# Besançon model update
# Implications for Gaia simulations

# Outlines

- Bulge and bar modelling
- Thin disc improvement : tracks, SFR/IMF, binarity
- On-going :
  - Extinction modelling
  - Thick disc / halo SDSS fitting
  - Spiral structure
  - Micro-lensing
  - Dynamics

# Besançon model : New fit to 2MASS data

Attempt to fit the bulge region

200 fields
-20<l<20°
-10<b<10°

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

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

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

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

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

See also Marshall, Fux, Robin, Reylé (2009) for the dust lanes

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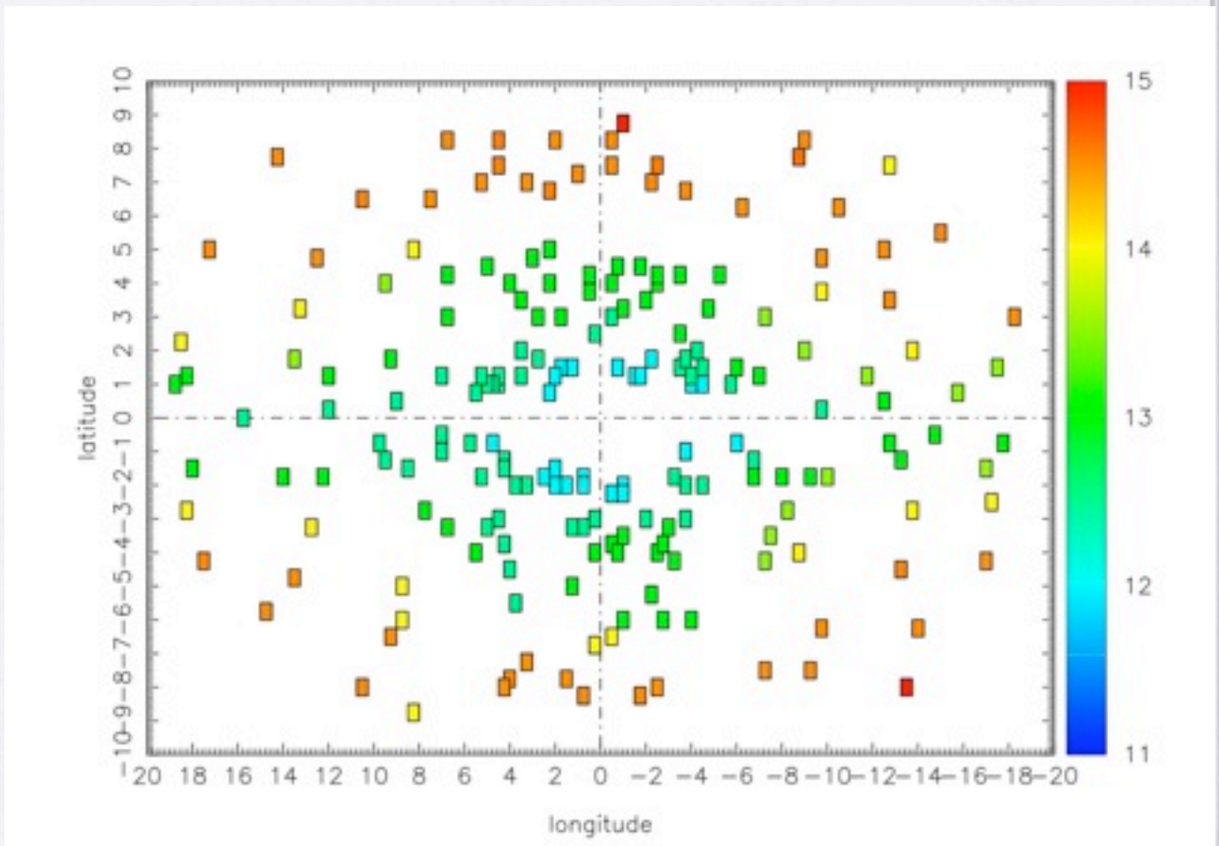


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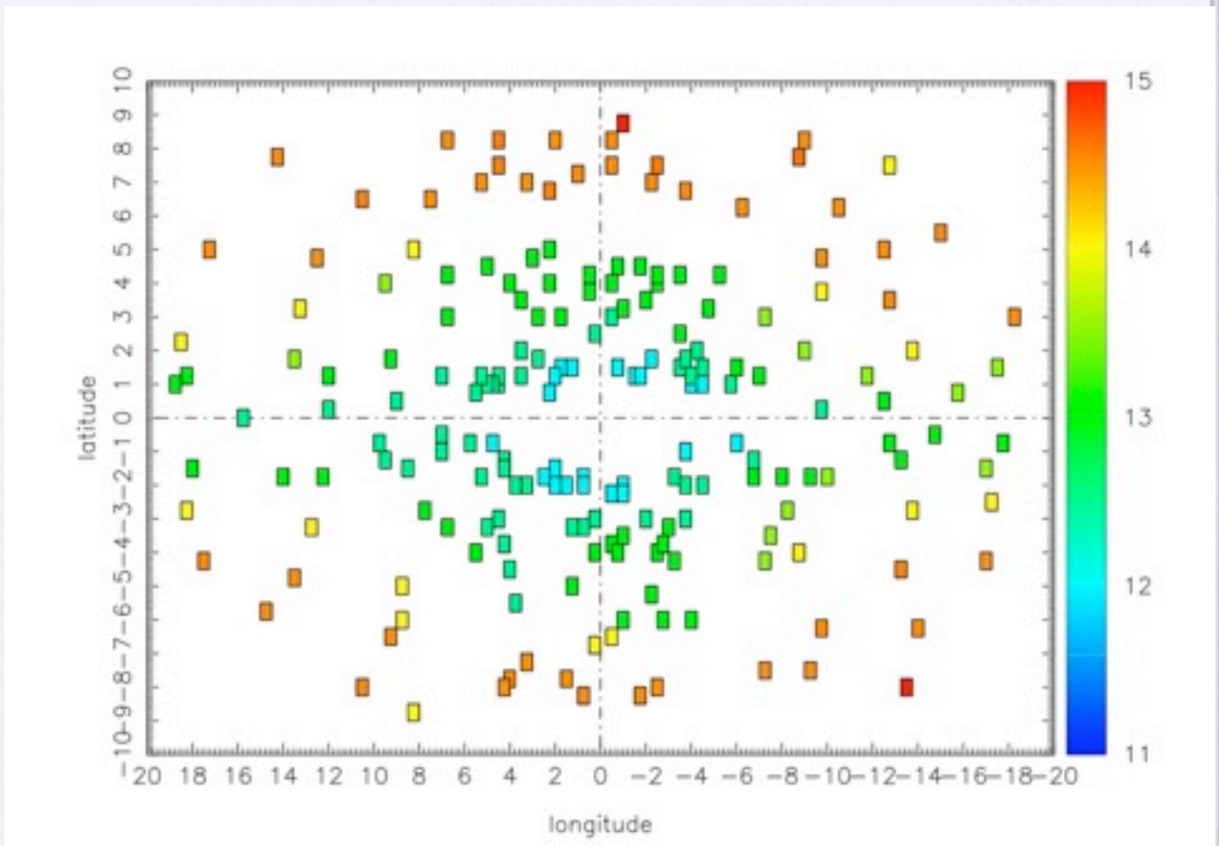


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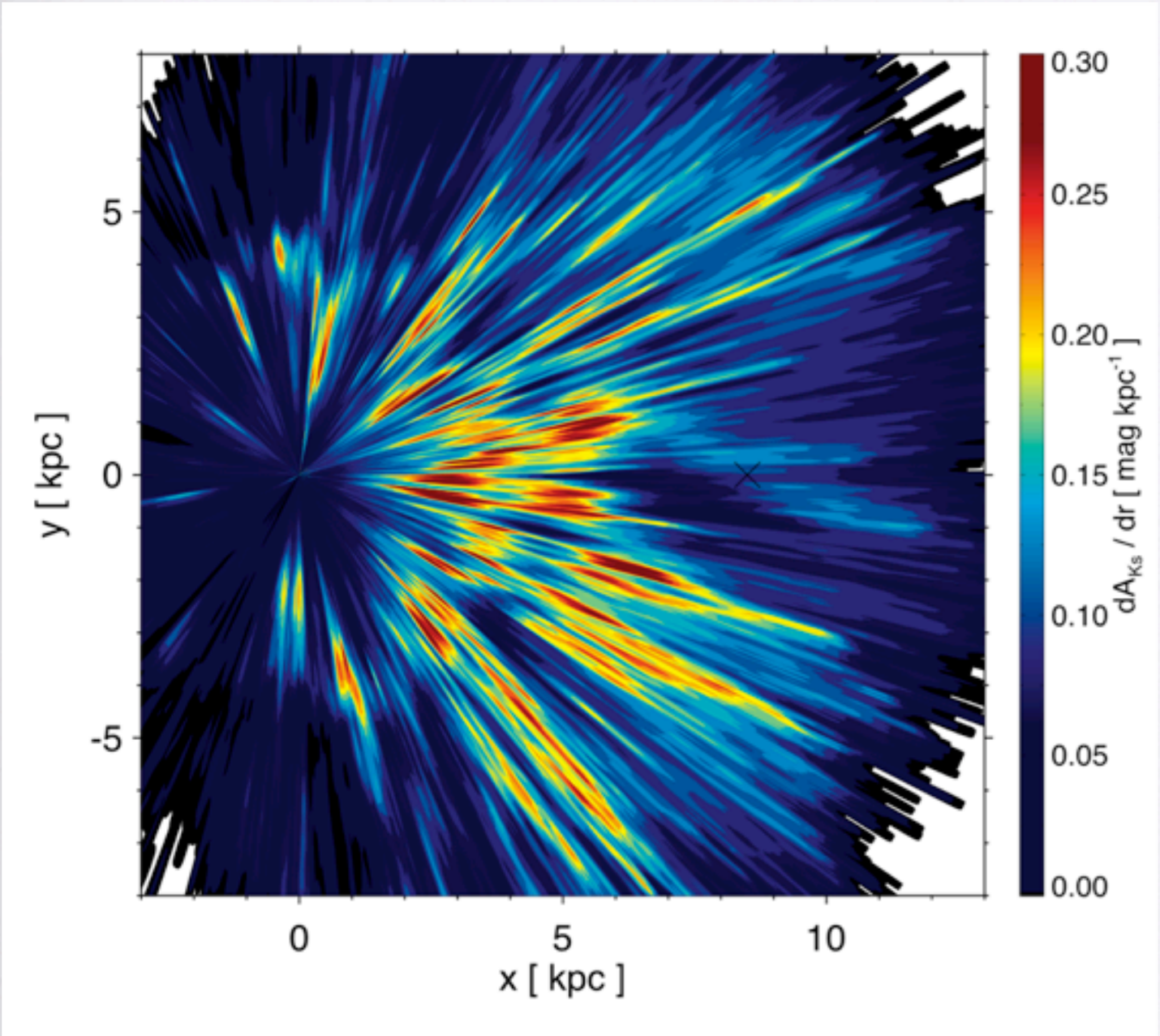
**Solution** : bulge region fit with 2 structures (*Robin, Marshall, Schultheis, Reylé, (2012) A&A 538, A106)*

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

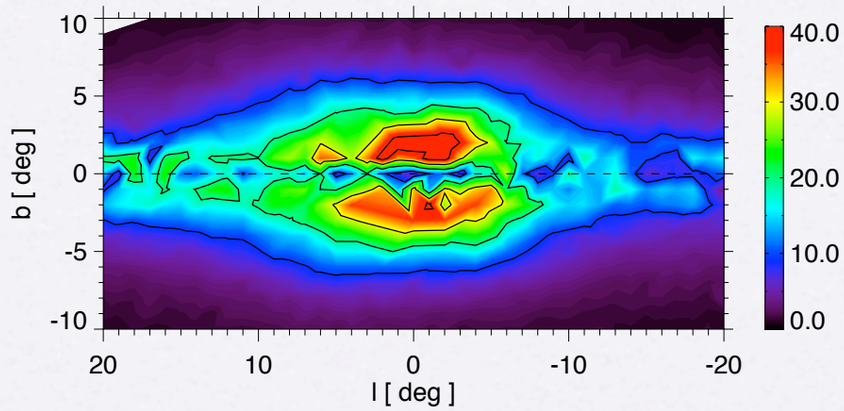
**Extinction: 3D model from Marshall et al (2006).**
See also Marshall, Fux, Robin, Reylé (2009) for the dust lanes

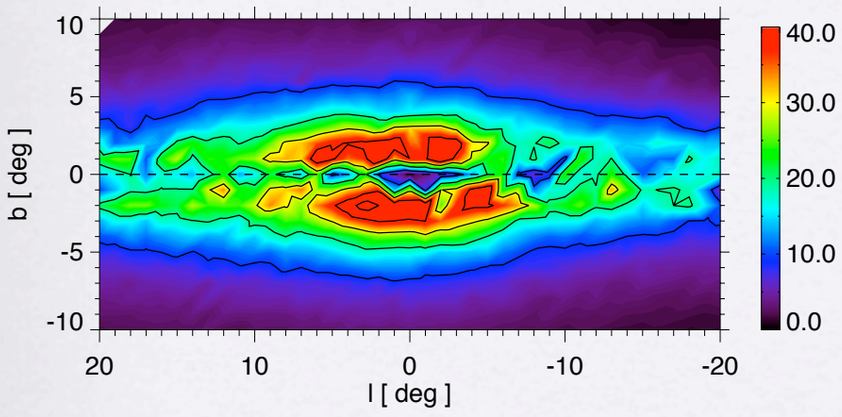
# Galactic plane from the top (slice b=0°)

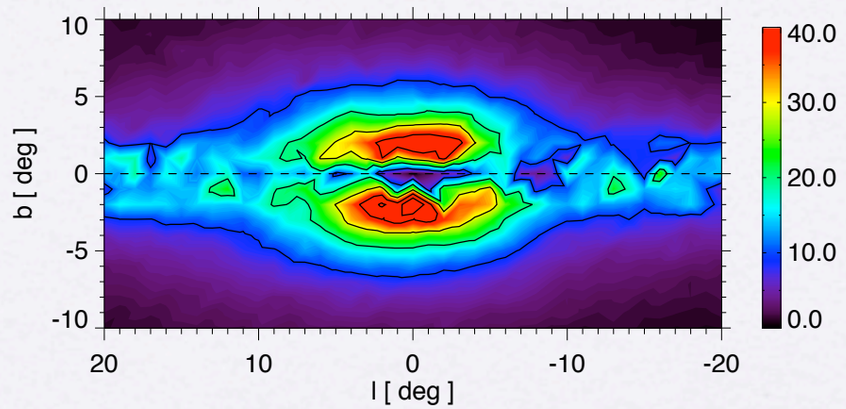


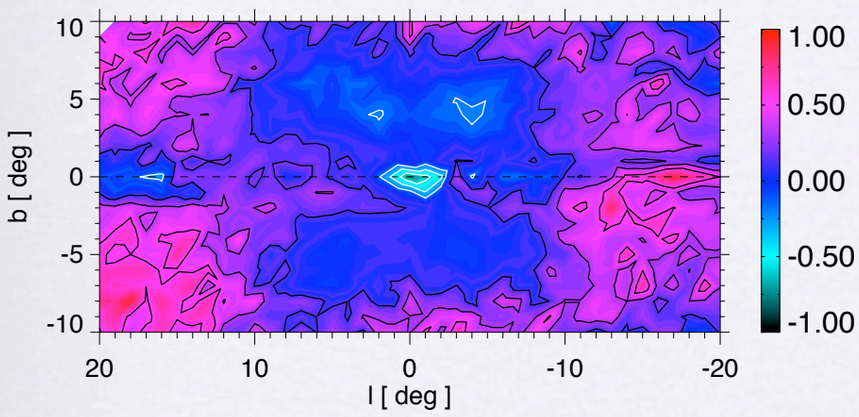

Evidence for dust lanes associated with the bar (Marshall, Fux, et al 2008)

Data =>

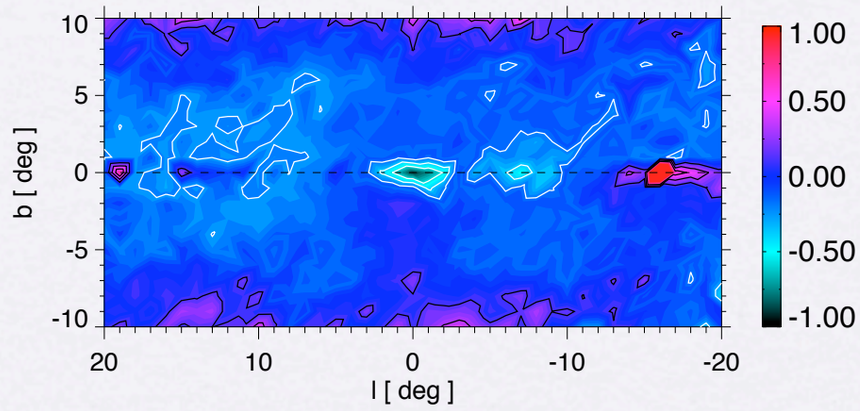



1 structure (S)




2 structures (S+E)

| Φ | 5.9° | 13° |
|---|---|---|
| x0 | 3.17 kpc | 1.46 / 4.44 |
| y0 | 0.62 kpc | 0.49 / 1.31 |
| z0 | 0.38 kpc | 0.39 / 1.21 |
| Mass | 6.1 $10^9$ | 2.6 $10^8$ |
| [Fe/H] | 0. | -0.4 |

# CMD

Baade's window

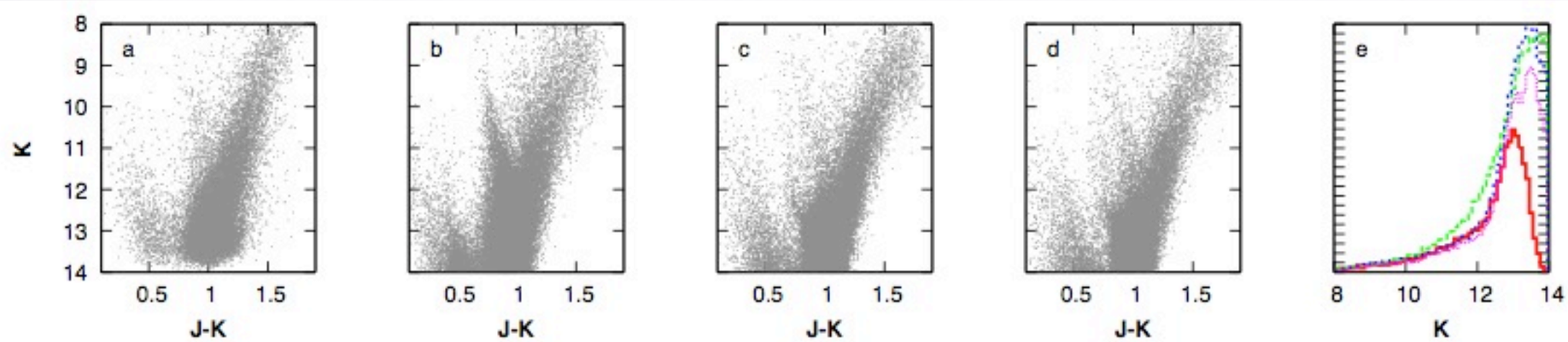



**Fig. 9.** Colour-magnitude diagrams for the 2MASS field at l=0, b=-4. (a) data; (b) best-fit model with 1 ellipsoid; (c) best-fit models with 2 ellipsoids; (d) modified model with flared bar; (e) histograms of data (red solid) and models (1 ellipsoid: green long dashed; 2 ellipsoids: blue dotted, flared bar: magenta short dashed).

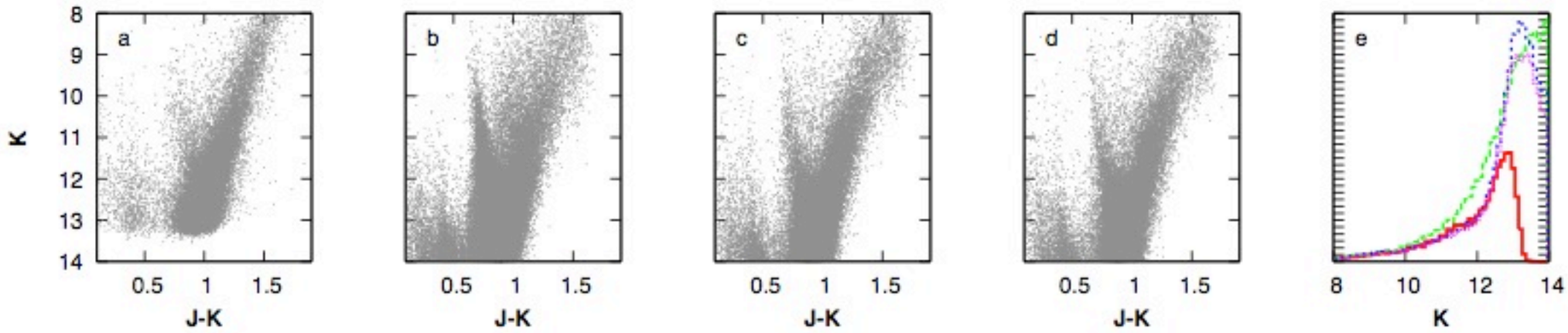



**Fig. 10.** Colour-magnitude diagrams for the 2MASS field at l=+3, b=-3. Same coding as in fig 9.

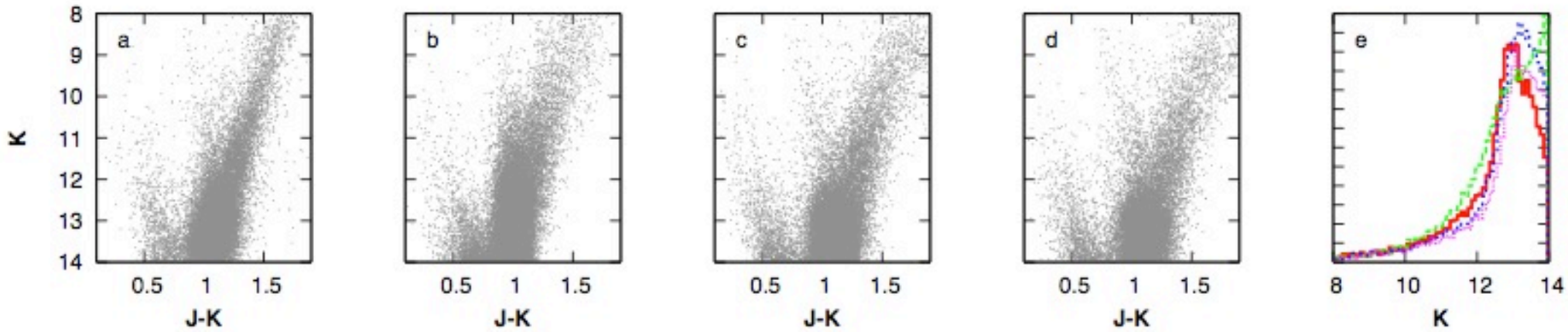
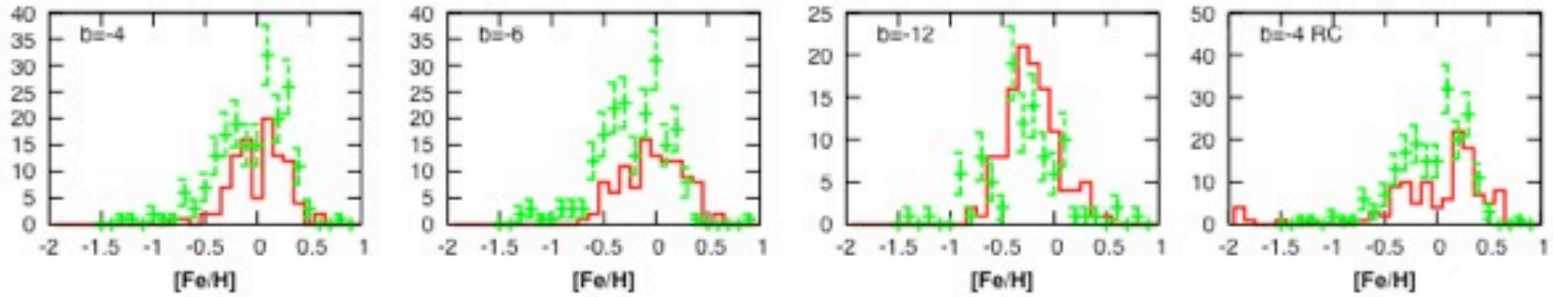
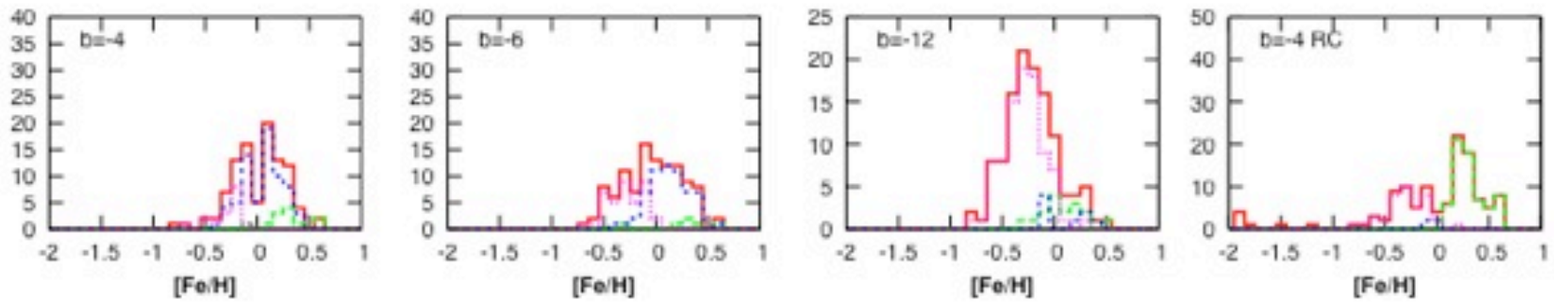



**Fig. 11.** Colour-magnitude diagrams for the 2MASS field at l=5, b=4.5. Same coding as in fig 9.

# MDF

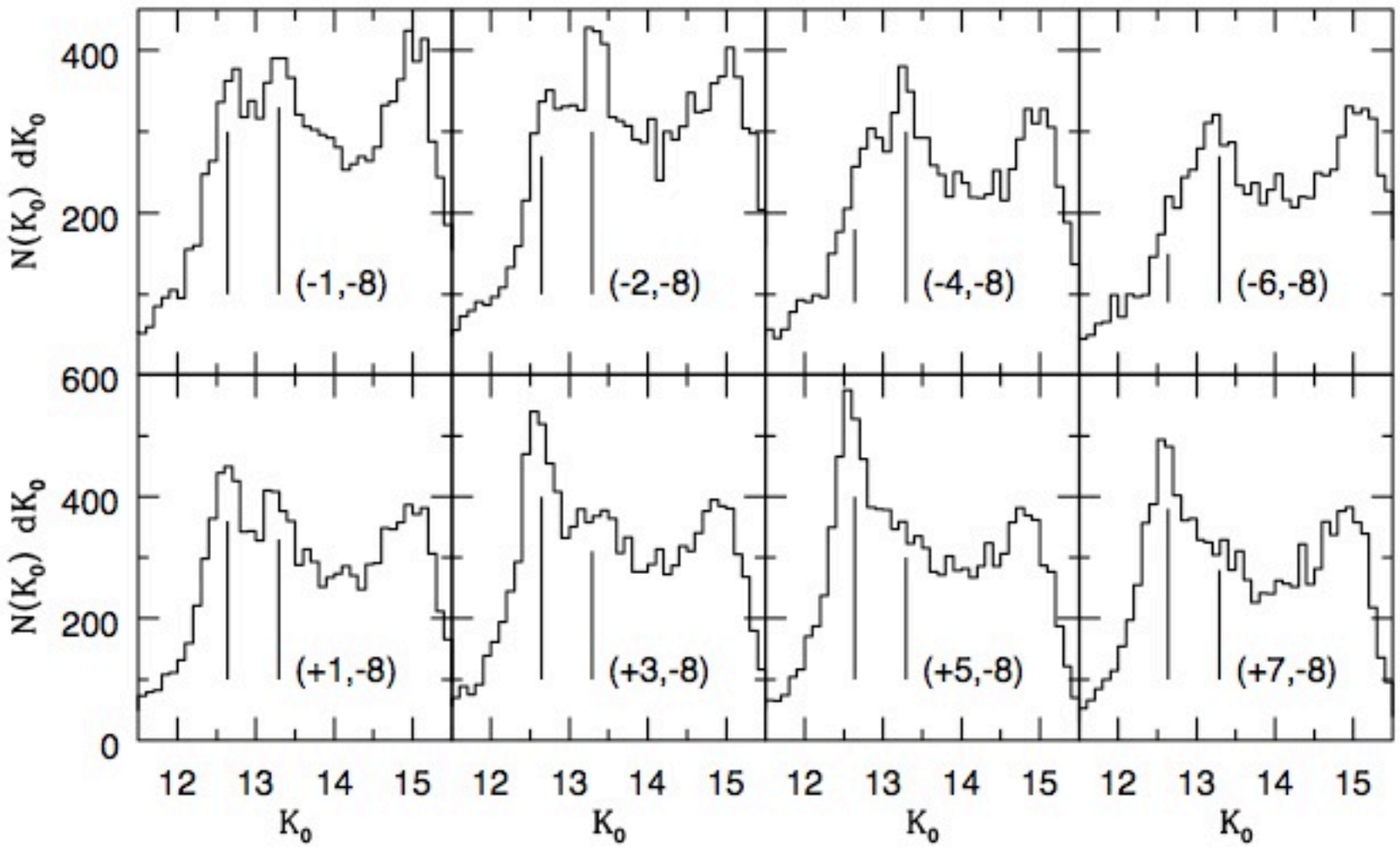



Zoccali et al 2008

- «Thick bulge»
- Bar
- Disc

Two Red Clumps

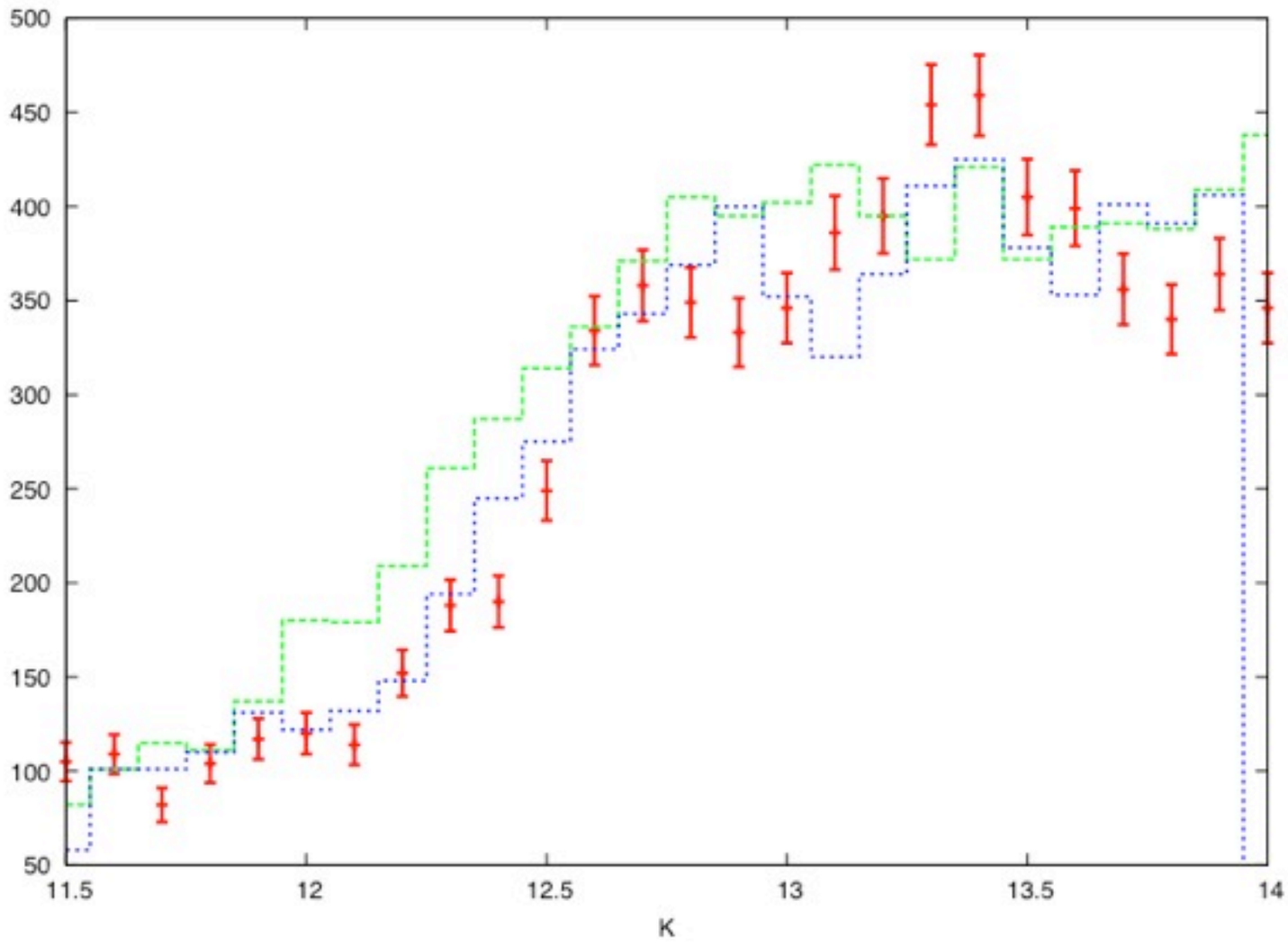



McWilliam & Zoccali (2010)
Nataf et al (2010)
Saito et al (2011)

# Flaring bar !

$$dz = dz0 \times (1 + 0.3 \times sin(x/650.)$$

l=0°, b=-7°




- Data
- Model standard Bar
- Model with flaring bar

Integrated flux in the visible (from UBV colour combination)
and in NIR (from JHK)

Model

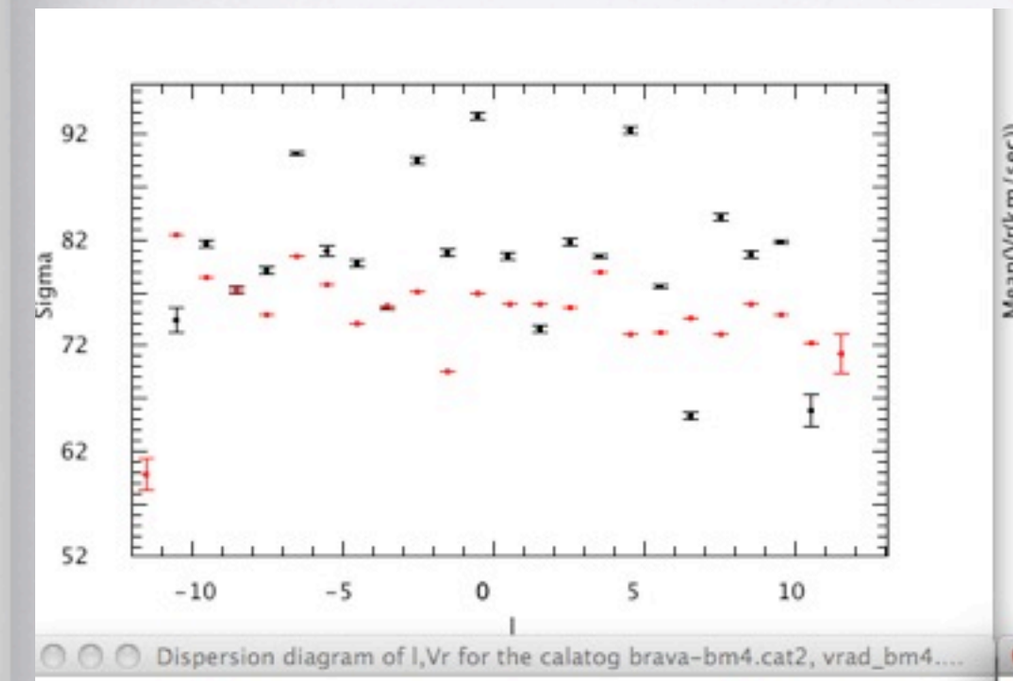
Data

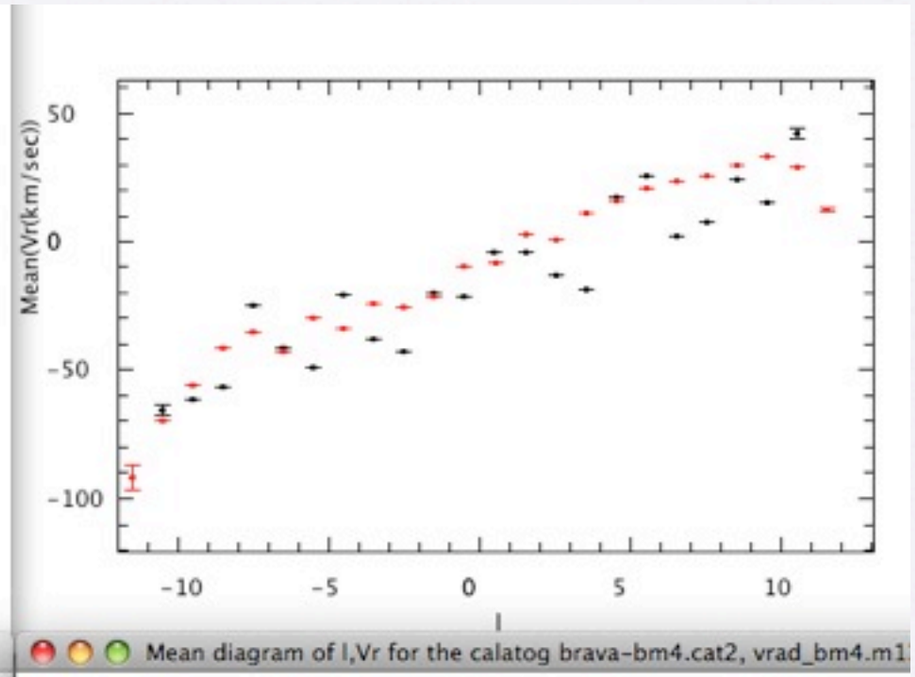
Visible (from A. Mellinger)

NIR (from 2MASS)

# Kinematics

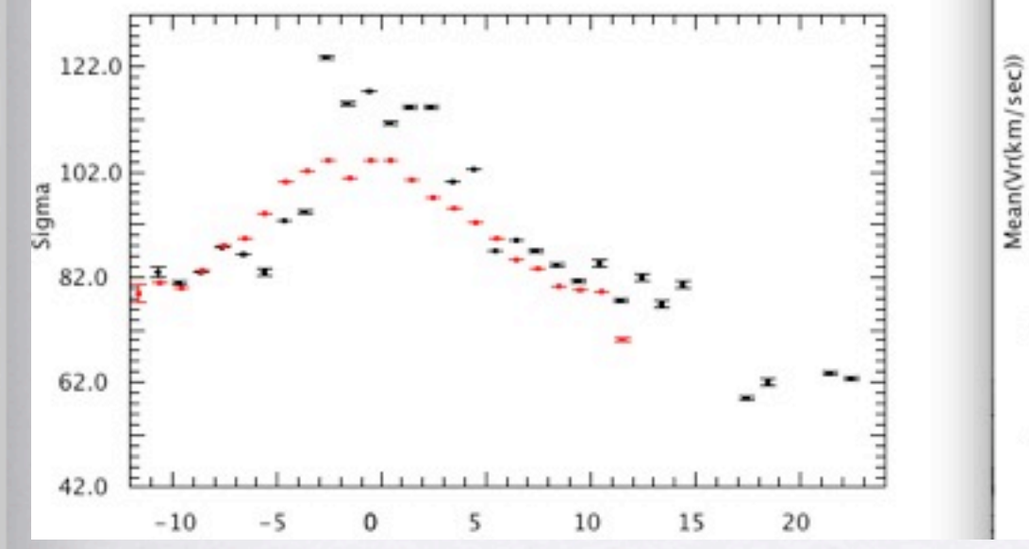
- Brava survey
- Kinematical model :
  - Based on Fux (1999) dynamical model for the bar
  - Several attempts for the «thick bulge» (thick disc, halo ?)

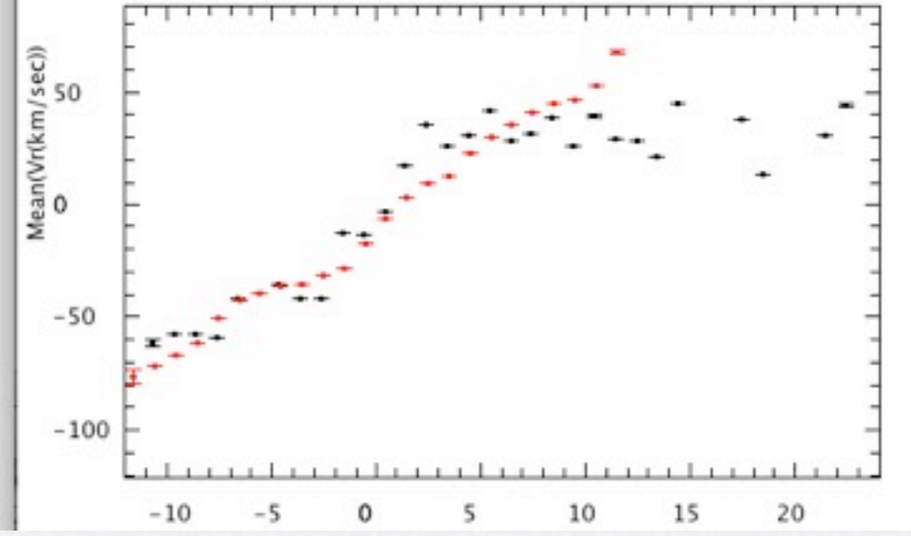


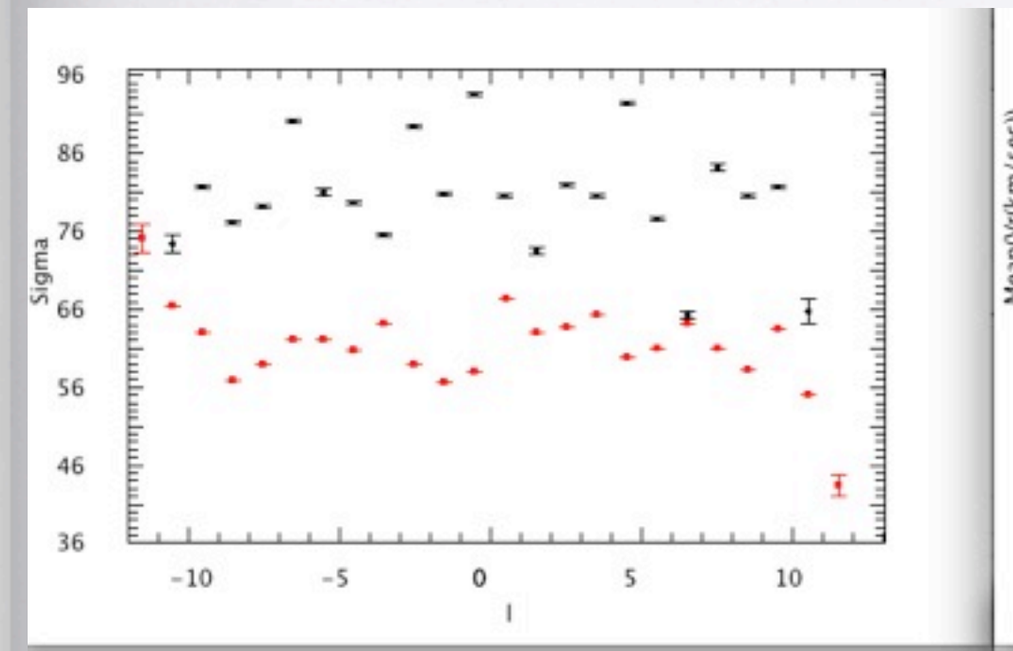

b=-8°

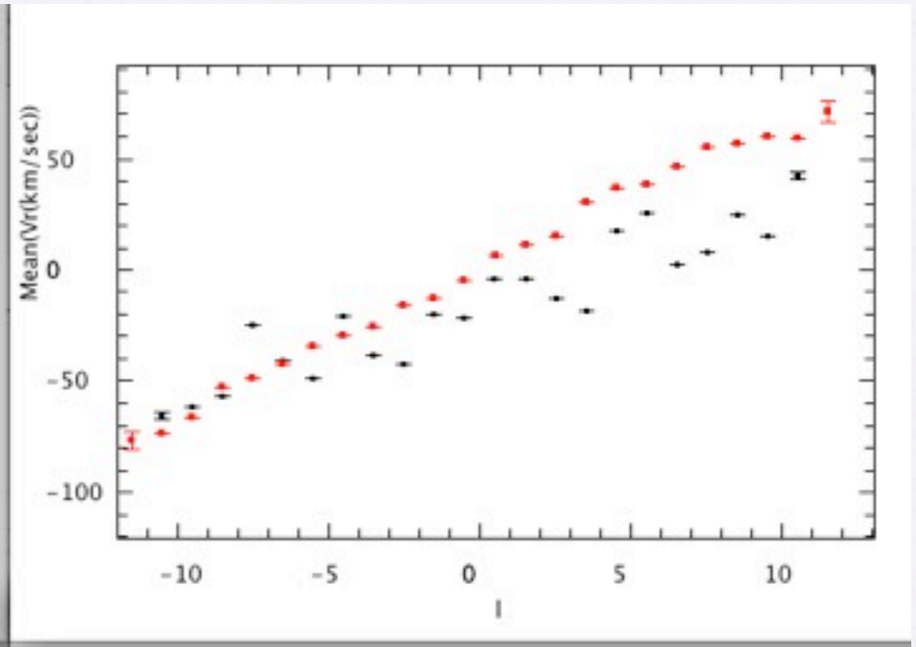
- Data
- Bar : Model Fux+
Bulge : Halo kinem



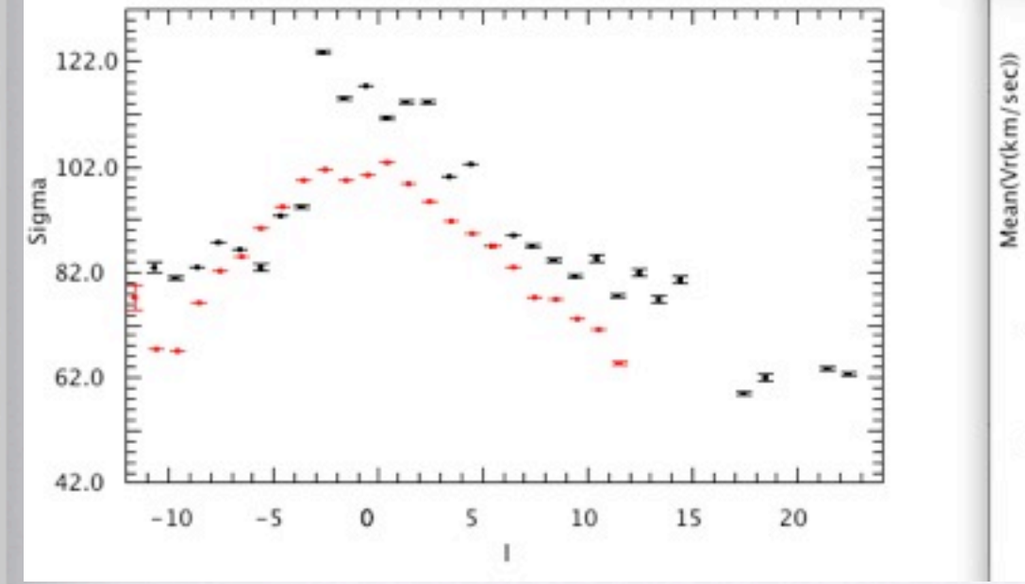

b=-4°

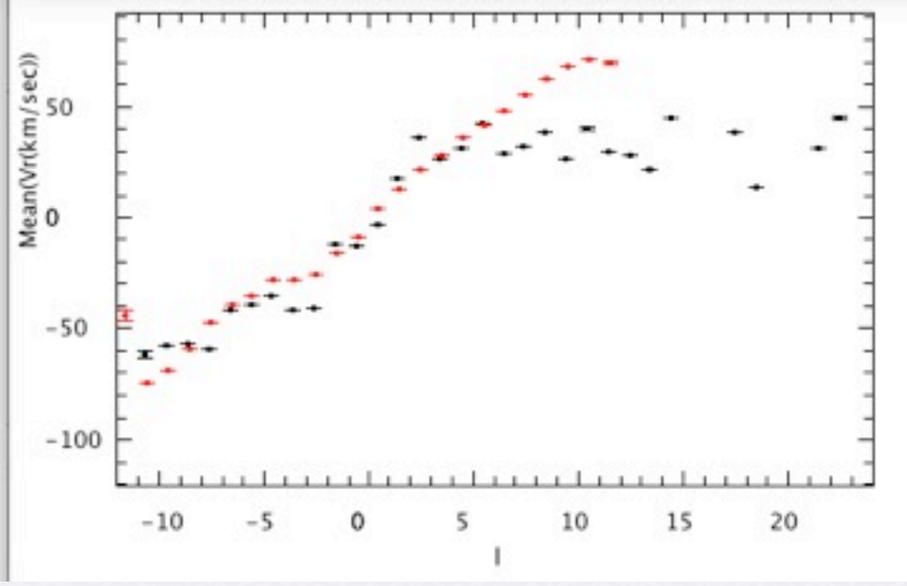



b=-8°

- Data
- Bar: Model Fux+ Bulge: Thick disc kinematics

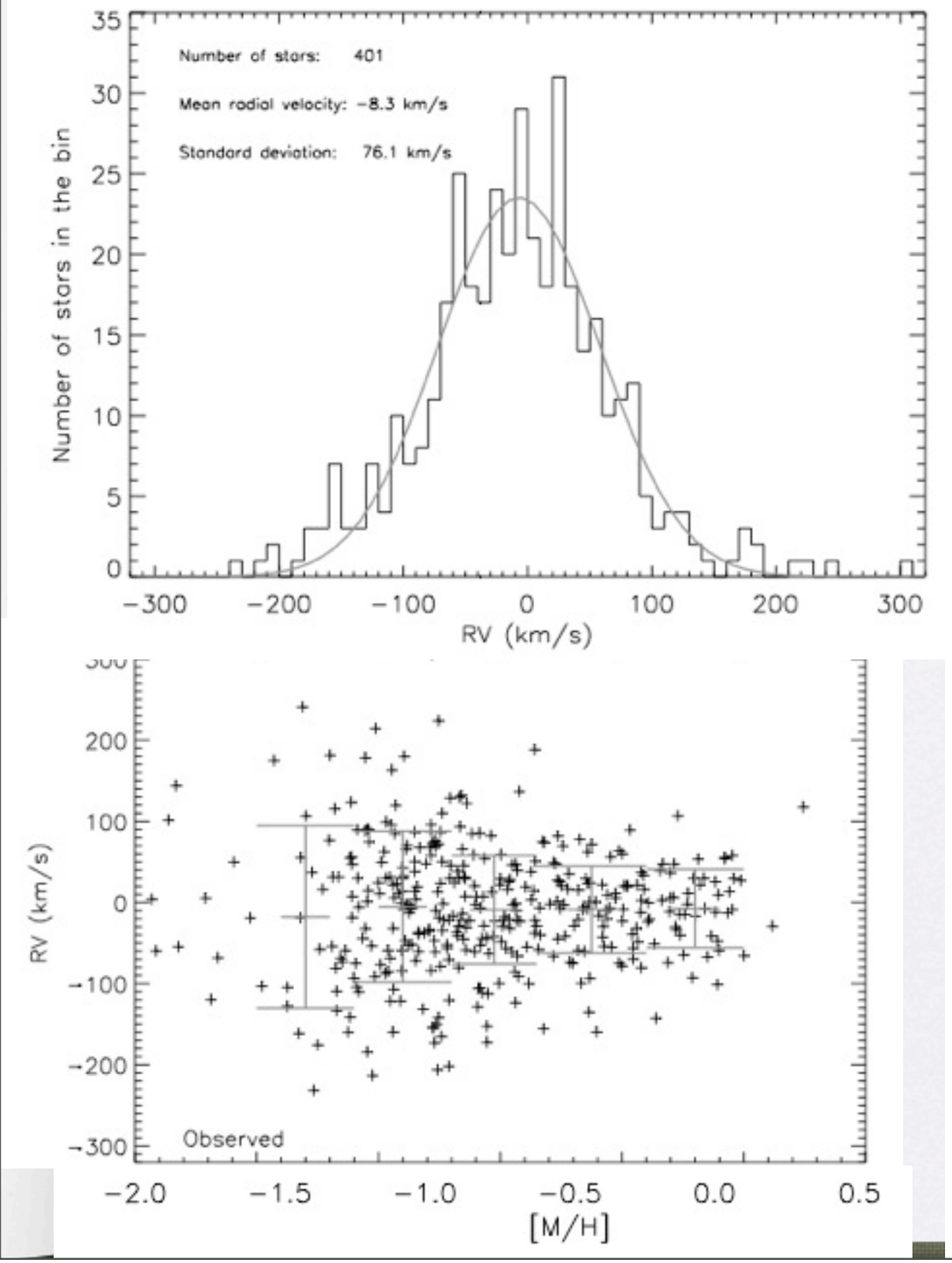


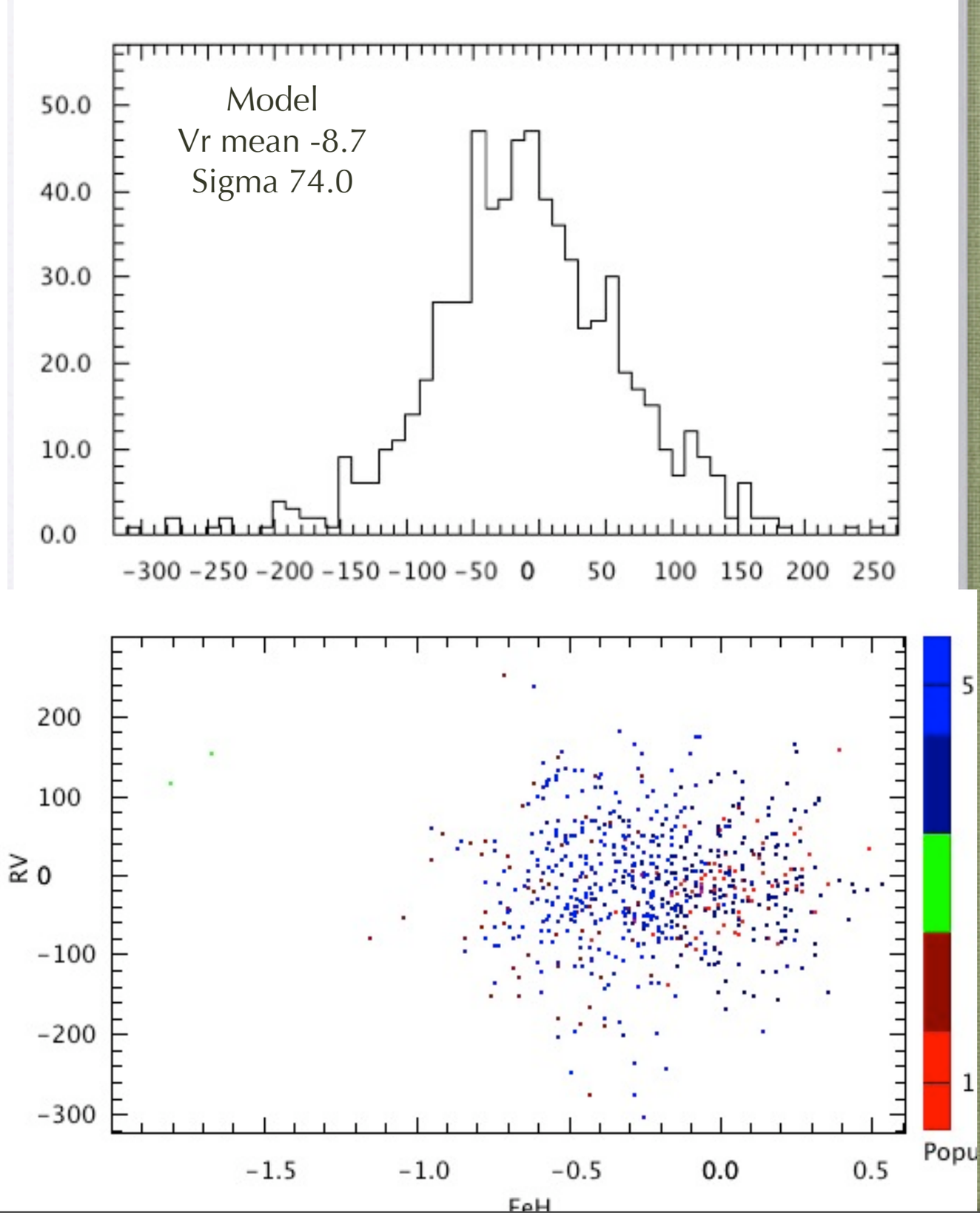




b=-4°

# Metallicity / kinematics

- Exemple : l=0°, b=-10° (Uttenhaler et al, subm.)



# Preliminary conclusions

- The bar has a bar kinematics (as Fux's model) and a near-solar metallicity, and is flaring (thin disc star trapped in resonnances).

- The «thick bulge» is poorer in metals (similar to the thick disc). But has a larger velocity dispersion (like the halo). Scenario : bulge population flattened by the bar potential ? Or inner thick disc ?

- Two few fields with metallicity AND kinematics

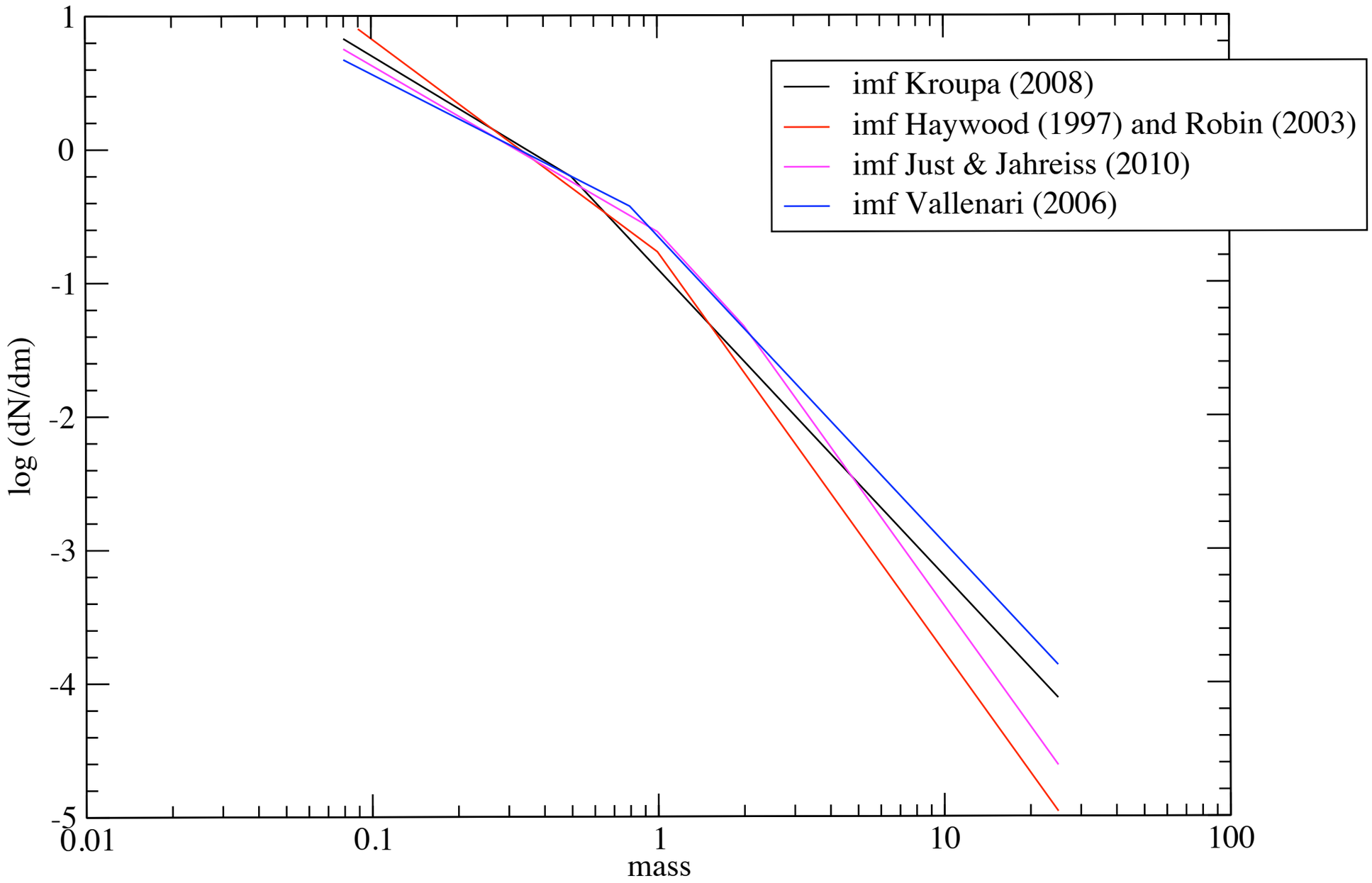
- Waiting for on-going spectroscopic surveys (Gaia-Eso, APOGEE...)

# Thin disc improvements

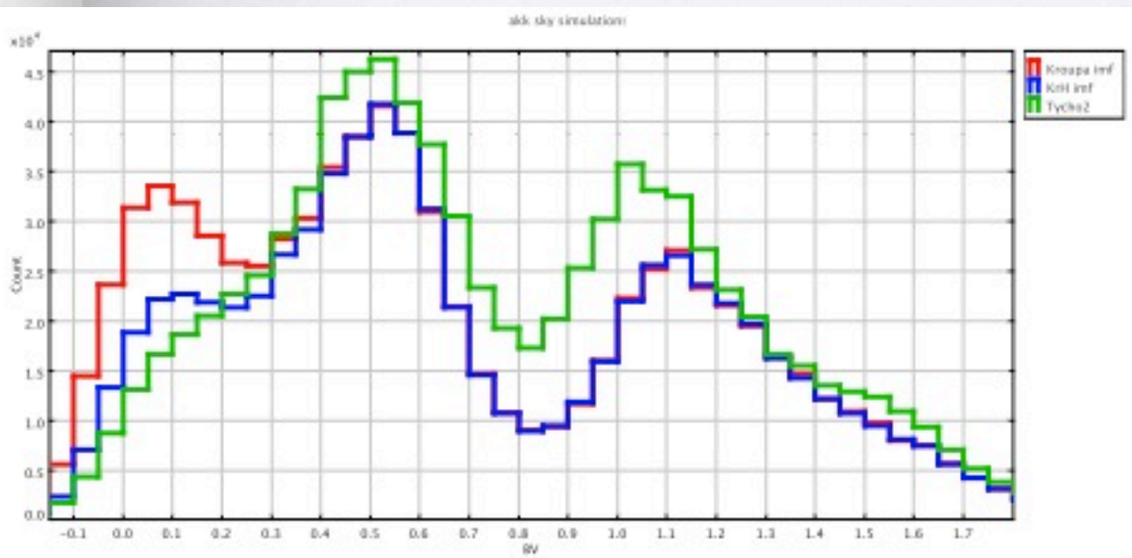
(Maria Czekaj, Francesca Figueras, Xavier Luri)

- Constraints on the local SFR and IMF from Tycho data
- New algorithm for computing simulations (star drawing)
- New tracks (Bertelli et al) and model atmosphere (Basel 3)
- More flexibility in the use of tracks, SFR, IMF, age/$\sigma_W$ relation
- Binarity included

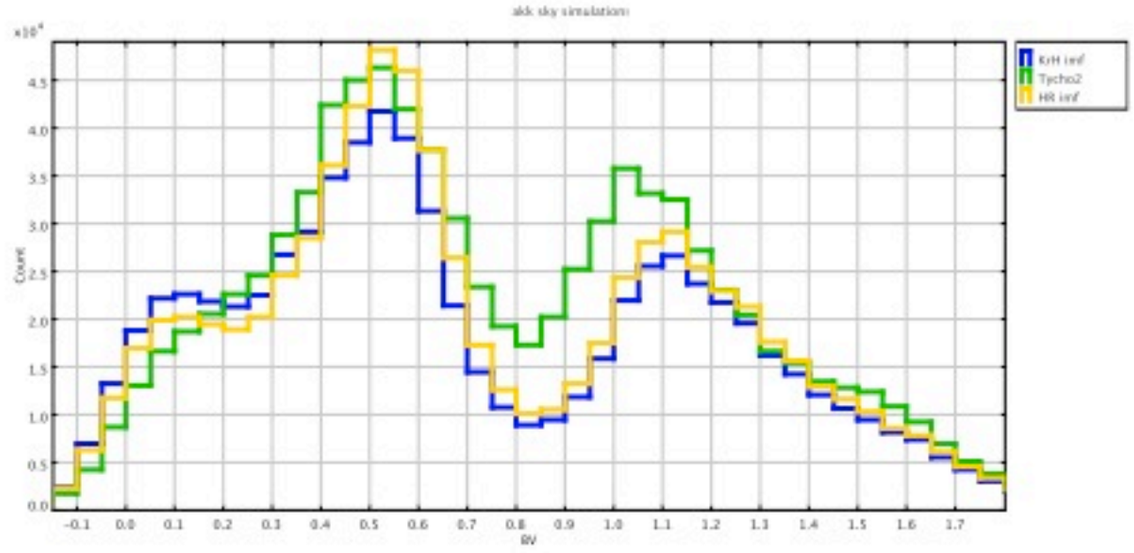
# Four Initial Mass Functions we have tested (11.05.2011)



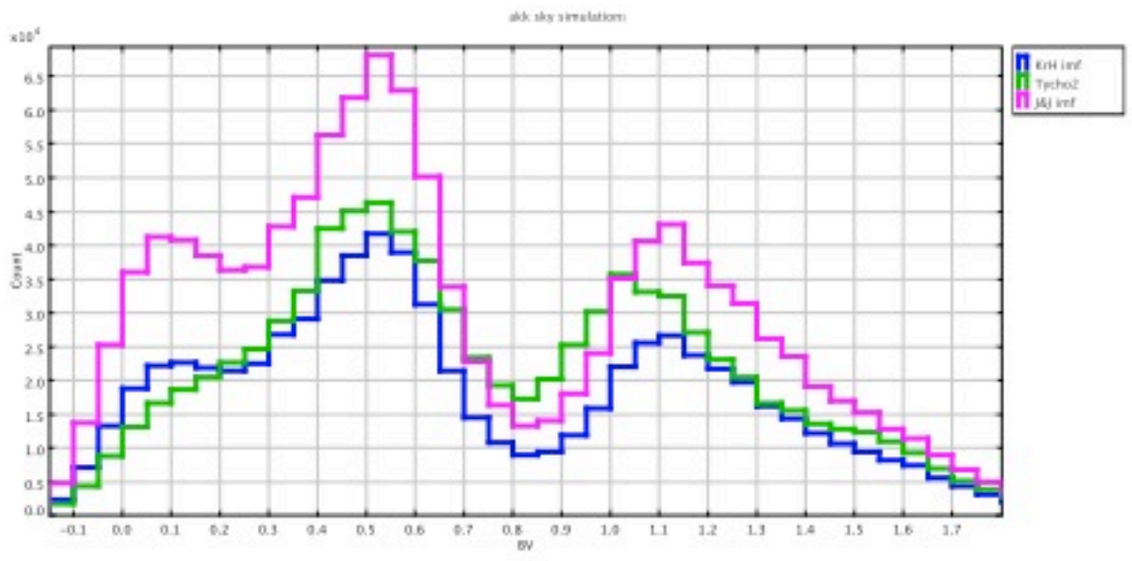
# IMF test



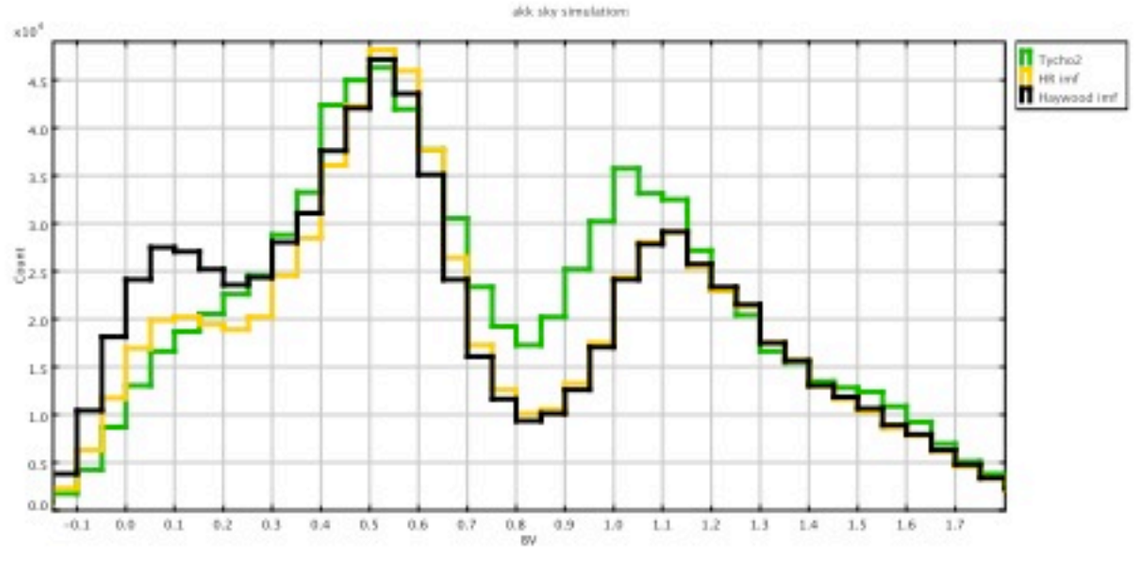

a) KrH IMF, Kroupa 2008 IMF, Tycho2




b) KrH IMF, Haywood-Robin IMF, Tycho2




b) KrH IMF, Just & Jahreiss IMF, Tycho2




c) Haywood 1997 IMF, Haywood-Robin IMF, Tycho2

# On-going

- 3D Extinction map : from Spitzer, VVV, UKIDSs (see Douglas Marshall presentation)

- Thick disc shape / halo shape from SDSS  (with A. Martins)

- Spiral structure : 2Mass data fitting at -5°<b<5°, Amores et al. in prep.

- Micro-lensing: Application to computation of optical depth and light curves towards microlensing events. Kerins et al. Ex: Euclide. (*MaBμLS*=> on line )

- Dynamics: M2M, see Esko Gardner presentation)

# Improving the Gaia Mock catalogue for CU2

- Update stellar population parameters.
- Clusters.

  Uncertain :

- New tracks, IMF and SFR ?
- New 3D extinction map ?
- More backgrounds from HII regions, more PN, ... ? Something else ?

- Or live it as is. Other models => GOG mock catalogS