Tracing the Perseus Spiral arm

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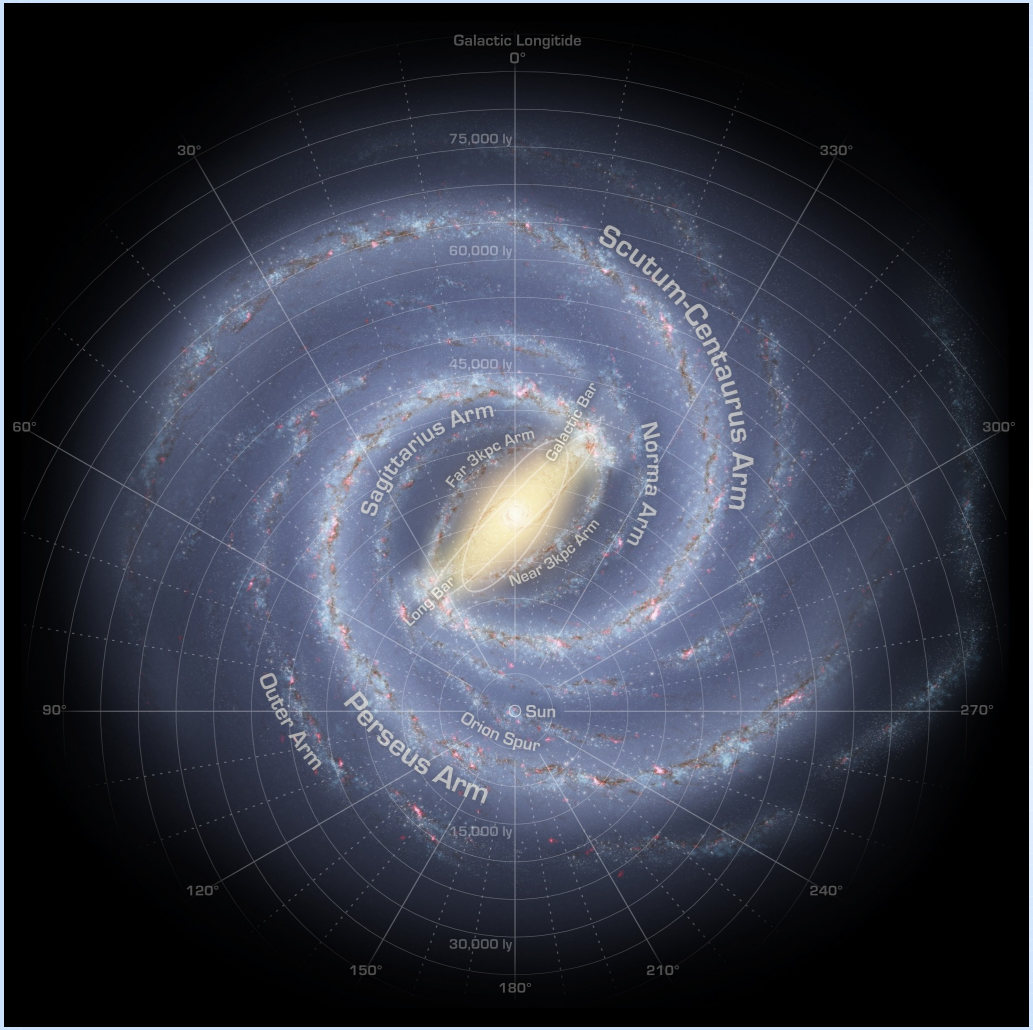
REG-Sitges, January 23, 2013



- Photometric survey to trace star density
- Spectroscopic survey to trace kinematic perturbation

- **Photometric Survey**:
  - **To trace the stellar overdensity**
  - Observing runs 2009A-2010AB-2011A
  - INT telescope – WFC
  - Stromgren photometry (uvbyHβ)
  - To obtain distances and physical parameters
- **Spectral survey**
  - To trace kinematic perturbation (5-15km/s?)
  - Observing run 2010B, 2011B, 2012B
  - 4.2m WHT telescope AF2-WYFFOS multifiber instrument
  - Radial velocities

- Spectral range selection: B5-A3
  - Low velocity dispersion
  - Good spiral arm tracers
- Why Strömgren?
  - Accurate distance (10-20%)
  - Accurate reddening (clumpy ISM)
  - Age and other physical parameters
- Why in the anticenter?
  - Radial Velocity directly trace the radial spiral wave perturbation
  - Avoiding galactic rotation
- To discriminate between models
  - Density wave, Manifolds, ...

Photometric survey

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Strömgren photometric survey in the Galactic anticenter direction ⋆,⋆⋆

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ABSTRACT

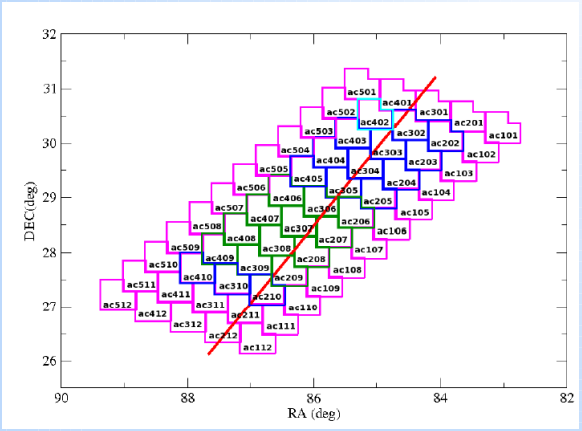
Aims. The main purpose is to map the radial variation of the stellar space density for the young stellar population in the Galactic anticenter direction in order to understand the structure and location of the Perseus spiral arm.

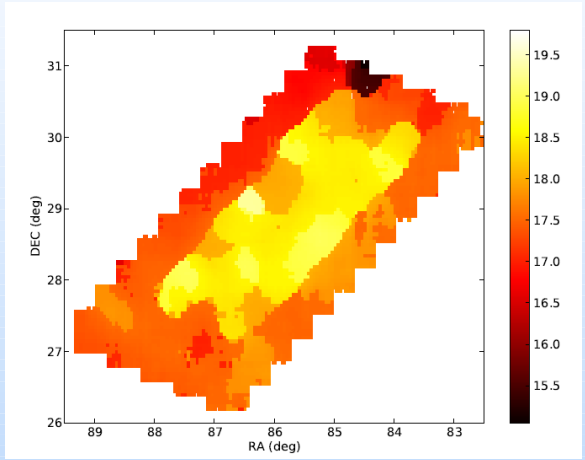
Catalog available trough CDS.

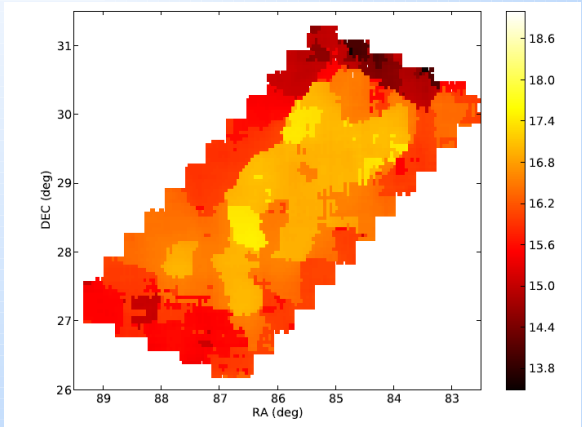
Photometric survey

- uvbyHβ Stromgren photometry
- 96980 stars
- 35974 stars with complete data.
- 16 square degrees
  - Central 8 sqd. V~17
  - External 8 sqd. V~15.5

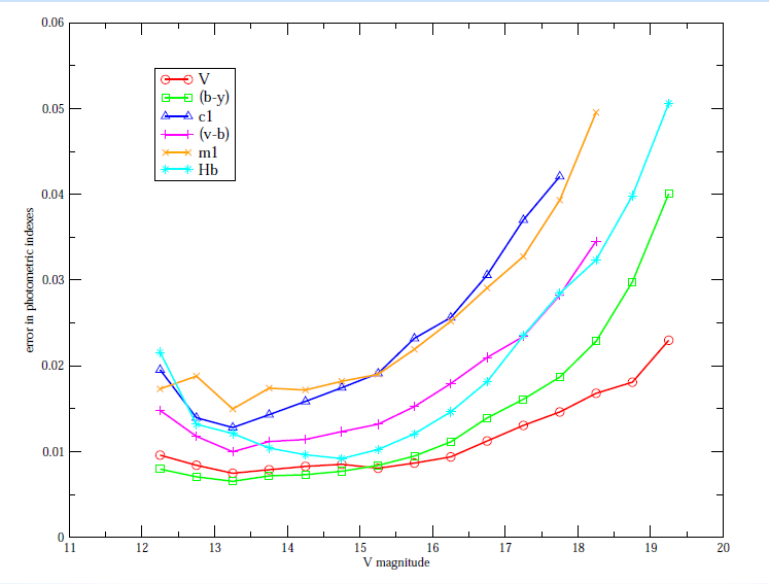
♯ stars	V	$(b-y)$	c_1	$(v-b)$	m_1	$H\beta$	flagIA
1725	-	-	-	-	-	×	000001
13259	×	×	-	-	-	-	110000
624	×	×	-	×	×	-	110110
22632	×	×	-	×	×	×	110111
22616	×	×	-	-	-	×	110001
150	×	×	×	×	×	-	111110
35974	×	×	×	×	×	×	111111
96980	95255	95255	36124	59380	59380	82947	

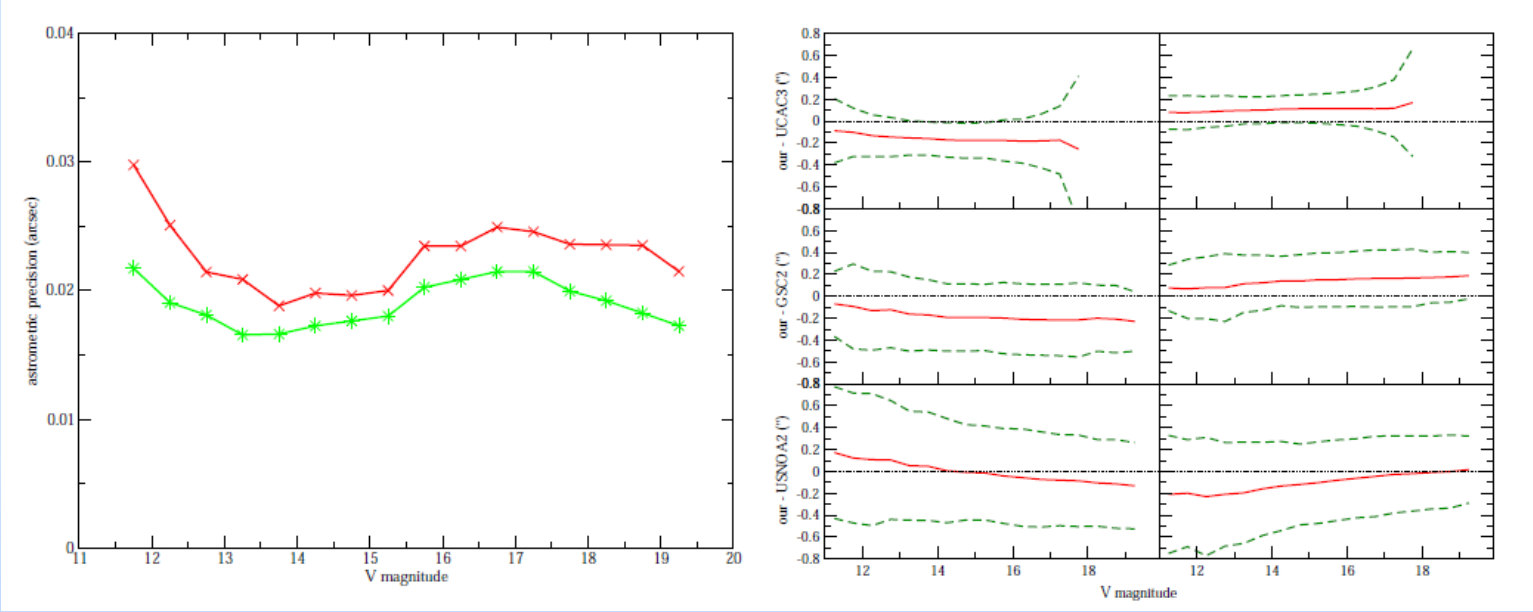






Accuracy


V
(b-y)
c1
(v-b)
m1
Hb
error in photometric indexes
V magnitude


astrometric precision (arcsec)
V magnitude
our - UCAC3 (")
our - GSC2 (")
our - USNO A2 (")
V magnitude

Current steps: Physical parameters and distances

- **Old approach**: Empirical calibrations (pre-HPC. Crawford78,79, etc.)
- **New approach**: Atmospheric models + evolutionary tracks
  - Ingredients:
    - ATLAS9 model atmospheres with synthetic colors (Castelli et al 2006, Smalley 1995, 1997)
    - Evolutionary tracks (Bressan1993, Bertelli 2008)
  - Strategy:
    - fit in a 3D space ([m1], [c1], Hb): maximizing probability taking into accoun the ellipsoidal error
    - Interpolation on solar metallicity evolutionary tracks
    - Errors computed through MC simulation.

Advantages:

-No need for preliminary classification (no discontinuities)

-Easy to evaluate metallicity effects

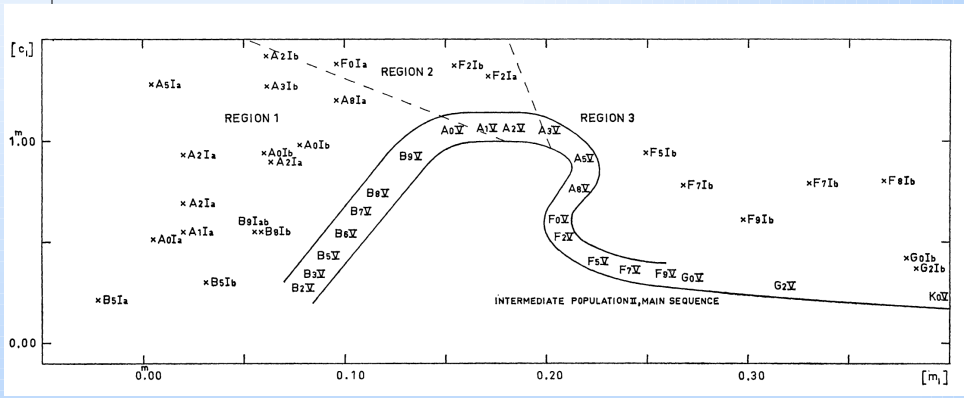
-Realistic error assignment

-The process provides both Av and Mv (no need for different calibration)

Drawbacks

-Systematic trends in model atmospheres.

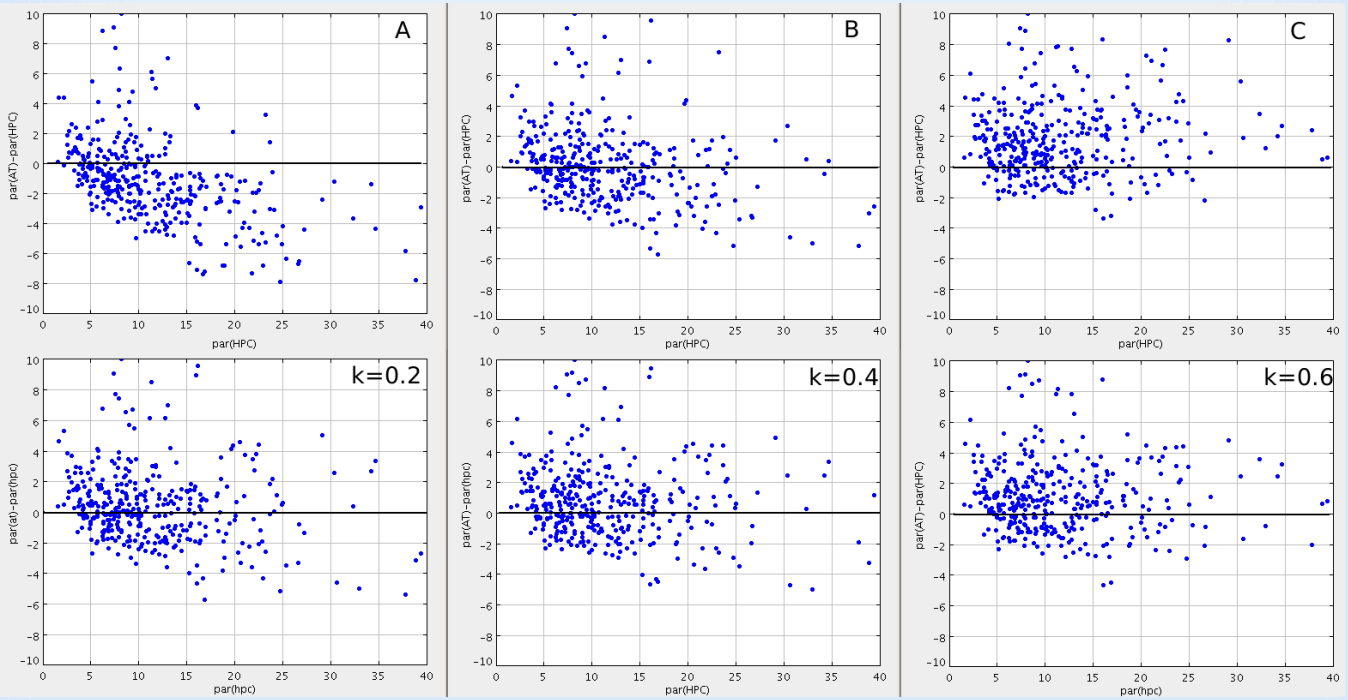
-Discriminant analysis between regions 1 and 3 (gap in the [m1]-[c1] plot)



Test: Hipparcos stars

Nearby stars.
No extinction

- Comparing atmospheric models

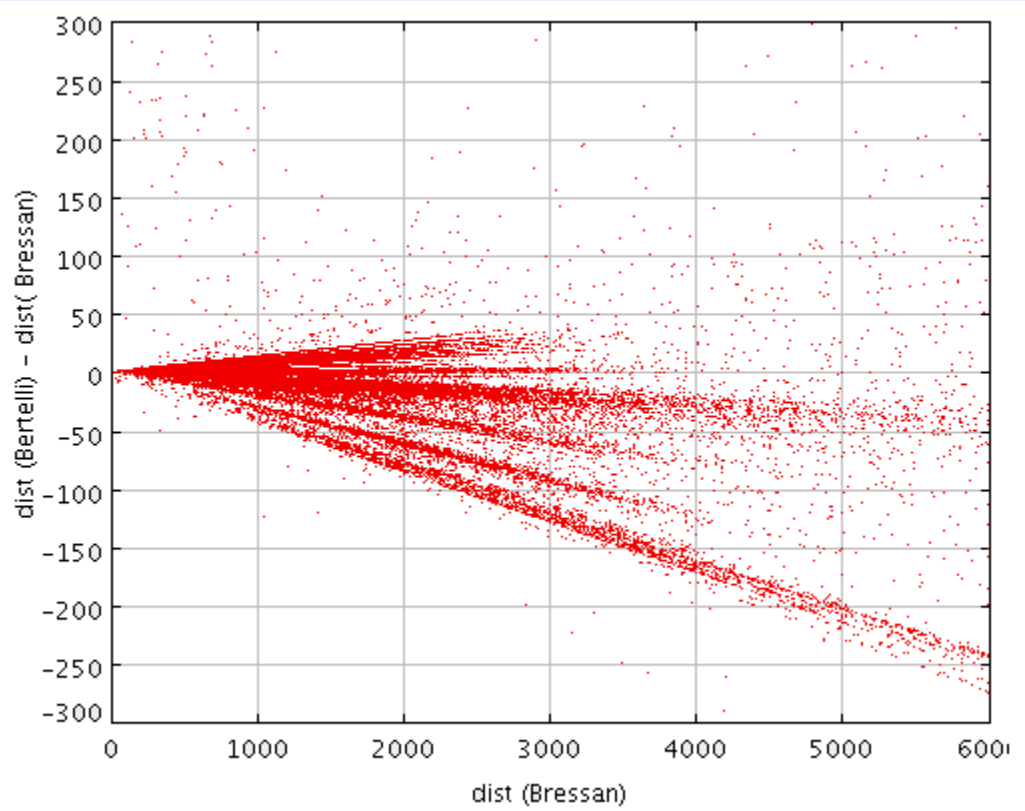


A: Castelli2006
B: Castelli 2006 + Smalley 1997 (uvby, region 3)
C: Castelli 2006 + Smalley 1997 (uvby, r3) + Smalley 1995 (Hb r3)

Test: evolutionary tracks

- Bressan 1993 vs Bertelli 2008

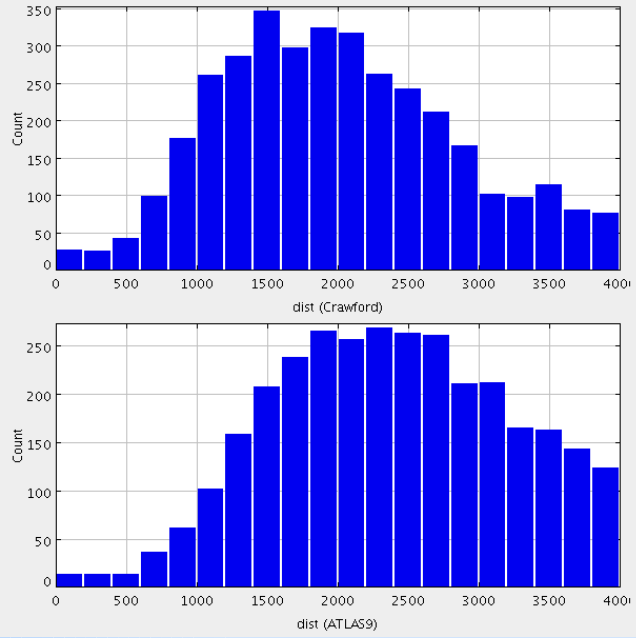
Solar metallicity

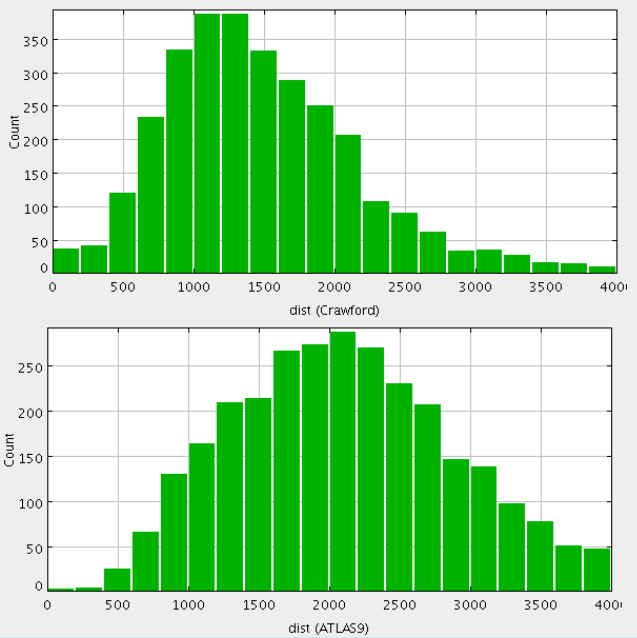


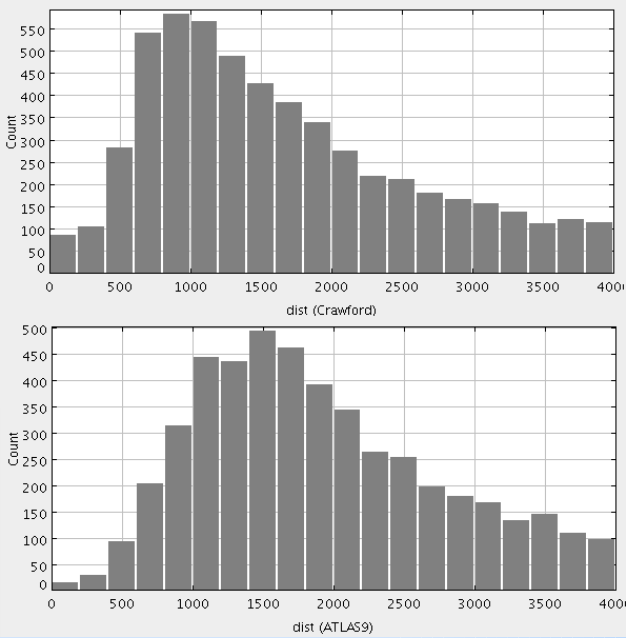
Differences in distance estimations

Empirical calibrations vs model atmospheres

B0-B9 A0-A3 A4-A9



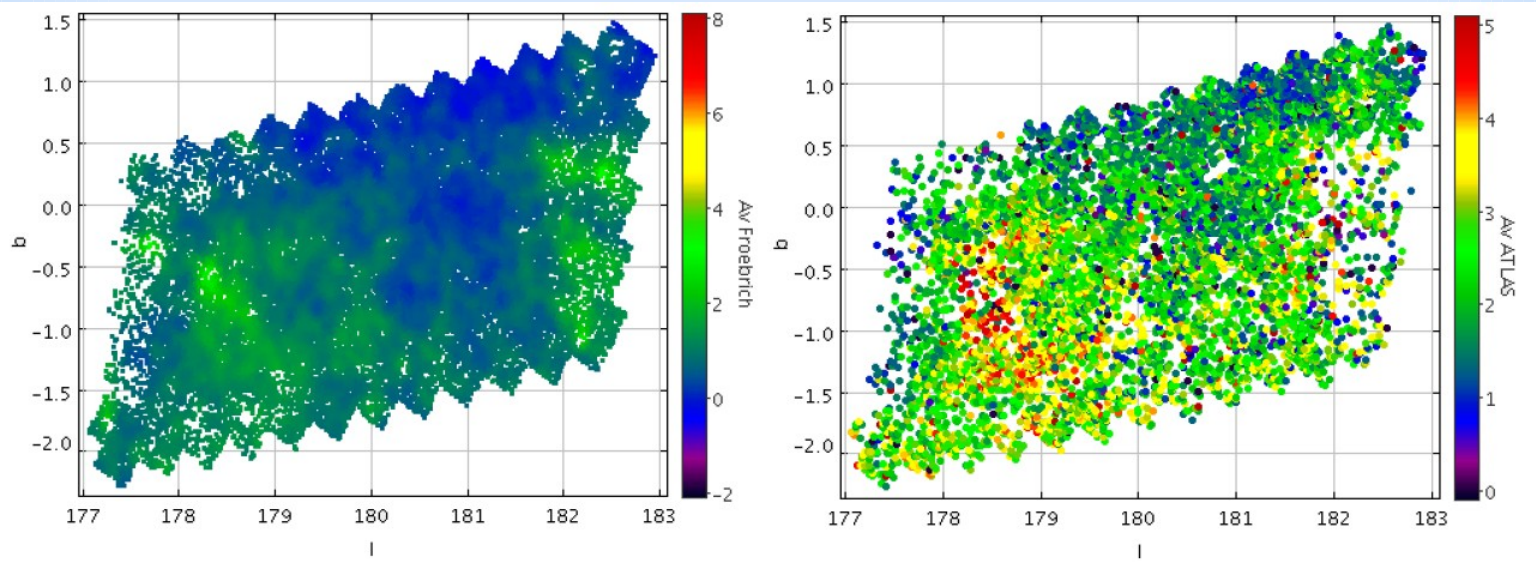


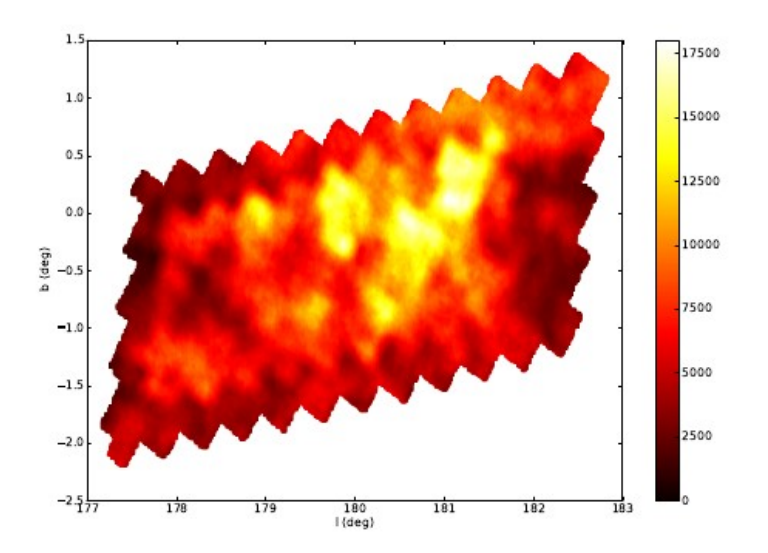


Comparing with extinction maps

Froebrich et al 2007

ATLAS Av B0-A3

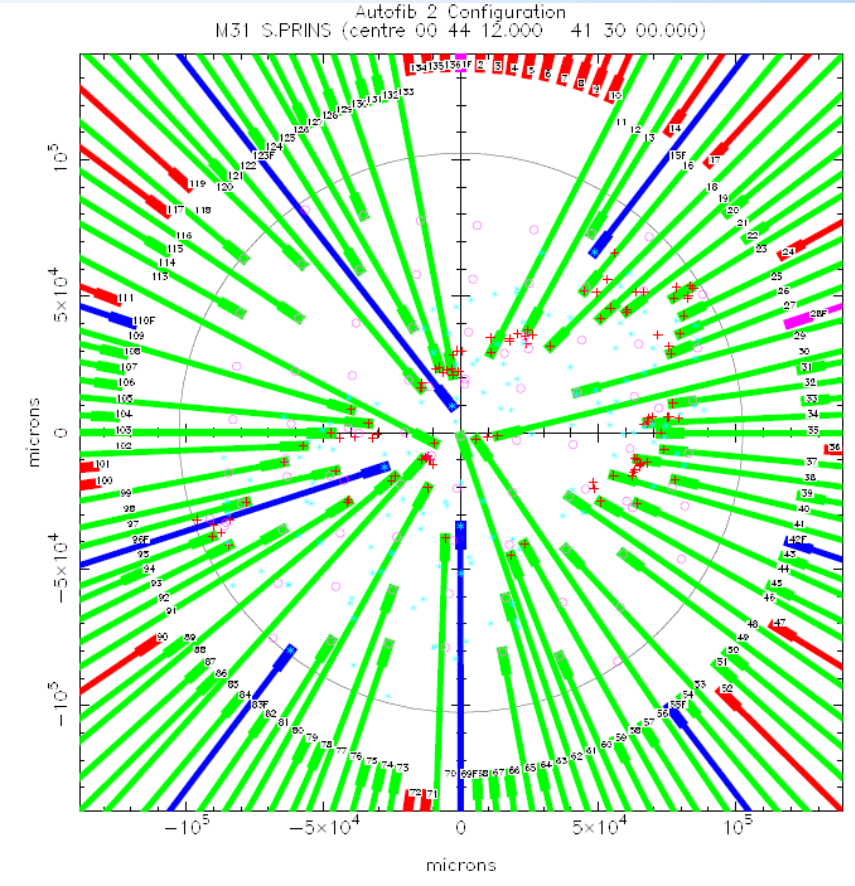




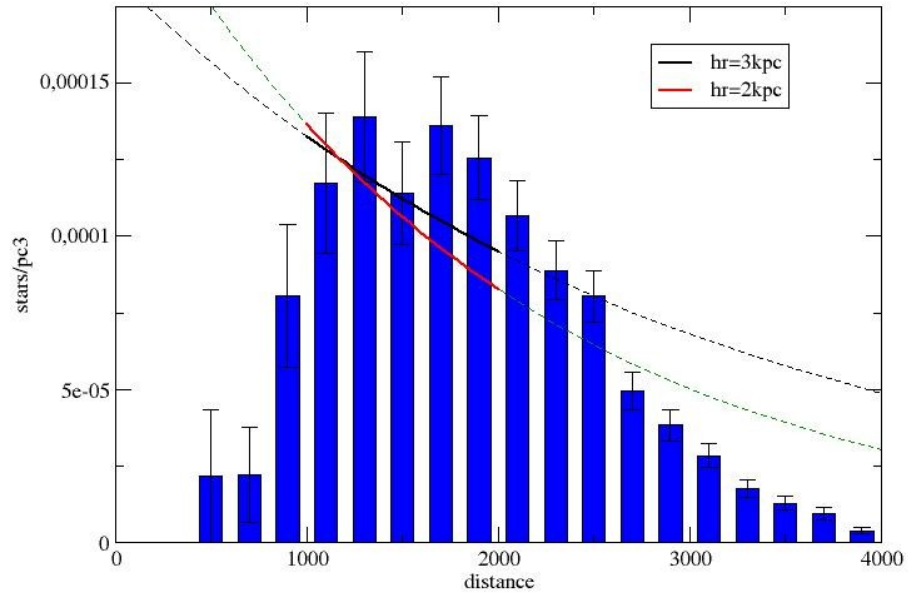
Surface density in our survey

Spectral survey

- WYFFOS observations:
  - ~50-60 spectra each pointing (12 fields)
  - Two epochs
  - Data being reduced.
  - Lim mag?
  - Accuracy in RV?



Gracias!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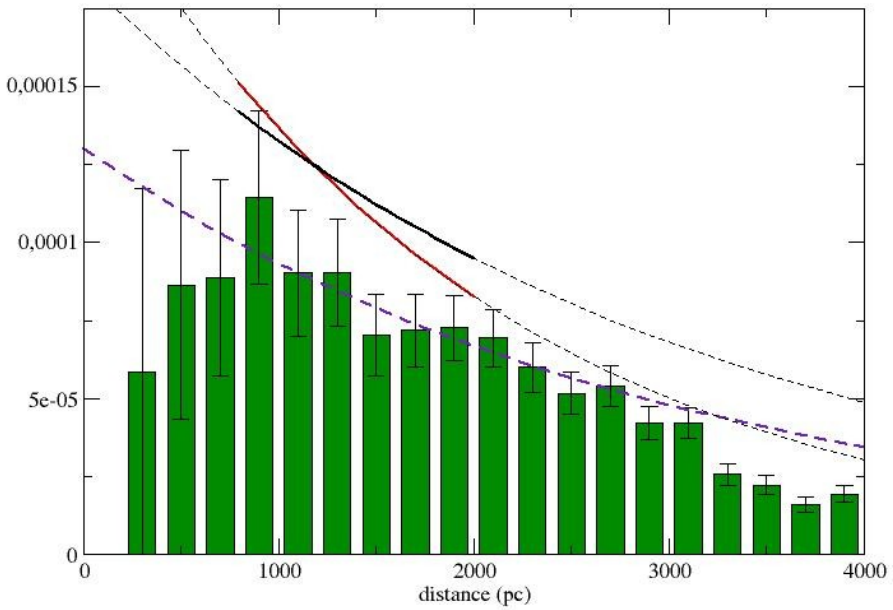
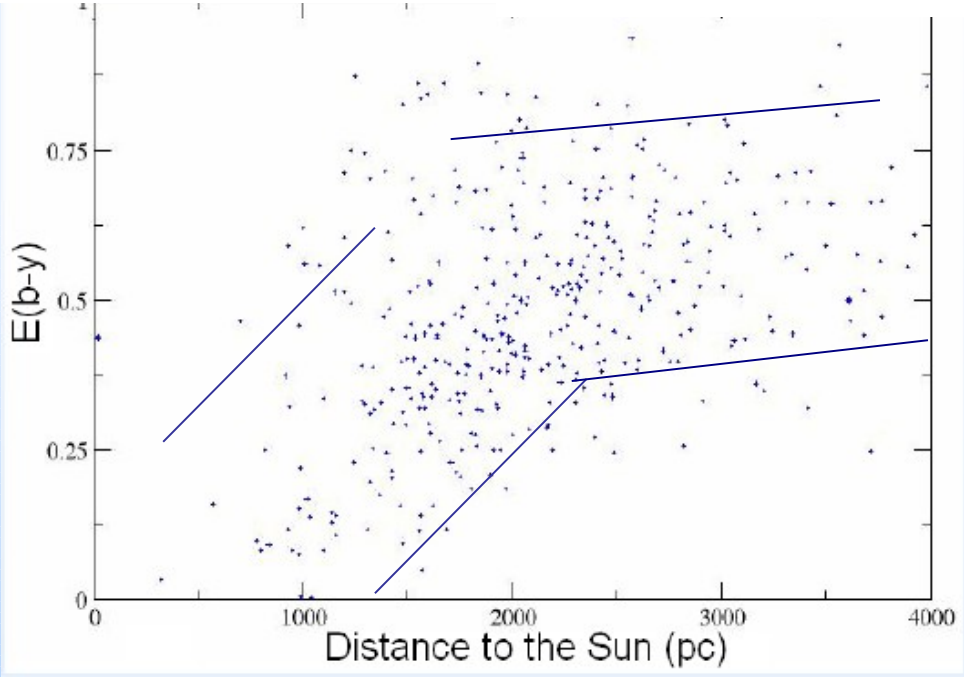
hr=2kpc
0,00015
0,0001
5e-05
0
stars/pc3
0
1000
2000
3000
4000
distance


0,00015
0,0001
5e-05
0
0
1000
2000
3000
4000
distance (pc)


0.75
0.5
0.25
0
E(b-y)
0
1000
2000
3000
4000
Distance to the Sun (pc)