The Millennium Galaxy Catalogue

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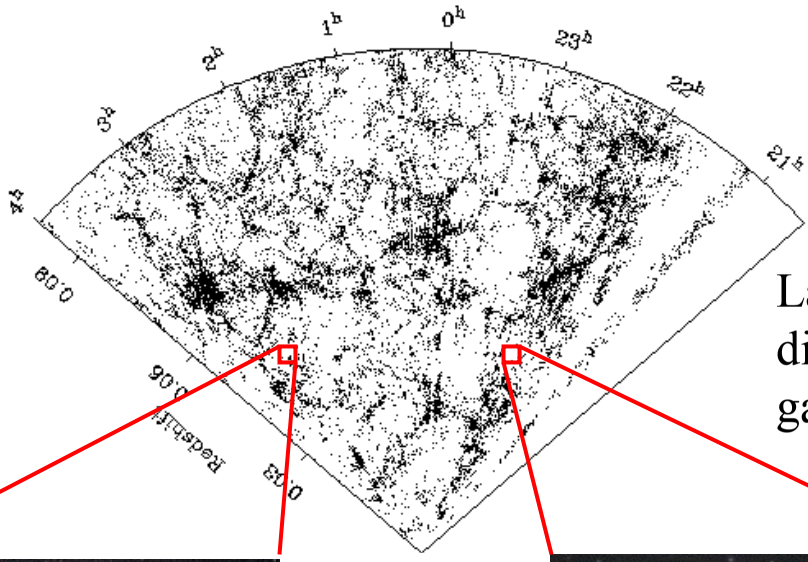
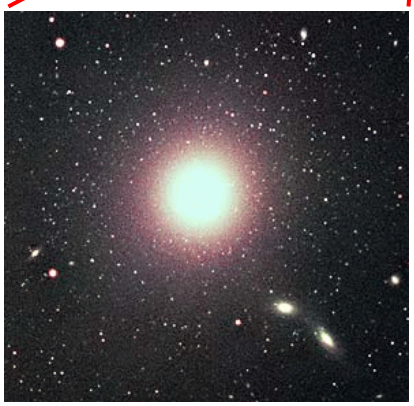
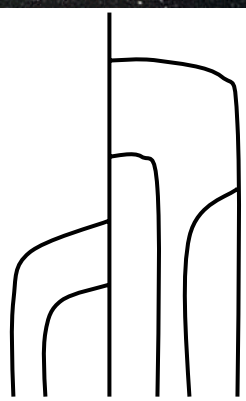
Dave Lemon	St Andrews
Nick Cross	Johns Hopkins

The big picture



Large scale distribution of galaxies





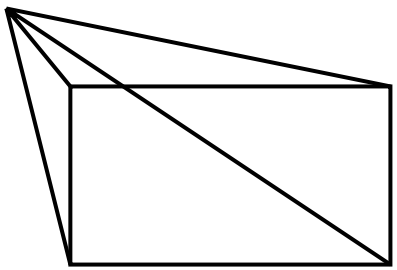
Hierarchical galaxy formation

time

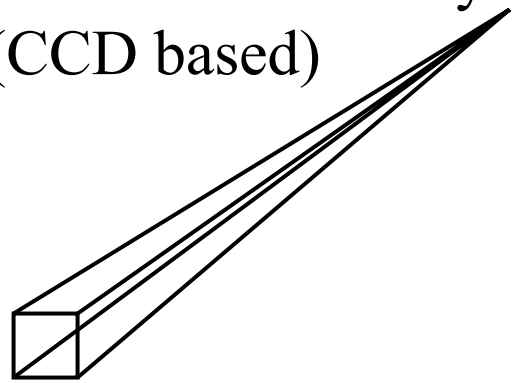
Dark matter density perturbations

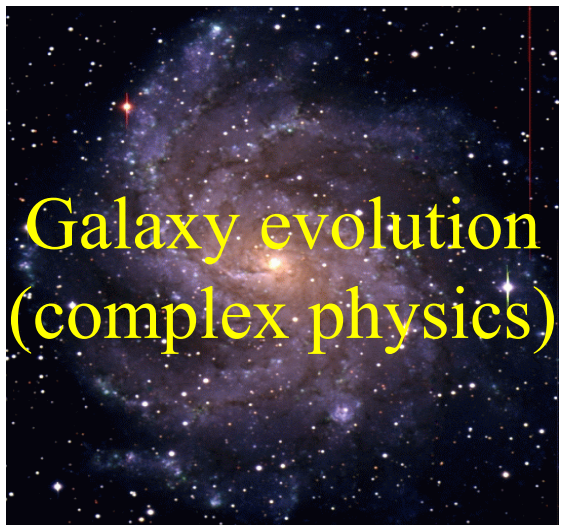
What is required?

Large, but shallow
all-sky surveys
(photographic)

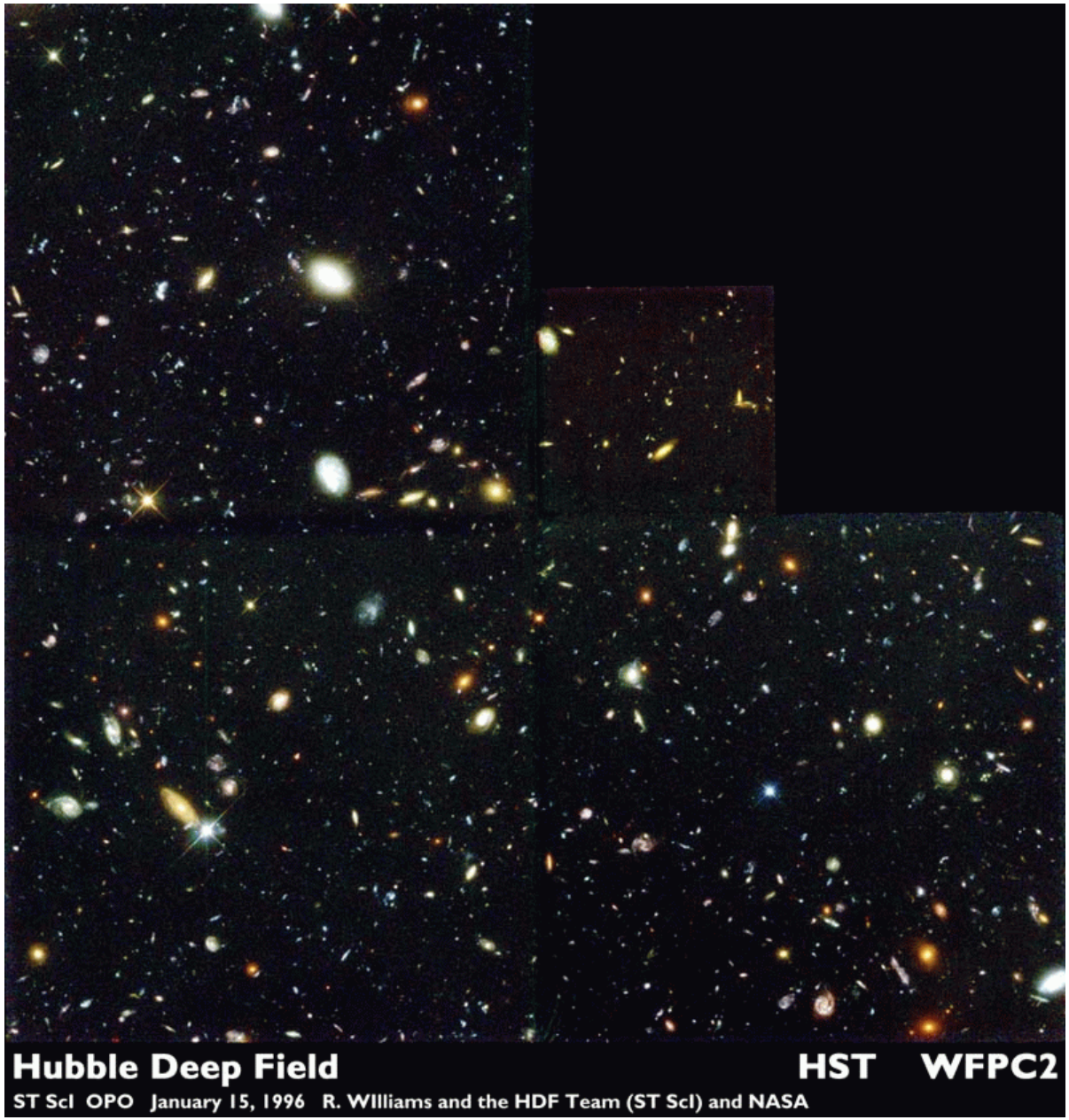


Deep, but small
pencil-beam surveys
(CCD based)





Theory
(analytic, semi-analytic, numerical)



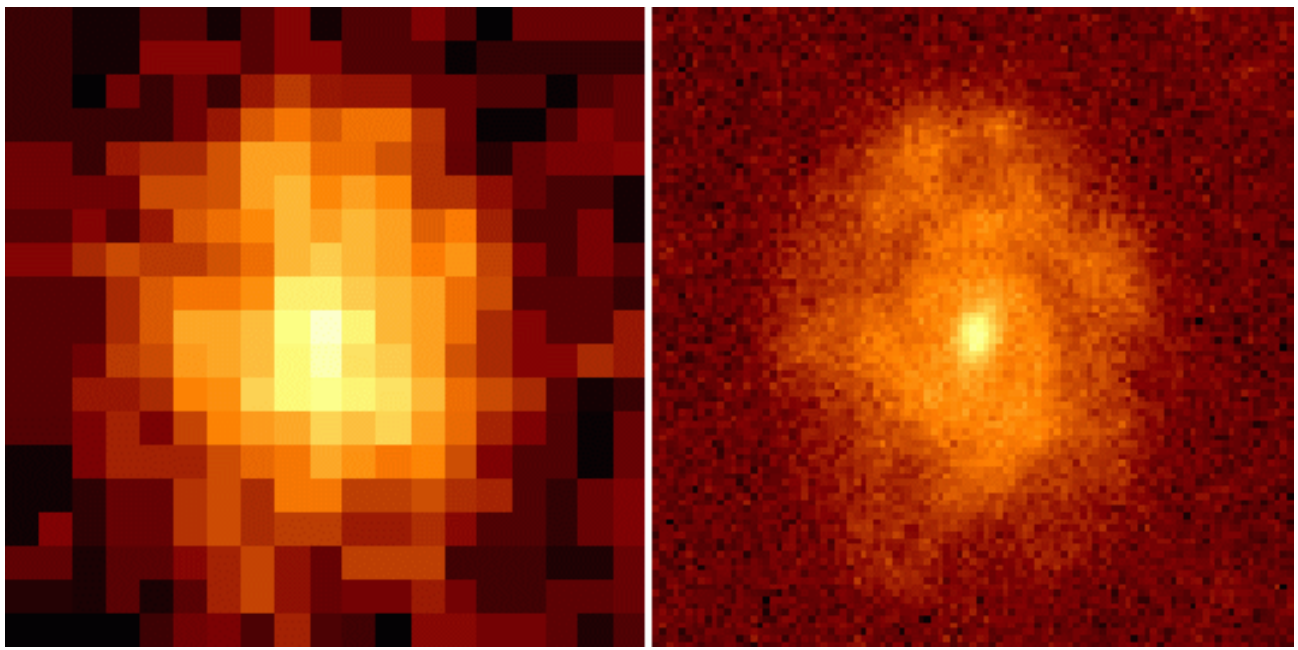
HDF:

Provides detailed information on distant galaxies.

The Millennium Galaxy Catalogue

Purpose:

- Replace photographic surveys as a resource to describe local galaxies.
- Provide benchmark for comparison with theory and high-z observations.



Photographic MGC

MGC survey parameters

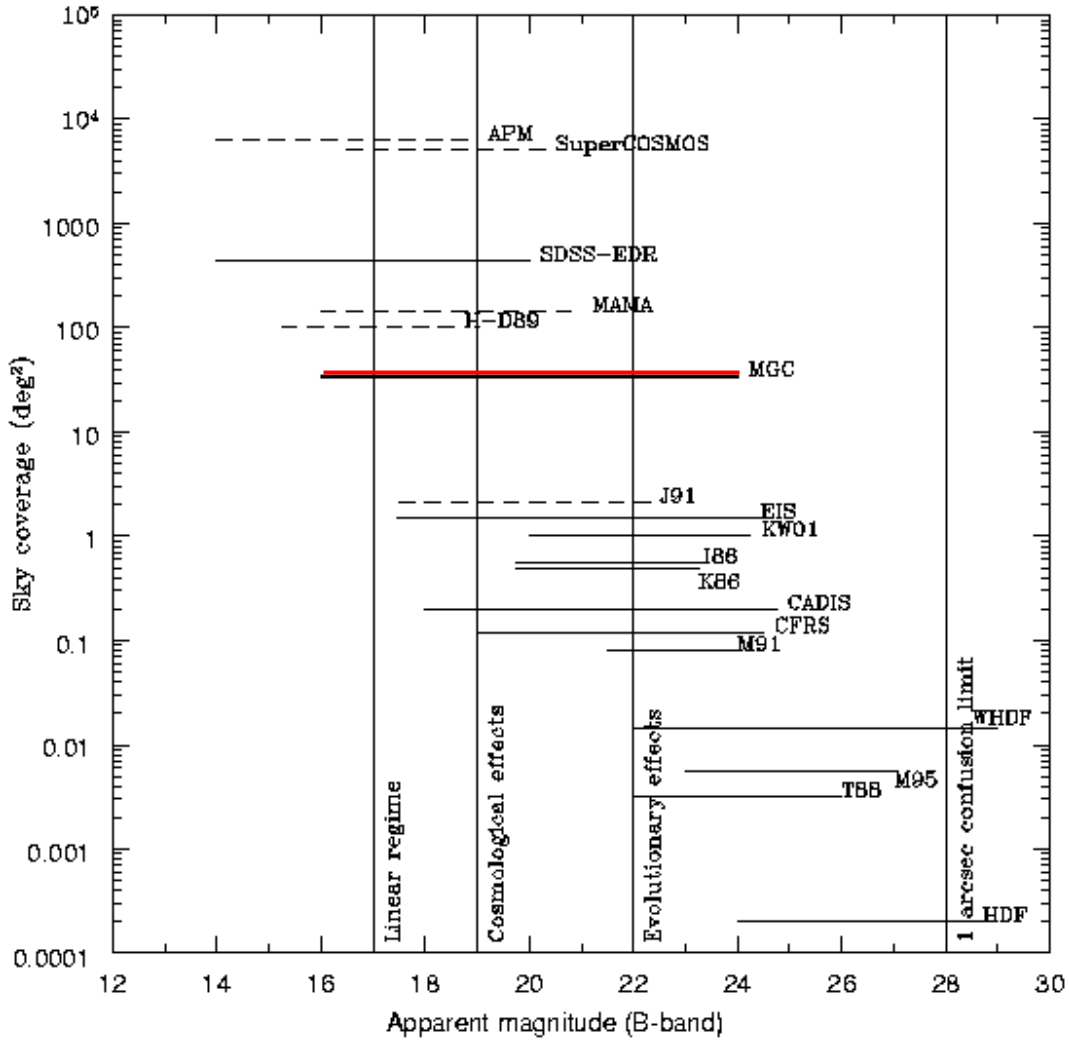
- Instrument: INT Wide Field Camera
- Filter: B_{KPNO}
- Area: 37.5 deg^2 (144 WFC fields)
  30.9 deg^2 after cleaning > previous CCD surveys
- B_{lim}: 24 mag
- μ_{lim}: 26 mag/arcsec^2

} deeper than photographic surveys

The MGC in comparison

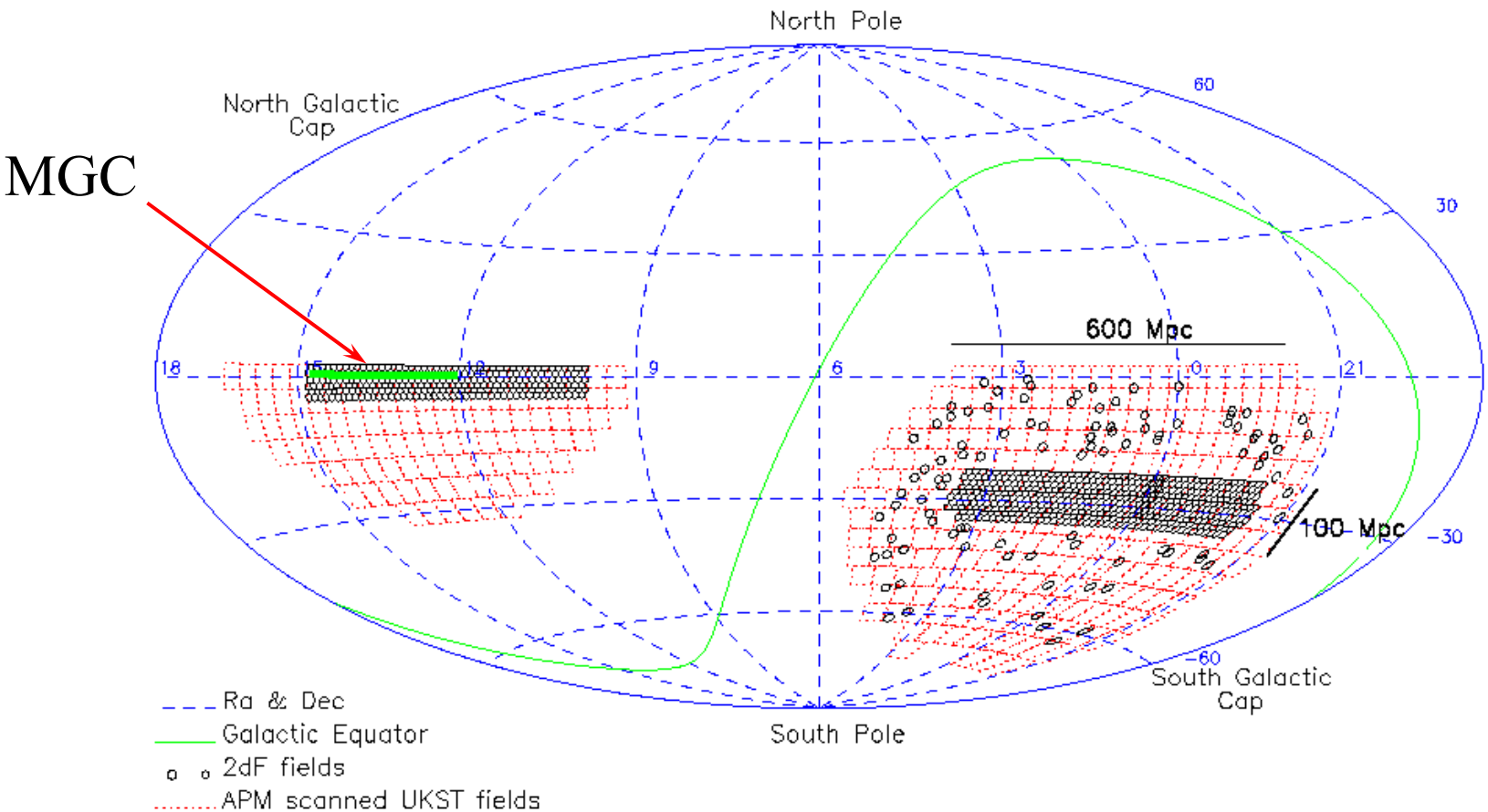
Photographic

CCD

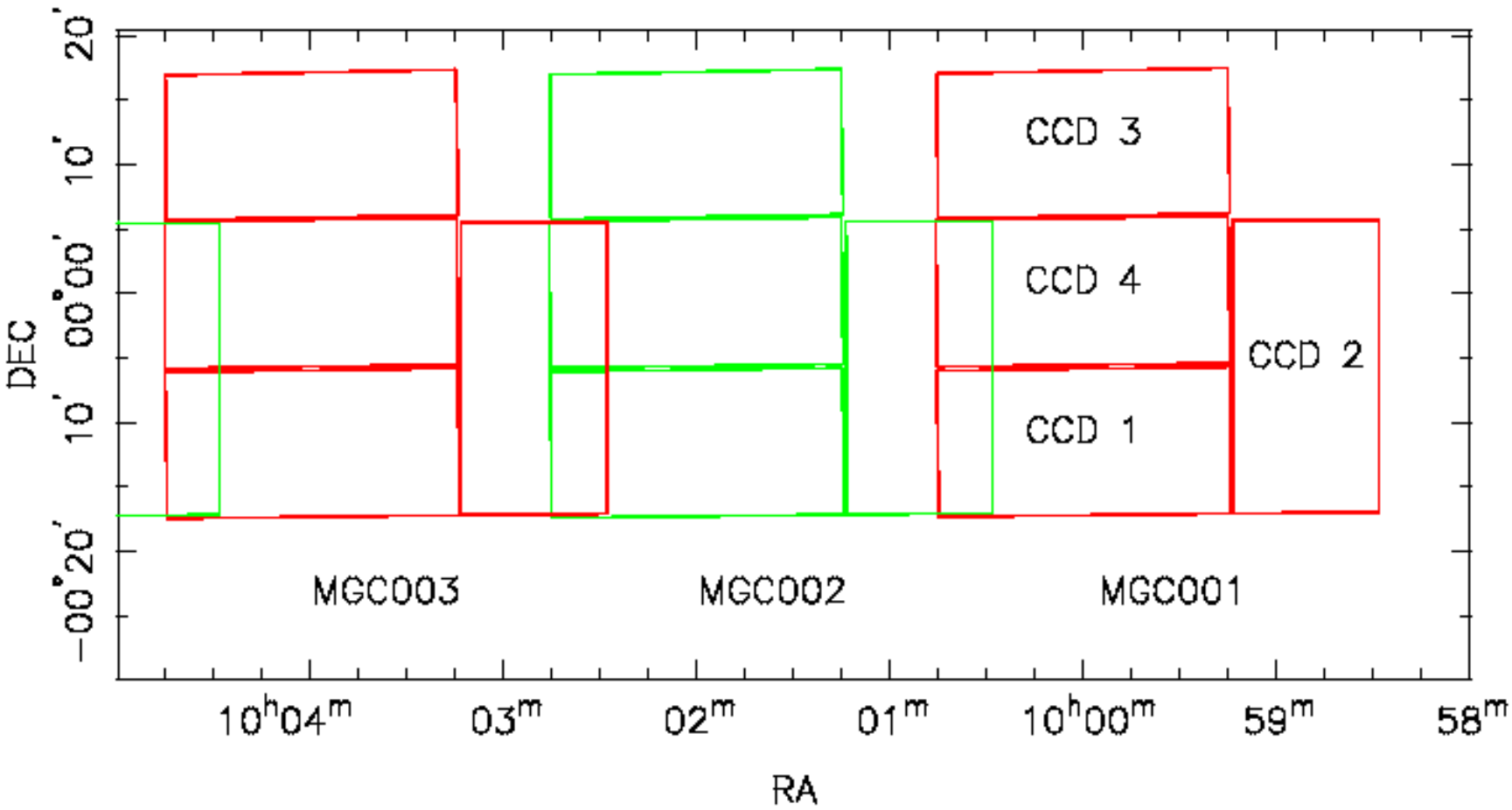


MGC survey region

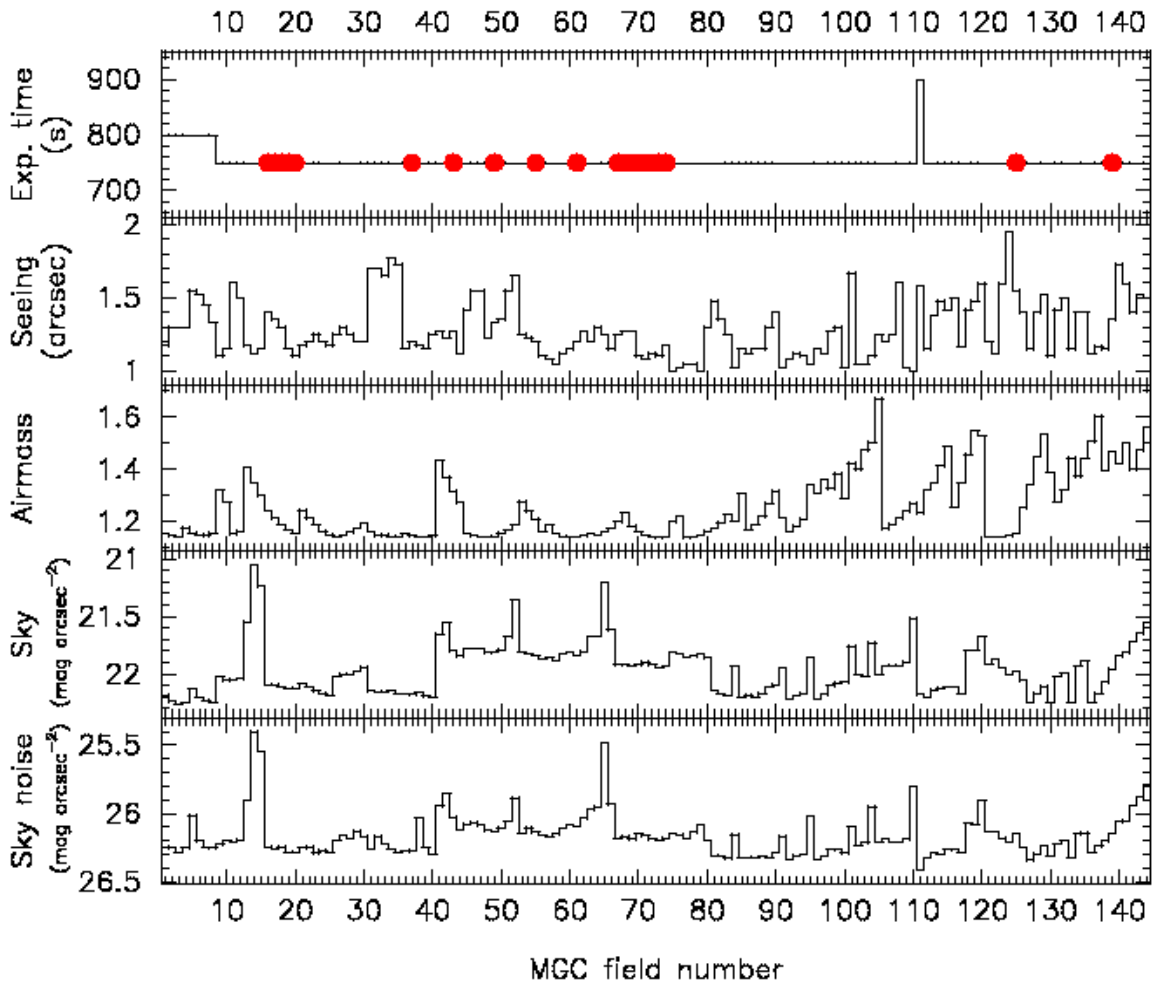
$9^h\ 58^m < RA < 14^h\ 47^m$ $\quad -0.3° < DEC < 0.3°$



MGC survey outline



MGC observational stats

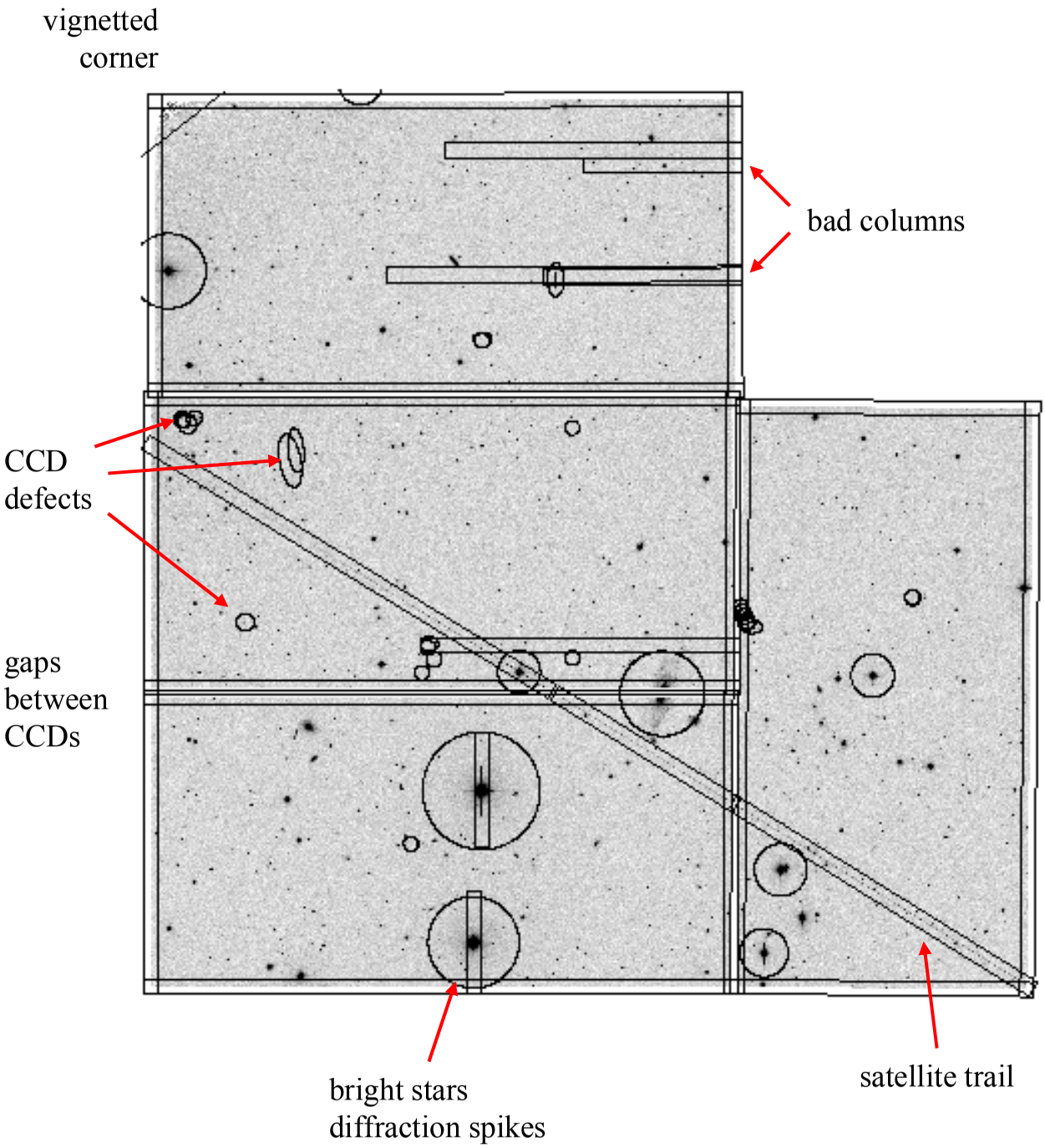


t_{exp} = 750 s

Seeing = 1.25’’

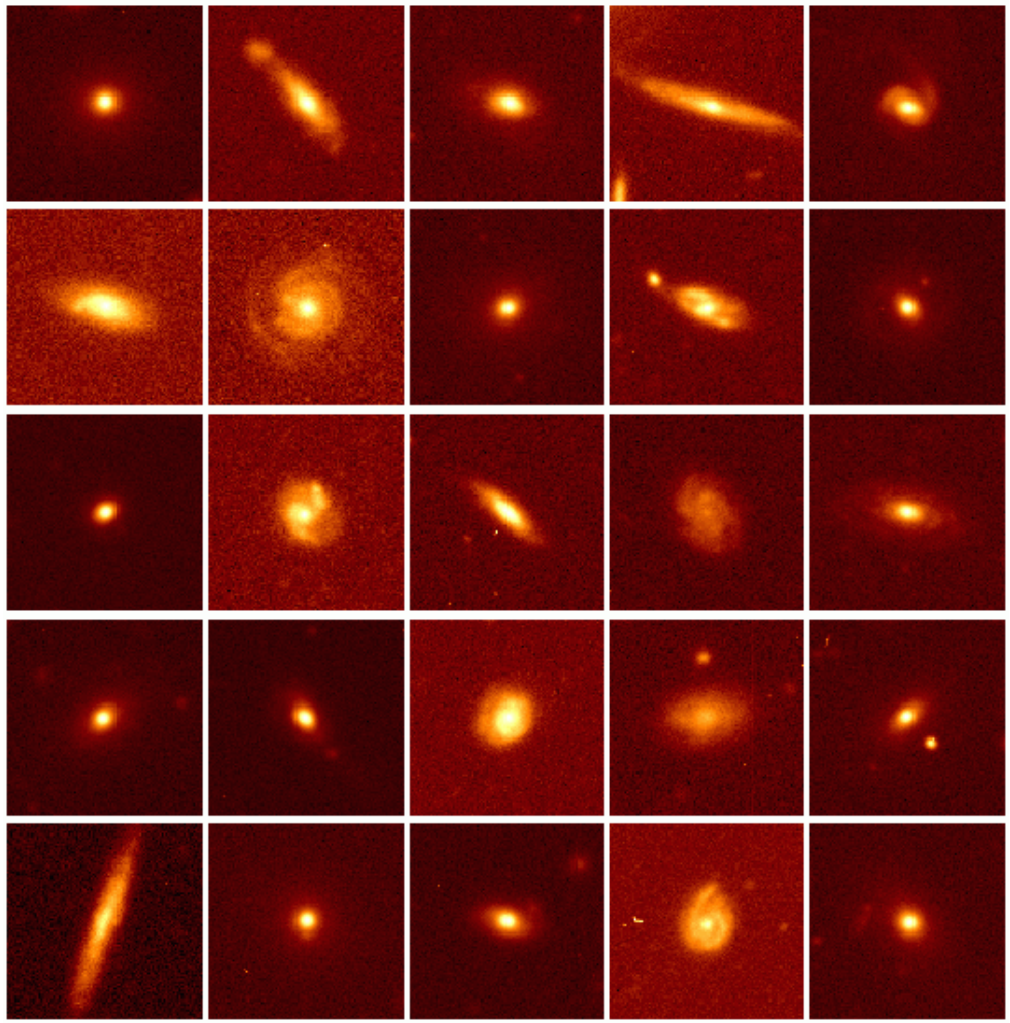
μ_{lim} = 26 mag/□^{2}

MGC example field

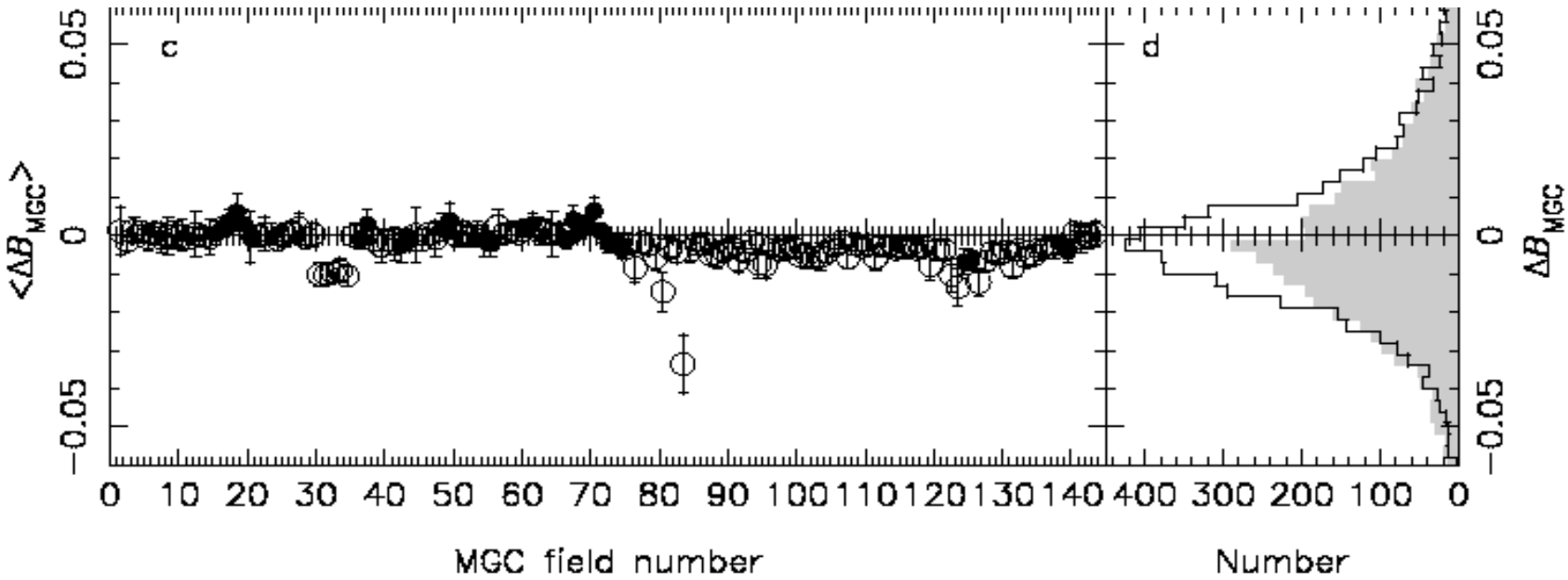


MGC example galaxies

deep imaging
+
good seeing
=
structural parameters
to $B_{MGC} = 20$ mag



Internal photometric accuracy



$$\sigma_{B_{MGC}} = 0.03 \text{ mag}$$

Data products

MGC-FAINT: $20 < B_{MGC} < 24$

650,000 galaxies

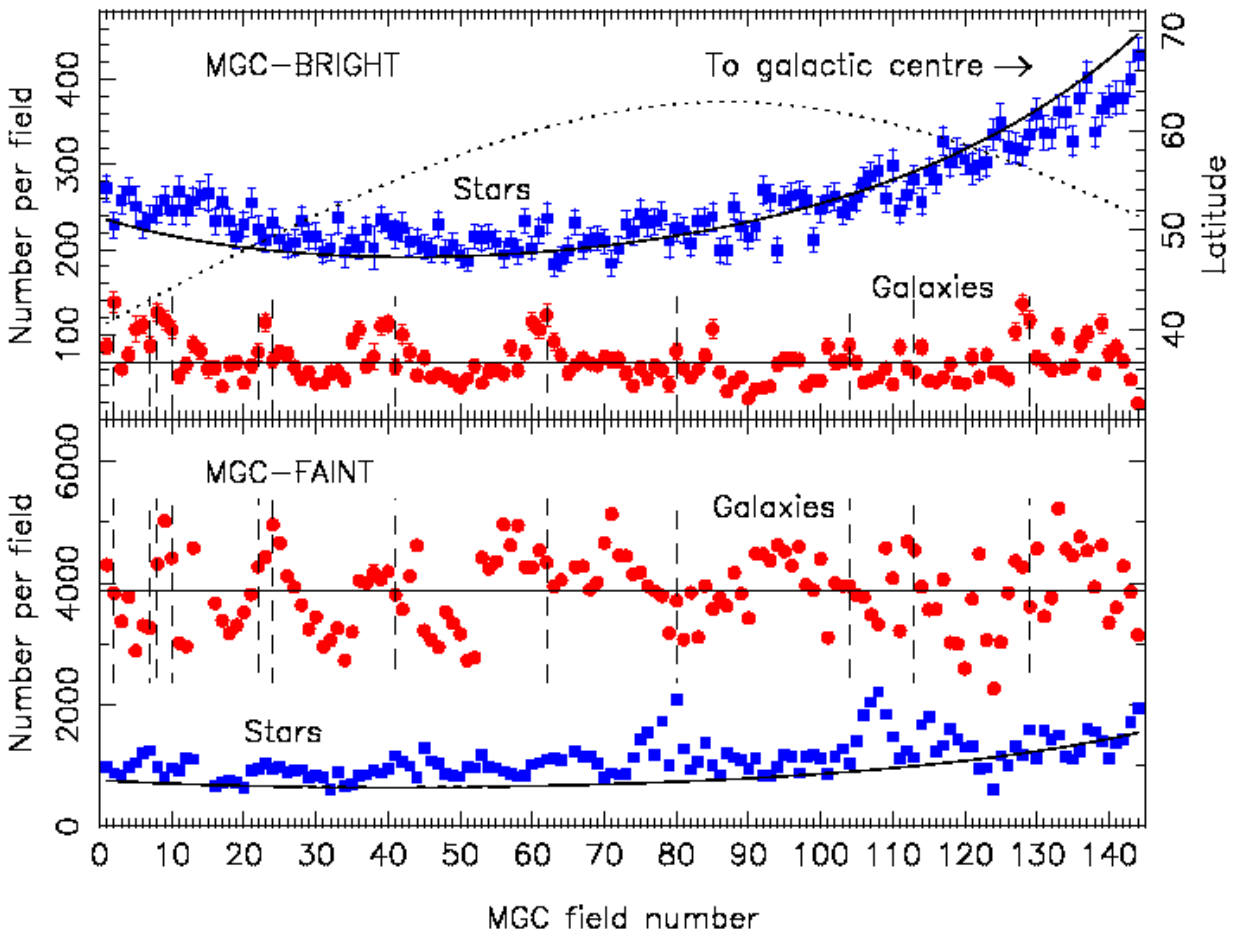
- *B*-band photometry
- shape paremeters
- isophotal areas

MGC-BRIGHT: $16 < B_{MGC} < 20$

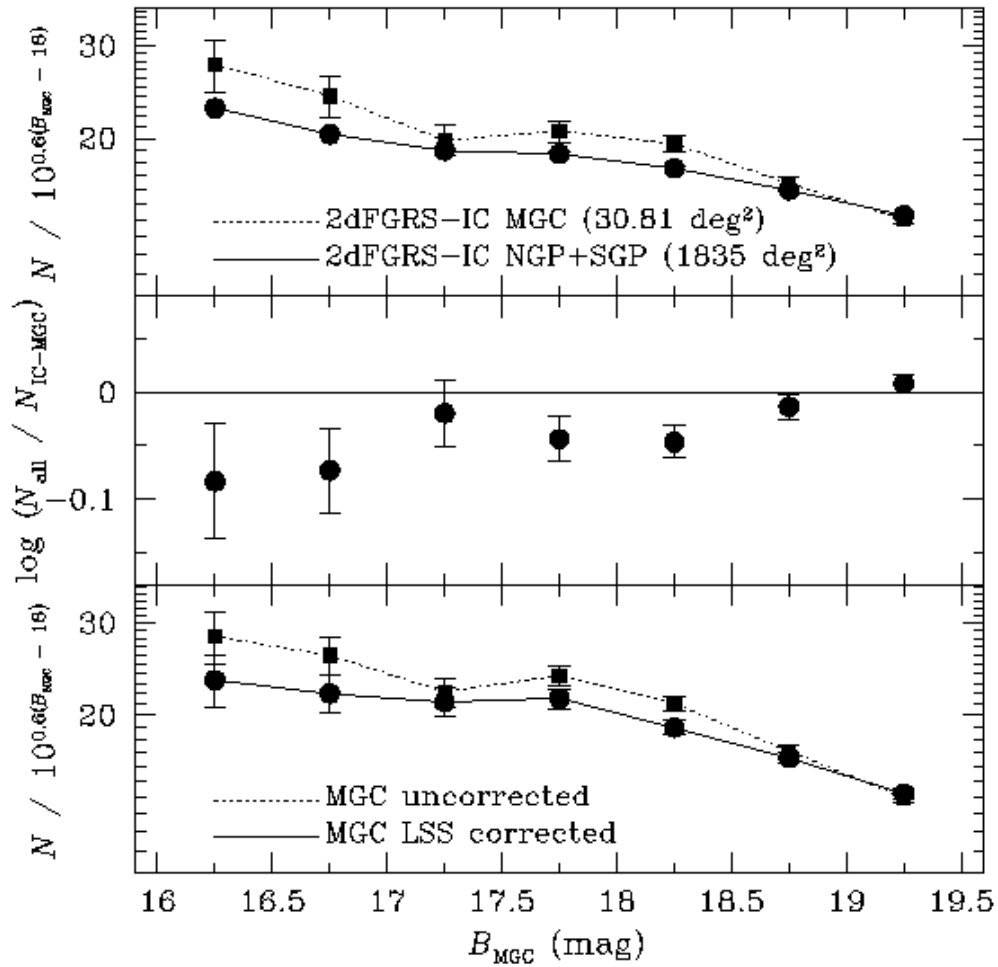
9800 galaxies

- *uBgriz* photometry (SDSS)
- redshifts (2dFGRS, SDSS, MGCz)
- morphologies
- structural parameters
- spectral classification

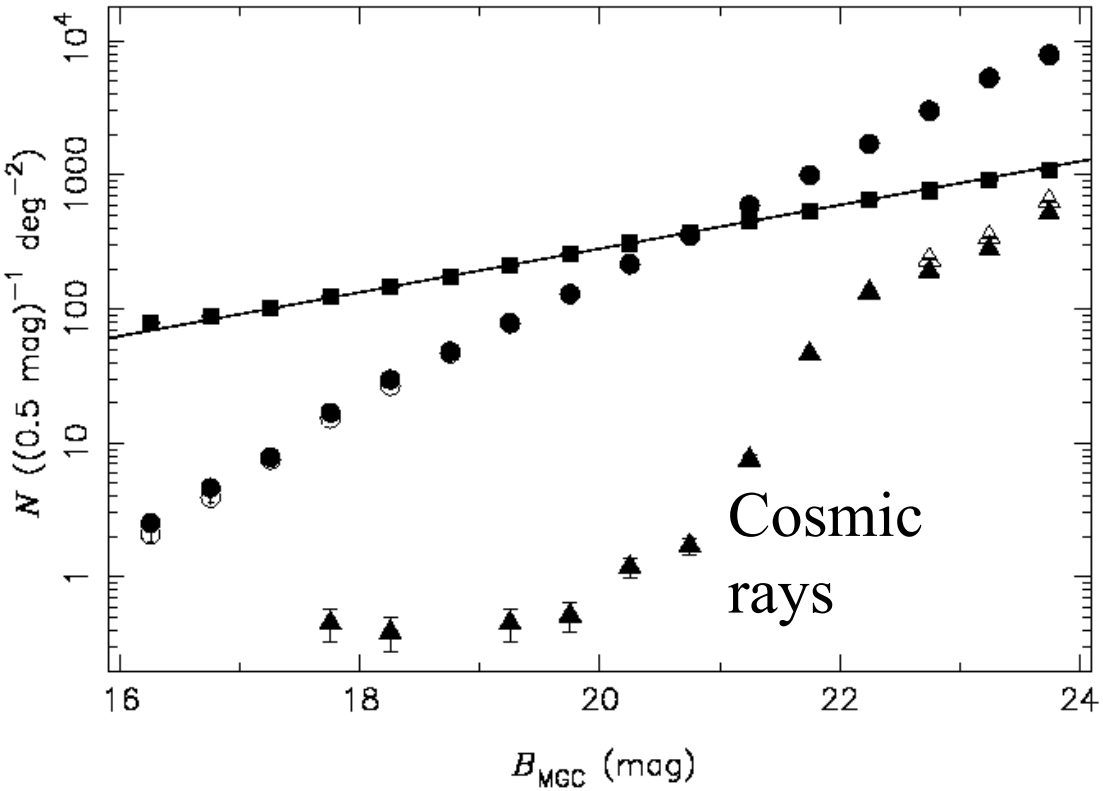
Distribution of stars and galaxies



LSS correction of number counts

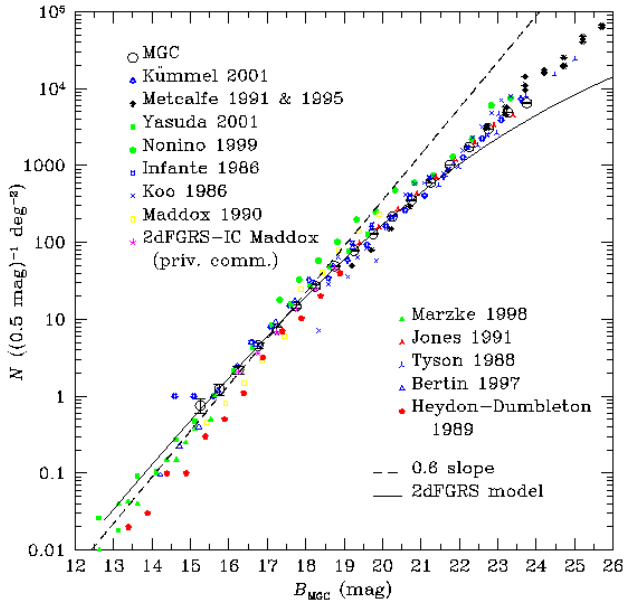


MGC number counts

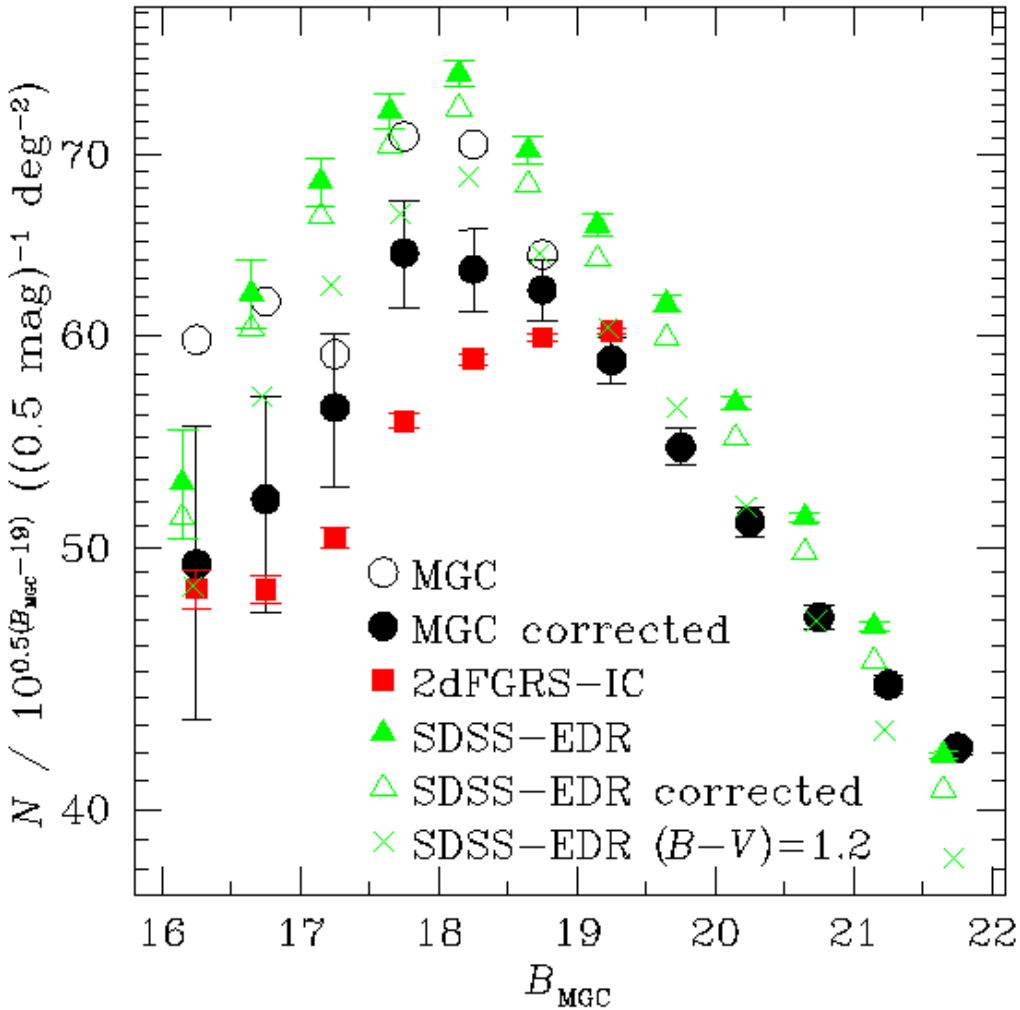


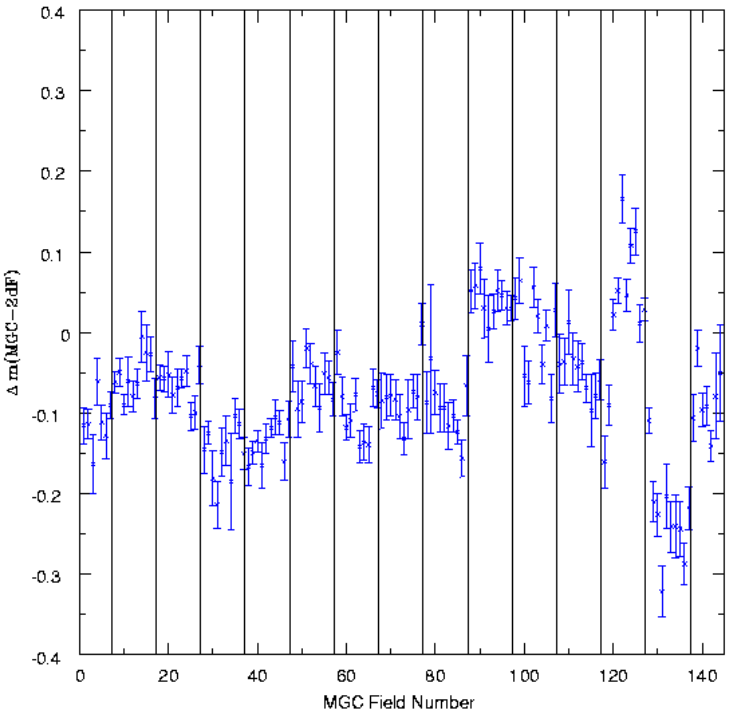
Galaxies

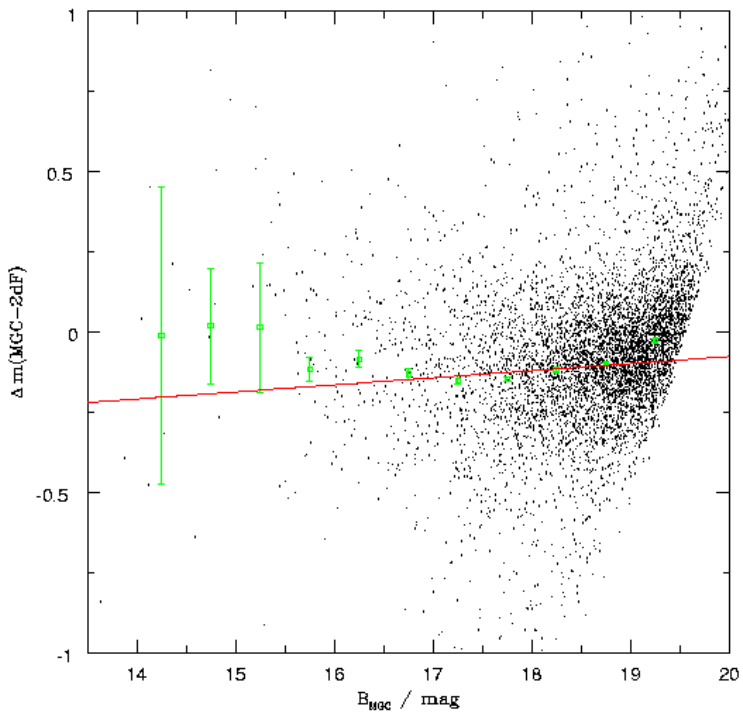
Stars

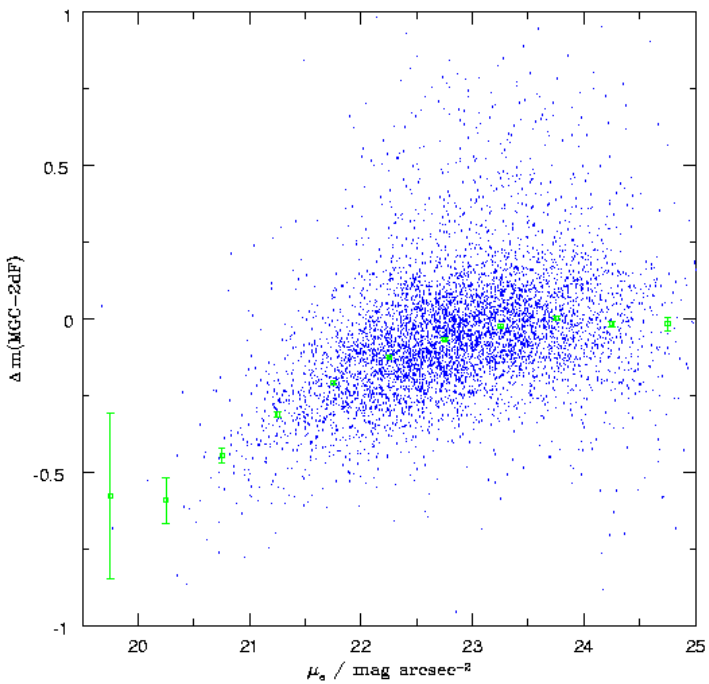


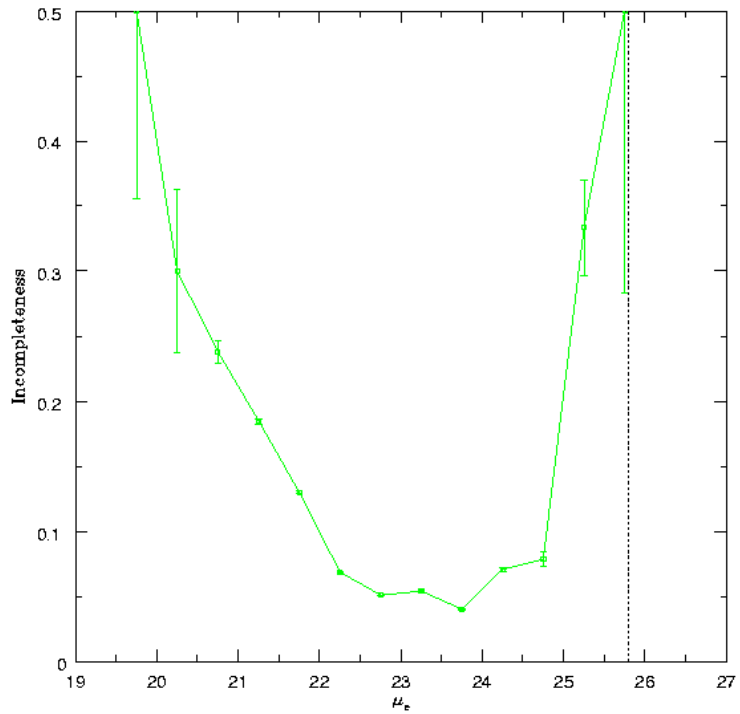
Detailed comparison

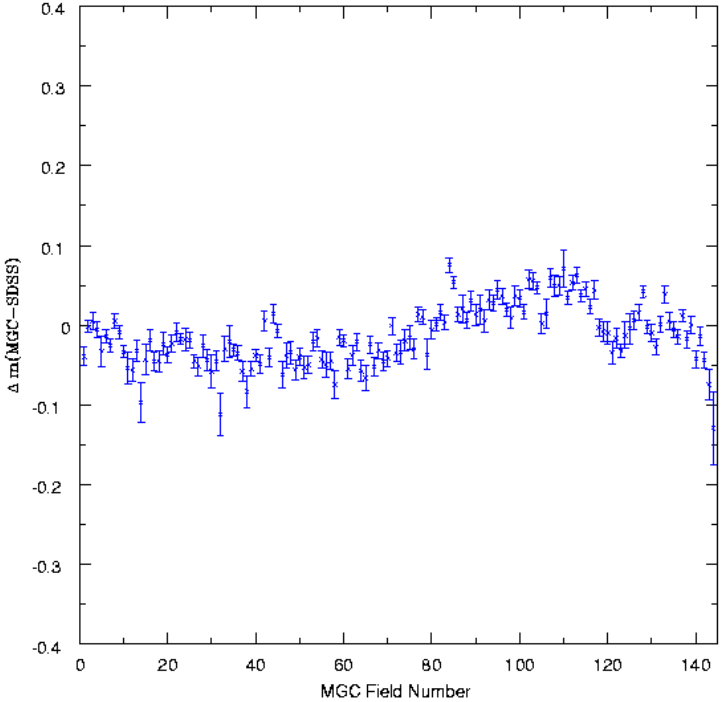


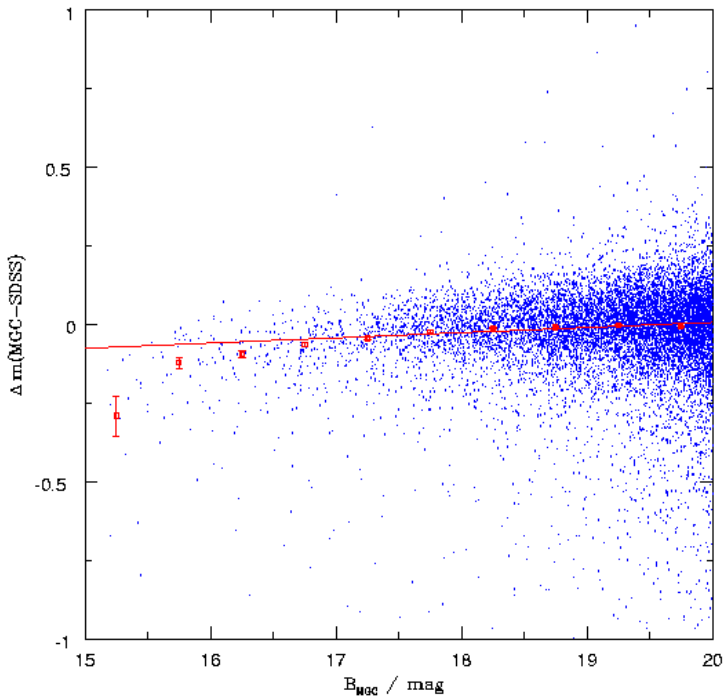

Δ m(MGC−2dF)
MGC Field Number

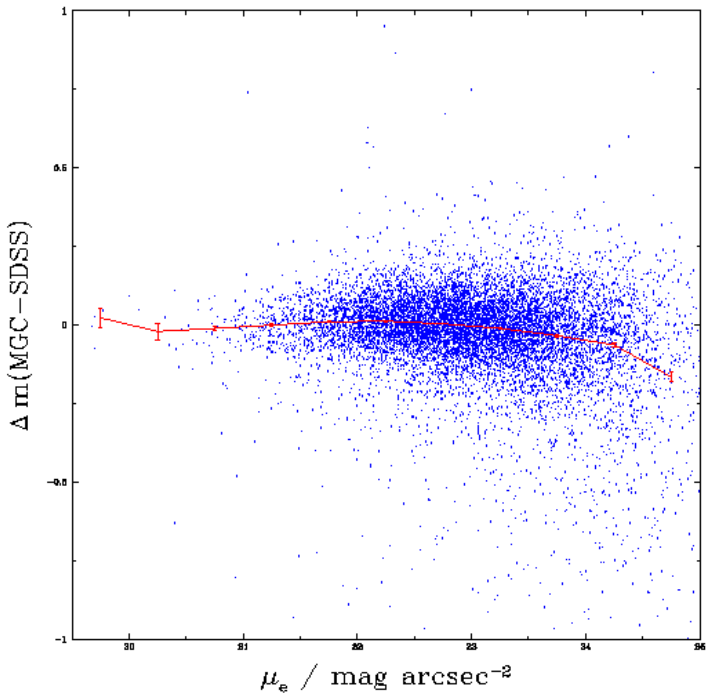

Δ m(MGC−2dF)
B_MGC / mag

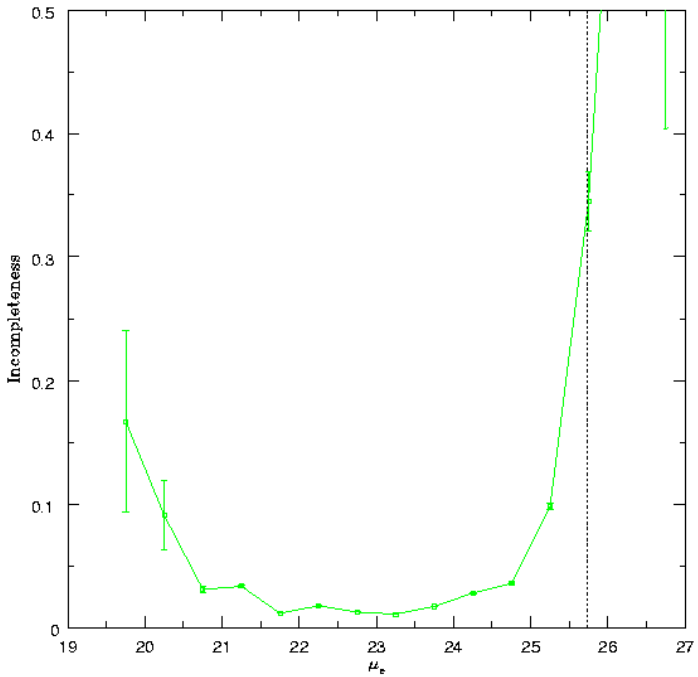

Δ m(MGC−2dF)
μ_e / mag arcsec⁻²


Incompleteness
μ_e

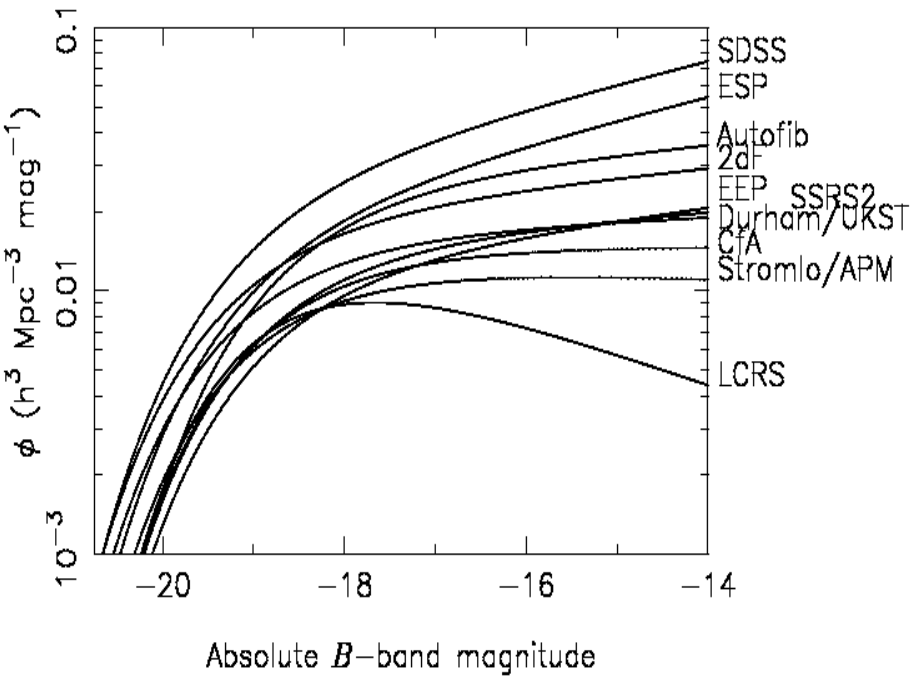

Δ m(MGC−SDSS)
MGC Field Number


Δ m(MGC−SDSS)
B_MGC / mag


Δ m(MGC−SDSS)
μe / mag arcsec−2

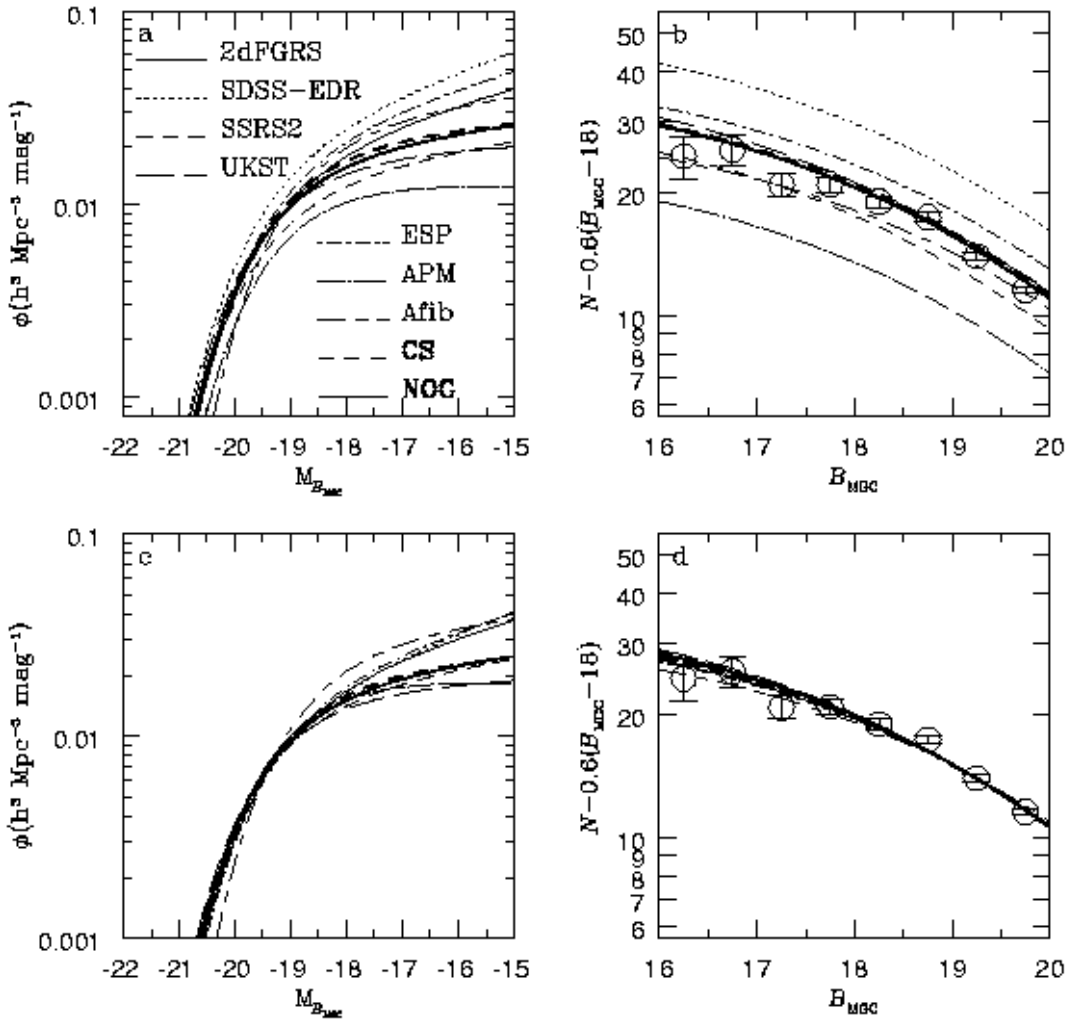

Incompleteness
μe

The luminosity function

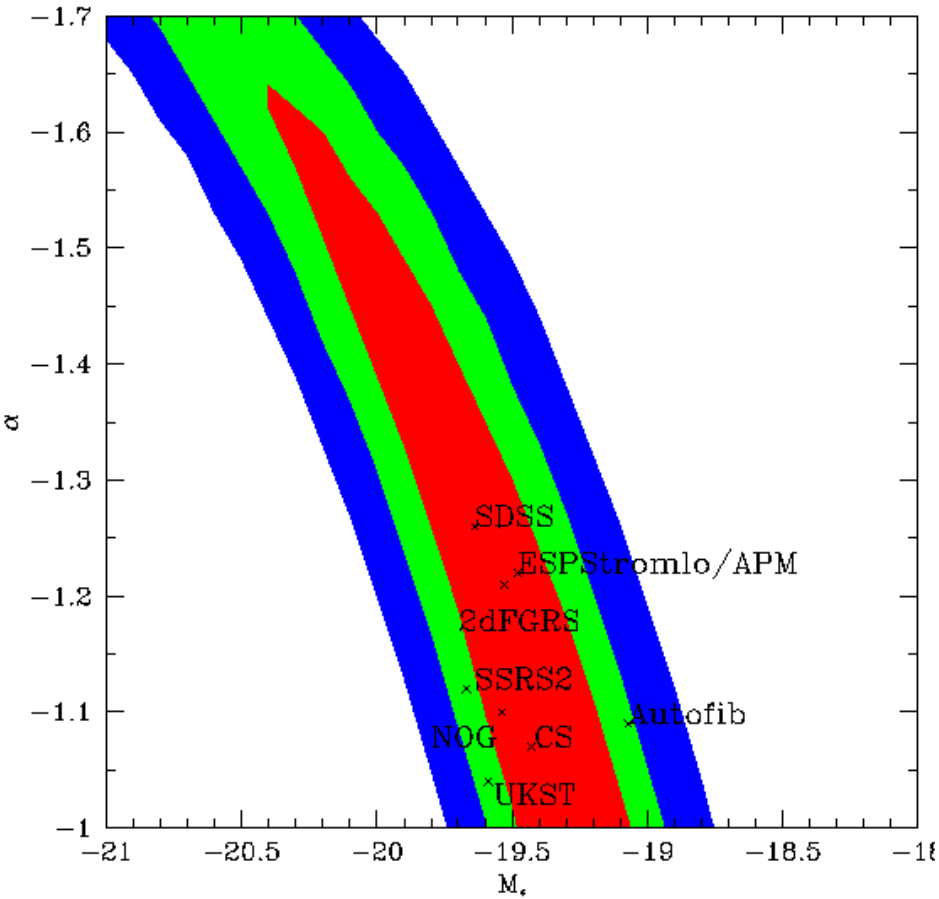


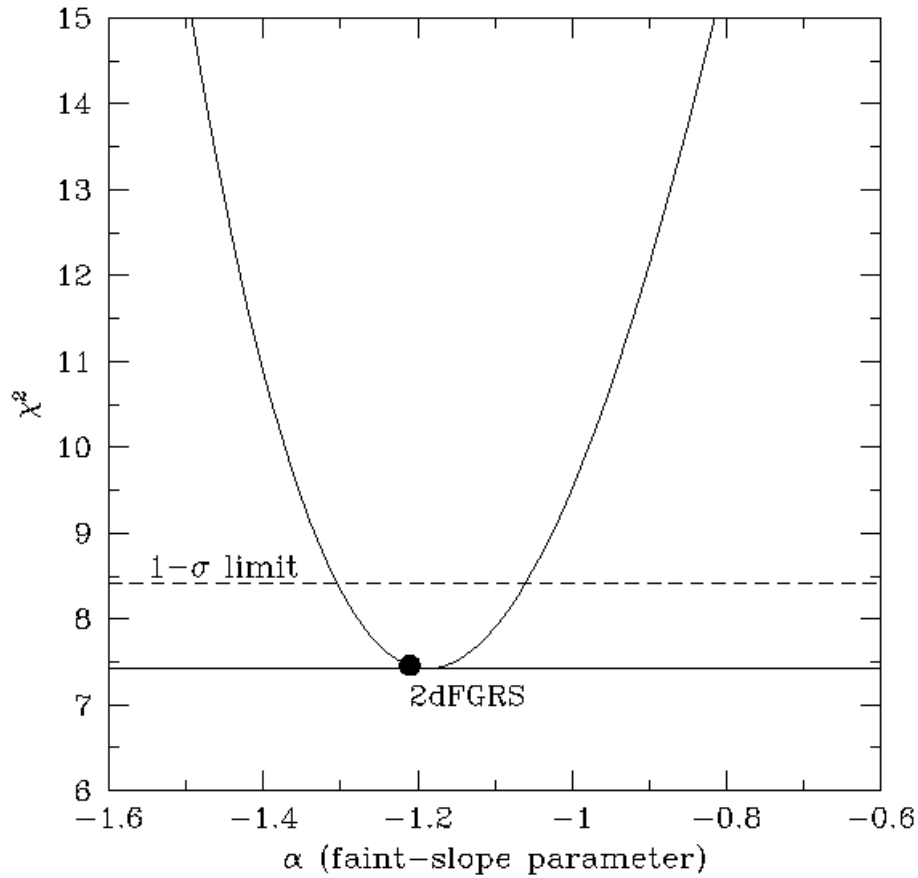
Uncertainty	Possible reason	
Overall normalisation	Clustering?	
Turn-over point	Missing light?	SB effects
Faint-end slope	Missing galaxies?	SB effects
	Clustering?	

Determining Φ*

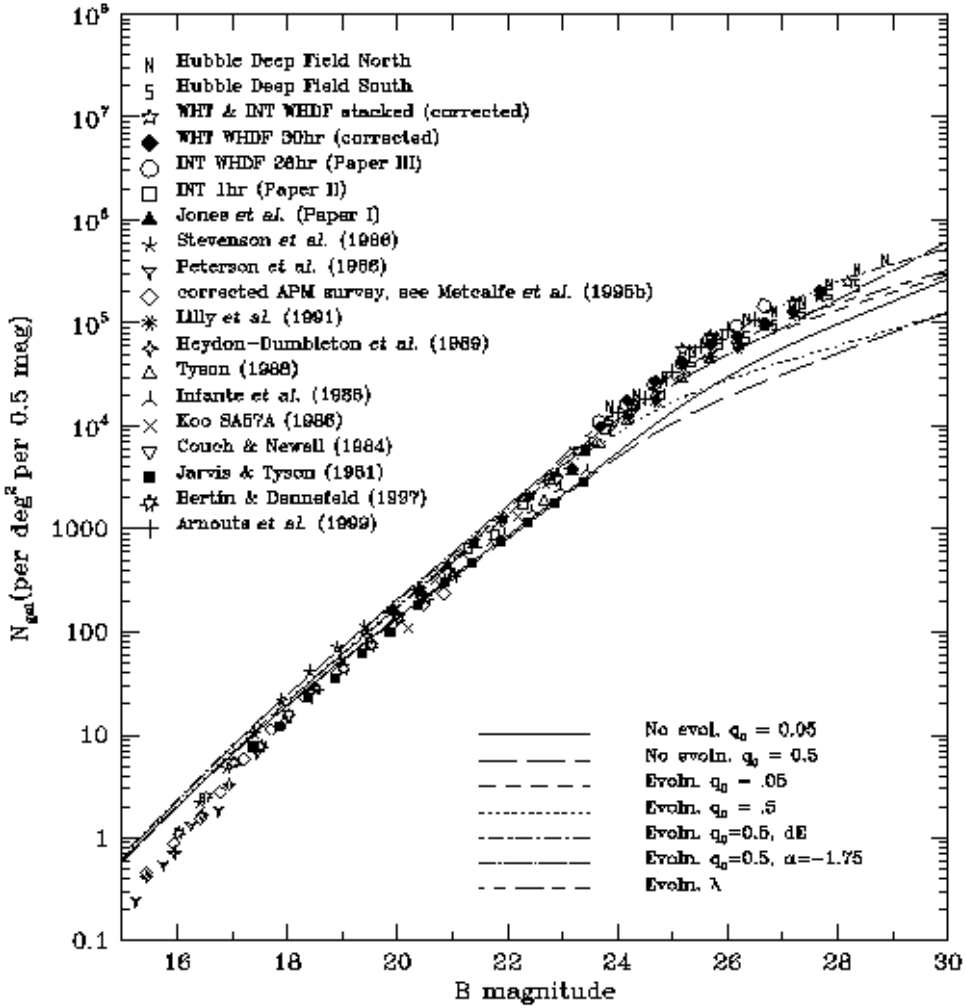


M^* and α?


−1.7
−1.6
−1.5
−1.4
−1.3
−1.2
−1.1
−1
α
−21
−20.5
−20
−19.5
−19
−18.5
M*
SDSS
ESPStromlo/APM
2dFGRS
SSRS2
NOG
CS
Autofib
UKST


15
14
13
12
11
10
9
8
7
6
χ²
1−σ limit
2dFGRS
−1.6
−1.4
−1.2
−1
−0.8
−0.6
α (faint−slope parameter)

Galaxy number counts



Luminosity function

+

Galaxy evolution

+

Cosmological parameters

=

Number counts

Morphological LFs

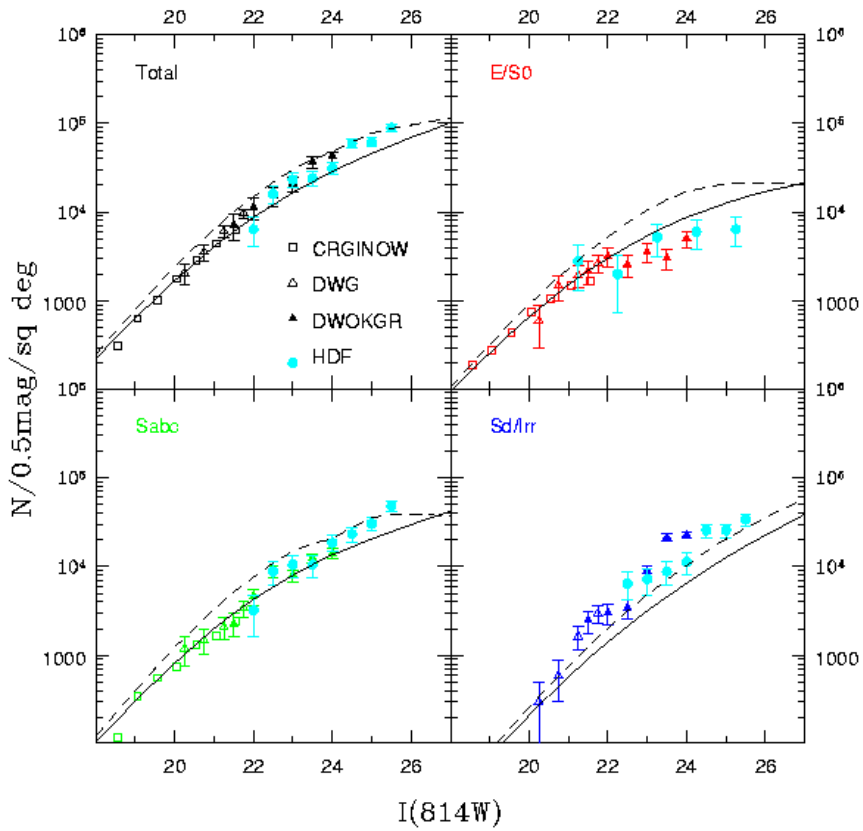
Combine:

- Morphol. LF (MGC)
- Deep morphol. counts (BBPAR, HDF)

→ E-S0/Sabc/Sd-Irr evol.

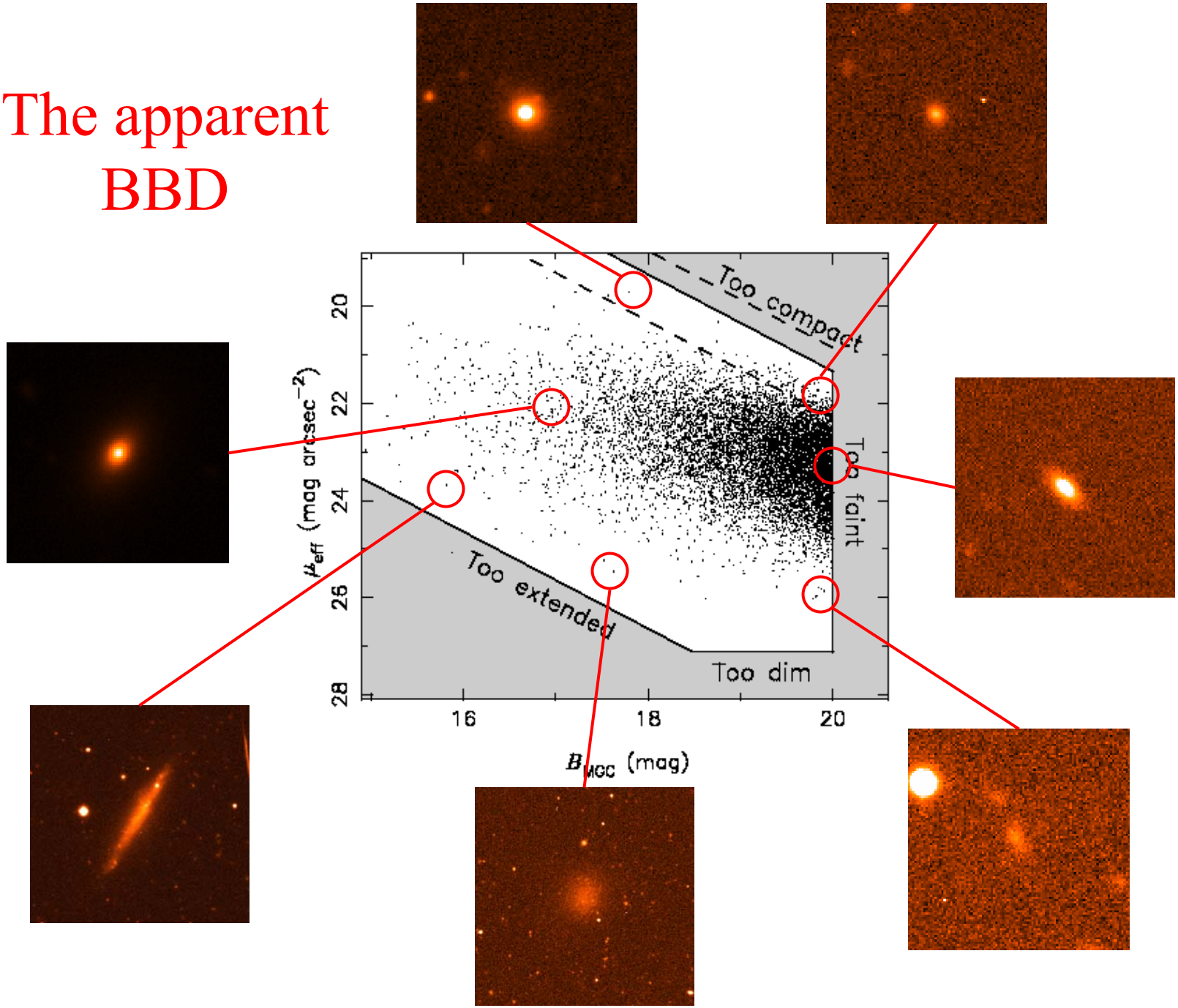
- z distribution of faint gals (Gemini)

→ Cosmological params?



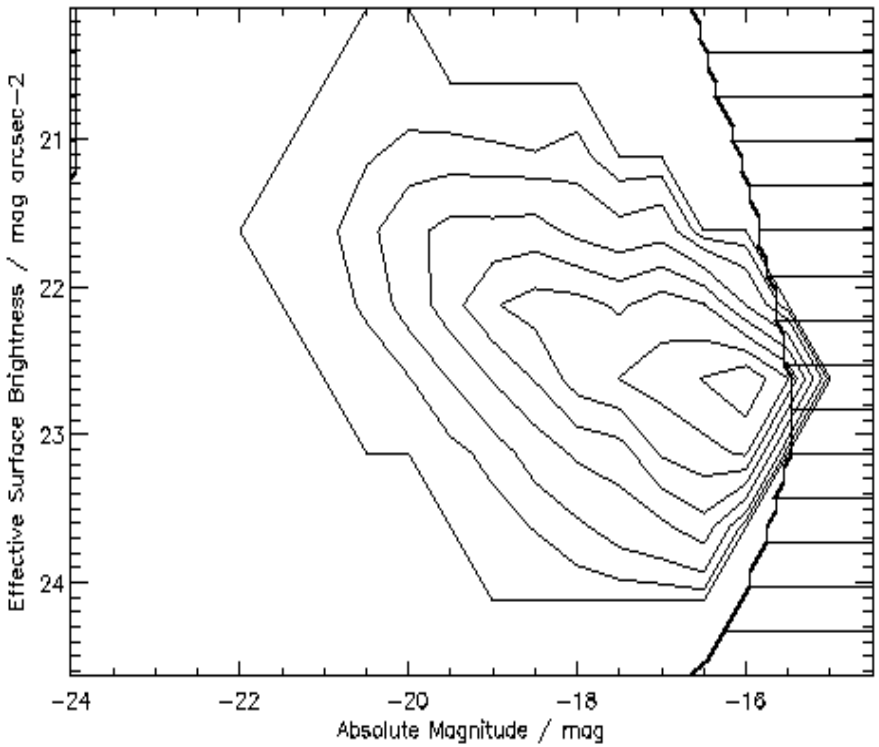
HDF: E/S0s have simple evolution?

The apparent BBD

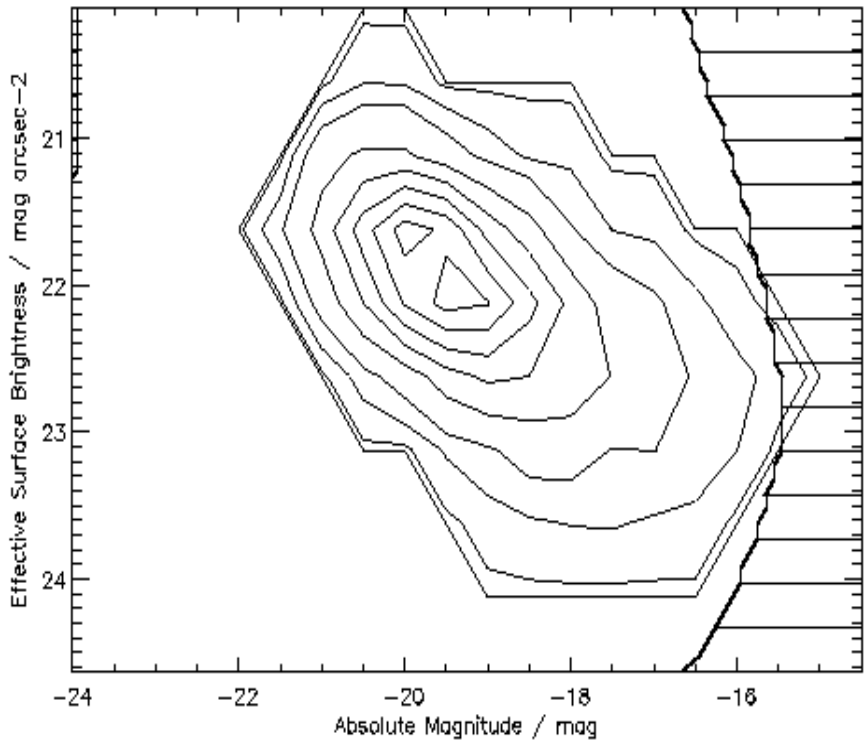


Cross et al., 2001, MNRAS, 324, 825

The 2dFGRS BBD



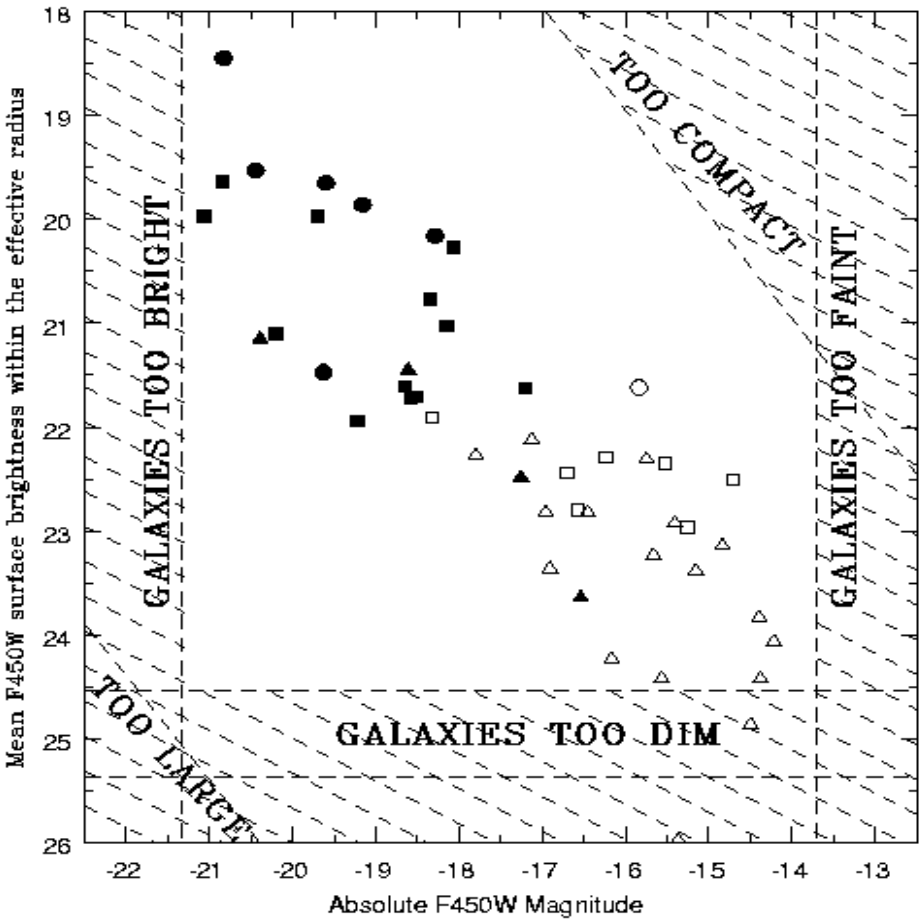
Number density

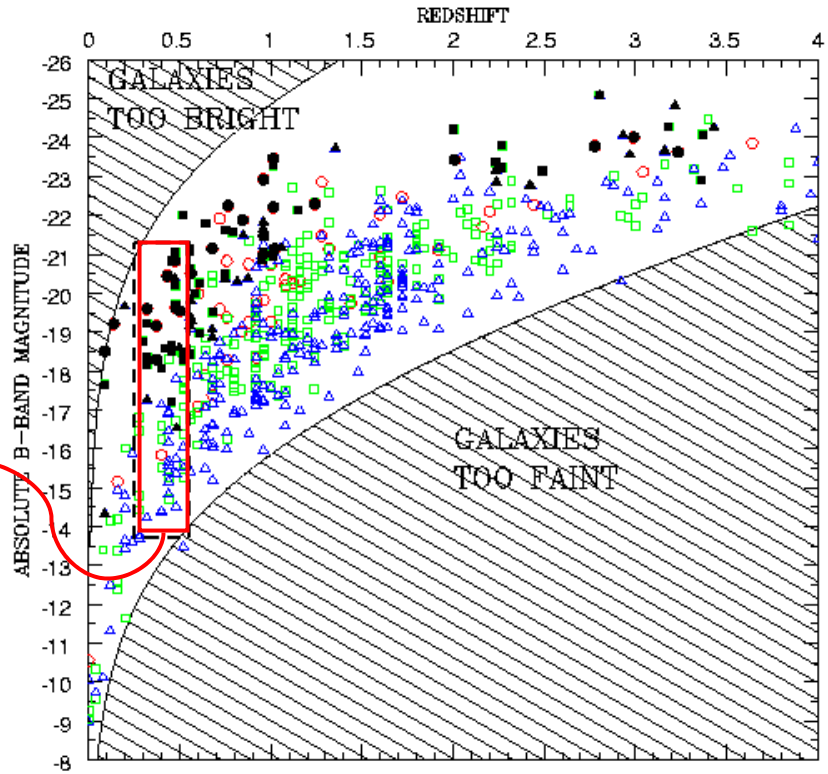


Luminosity density

Driver, 1999, ApJ, 526, L69

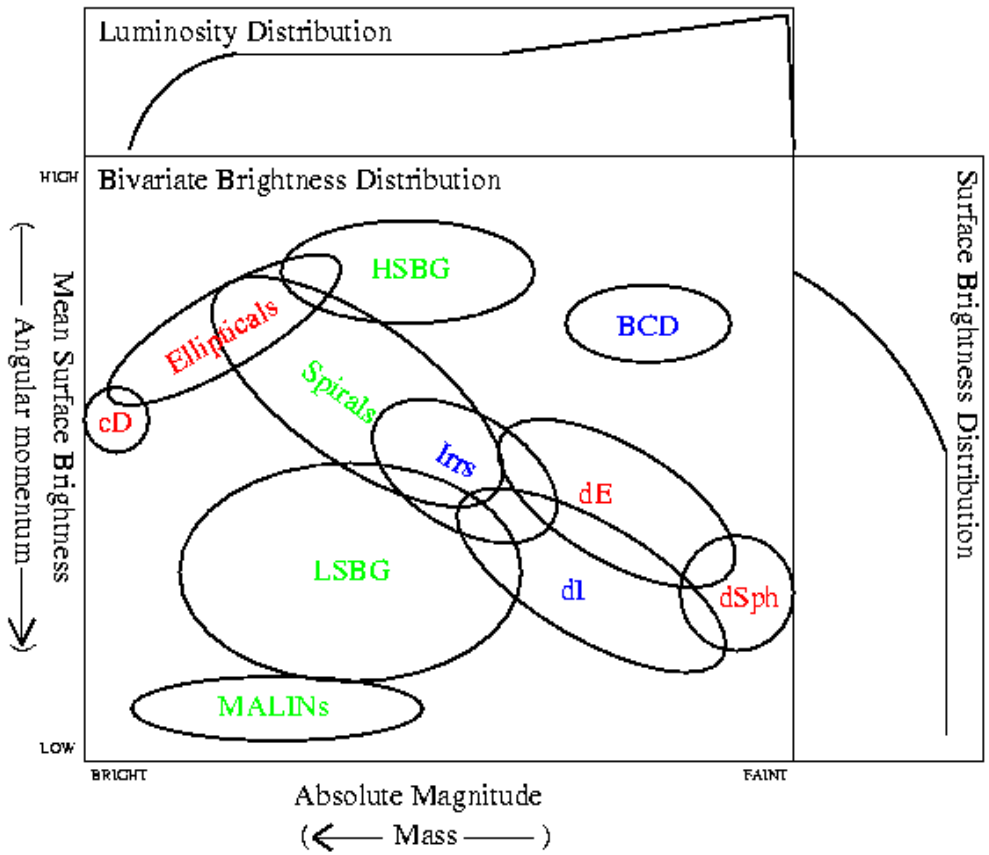
A volume limited BBD



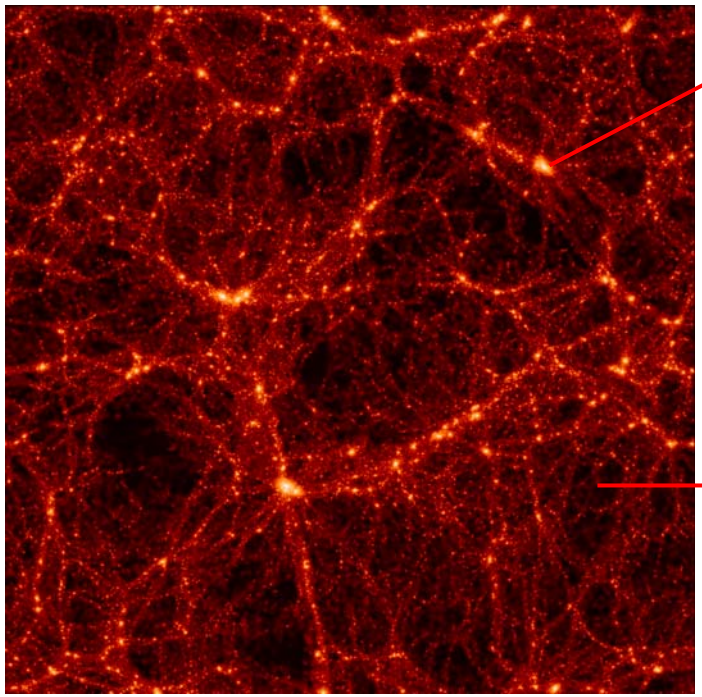


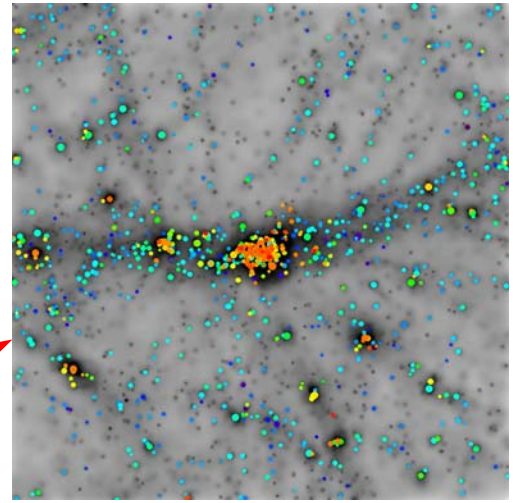
Beyond LFs: the BBD

- (SB selection effects 'built in'.)
- HR-diagram of galaxies (i.e. physics of galaxy formation and evolution)?

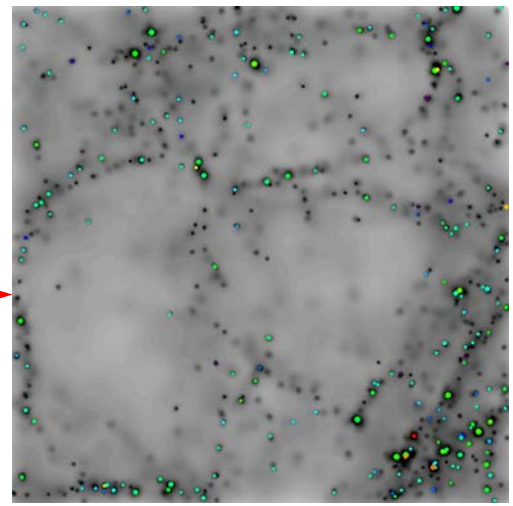


Dwarfs in voids





Cluster



Void

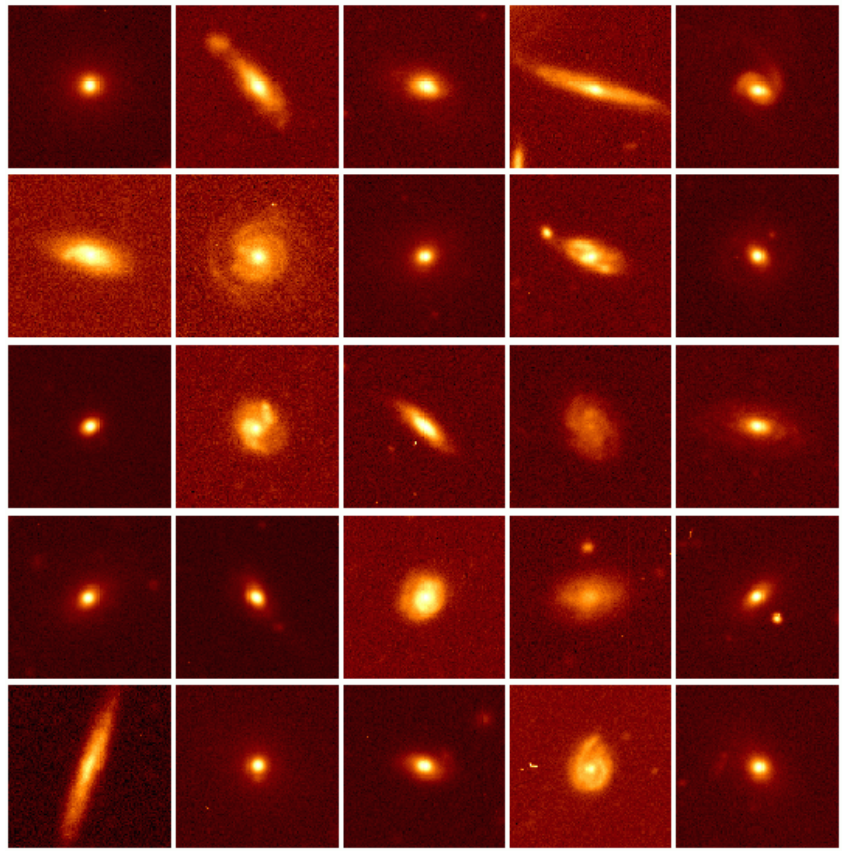
N-body simulation
of dark matter

+

semi-analytic prescriptions
for cooling, star formation, etc.

Summary

- The MGC is a unique database for studying the local galaxy population.
- Provides detailed information necessary for meaningful comparison with both high-z observations and theory.



Project timeline

Base-catalogue definition complete — Now

To do:

- Measurement of morphologies and structural parameters
- MGC redshift campaign
  → 2dFGRS completeness

1 year

- Luminosity functions(disk-to-bulge ratio)
- Bivariate Brightness Distribution
- Dwarf galaxies in voids

3 years