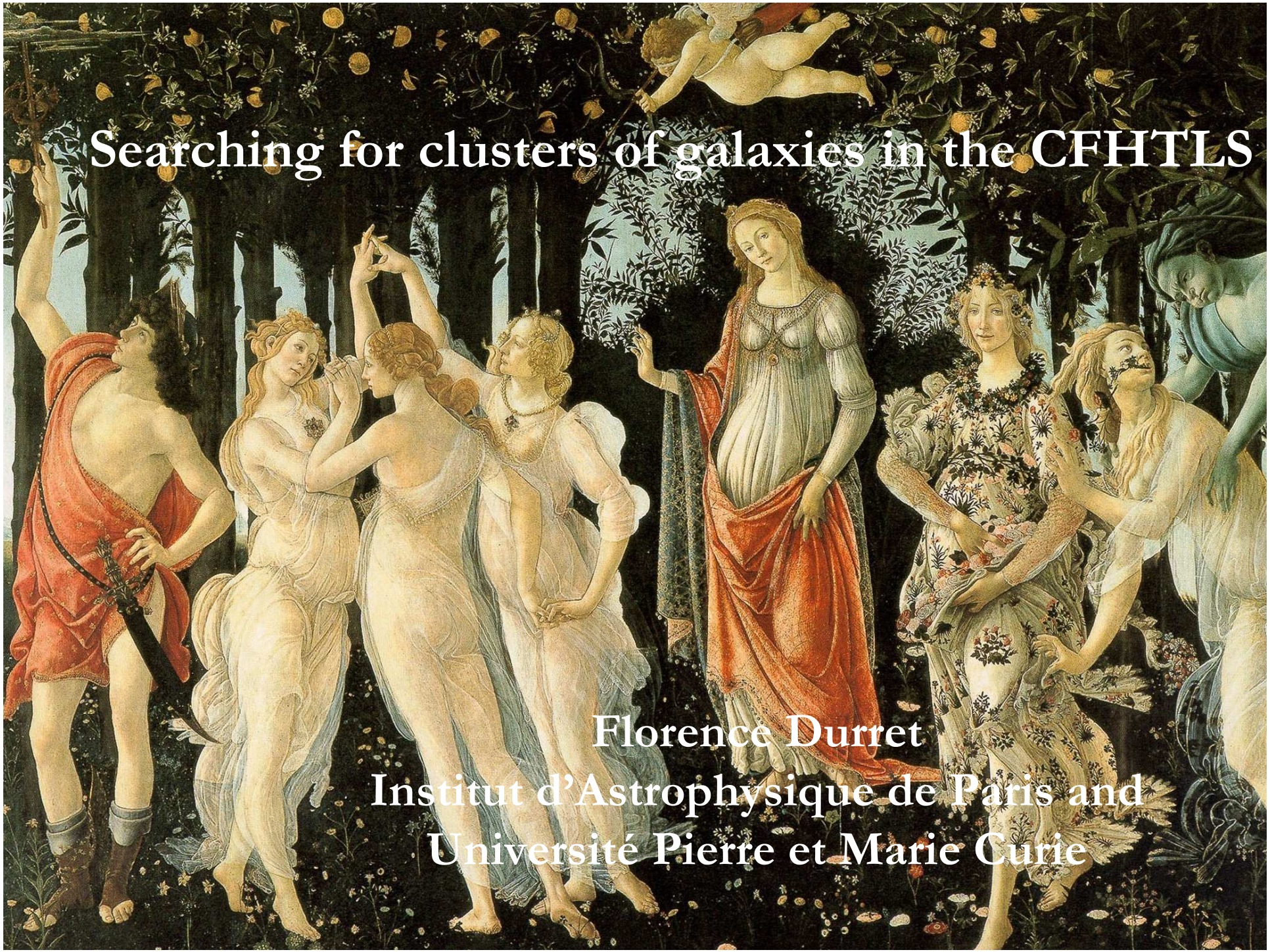


Searching for clusters of galaxies in the CFHTLS

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Collaborators

- Christophe Adami
- Christophe Benoist
- Alberto Cappi
- Jean Coupon
- Olivier Ilbert
- Isabel Márquez
- Sophie Maurogordato
- Alain Mazure
- Students Cédric Mezrag and Thierry Maxwell Edorh

and many others

Papers

- Mazure, Adami, Pierre et al. 2007, A&A 467, 49 (M07)
- Adami, Durret, Benoist, Coupon, Mazure, Meneux, Ilbert, Blaizot et al. 2010, A&A 509, 81 (A10)
- Durret, Adami, Cappi, Maurogordato, Márquez, Ilbert, Coupon et al. 2011, A&A submitted (D11)
- Márquez, Adami, Durret et al. in preparation

Data

- CFHTLS u, g, r, i or y, z bands

- M07: Deep 1 field

- A10:
  - Deep fields: Deep 2, Deep 3 and Deep 4
  - Wide fields: Wide 1, Wide 3 and Wide 4 in data release 4

- D11:
  - Wide fields: Wide 1, Wide 3 and Wide 4 in data release 6

Areas covered

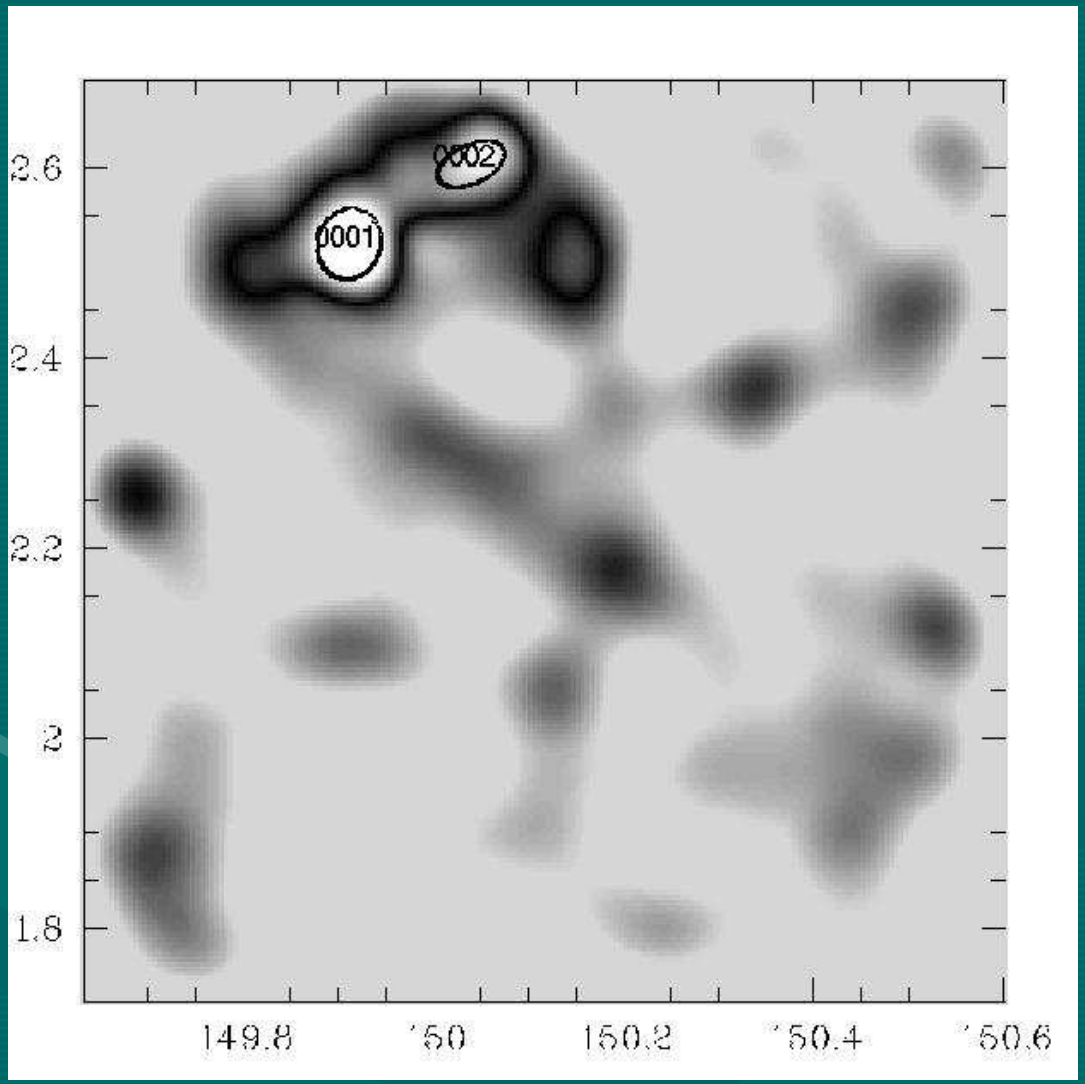
- Deep fields: 1x1 deg^2 each
- Wide fields:

  A10 34 deg^2

  D11 154 deg^2

Method

- Extract galaxy catalogues and apply magnitude limits
  - i<25 for the Deep fields
  - i<23 in A10, z<22.5 in D11 for the Wide fields
- Estimate photometric redshifts for all galaxies with LePhare
- Build galaxy density maps in photo-z bins of 0.1 incremented by 0.05 based on an adaptive kernel technique
- Detect structures in these maps with SExtractor at a chosen significance level (2σ, 3σ, 4σ, 5σ, 6σ, 9σ)
- Assemble the structures detected with a friends-of-friends algorithm (minimal spanning tree)



Example of a density map: Deep 2 field in the]0.65-0.75] redshift bin with two candidate clusters detected at 6σ

Validation on the millennium simulation

- Validate method by applying same procedure to the millennium simulation (modified to be comparable to our data)
- Masses as a function of detection threshold for Deep and Wide fields separately
- Percentages of fake detections as a function of redshift and of detection threshold
- Errors on cluster positions
- Variation of distance from a random distribution as a function of redshift

Results for A10

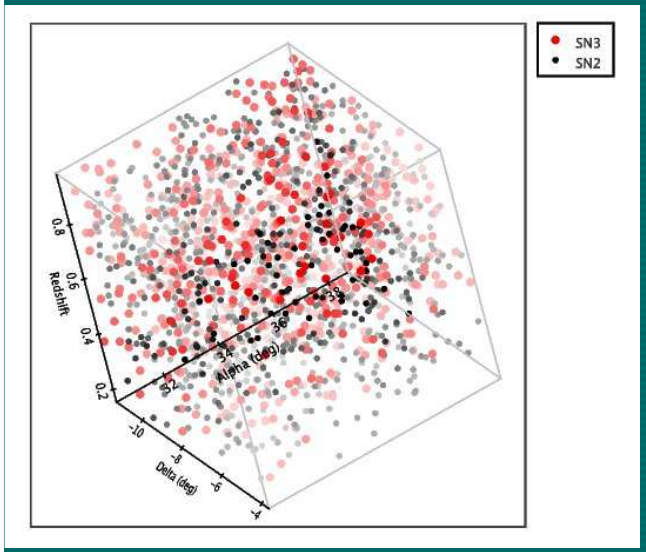
- 1200 cluster candidates

- Cluster candidates at z>= 1
- 141 at 3σ
- 79 at 4σ
- 46 at 5σ
- 31 at 6σ

Results for D11

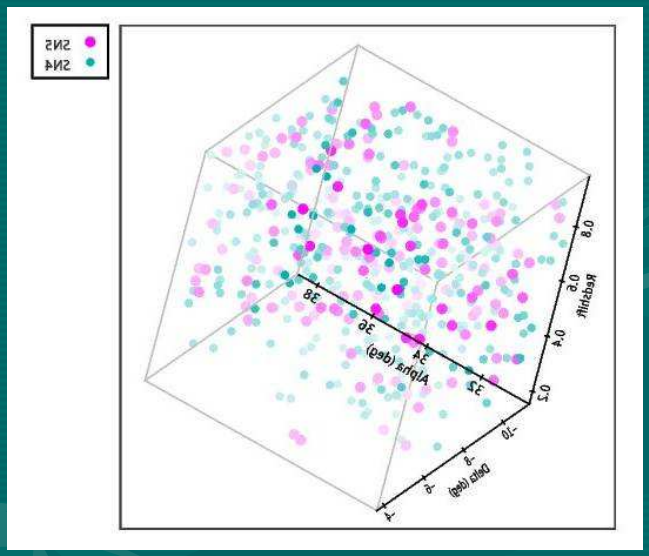
- 4061 cluster candidates detected at >= 3σ
  - redshift range $0.2<z<1.15$
  - masses between $1.3\ 10^{14}$ and $12.6\ 10^{14}\ M_{solar}$
- These cluster candidates have typical cluster properties (colour-magnitude relation, luminosity function)

Spatial distribution in Wide 1

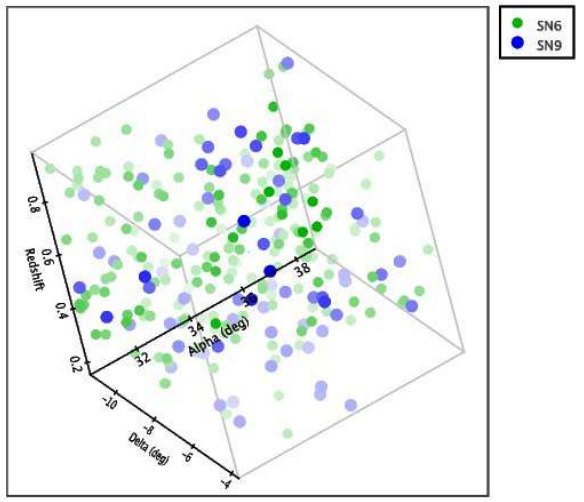


S/N=2 and 3

S/N=4 and 5

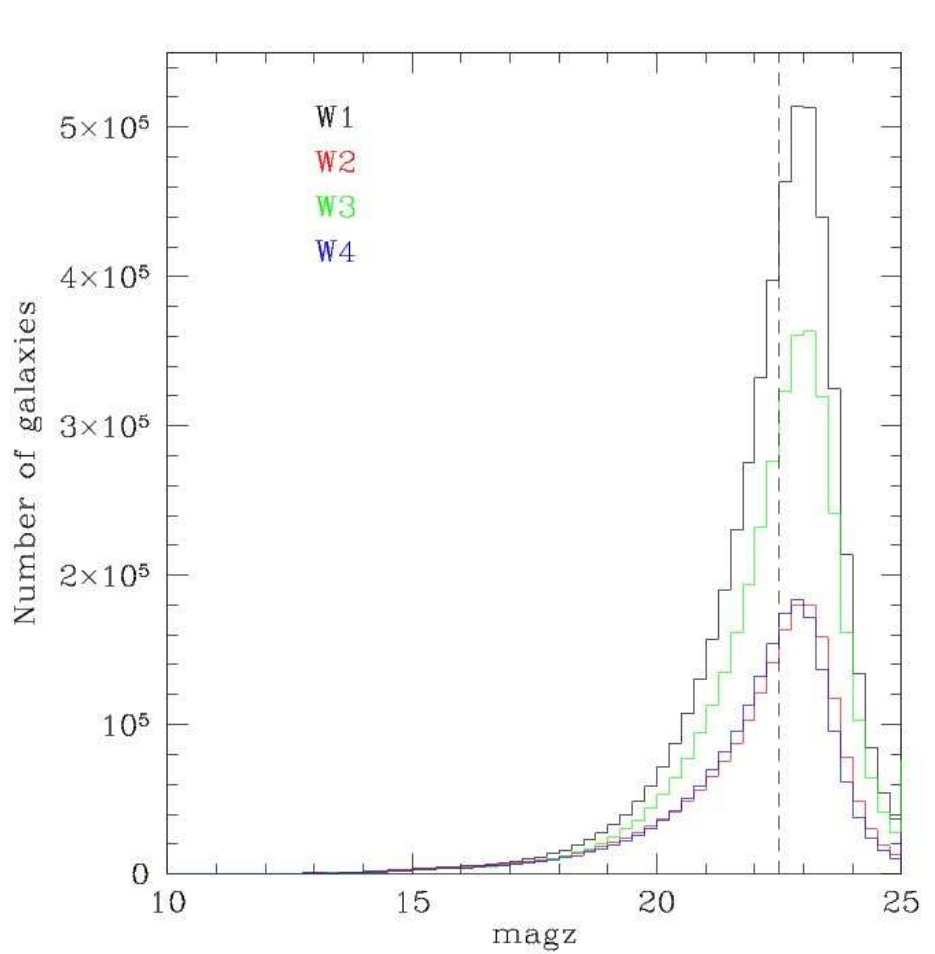


S/N=6 and 9



No obvious concentration or large scale structure visible

Completeness



Cut at magz'=22.5

to avoid incompleteness effects

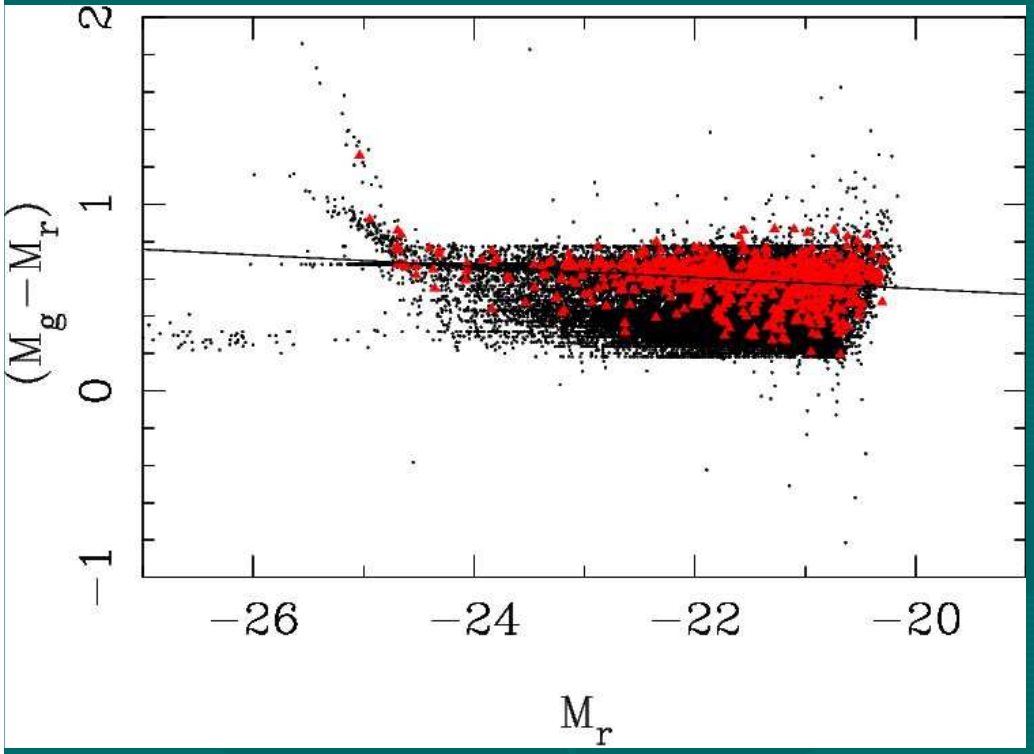
magz'=22.5 corresponds to

$M_{z'}$ = -19.2 at z=0.4

- 21.0 at z=0.8

Properties of 45 stacked clusters

Colour-magnitude relation



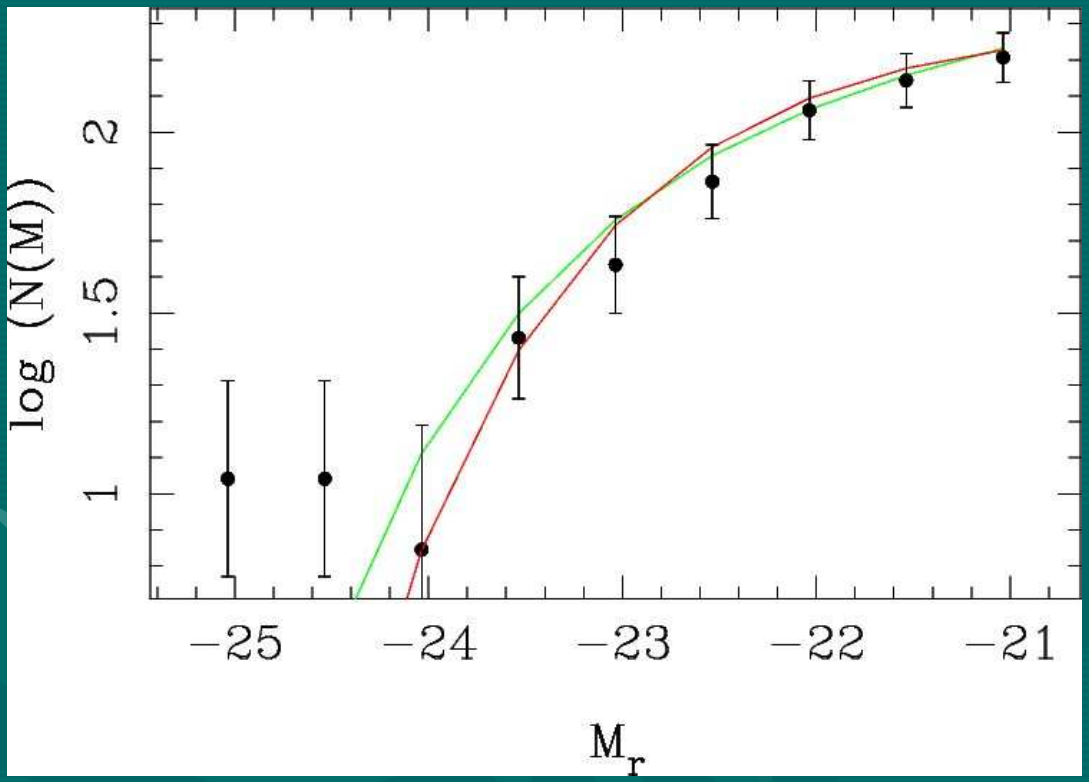
45 clusters detected at >= 3σ by D11, A10 *and* Thanjavur et al. 09

Black points: all the galaxies within R=1 Mpc of cluster centers and within ±0.1 of cluster redshifts

Line: best fit to the CMR

Red points: galaxies within ± 2σ of this relation

Galaxy luminosity function



Galaxy luminosity function of the galaxies selected for the 45 stacked clusters (red points in previous figure)

Green: best fit Schechter function

α=-1.16 ± 0.04

M*=-23.00 ± 0.93

Φ^* = 312 ± 15

Red: best fit Schechter function after excluding brightest points

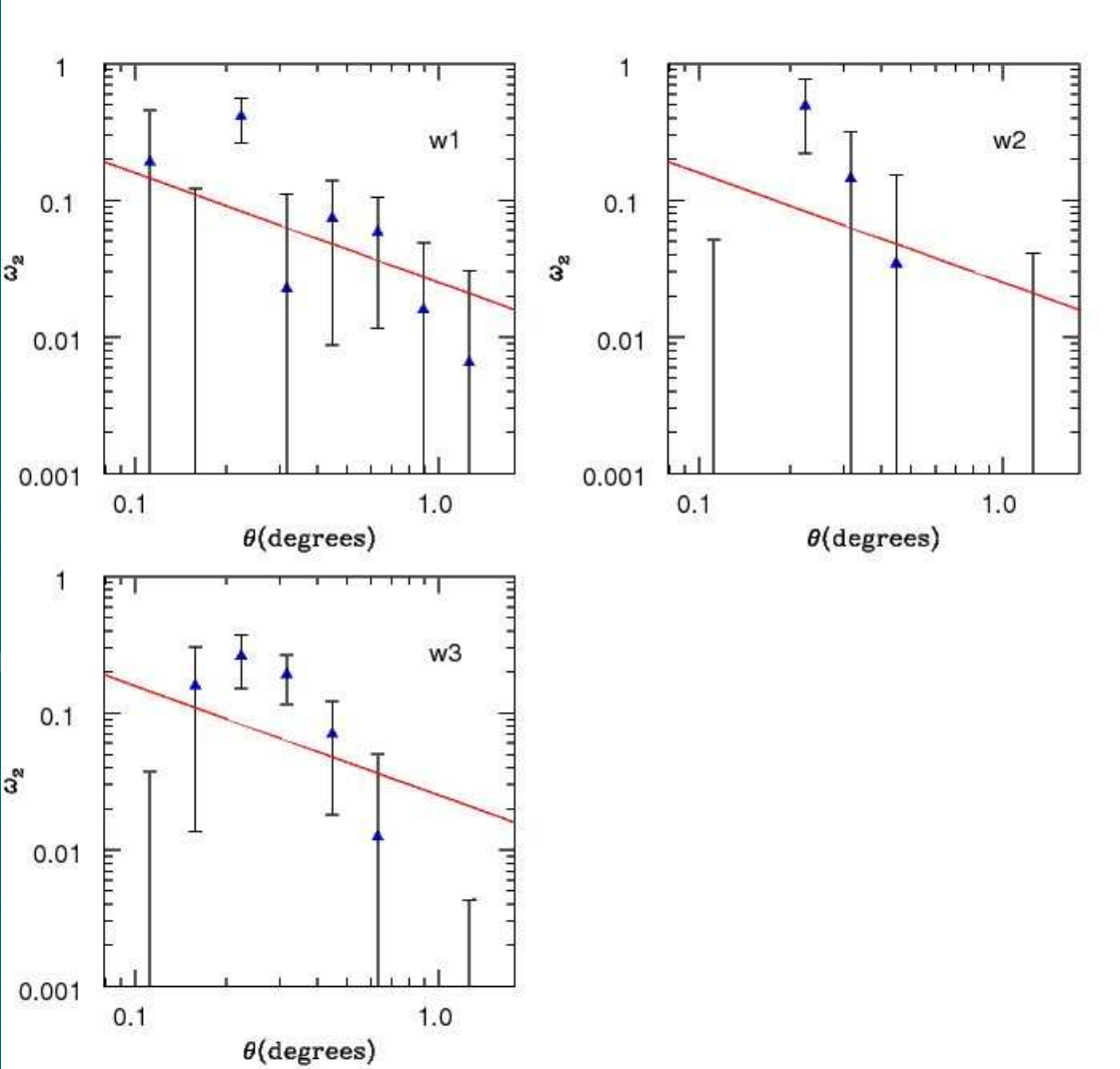
α=-0.97 ± 0.27

M*=-22.49 ± 0.43

Φ^* = 237 ± 98

Excess of bright galaxies over Schechter function

Angular correlation function



Sample: all clusters at $>=6\sigma$ with $0.3<z<0.9$

Angular correlation function

$\omega_{cc} = (\theta/\theta_0)^{\delta}$ with $\delta \sim 0.8$

Red line:

$\omega_{cc} = (\theta/0.01)^{-0.8}$

Data consistent with expected power law within the large error bars

Large scale structure around candidate clusters

Mean significantly detected galaxy concentrations analysed as a function of:

- distance to cluster center
- detection level of clusters
- Magnitude
- redshift…

In progress

- Full analysis of all the clusters: individual colour-magnitude relations, galaxy luminosity functions, Schechter function fits

- Global properties of candidate clusters stacked by mass intervals (for example)