"Dépoussiérer" le disque Galactique avec la DR2

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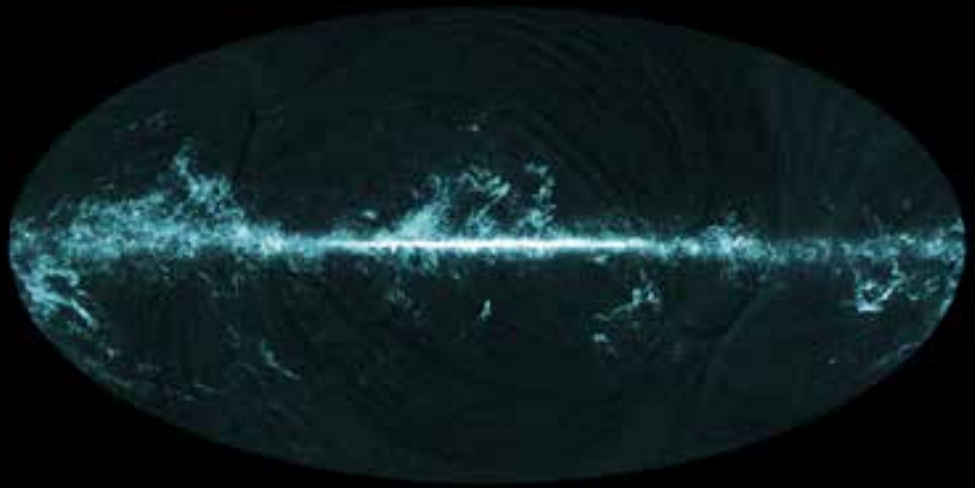
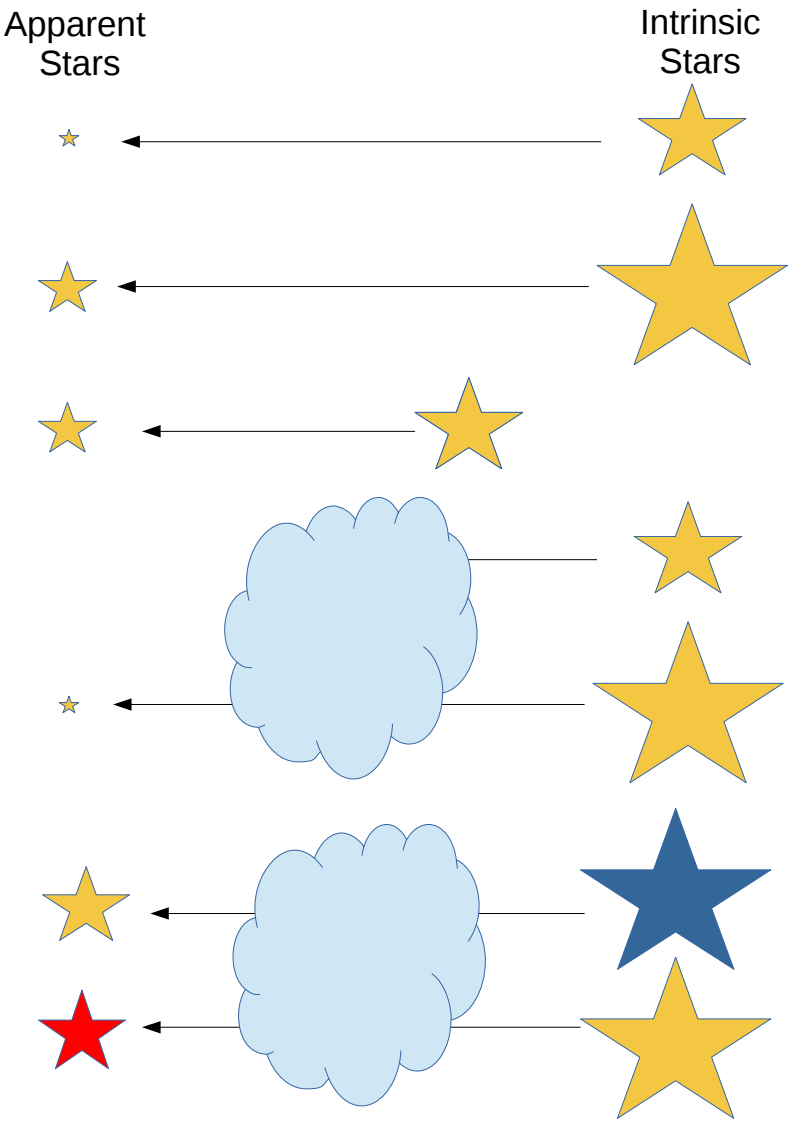
The Galactic plane



PLANCK :
INTERSTELLAR CO
(115GHz)

Gaia Data Release 2 :
STARS

Extinction and reddening



- Apparent magnitude depends :
  - Intrinsic magnitude
  - Distance
  - Extinction
- Star apparent color depends
  - Effective Temperature
  - Extinction

2 Approaches, same data

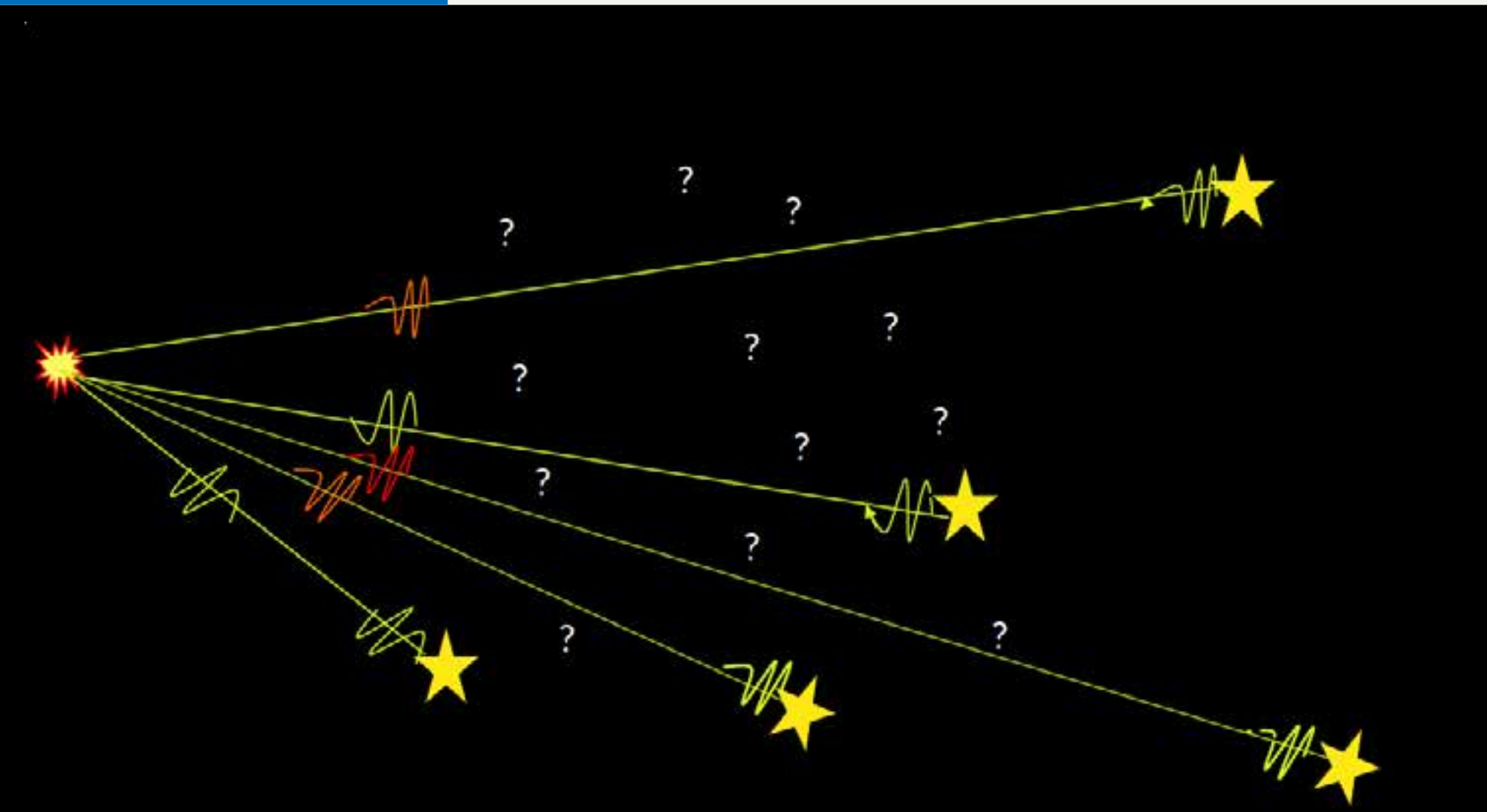
- 3D Inversion
  - Lallement, Babusiaux, Vergely et al, 2019
- Field of view by field of view
  - Babusiaux et al 2020
  - Hottier et al 2020 A&A : CDS
  - Hottier et al 2021 *in prep*

Both based on crossmatch Gaia DR2 and 2MASS

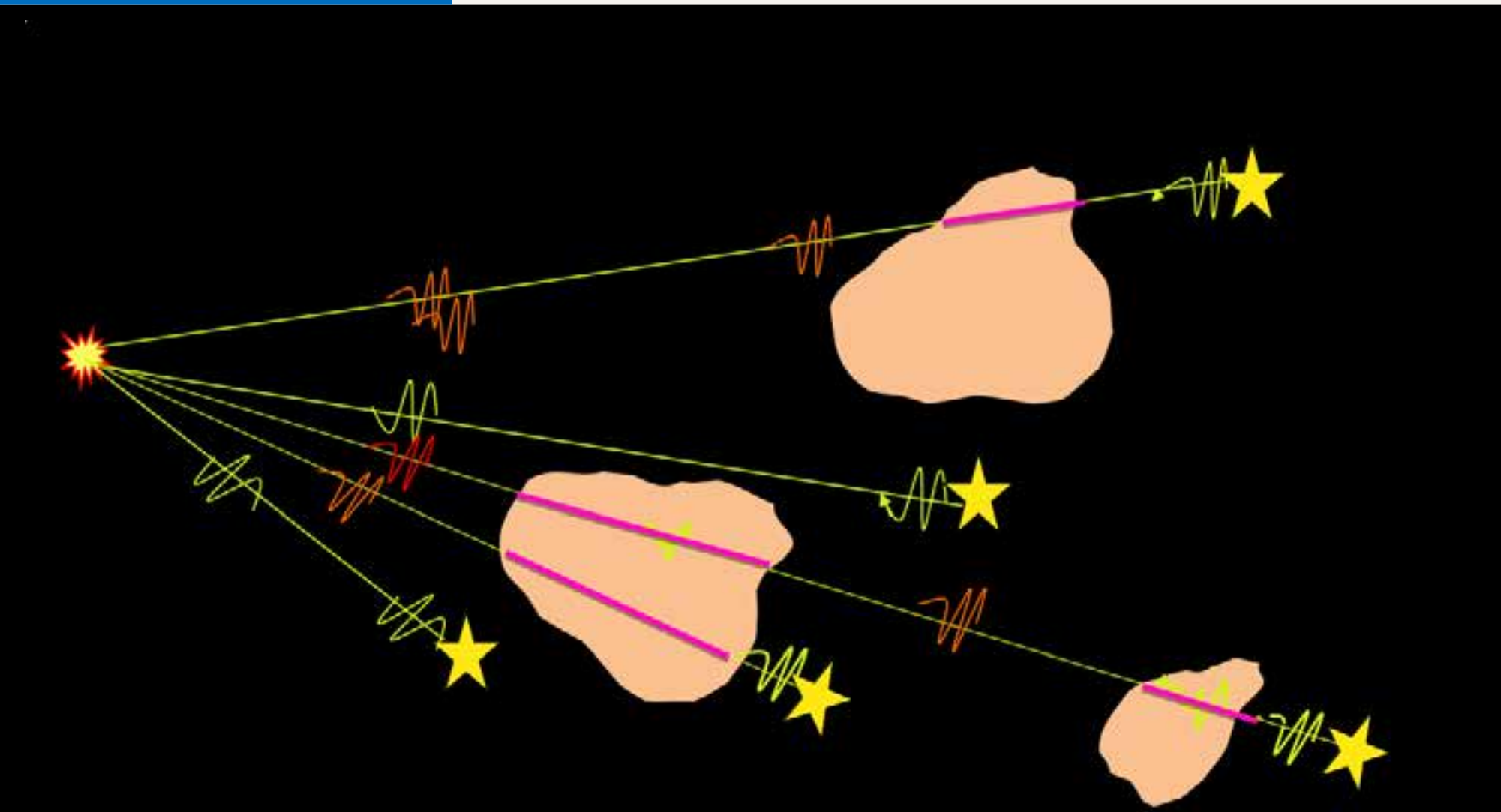
3D inversion

- Gaia DR2 : 1.3 billion stars
  - Map : Restriction on relative errors on parallaxes better than 20%: about 40 millions objects (20 millions < 2.5 kpc)
- Individual stars extinction evaluation :
  - photometric data in visible (Gaia) and infrared (2MASS)
  - comparison with stellar parameter
  - parallactic distance as prior

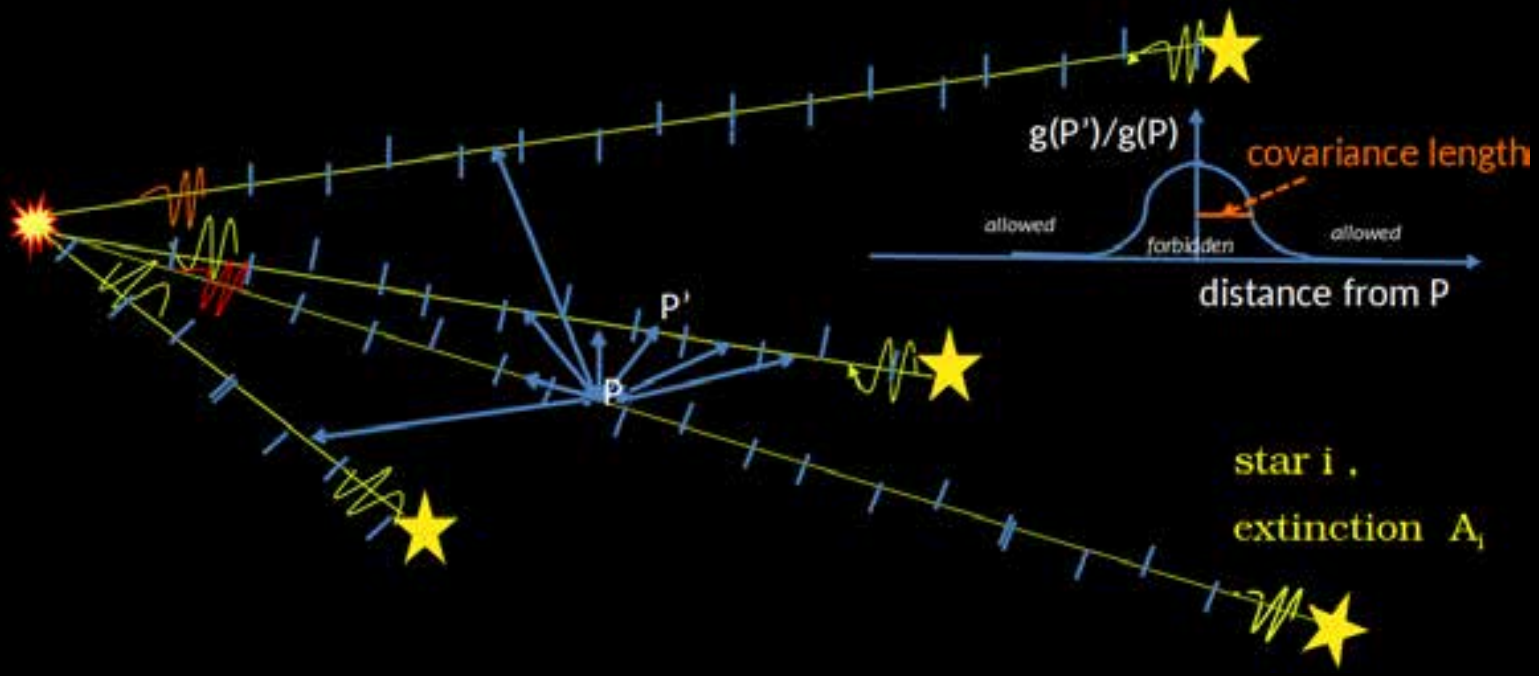
Inferring dust density



Inferring dust density



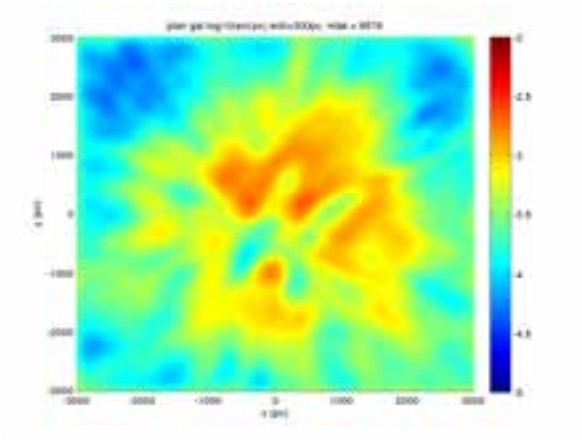
Inferring dust density

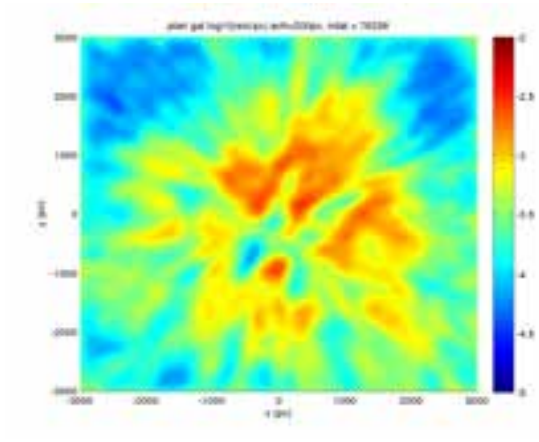


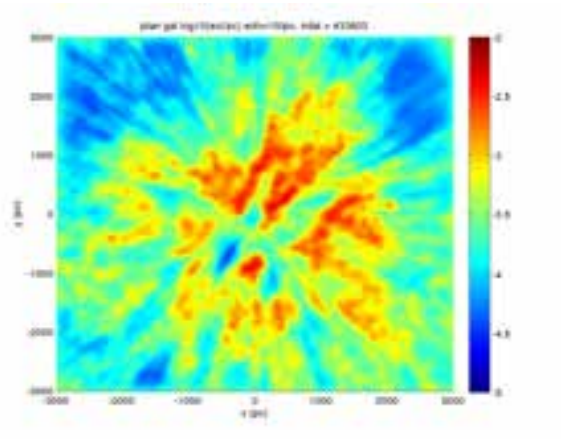
$g(P)$: reddening per distance (mag/pc) at P

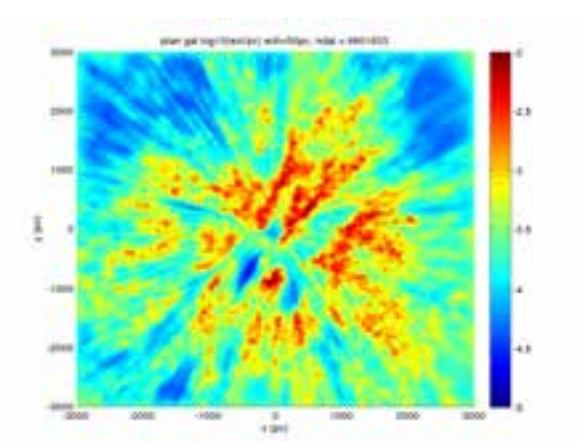
- Data: measured reddening/extinction $Ai = \int g(P)dP$ for each stars i
- Prior conditions on the 3D distribution (Bayesian aspect)
- 3D covariance kernel(s) => minimum size of structures (regularization)=> $g(P')/g(P)$ limited

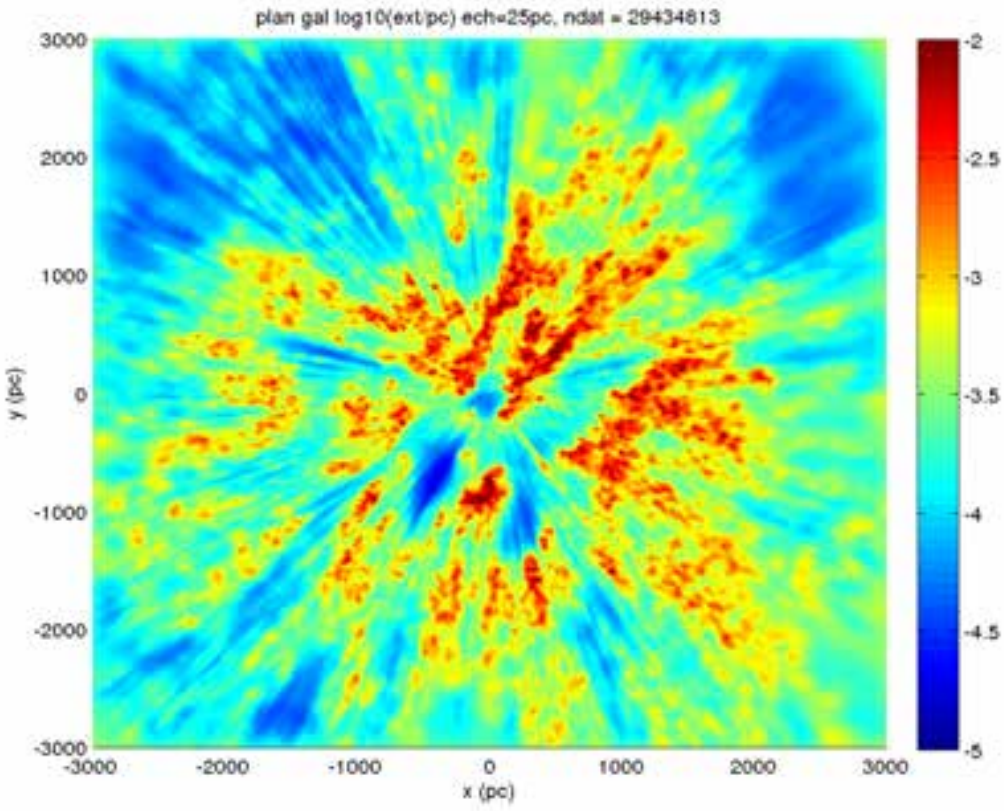
Hierarchical technique





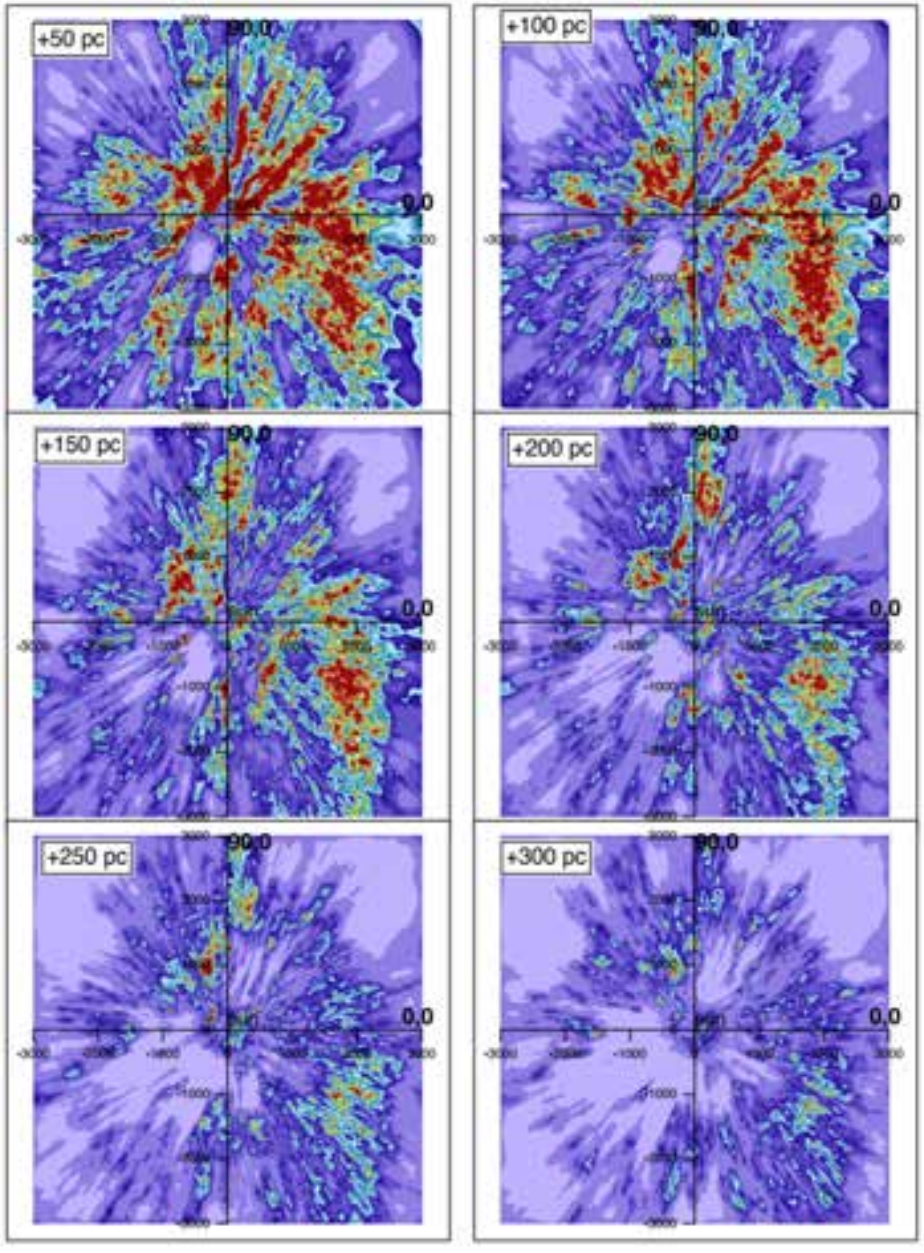


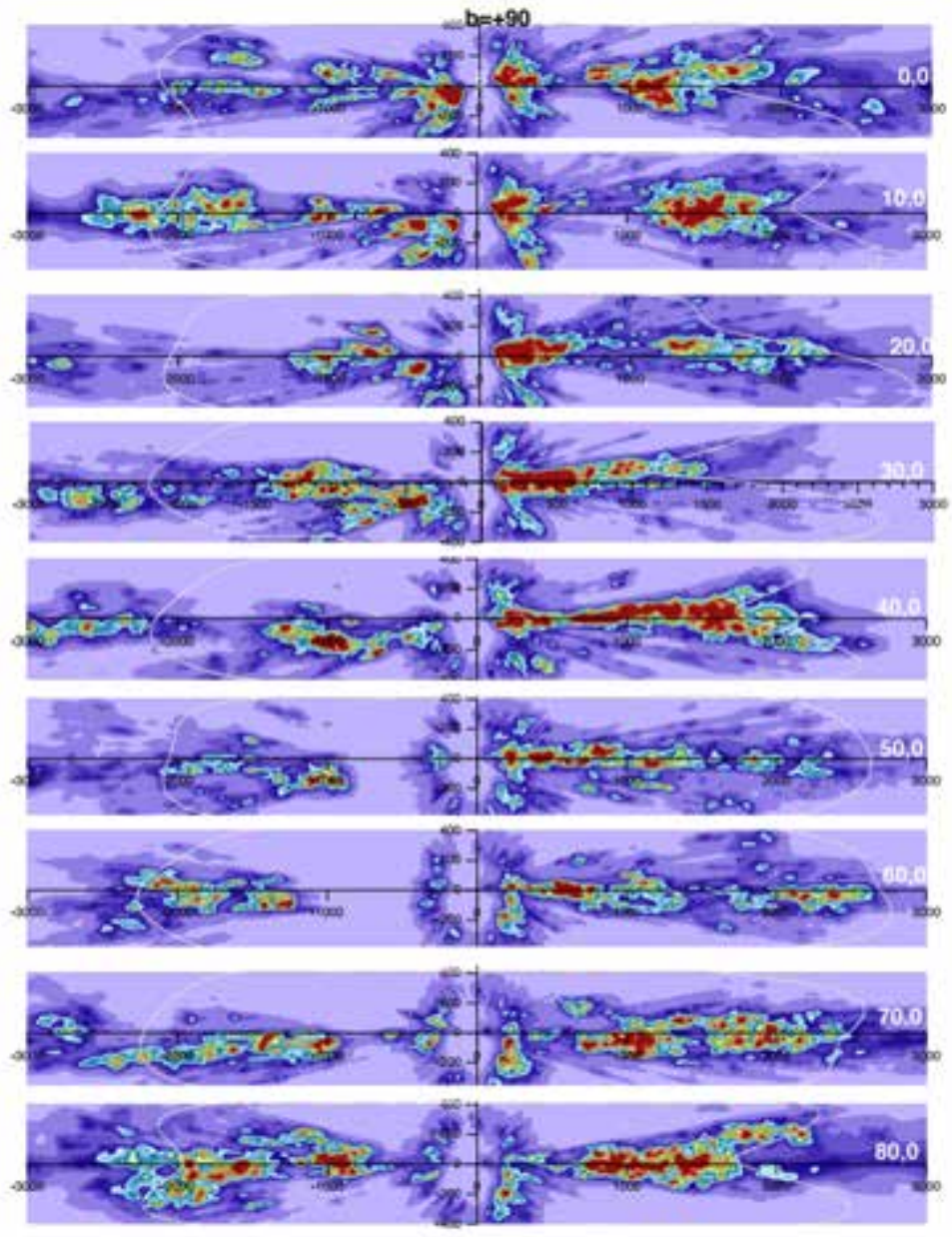




- Hierarchical
- Gaussian kernel

3D cube (Lallement *et. al.* 2019)



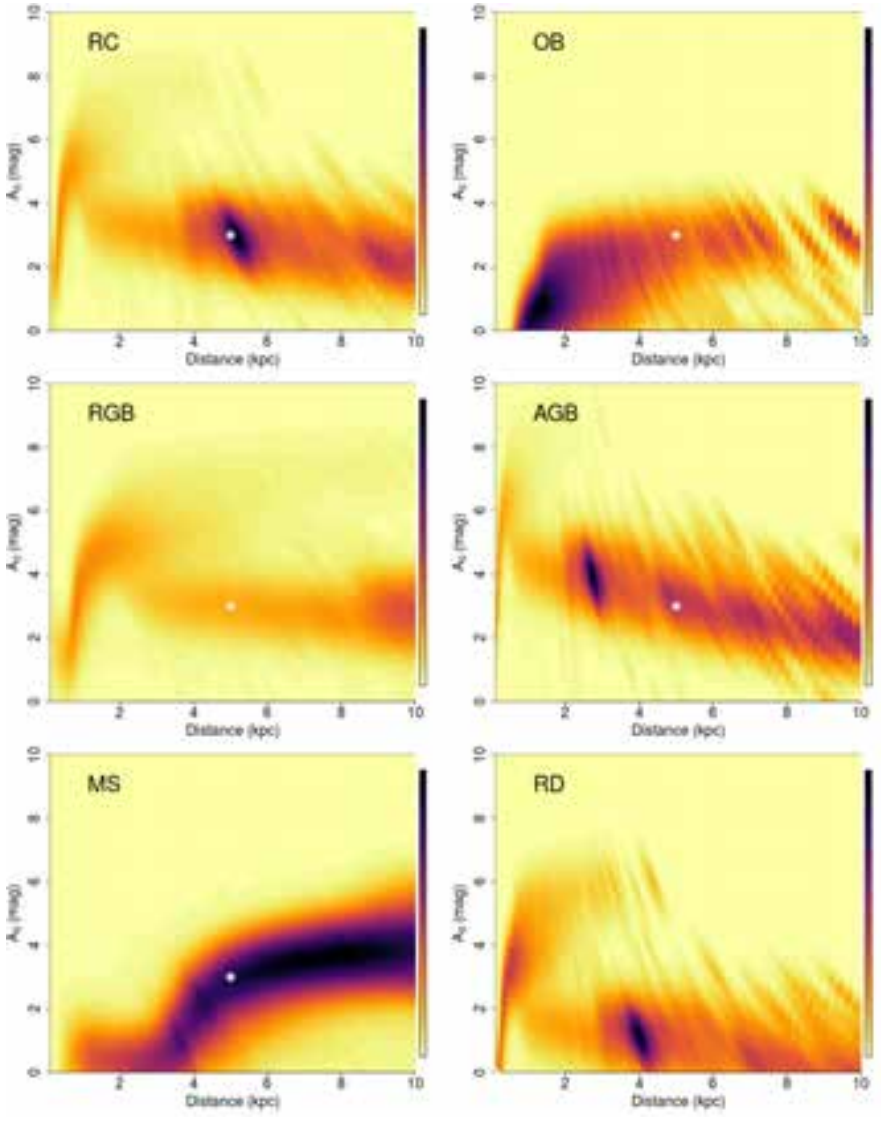


FEDReD (Babusiaux *et al* 2020 and Hottier *et al* 2020)

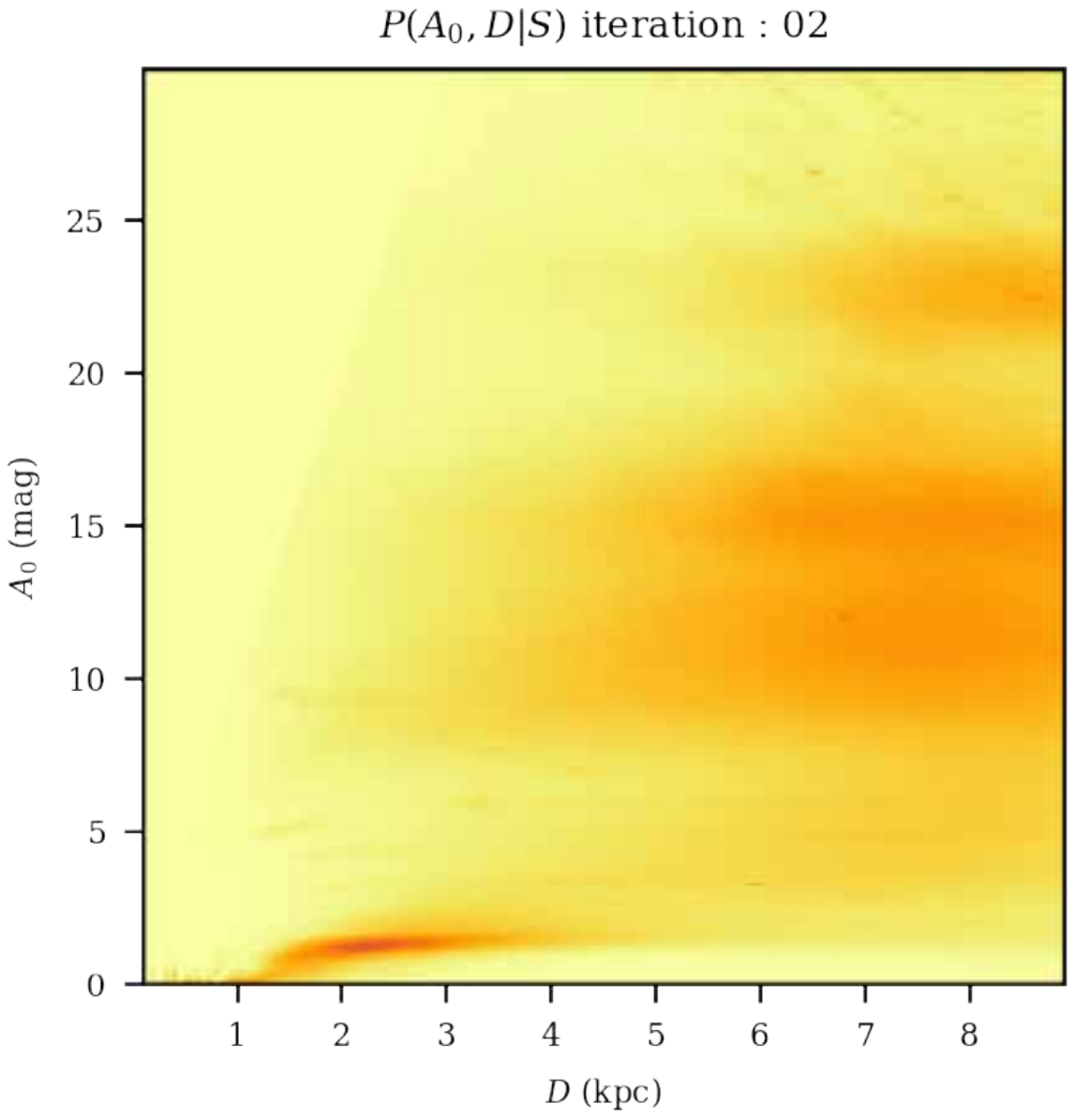
- Photometry (2MASS and Gaia) and Parallax
- Completeness taking into account
- Field of view based methods
- Two steps :
  - Analyzes of each stars
  - Deconvolution

Stars analysis

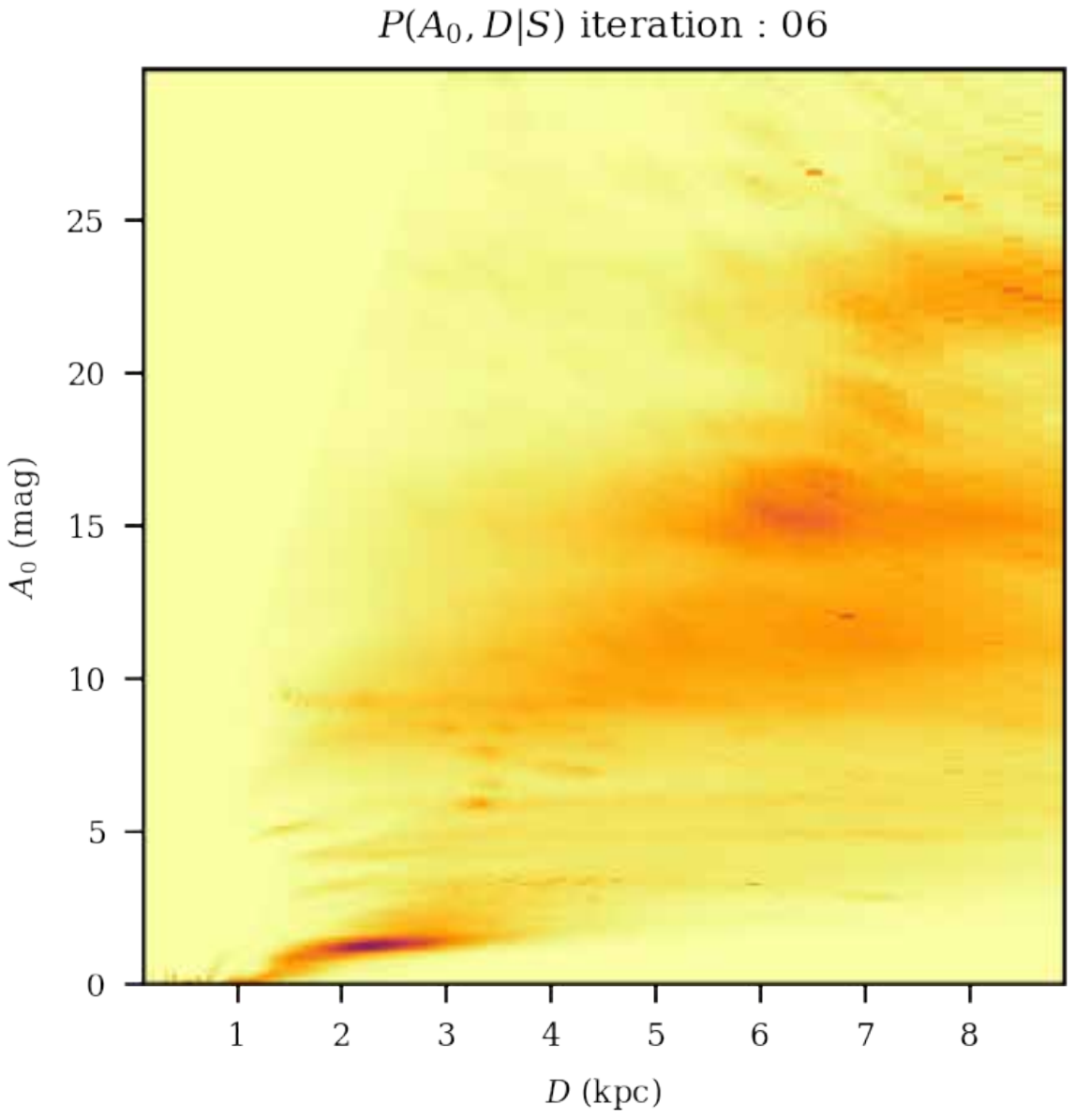
- Processing of $\mathrm{P}(O \mid A_0, D)$
  - Comparing to empirical HR
  - Polynomial extinction law
- Merging result with an iterative deconvolution



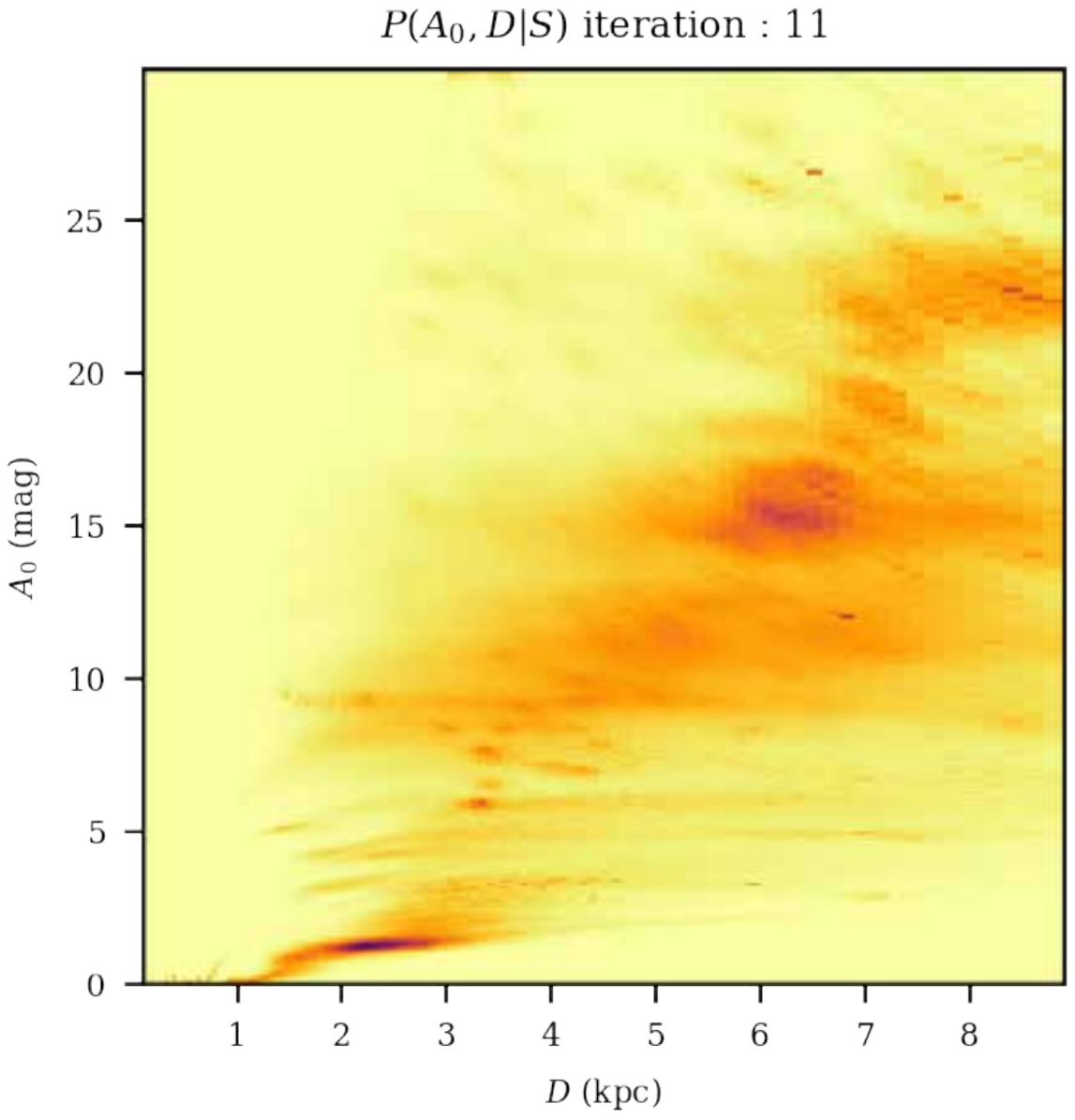
Bayesian deconvolution



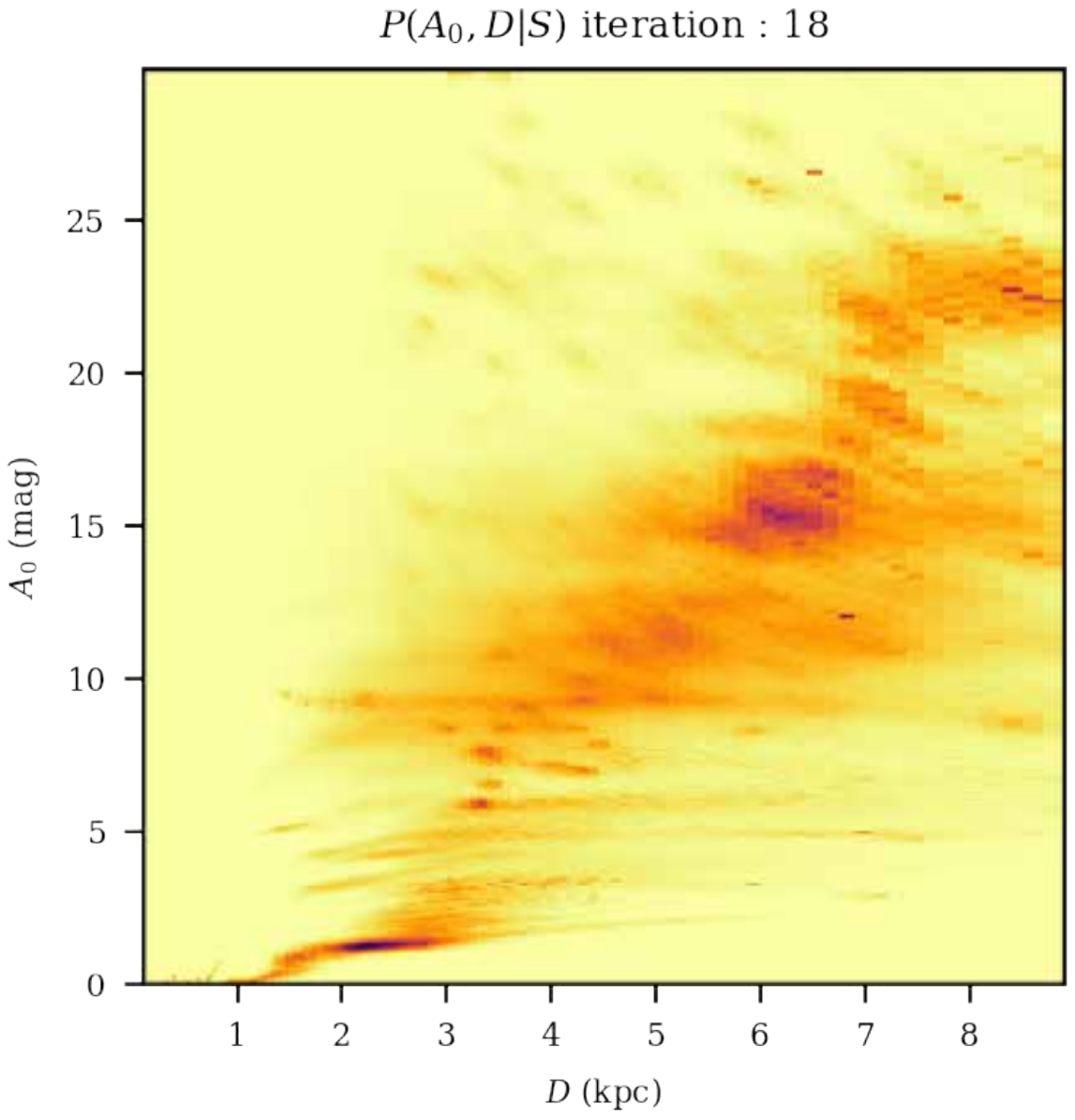
Bayesian deconvolution



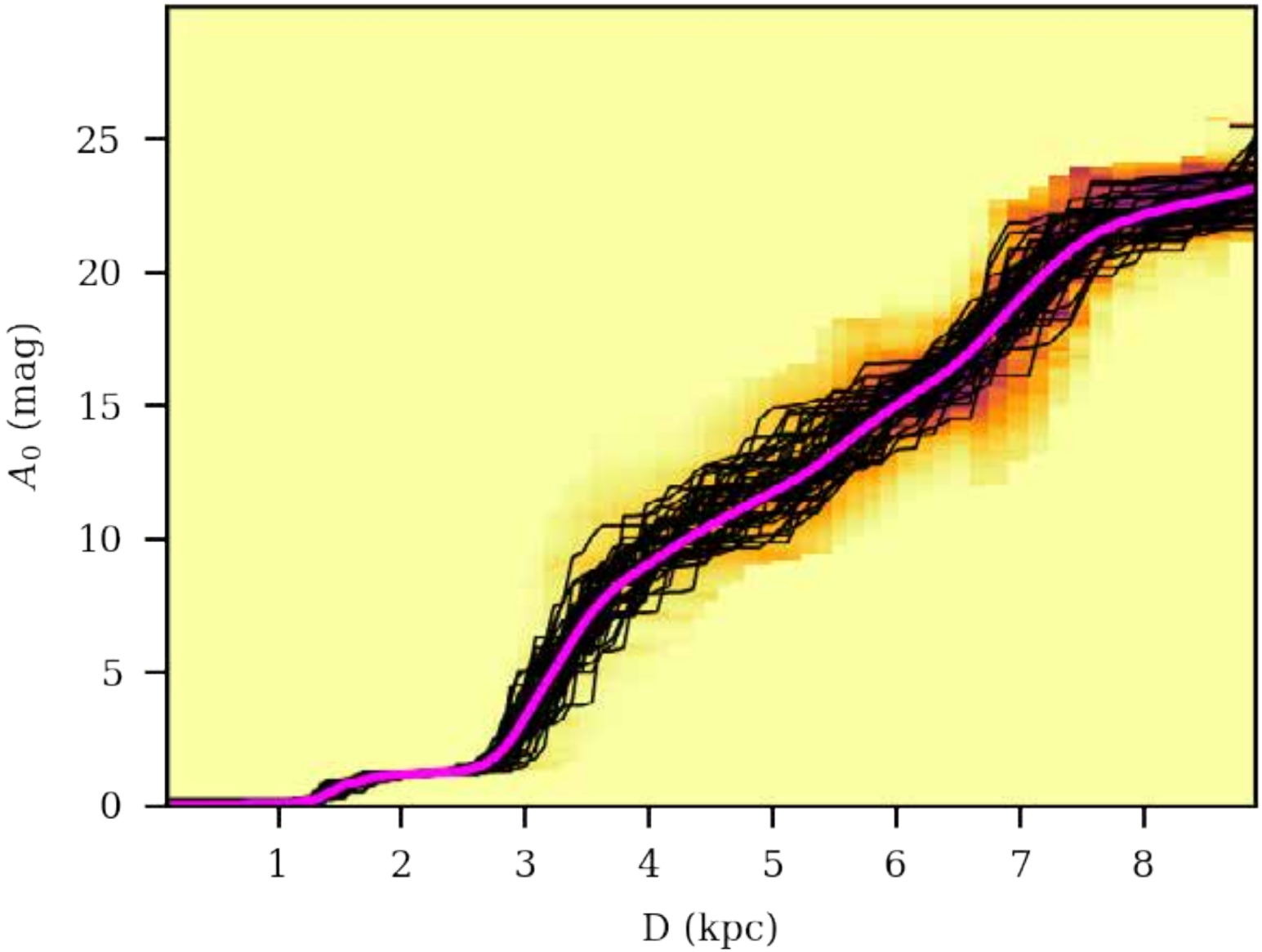
Bayesian deconvolution



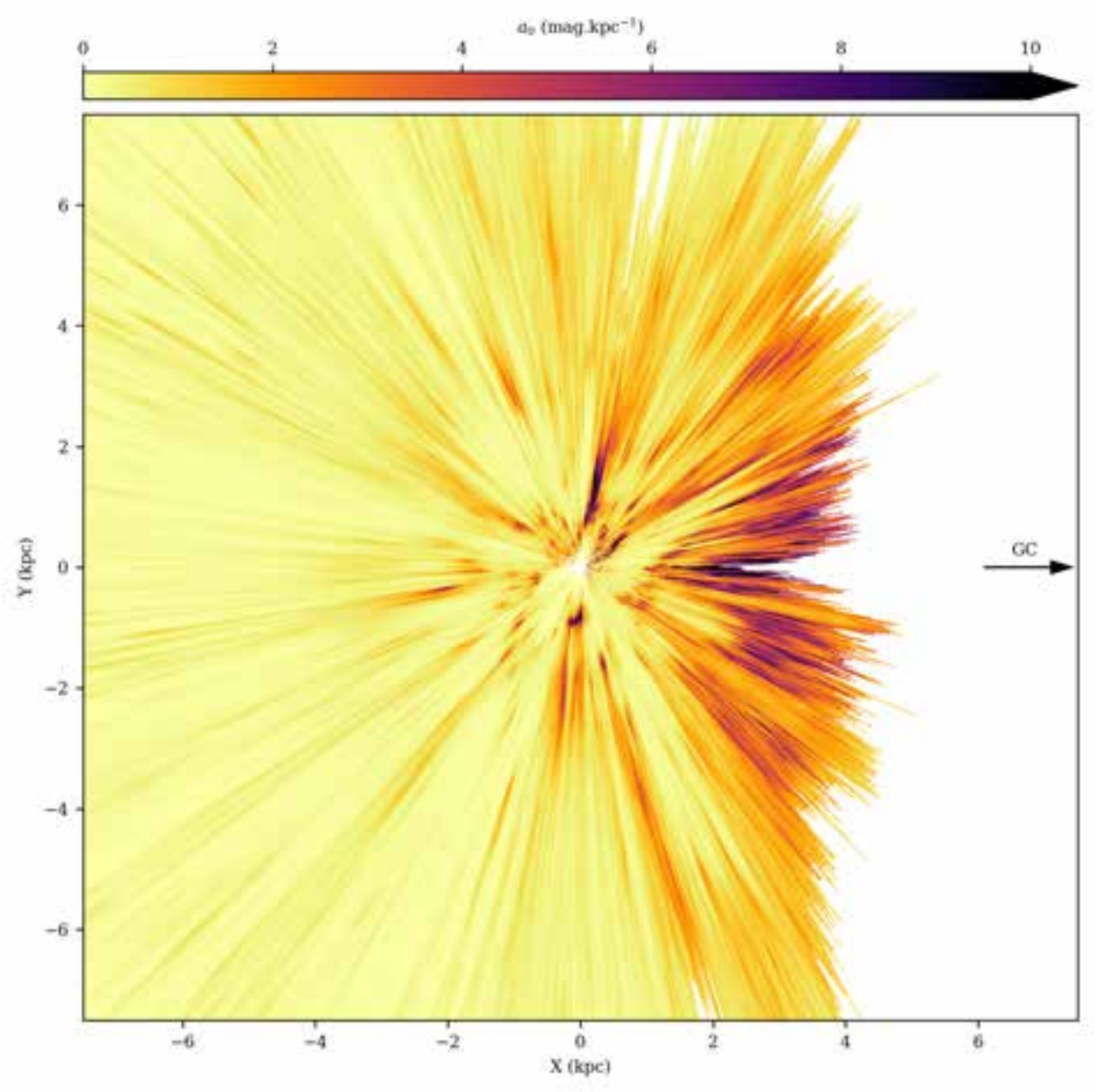
Bayesian deconvolution



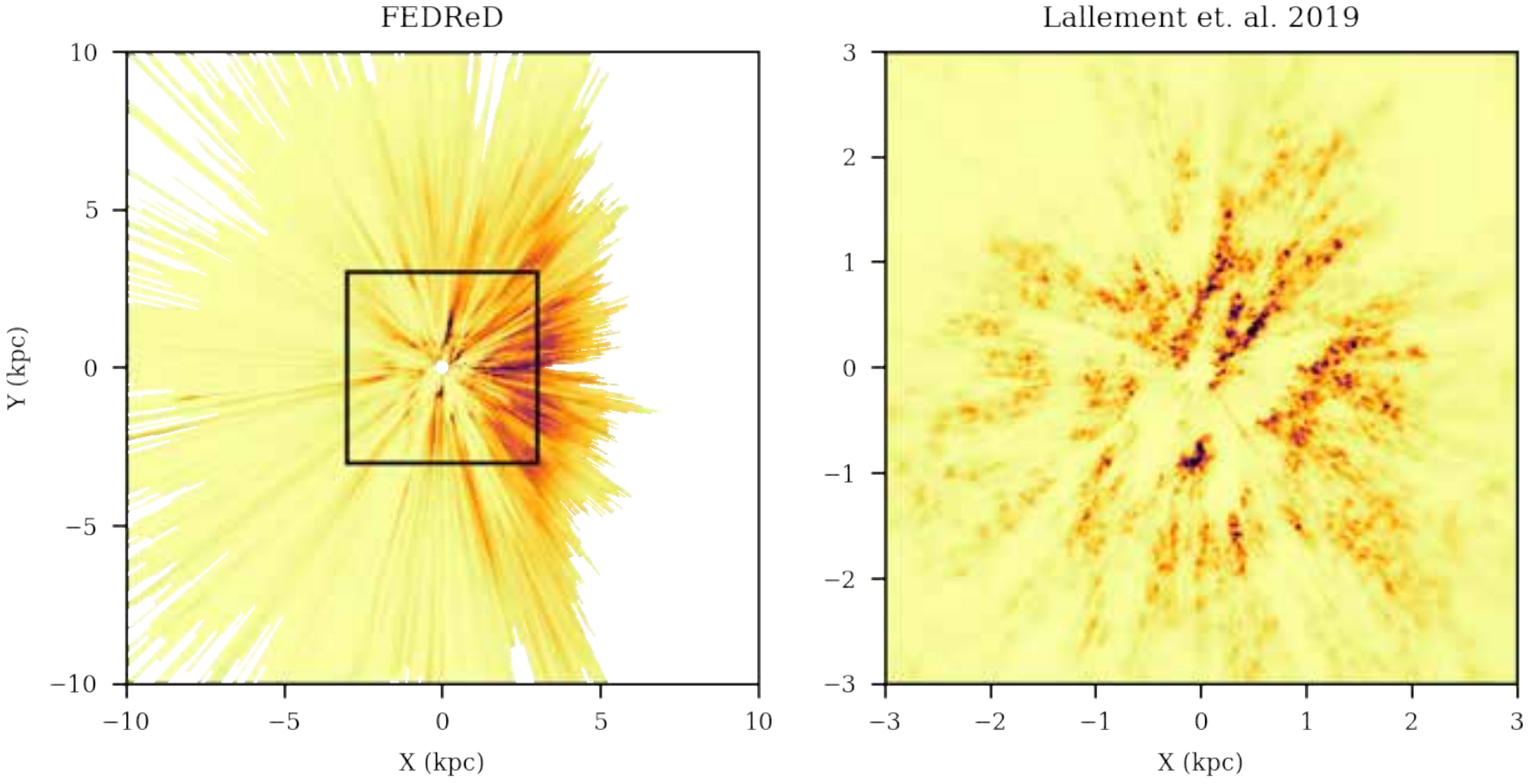
Bayesian deconvolution



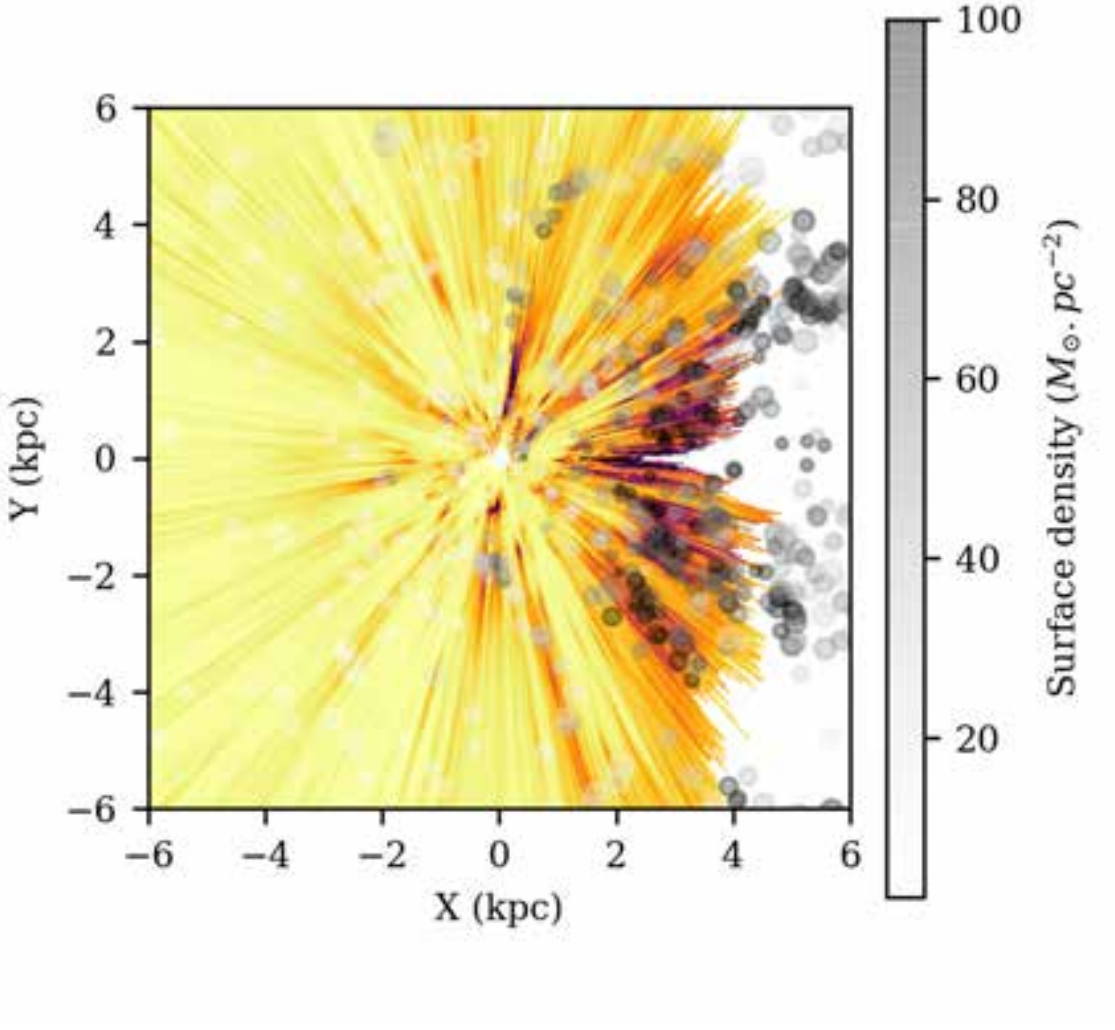
Extinction map

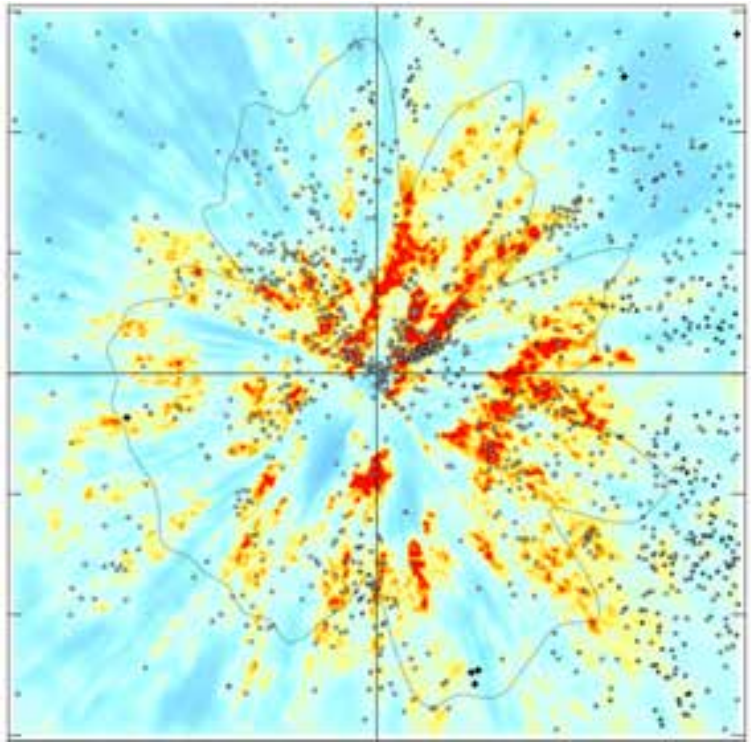


Results

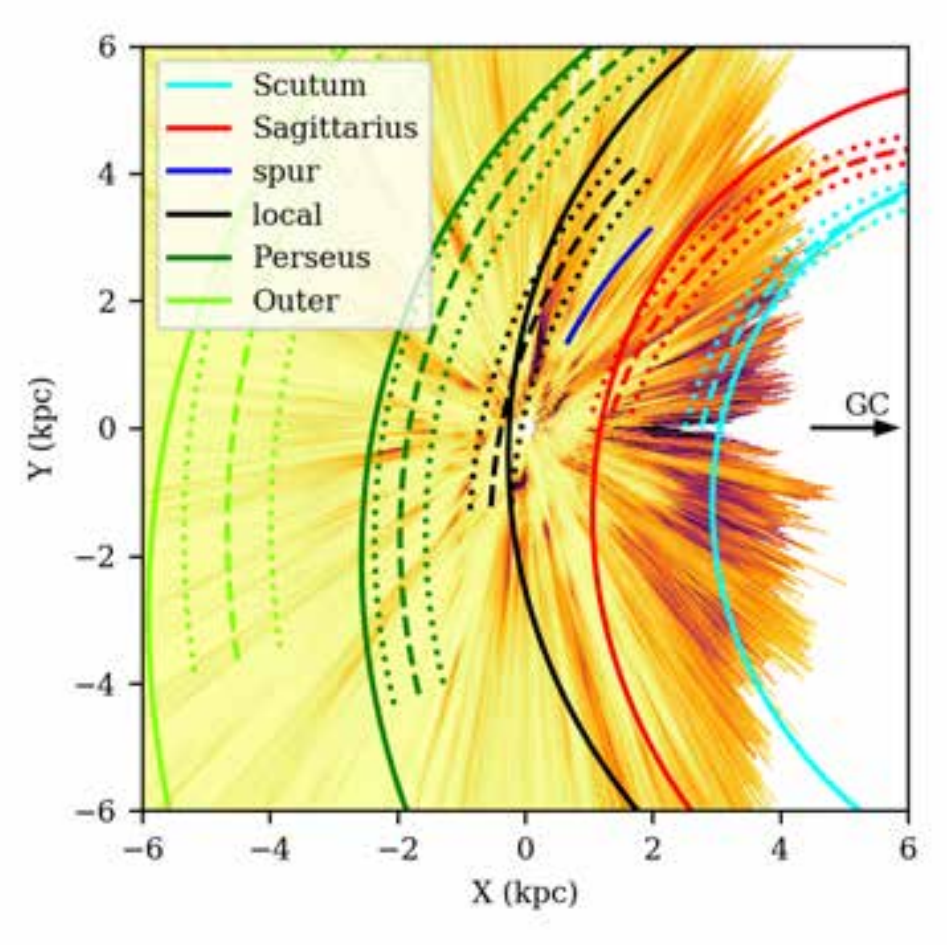

FEDReD
Lallement et. al. 2019
Y (kpc)
X (kpc)
X (kpc)
10
5
0
−5
−10
−10
−5
0
5
10
3
2
1
0
−1
−2
−3
−3
−2
−1
0
1
2
3

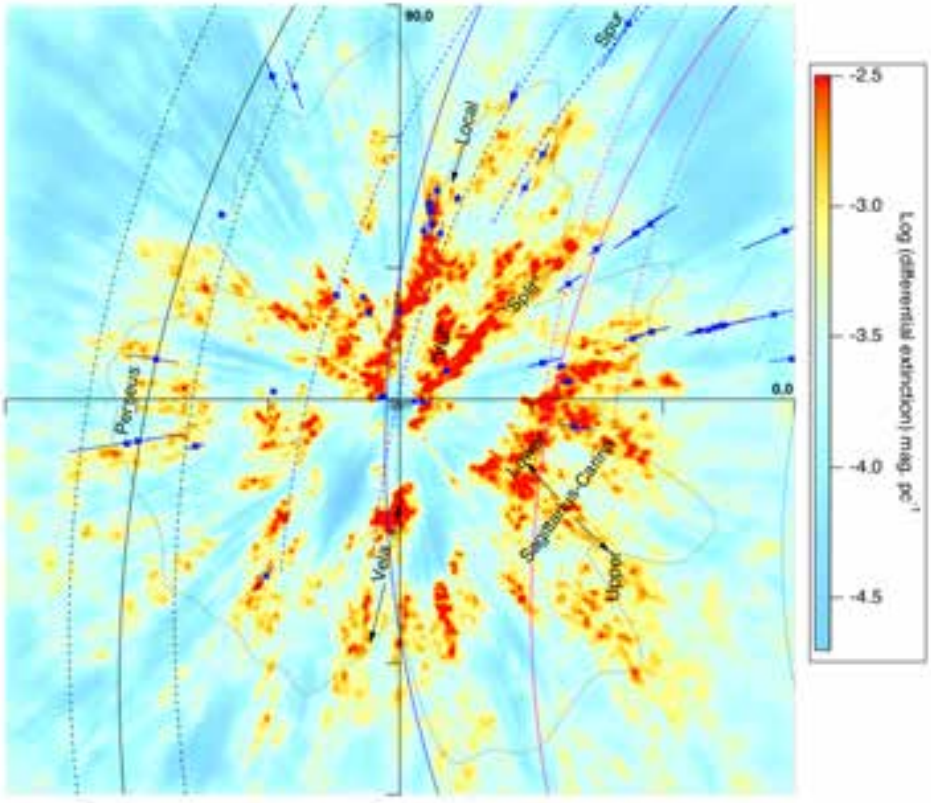
CO cloud


6
4
2
0
−2
−4
−6
Y (kpc)
−6
−4
−2
0
2
4
6
X (kpc)
100
80
60
40
20
Surface density ($M_\odot . pc^{-2}$)

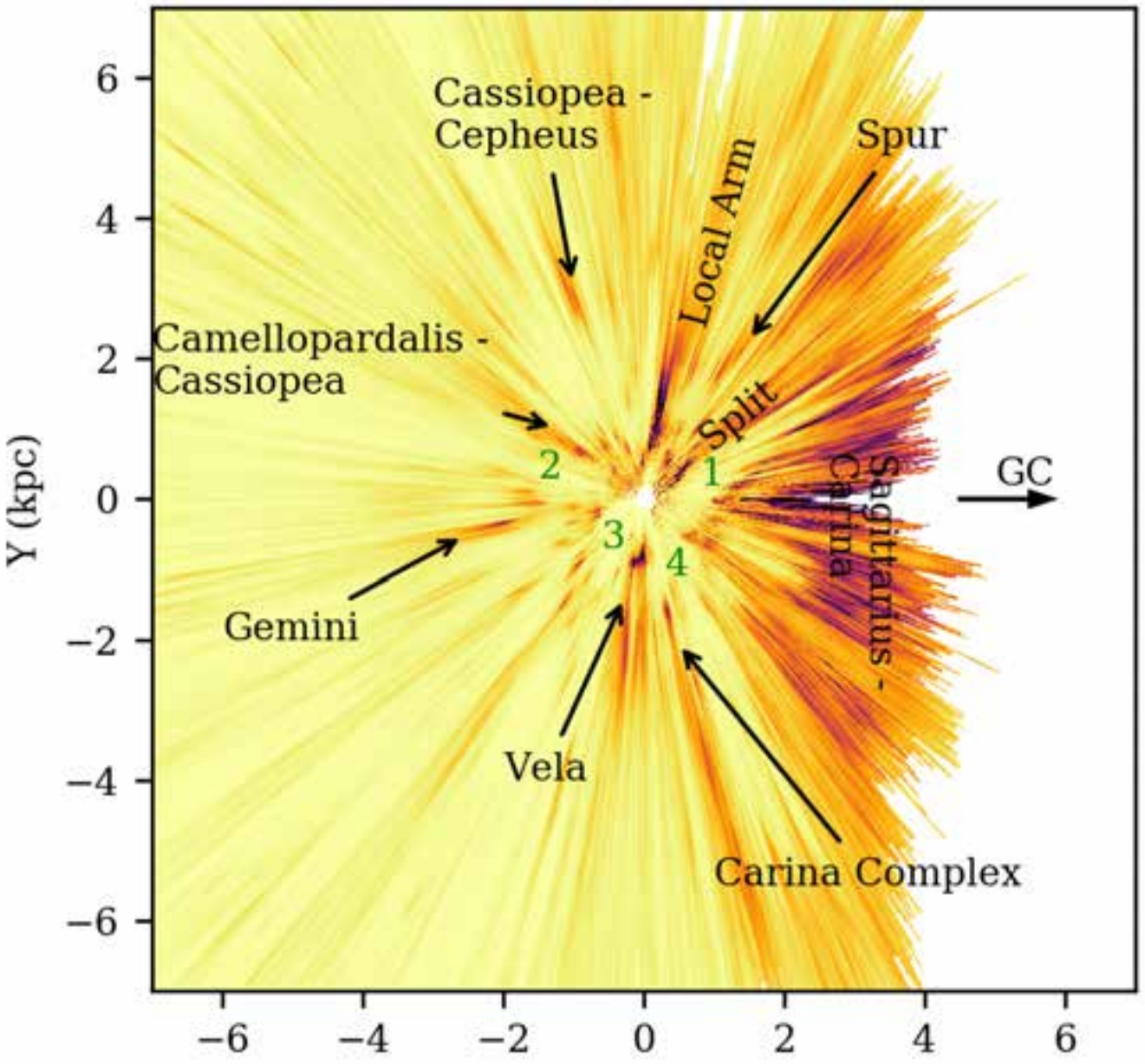


Spiral arms

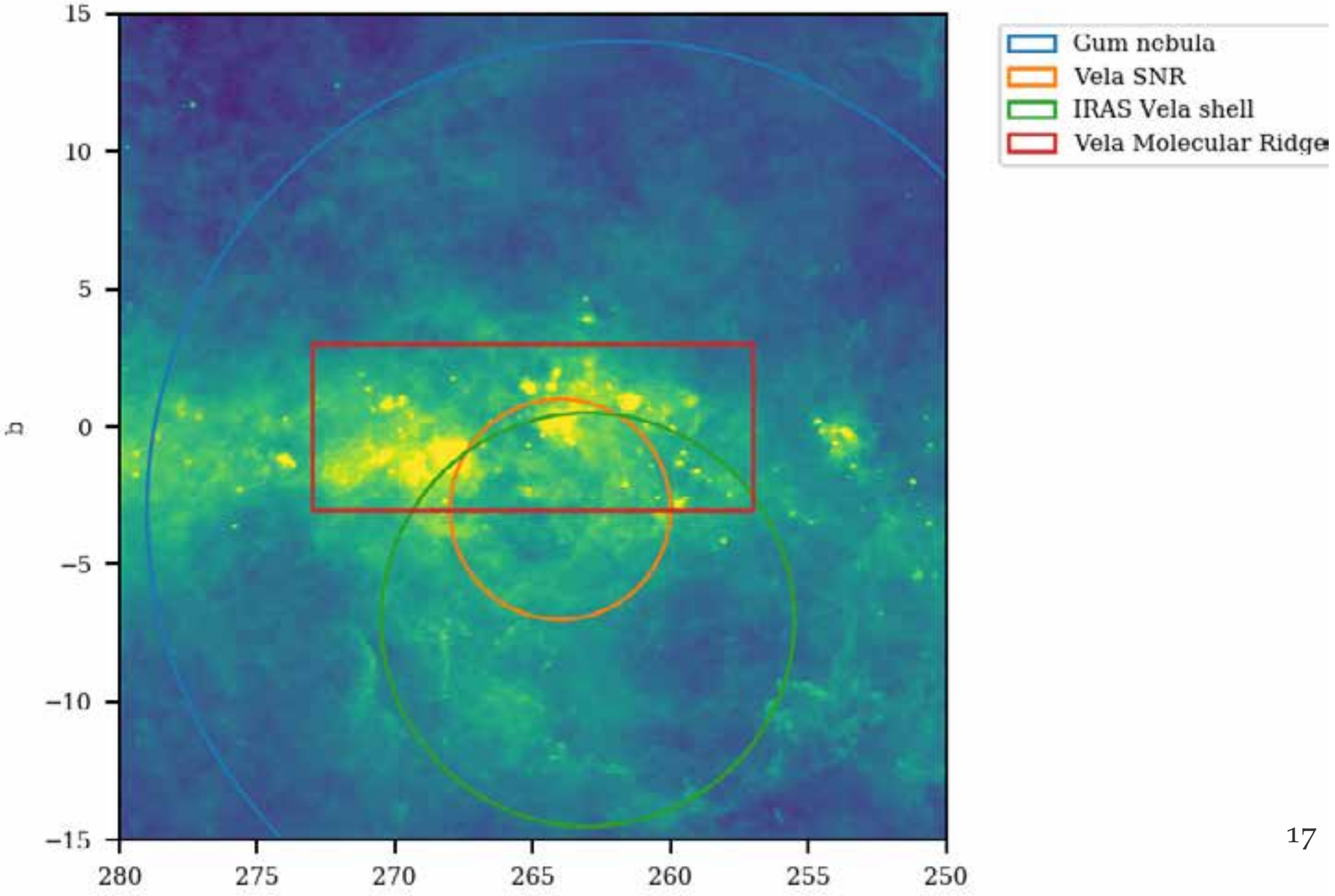

Scutum
Sagittarius
spur
local
Perseus
Outer
GC
Y (kpc)
X (kpc)
6
4
2
0
−2
−4
−6
−6
−4
−2
0
2
4
6


Spur
Local
Perseus
Vela
Upper
-2.5
-3.0
-3.5
-4.0
-4.5

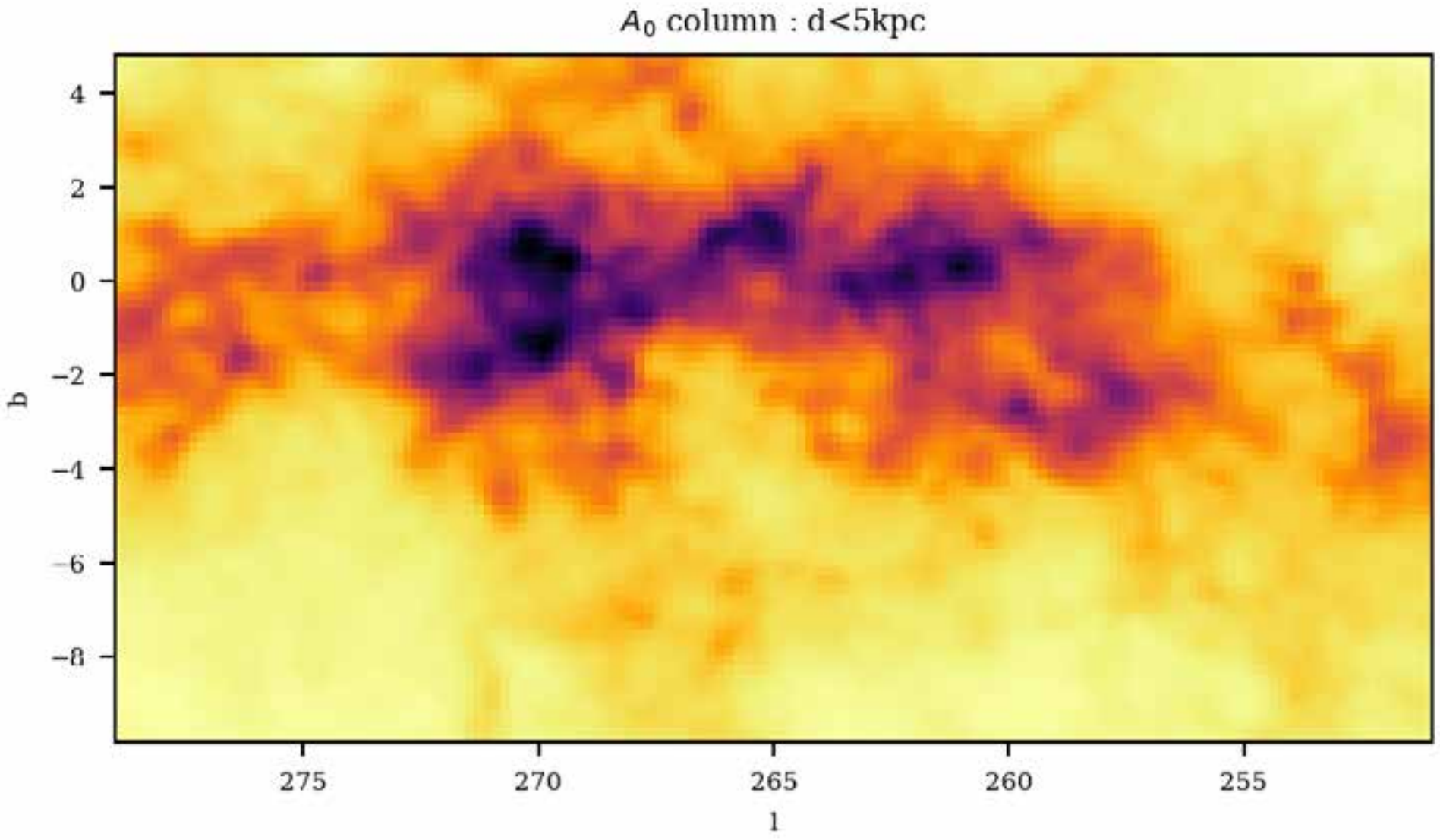
Structures in extinction



Vela in infrared

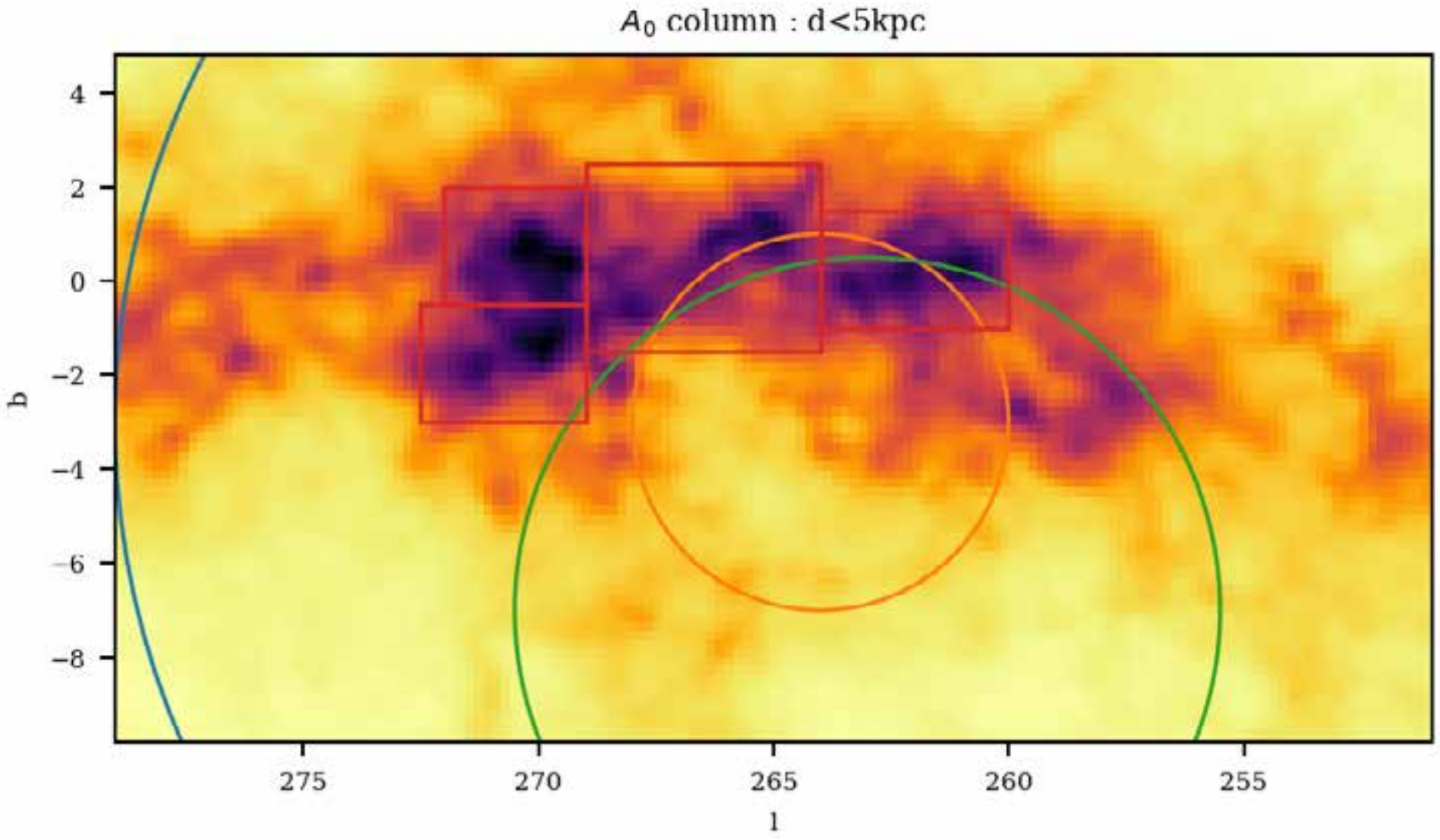


Column extinction (Hottier *et. al.* in prep.)



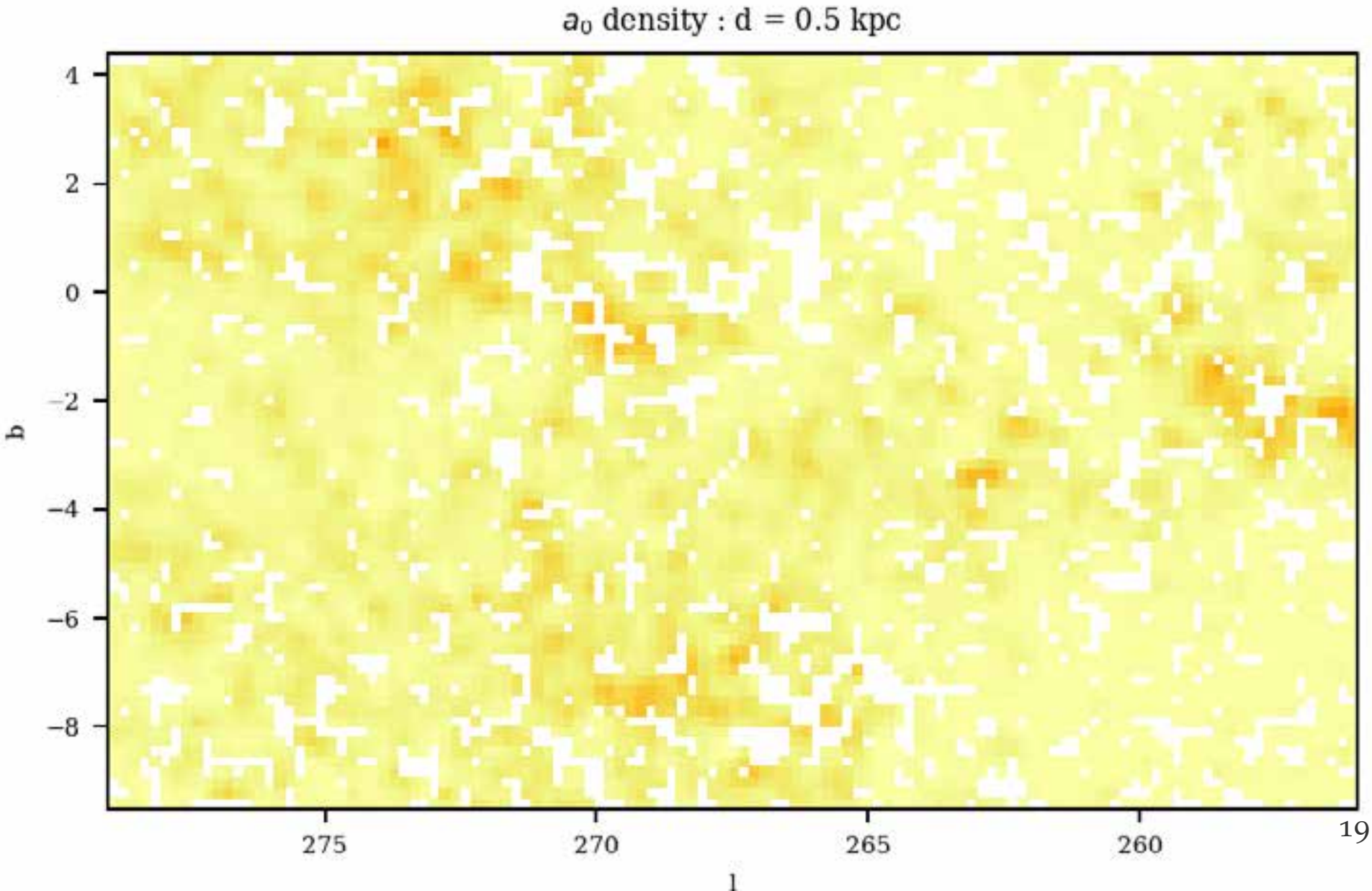
Extinction density show same structures than in infrared

Column extinction (Hottier *et. al.* in prep.)

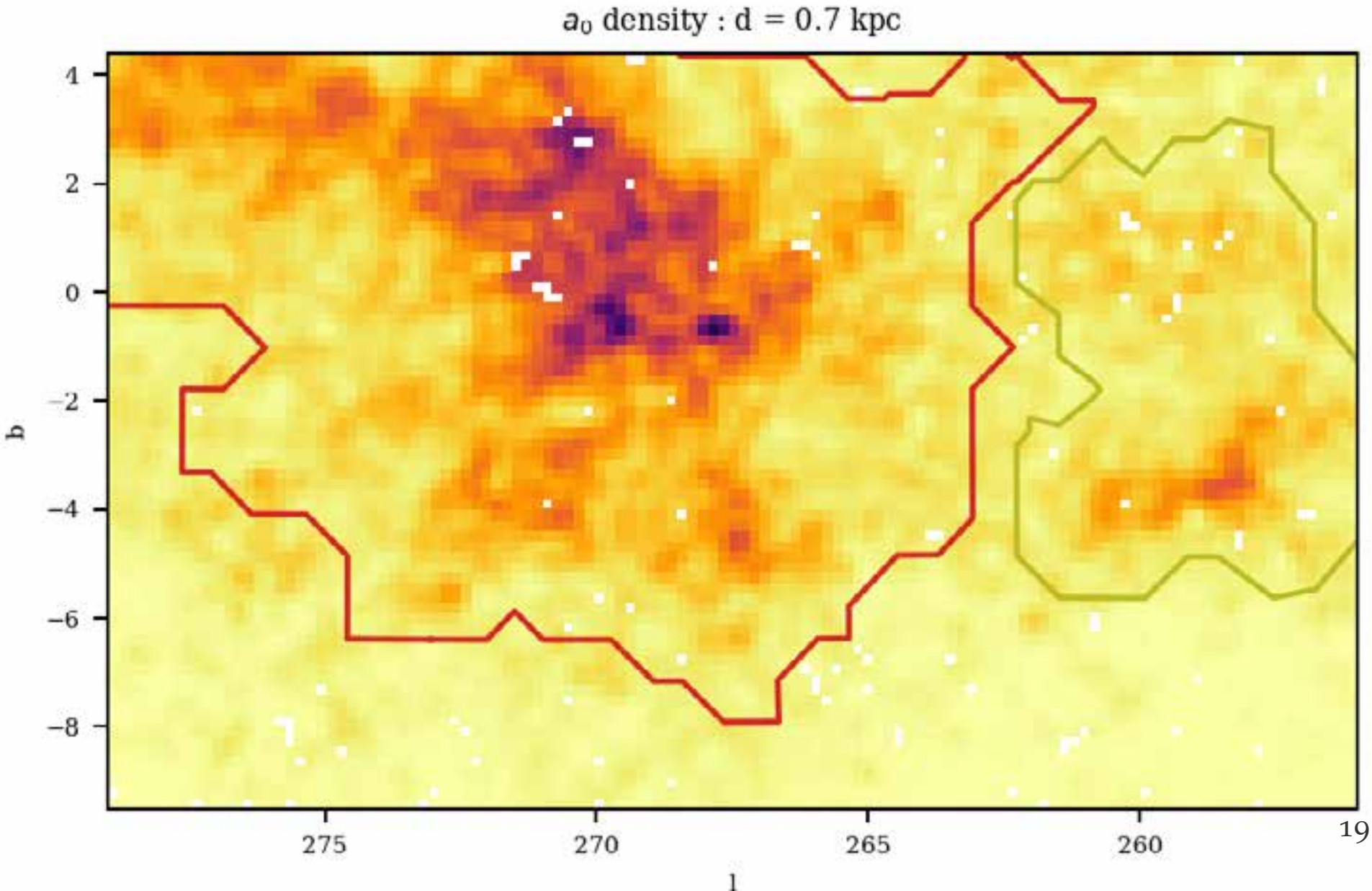


Extinction density show same structures than in infrared

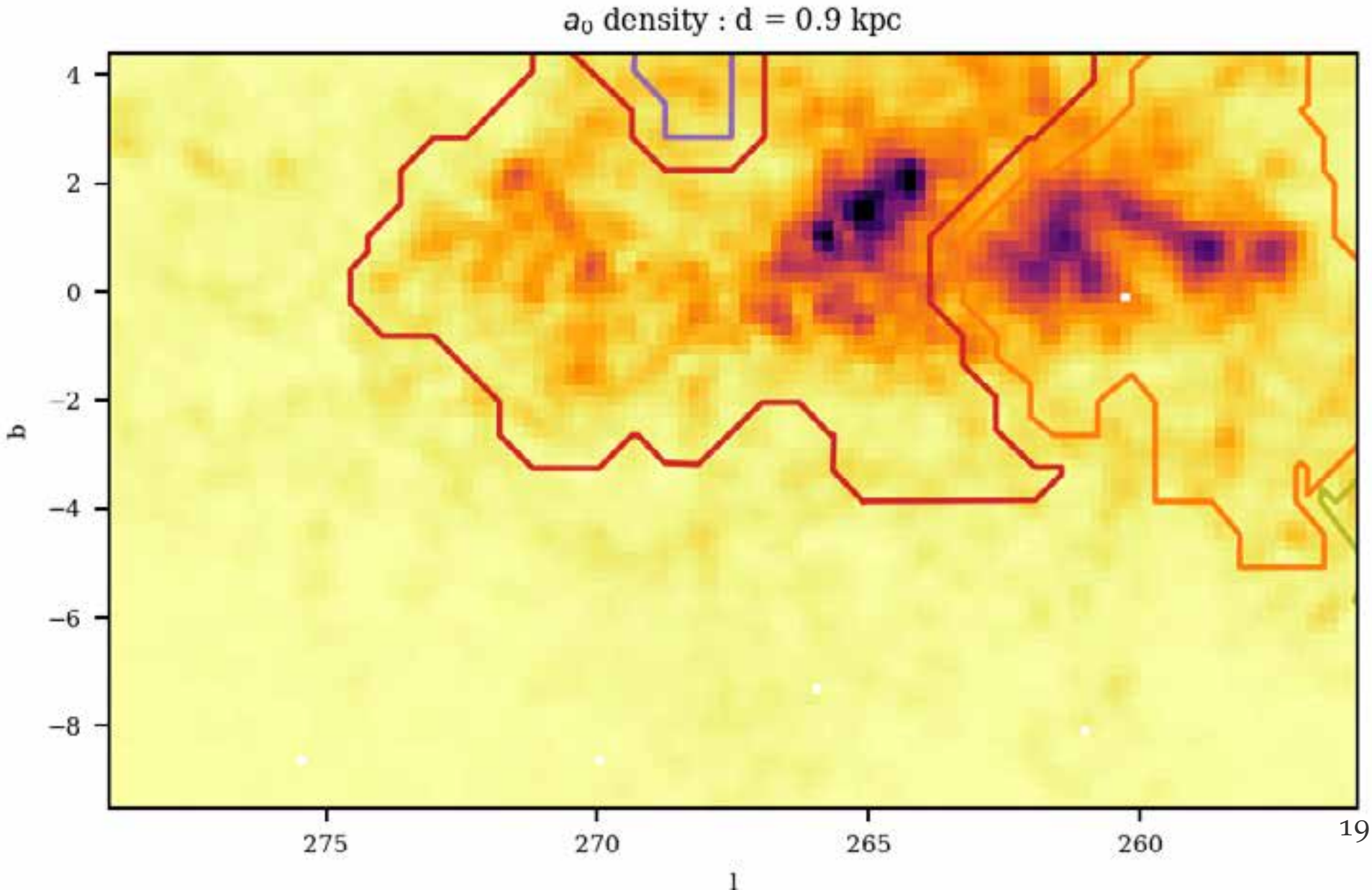
The Vela clouds unravelled



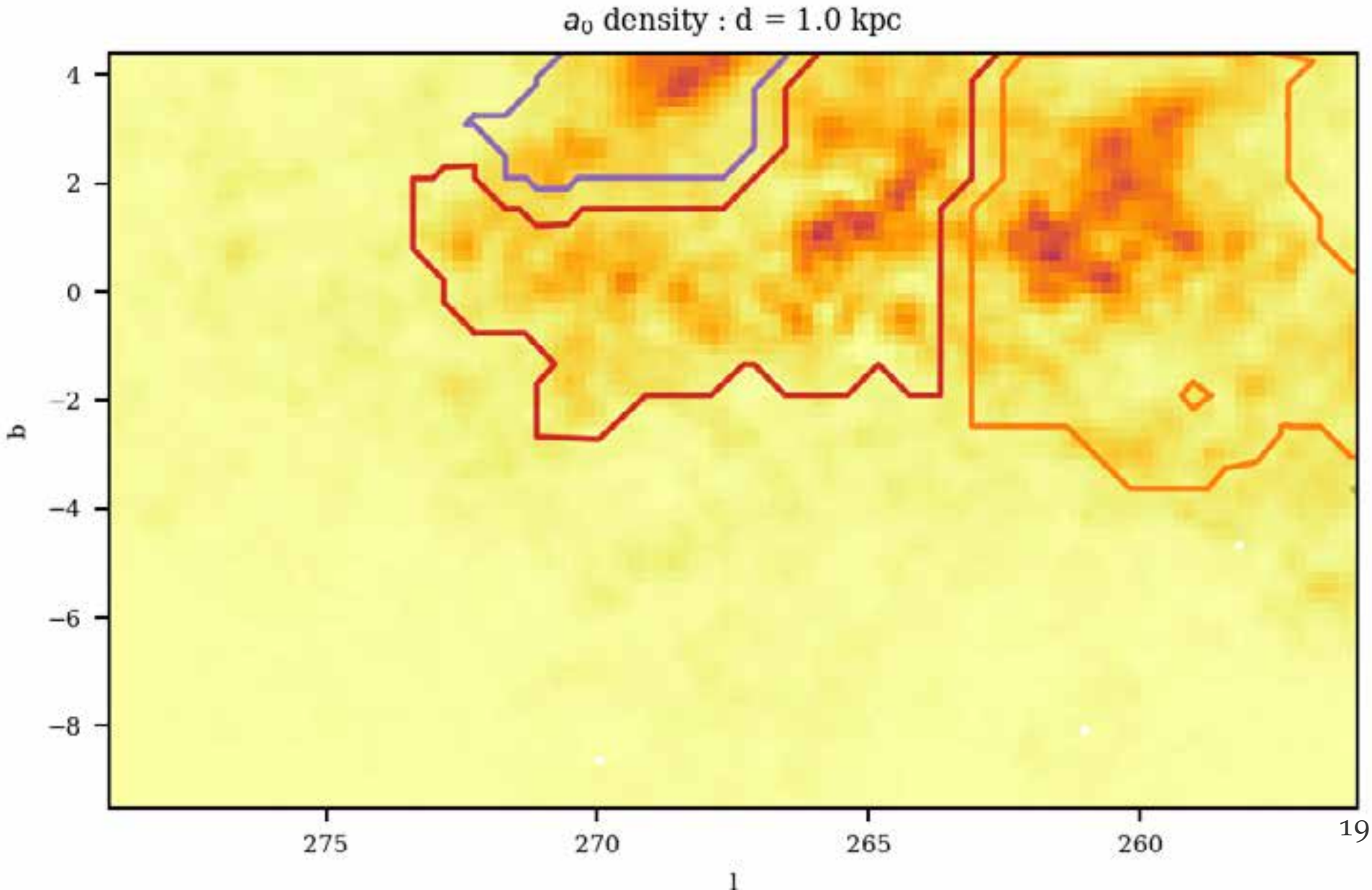
The Vela clouds unravelled



The Vela clouds unravelled



The Vela clouds unravelled



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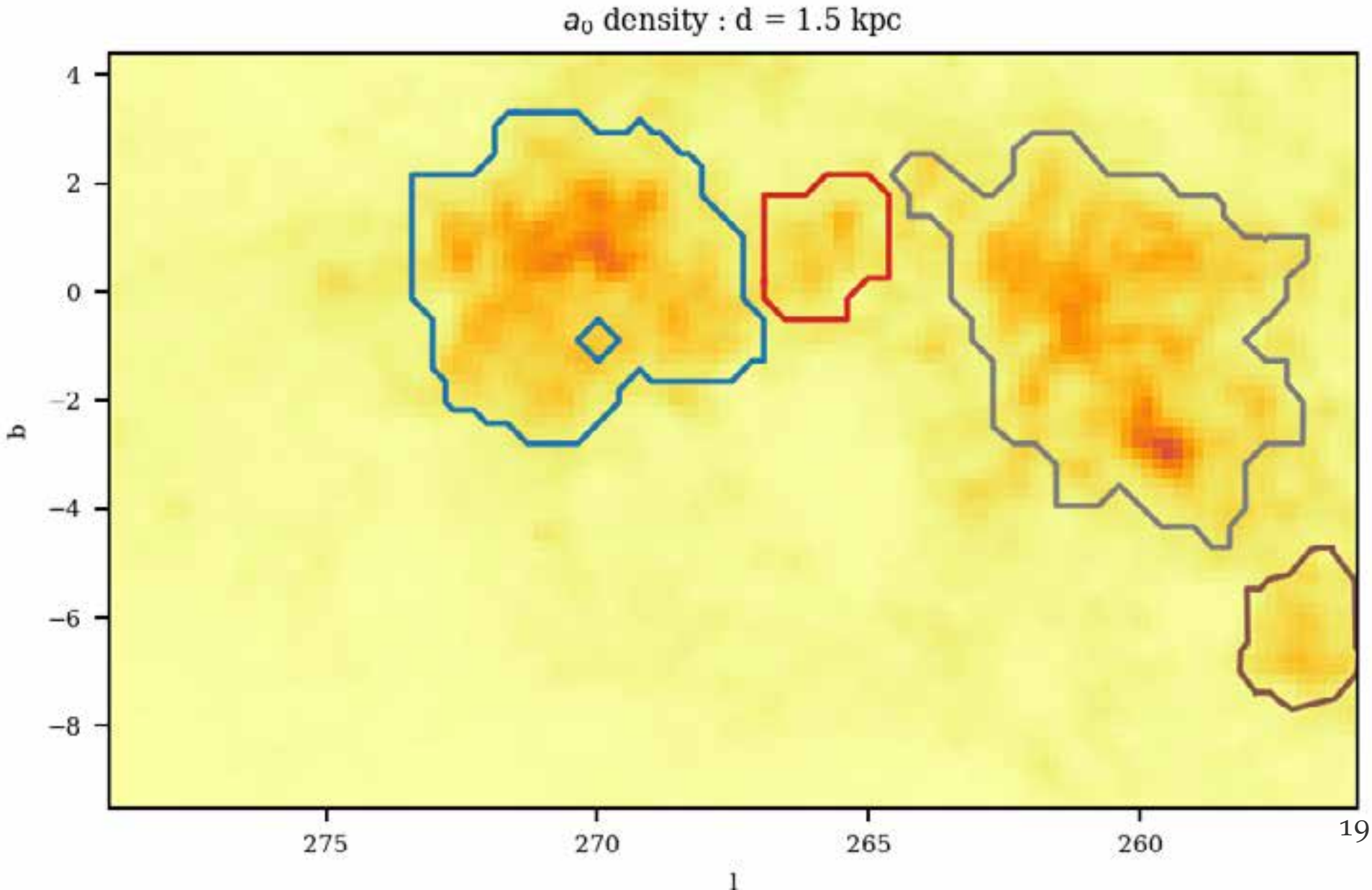

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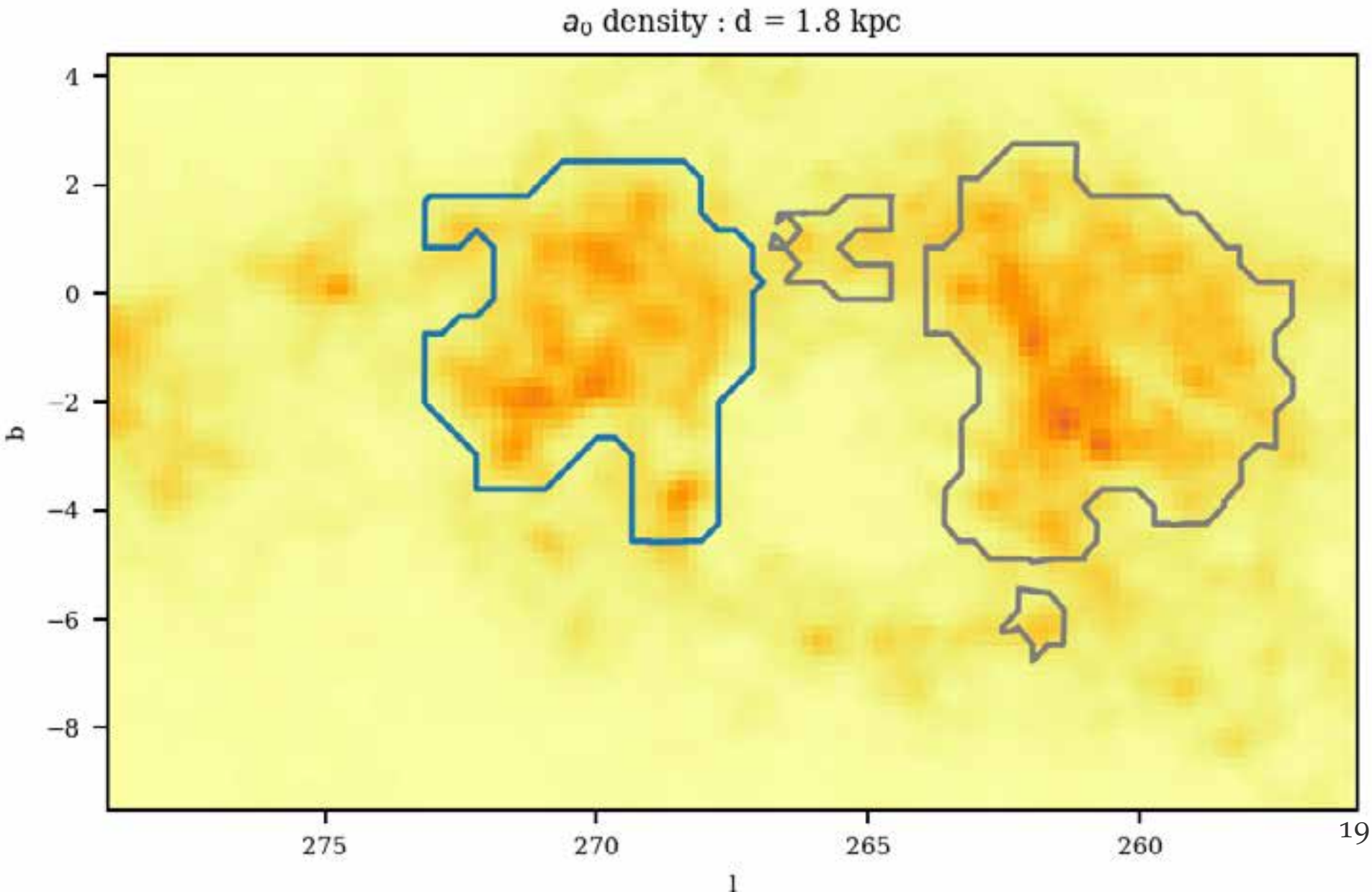
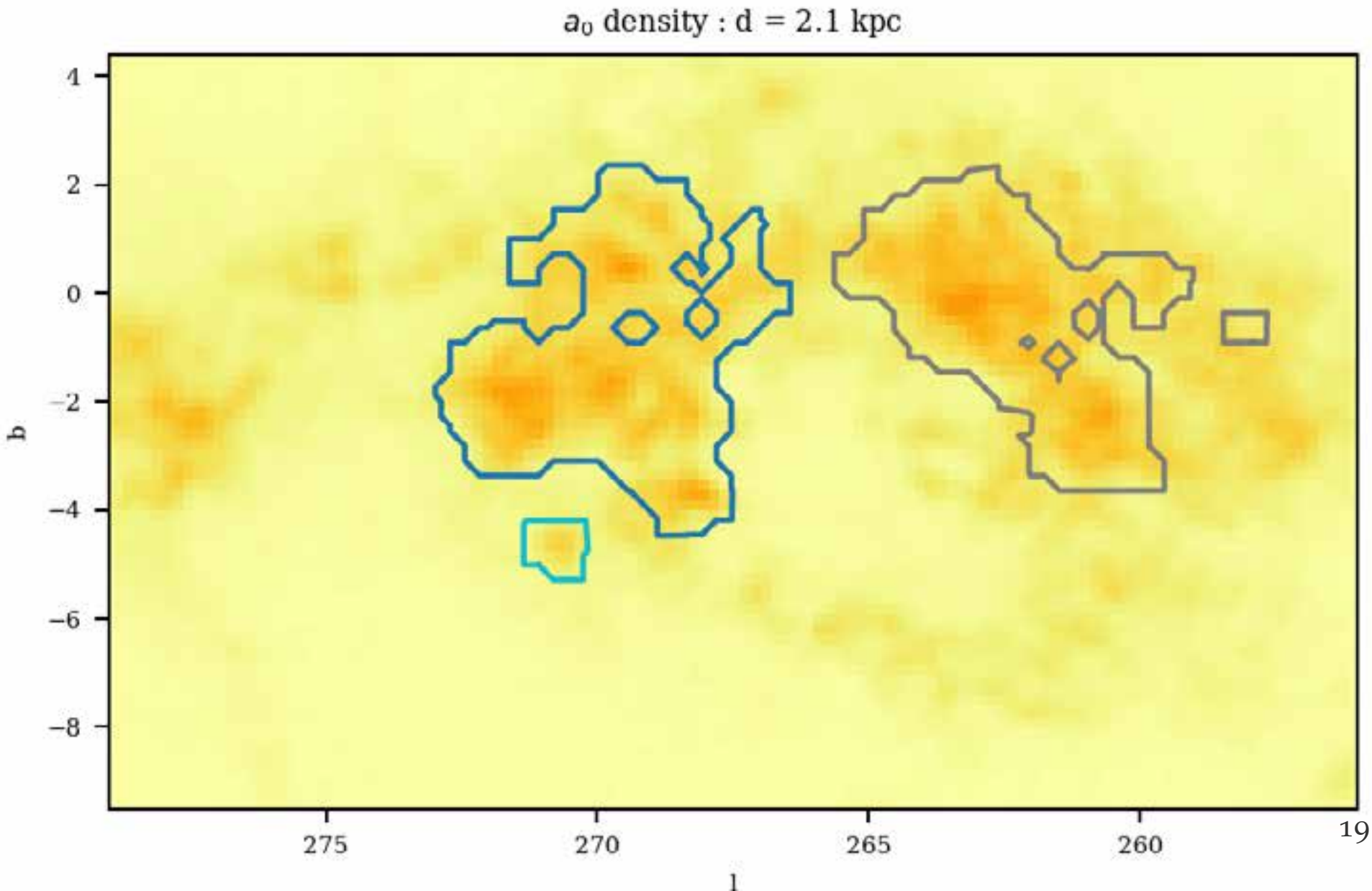
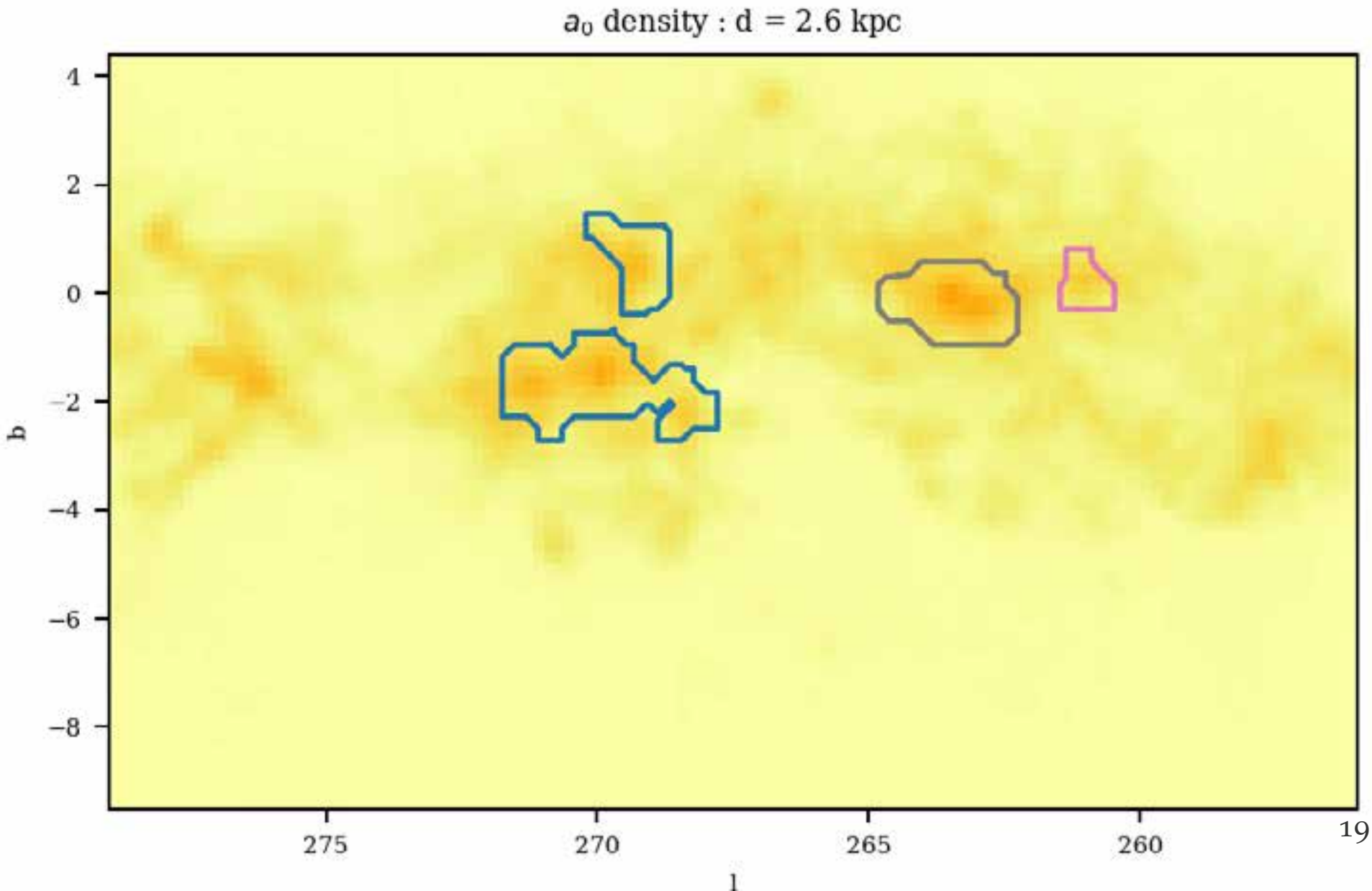


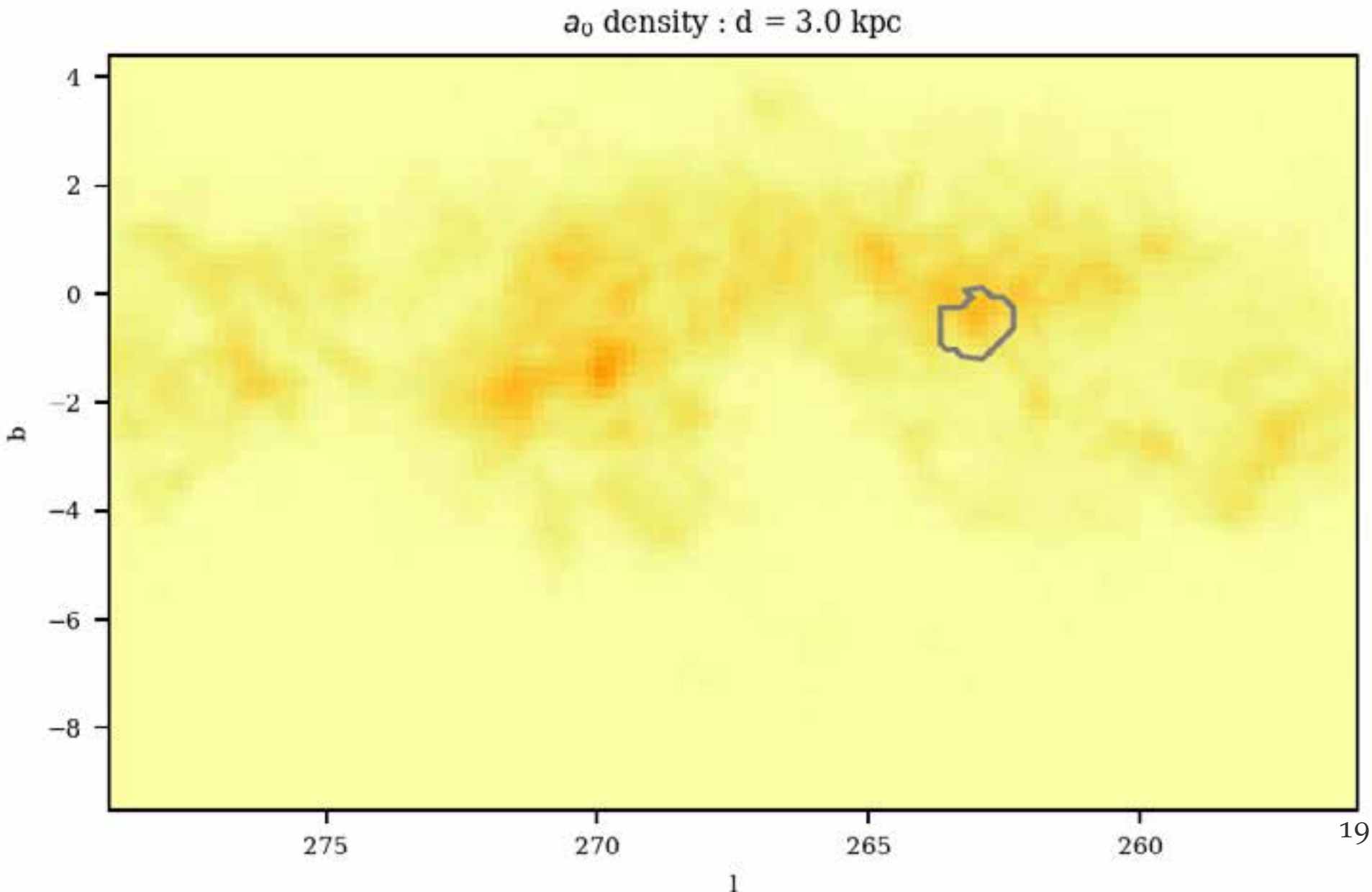
The Vela clouds unravelled



The Vela clouds unravelled



The Vela clouds unravelled



Take home

DR2 :

- Extinction Map of "Close area"
- Distance and shape of structures (Split, Vela...)

EDR3 Objectif:

- Mapping the Galactic Center and beyond
- Observe the bar fingerprint in dust