
Bar versus thick disc populations in the bulge region

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Besançon model : 2012

Fit of the bulge to 2MASS data

Attempt to fit the bulge region

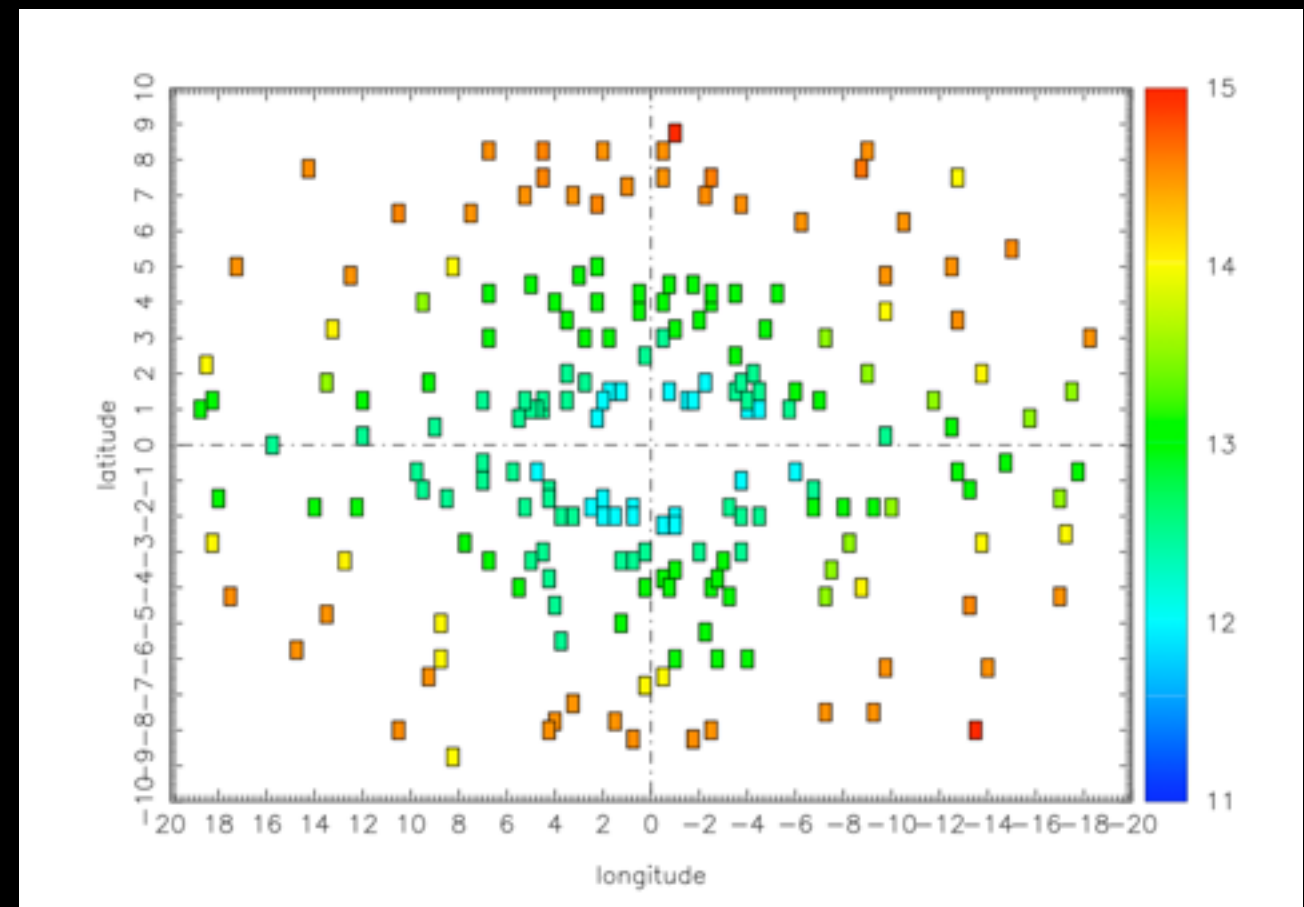
200 fields
 $-20 < l < 20^\circ$
 $-10 < b < 10^\circ$

K/J-K star counts
 $K < 12-14$ (completeness limit)

$$R_{\perp}^{c_{\perp}} = \left(\frac{|X'|}{a_x} \right)^{c_{\perp}} + \left(\frac{|Y'|}{a_y} \right)^{c_{\perp}},$$

$$R_s^{c_{\parallel}} = R_{\perp}^{c_{\parallel}} + \left(\frac{|Z'|}{a_z} \right)^{c_{\parallel}}.$$

$$\rho \propto \text{sech}^2(R_s)$$

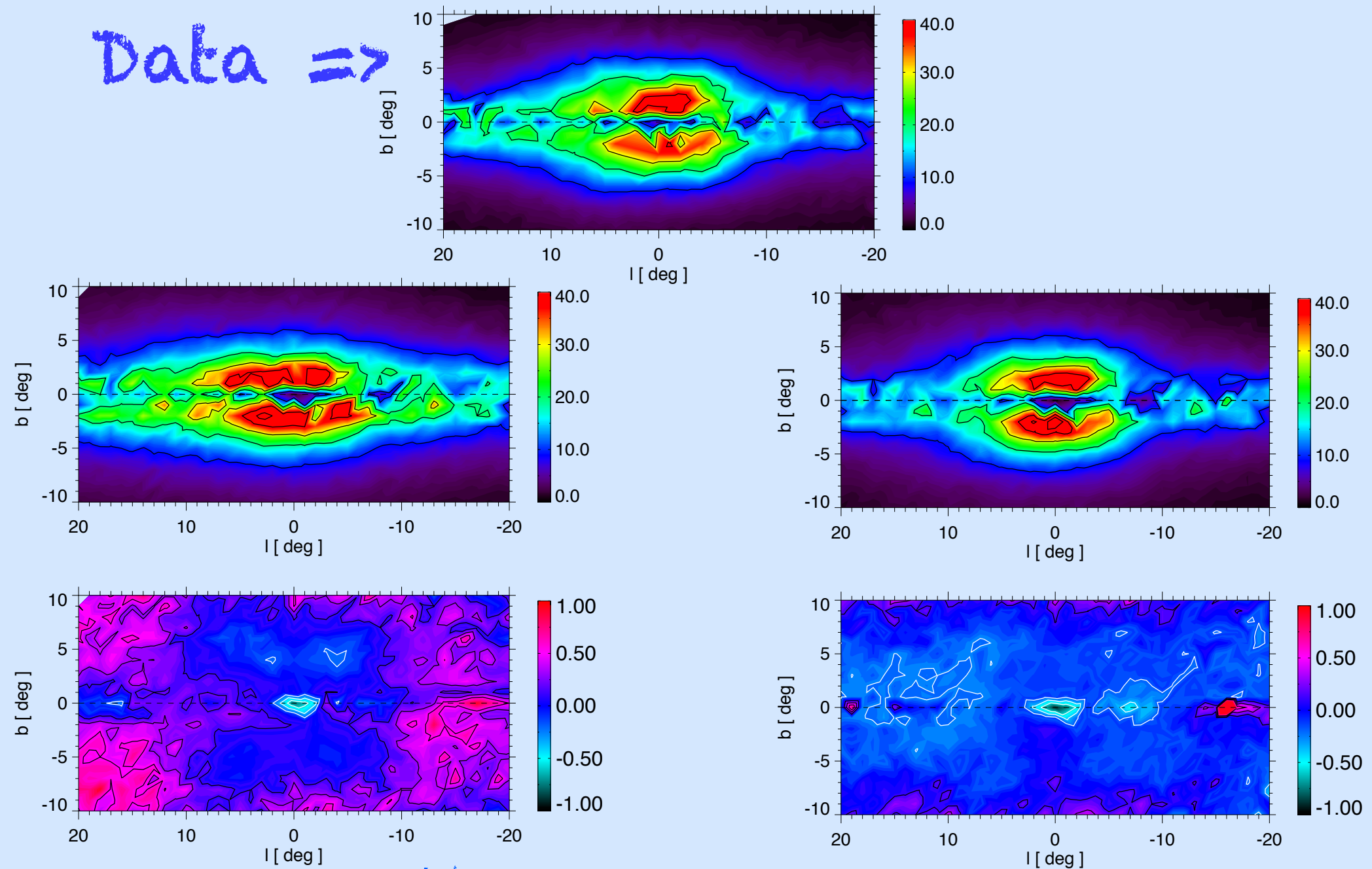


Solution : bulge region fit with 2 structures (*Robin, Marshall, Schultheis, Reylé, (2012) A&A 538, A106*)

Extinction: 3D model from Marshall et al (2006).

- A bar (dominating)
- A weaker «thick bulge»

Data =>



1 structure (S)

2 structures (S+E) : a bar and a thick bulge

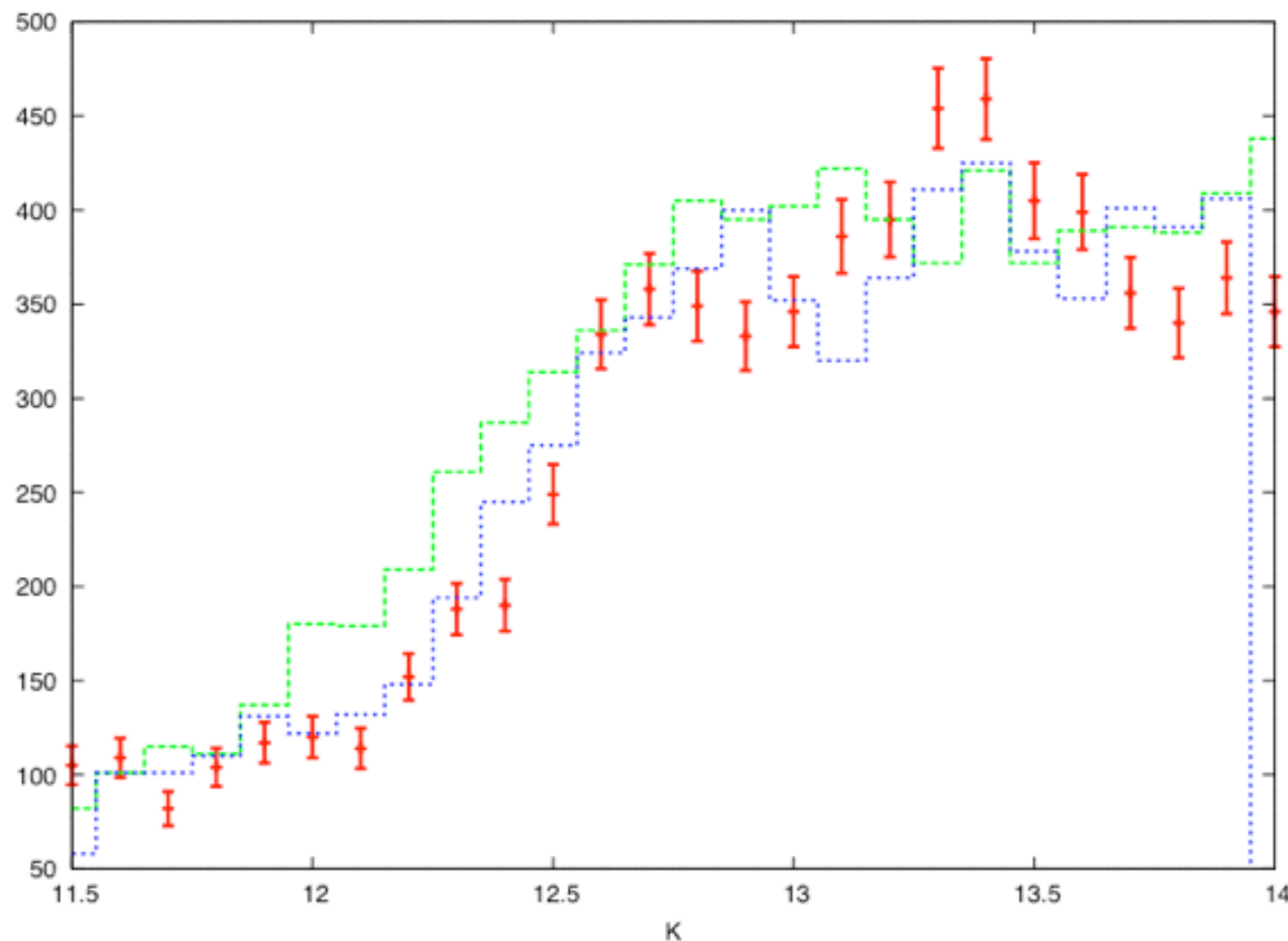
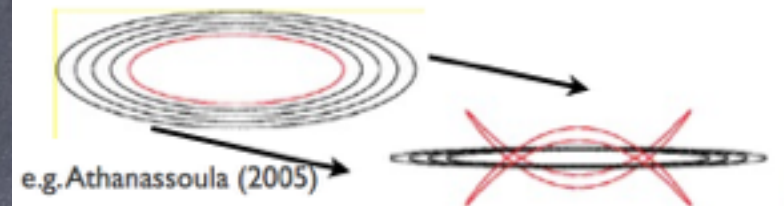
Φ	6°	13°
x_0	3.17 kpc	1.46 / 4.44
y_0	0.62 kpc	0.49 / 1.31
z_0	0.38 kpc	0.39 / 0.8

The 2 clumps observed in the X-shape pseudo-bulge are modeled via changing the scale height as a fact of Galactocentric distance

$$dz = dz_0 \times (1 + 0.3 \times \sin(x/650.))$$

N-body simulations

- Bar potential
- Periodic x1 orbits buckle



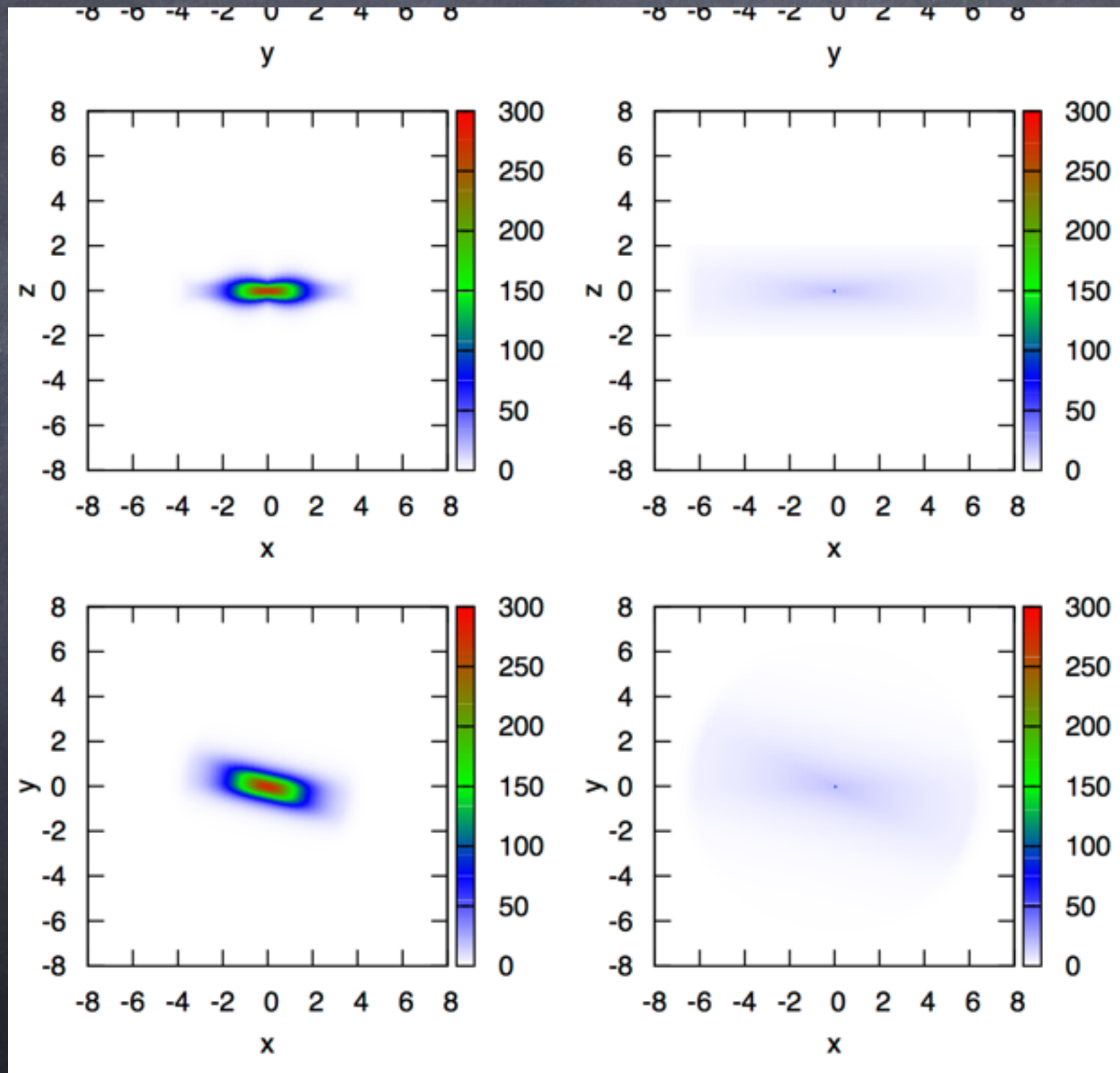
$$l=0^\circ, b=-7^\circ$$

- Data
- Model standard Bar
- Model with X-shape

The model (2012)

X-shape bar

Thick bulge or thick disc



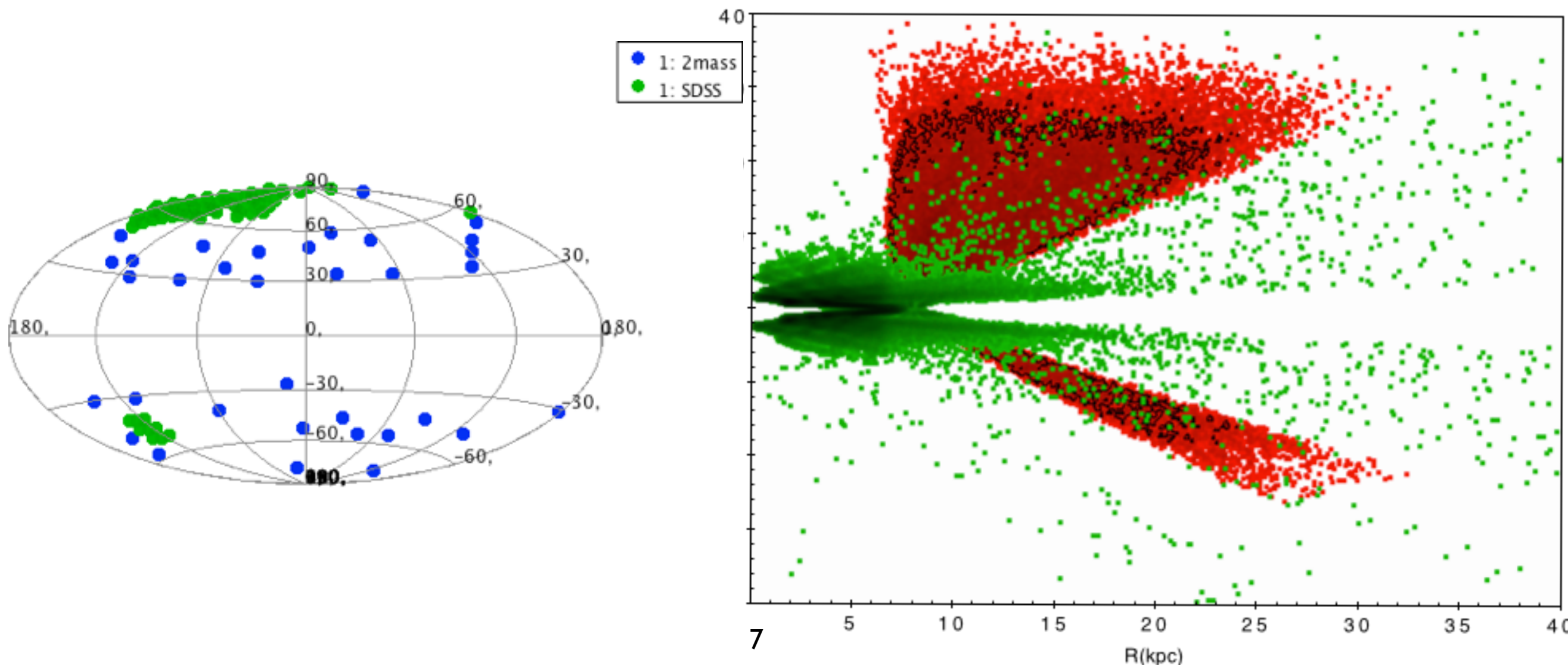
Influence of the thick disc on bulge region

- ❖ Thick disc contribution in the bulge region depends on its scale length. Shorter it is, stronger is the contribution (assuming the same normalisation in the solar neighborhood).
- ❖ Investigation of the thick disc scale length from SDSS +2MASS data

Revisiting the thick disc and halo

From SDSS + 2MASS

- Fit SDSS fields with no streams (photometry) (F1,F2,F3,F4 patches)
- Add 2MASS fields at intermediate latitudes and a larger longitude range
- ABC-MCMC fit, maximum likelihood g.o.f. : halo shape, thick disc shape, age, mean $[\text{Fe}/\text{H}]$



Resulting contribution of the thick disc in the bulge region

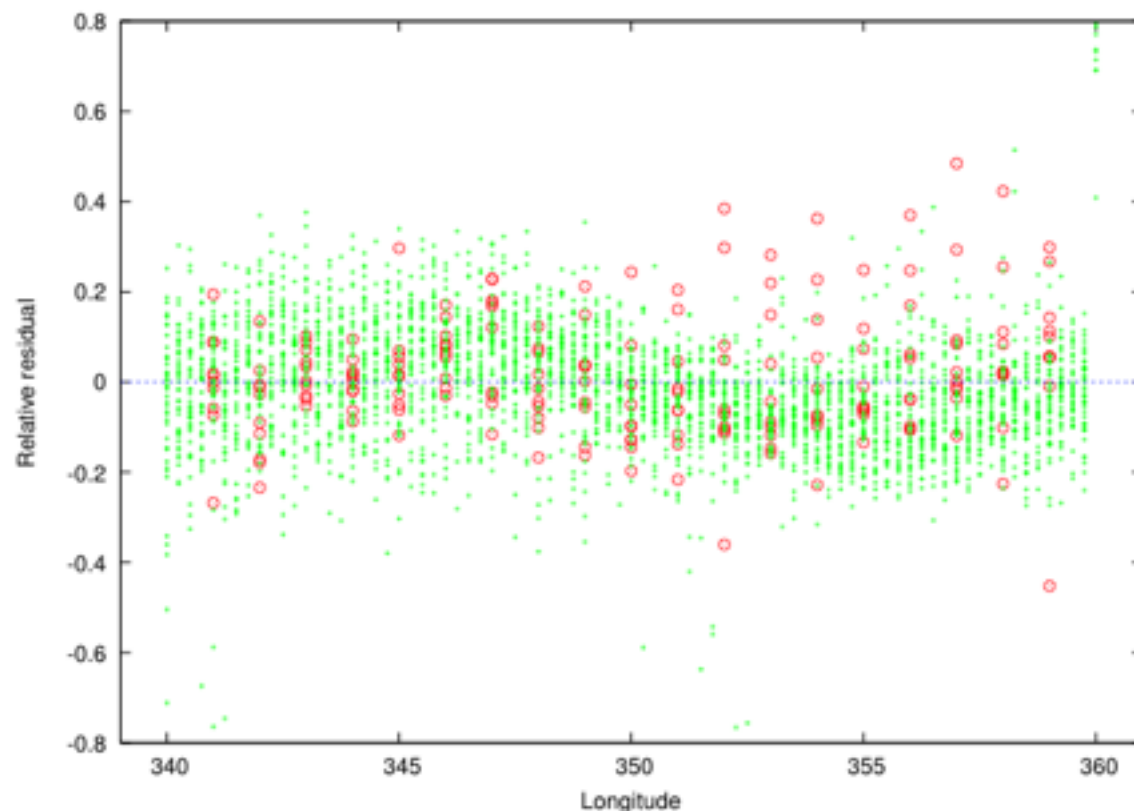
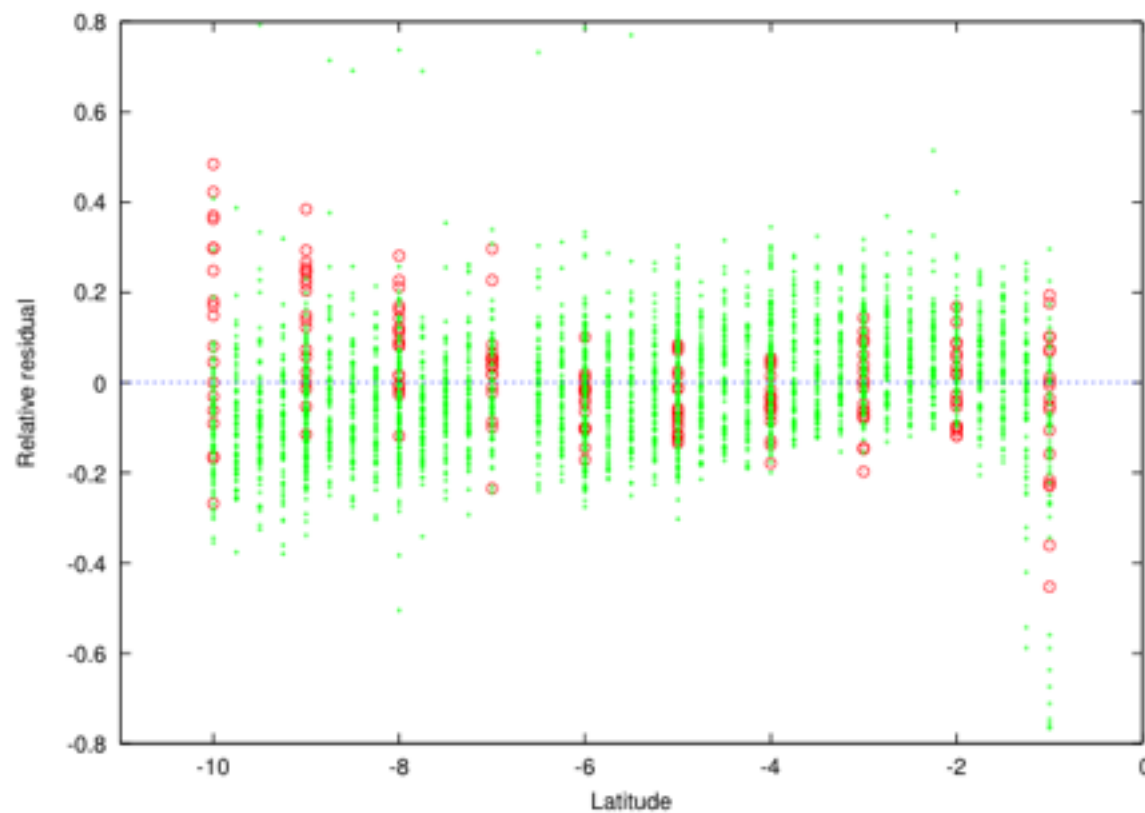
Robin et al (2012):

Bar + « thick bulge »

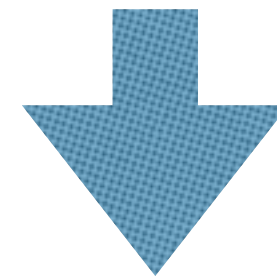
(thick disc supposed to have a 2.5 kpc scale length)

Robin et al. 2014:

Bar + thick disc with a shorter scale length



○ Bar + thick bulge (2012)
+ Bar + new thick disc (2014)



Good fit of the bulge star counts
with : bar + thick disc + thin disc

Reproduce the double clump at $b > 4^\circ$

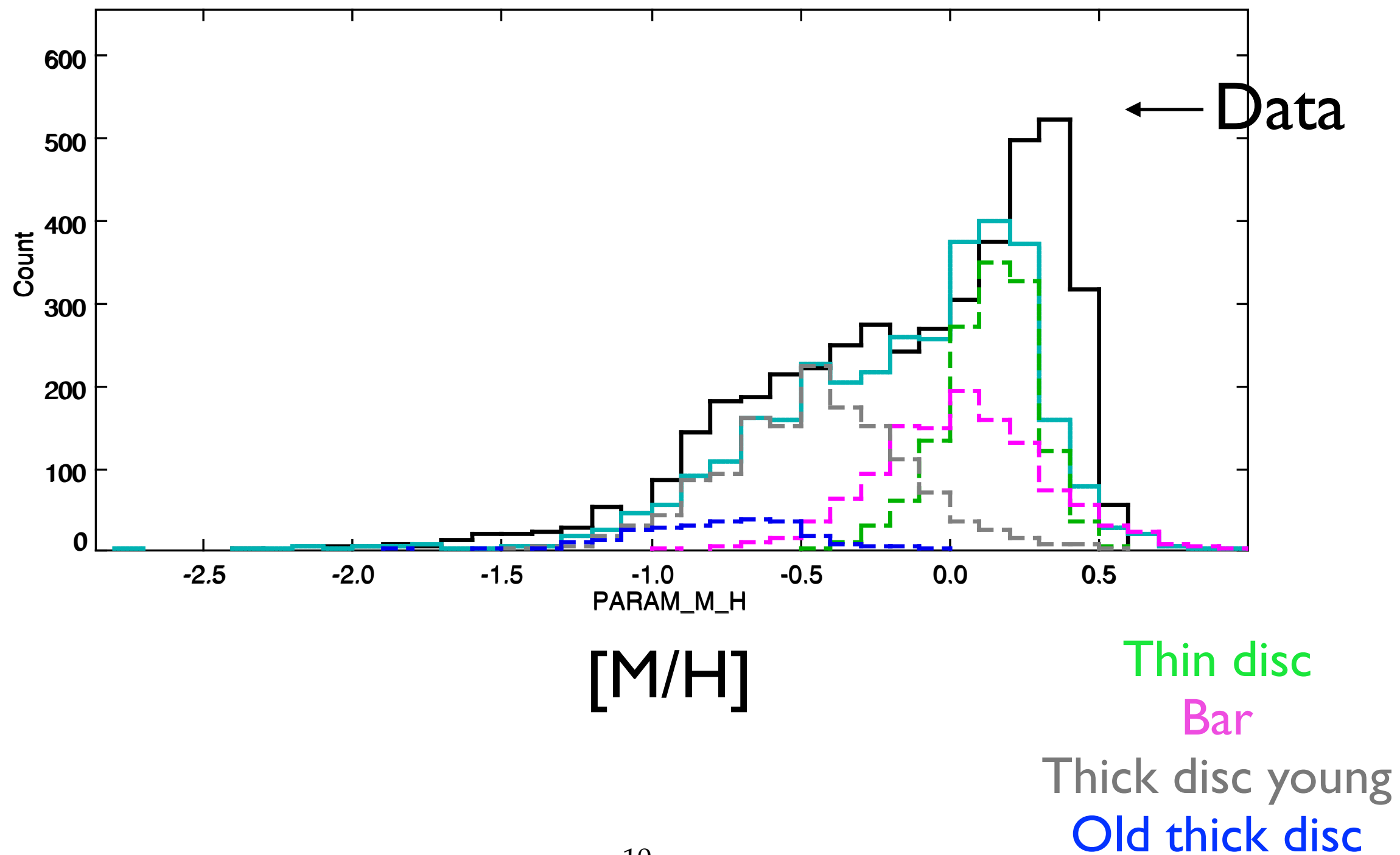
Reproduce the MDF

Reproduce the velocity dispersions

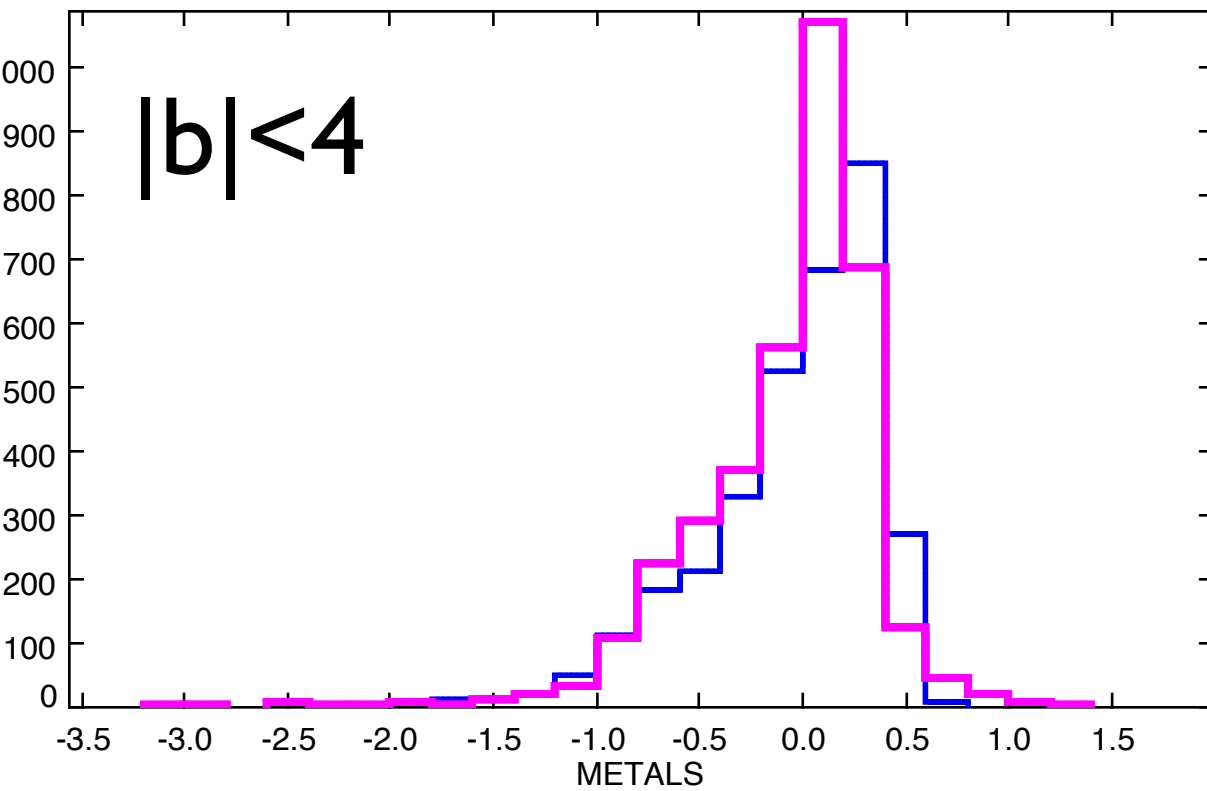
APOGEE

- Preliminary application of the target selection in the bulge region
- Test for the new model of thin and thick disc in the bulge region

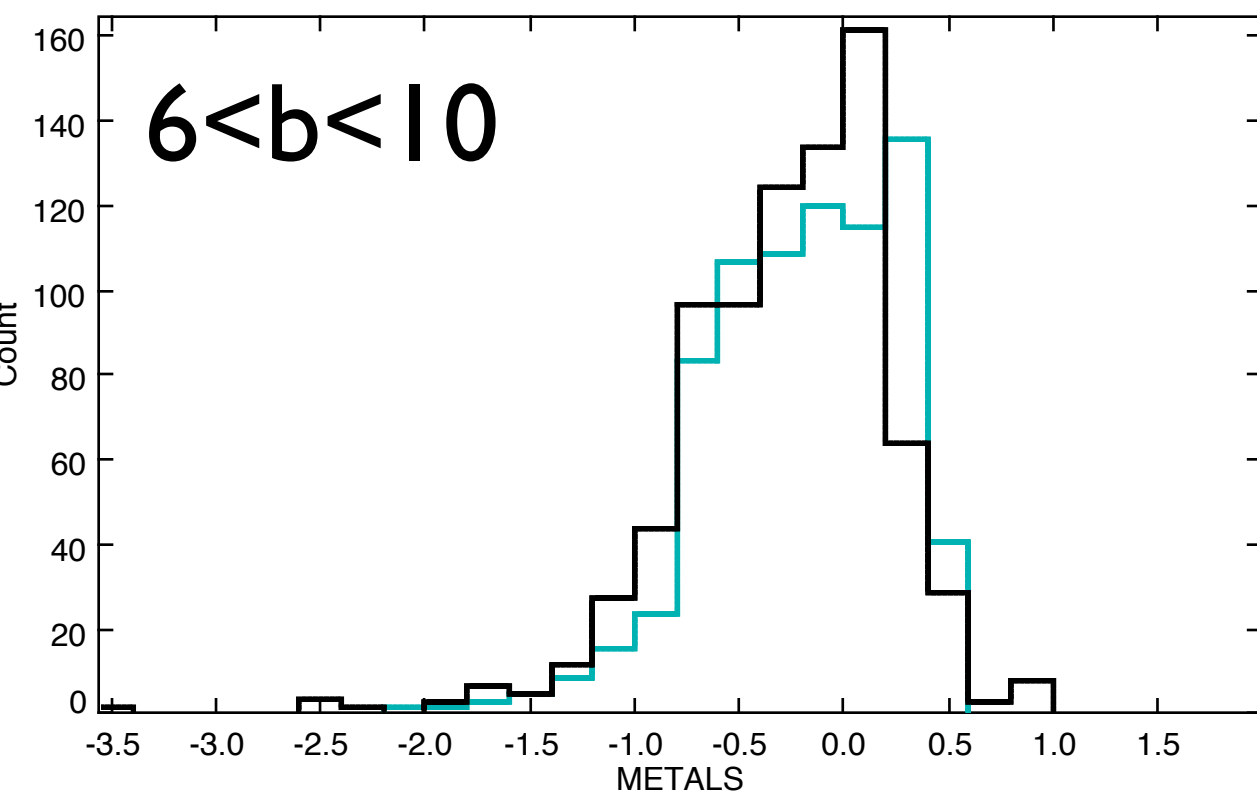
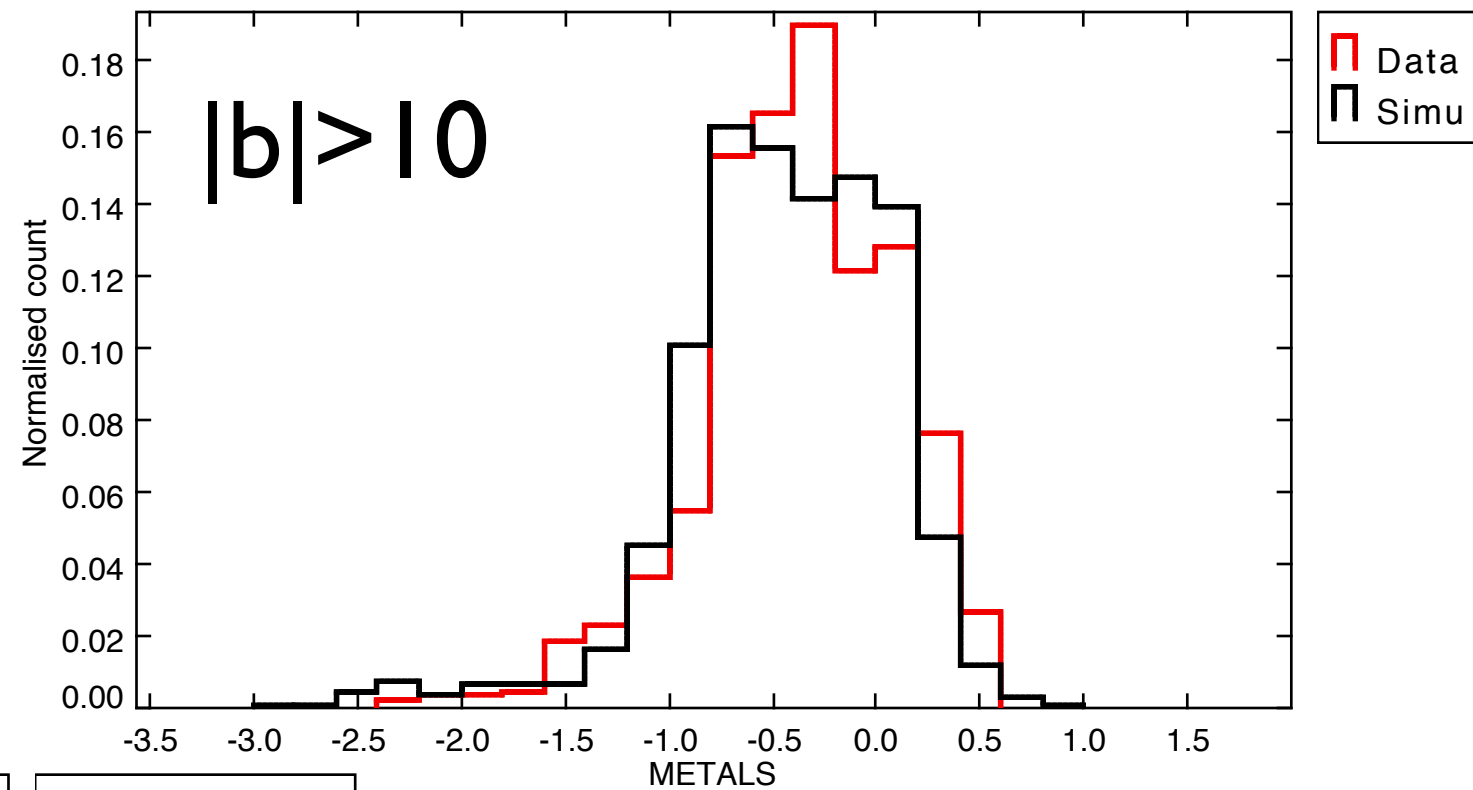
Bulge fields : $0^\circ < l < 18^\circ, -14^\circ < b < 14^\circ$



[M/H]: APOGEE vs Model



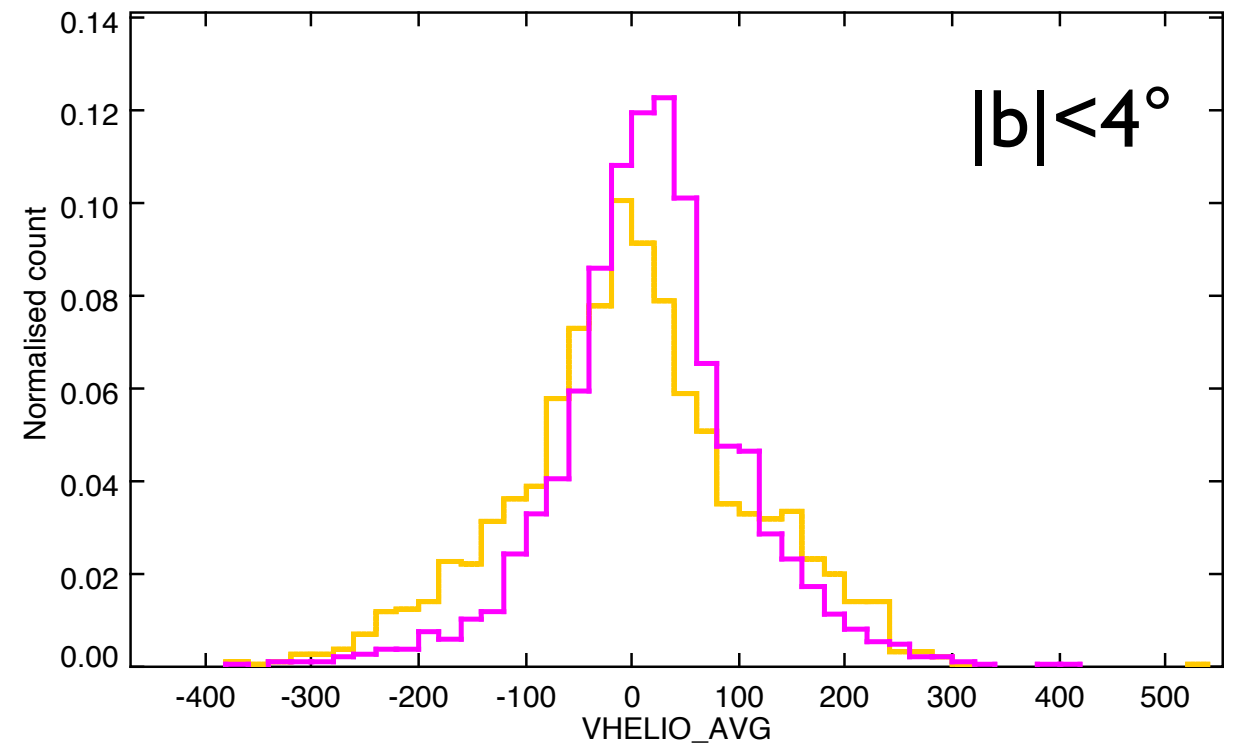
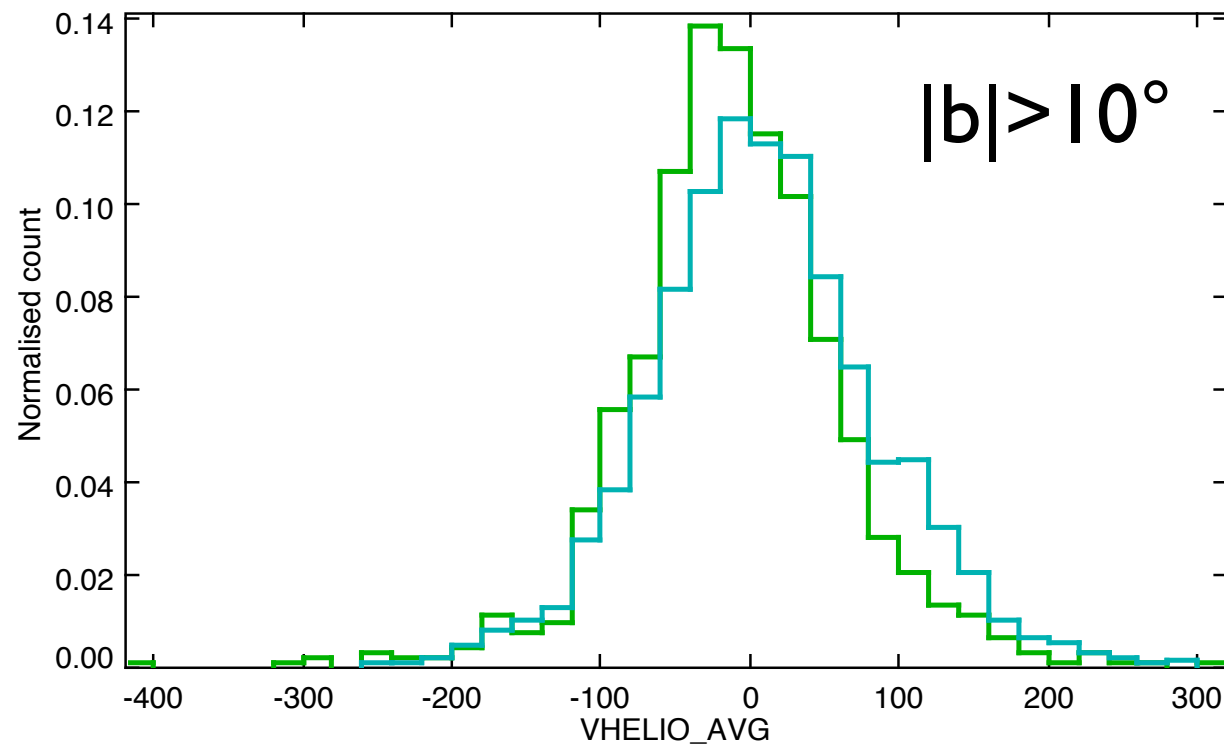
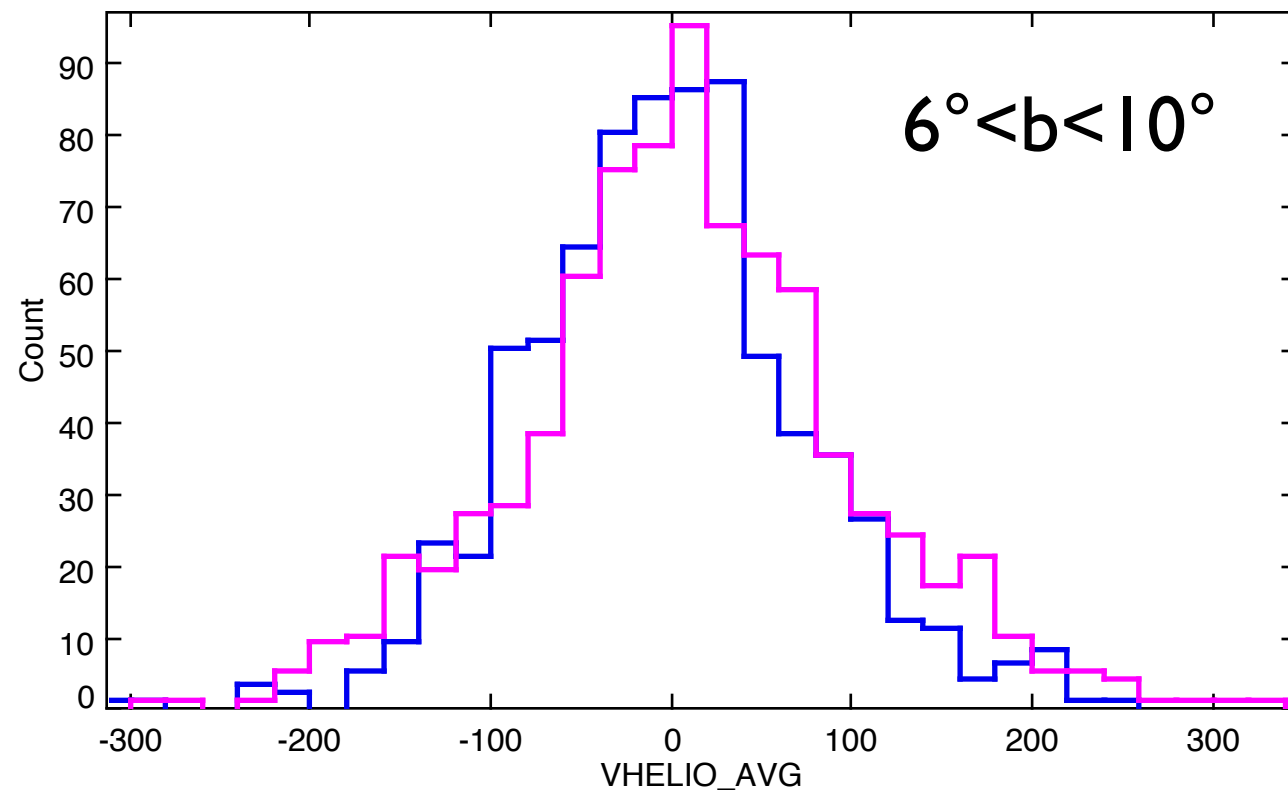
Legend: Data -4<b<4, Simu -4<b<4



Legend: Data 6<b<10, Simu 6<b<10

Bulge region $-5^\circ < l < 18^\circ$
No fit

Vrad:APOGEE vs Model



Bar model (no fit)
: Debattista+ 2006, Gardner+ 2013

Conclusions

A model with a bar, a short scale length thick disc + thin disc with a central hole

- Reproduce star counts in the area $-10^\circ < l < 10^\circ$ and $-10^\circ < b < 10^\circ$, with the double clump at $|b| > 4^\circ$
- Reproduce the metallicity distribution function
- Reproduce the velocity dispersions

Validate a bulge region with no classical bulge

Ref:

Robin et al, 2012 A&A...538A.106

Robin et al, 2014A&A...569A..13R