# star formation and inside-out growth on the outer-disc age profiles

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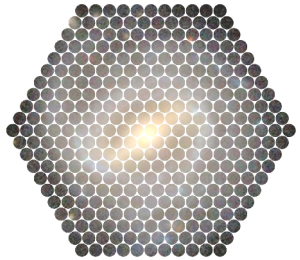
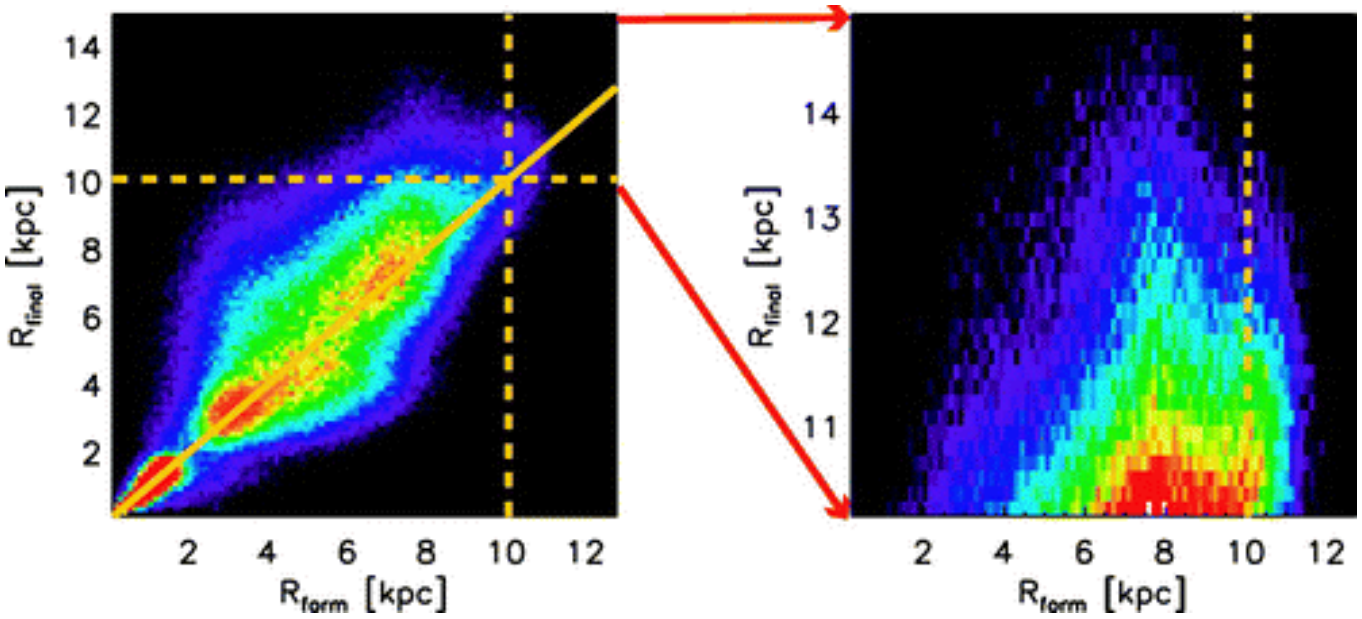
GARNET
Galactic Archaeology Network



CALIFA Survey

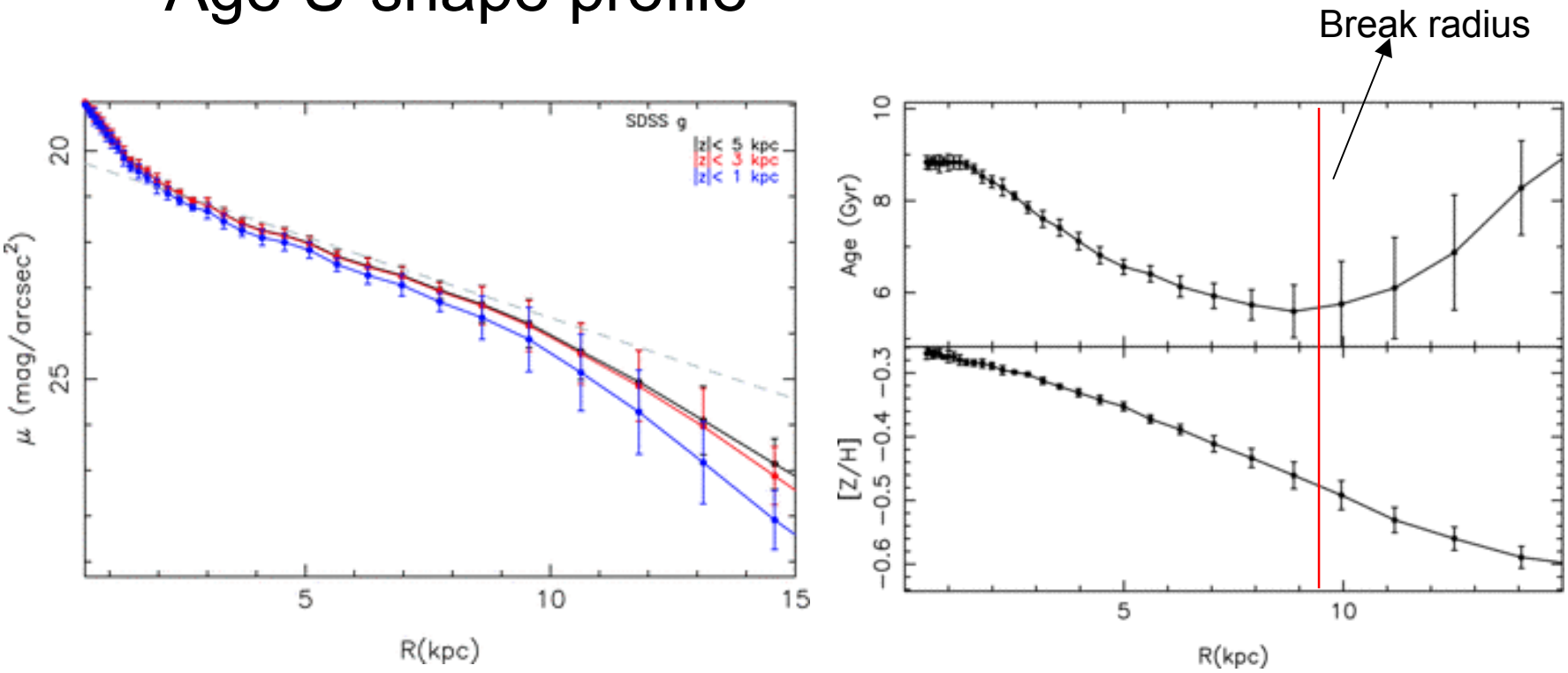
# Stellar migration to form the galaxy outer parts




Roskar et al. 2008

Outward migrated stars populate the external parts of discs as its outer gas density is well below the star formation threshold. Implications in the age distribution (U-shape) and surface brightness profiles (type II)

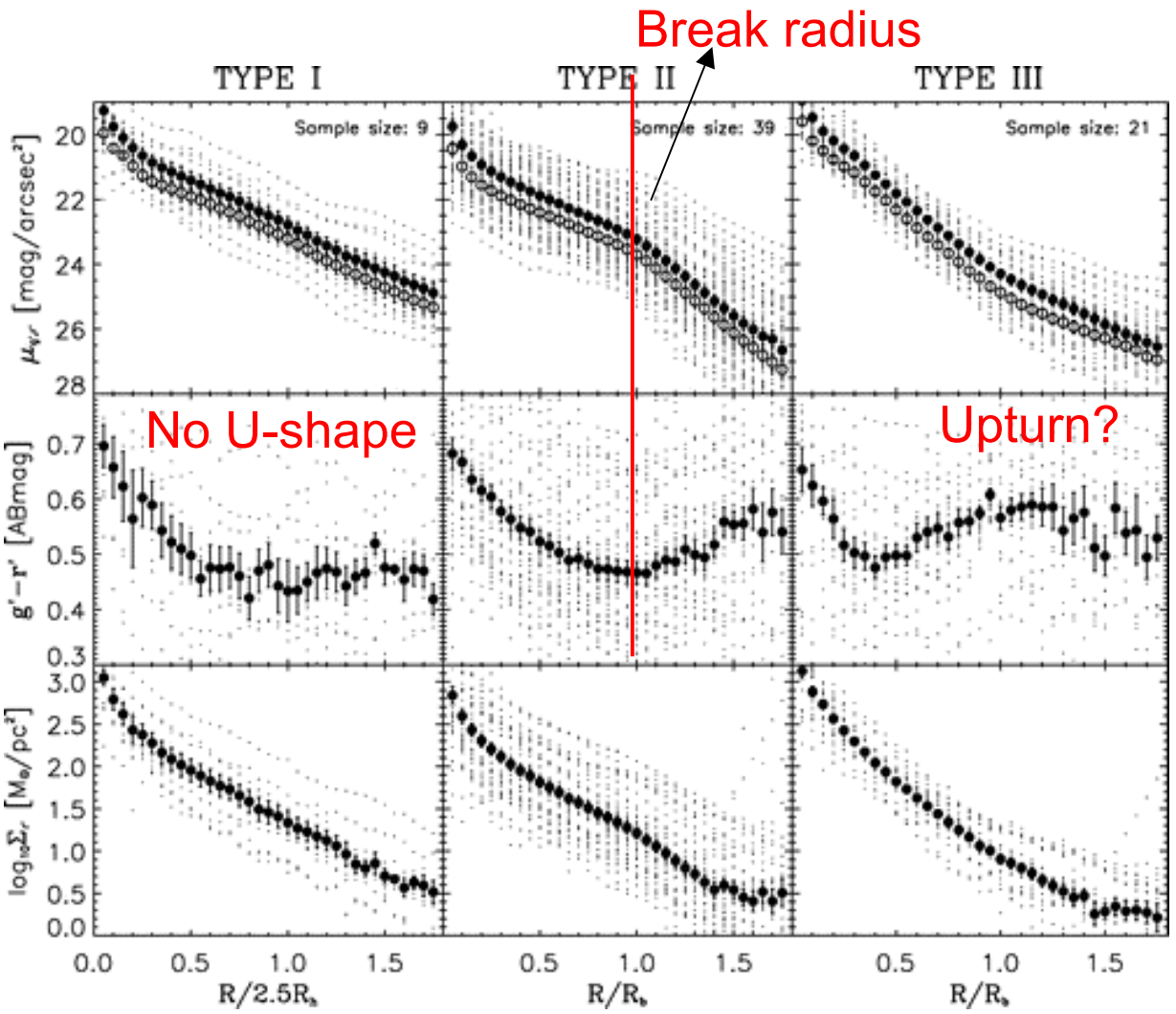
# Age U-shape profile




Sánchez-Blázquez et al. 2009

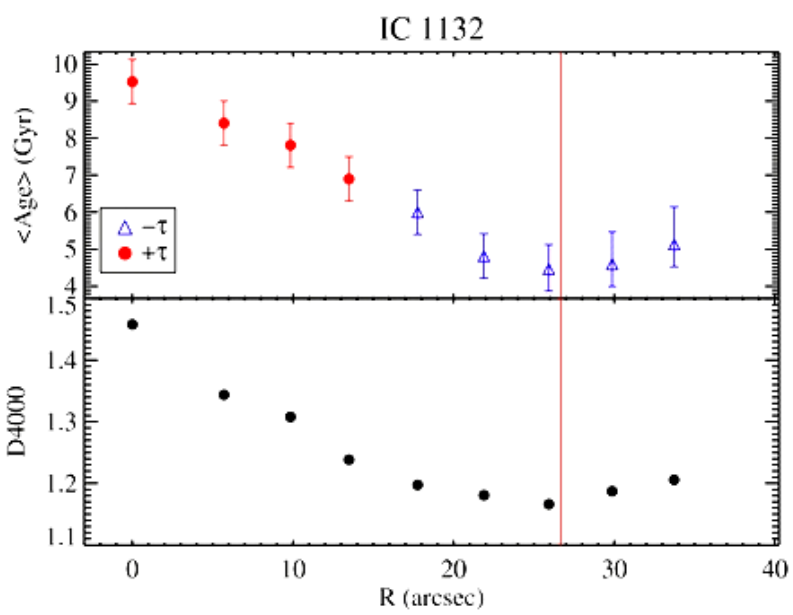
U-shape profile found in type II surface brightness discs (cosmological and non-cosmological simulations). But, it is also recovered even when radial migration is not allowed

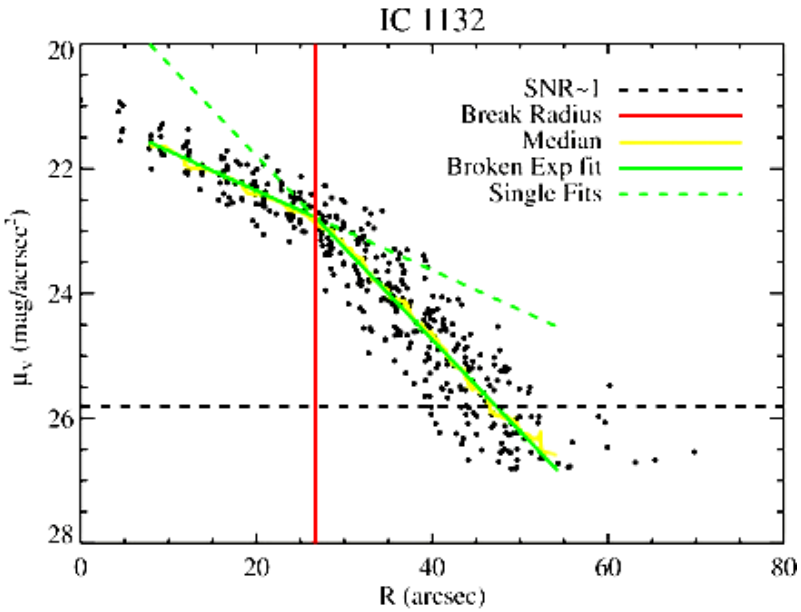
# Observations of U-shape profiles: colours




Bakos et al. 2008

# Observations of U-shape profiles: spectra

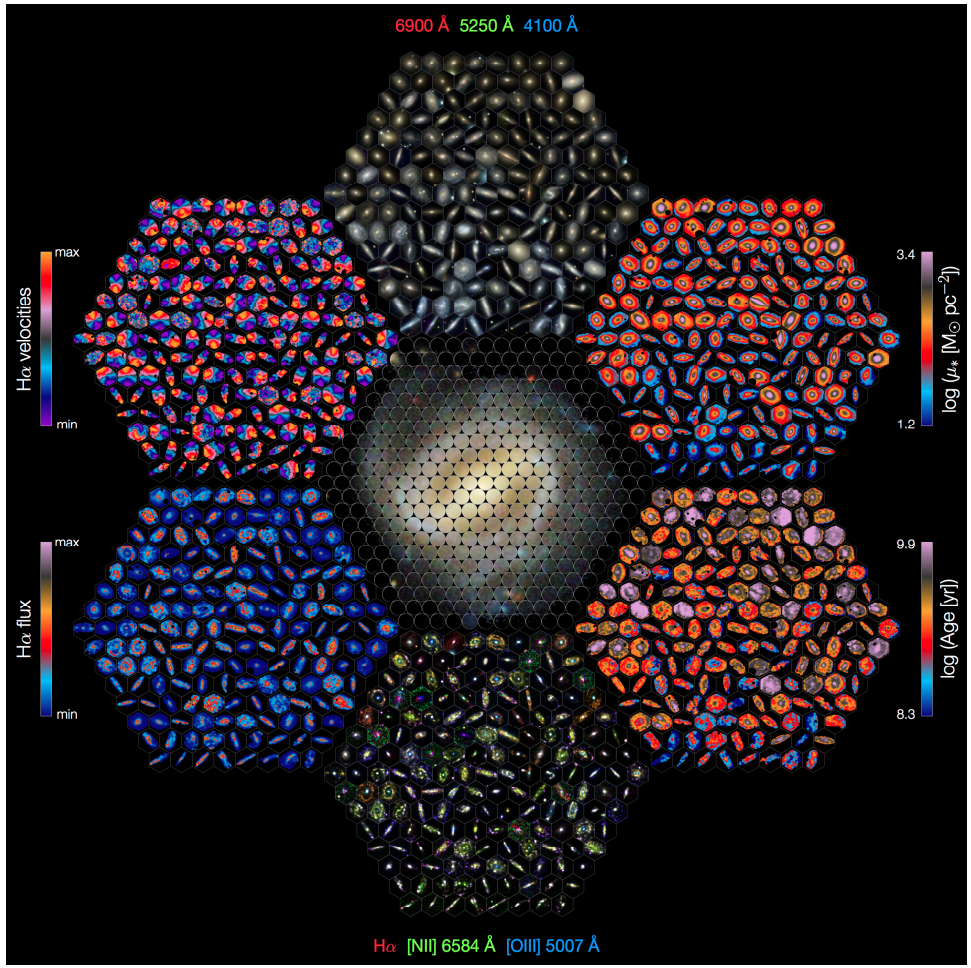



Yoachim et al. 2012

Virus-P IFS data for 6 type II galaxies (3 showed U-shape, light-weighted values).

# Search for U-shape profiles within the Calar Alto Legacy Integral Field Area survey (CALIFA)




- International collaboration (PI: S.F. Sánchez)
- 600 galaxies, nearby Universe
- PPAK mode (1 arcminute F-o-V)
- high resolution mode (V1200, R~1700, 3700-4200 Å), and a low resolution mode (V500, R~850, 3750-7500 Å).
- Each data cube contains ~1000 independent spectra

DR2, García-Benito et al. 2014

# Search for U-shape profiles within the Calar Alto Legacy Integral Field Area survey (CALIFA)

69 galaxies with the following criteria:

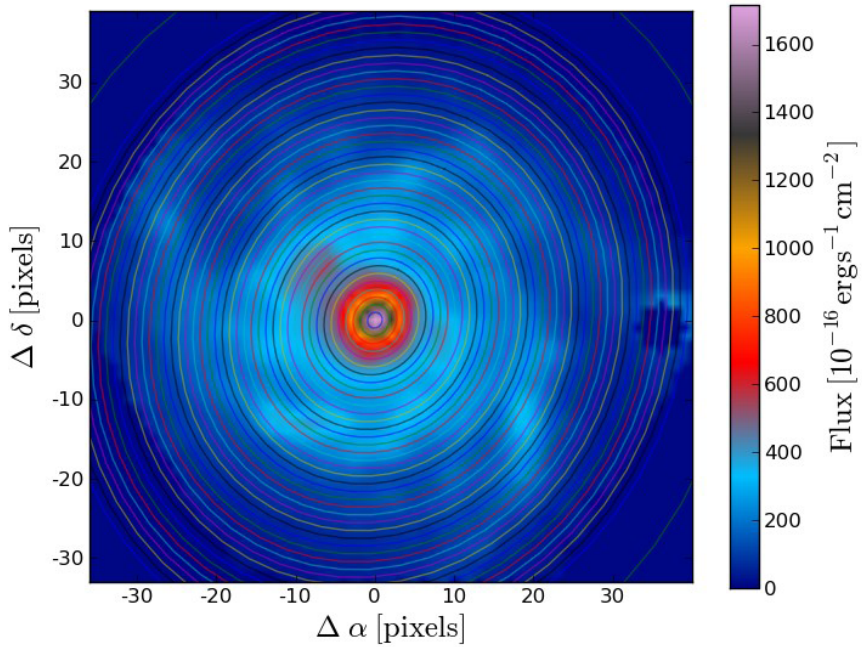
- Small galaxies: log(0.1*D25) < 1.1
- Inclination: 0º – 75º
- Morphological type: Sa – Sd
- We have visually rejected galaxies showing signs of interaction

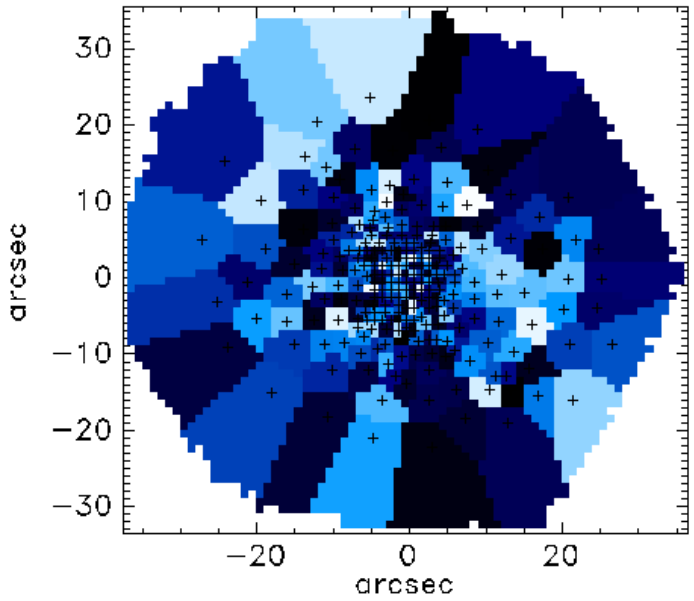
See Ruiz-Lara Poster!

# Final sample for the study of U-shape profiles

- 2-D (GASP2D) bulge/disc/bar decomposition of the 72 galaxies (Méndez-Abreu et al. In prep)
- For 44 galaxies we reach beyond the break radius (for the type II) and beyond 3 scale-lengths (type I)
- 15 out of the 44 display U-shape in age
- Barred (43%) - Unbarred (57%) -- Type I (41%) - Type II (53%) -- - compare to : Erwin, P. et al 2008 (32%,46%,22%); Gutiérrez et al. 2011 (27%,21%,51%)

# Methodology for the study of the stellar populations

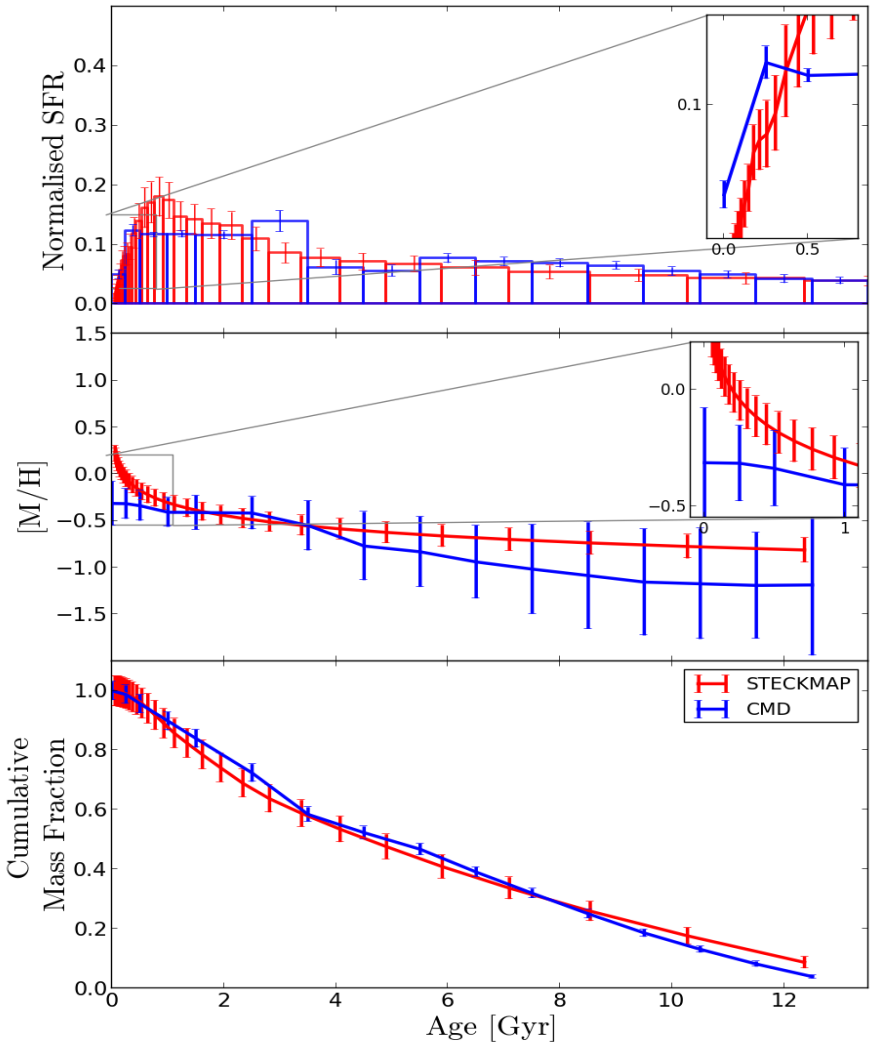



Extraction of spectra over elliptical apertures; Voronoid binning (Cappellari & Copin, 2003)

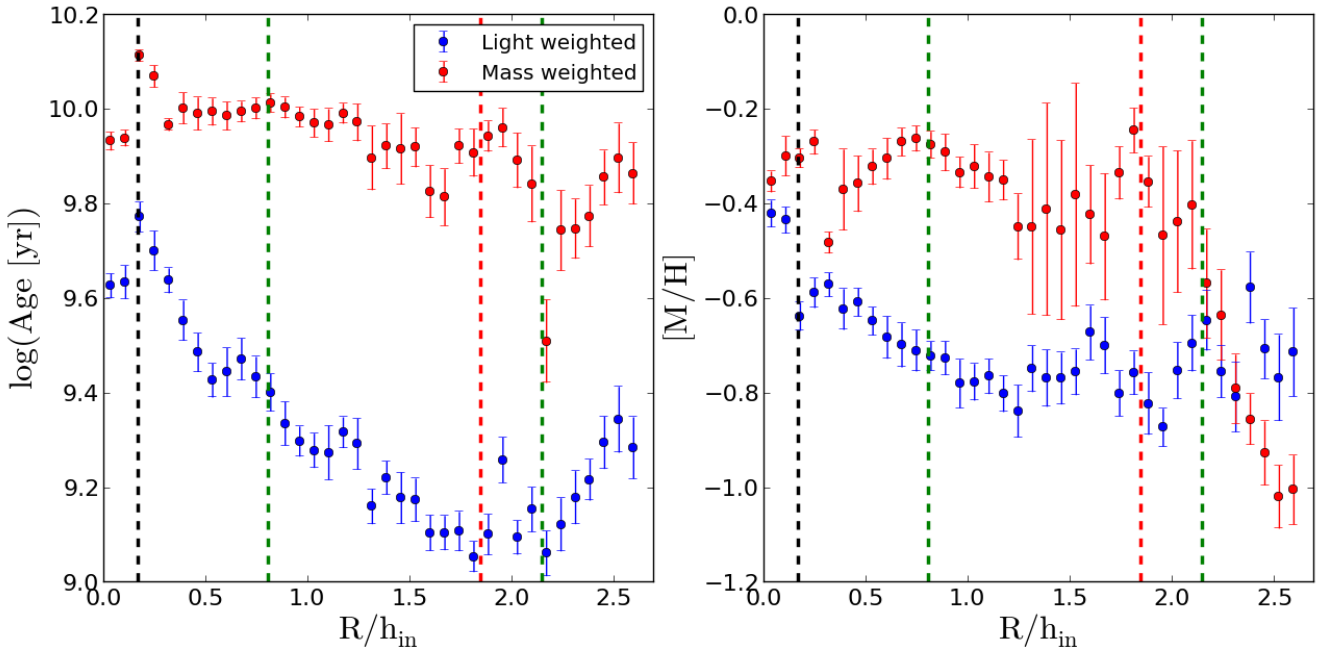
- Emission line removal with GANDALF (Sarzi et al. 2006)
- Full spectral fitting with STECKMAP (Ocvirk et al. 2006)

# Stellar population analysis: resolved vs. Integrated spectra



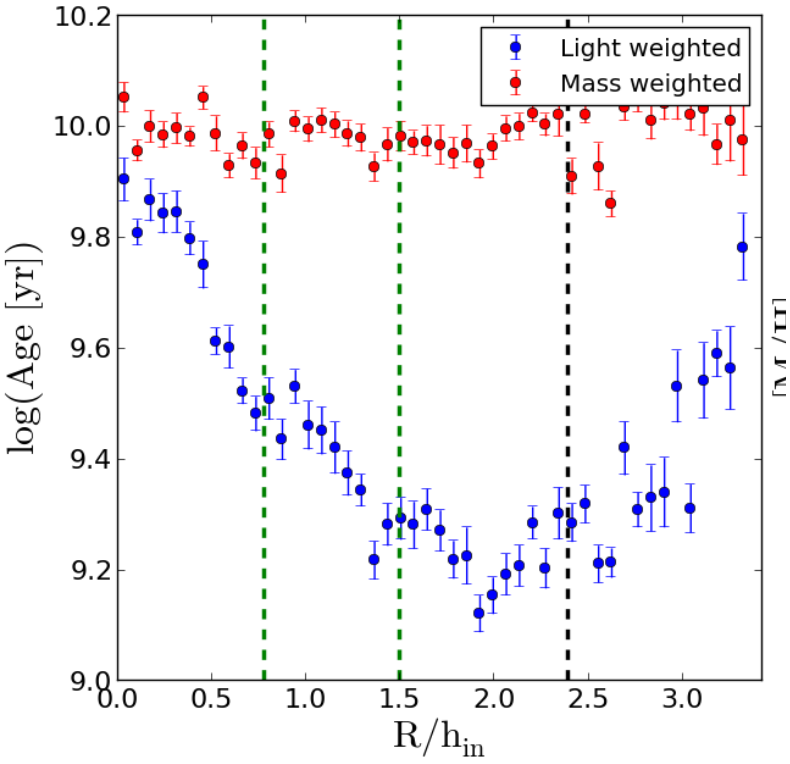

SFH for a field in the bar of the LMC

Ruiz-Lara, IP, Gallart, et al. submitted.

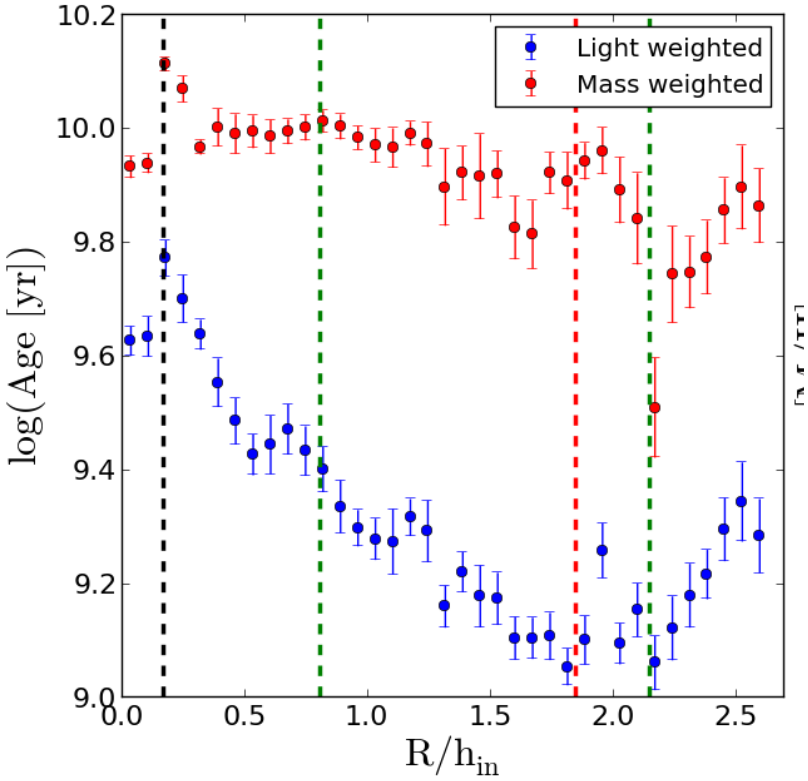



- 15 out of the 44 display ‘U-shape’ profile in age
- This age ‘U-shape’ disappears when mass-weighted for all the 15 galaxies
- No correlation for the appearance of ‘U-shape’ with galaxy mass, t or colour

NGC0551 - type I




NGC4711 - type II




- Type I SB galaxies also show ‘U-shape’ profile in age.
- In type II galaxies minimum seems to be located before the break radius

# Summary:

- Almost 40% of the sample galaxies present a ‘U-shape’ profile in age (lower limit, interesting all the galaxies that do not show it)
- Both type I and II present this age profile
- The age ‘U-shape’ disappears with mass weighted quantities

Points to the early formation of the disc mass and a later inside-out growth (SF). This SF is not the cause of the different SB profiles, different radial migration efficiencies cannot be ruled out

(see Ruiz-Lara et al. Poster for evidences of ‘no’ radial migration in this CALIFA sample)