ALHAMBRA Morphologies: Rest-frame I-band morphologies vs. Spectral type for M>5x10^10 galaxies from z=1

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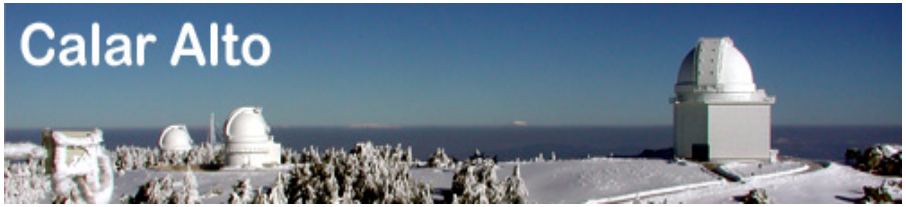
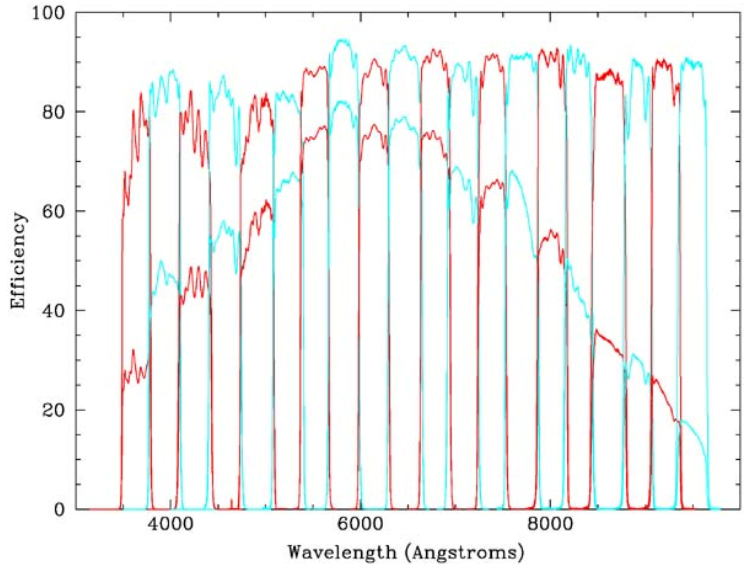
ALHAMBRA Survey





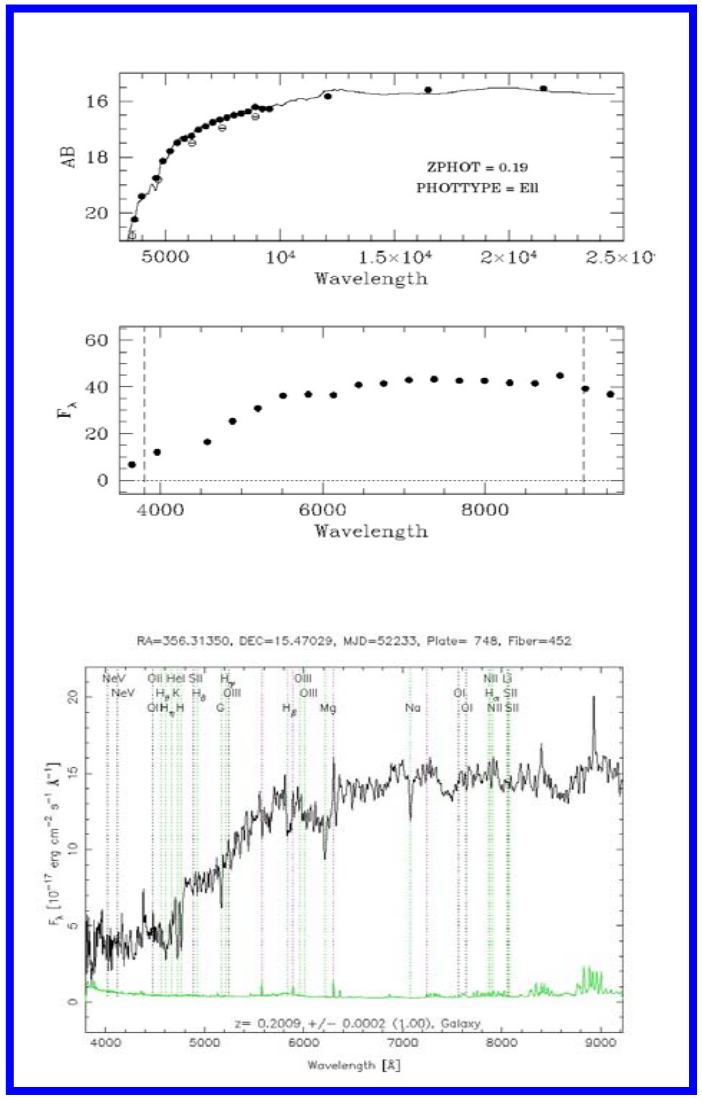
- The main goal of ALHAMBRA project is the determination of accurate photometric redshift using photometry information
- ALHAMBRA was designed to cover all the visible spectral domain with 20 equal wide filters + J,H and K filters to optimize the accuracy of z and SED determinations (see Benitez et al. 2009).
- Precursors: CADIS (Meisenheimer et al. 1998); COMBO-17 (Wolf et al. 2001).
- COMBO-17: UBVRI+12 medium band filters. They reach 1% of error in z at R=21.0 in 1 deg^2
- ALHAMBRA will get about 1 million z, with accuraty less than 3% down to 25 AB magnitude.

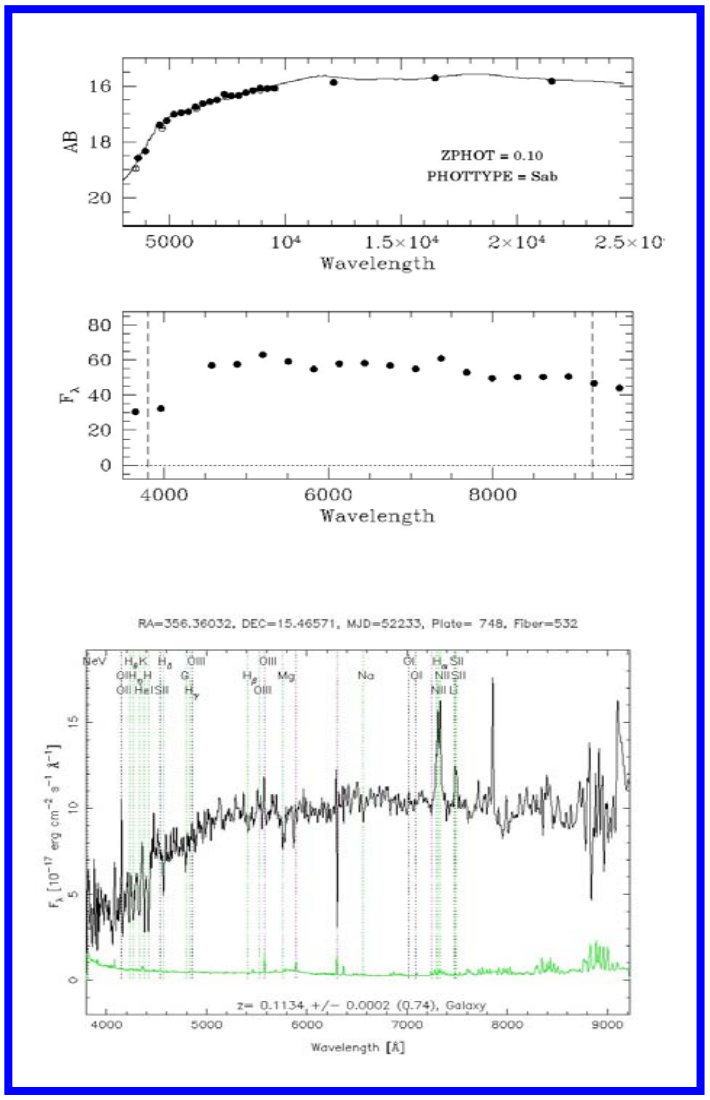
More information: Moles et al. 2008; http://www.iaa.es/alhambra

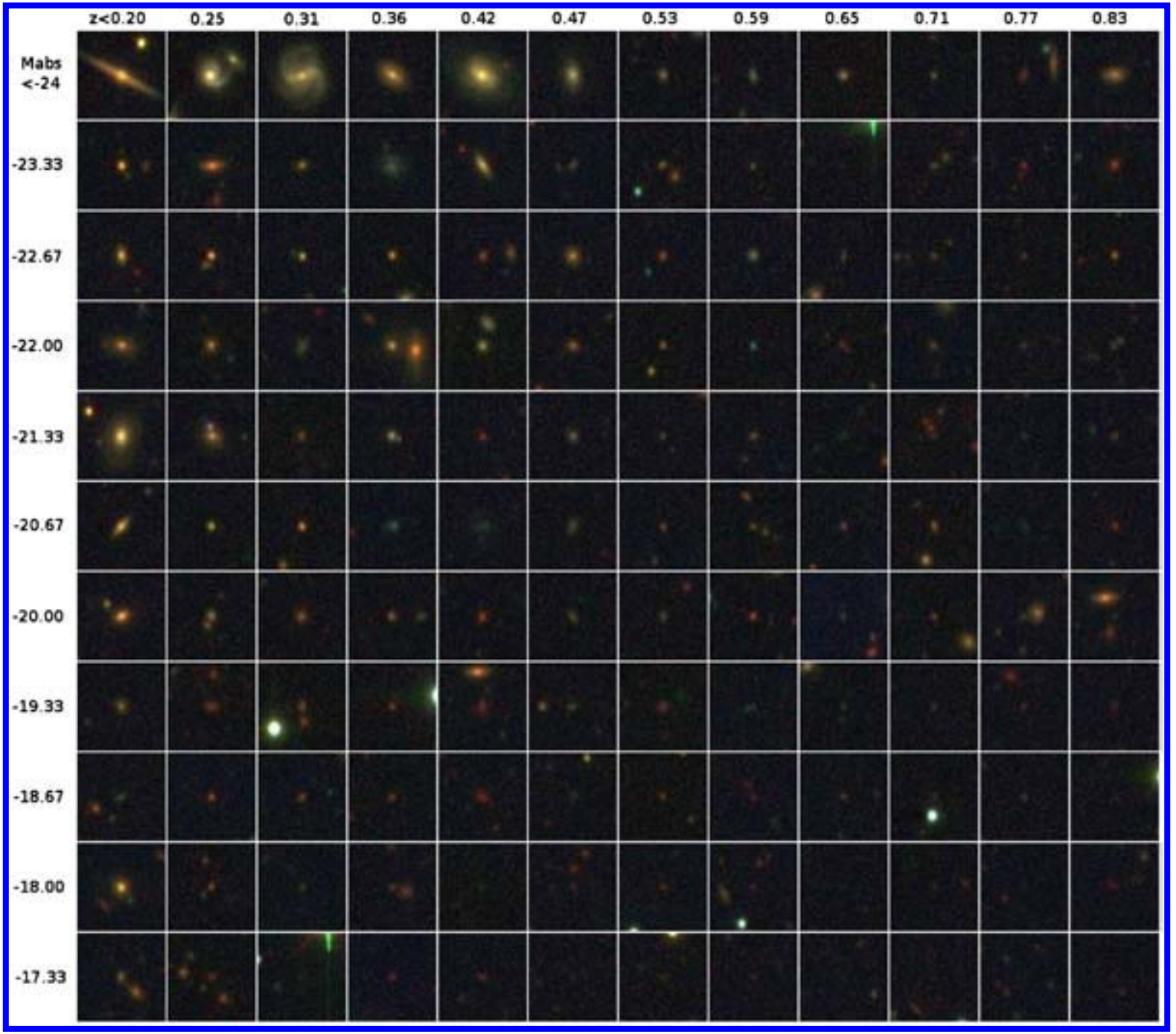
About filter system: Benitez et al. 2009

Galaxy number counts: Cristobal-Hornillos et al. 2009

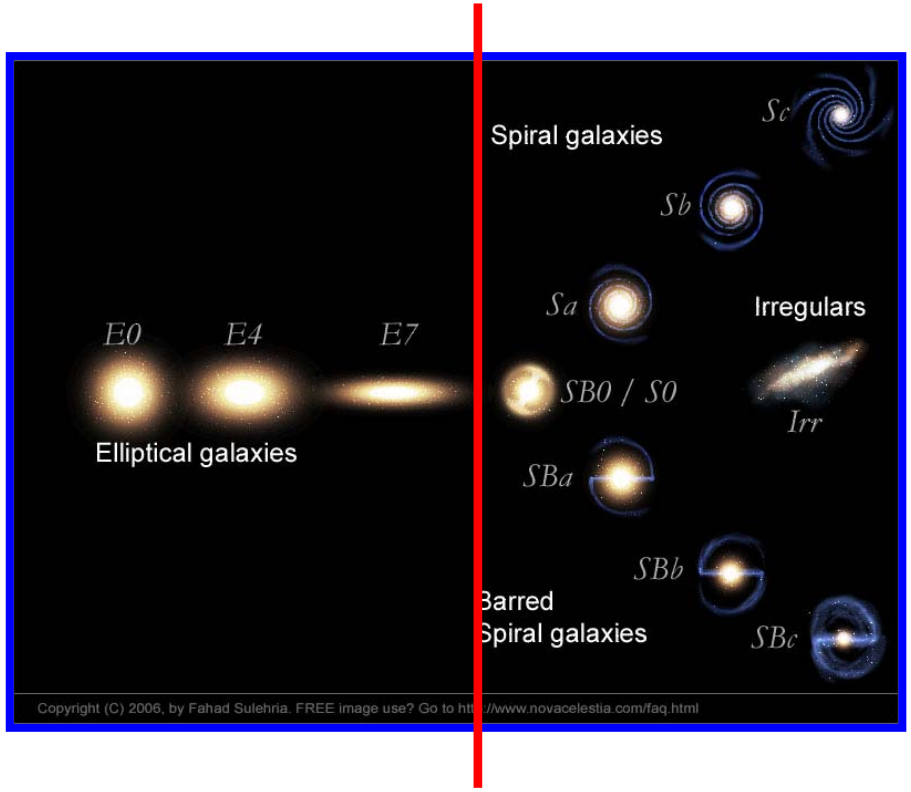
ALHAMBRA Survey






z<0.20
0.25
0.31
0.36
0.42
0.47
0.53
0.59
0.65
0.71
0.77
0.83
Mabs
<-24
-23.33
-22.67
-22.00
-21.33
-20.67
-20.00
-19.33
-18.67
-18.00
-17.33

Galaxy morphology



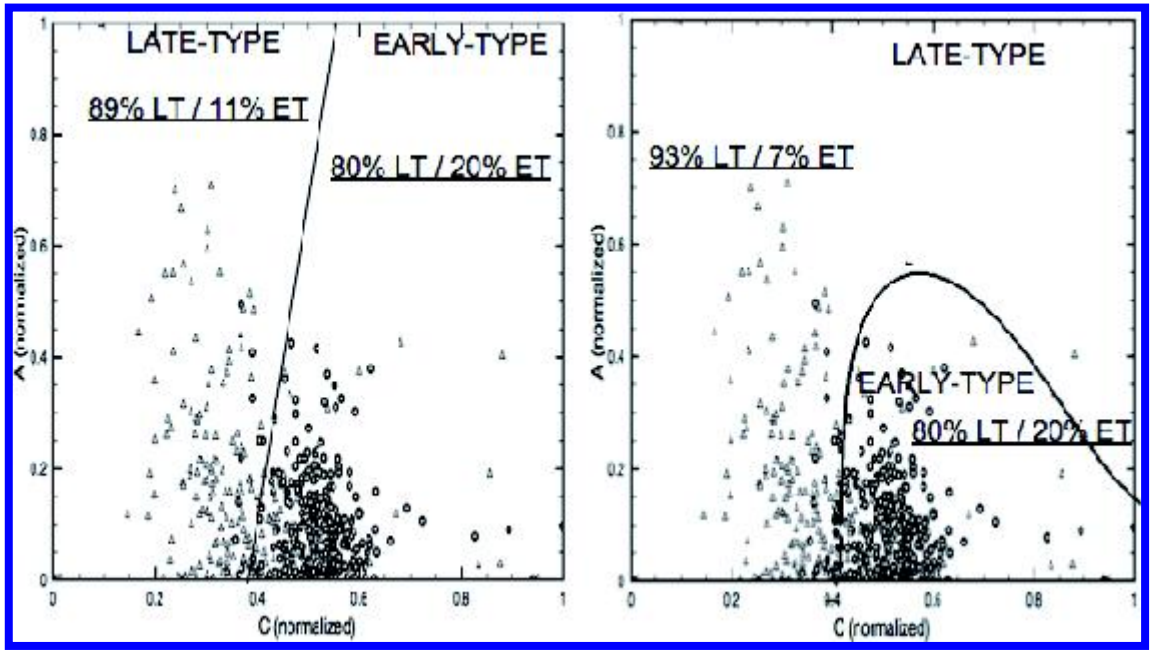
Early-type galaxies
25% in number
60% in mass

Late-type galaxies
75% in number
40% in mass

- Determine the galaxy morphology is a visual task.
- Automatical galaxy classifications try to emulate the human eye
  - Parametric procedures: Fit of the galaxy stuctural components (see e.g. Prieto et al. 2001; Aguerri et al. 2004, 2005; Mendez-Abrue et al. 2008)
  - Non-Parametric procedures: colors, light-concentration, Asymmetry, ….
- Present day: bimodal distribution of galaxies (Early/Late)
- Who is builded the Hubble sequence?
  - Mass assembly
  - Luminosity evolution
  - Star formation evolution

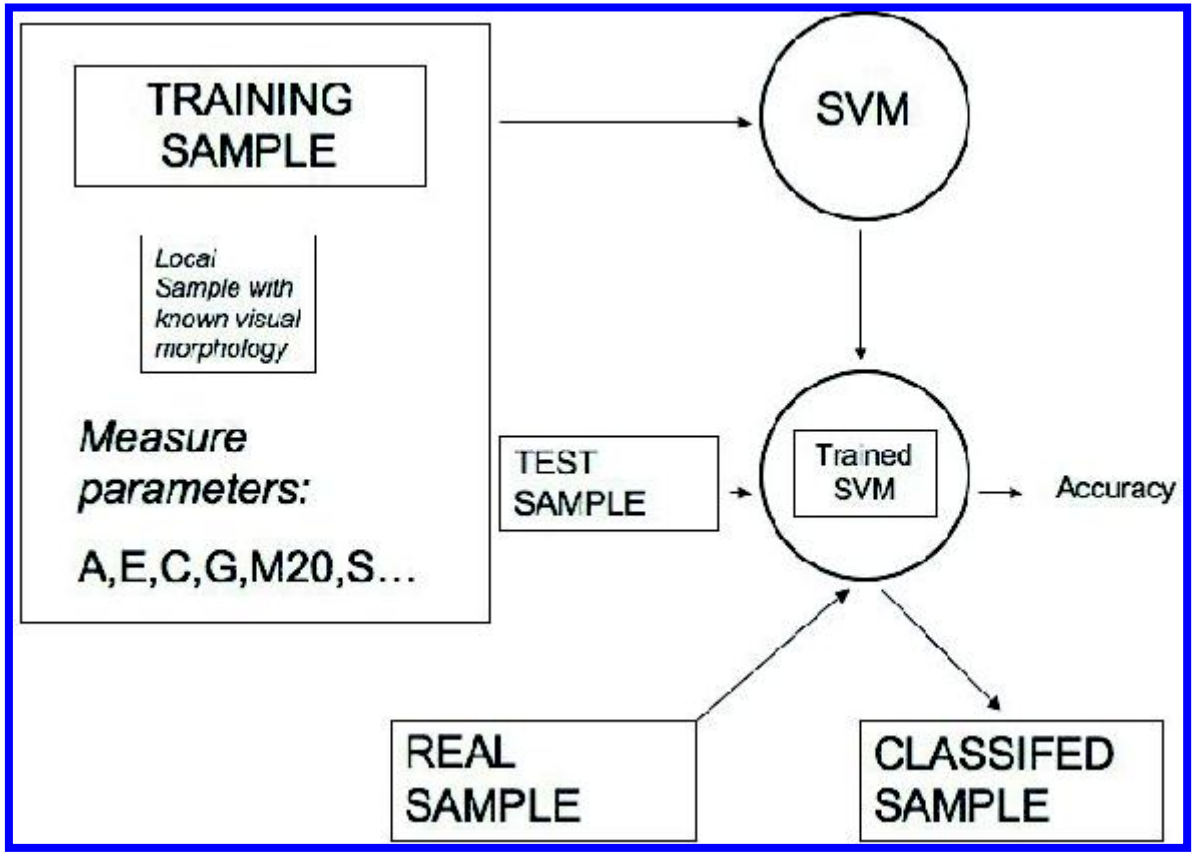
Galaxy morphology

The galaxy morphology in the ALHAMBRA images was determined using the GALSVM code (Huertas-Company et al. 2007)

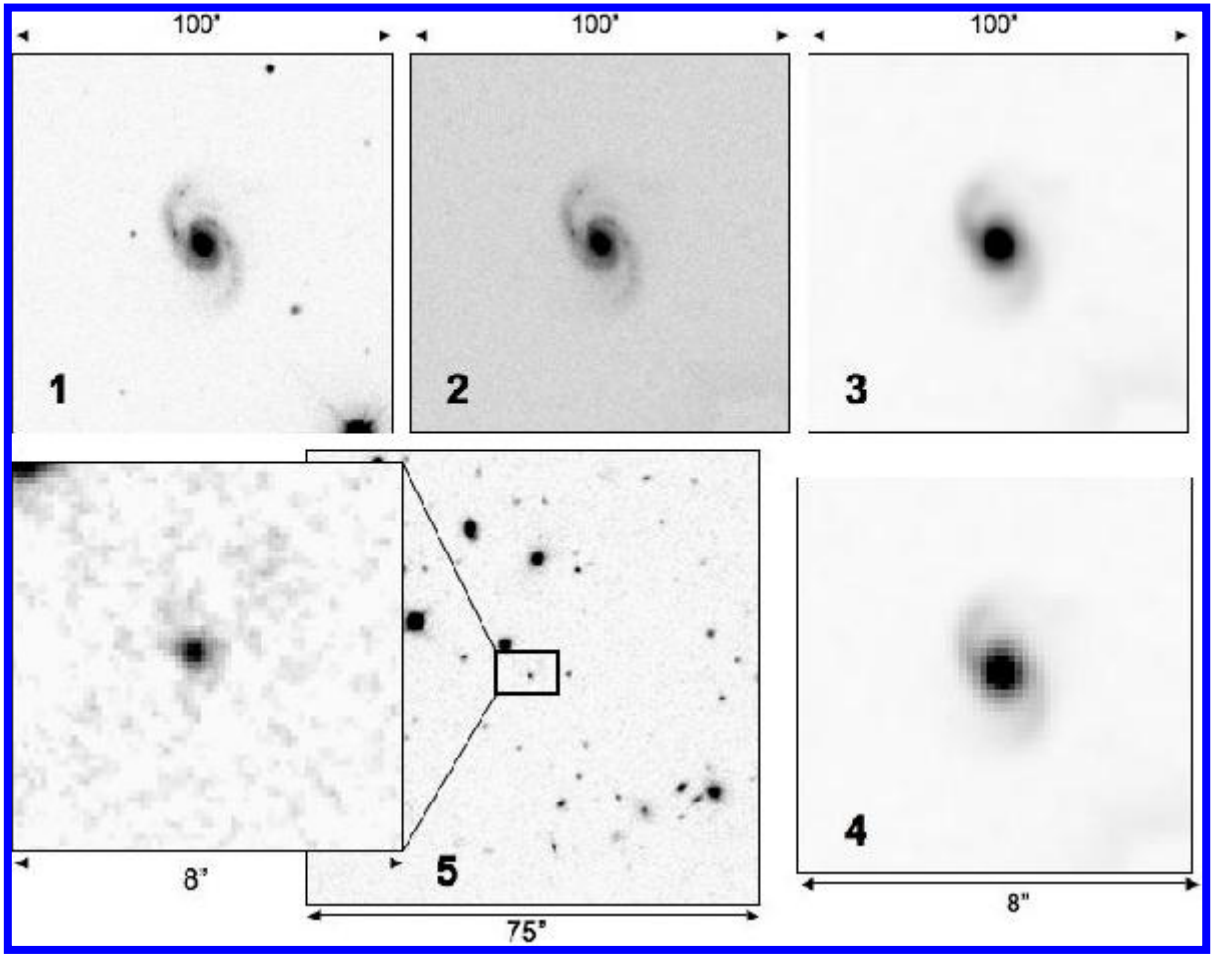


- Non-parametric method based on a particular family of learning machines: Suport Vector Machines (SVM)
- Generalization of classical C/A classifications but with more dimensions and non-linear boundaries between regions.

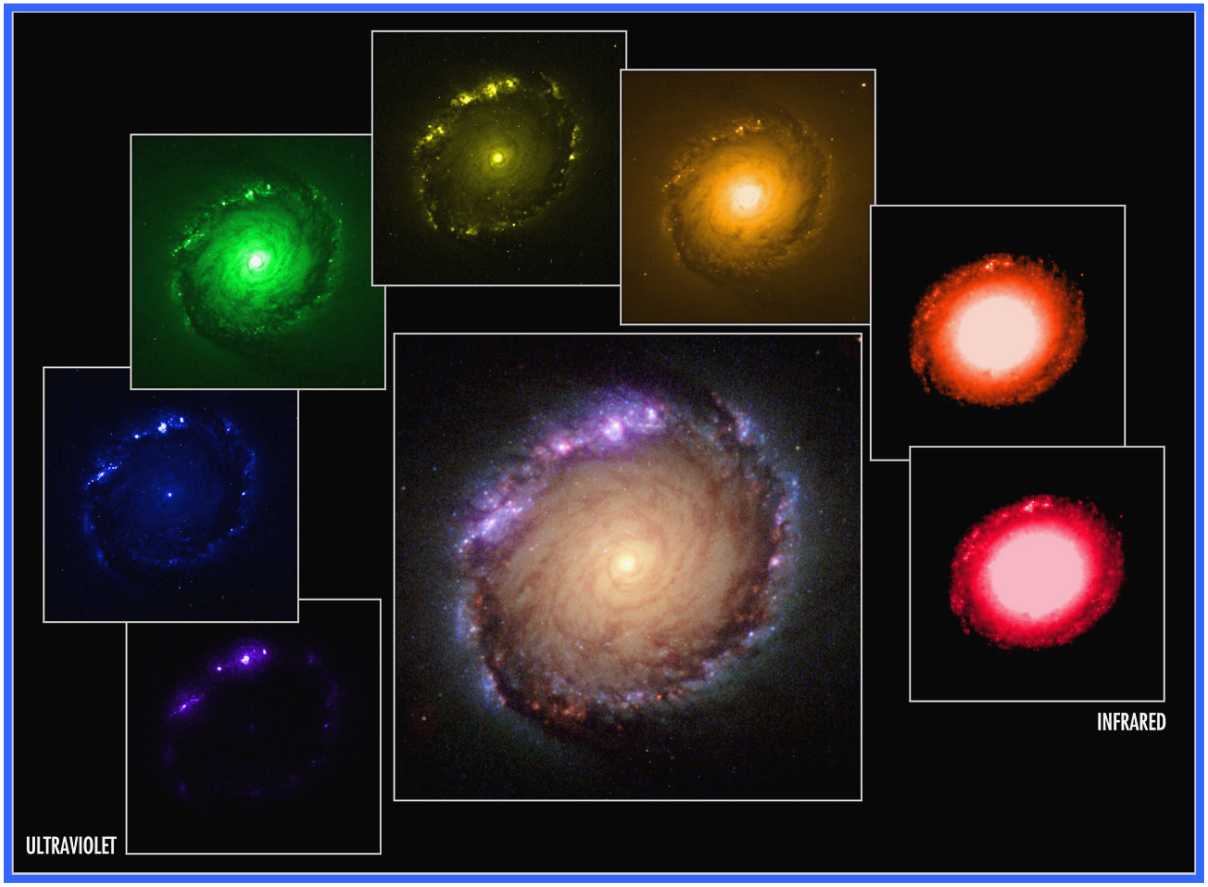
Galaxy morphology

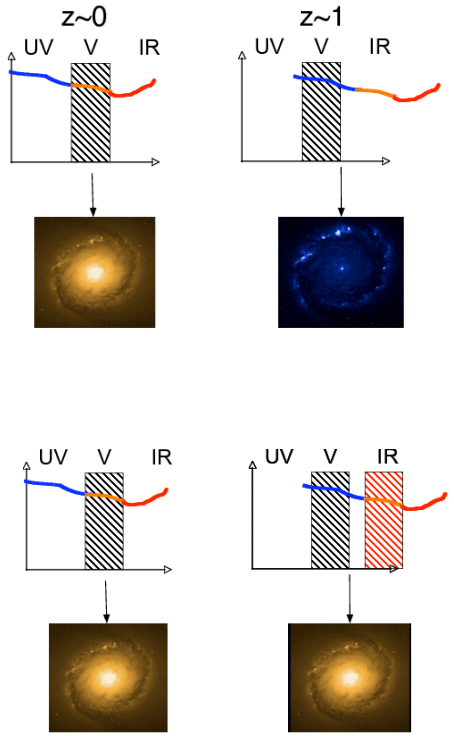


Galaxy morphology

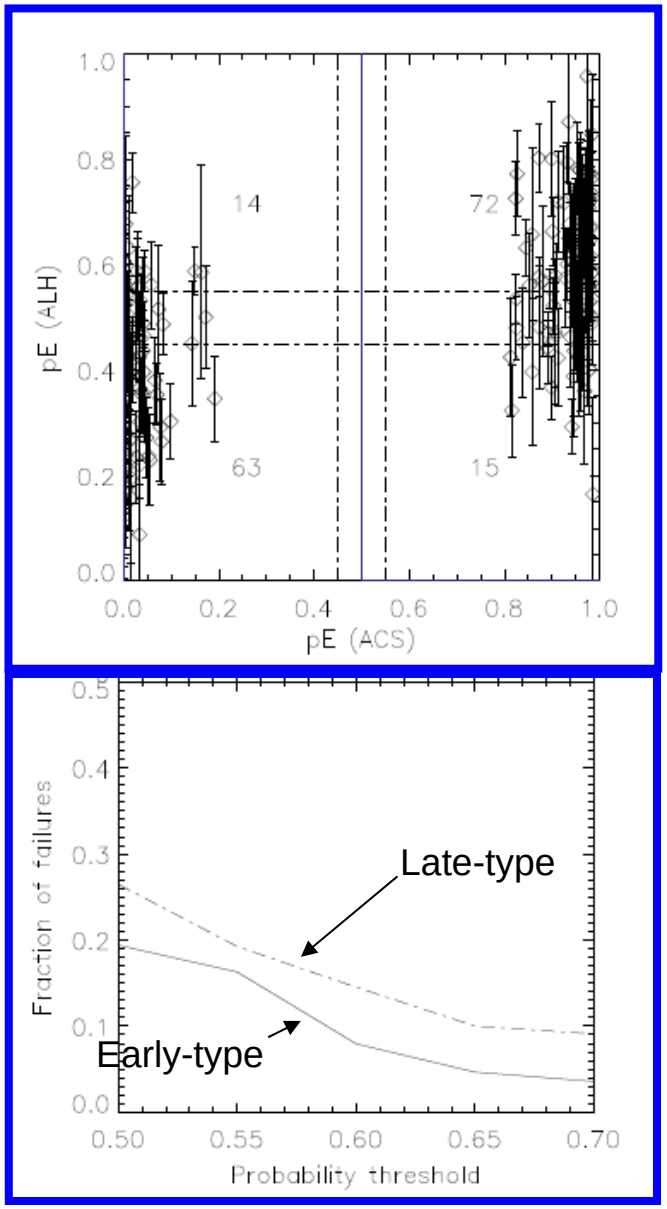


Galaxy morphology



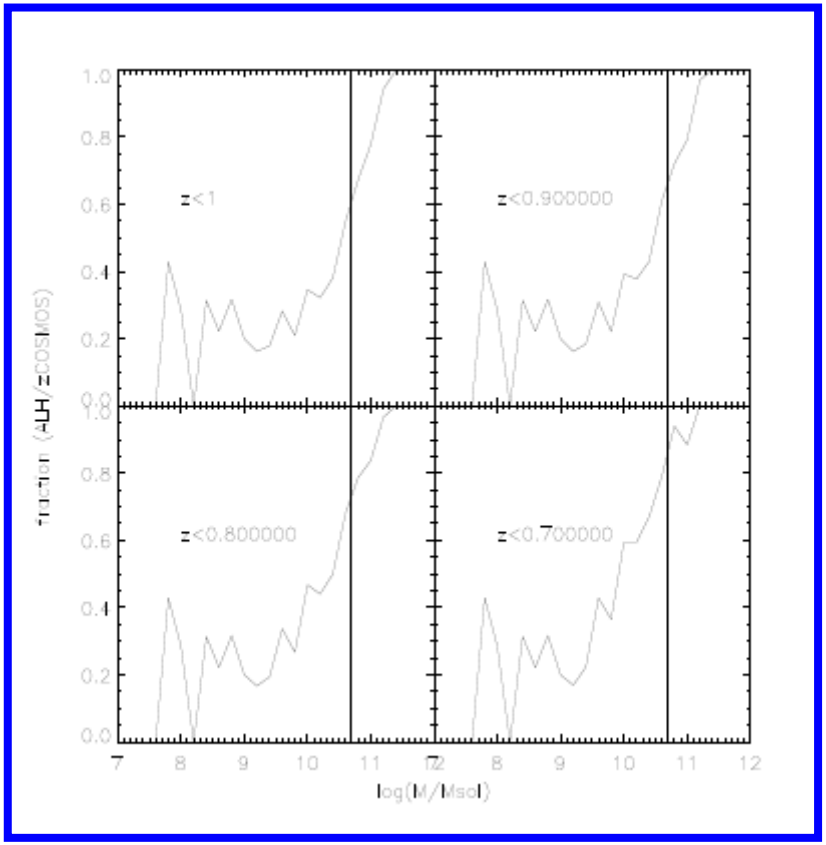


ALHAMBRA morphology



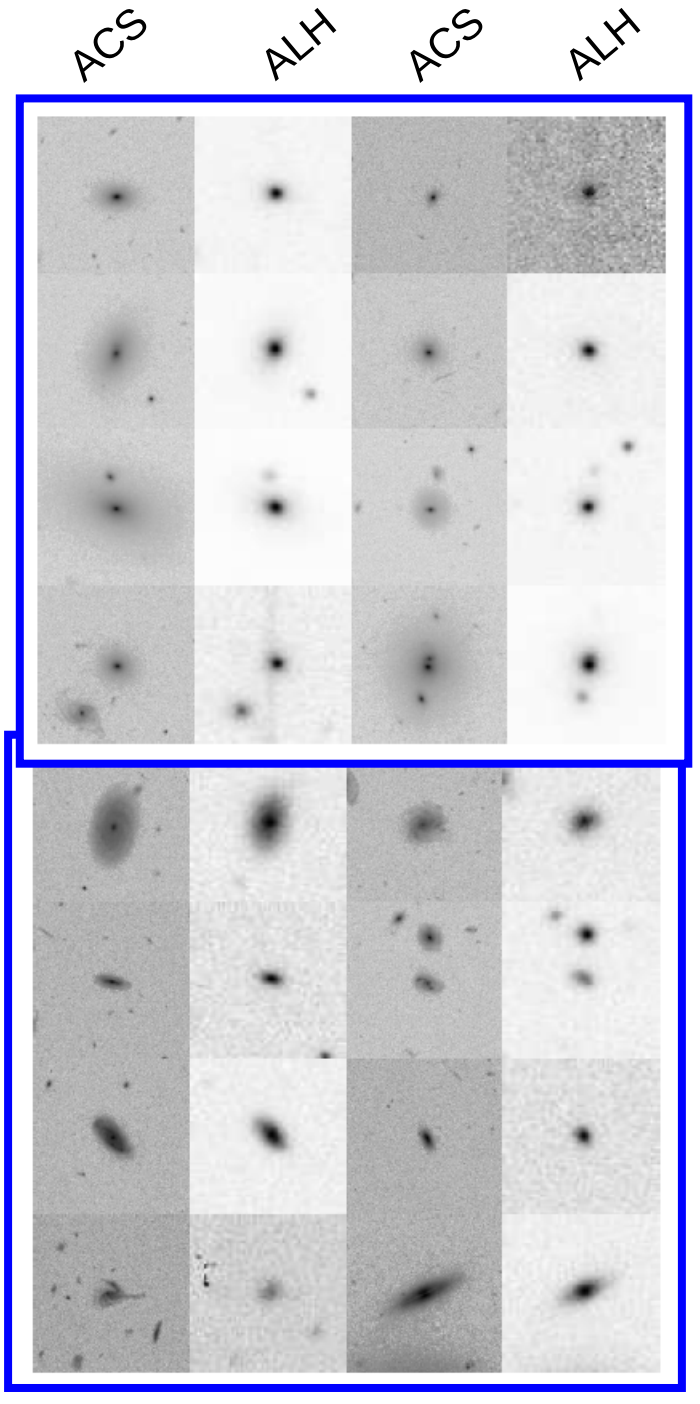
- ALHAMBRA observes in 8 fields of 0.5 square degree each. One of the fields (ALH-4) is part of the COSMOS field
- We have classified the galaxies down to I(AB)=21.5 in the ALHAMBRA-4 field.
- We have compared the HST and ALHAMBRA morphologies.
- The fraction of contamination depends on the probability adopted for splitting early and late-type galaxies.
- Probabilities larger than 0.65 ensure to have less than 10% of missclasified galaxies.

ALHAMBRA morphology

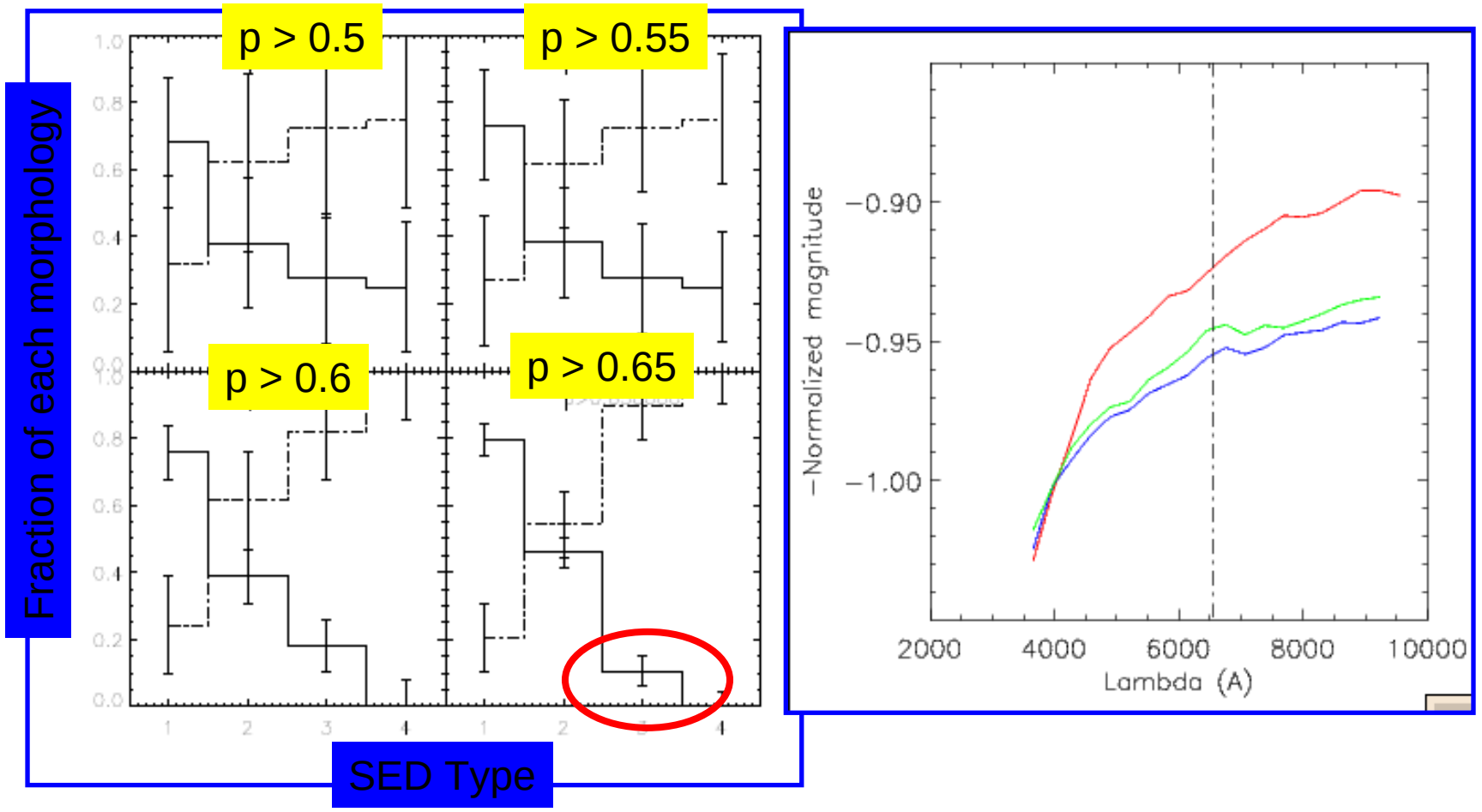


Early-type

Late-type

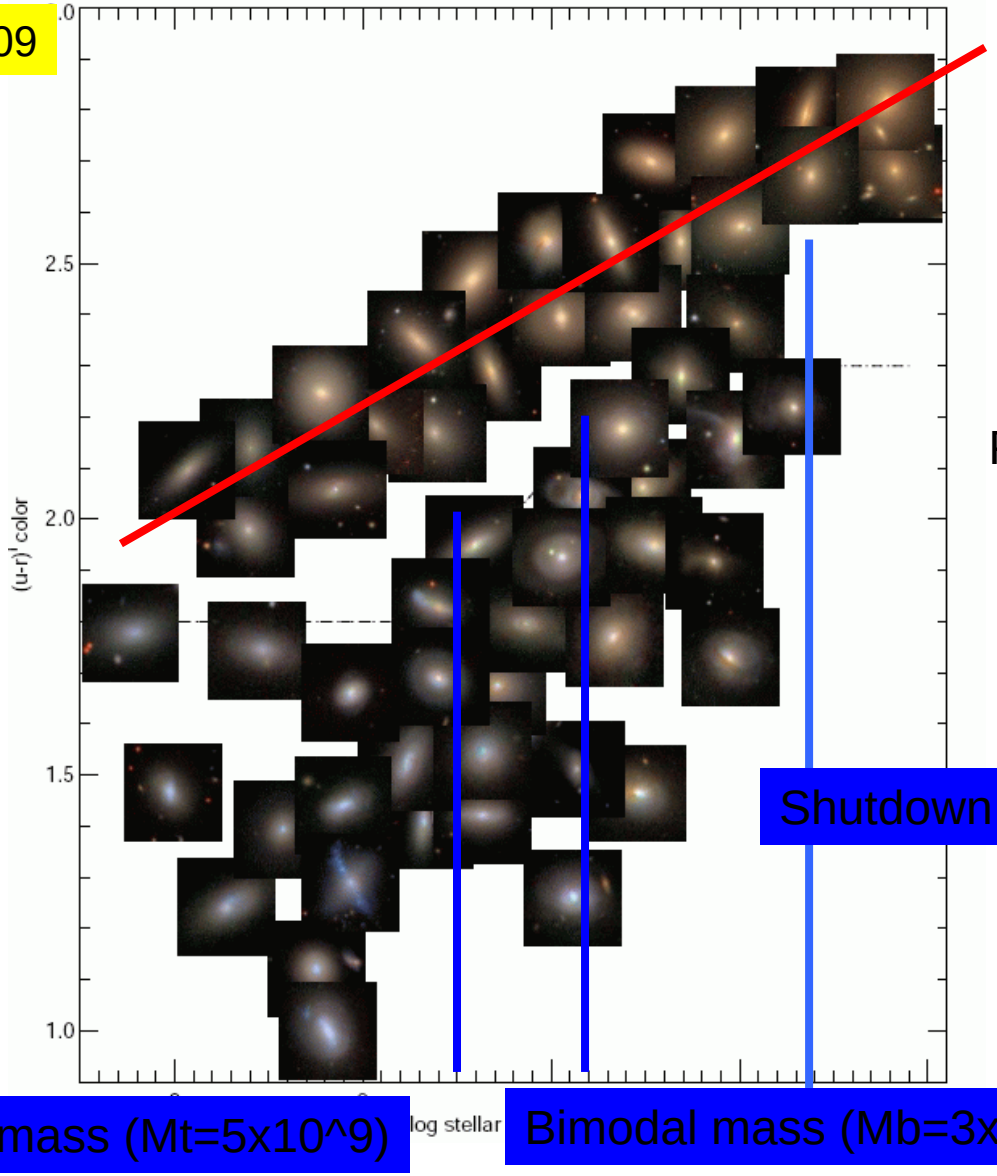


ALHAMBRA morphology



Blue early-type galaxies in the nearby Universe

Kannappan et al. 2009



Red Sequence

Post-merger galaxies

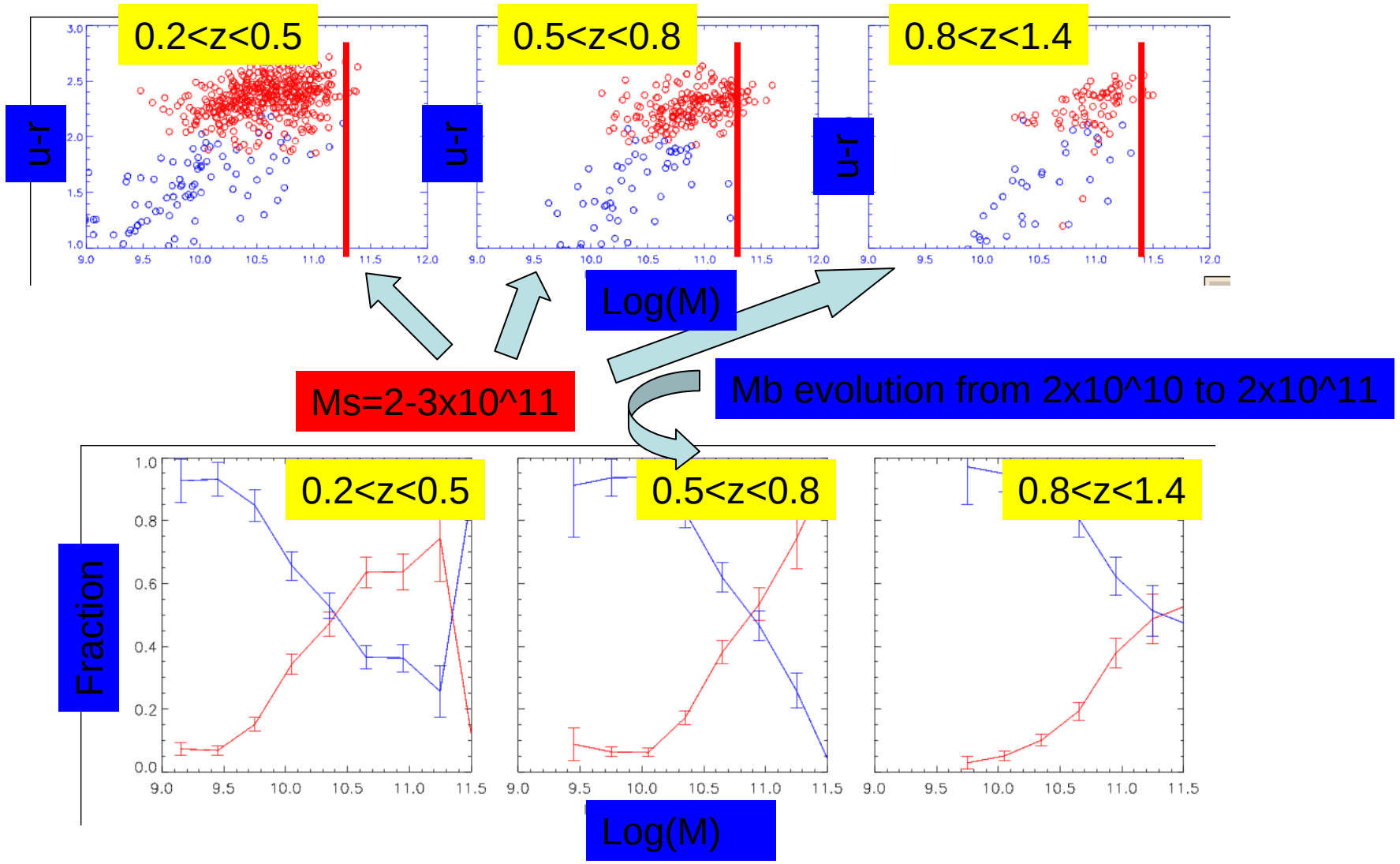
Disk build-up

Shutdown mass (Ms=2x10^11)

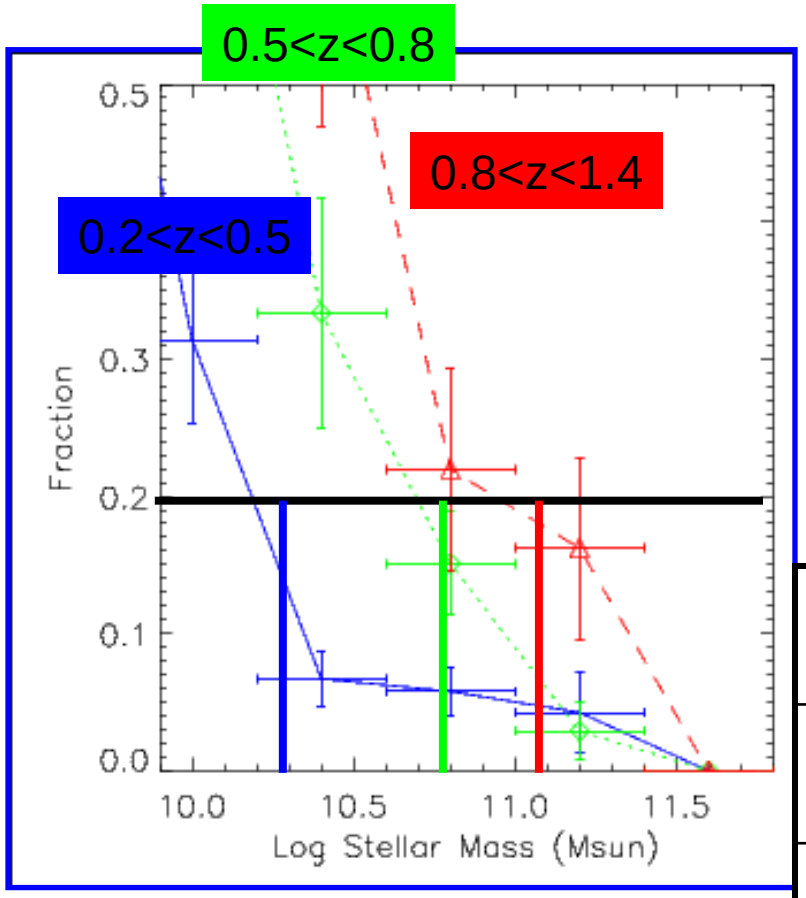
Threshold mass (Mt=5x10^9)

Bimodal mass (Mb=3x10^10)

Blue early-type galaxies at z<1.5



Blue early-type galaxies at z<1.5

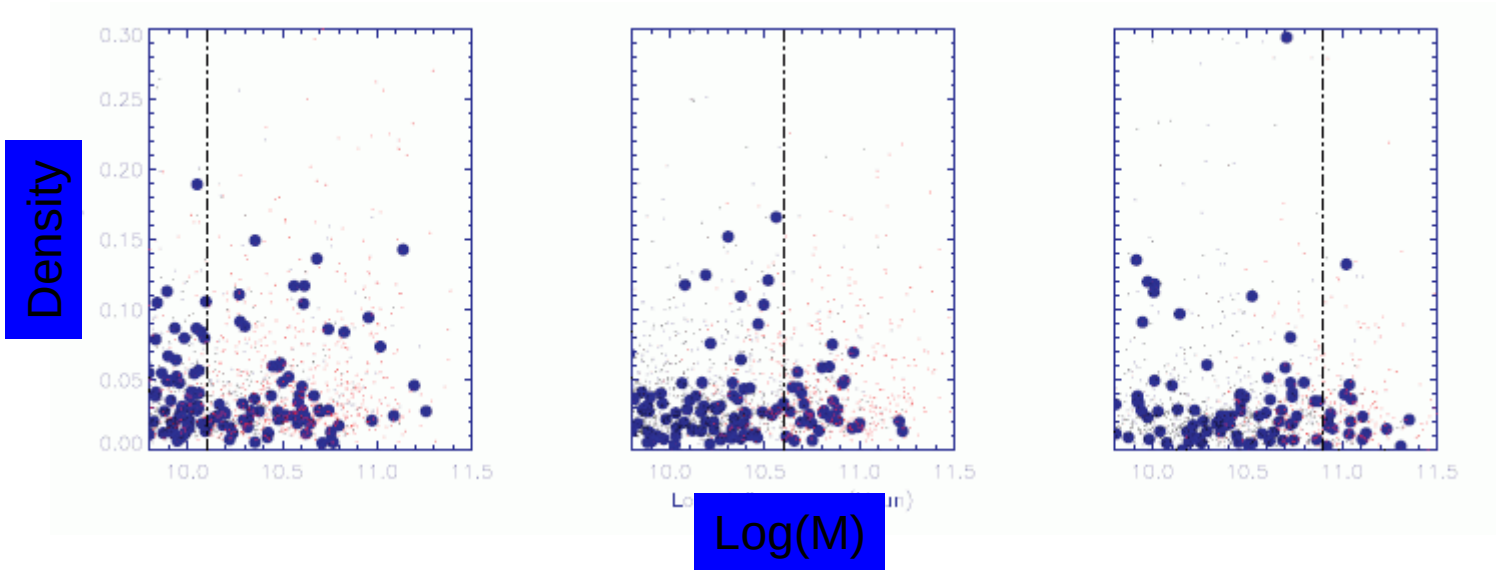


The shutdown mass is constant with z

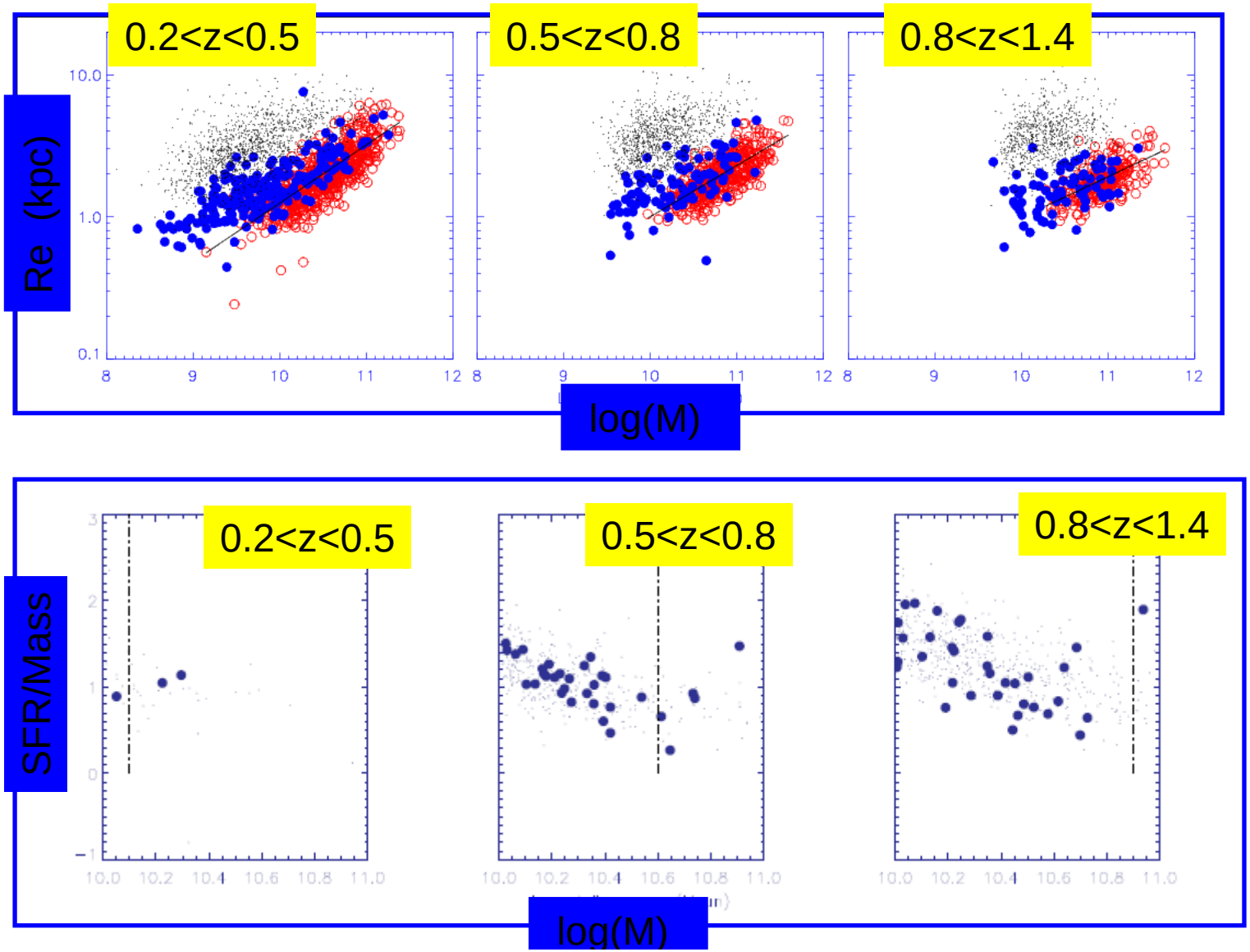
The bimodal and threshold masses evolved together

Log(M)	Z=0	0.2<z<0.5	0.5<z<0.8	0.8<z<1.5
Log(Ms)	11.5	11.5	11.5	11.5
Log(Mb)	10.1	10.4	10.8	11.3
Log(Mt)	9.7	10.1	10.5	11.1

Blue early-type galaxies at z<1.5



Blue early-type galaxies at z<1.5



Conclusions

- We can obtain the automatical morphology of galaxies in ALHAMBRA data until z<1 and log(M)>10.5
- About 10% of the early-type galaxies show late-type spectra (blue early-type galaxies)
- There is no evolution in the shutdown mass with redshift
- The bimodal and transition masses evolved with redshift, being larger at higher redshits.
- Blue early-type galaxies live in low density environments
- Low mass blue early-type galaxies show larger sizes than red early-types but smaller than late-type ones.
- The SFR per unit mass of blue early-type galaxies is similar to normal sprials for those with masses smaller than the bimodal mass
- Small blue early-type galaxies could be galaxies forming the disc as at z=0.