Department of Space and Climate Physics
Mullard Space Science Laboratory
http://www.ucl.ac.uk/mssl

A systematic variation of the stellar IMF with galaxy mass

Ignacio Ferreras

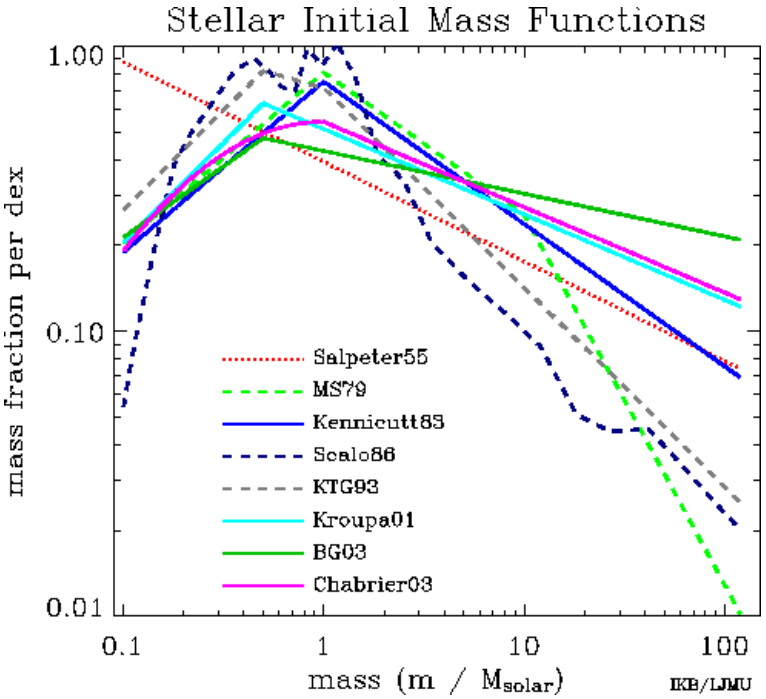
Collaborators:
Francesco La Barbera, Alex Vazdekis,
Ignacio G. de la Rosa, Reinaldo de Carvalho,
Jesús Falcón-Barroso, Marina Trevisán, Elena Ricciardelli

NAM 2013 – Parallel Session 29
St Andrews, Scotland

July 2nd, 2013

… a cherished belief

- The stellar mass distribution at birth is an essential piece for the interpretation of light from unresolved populations:
  - Stellar Mass
  - Star formation history
  - Chemical enrichment
- It is generally assumed that the IMF is universal
  - Simple power law (Salpeter)
  - With a cutoff towards low masses (Kroupa, Chabrier)



Ivan Baldry (Liverpool John Moores)

How universal is the IMF?

<u>M31 nucleus</u>

(e.g. Spinrad & Taylor 1971; Faber & French 1980)

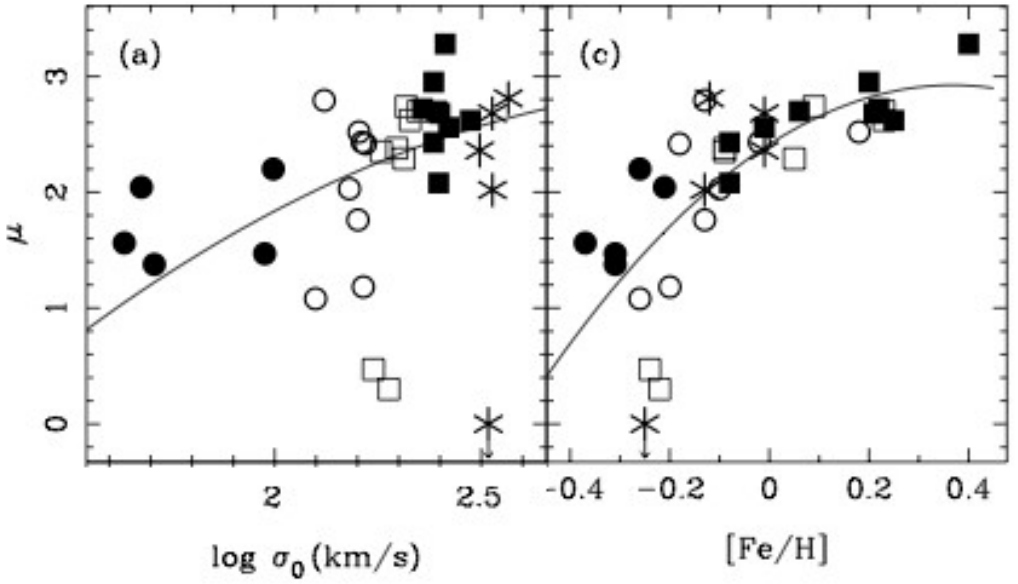
<u>Massive ETGs</u>

I. CaT decrease (Cenarro et al. 2003)

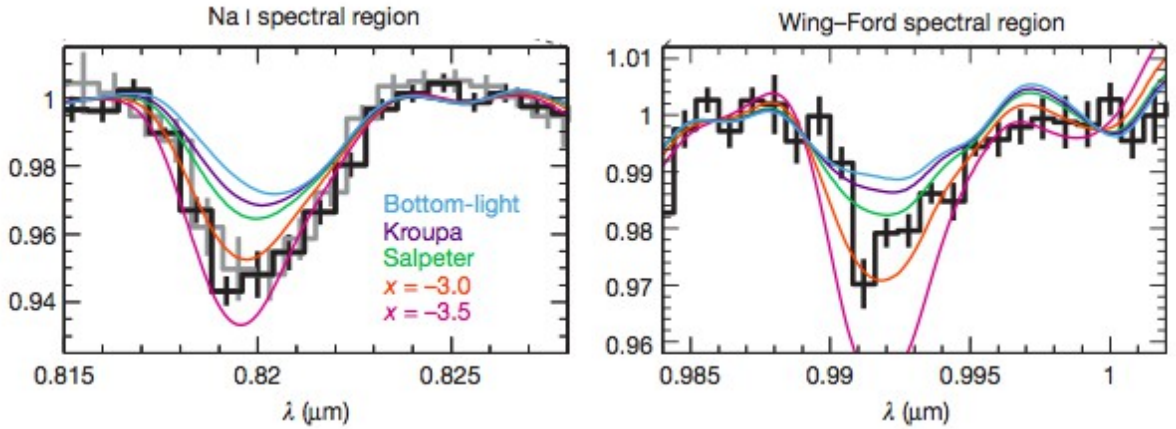
II. Na8190 & FeH increase (van Dokkum & Conroy 2010)

III. Dynamical modelling (Cappellari et al. 2012)

Excess of M dwarves (bottom-heavy IMF)



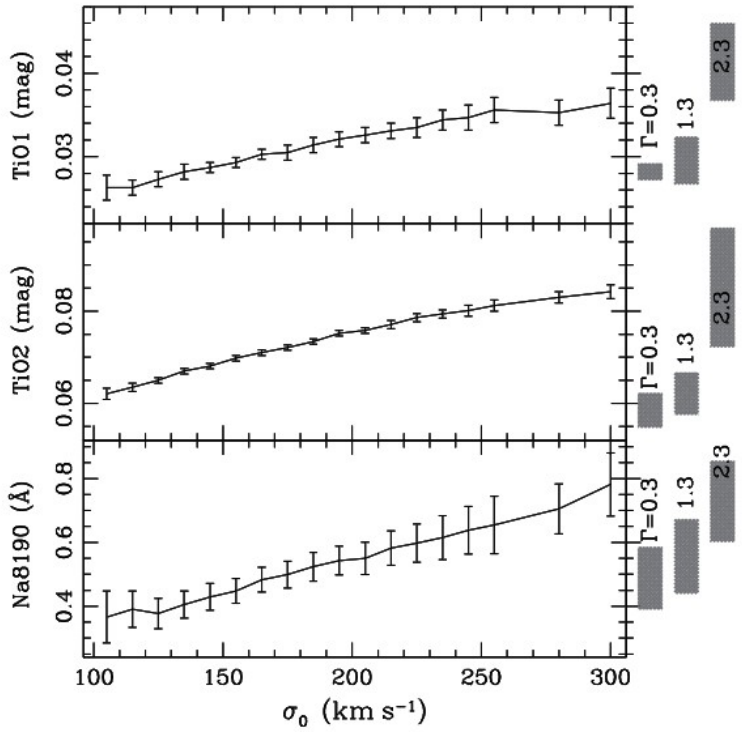
Cenarro et al. (2003)



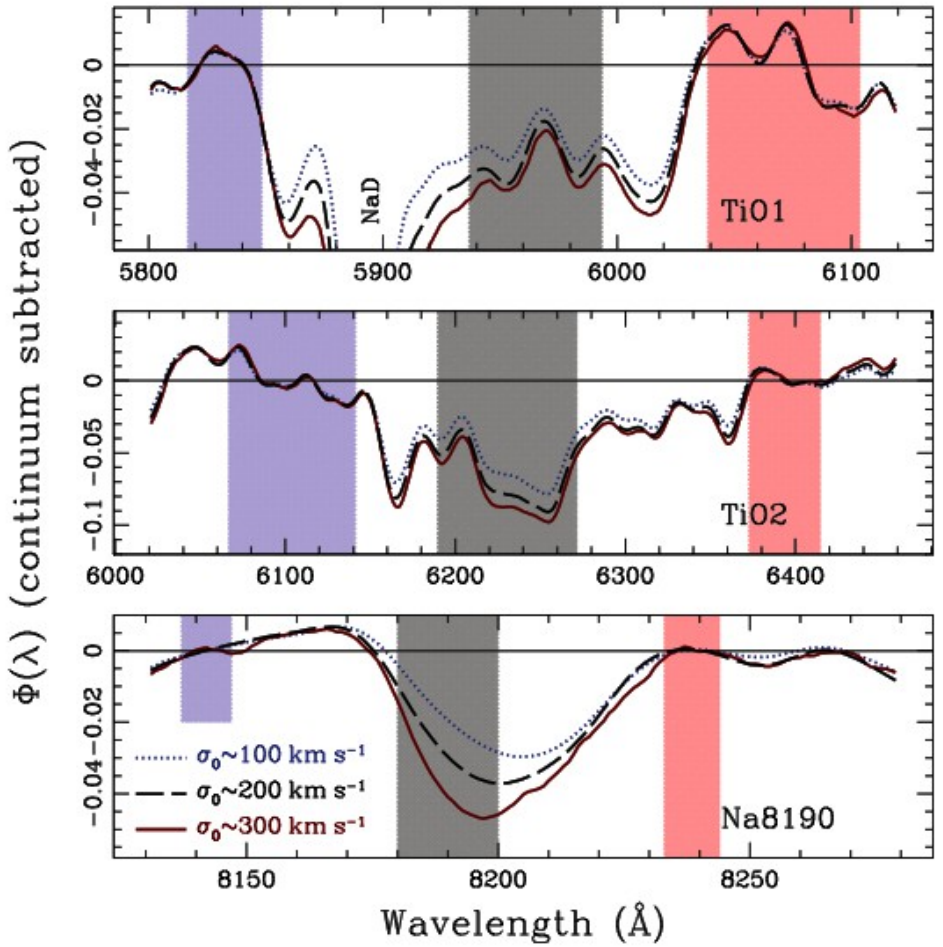
Van Dokkum & Conroy (2010)

The SPIDER (SDSS/ETG) sample

A compilation of 40k SDSS spectra (SPIDER, la Barbera et al. 2010) was used, selecting a sample of ~25k galaxies (z<0.1), binning with respect to velocity dispersion (18 bins), stacking the data to obtain very high SNR in the dwarf-sensitive indices TiO1, TiO2, Na8190 (among others), to find a systematic increase with sigma.



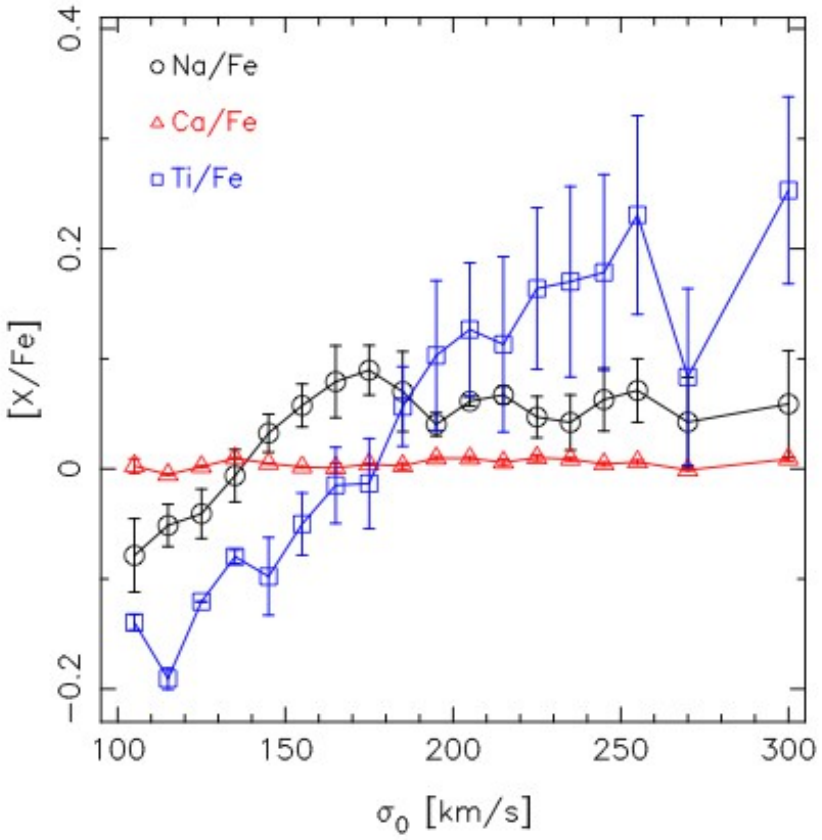
Ferreras et al. (2013, MNRAS, 429, L15)

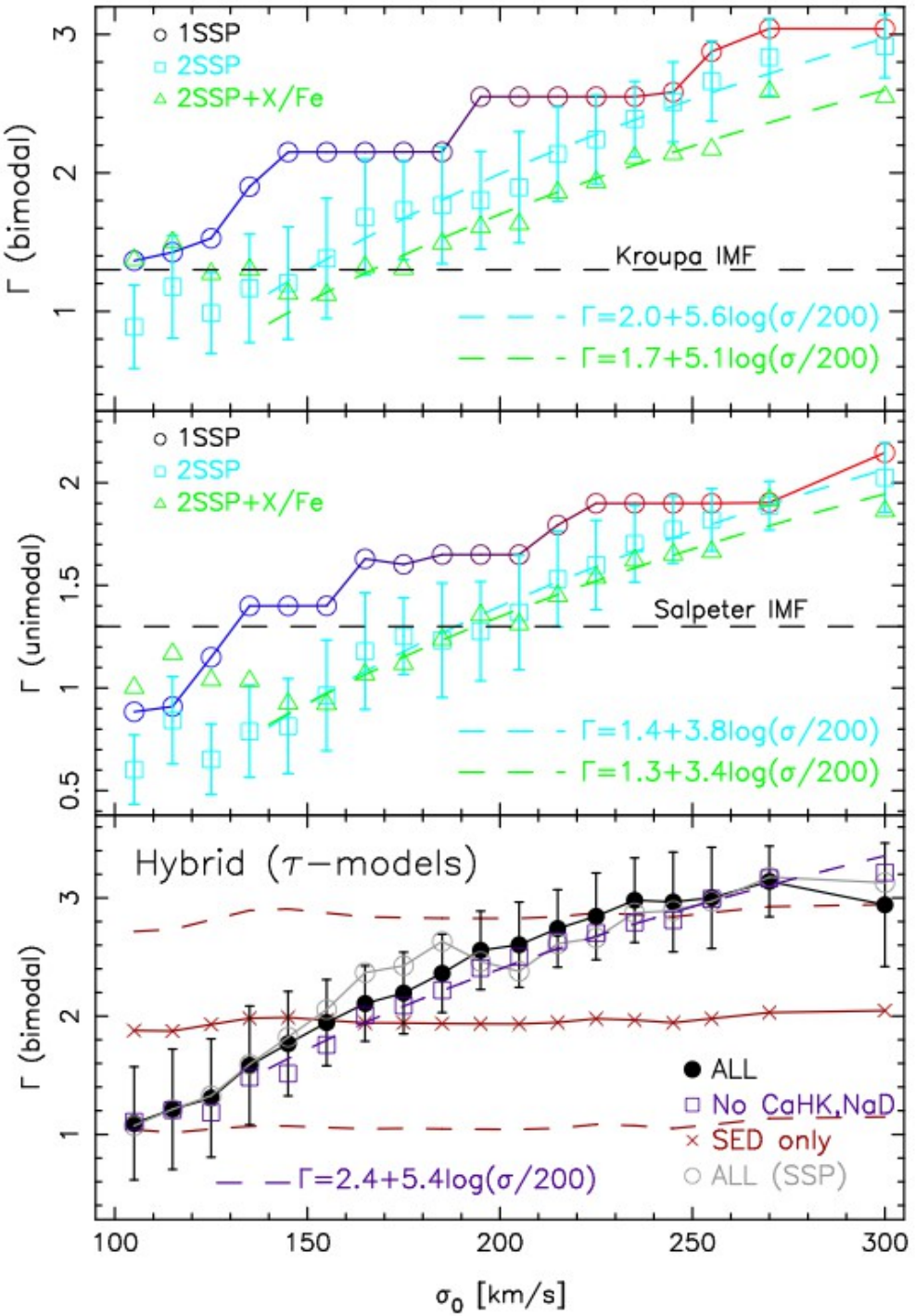


IMF vs σ trend

La Barbera et al. (2013, MNRAS, arXiv:1305.2273)

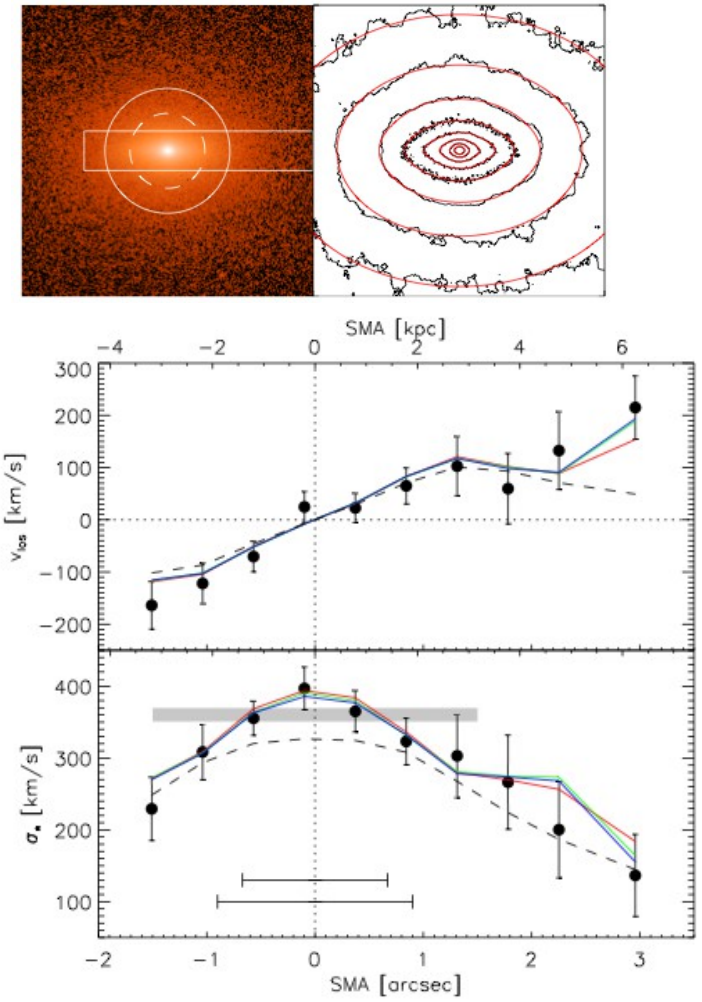
Different methods (1SSP,2SSP, +X/Fe,Hybrid) show the same trend, requiring a significantly high Γ in massive ETGs

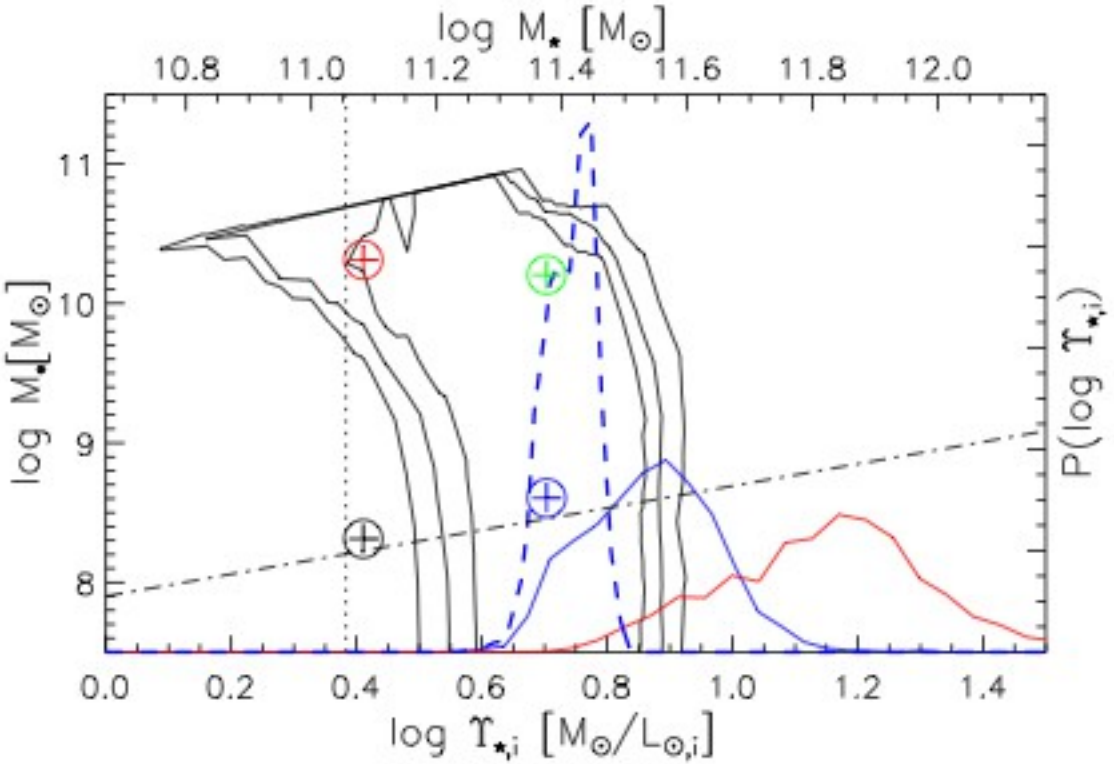




A solution to the problem of “übermassive” BHs

SDSS J151741.75-004217.6





The recent suggestion of very massive central BHs in compact galaxies with very high σ (van den Bosch et al. 2012) may be explained, instead, by the presence of a bottom-heavy IMF.

Läsker et al. (2013, MNRAS, arXiv:1305.5542)

What can cause this trend?

- "Microphysics": Star forming regions with a high Mach-number ISM could trigger fragmentation (e.g. Hopkins 2012)
- The variation of the IMF during the star formation history of a galaxy can create an "Integrated Galactic IMF" that is compatible with the observations (Vazdekis et al. 1996; Weidner et al., arXiv:1306.6332)