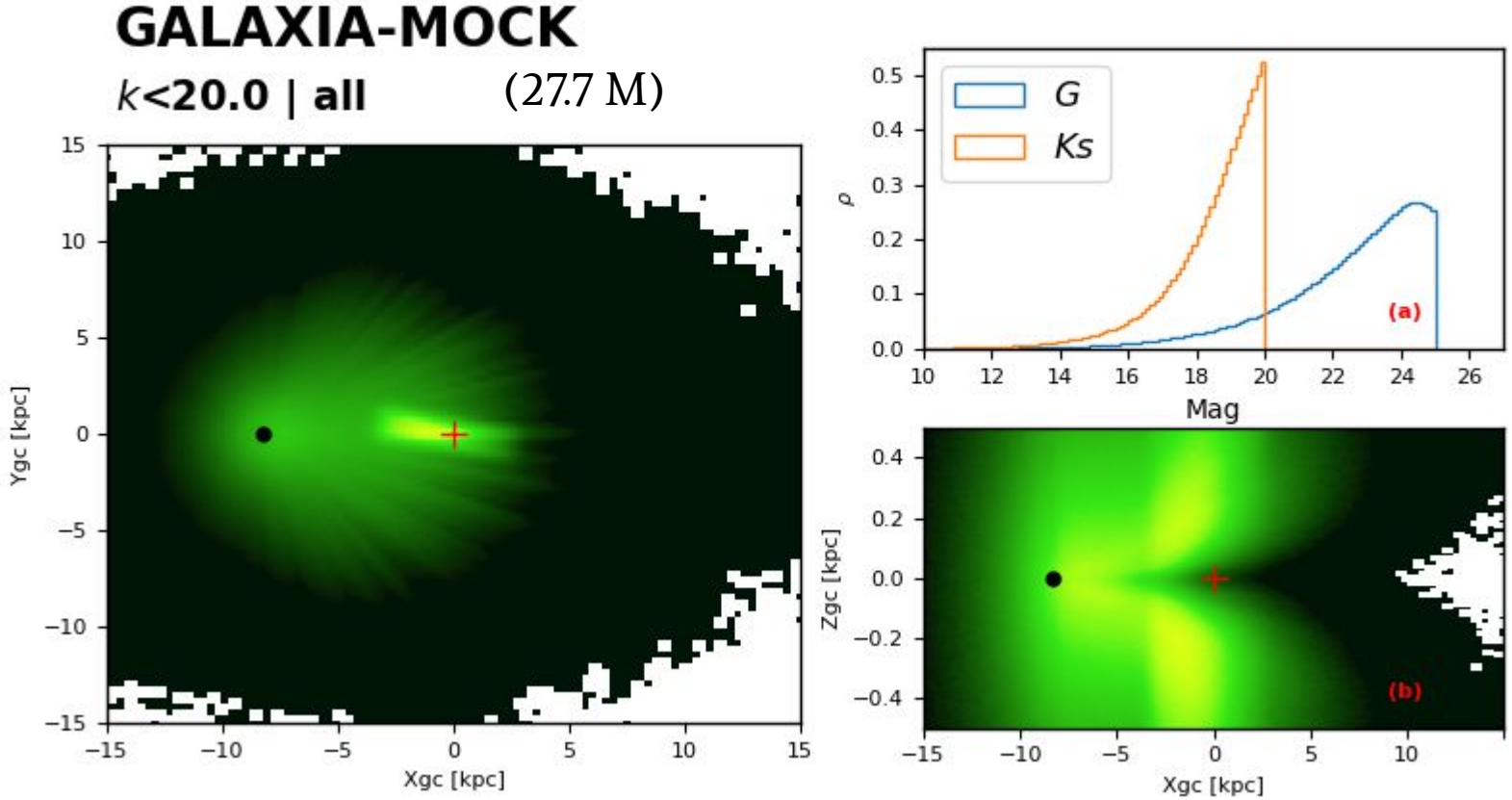
Using the VIRAC2 data set, we select a region in the inner part of the Galactic bulge, in a box within $-5\,\mathrm{deg} < l < 5\,\mathrm{deg}$ and $-3\,\mathrm{deg} < b < 3\,\mathrm{deg}$. The total number of sources from VIRAC2 within the 60 sq.deg region is 112 599 161. In the same area, there are 36 101 569 sources in *Gaia* .

For a sample complete to K < 16.

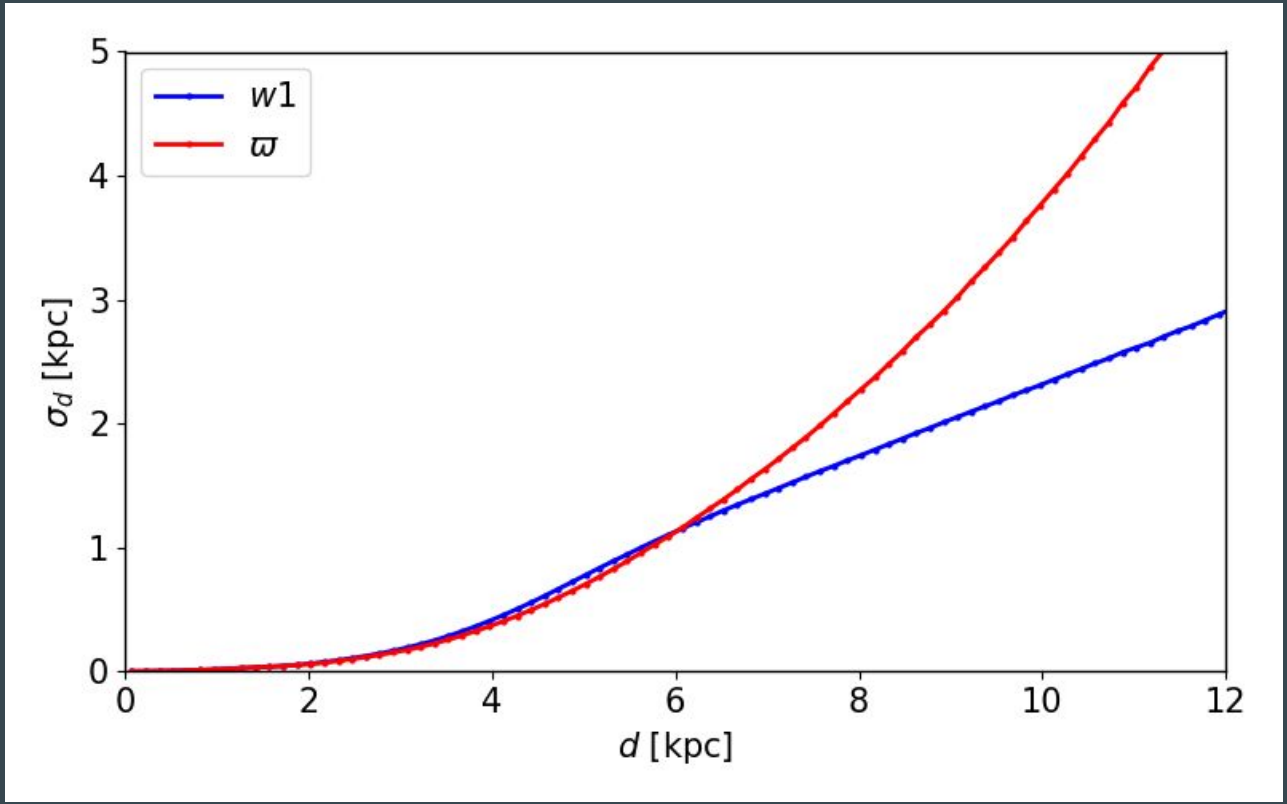
Mapping in the visible



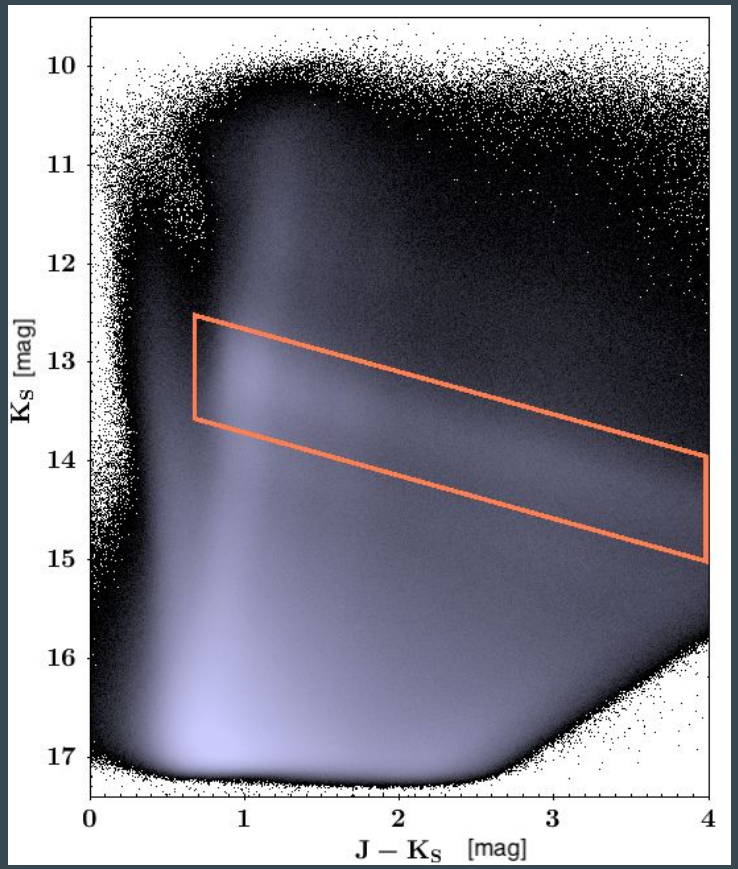
Mapping in the NIR

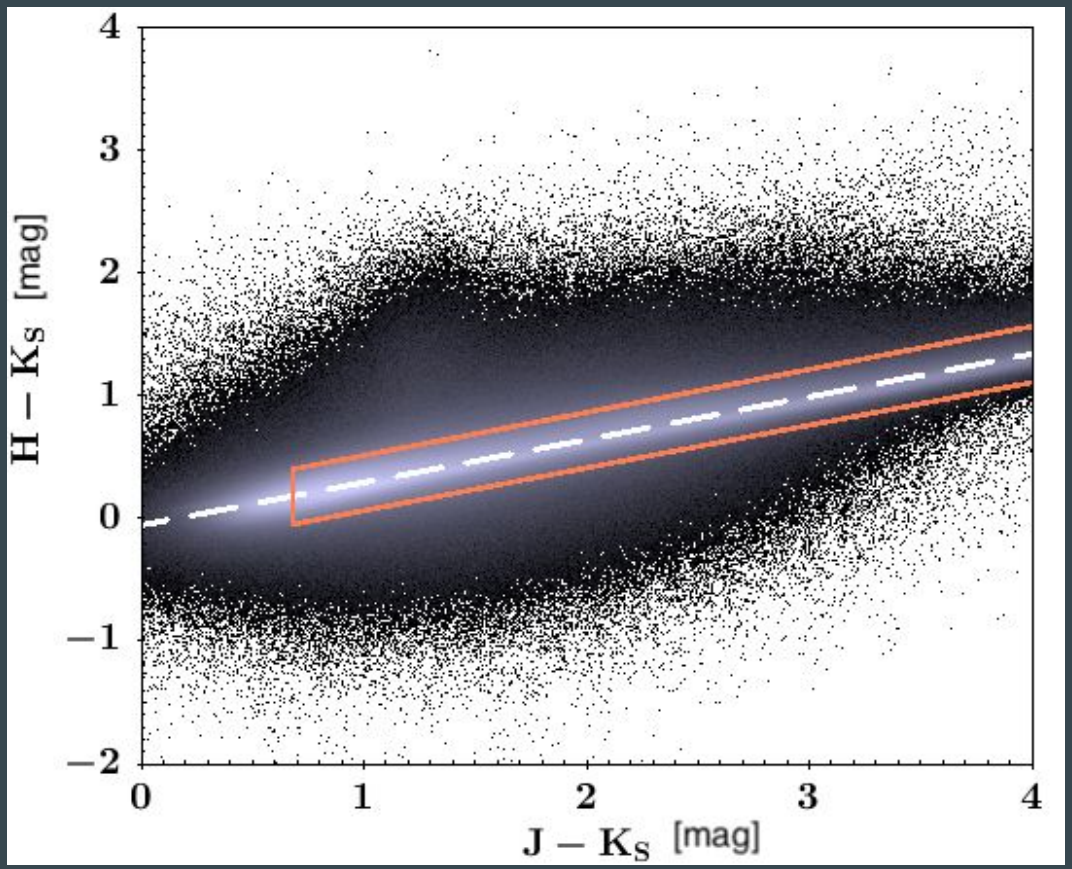


Photometric vs parallactic distance uncertainties

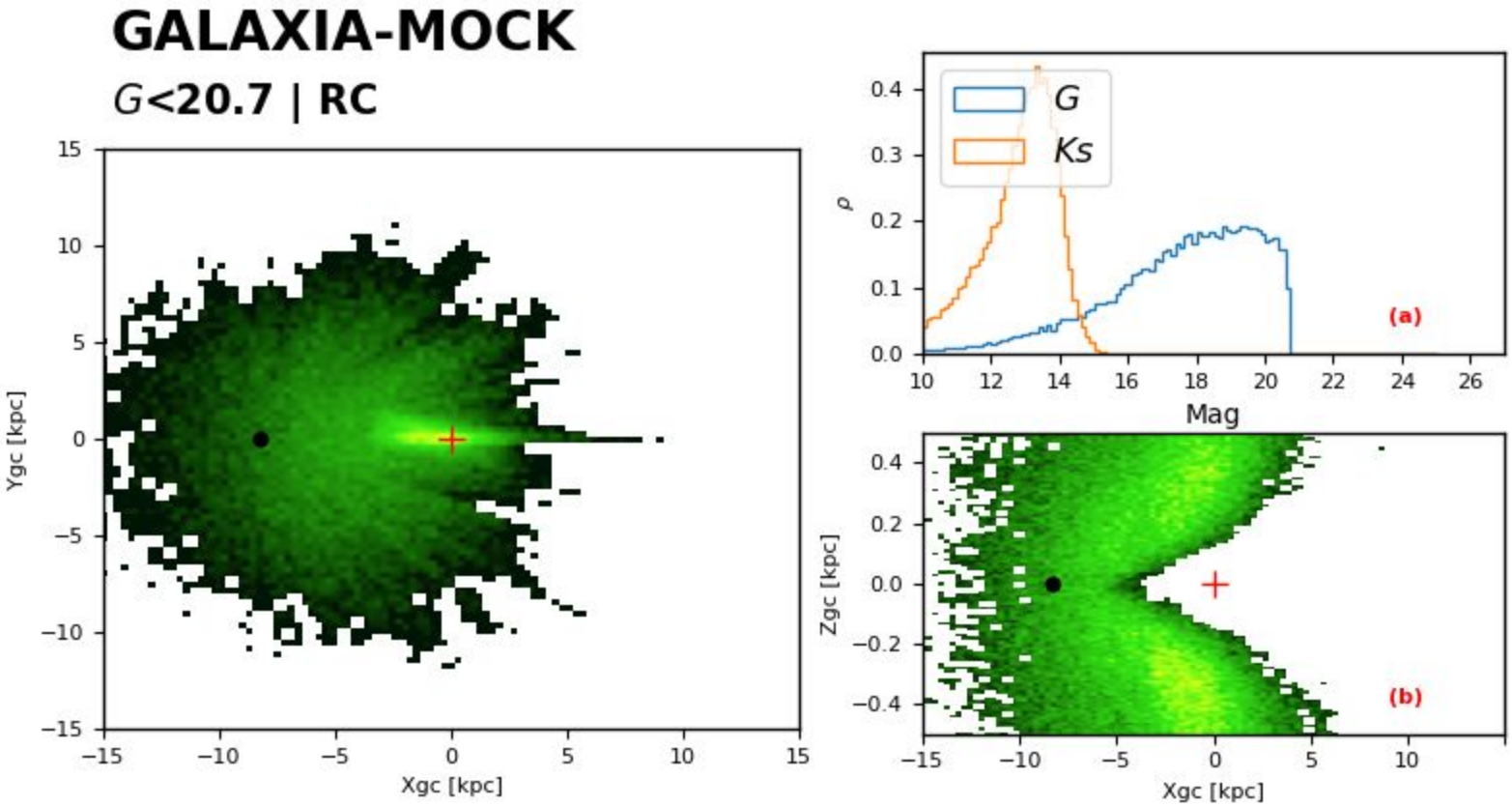


Selecting RC stars

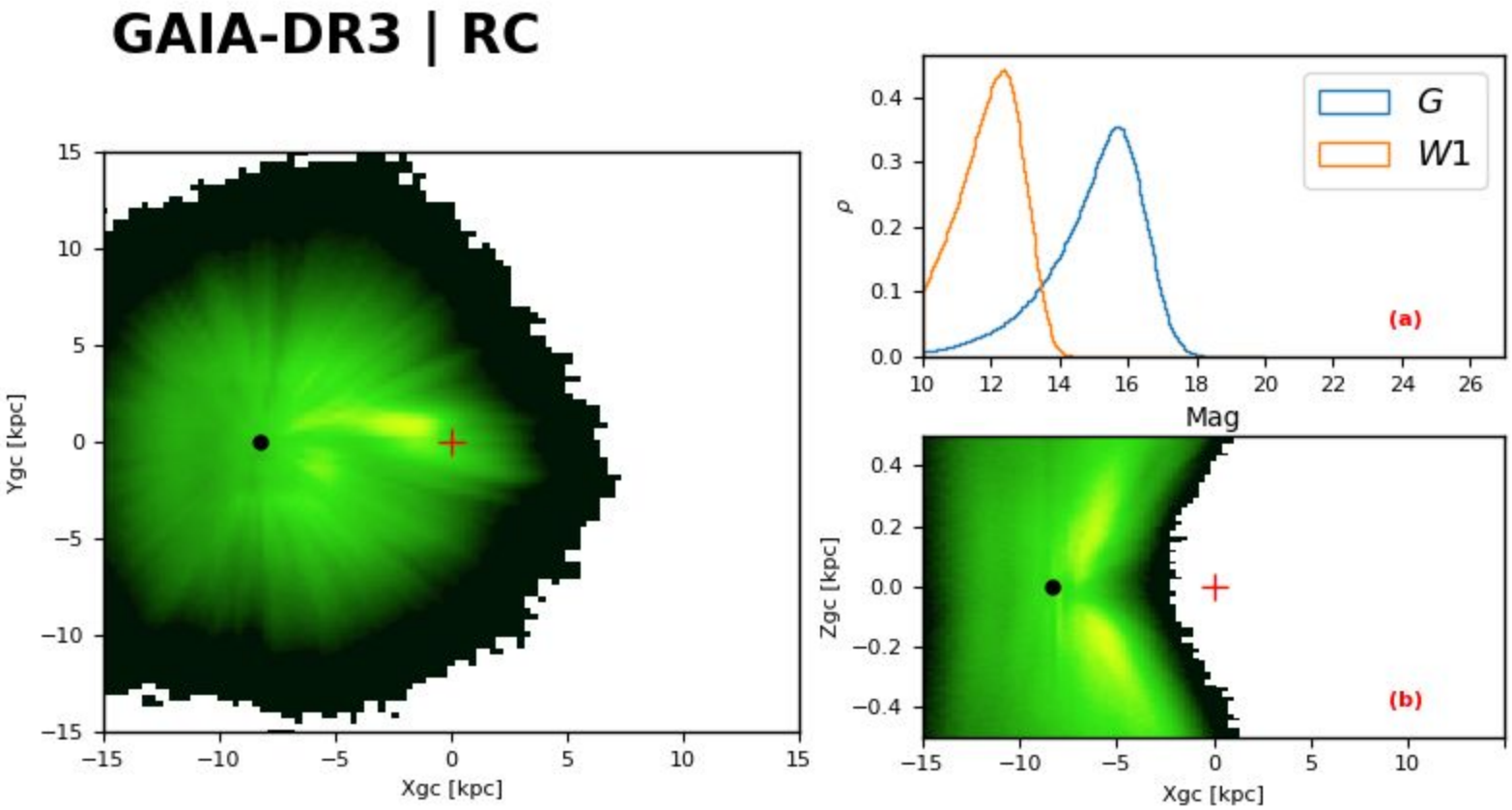




Mapping the disk with RCs



Mapping the disk with RCs



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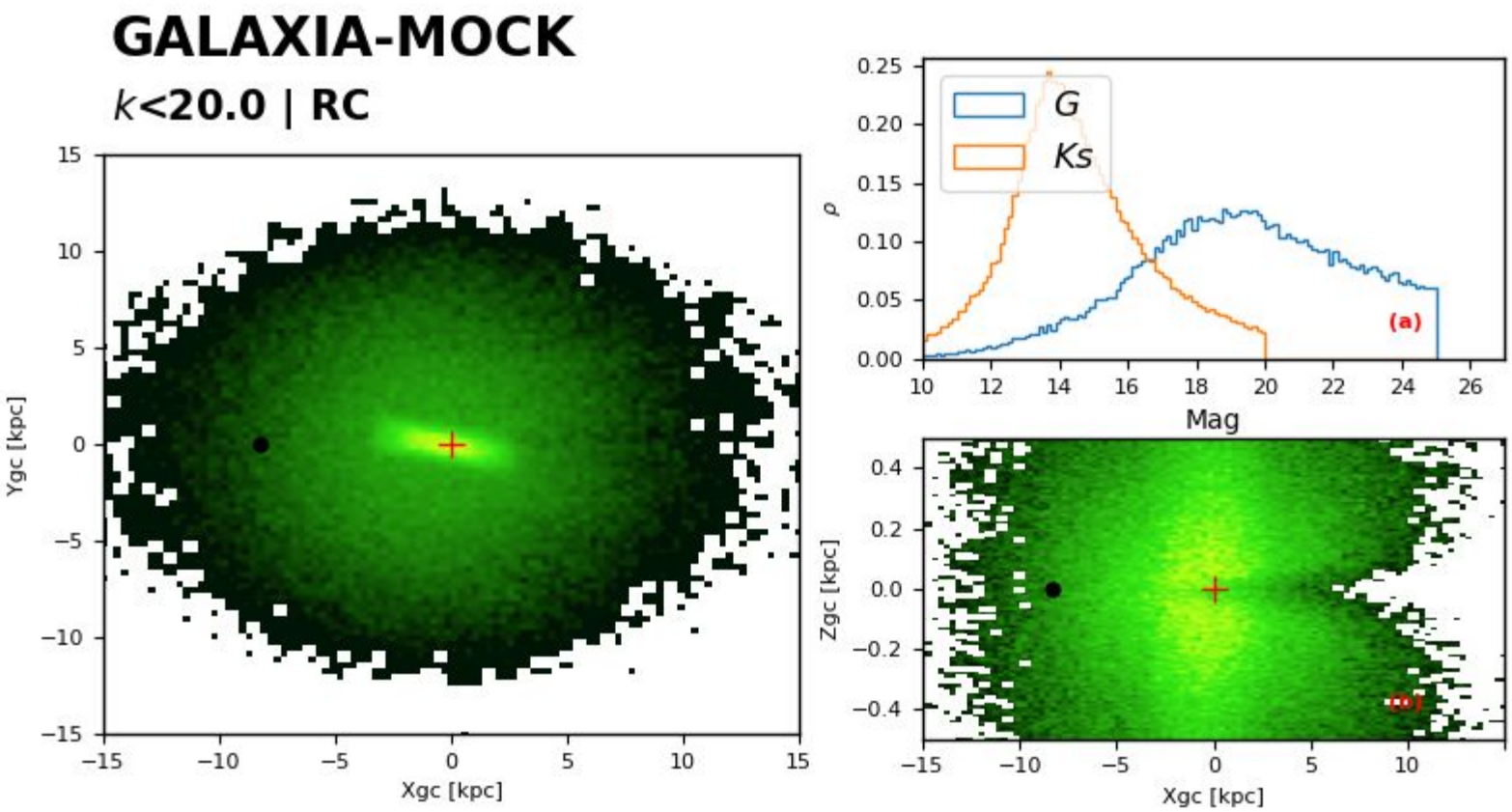

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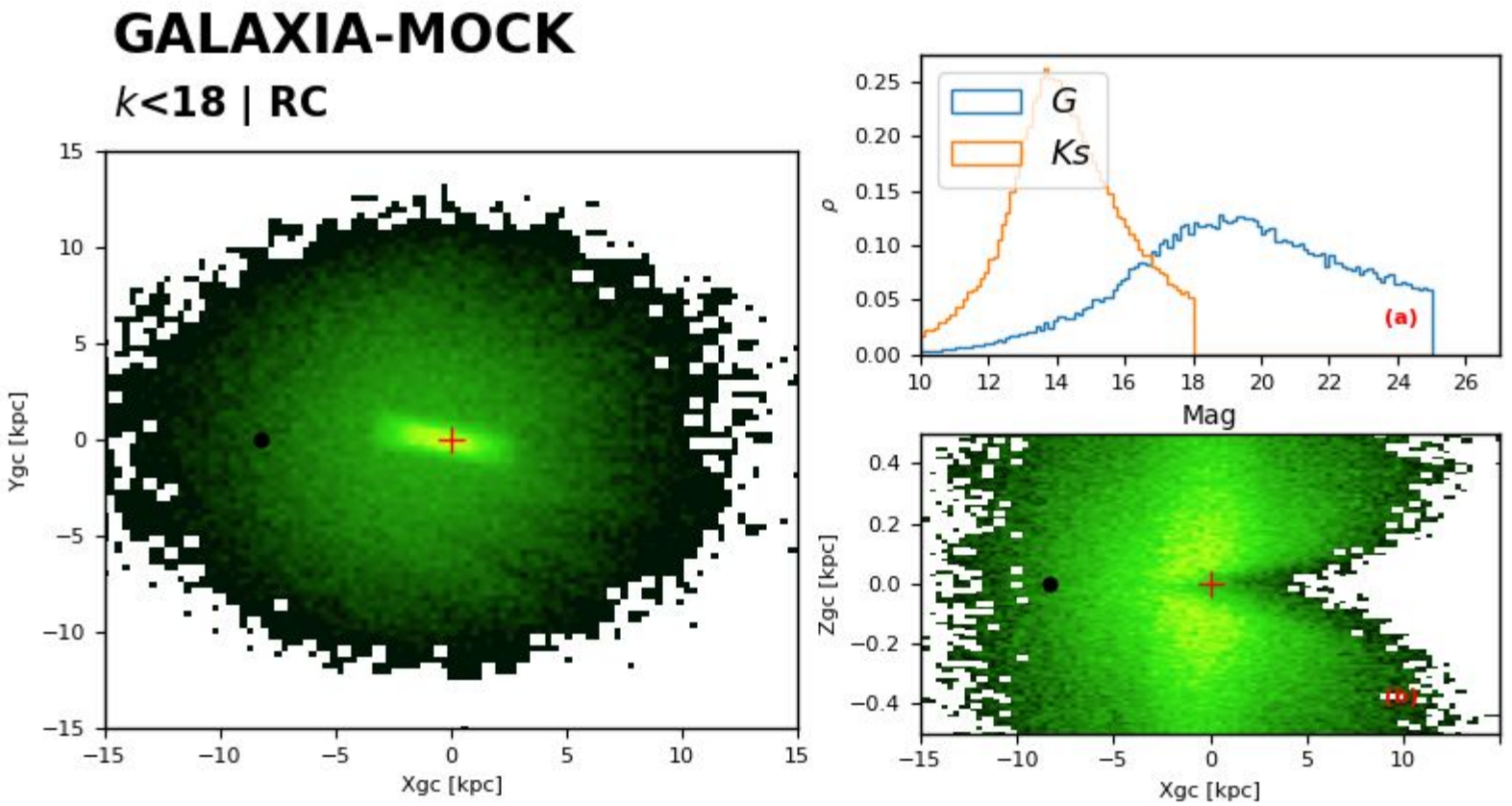


Mapping the disk with RCs

Why RCs?

- They're numerous
- They're a standard candle (K_s magnitude = −1.61±0.07 mag)
- They're easy to select using NIR colors
- Tracing a dynamically relaxed (ie. "old") population

Kinematics with GaiaNIR

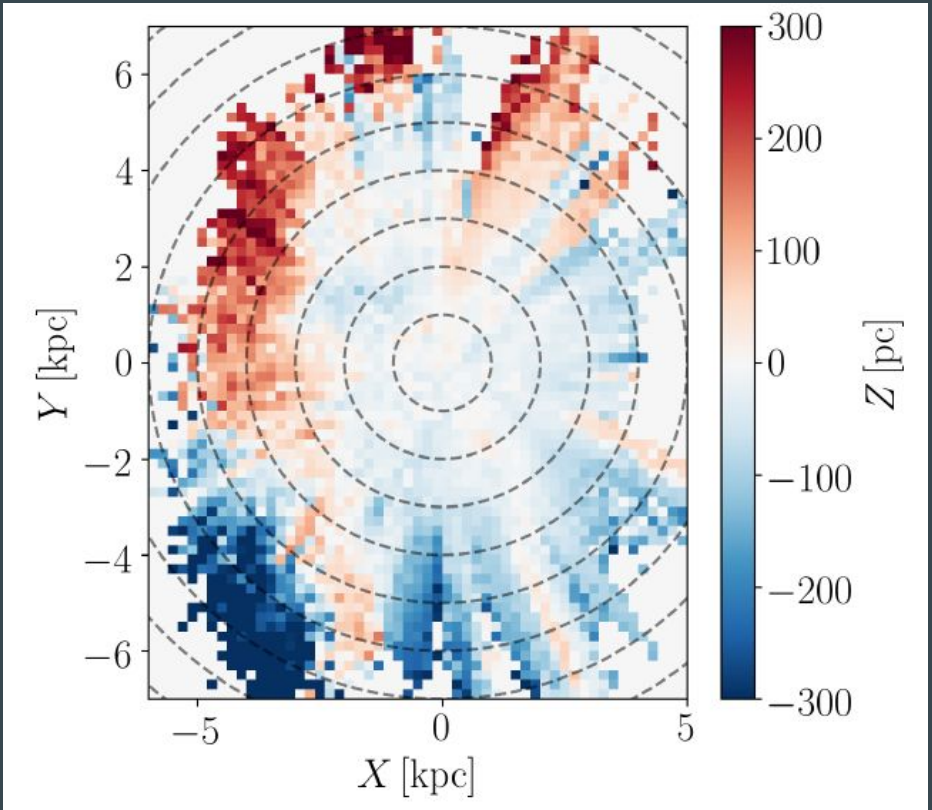
RVS or no RVS?

Even without RVS, the proper motions allows us to map the vertical motions in the disc...

Some open questions

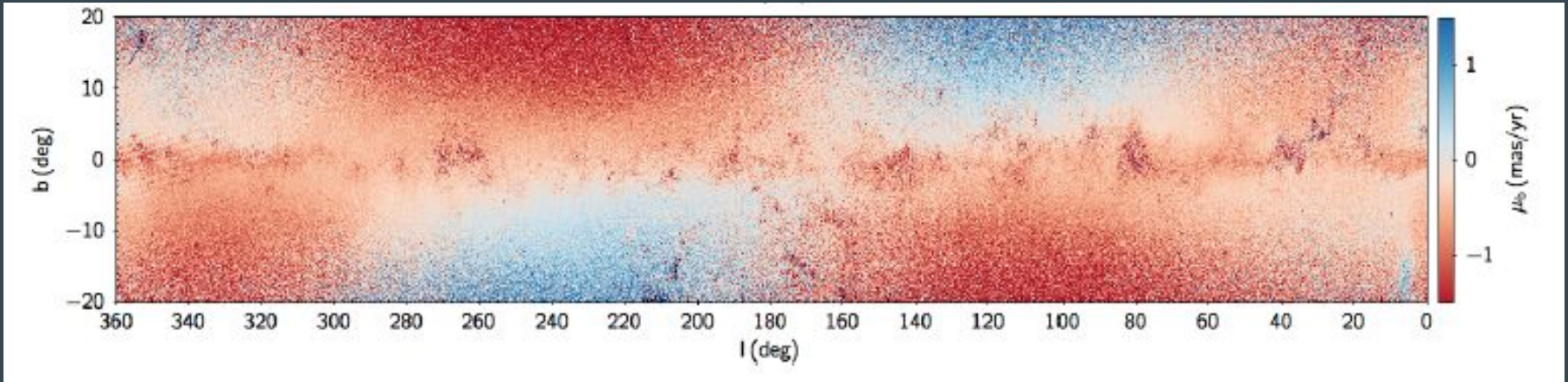
- Does the stellar warp follow that seen in the gas? Is it different for different stellar populations? (Age dependency?)
- Is there evidence of a spiral density wave in the “old” stellar disk? If yes, what is it’s geometry?
- What is the angle of the bar?

Kinematics with GaiaNIR



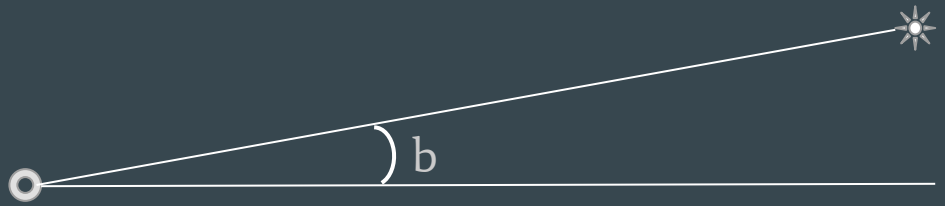
Median Z height of UMS sample from Zari et al 2021.

Kinematics with GaiaNIR

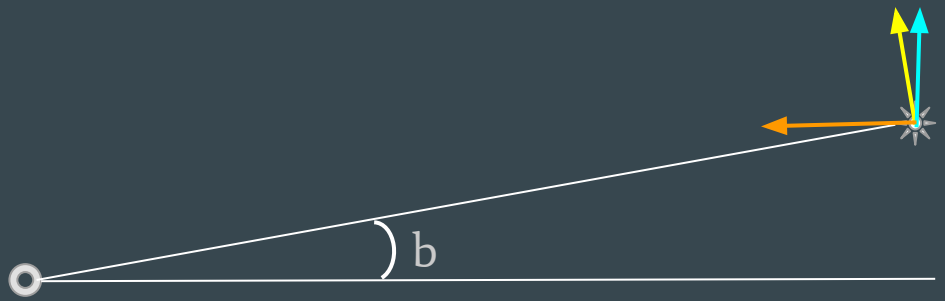


Poggio, Drimmel et al. 2020

Kinematics with GaiaNIR



Kinematics with GaiaNIR

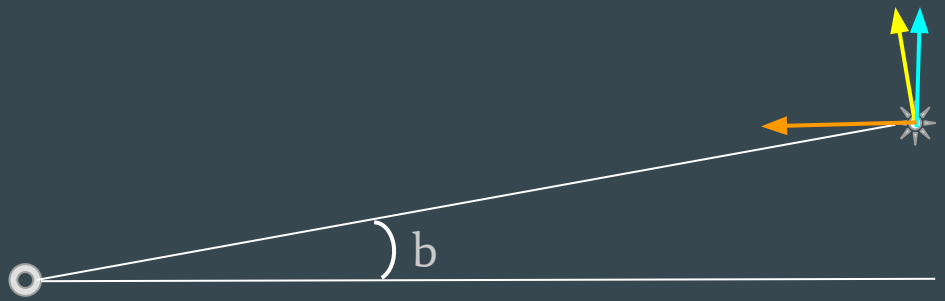


Taking $\mathrm{v}_\odot = (U, V, W)_\odot$ and $\mathrm{v} = (U, V, W)$, defined in the same right hand coordinate system as x, one can write from Eqs. (6) and (7):

$$W = \frac{4.74 d \mu_b}{\cos b} + W_\odot + (S - S_\odot) \tan b, \qquad (8)$$

where S is the component of the star's velocity parallel to the Galactic plane and in the plane that contains the LOS and is at right angles to the Galactic plane, that is $S = U \cos l + V \sin l$, and similarly for $S_\odot$.

Kinematics with GaiaNIR



S = mean motion + peculiar motion

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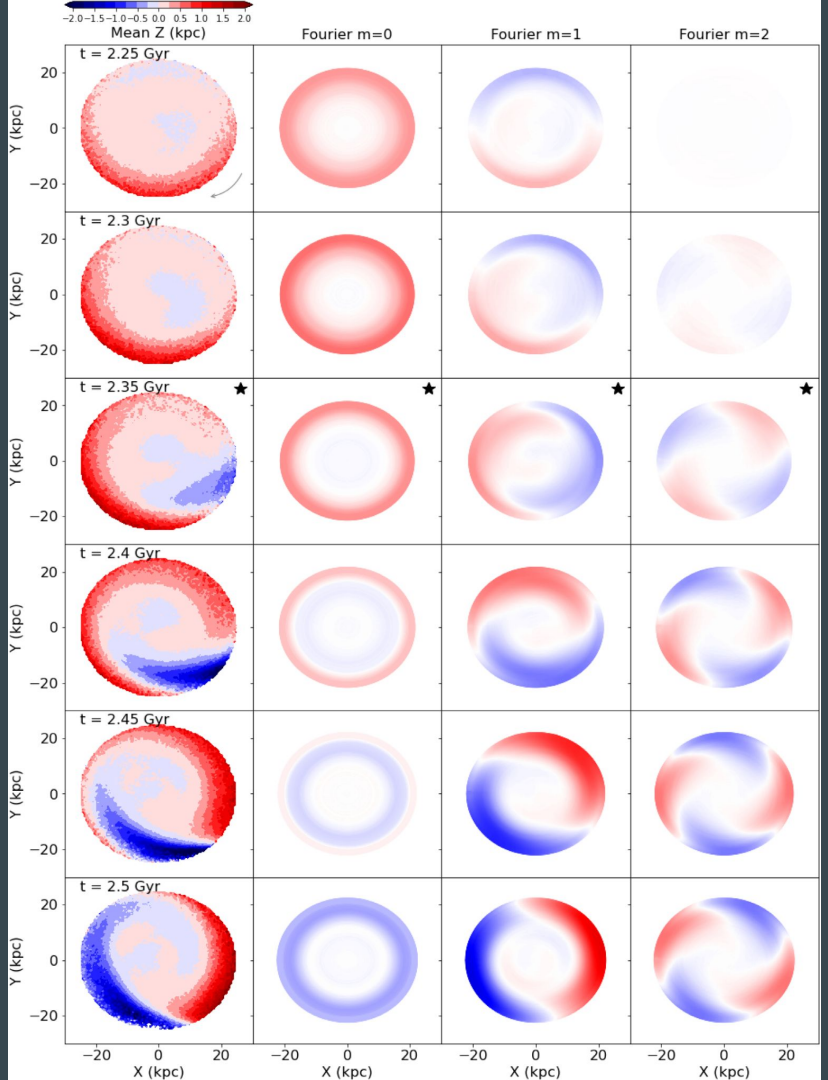
Kinematics with GaiaNIR

Simulation of disk undergoing an interaction.

From Poggio et al 2021.



Summary

- Huge increase to be expected in the number of sources at low galactic latitudes
- Photometric distances to standard candles will be important beyond about 5-6kpc
- Red Clump stars will allow us to map much of the stellar disk
- GaiaNIR will allow us to map both the near and far side of the bar
- Vertical structure (i.e. the stellar warp) will become clearer
  - Old versus Young stars
- Even without RVS data, a complete and detailed mapping of the vertical kinematics across the disk should be possible: Galactic seismology!