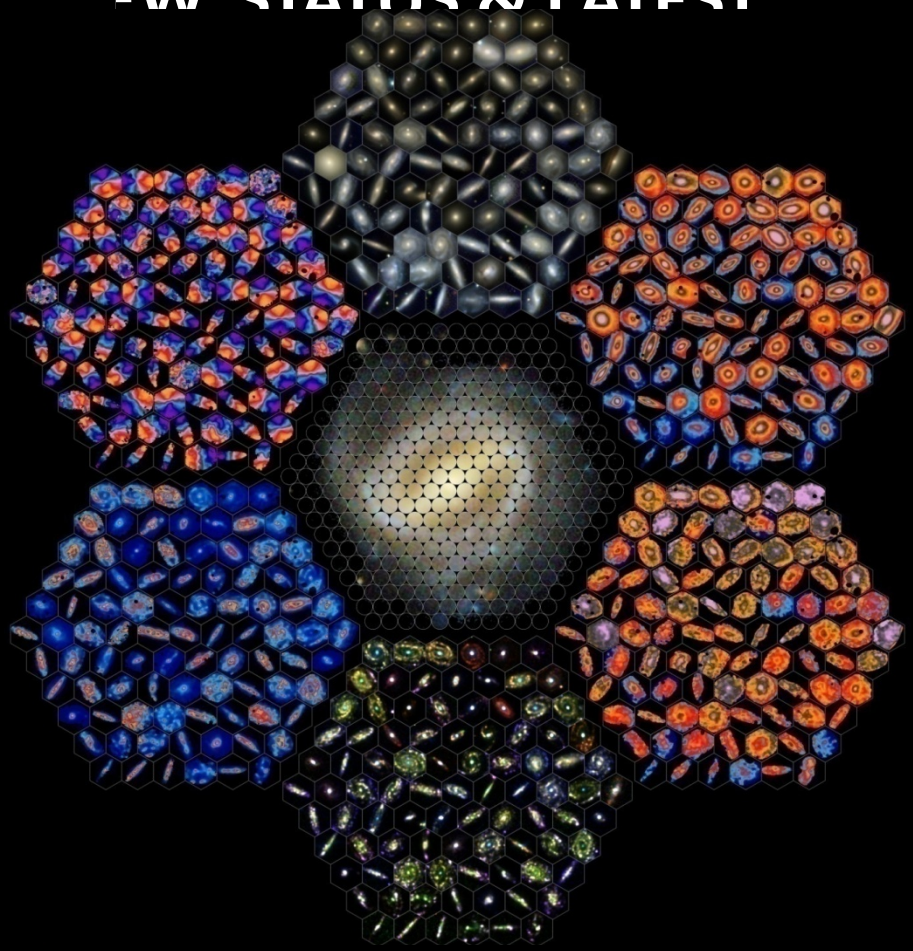
CALAR ALTO LEGACY INTEGRAL FIELD AREA SURVEY

OVERVIEW, STATUS & LATEST RESULTS



Jesús Falcón-Barroso

www.iac.es/project/traces

THE CALIFA TEAM

AIP

THE UNIVERSITY OF SYDNEY

TÉCNICO LISBOA

RMC CMR

AAO

university of groningen

UNIVERSIDADE FEDERAL DE SANTA CATARINA

INAOE

institut für astrophysik UNIVERSITÄTSSTERNWARTE WIEN

Centro de Astrofísica da Universidade do Porto

UNIVERSIDAD AUTONOMA DE MADRID

University of St Andrews

INAF - Arcetri

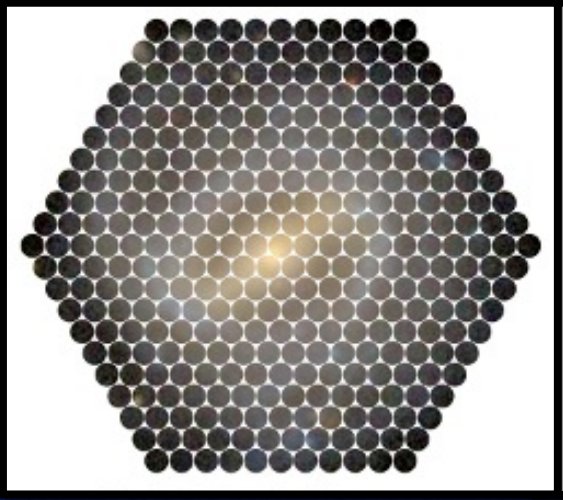
Ciemat Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas

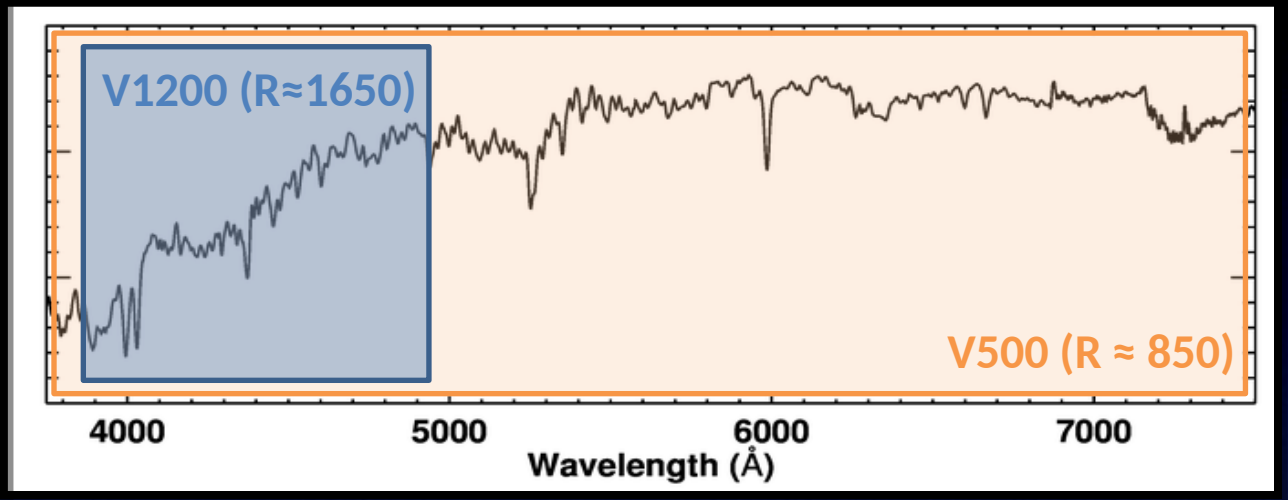
INAF ISTITUTO NAZIONALE DI ASTROFISICA

THE CALIFA SURVEY

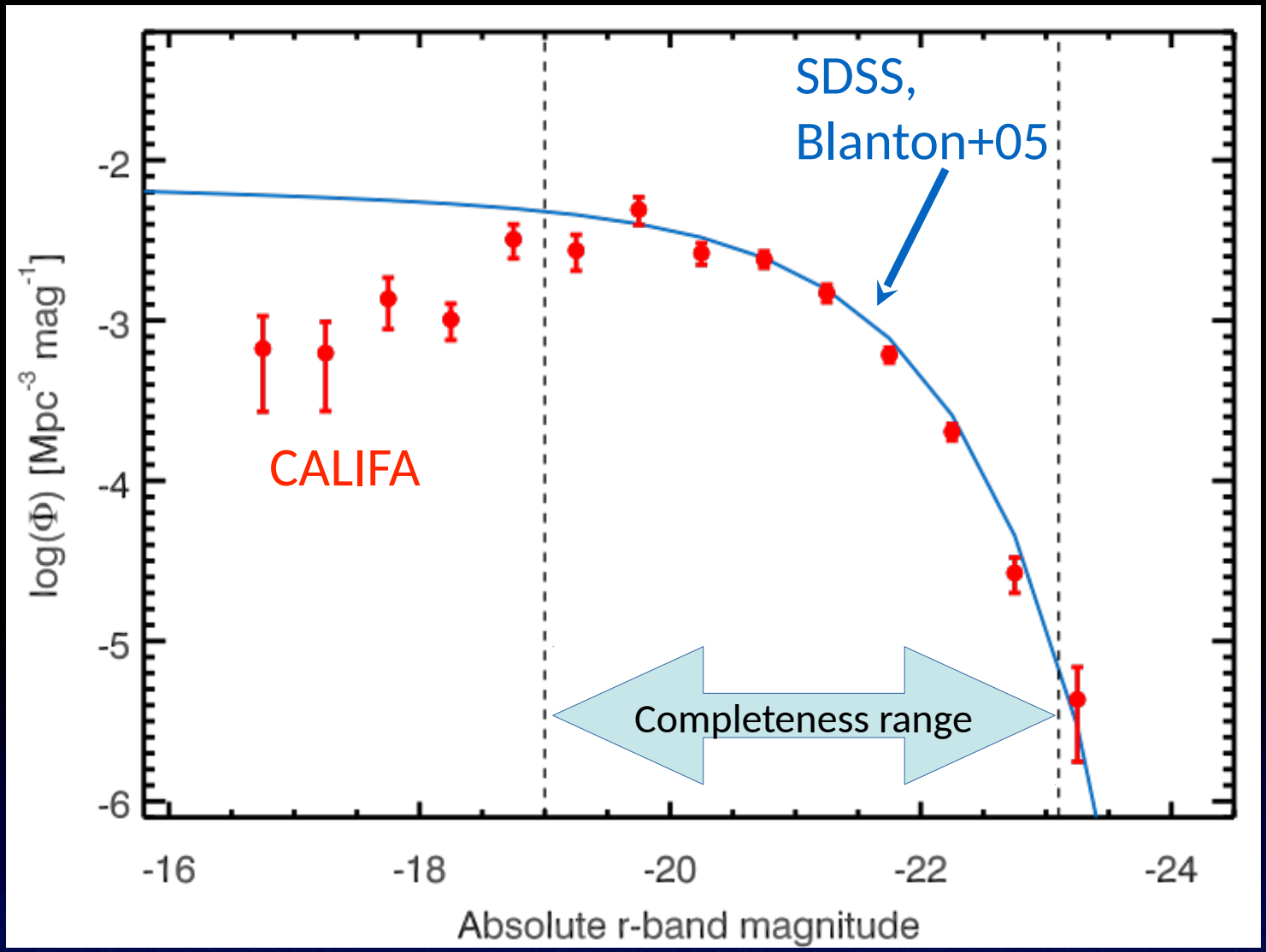
www.caha.es/CALIFA

- IFU survey using the PPAK@3.5m CAHA
- 600 galaxies in the local universe (0.005 < z < 0.03)
- Large wavelength coverage
- Large FoV (2 Reff) with 1 kpc spatial resolution
- Large, homogeneous sample across the Hubble sequence





SAMPLE LUMINOSITY FUNCTION



Walcher et al. (2014)

CALIFA SURVEY STATUS

www.caha.es/CALIFA

- Granted 210 dark nights at CAHA over 3 years
- Observations will stop in Summer 2015
- 498/554 objects observed in V1200/V500 setups
- Automatic data reduction pipeline working, v.1.4
- Final Data Release planned for early 2016

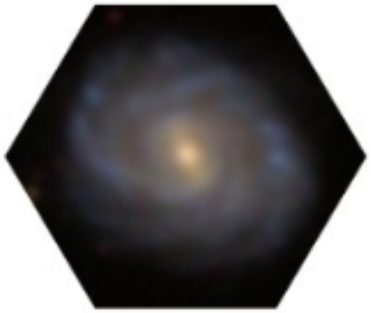
Data Release 2:
October 2014!
200 objects with good quality
http://califa.caha.es/DR2/

García-Benito et al. (2015) [arxiv:1409.8302]

THE UNIQUENESS OF CALIFA

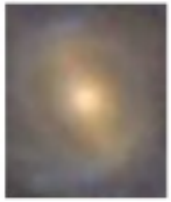
SDSS 90”x90” image

CALIFA (V500/V1200)



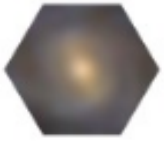
Atlas3D

z~z califa

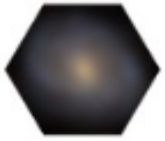


z~z Atlas3D

MaNGA largest FoV



FoV~1.5Re

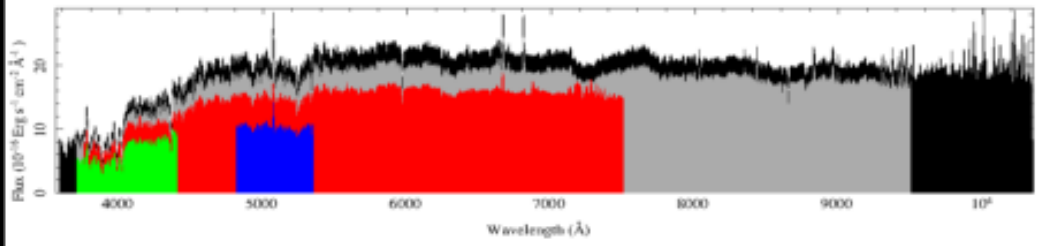


~2.5Re

SAMI

z~z califa

z~z SAMI



CALIFA
2x3x331 spaxels; 2.7”/spaxel
600 galaxies of any type
~1.200.000 spec.; 3700-7500 Å

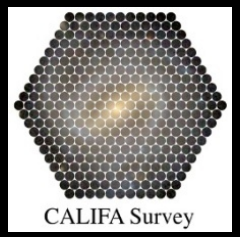
Atlas3D
1577 spaxels; 0.94”/spaxel
260 ETGs
~400.000 spectra; 4810-5350 Å

MaNGA
3x(19-127) spaxels; 2”/spaxel
7000 gal. of any type (~1.5Re)
2000 gal. of any type (~2.5Re)
1000 gal. of any type (any Re)
~800.000 spec.; 3550-10000 Å

SAMI
9x61 spaxels; 1.6”/spaxel
3400 galaxies of any type
~1.900.000 spec.; 3700-9500 Å

THE CALIFA SURVEY

www.caha.es/CALIFA



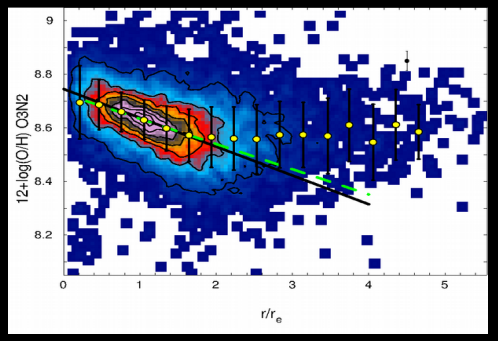
- Where and when do the stars in galaxies form?
- How is angular momentum lost and found?
- Where and when are the heavy elements made?
- How is the gas in galaxies processed?

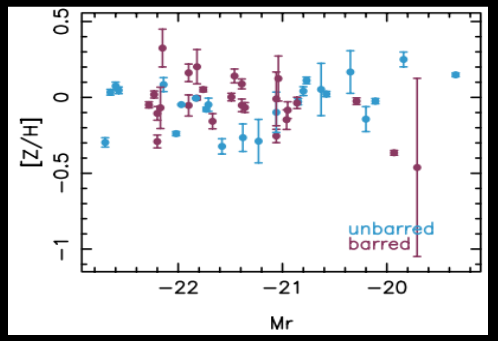
Color

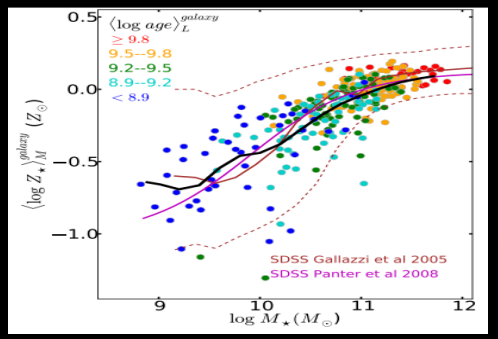
Absolute Magnitude

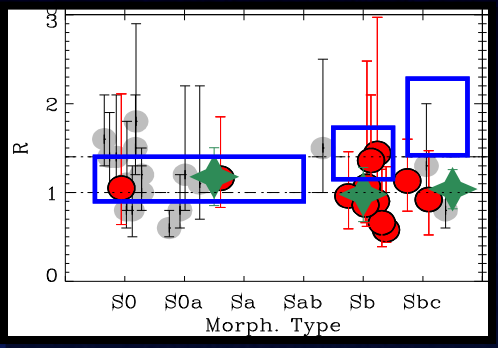
SCIENCE TOPICS COVERED

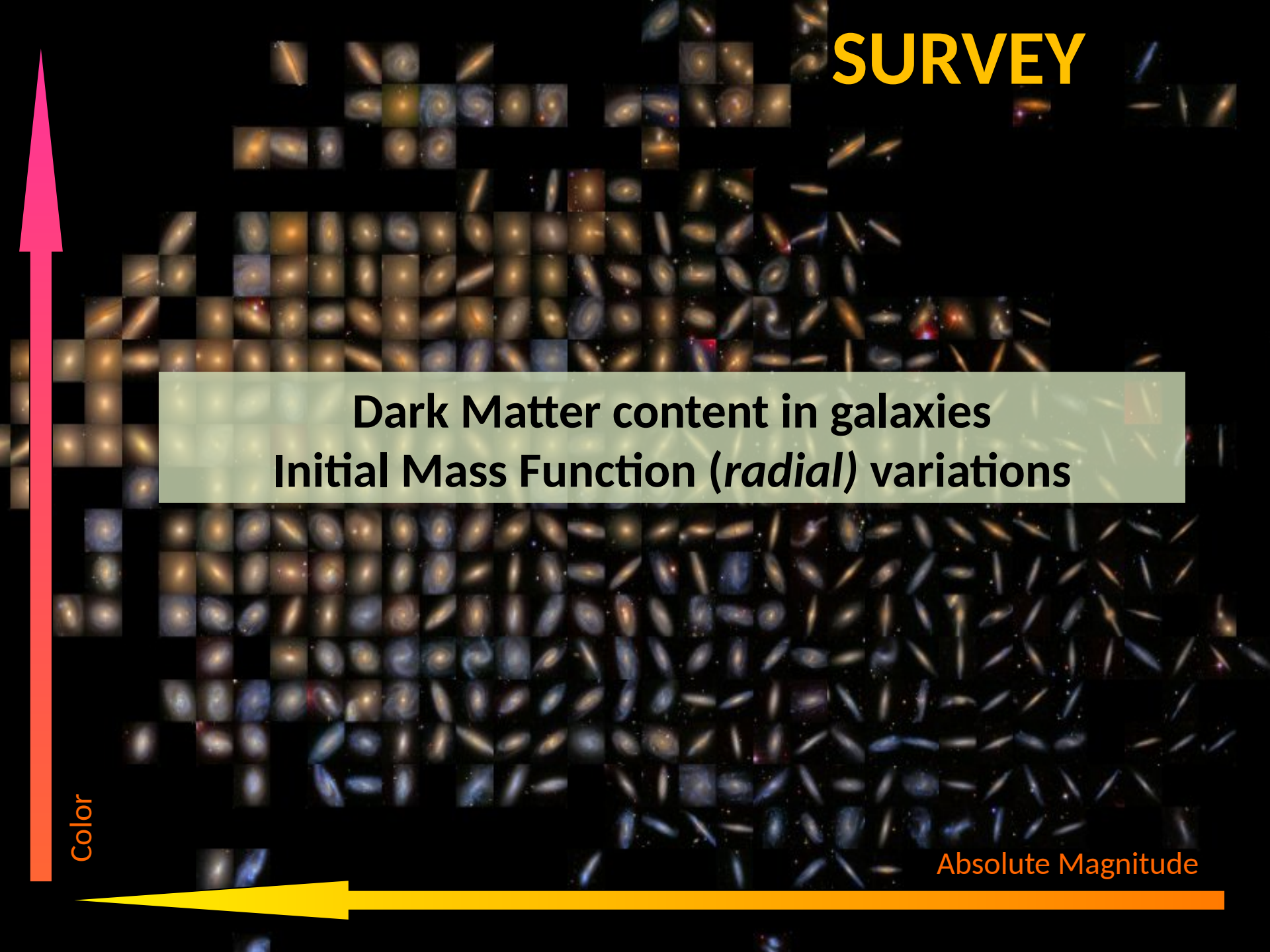
- Presentation, Sample definition and DR papers
  Sánchez+12, Husemann+13, Walcher+14, García-Benito+15
- Star formation histories
  Pérez+12 , Cid-Fernandes+13, González-Delgado+14ab
- Abundance gradients and calibrators
  Sánchez+13, Marino+13, Sánchez+14, Sánchez-Blázquez+14
- Ionised gas morphology and kinematics
  Kehrig+12, Papaderos+13, García-Lorenzo+14
- Effects of spatial resolution, aperture corrections
  Iglesias-Páramo+13, Mast+14
- Interacting galaxies
  Wild+14, Barrera-Ballesteros+14
- Nature of LINERS Singh+13
- HII regions Sánchez+14
- Supernova host galaxies Galbany+14
- Pattern speeds in bars Aguerri+15







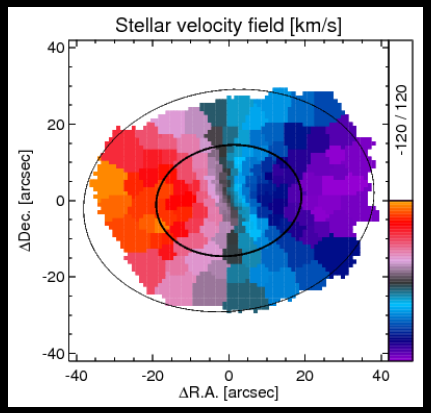


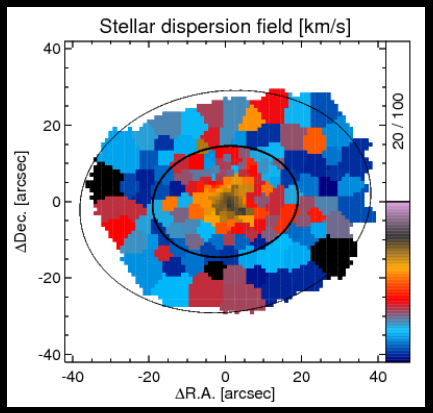

SURVEY
Dark Matter content in galaxies
Initial Mass Function (*radial*) variations
Color
Absolute Magnitude

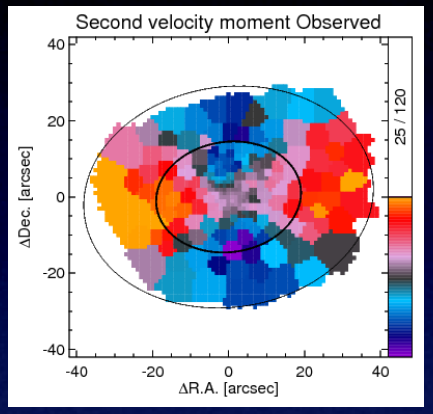
Dark Matter content in galaxies

TOTAL MASS FROM DYNAMICAL MODELLING

NGC4210



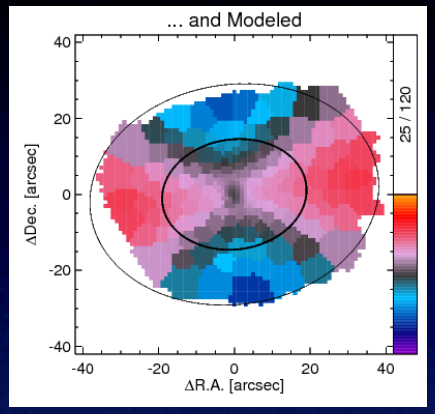




Jeans dynamical models

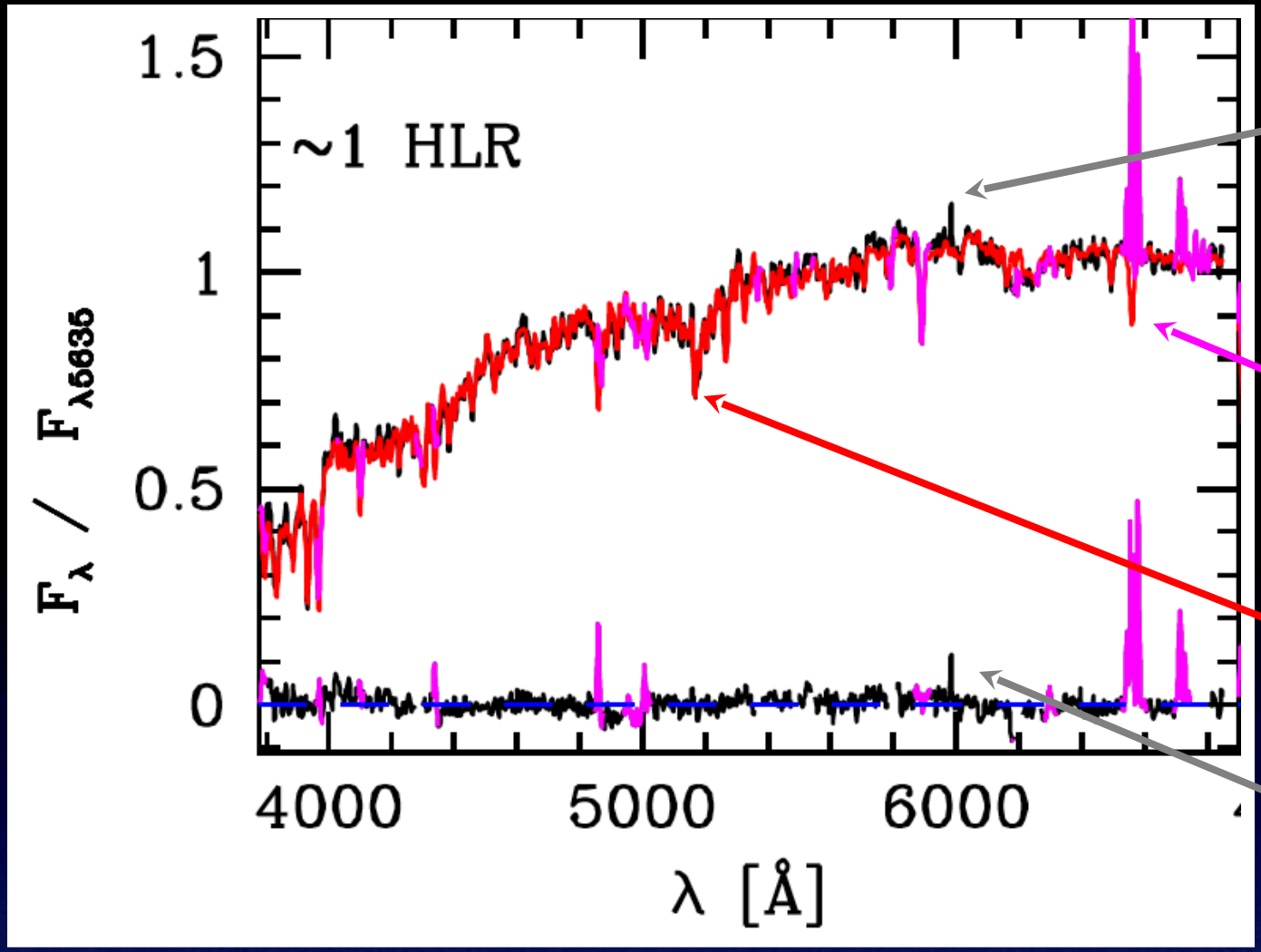
&

Schwarzschild



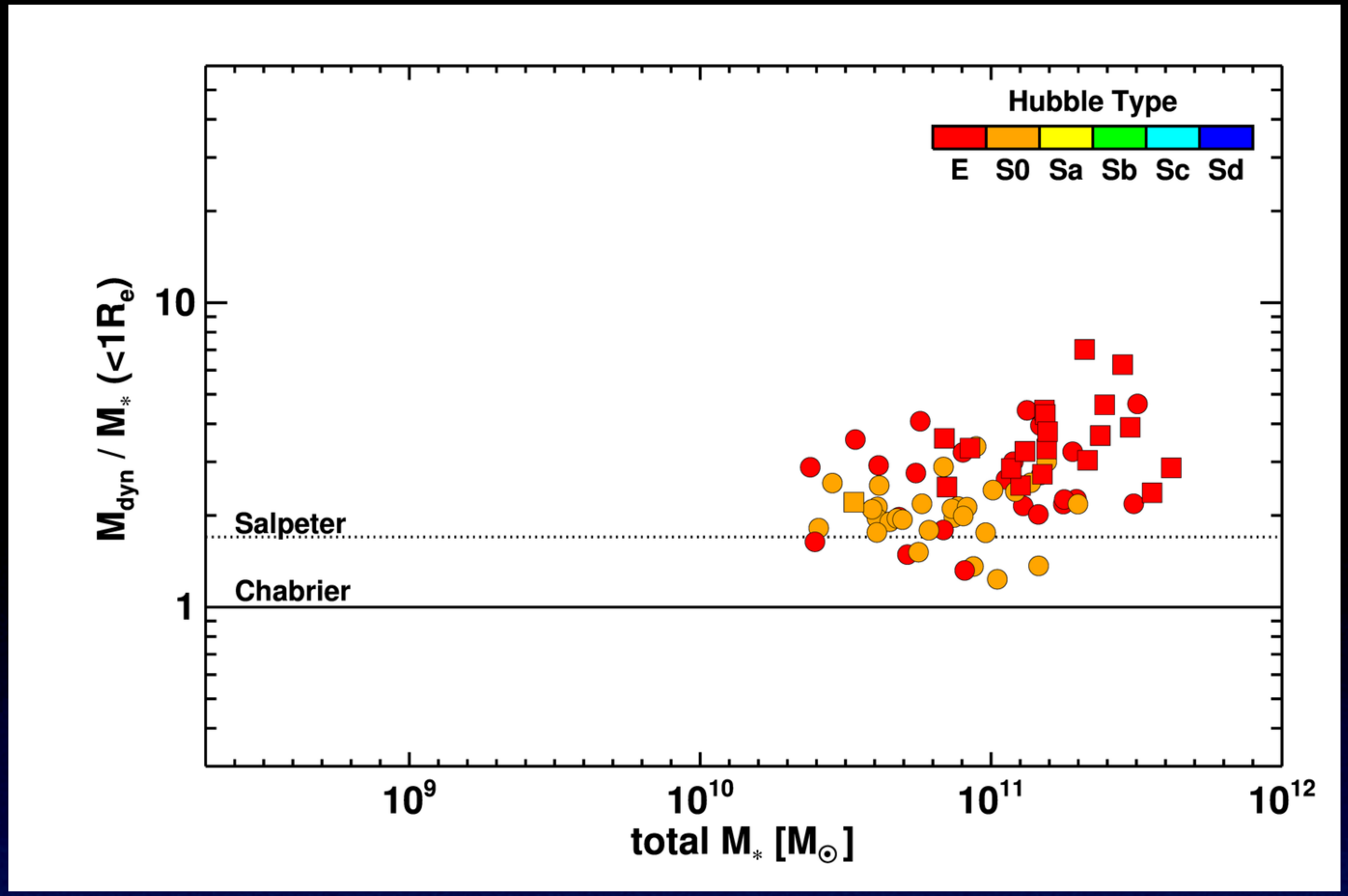
STELLAR MASSES FROM SPECTRAL FITTING

STARLIGHT code applied to CALIFA (Cid Fernandes et al. 2013)



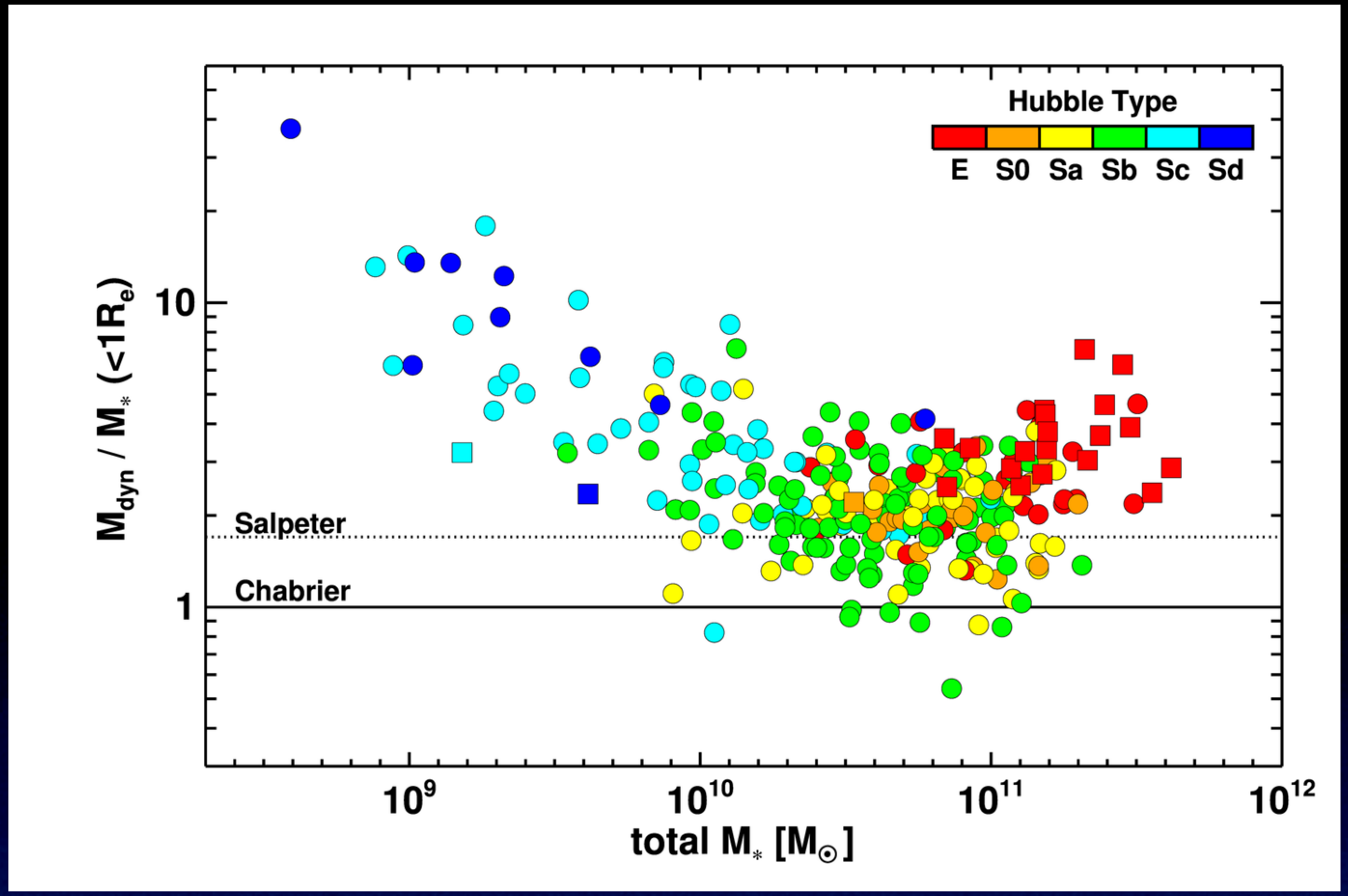
González-Delgado et al. (2014)

ARE LOW-MASS SPIRALS DM DOMINATED?



If bottom-heavy IMF, DM content of most massive galaxies will decrease

ARE LOW-MASS SPIRALS DM DOMINATED?

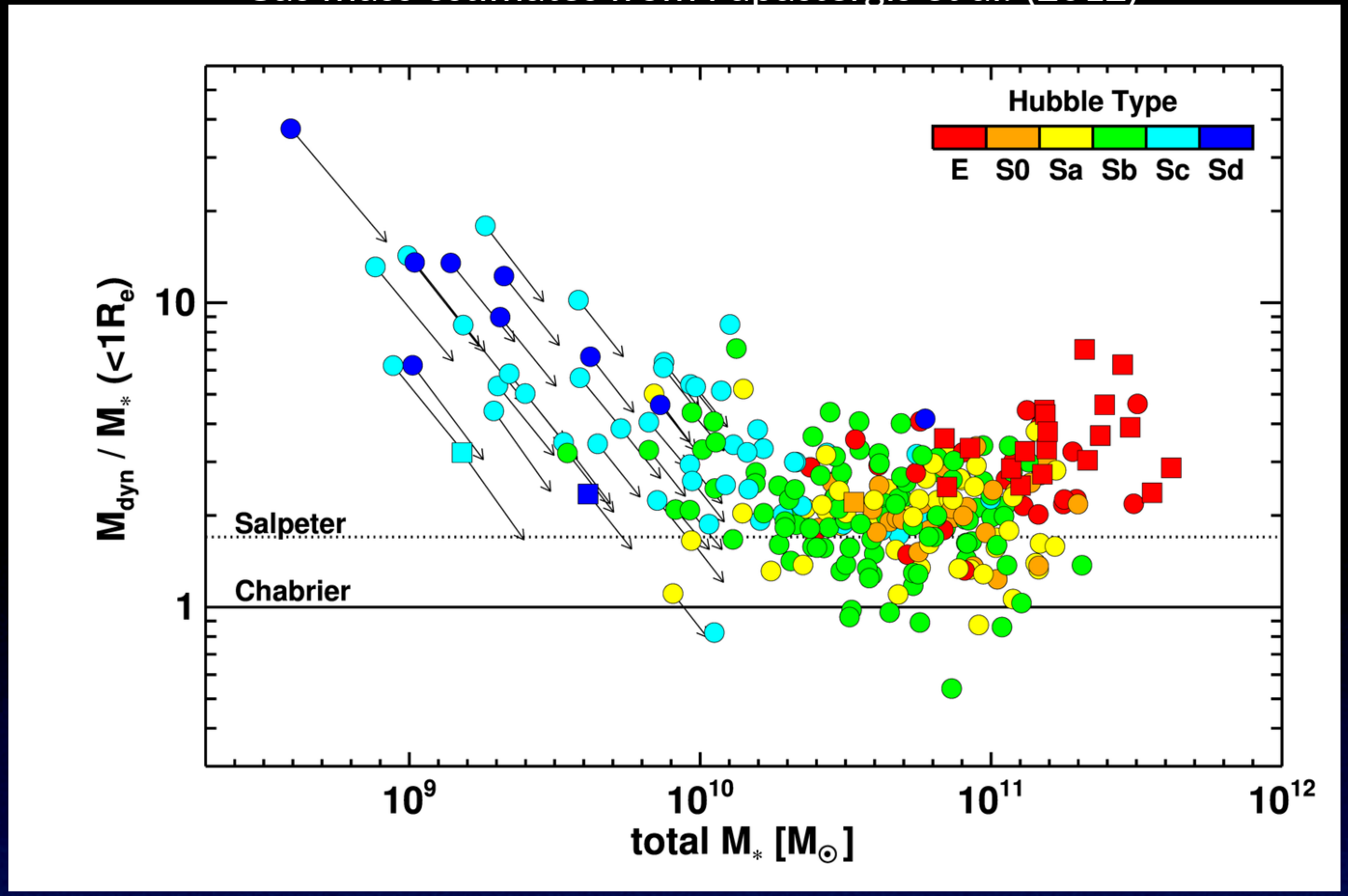


Most galaxies have similar DM content except low-mass spirals

Lyubenova et al. (to be submitted)

ARE LOW-MASS SPIRALS DM DOMINATED?

Gas mass estimates from Papastergis et al. (2012)

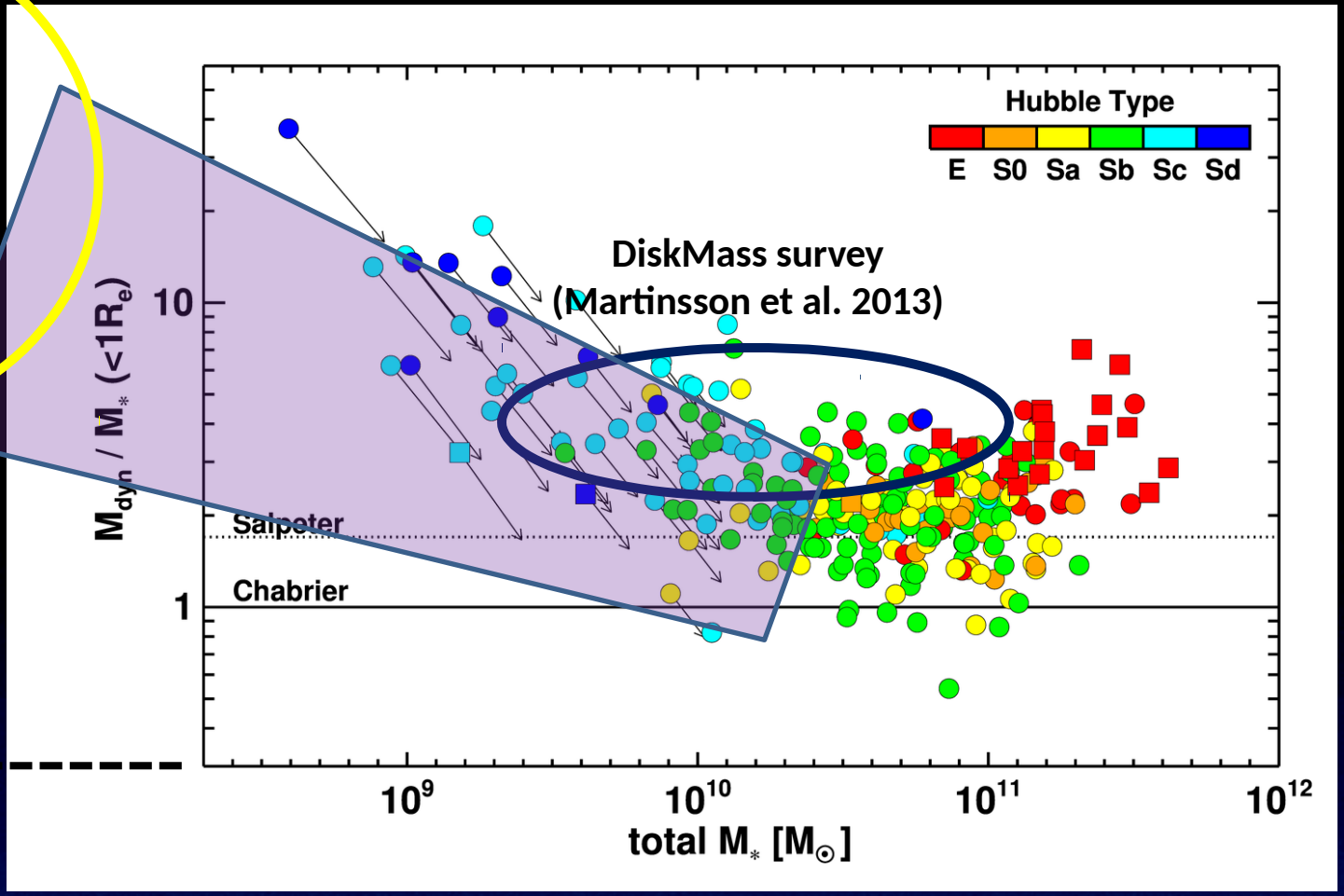


Situation remains even if gas content considered

Lyubenova et al. (to be submitted)

ARE LOW-MASS SPIRALS DM DOMINATED?

dSphs
(Collins et al. 2014)



10^6

Lyubenova et al. (to be submitted)

IMF radial variations

IS THE IMF UNIVERSAL?

Cenarro et al. 2003

Treu et al. 2010

van Dokkum & Conroy 2010

Cappellari et al. 2012

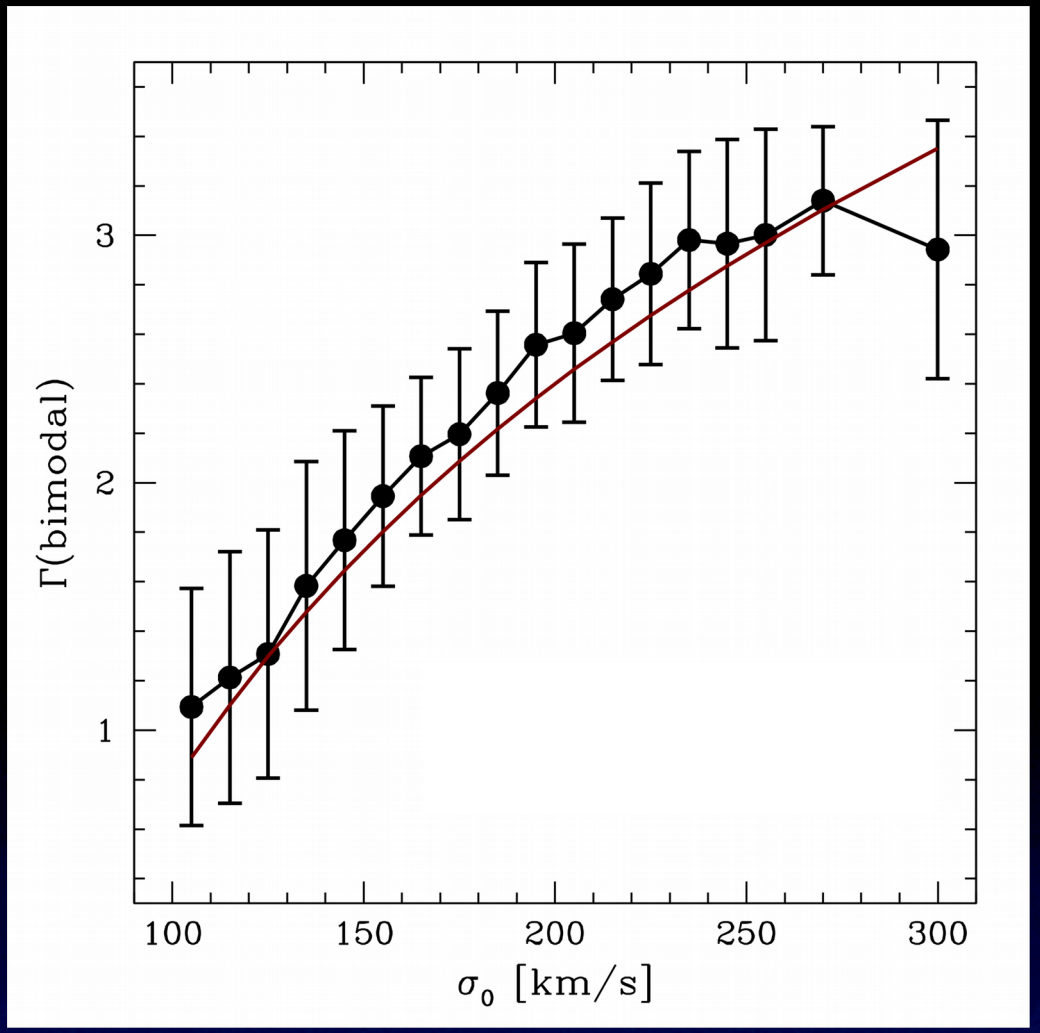
Spiniello et al. 2012

Ferreras et al. 2013

La Barbera et al. 2013

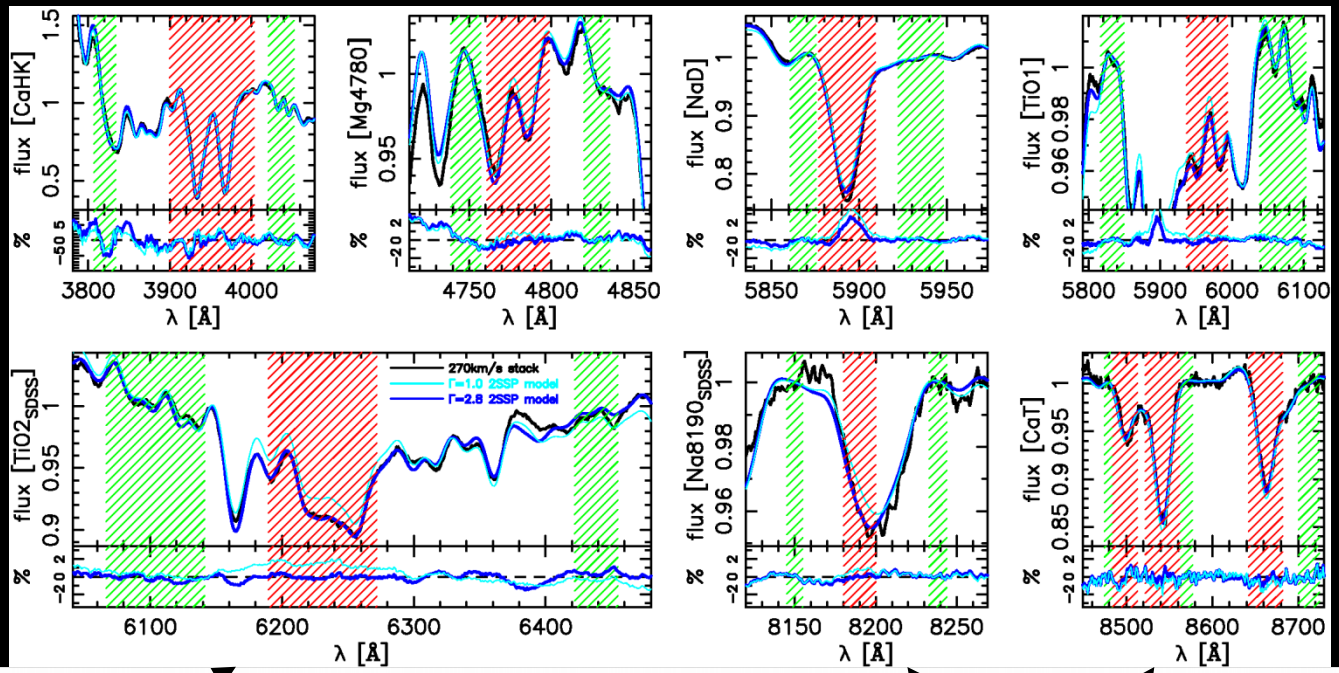
.
.
.

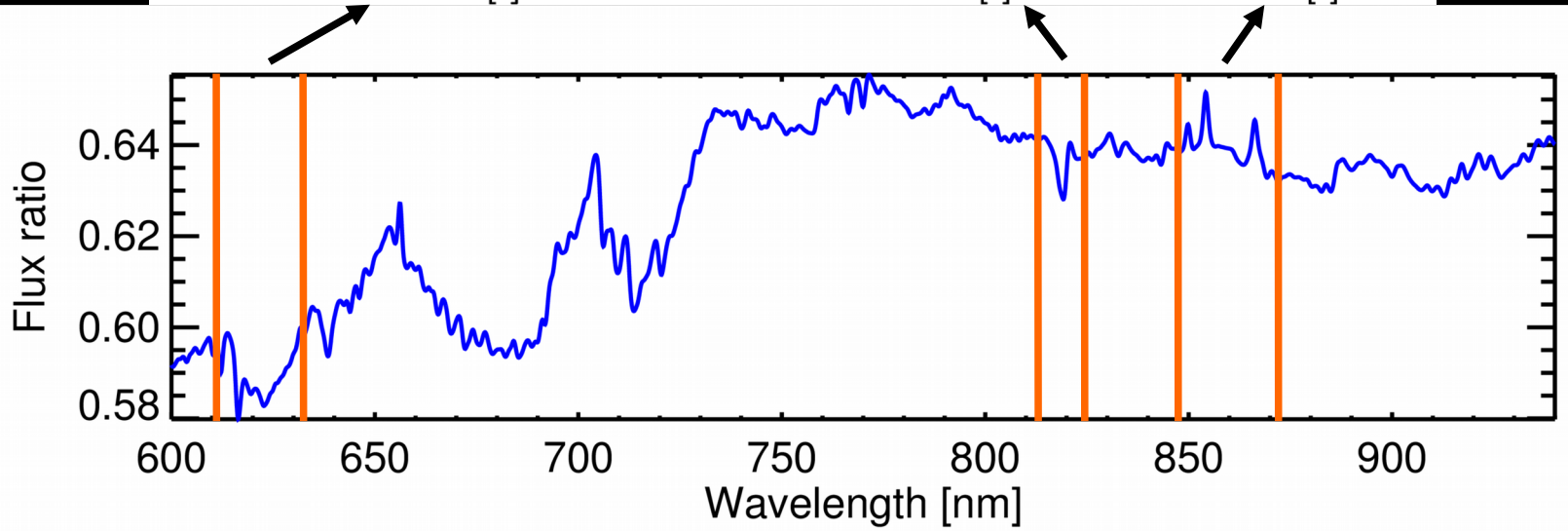
IMF slope



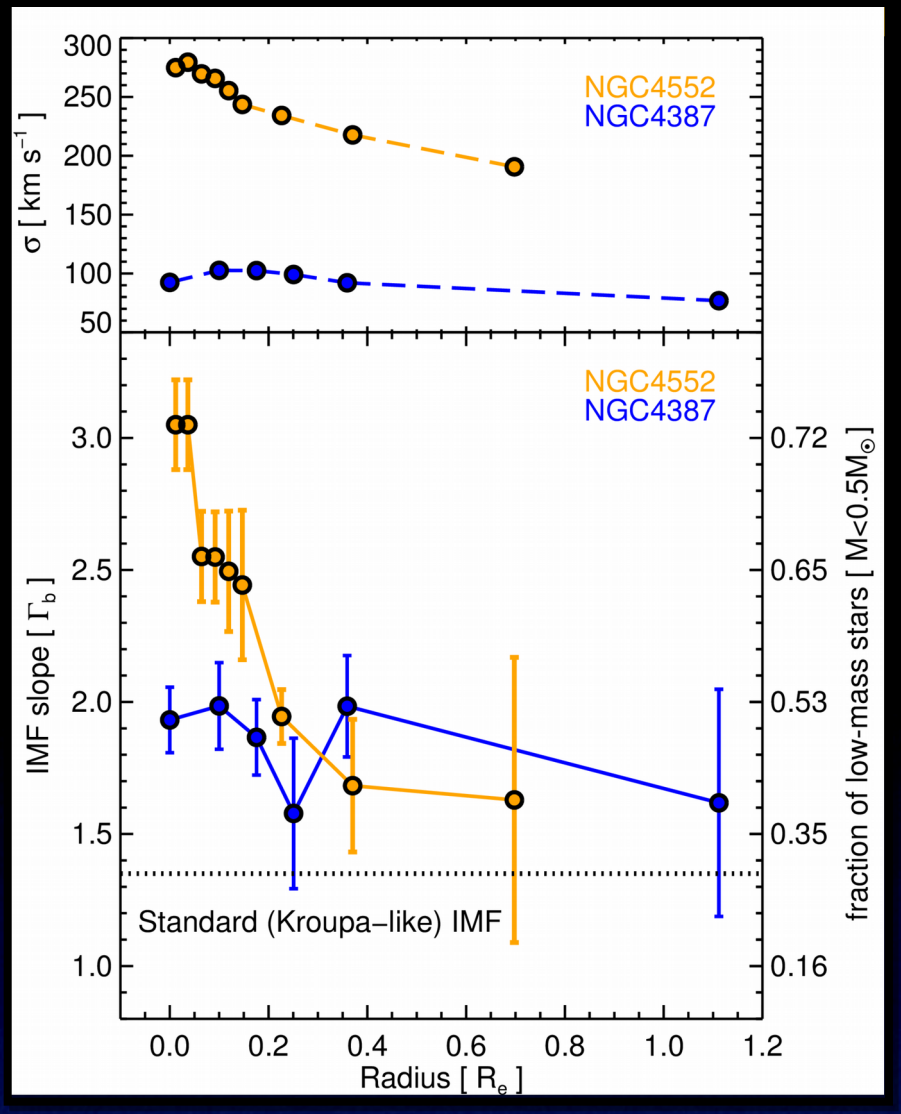
Central velocity dispersion

INFERRING THE IMF





ARE THERE IMF RADIAL GRADIENTS?

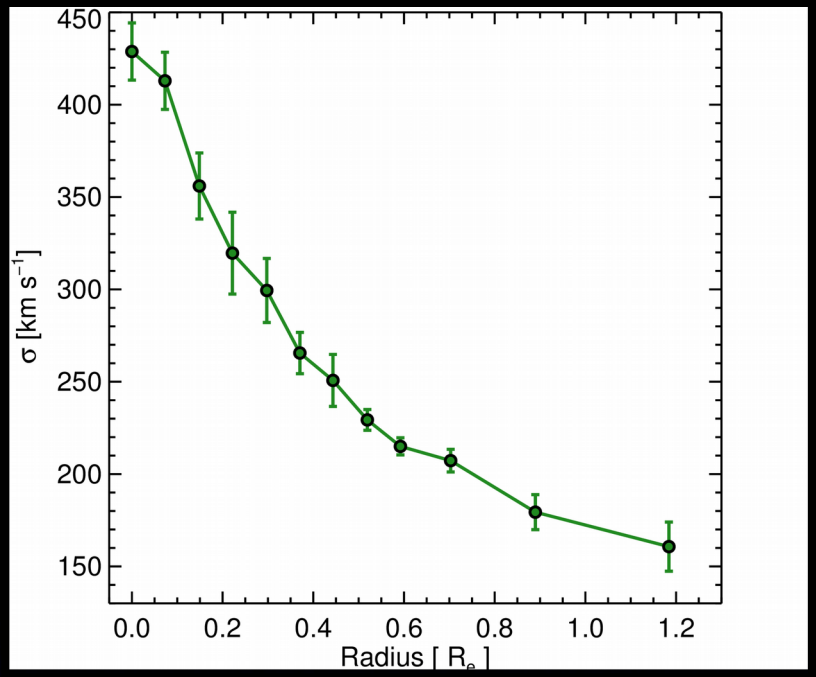


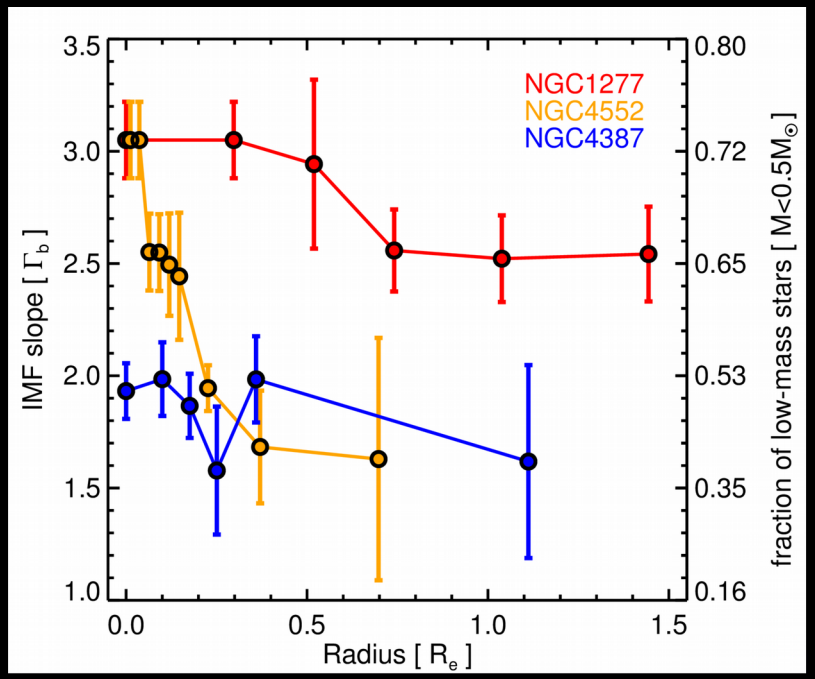
Based on 10.4m GTC data

- More massive galaxies exhibit stronger IMF slope variations

- At first, it appeared to be related to local velocity dispersion (Martín-Navarro et al. 2014a)

NGC1277: THE PRISTINE IMF

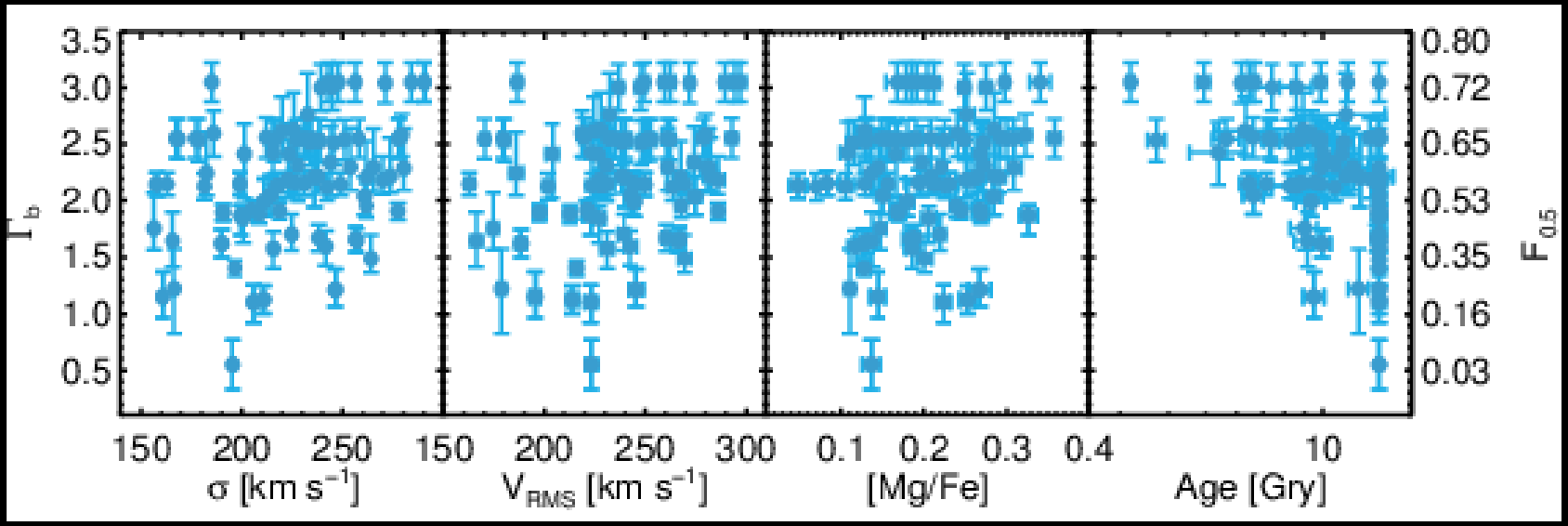




…. but then we found a galaxy with a steep velocity dispersion profile and rather constant IMF slope

(Martín-Navarro et al. 2014b)

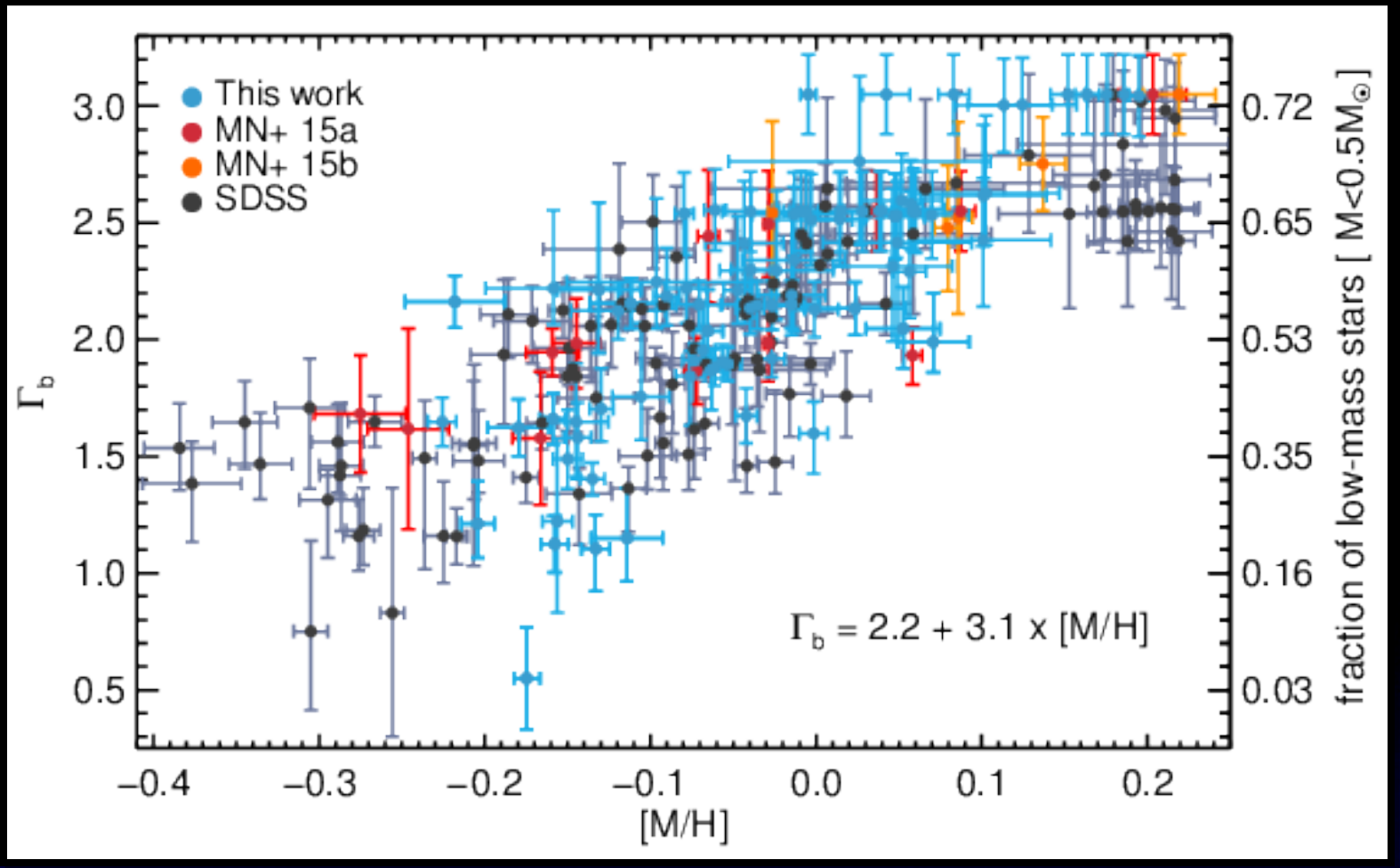
IMF VARIATIONS IN CALIFA



No strong dependency on σ, V_{RMS}, [Mg/Fe], Age

Martín-Navarro et al. (to be submitted)

IMF VARIATIONS IN CALIFA



Strongest correlation is with [Z/H]

Martín-Navarro et al. (to be submitted)

CONCLUSIONS

- ***CALIFA*** is a unique opportunity to understand the baryonic physics of galaxies using integral field spectroscopy.

- ***CALIFA*** is a legacy survey, data are being collected, quality is excellent, and all will be public!

- ***CALIFA*** is producing exciting science results

- ***CALIFA*** will retain properties that make it interesting even after next generation IFS surveys are available.

http://califa.caha.es/

The End