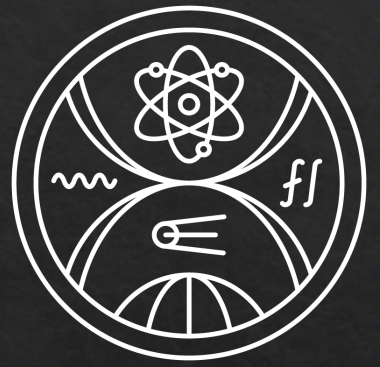
STRUCTURE OF THE GALAXY



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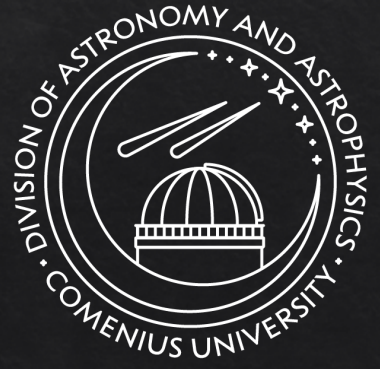
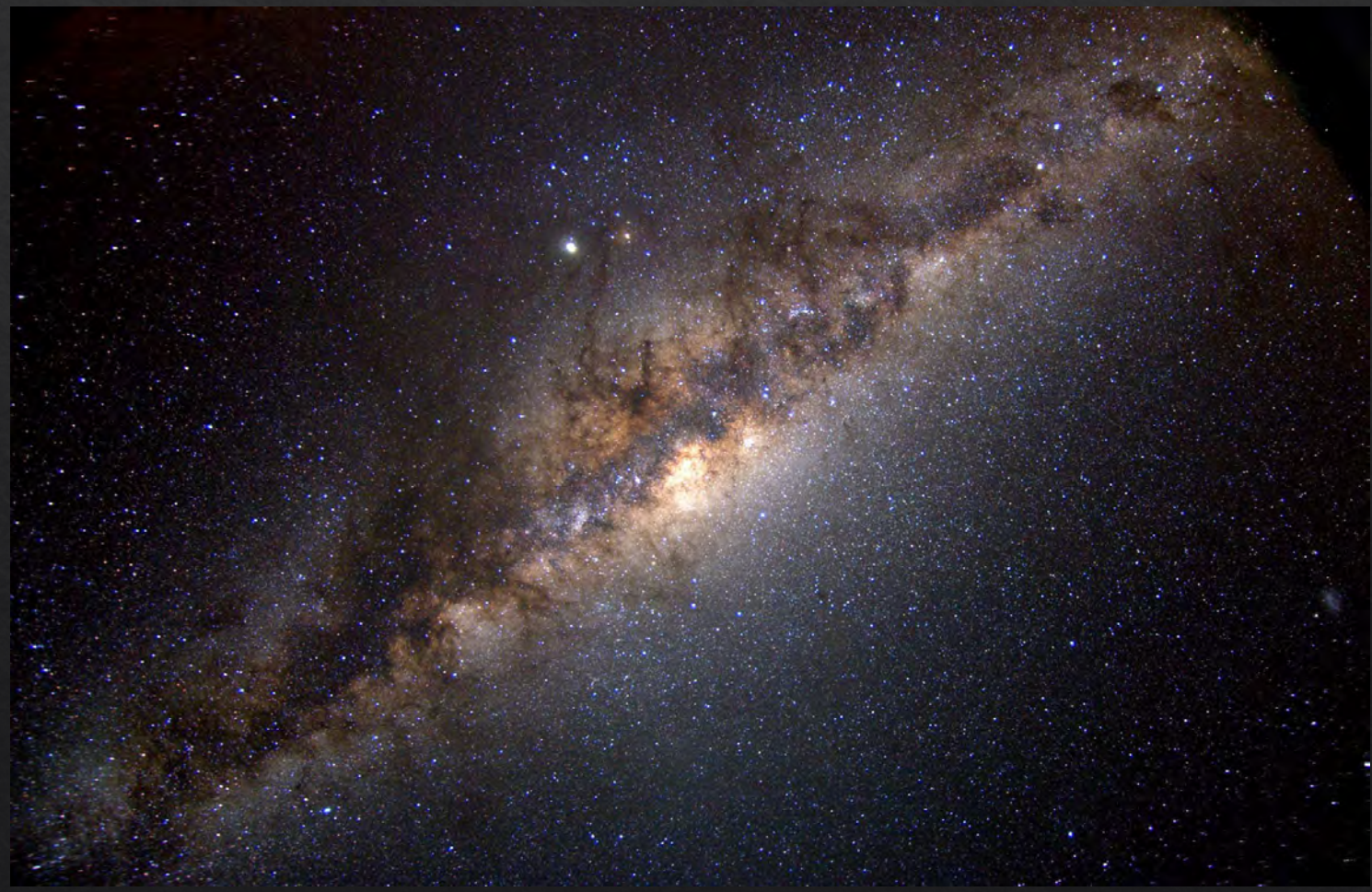


INTRODUCTION

- Milky Way
- Gaia mission
- Galactic flare
  - Structural flare
  - Kinematic flare

MOTIVATION

- Why should we study galaxies?
- Formation, evolution, structure
- Dark matter problem
- Refining of cosmological models
- Milky Way

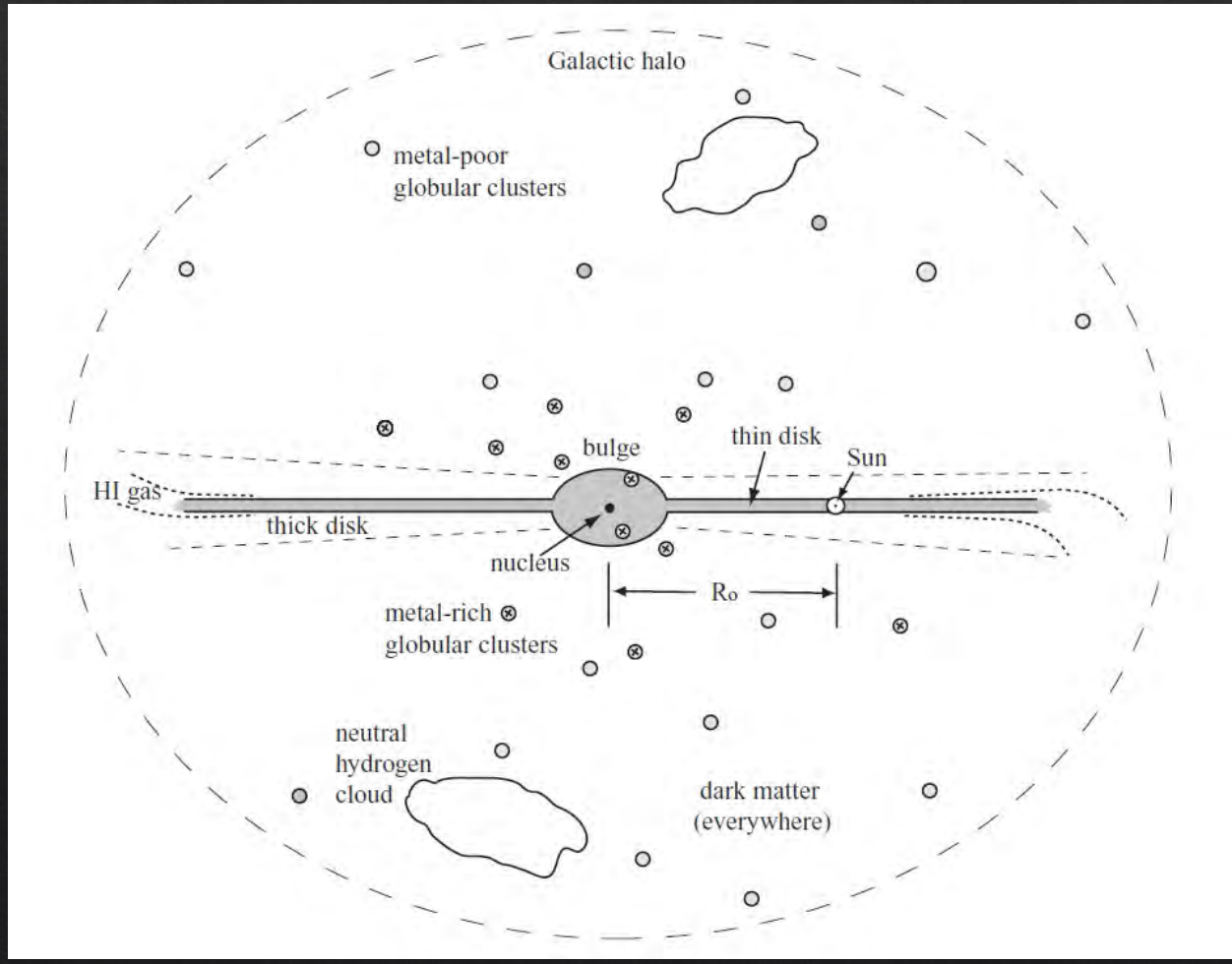


NASA (2017)

MILKY WAY

- 10^{12} M_S
- Spiral between SBc and Sbc class

- Bulge
- Disc
  - Thin
  - Thick
- Halo
  - Stellar
  - Hot
  - Dark



Sparke & Gallagher (2007)

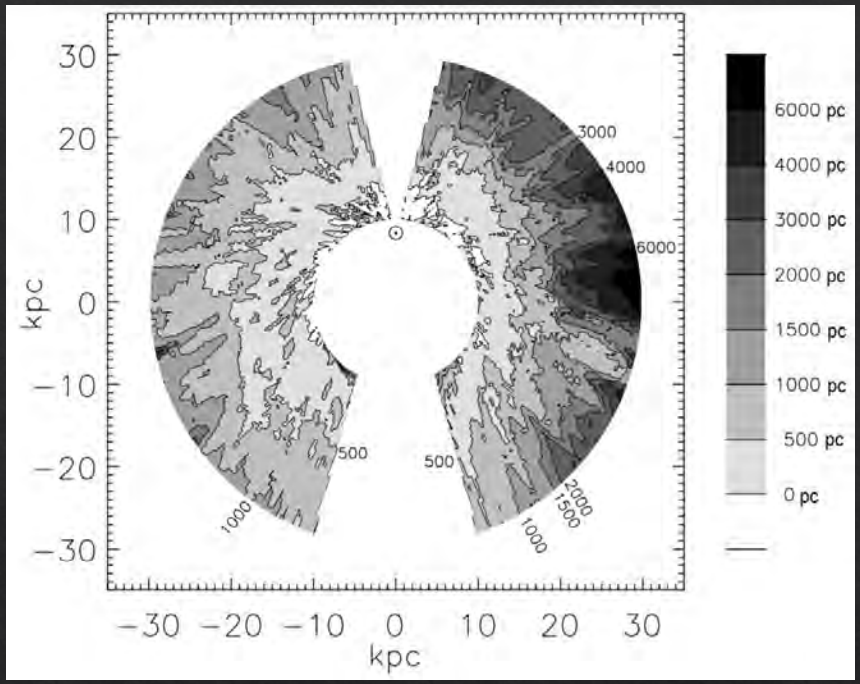
GAIA

- European Space Agency (ESA)
- 19.12.2013 (launched)
- 7. 2014
- L2
- Astrometry
- DR1 (2016), DR2 (2018), EDR3 (2020), DR3 (2022)
- More than 1.8 billion objects
- Main source of data

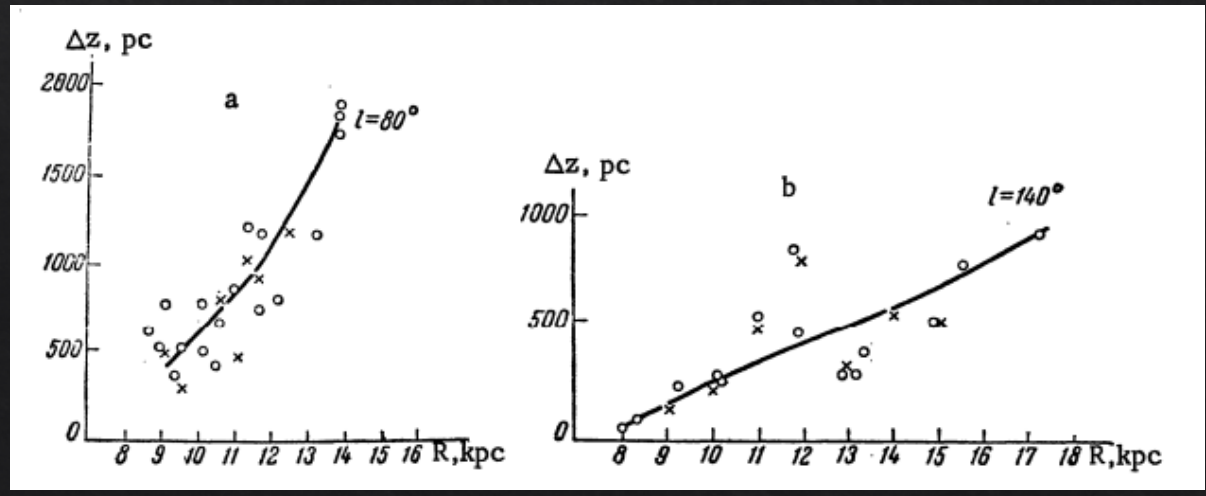
ESA (2013)

FLARE

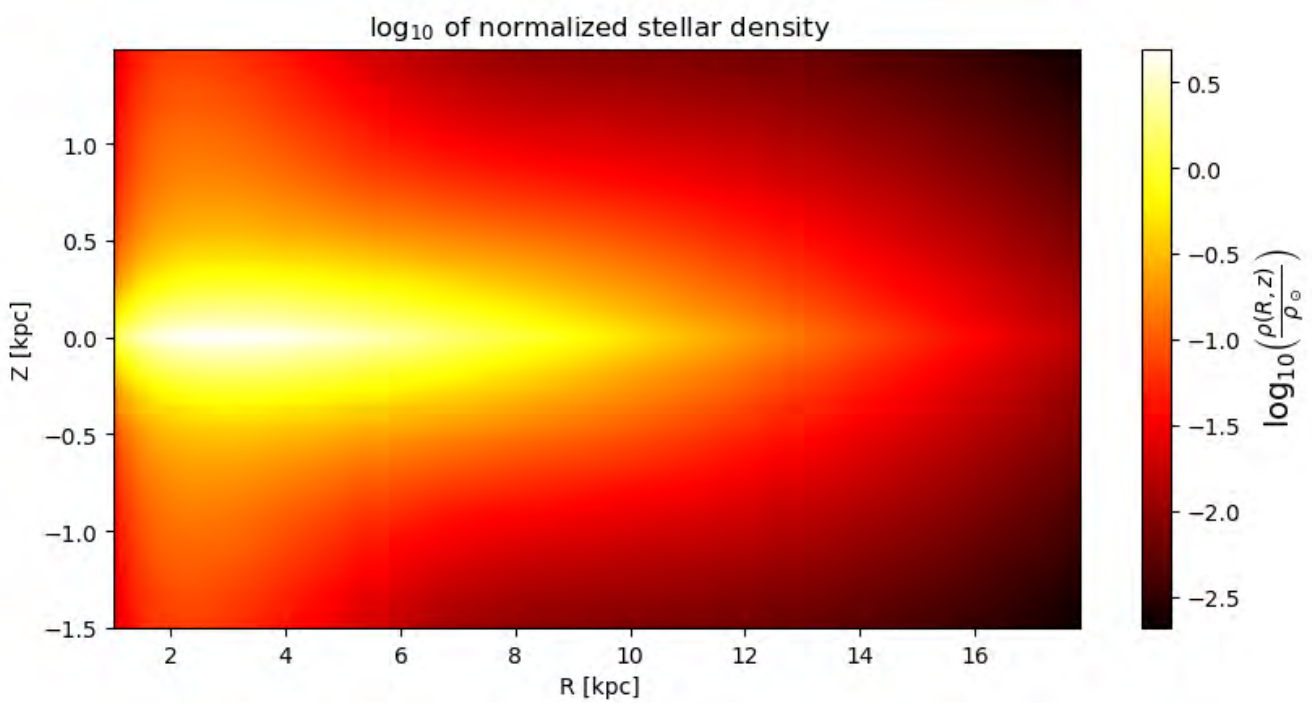
- Increase of the scale height h_z with radial distance
- First observation (Lozinskaya & Kardashev, 1963)
- Present in all components, with different profiles
- Unknown origin
- Several mathematical expressions
  - Scale height
  - Half thickness
  - FWHM

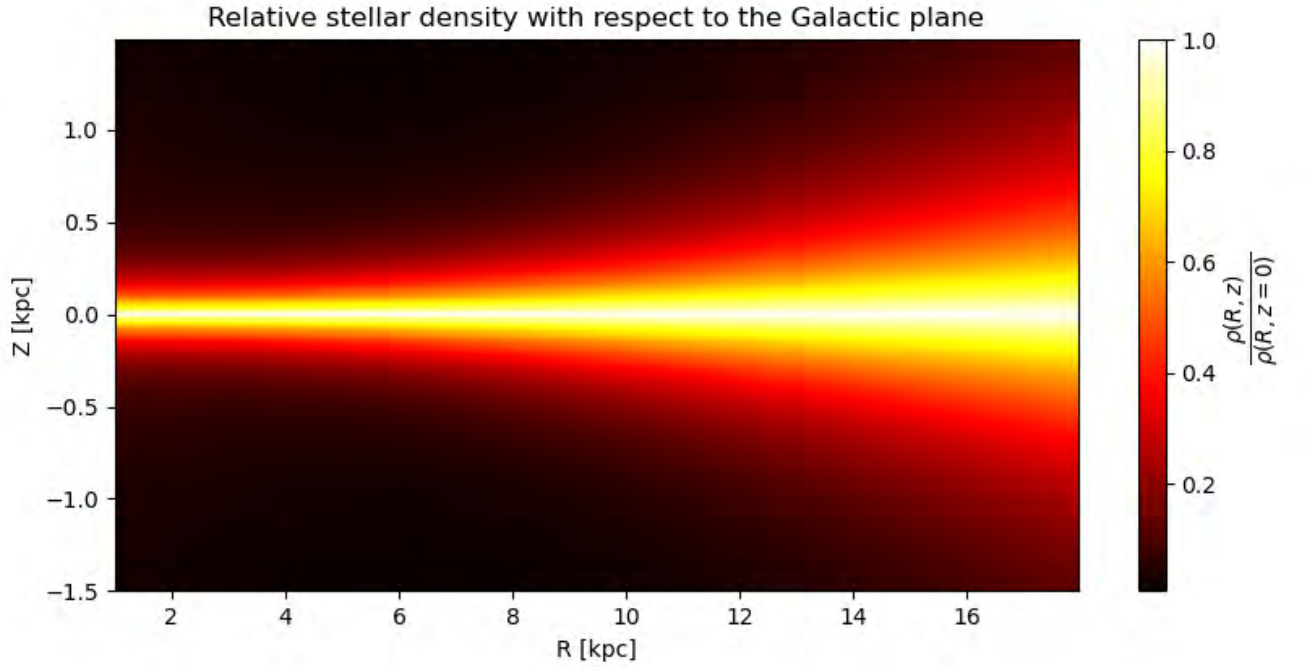


half-half thickness profile (Levine et al., 2006)



Lozinskaya & Kardashev (1963)

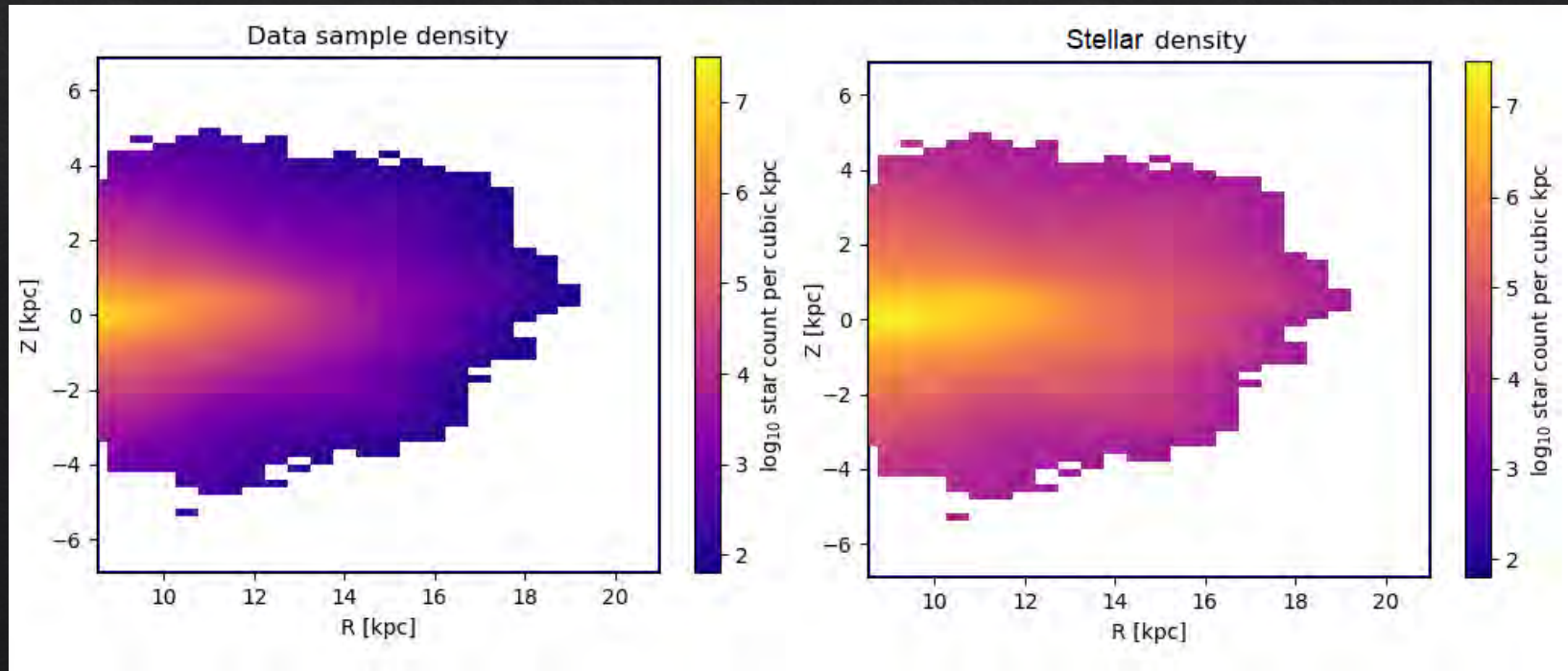

log10 of normalized stellar density
Z [kpc]
R [kpc]
1.0
0.5
0.0
−0.5
−1.0
−1.5
2
4
6
8
10
12
14
16
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
$\log_{10}\left(\frac{\rho(R,z)}{\rho_\odot}\right)$


Relative stellar density with respect to the Galactic plane
Z [kpc]
R [kpc]
1.0
0.5
0.0
−0.5
−1.0
−1.5
2
4
6
8
10
12
14
16
1.0
0.8
0.6
0.4
0.2
$\frac{\rho(R,z)}{\rho(R,z=0)}$

STRUCTURAL FLARE

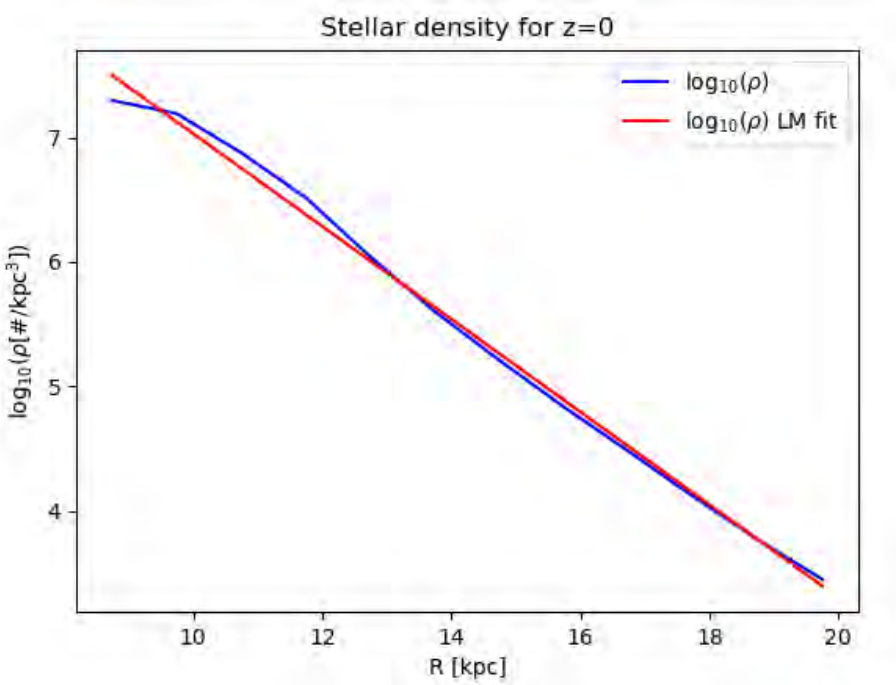
- Double exponential density model
- Gaia DR3
- $160° < l < 200°$
- $12 < G < 17$ (330 - 1050 nm)
- 8 533 564 sources
- Luminosity function correction (Chrobáková et al., 2020)

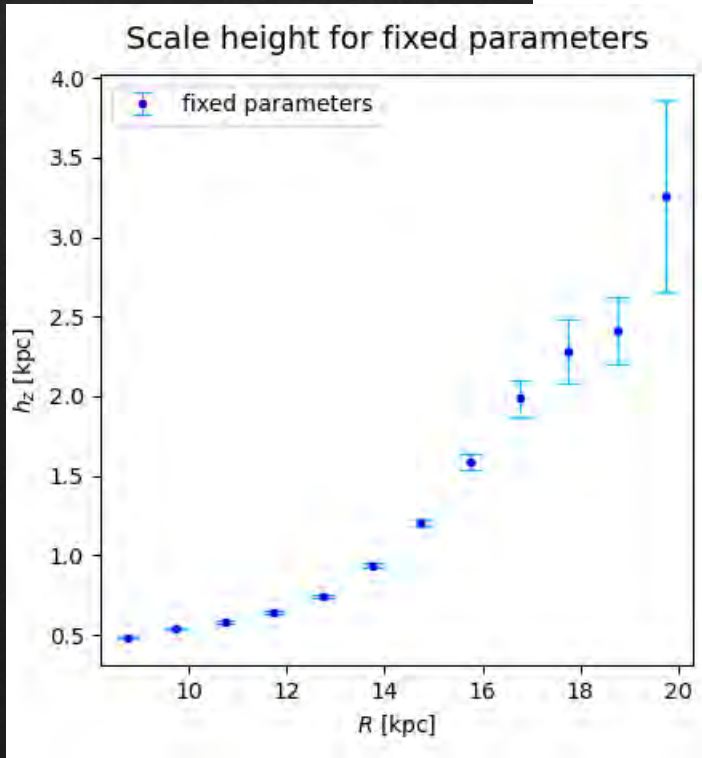
- Non-linear least squares (Levenberg Marquardt algorithm)
- Fitting everything at once does not produce good results

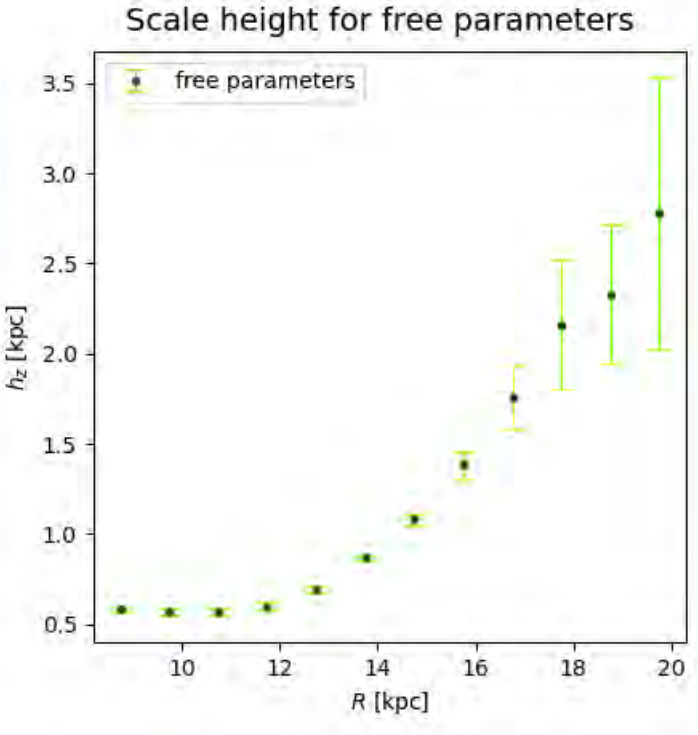


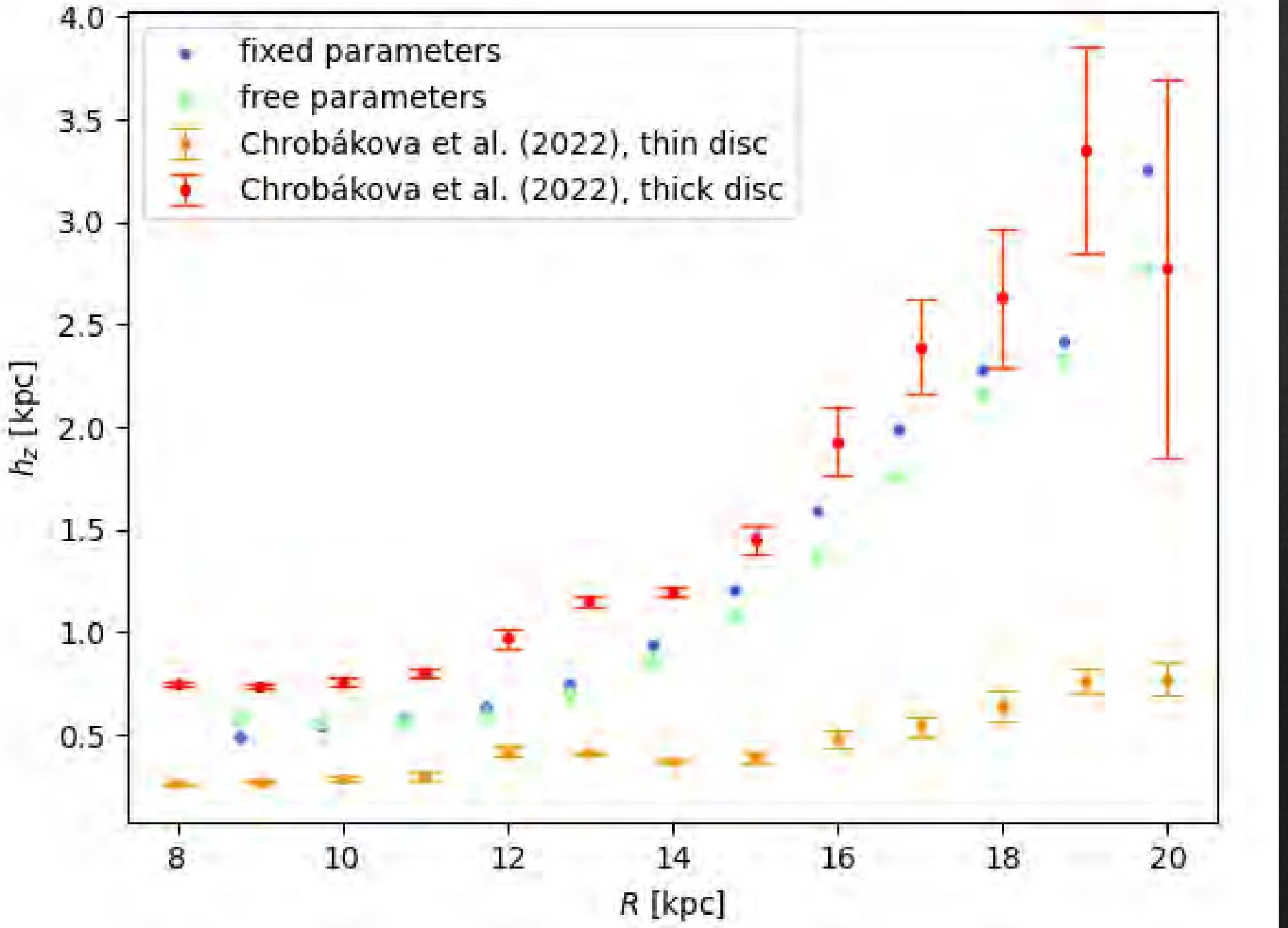
- First approach: procedure is split into two parts:
  - Horizontal (z = 0)
    - ρ_s = 4.84 x 10^7 kpc^{-3} +/- 12.8%
    - h_r = 1.16 kpc +/- 1.7%
    - h_r = 2.19 kpc +/- 8.2% (Chrobáková et al., 2022)
  - Vertical
- Second approach: fitting only the vertical part

- Increasing lack of sources with R





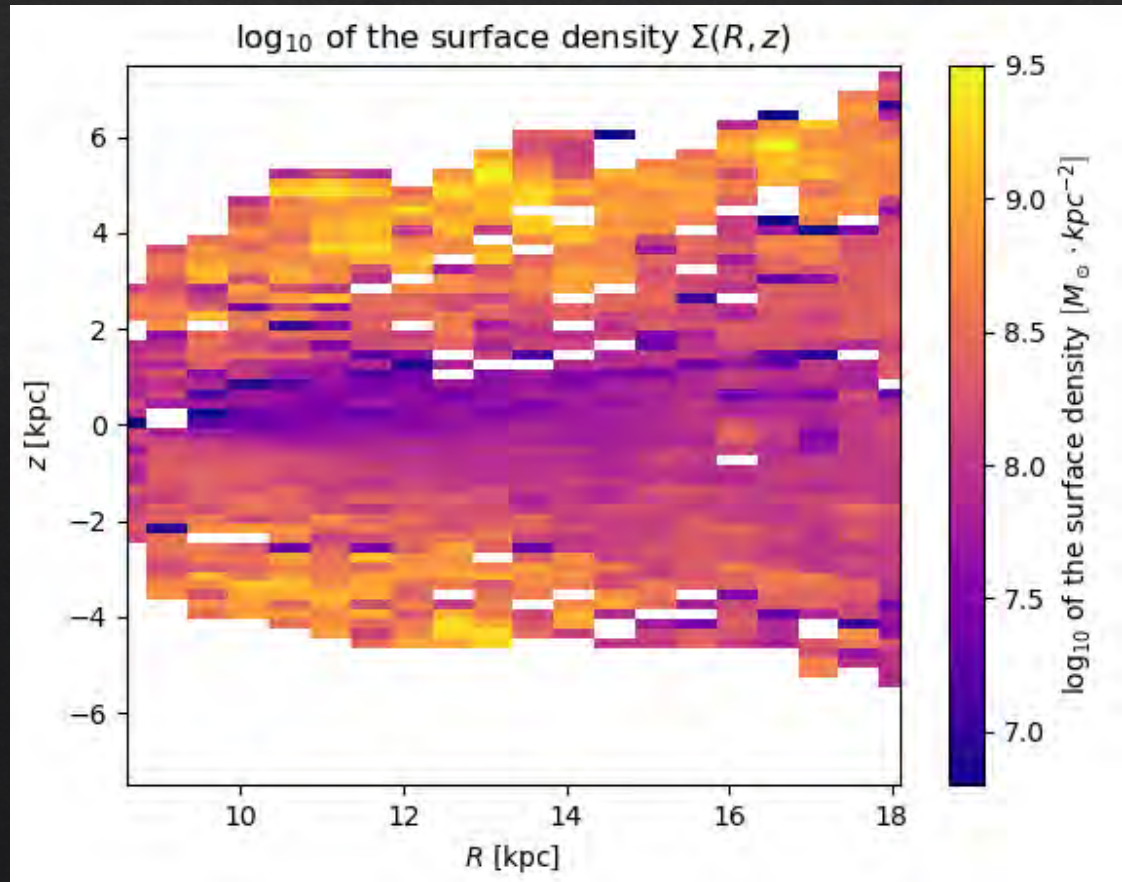



fixed parameters
free parameters
Chrobákova et al. (2022), thin disc
Chrobákova et al. (2022), thick disc
h_z [kpc]
R [kpc]
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
8
10
12
14
16
18
20

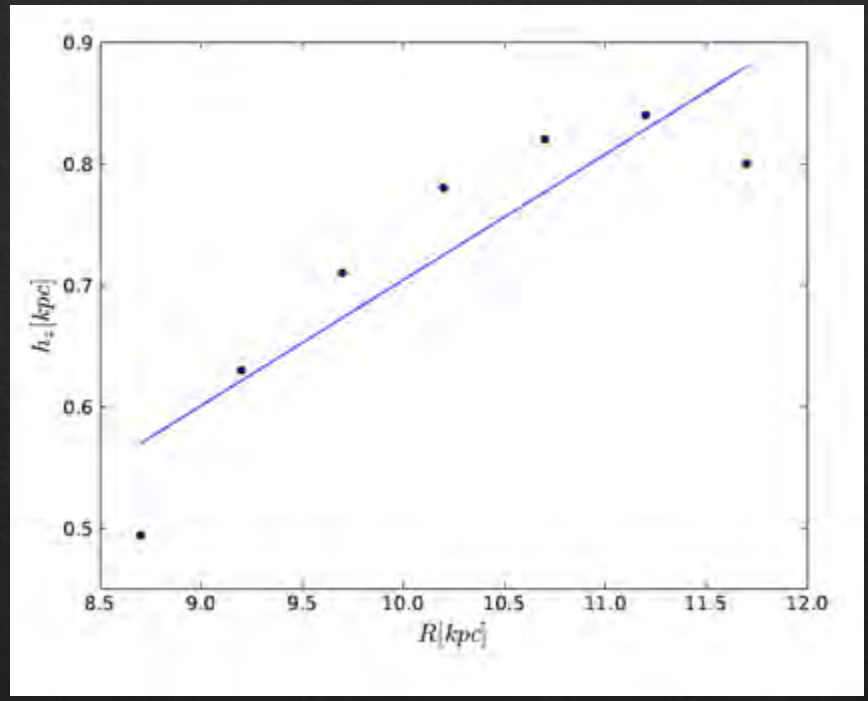
KINEMATIC FLARE

- Surface density determined from the velocities (Moni Bidin et al., 2012)
- Pre-processed Gaia DR2 data (López-Corredoira & Labini, 2019)
  - (location, velocity, velocity dispersion)
- No satisfactory results
  - Limited quality of input data
  - High errors of input data
  - Negative surface density

- Binning
- Various z-coordinate boundaries



- López-Corredoira et al. (2020)
  - Only up to R=12 kpc
  - Admitting very large errors
  - Imprecise established scale heights



López-Corredoira et al. (2020)

CONCLUSION

- Structural flare:
  - Scale height in agreement with literature
  - Lower scale length
- Kinematic flare:
  - No satisfactory results
  - Limited quality of input data

THANK YOU FOR YOUR ATTENTION

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