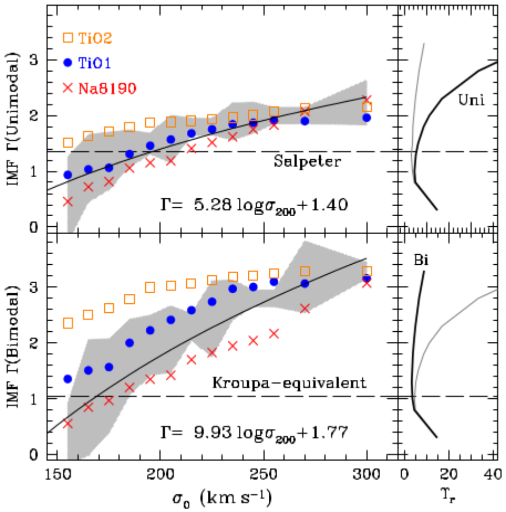
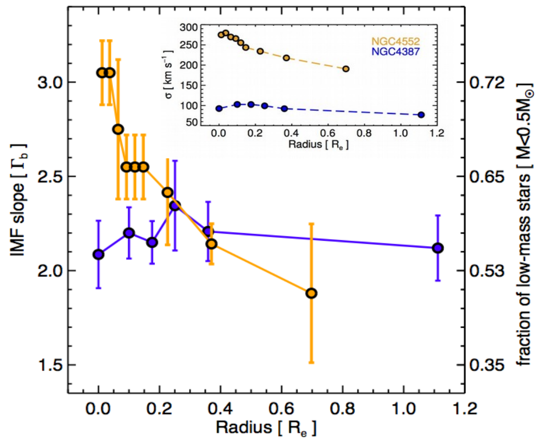
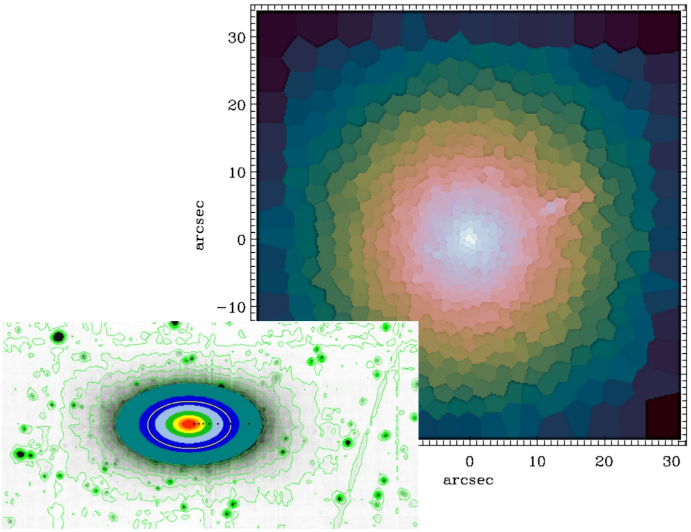
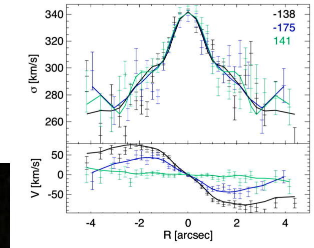


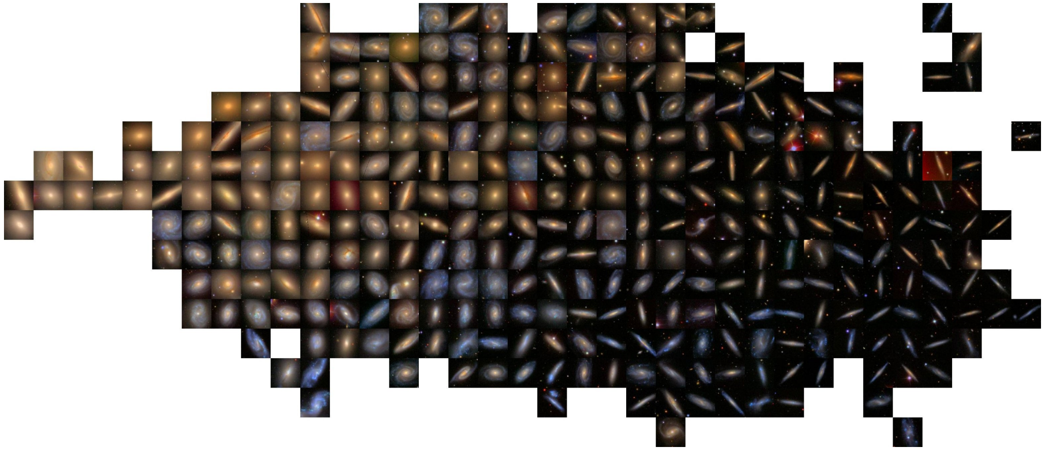


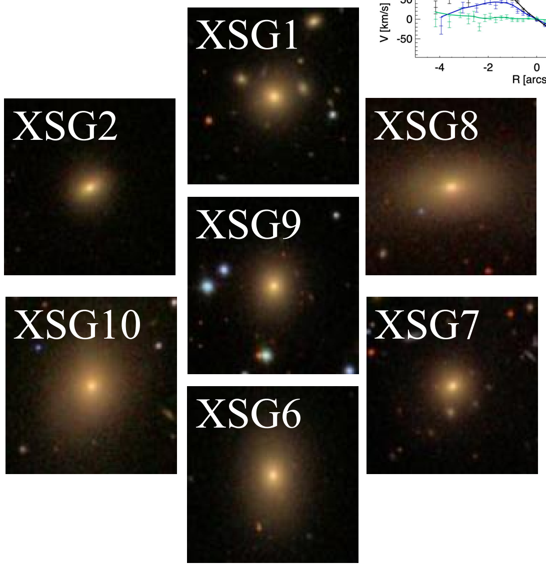


Radial constraints on the stellar IMF of ETGs

Francesco La Barbera
INAF-Osservatorio Astronomico di Capodimonte







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I. Martín-Navarro (IAC, ES)
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R. R. de Carvalho (INPE, BR)
C. Weidner (IAC, ES)
I.G. de la Rosa (IAC, ES)
M. Trevisan (INPE, BR)
B. Barbuy (IAG, BR)
E. Ricciardelli (Valencia, ES)
M. Cappellari (UO, UK)
I. Trujillo (IAC, ES)
A. Ferré-Mateu (ST, USA)
R. Läsker (FINCA, FI)
G. van de Ven (MPI-ESO, DE)
M. Lyubenova (KAI, NL)
R. Peletiér (KAI, NL)
J. Mentz (KAI, NL)

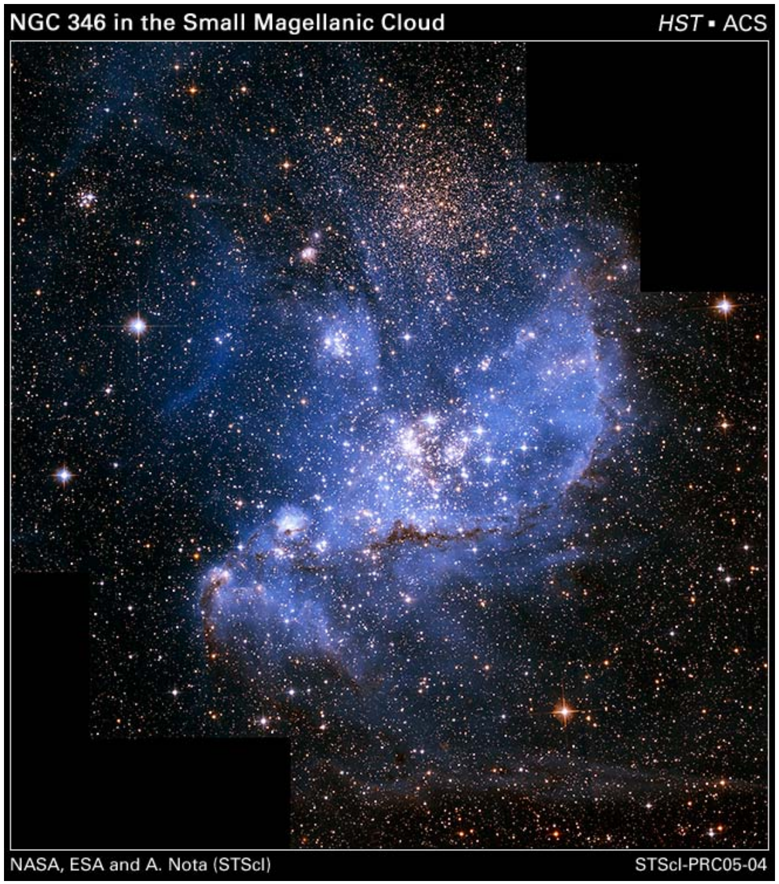
(State-of-art SSP models @miles.iac.es)

LAYOUT

- Basic definitions/results
- IMF inside low- and high-mass ETGs (MUSE+X-Shooter)
- IMF vs. environment

The stellar Initial Mass Function (IMF)

The stellar IMF is the mass distribution of stars collectively born in one event of star formation.

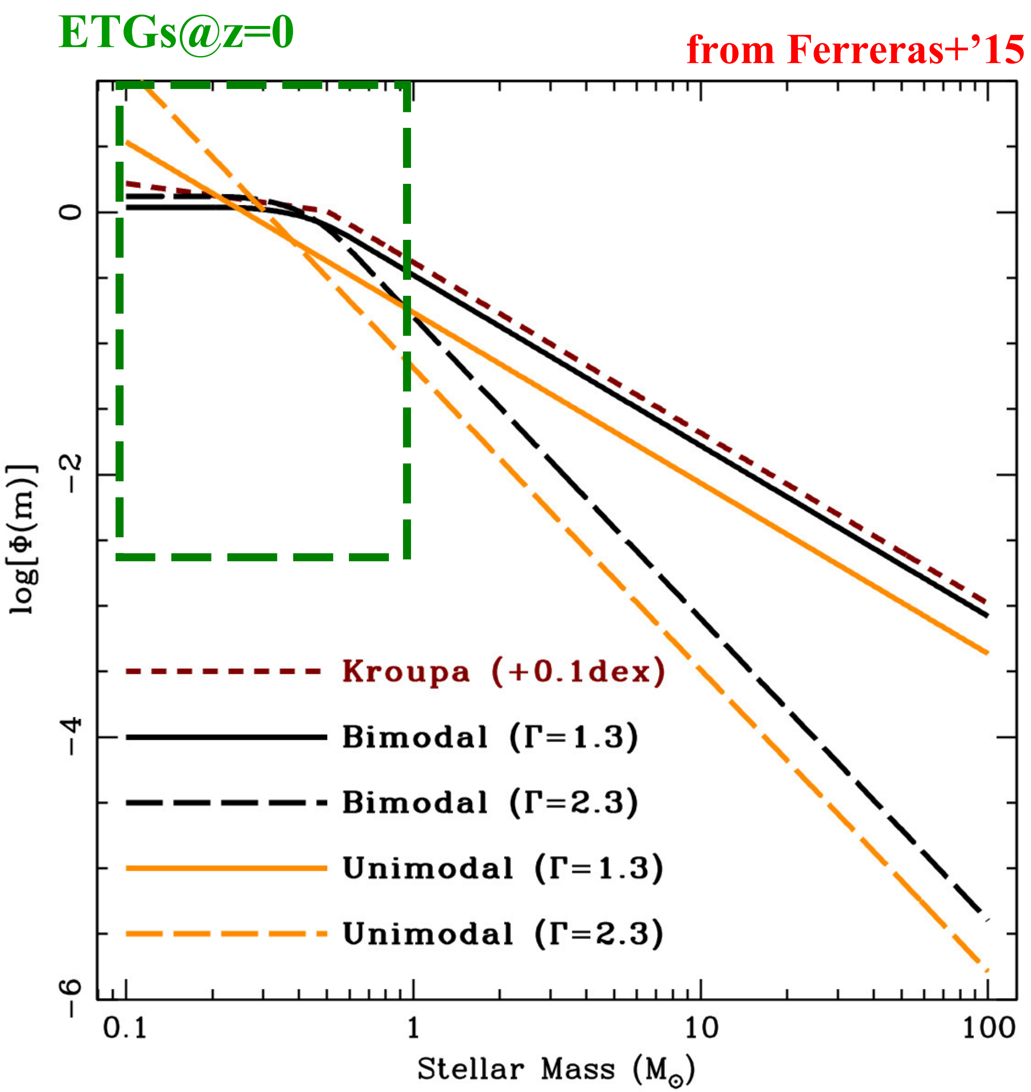


"One event" means a gravitationally-driven collective process of transformation of the interstellar gaseous matter into stars on a spatial scale of about one pc and within about one Myr (Kroupa+2012, "Stellar Systems and Galactic Structure").

Why is it important ?

- It governs the matter cycle of galaxies, i.e. how gas is being converted into stars.
- It sets the mass scale of galaxies (both luminous and dark matter), a fundamental ingredient of any galaxy formation theory.
- It enters the conversion of typical diagnostics of star formation.
- It drives the energy feedback and the enrichment pattern of the inter-stellar medium (ISM) through the evolution of massive stars.
- The IMF is deeply connected to the physics of star formation.
- Constraining the IMF has implications for our understanding of stellar evolution and structure.

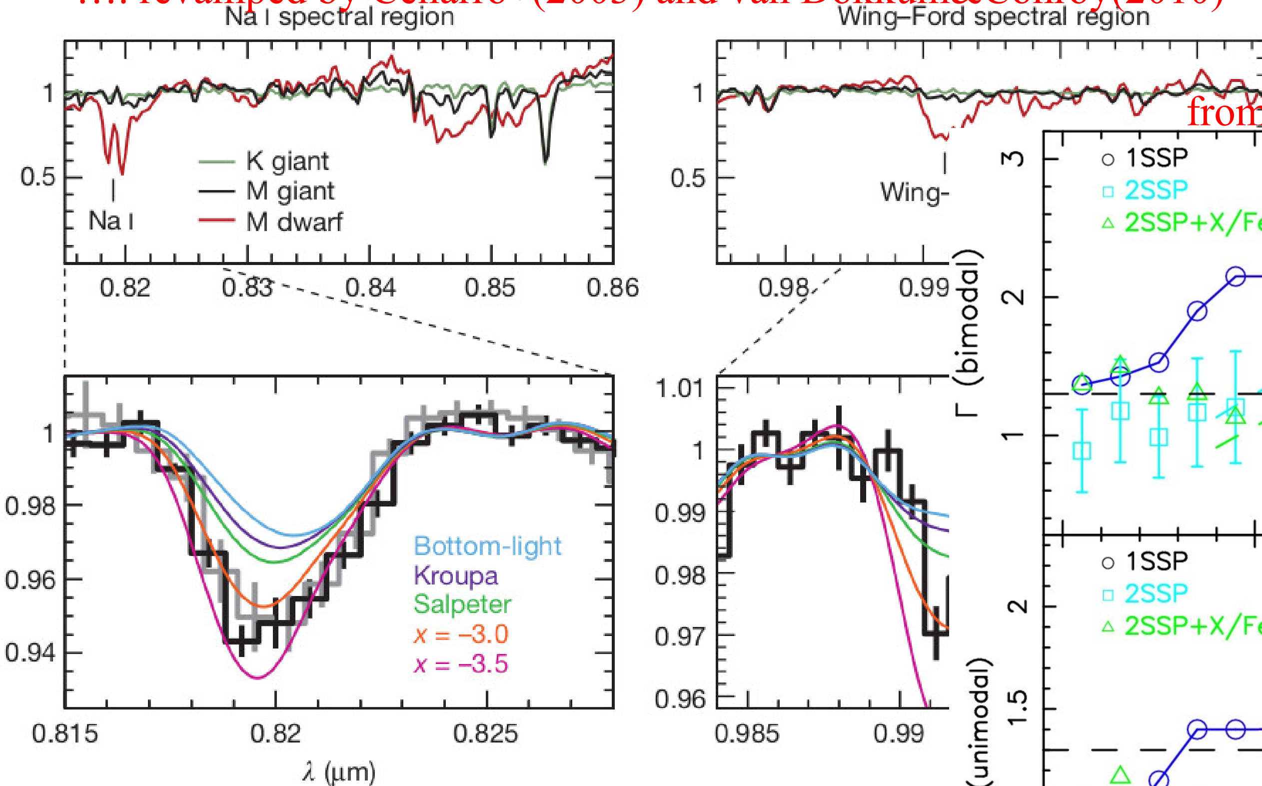
The stellar IMF: functional forms



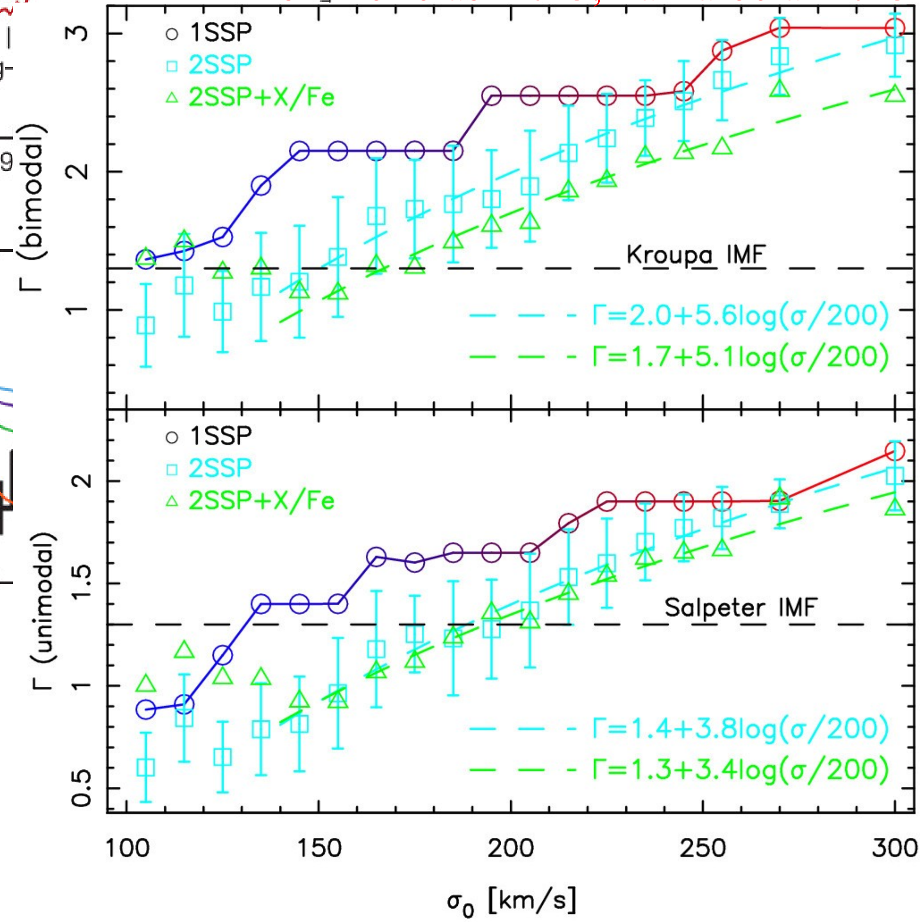
The stellar IMF of unresolved stellar populations

- Old idea but early studies plagued by small N, low S/N and R, uncertain SP models
  (Spinrad'62; Cohen'78; Faber&French'80; Carter+'86; Hardy&Couture'88; Delisle&Hardy'92)

…. revamped by Cenarro+(2003) and van Dokkum&Conroy(2010)



from Ferreras+2013, La Barbera+2013



LAYOUT

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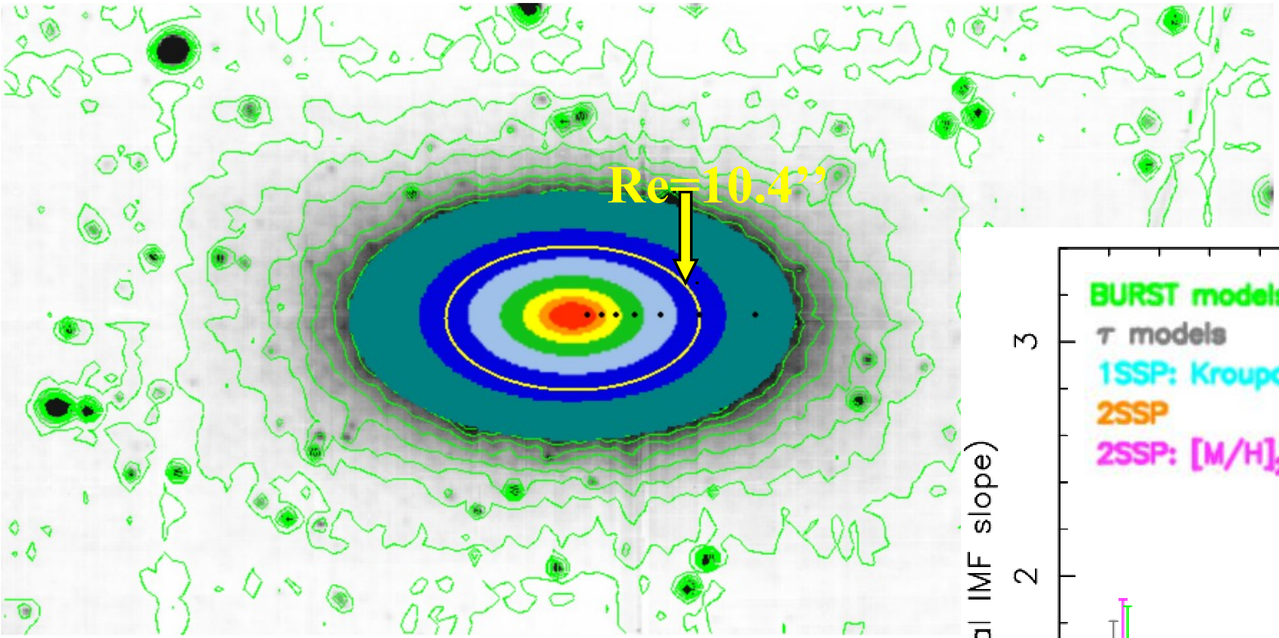
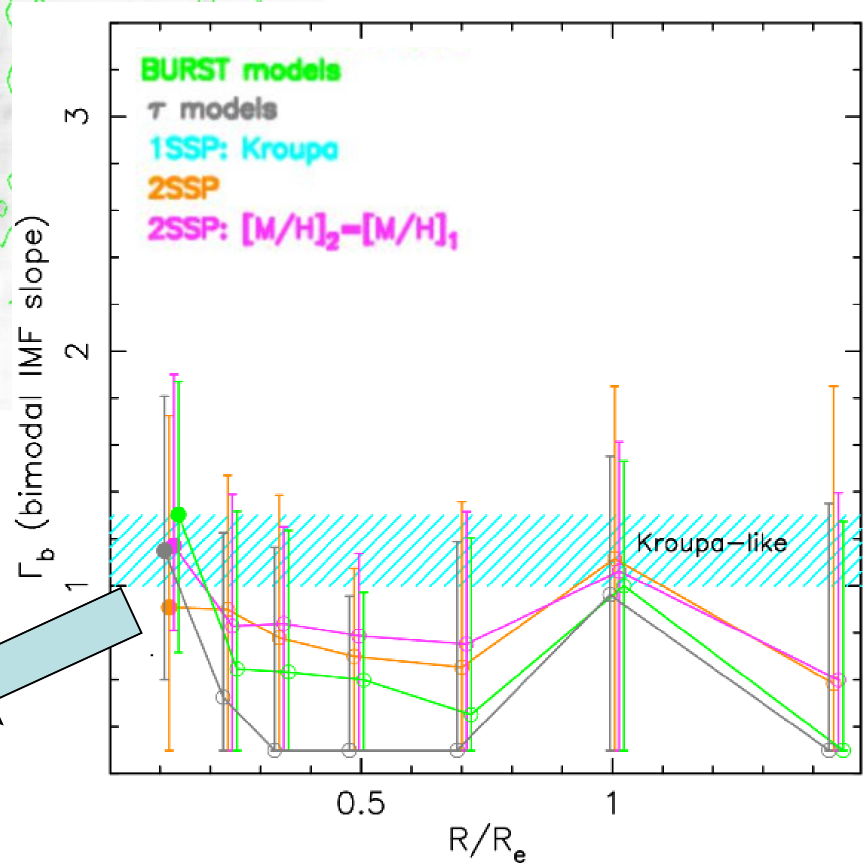
IMF variations in early-type dwarf galaxies

(Mentz+2016, MNRAS, 463, 2819)

MUSE data for NGC1396 (094.B-0895; PI: T. Lisker)
Two pointings (E+W; 3hr on target each)



Gravity-sensitive features:
NaD, NaI8190, CaT + Hβ, Mgb, Fe lines



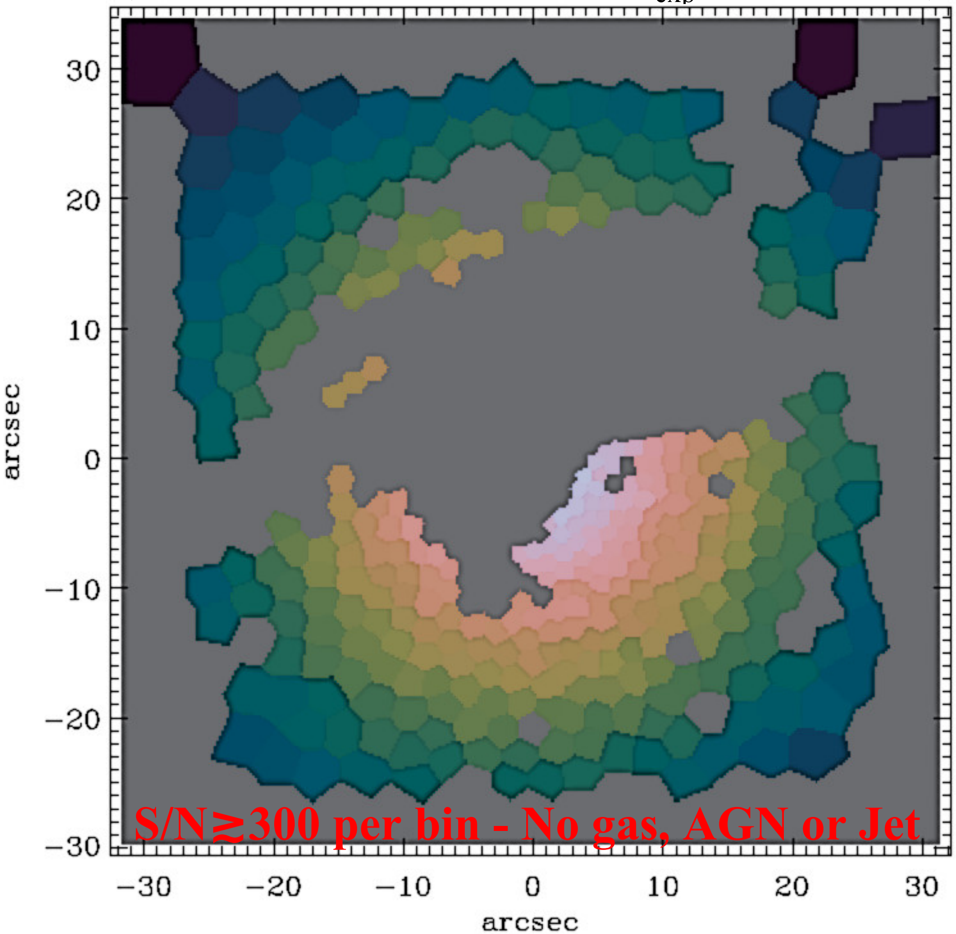
… consistent with either a top-heavy, or a Kroupa-like IMF; a bottom-heavy IMF is firmly ruled out

IMF variations in M87

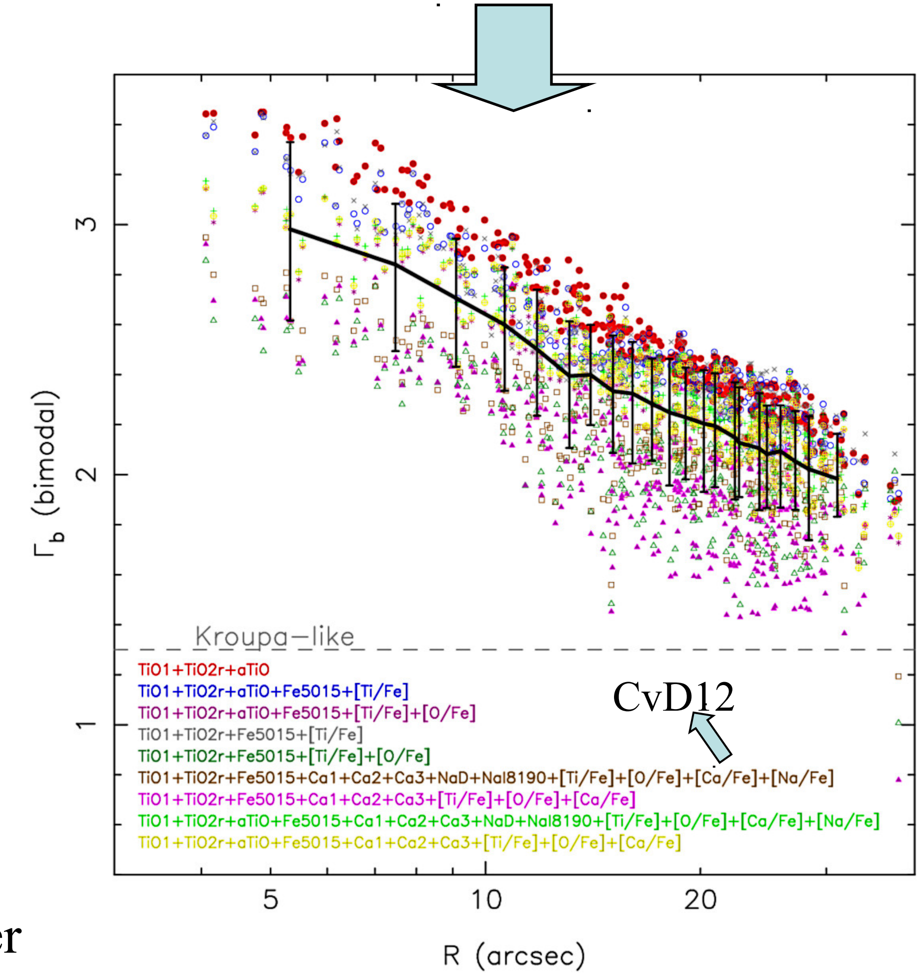
(Sarzi, Spiniello, La Barbera, Krajnovic, van den Bosch, 2017, MNRAS, sub.)

MUSE SV data for M87

(60.A-9312; PI: M. Sarzi; T_{exp}=2x1800sec)



Fitting EWs of IMF-sensitive features with EMILES SSPs (Vazdekis+2016, MNRAS, 463, 3409)

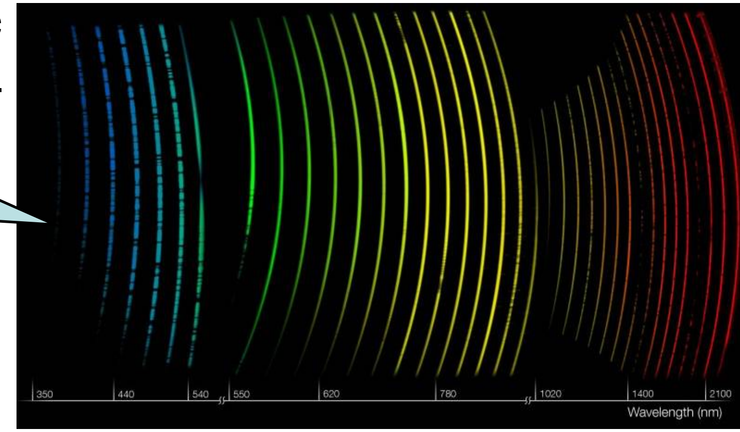


- bottom-heavy distribution in the center
- significant IMF radial gradient (almost Kroupa-like at ∼1/3Re)

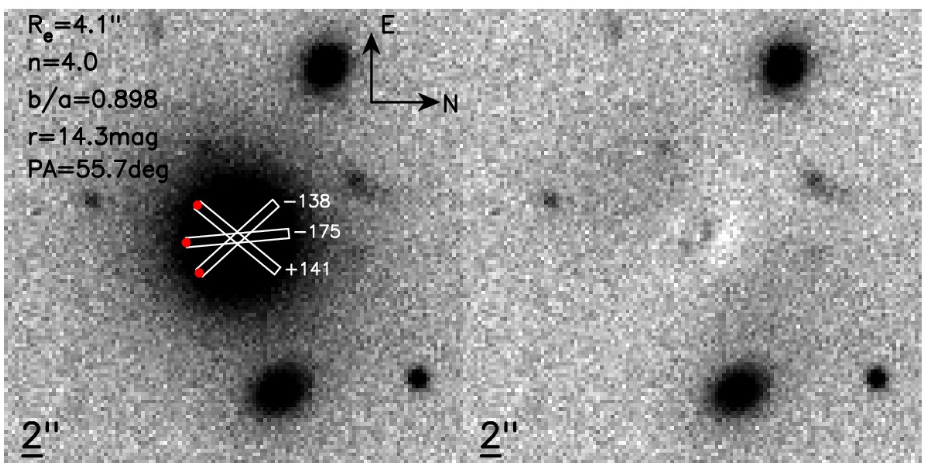
The stellar IMF of ETGs with X-Shooter

La Barbera, F., Vazdekis, A., Ferreras, I.
Pasquali, A., Martìn-Navarro, I., Falcón-Barroso, J., Allende Prieto, C., Aguado, D., Peletier, R.

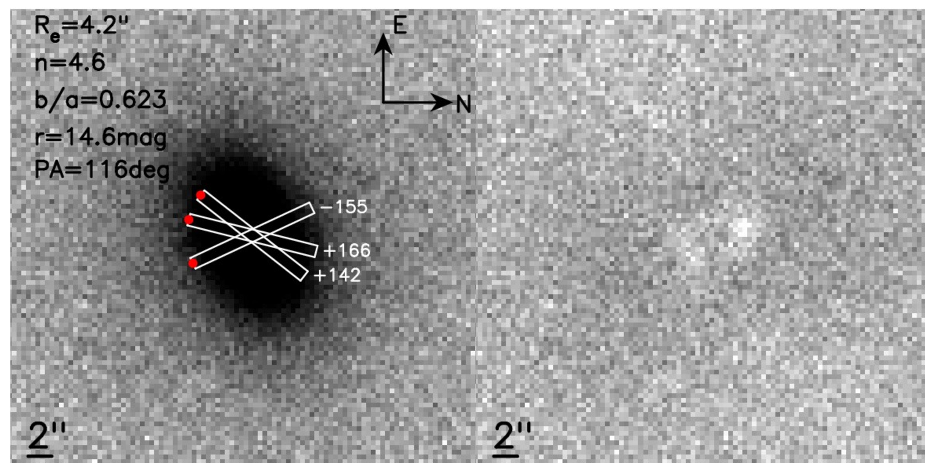
Long-slit spectroscopy for seven massive (σ>300km/s), ETGs at z~0.05, with X-Shooter@VLT (P92+P94+P97->P99; P.I. FLB)



- 11''-long slit ($\pm$0.5-1R_e)
- wavelength range 300→2400nm
- resolution 5000→7500 (FWHM)
- 5hrs integration (target/sky)
  S/N per Å ~400 in the galaxy center

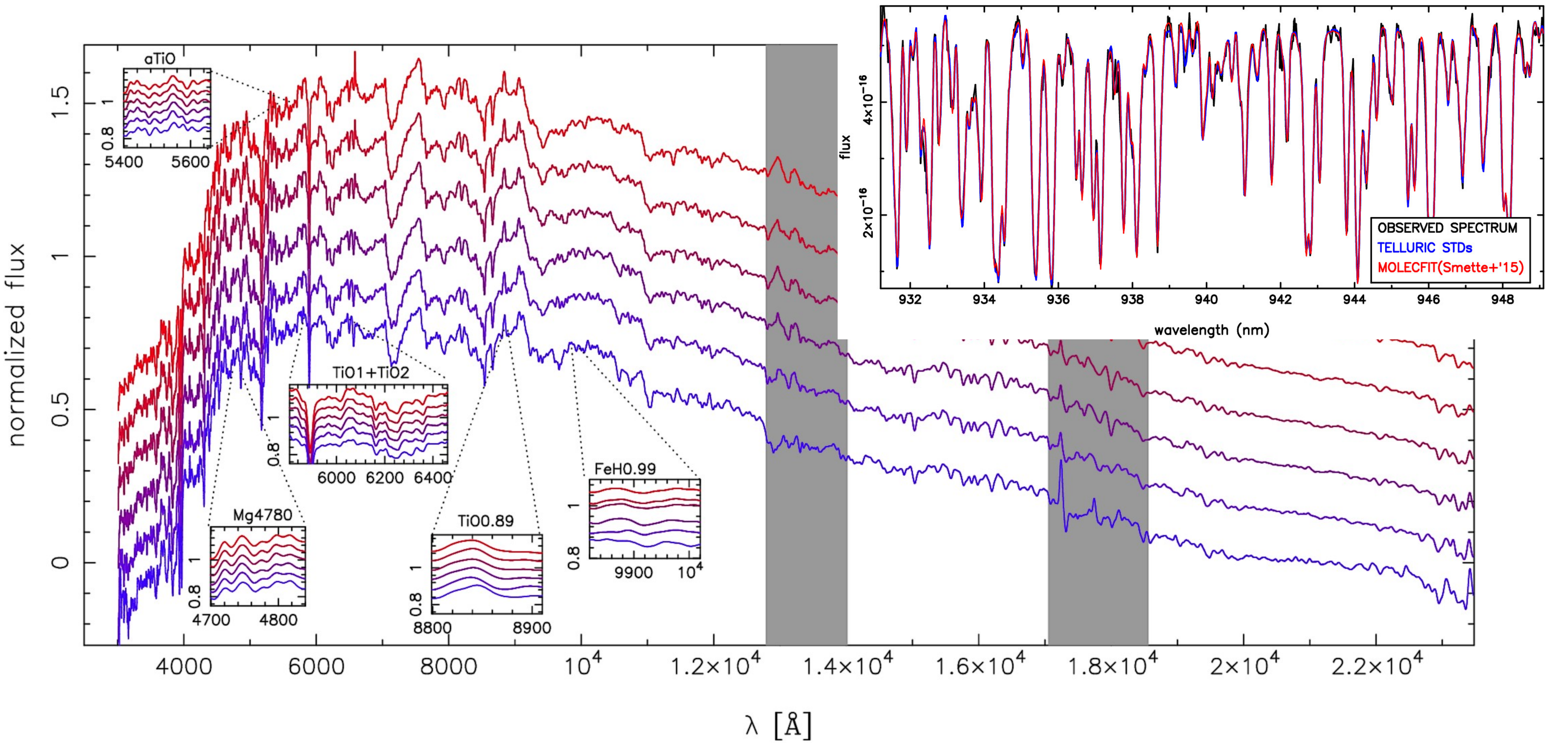


XSG1 ([α/Fe]~0.4; 350km/s)



XSG2 ([α/Fe]~0.25; 320km/s)

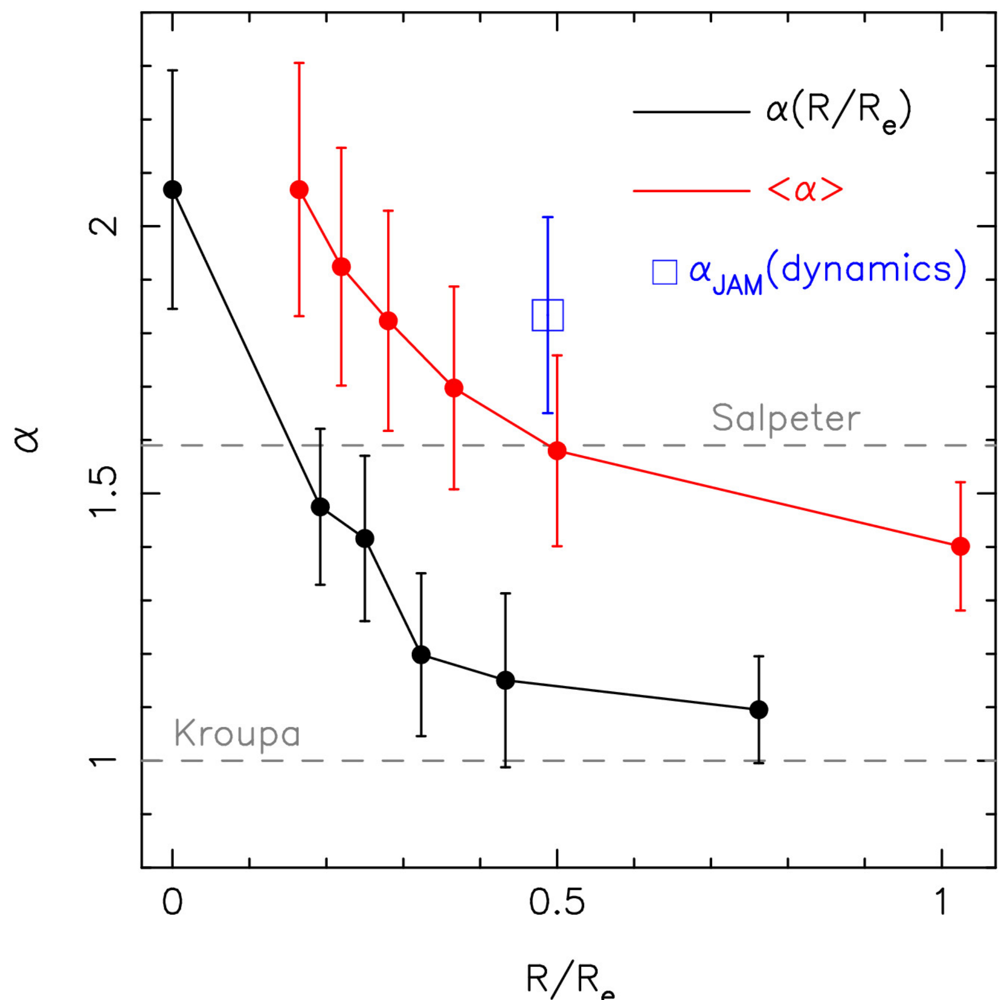
The stellar IMF of ETGs with X-Shooter

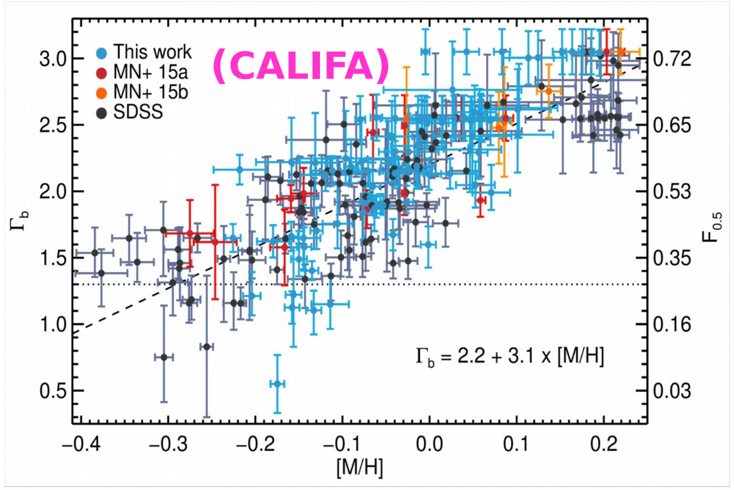


The stellar IMF of XSG1 – radial behavior

La Barbera, F., Vazdekis, A., Ferreras, I., Pasquali, A., Cappellari, M., Martìn-Navarro, I., Schönebeck, F., Falcón-Barroso, J., 2016, MNRAS, 457, 1468

La Barbera, F., Vazdekis, A., Ferreras, I., Pasquali, A., Allende Preto, C., Rock, B., Aguado, D.S., Peletier, R., 2017, MNRAS, 464, 3597



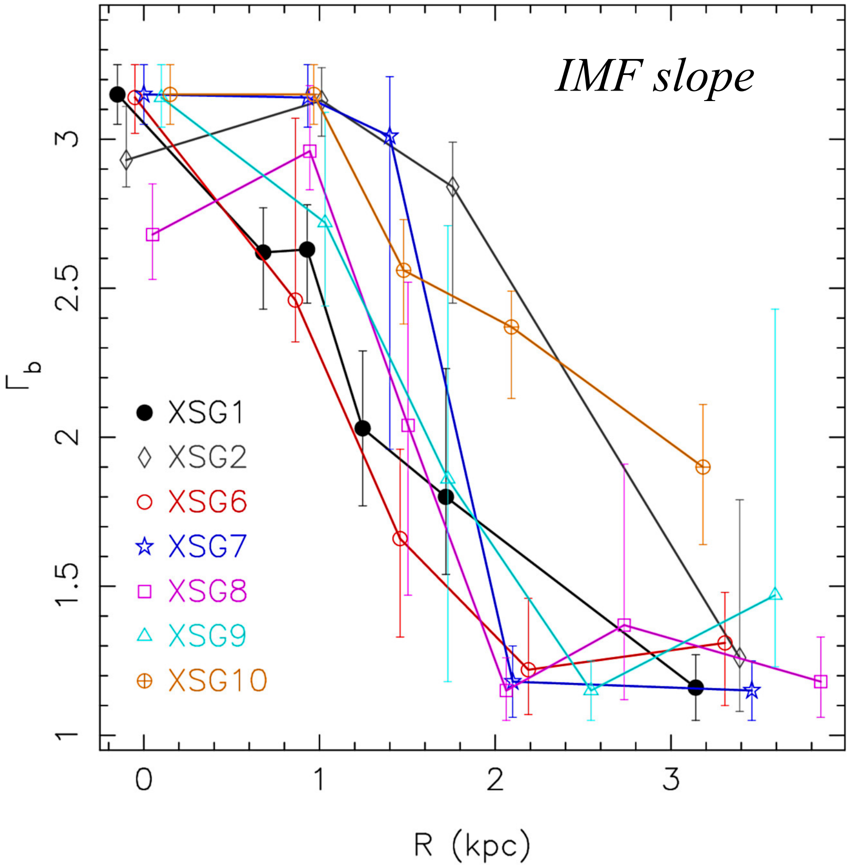


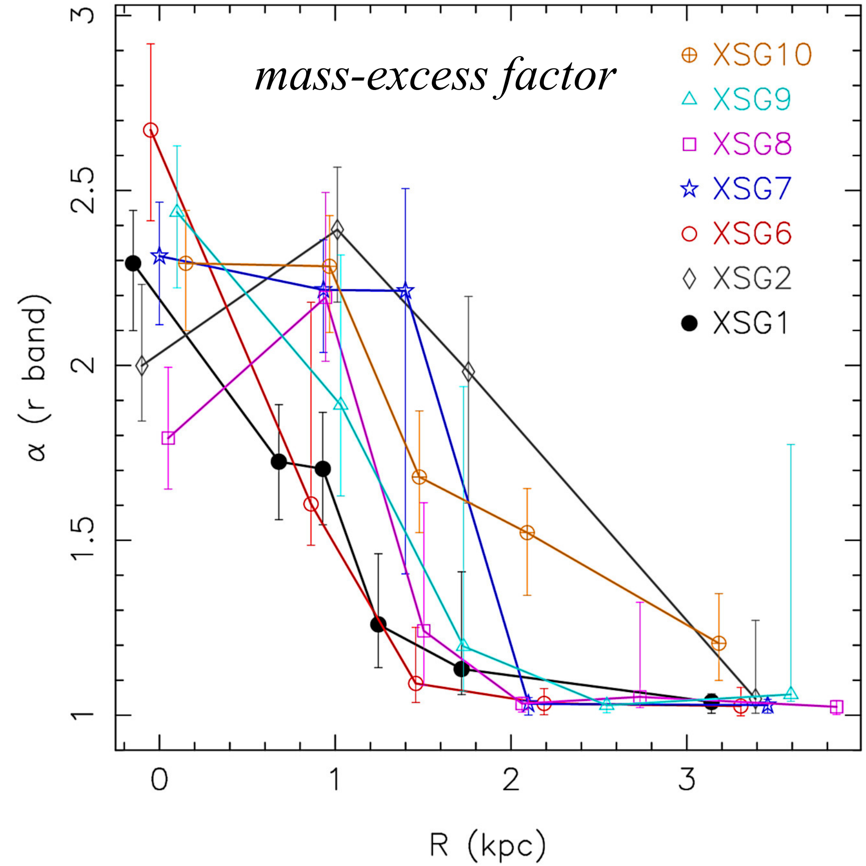
IMF-metallicity relation (Martin-Navarro+2015a,b)

Significant IMF radial gradient, consistent with JAM estimates

Radial trends for all the XSG's

- Results for all the XSG's (analyzed as for XSG1, i.e. TiO1+TiO2+aTiO+Mg4780)





La Barbera et al (2018), in preparation

- IMF slope (mass-excess factor) decreases with radius in all systems
- bottom-heavy population is confined to a region of 1-2kpc

Combined **SP + dynamical** constraints…..

(in collaboration with *L. Zhu @MPIA, G. van de Ven @MPIA, M. Lyubenova @ESO*)

Schwarzschild models

(Zhu et al. 2017, in press; arXiv:1709.06649)

spherical NFW DM

triaxial stellar component

Constraints

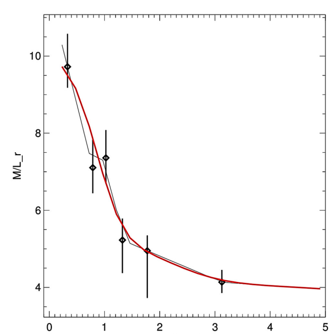
kinematics along different PA's

+

photometry

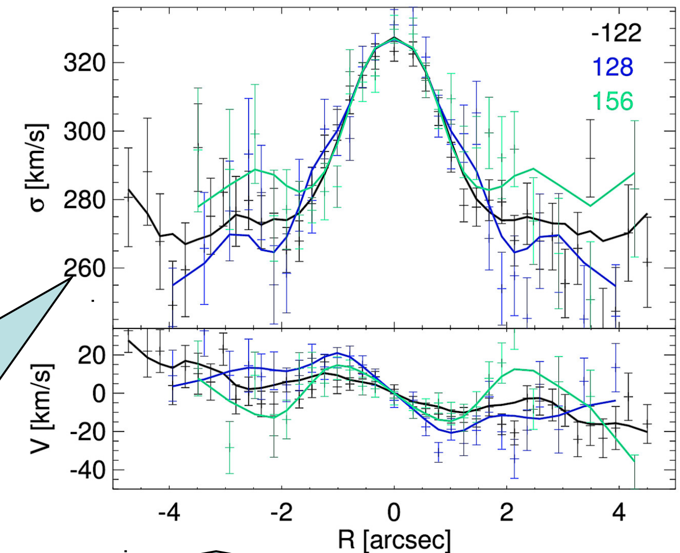
+

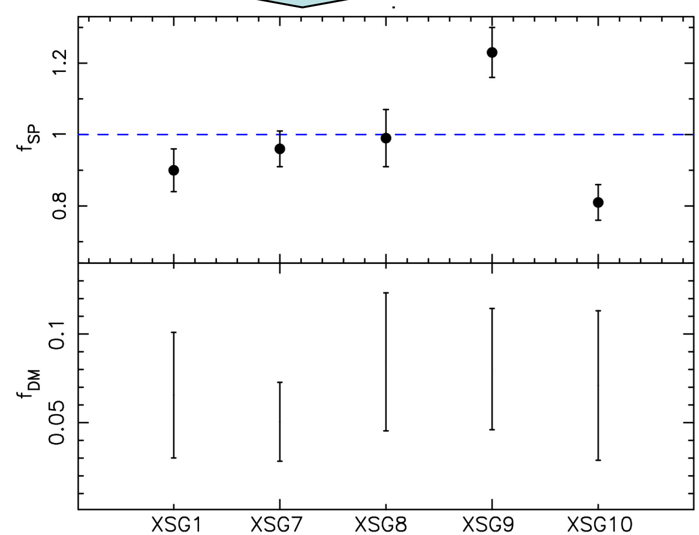
M*/L (stellar population analysis)



5 free param.s

p, q, Mv, bh, f_{SP}





Lyubenova et al. in preparation

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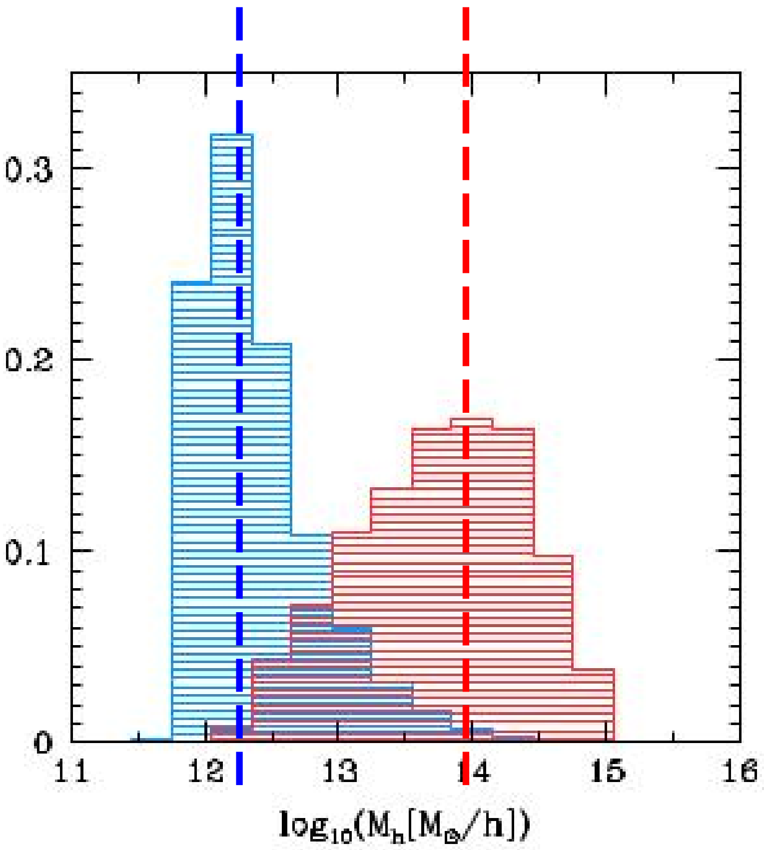
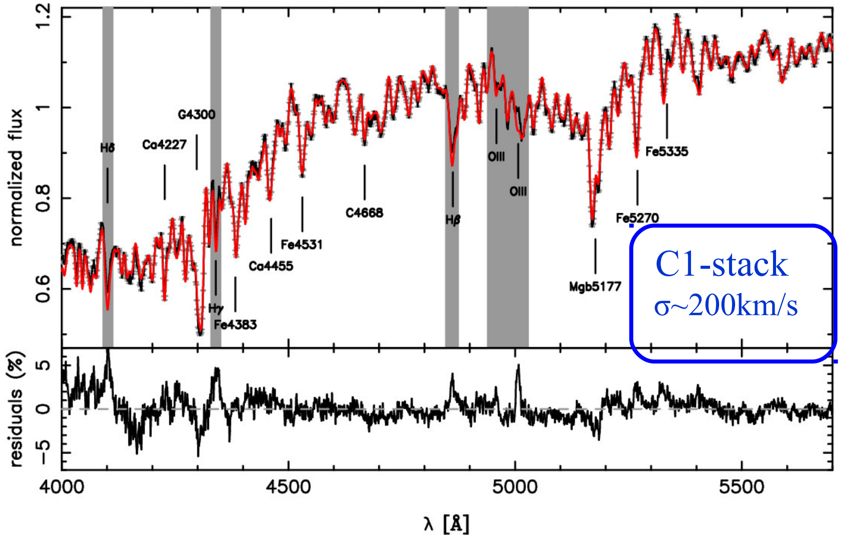
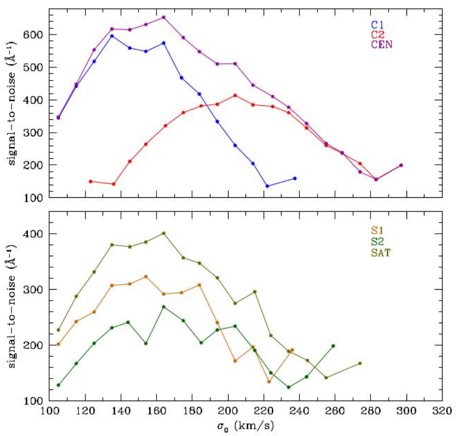
IMF vs. σ_0: environment

(Giulio Rosani master thesis @ARI;
Rosani+2017, MNRAS, submitted)

We stacked SDSS spectra of 20,977 SPIDER (La Barbera+2010) ETGs with environment (**centrals/satellites**/M_{halo}) defined from the updated (DR7) group catalogue of Yang+.



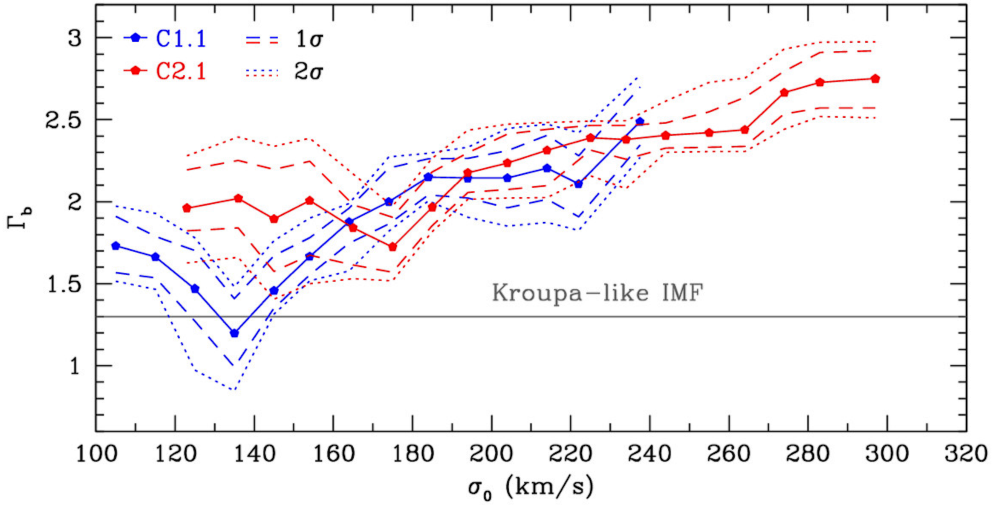


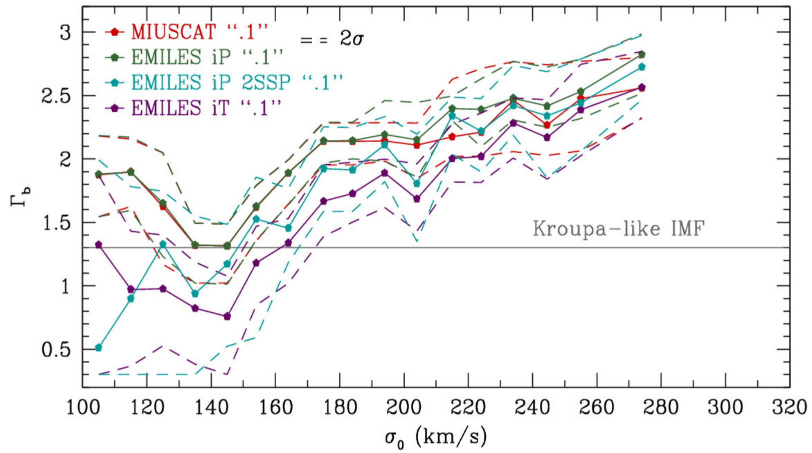


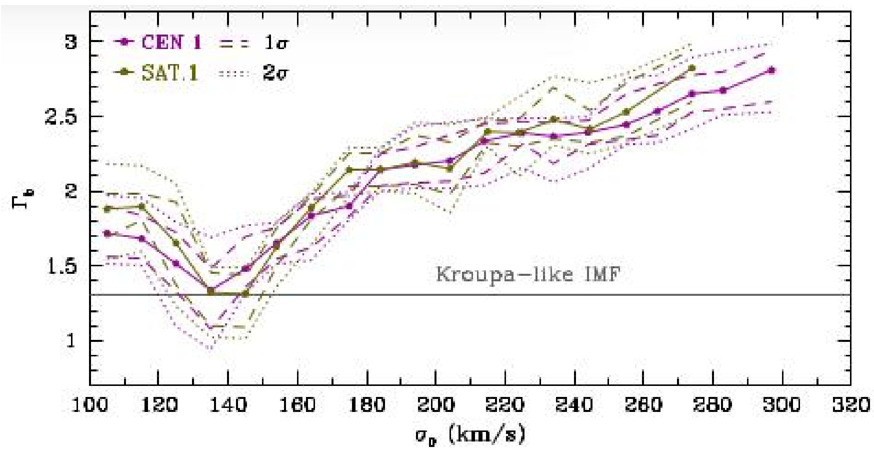
(see also La Barbera+2014 for age, Z, [Mg/Fe] trends)

IMF vs. σ_0: environment

(Giulio Rosani master thesis @ARI;
Rosani+2017, MNRAS, submitted)





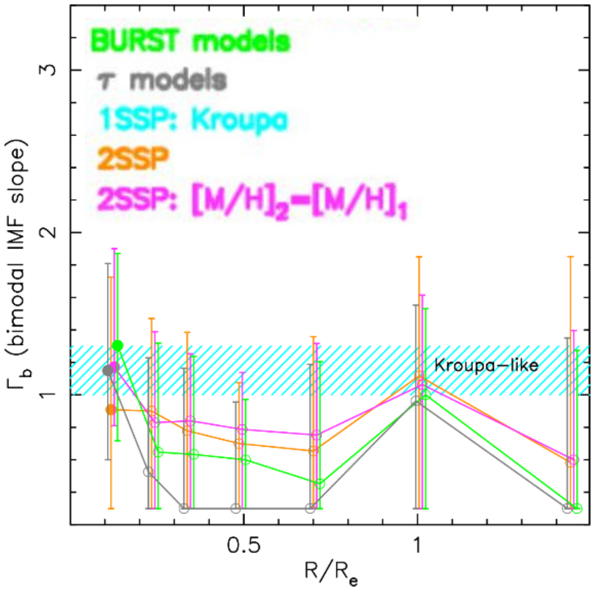


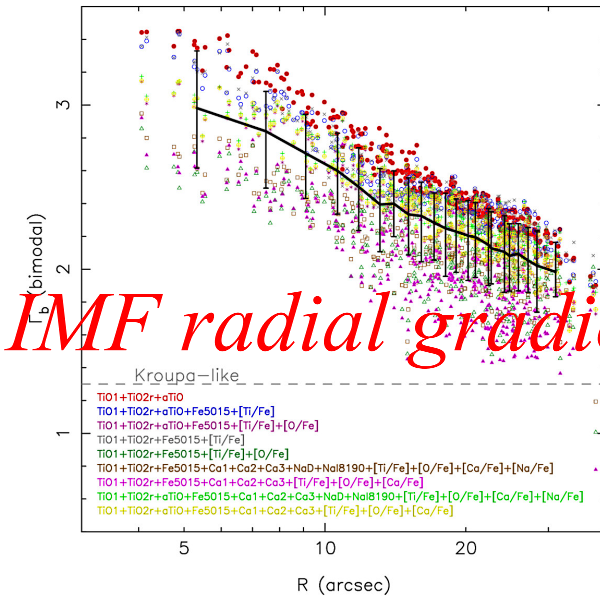
Results are robust against assumptions on SFH and models' ingredients

No dependence of IMF-σ_0 relation on environment

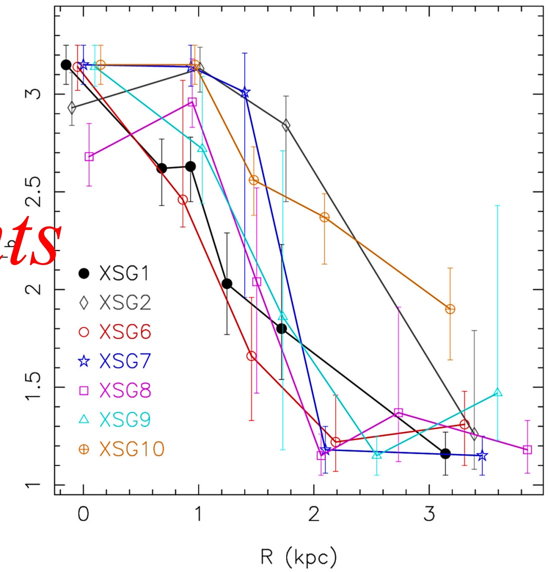
Summary

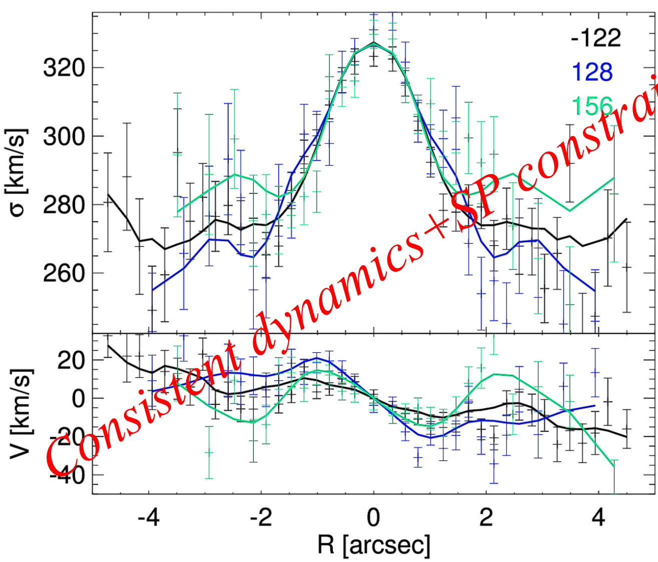
*Take home message



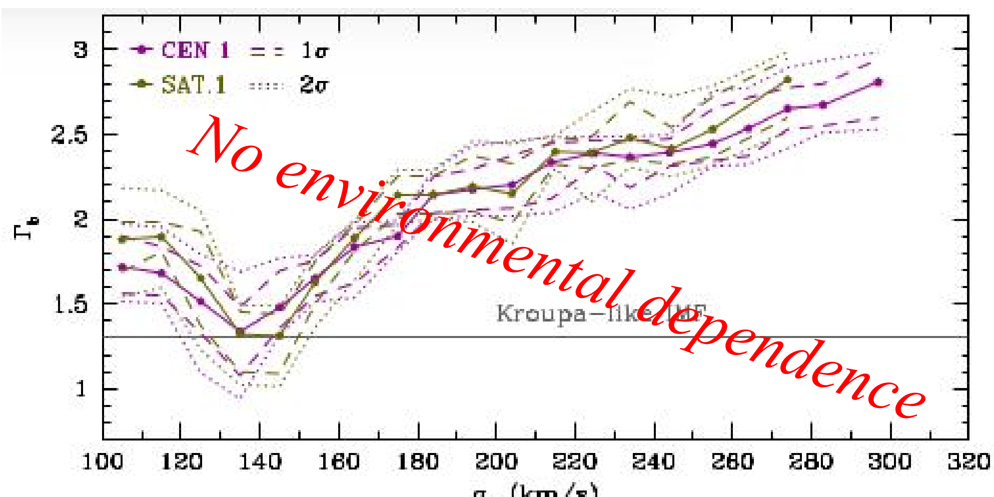


IMF radial gradients





Consistent dynamics+SP constraints



No environmental dependence