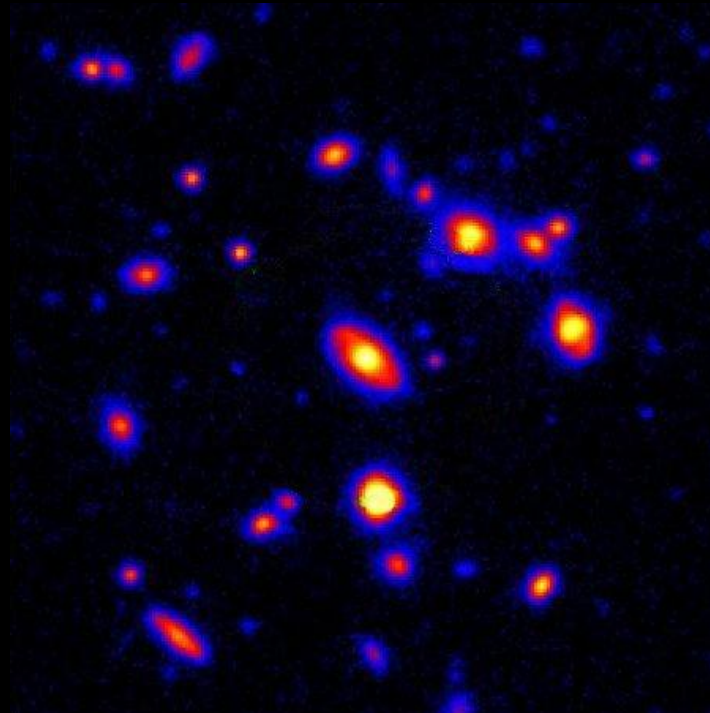


Stellar populations and the IMF of early-type galaxies in ALHAMBRA

EWASS 2013

(Turku, Finland 8-12 July 2013)



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CEFCA

(Centro de Estudios de Física del Cosmos de Aragón)

J. Cenarro (Supervisor)

Motivation

“Study of Stellar Populations of Massive Spheroids over a range in Redshift”

1. Development of generic tools for analyzing Multifilter surveys (ALHAMBRA, SHARDS, J-PLUS and J-PAS) to retrieve the main stellar population parameters.
2. Size effects: Stellar populations of compact and extended galaxies with redshift.
3. IMF constrains.

Analysis Techniques

Mixing
2 SSPs

INPUT

Spectral libraries
(SSP SEDs)

Photometric System

Multifilter
magnitudes/fluxes +
Errors

Early-types
of multifilter
surveys

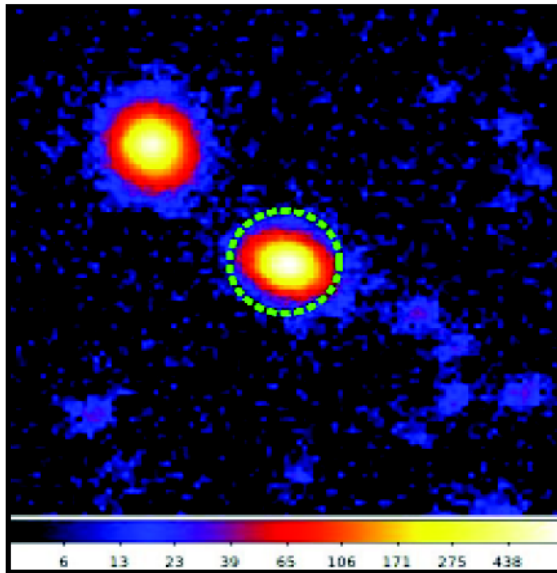
Code
 χ^2

OUTPUT

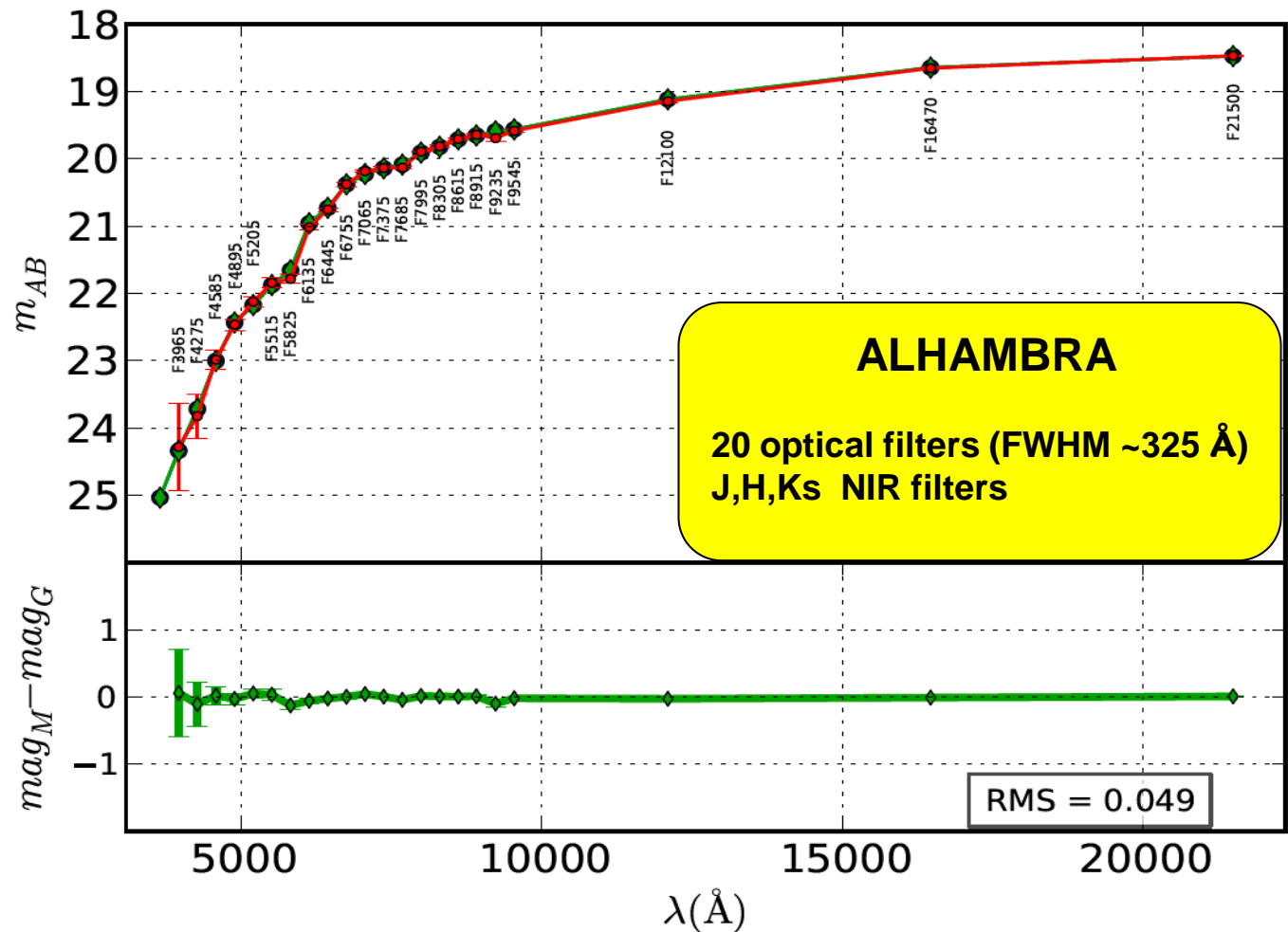
Redshift
L.W. Age
L.W. Metallicity
Extinction
Stellar mass
Emission lines
Stellar IMF

+ All parameter
errors

Analysis Techniques – Output example



$z \sim 0.45$
 Age ~ 3.5 Gyr
 $[Fe/H] \sim 0.4$
 $A_v \sim 0.0$
 Log Mstar ~ 11
 IMF \sim Chabrier



Stellar Populations of a Sample of Early-Type galaxies in the ALHAMBRA Survey

Studies using our generic CODE + ALHAMBRA Early-type Galaxies

1. Test case: Ages, metallicities and stellar masses of the Early-type galaxies and the IMF influence.
2. The IMF variation (ongoing work).

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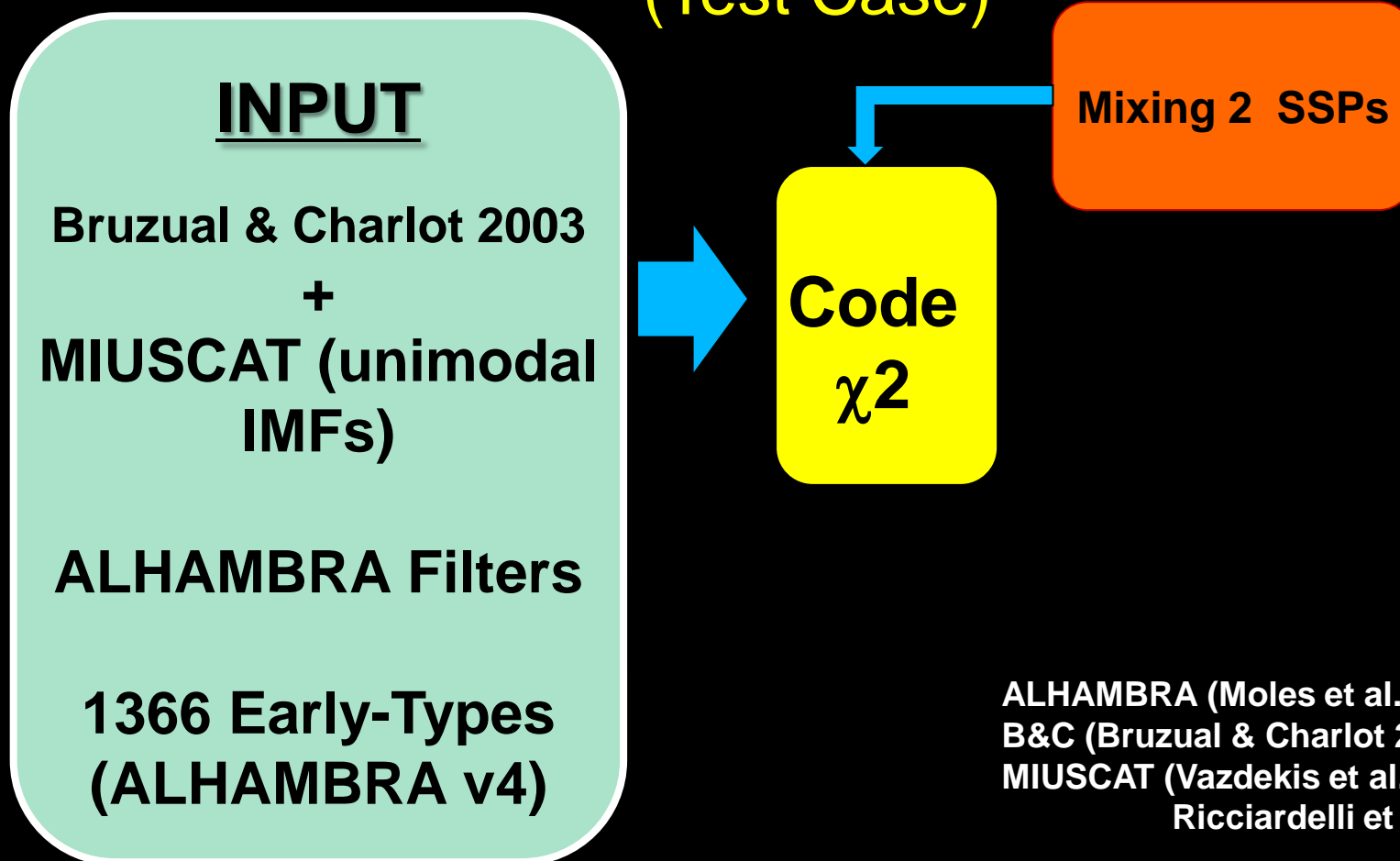
Stellar Populations of a Sample of Early-Type Galaxies in the ALHAMBRA Survey (Test Case)

Early-type Galaxies (ALHAMBRA photometry)
Selection Criterion:

1. Galaxies classified as Early-Type in the morphological ALHAMBRA catalog (Povic, M.; Huertas, M. et al. 2013)
2. Pure Ellipticals (Contamination < 10%)
3. $m_{AB} < 23$ (ALHAMBRA Filter F613)

**Number of sources:
1366**

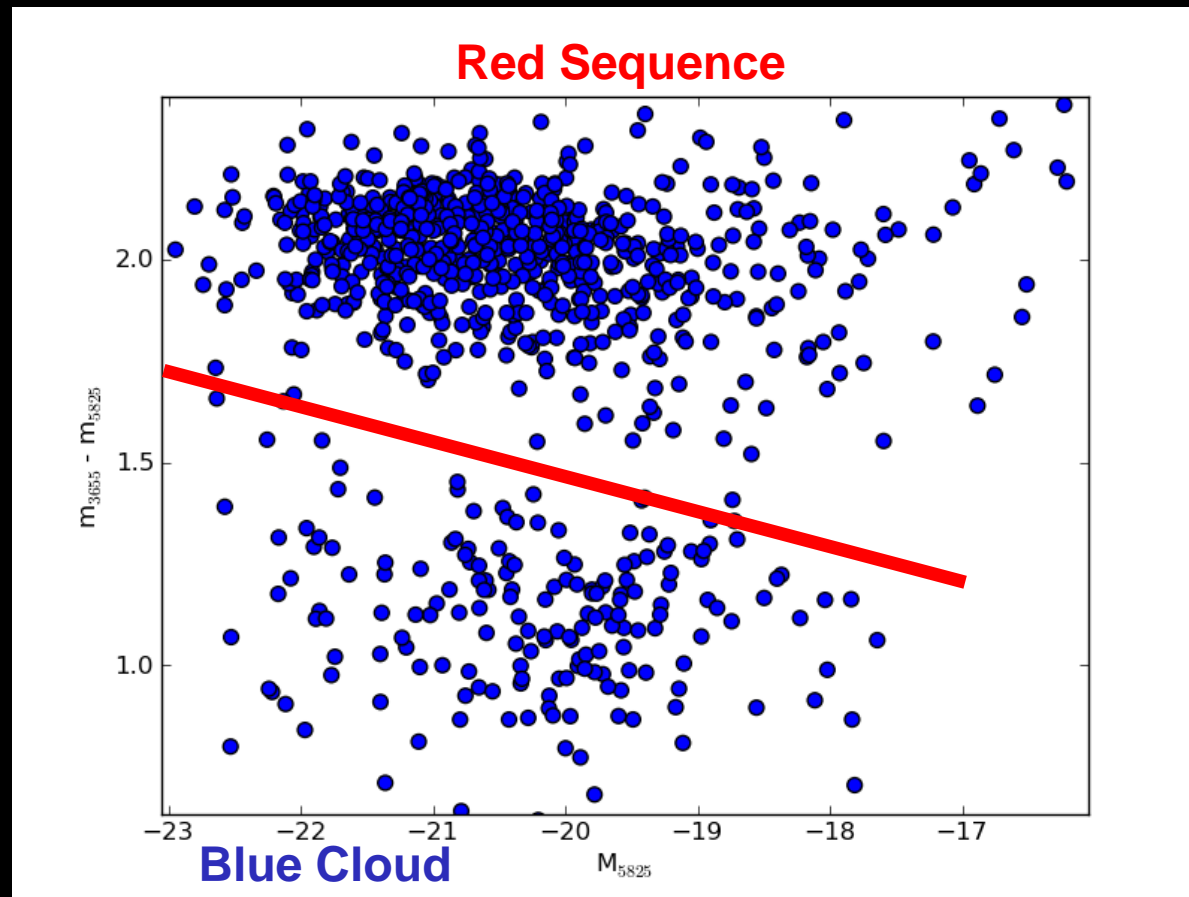
Stellar Populations of a Sample of Early-Type Galaxies in the ALHAMBRA Survey (Test Case)



ALHAMBRA (Moles et al. 2008)
B&C (Bruzual & Charlot 2003)
MIUSCAT (Vazdekis et al. 2012;
Ricciardelli et al. 2012)

Stellar Populations of a Sample of Early-Type Galaxies in the ALHAMBRA Survey (Test Case)

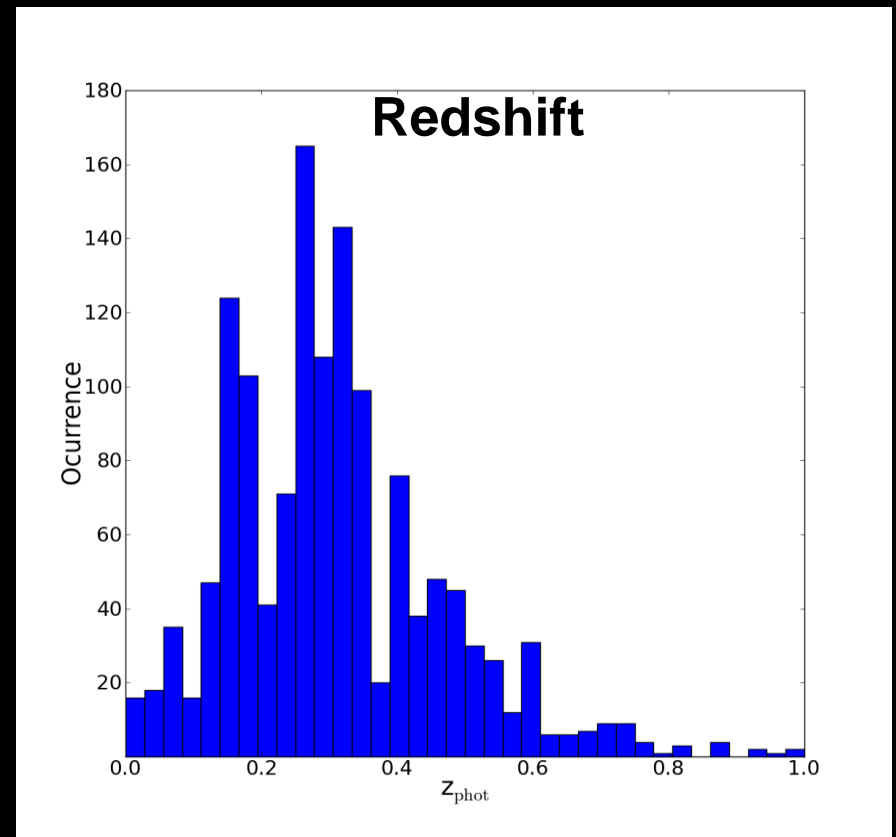
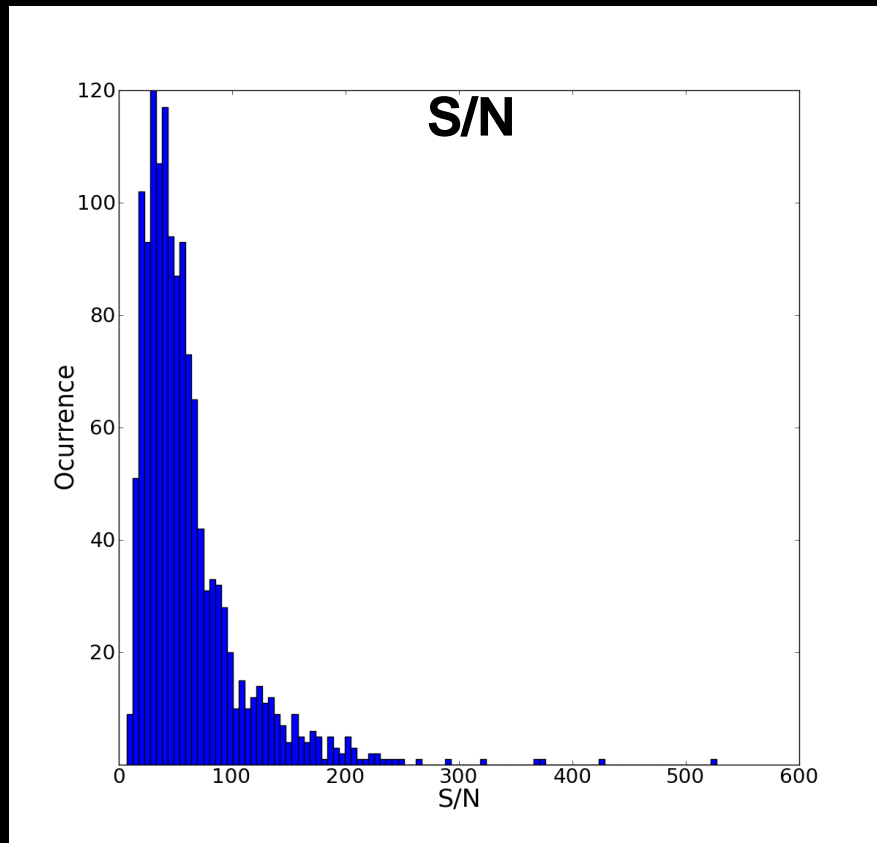
CMD



Bell et al. 2004
ApJ 608 752



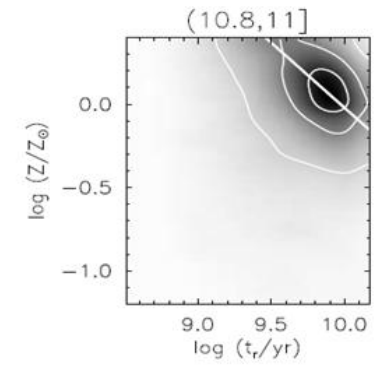
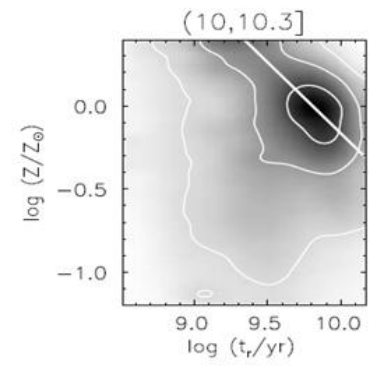
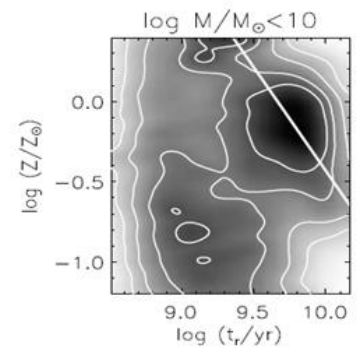
Stellar Populations of a Sample of Early-Type Galaxies in the ALHAMBRA Survey (Test Case) Galaxy Sample Characteristics



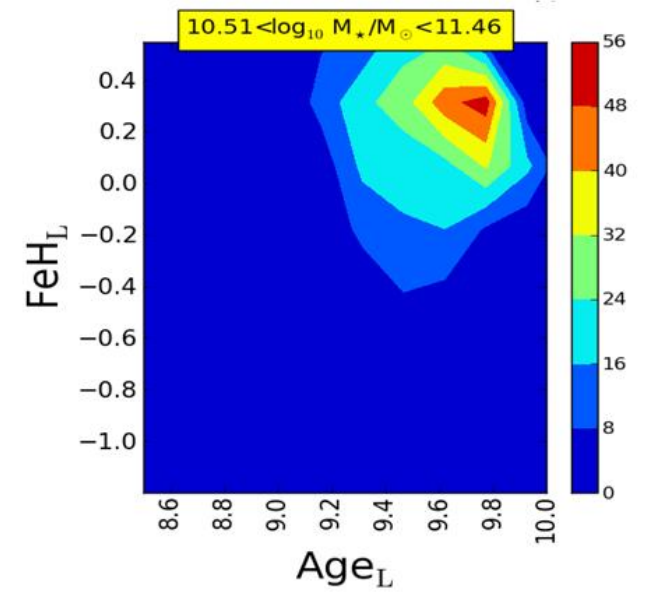
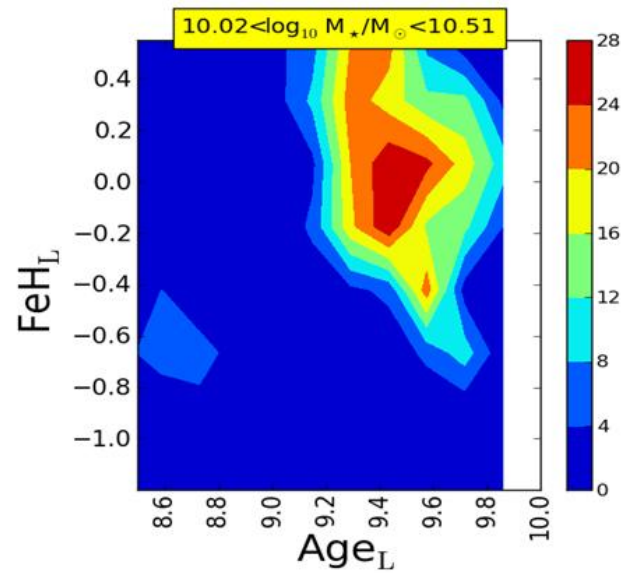
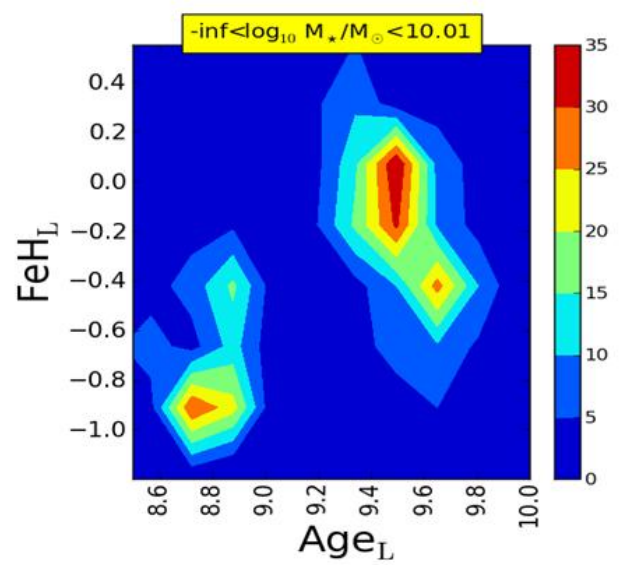
Stellar population and the IMF of early-type galaxies in ALHAMBRA

SDSS Spectroscopy
 ~26000 Early-Type Galaxies ($C > 2.8$)
 $Z < 0.22$

Gallazzi 2005 MNRAS 362 41



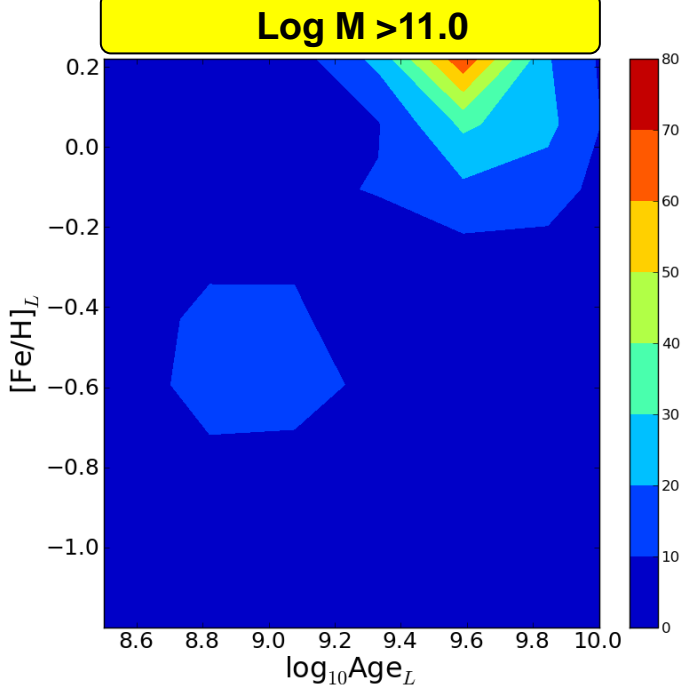
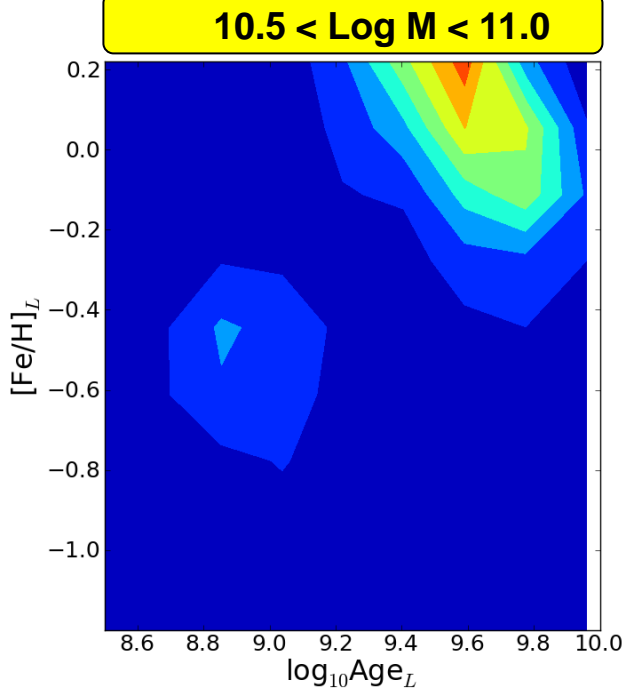
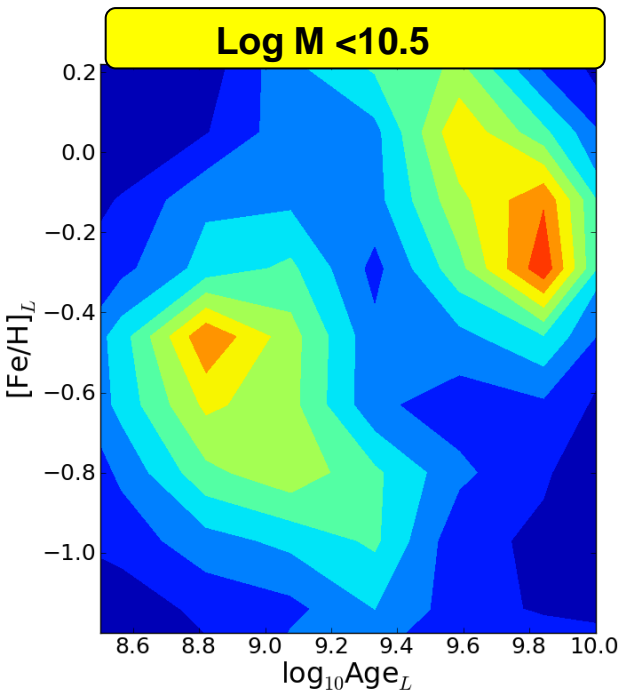
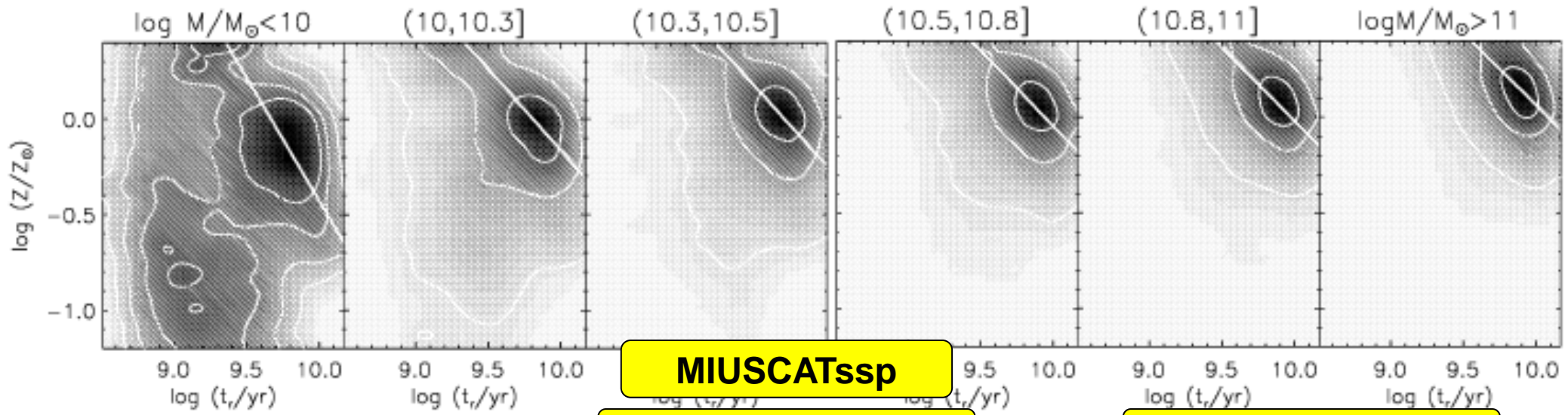
B & C 2003



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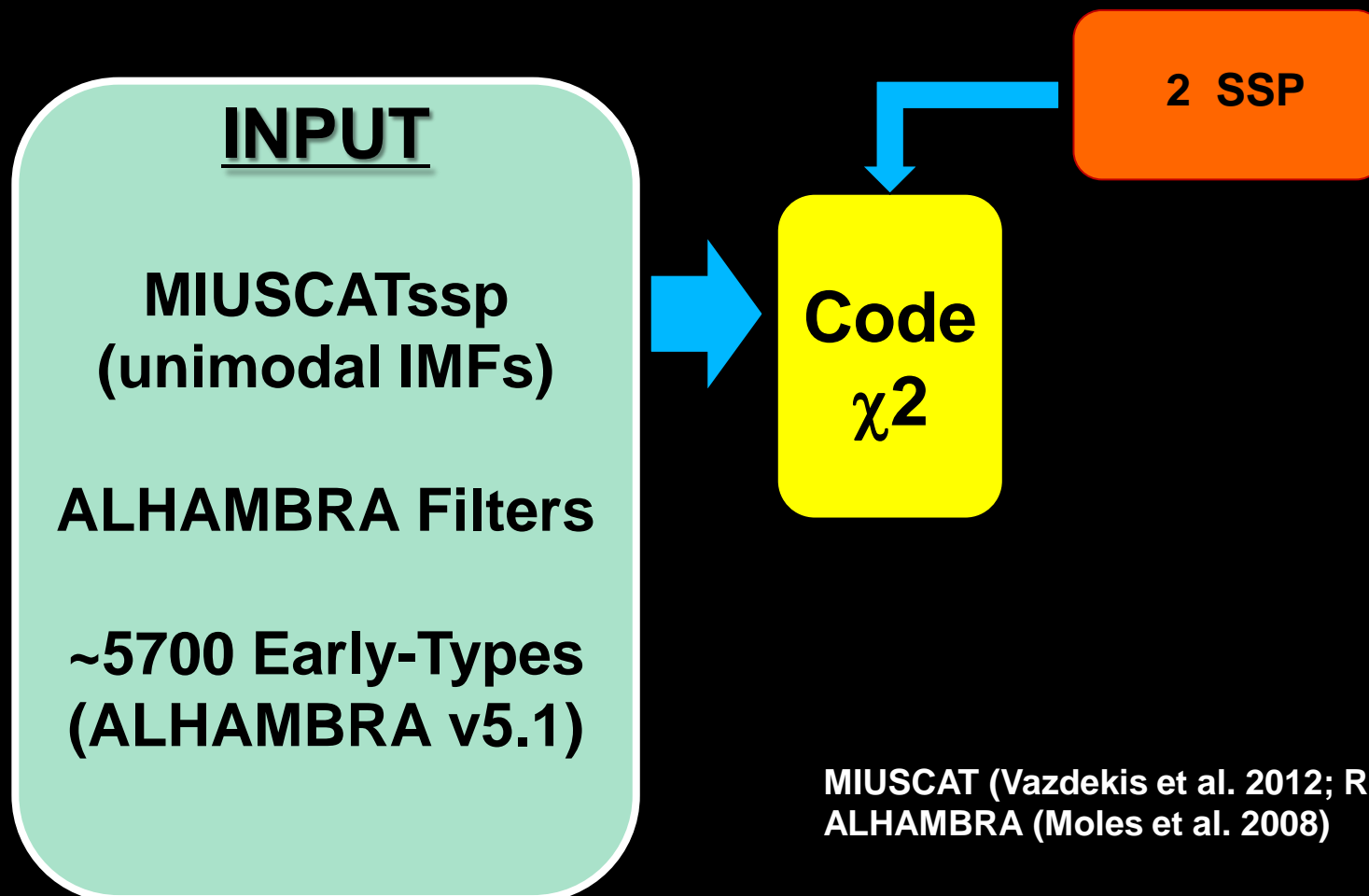
Stellar Populations of a Sample of Early-Type Galaxies using different IMF slopes (Preliminary results)

Early-type Galaxies (ALHAMBRA photometry)
Selection Criterion:

1. Galaxies classified photospectrally as Early-Type in the ALHAMBRA catalogue. Molino et al. (2013)
2. $S/N > 20$

Number of sources:
~5700

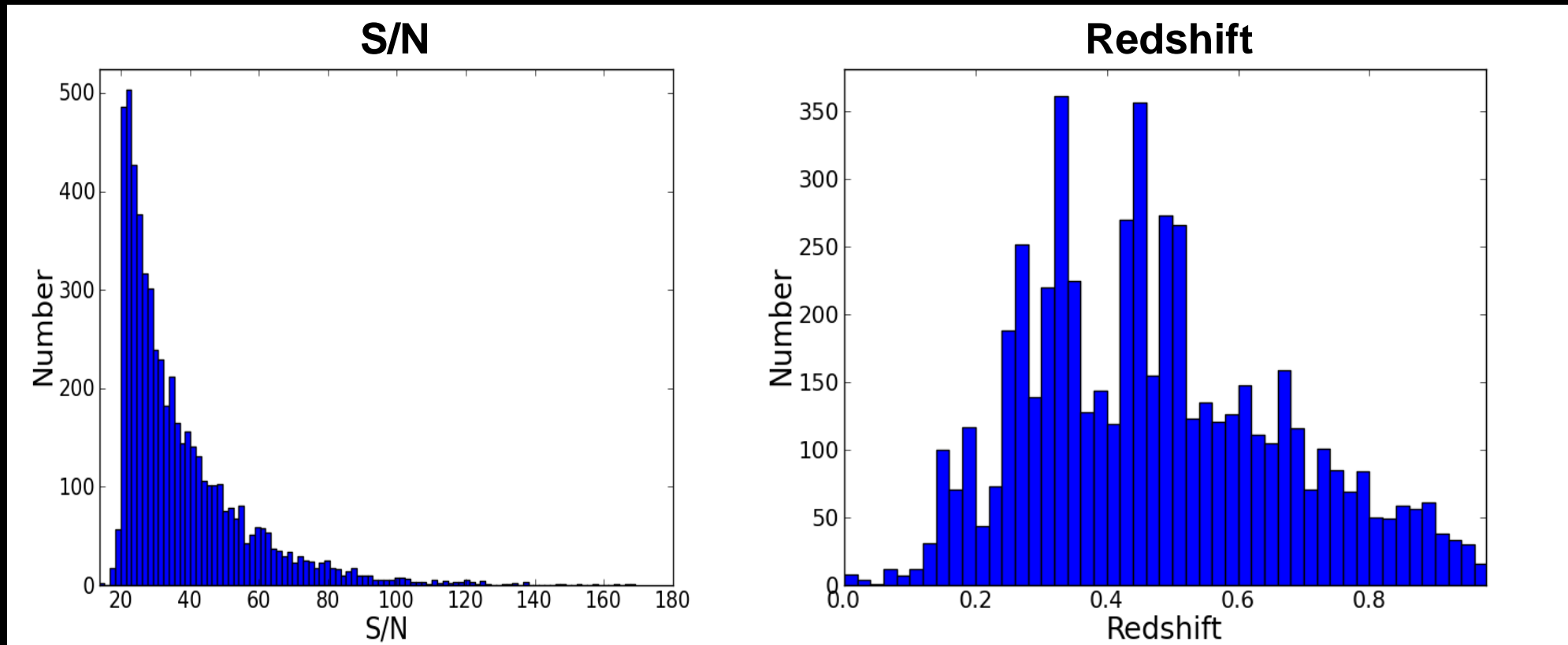
Stellar Populations of a Sample of Early-Type Galaxies using different IMF slopes (Preliminary results)



MIUSCAT (Vazdekis et al. 2012; Ricciardelli et al. 2012)
ALHAMBRA (Moles et al. 2008)

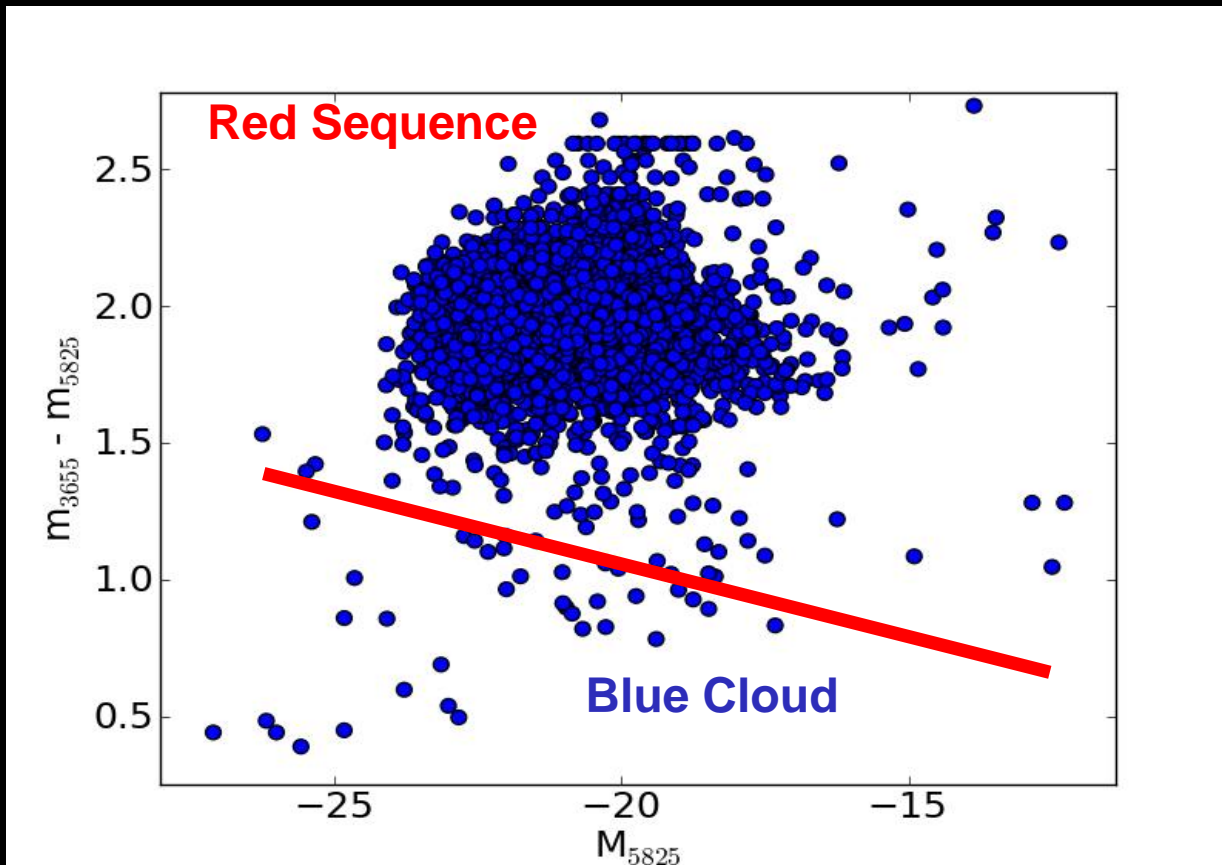
Stellar Populations of a Sample of Early-Type Galaxies using different IMF slopes (Preliminary results)

Galaxy Sample Characteristics



Stellar Populations of a Sample of Early-Type Galaxies using different IMF slopes (Preliminary results)

CMD



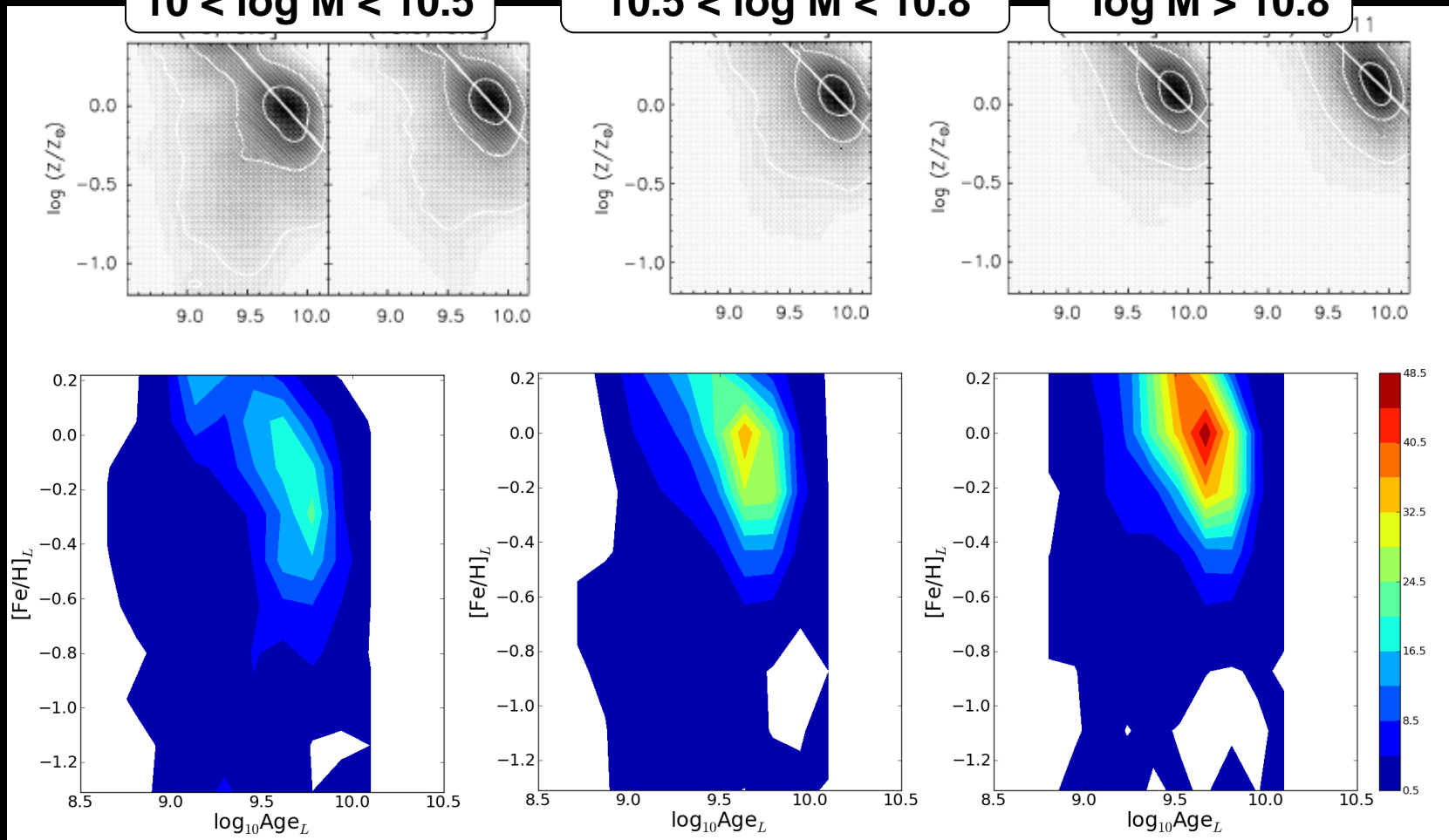
Bell et al. 2004
ApJ 608 752

Stellar Populations of a Sample of Early-Type Galaxies using different IMF slopes (Preliminary results)

$10 < \log M < 10.5$

$10.5 < \log M < 10.8$

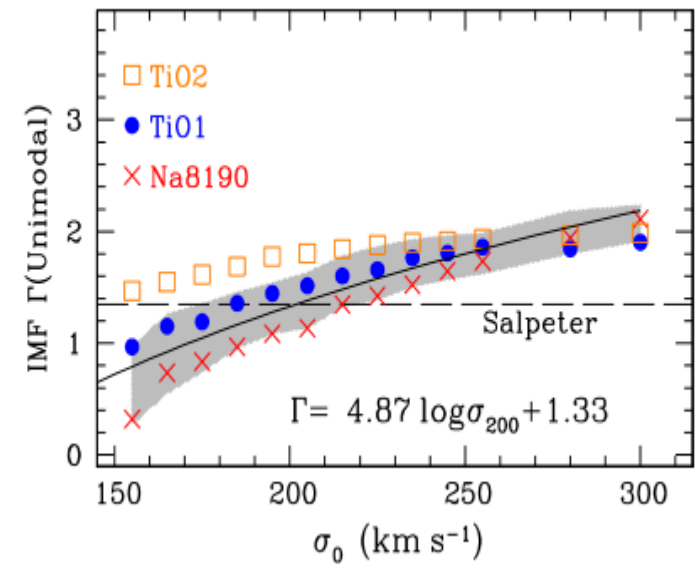
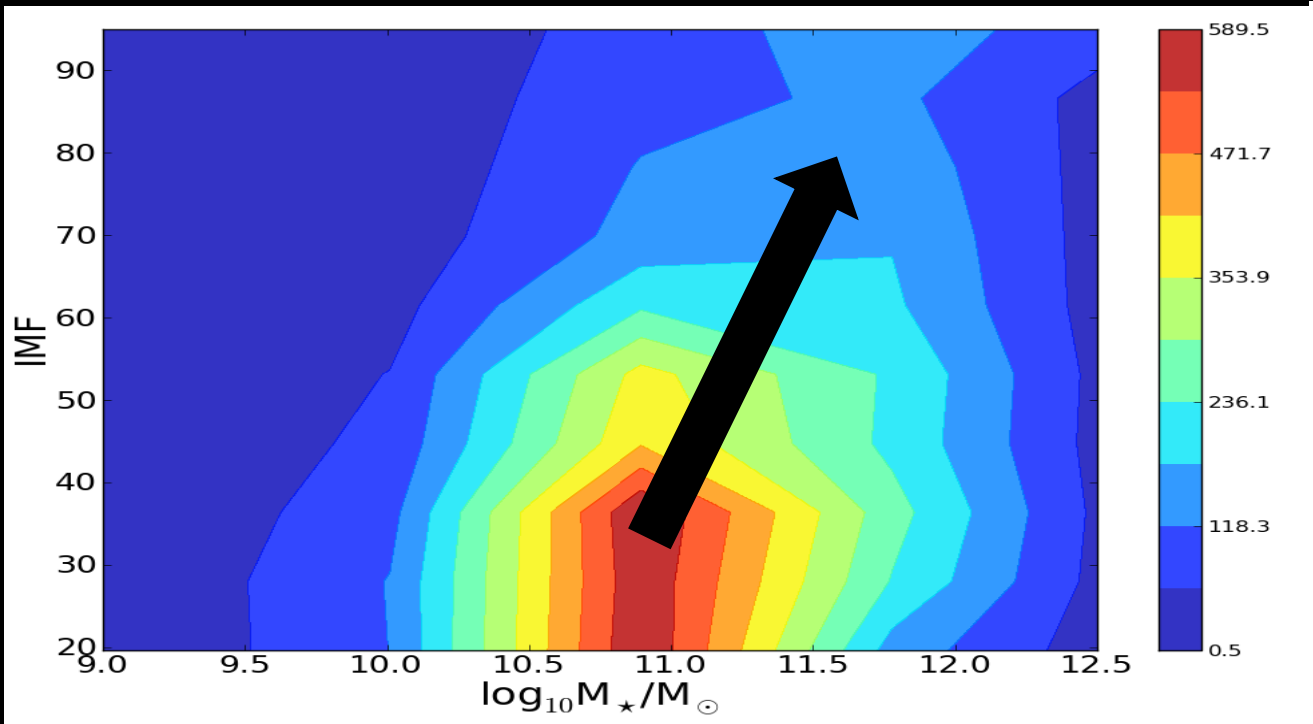
$\log M > 10.8$



$Z < 0.3$

IMF Slope and Stellar Mass

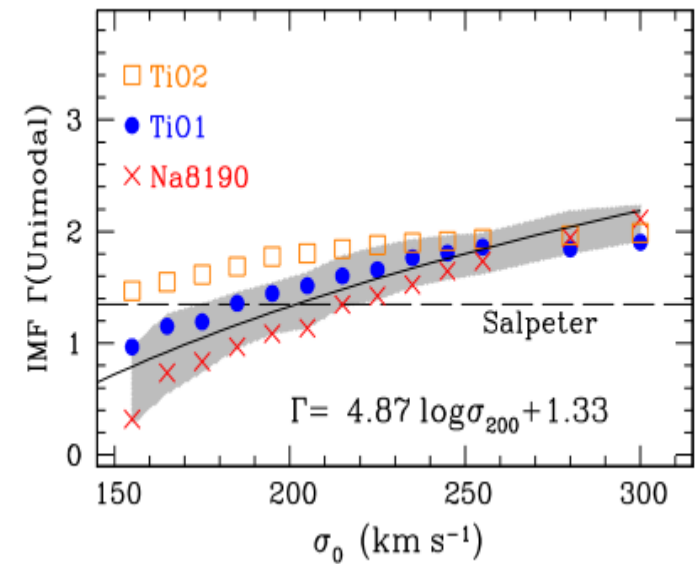
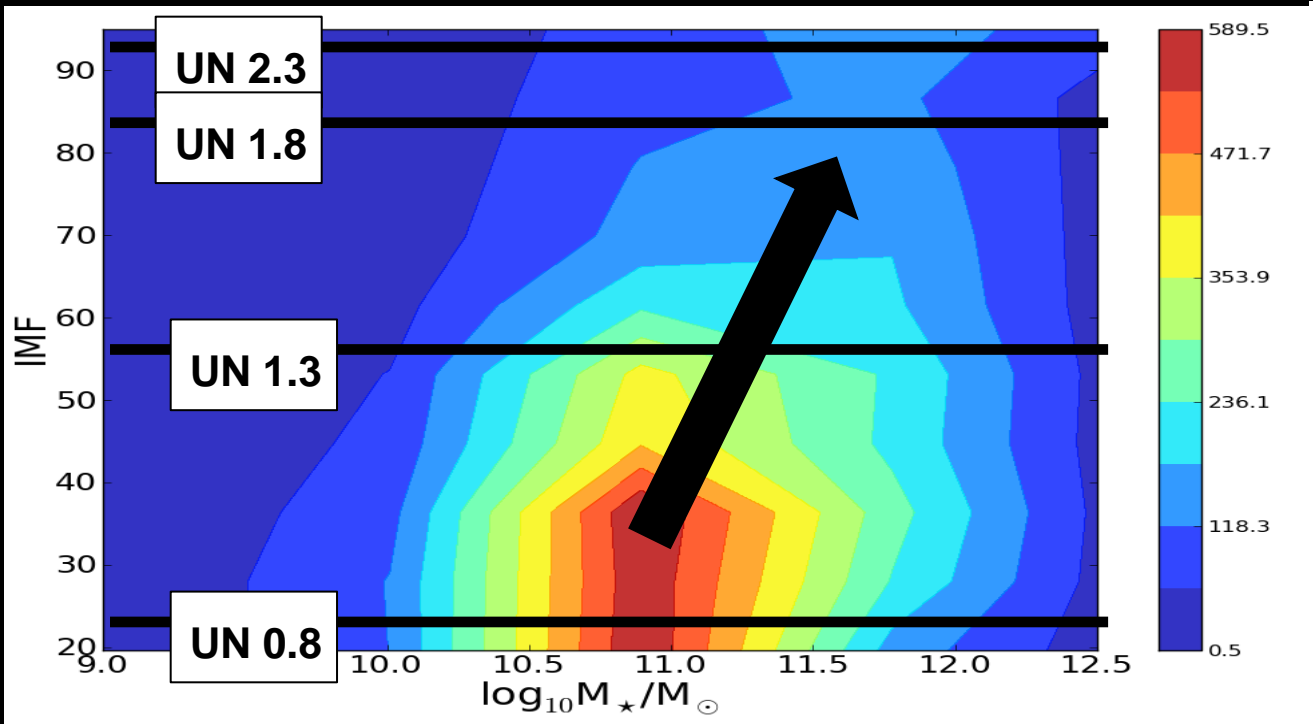
Ferreras et al. 2013
MNRAS 429L 15F



Cenarro et al. 2003
Ricciardelli et al. 2012
Conroy & Vandokum 2011

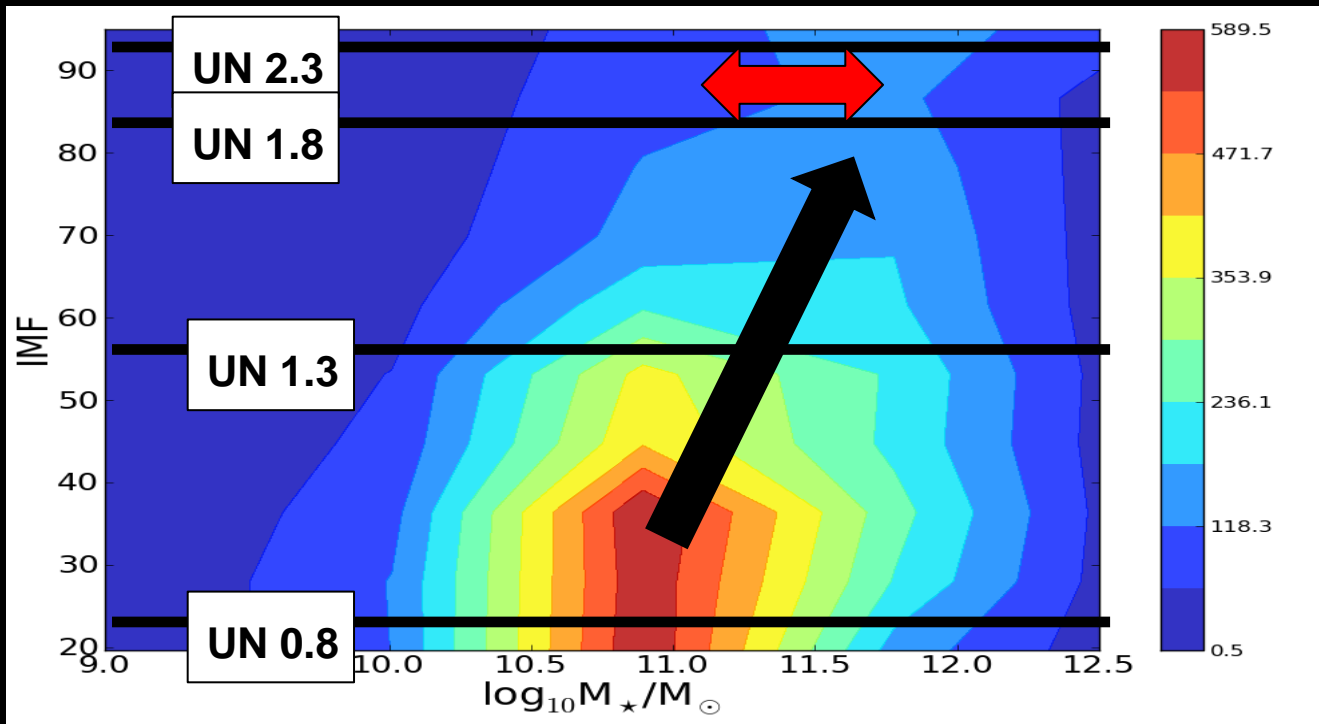
IMF Slope and Stellar Mass

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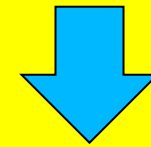


Cenarro et al. 2003
Ricciardelli et al. 2012
Conroy & Vandokum 2011

IMF Slope and Stellar Mass



The M/L can be affected by a factor of 4 !!!



Higher IMF slope implies higher stellar mass

No velocity dispersion with photometry





Stellar Populations of a Sample of Early-Type Galaxies in the ALHAMBRA Survey

Test Conclusions

- 1– Physical parameters (ages, metallicities, masses...) obtained for a sample of 1300 early types from the ALHAMBRA survey are compatible with spectroscopic results based on SDSS early types.
- 2 – Massive ellipticals appear older at same redshift using a universal IMF
→ Formed at very high redshift. Downsizing scenario.
- 3 – The general trends of Early-types remains (more or less) using a non-universal IMF.
- 4 – Massive galaxies are better fitted using bottom-heavy IMFs. (But related with the M/L)



Stellar population and the IMF of early-type galaxies in ALHAMBRA



Thank you for your attention!!!