Star count analysis using the GSC2 Export Catalogue

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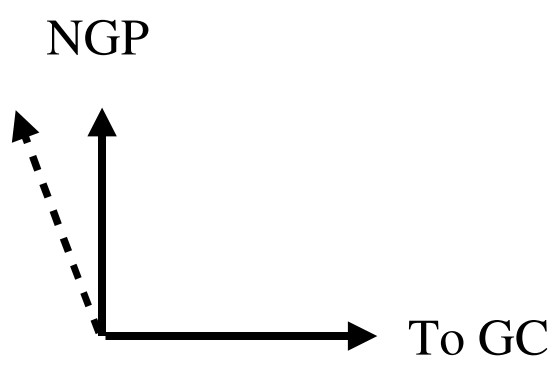
And others at OATo

This is a report of a work in progress, the analysis of data from about 160 fields within 25 degrees of the North and South Galactic Poles, covering nearly 4000 sq. degrees on the sky. Here I will report only on F band data for the north. The methods employed are model independent, though a model is used to check the reliability of the methods and to estimate uncertainties. Most significantly a method is presented to remove plate−to−plate systematic magnitude errors (zero point error).

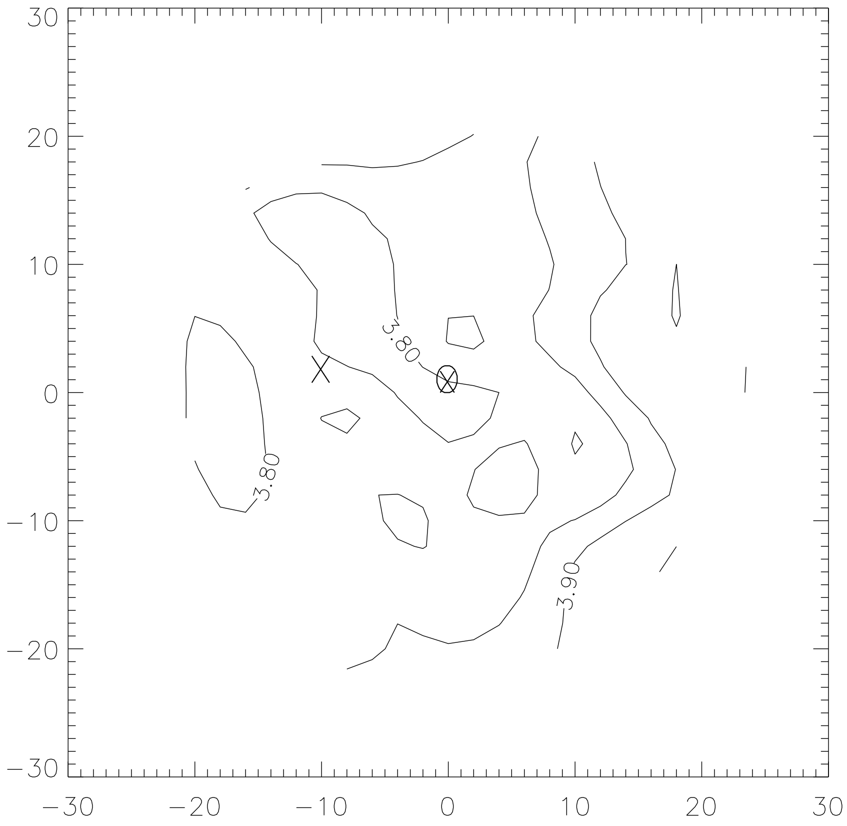
Motivation

- Assess asymmetry due to a local tilt in disk
  - Galactic warp starting inside Solar Circle
  - Global tilt
  - Mis–aligned Galactic coordinates
- Estimate the ratio of the disk scale height and length



$$\tan(b_m) = h_R / h_z$$

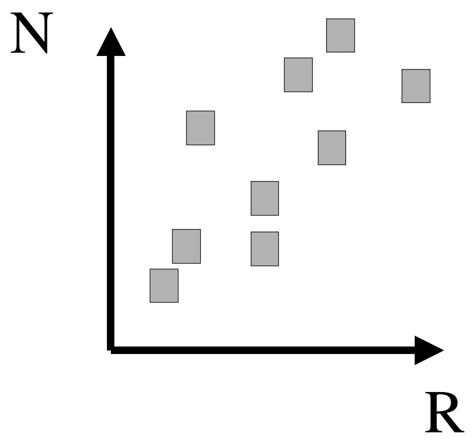
Isocounts toward the North Galactic Pole

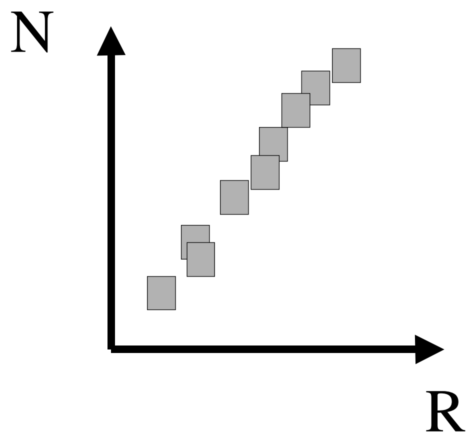


To GC

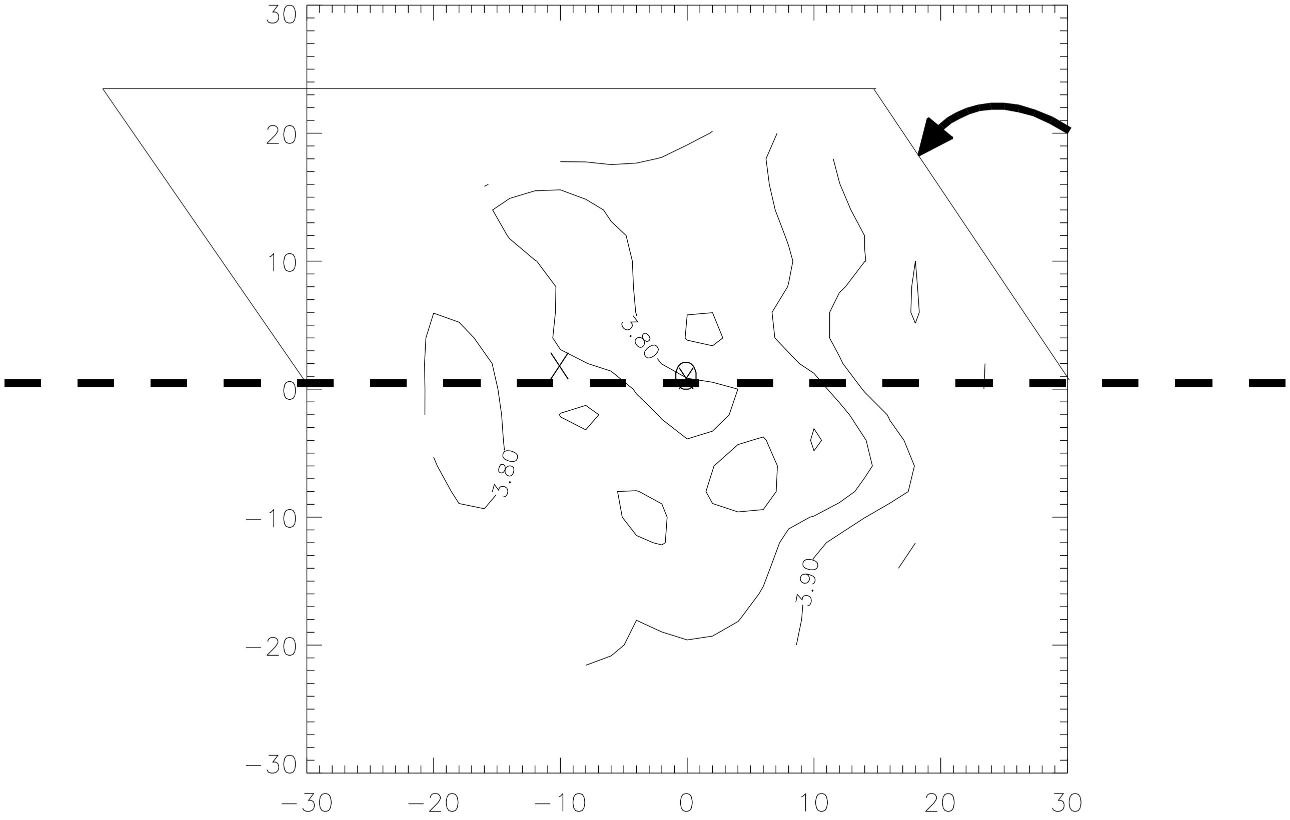
Method to find center

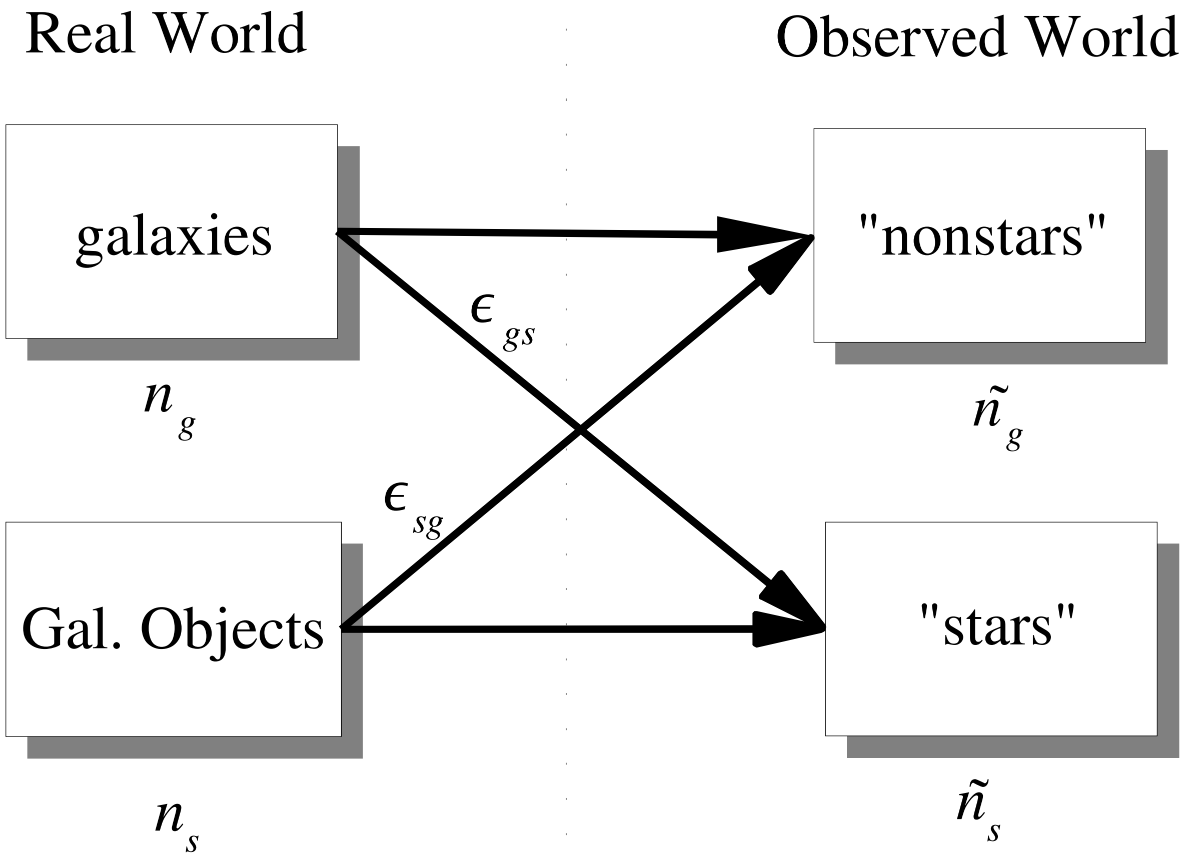
- Assume that counts increase monatonically with distance from the "center".
- Minimize two–sided significance of the rank correlation between the counts and the distance





Finding the symmetry plane

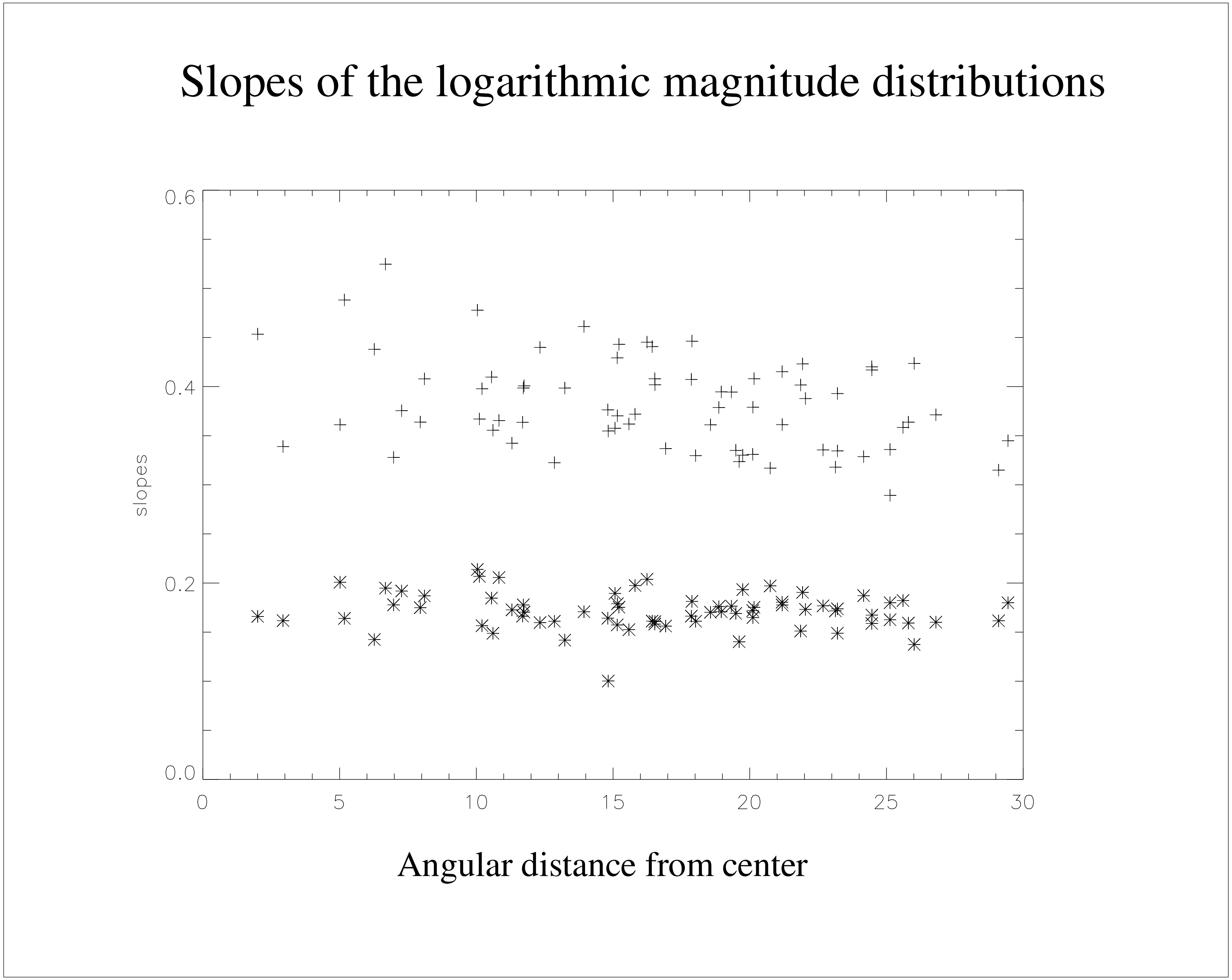




$$\tilde{n}_g = n_g(1-\epsilon_{gs}) + n_s\epsilon_{sg}$$

$$\tilde{n}_s = n_s(1-\epsilon_{sg}) + n_g\epsilon_{gs}$$

$$n_s + n_g = \tilde{n}_s + \tilde{n}_g$$



Slopes of the logarithmic magnitude distributions
0.6
0.4
0.2
0.0
slopes
0
5
10
15
20
25
30
Angular distance from center

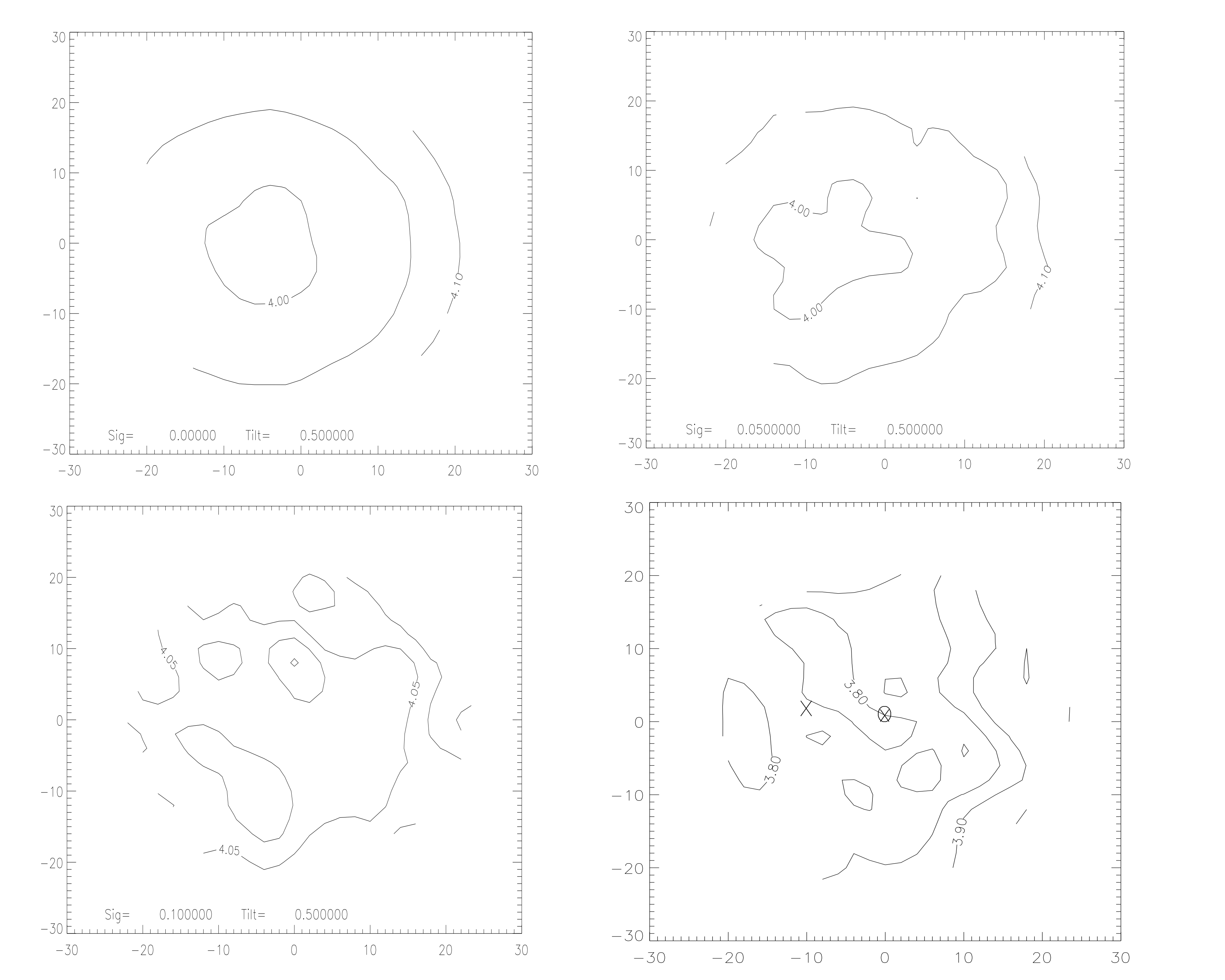
Star count model

Ingredients:

- Position of minimum
- Variation of cumulative counts on the sky
- Assumed magnitude distributions for "stars" and "nonstars"
- Random plate–to–plate magnitude systematics
- Assumed model for $\epsilon_{gs}(m)$ & $\epsilon_{sg}(m)$

Purpose:

- Check analysis methods
- Estimate errors
- **NOT** for modeling data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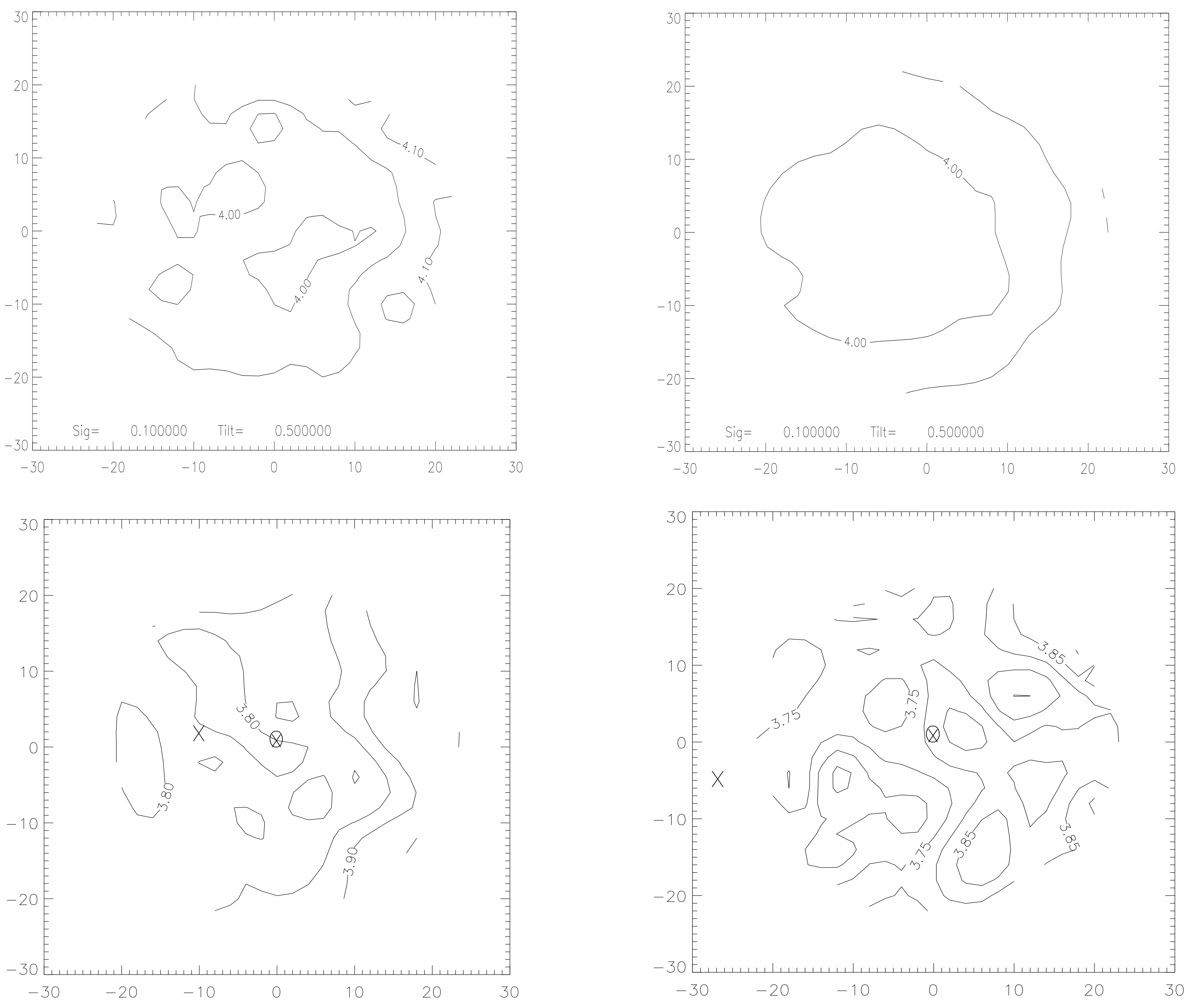
4.00
4.10
Sig= 0.0500000 Tilt= 0.500000
4.00
4.00
4.10
Sig= 0.100000 Tilt= 0.500000
4.05
4.05
4.05
3.80
3.80
3.90

Removing systematic offsets

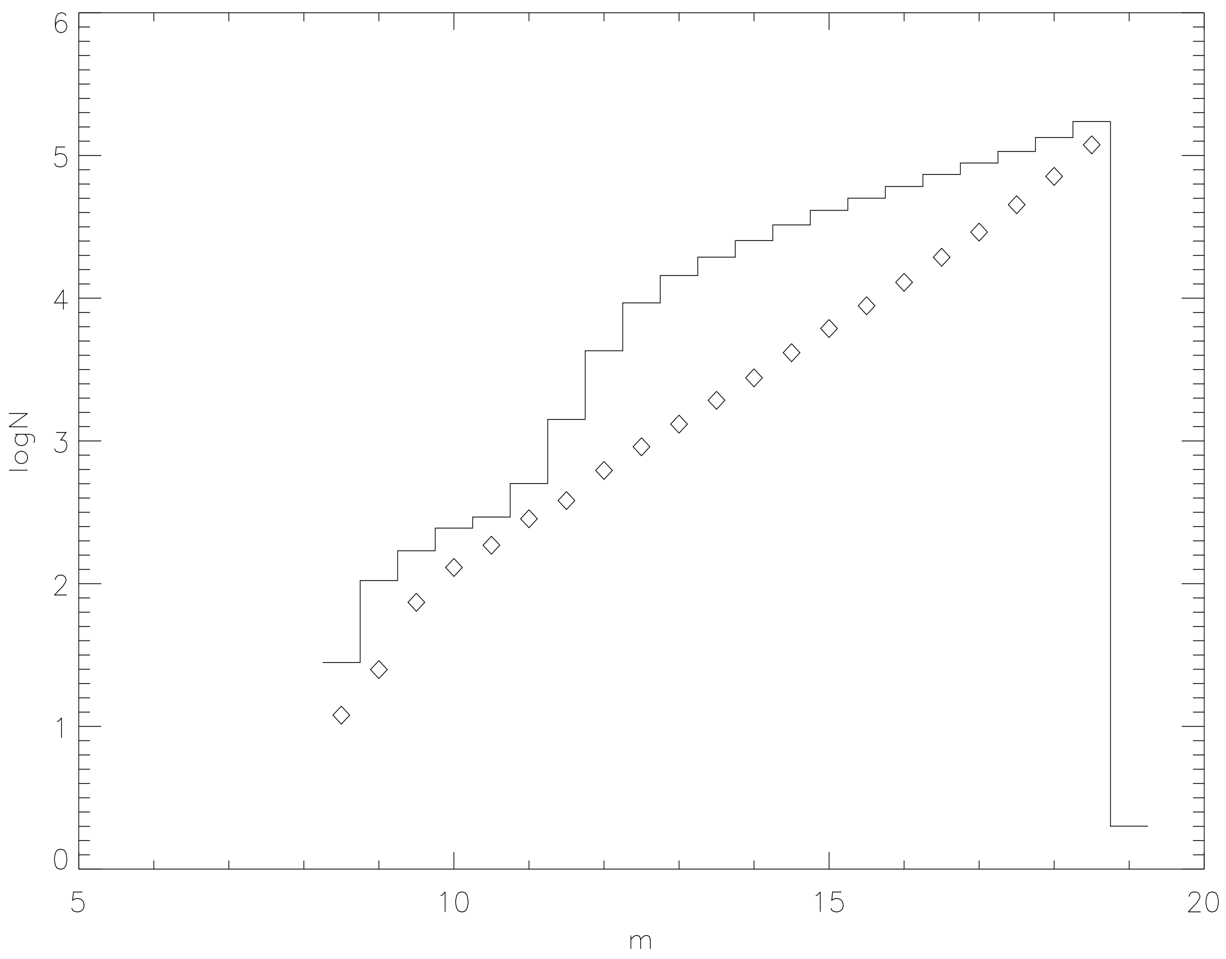
- Assume galaxies are isotropic on the sky.
- Assume ϵ_{sg} & ϵ_{gs} are isotropic.
- Adopt model for $\epsilon_{sg}(m)$.
- Adopt one plate as "standard".

$$\Delta \tilde{n}_g - \frac{\epsilon_{sg}}{(1-\epsilon_{sg})} \Delta \tilde{n}_s = 0$$



Sig= 0.100000 Tilt= 0.500000
4.10
4.00
Sig= 0.100000 Tilt= 0.500000
4.00
3.80
3.90
3.75
3.85

Magnitude distribution: Stars and Nonstars



Fields discarded

Fields	Comment
<u>XP219</u>	double entries due to bad astrometry
XP218, XP220	contaminated by XP219
<u>XP377</u>	too many objects (bad phot. calibration?)
XP378	contaminated by XP377
<u>XP445, XP383</u>	phot. Sigma > 0.2 (bad external sequence)
<u>XP504</u>	faintest calibrator brighter than 16.5 (bad calibration?)
XP384	GSPC1 only
XP579	bright star in field
XP791	anomalous nonstar mag distribution (?)

Future

- Need to "correct" nonstar magnitudes
- Finish QA (GSPC2 present? Etc.)
- Extend analysis to J
- Look at SGP data
- Deduce $\epsilon_{sg}(m)$ using assumed n_g and estimated ϵ_{gs}.
- Find better estimates of systematic offsets.

Conclusions

- Need for a plate catalogue for QA.
- Systematics in the photometry can be removed to at the level of 0.03 magnitudes, but the nonstars and "stars" need to be on same photometric system.
- Homogeneity is important for science
  - GSPC2 is critical (no external sequences!)
  - Global recalibration of photomety is needed