Galaxy properties in the infall region of groups of galaxies

Julian Martínez, Valeria Coenda
Hernán Muriel

IATE-OAC
Córdoba - Argentina

I A T E
CONICET
U N C

UNC

OAC
Observatorio
Astronómico
de Córdoba

Aim of this work

- We study the effects of the environment upon galaxies in filaments and falling into massive groups.
- The preprocessing in these environments may play an important role in transforming galaxies before they enter into the cluster/group environment.

- The goal of this study is to see how the environment that characterize the filaments and the infall region affects the star formation in galaxies.

- The environment of galaxies can strongly affect the galaxy properties: morphology, size, star formation, etc.
- The environment plays a key role in quenching the SF.
- Mechanisms: tidal interactions, ram pressure, strangulation, etc.

The growth of Groups/Clusters

- The accretion of galaxies usually happens through filaments in a non-isotropic way

Two different modes:

(i) Galaxies are reaching groups along filamentary structures, or

(ii) They are falling isotropically

Two particular environments

- The infall region of clusters/groups of galaxies
- The filamentary structure

- Can these environments affect differently the star formation?

- The properties of galaxies in these two environment will be compared with those of galaxies in the field and in groups

Galaxies in filaments

- Porter et al. 2008 found that the SF in galaxies falling into a cluster along filaments, are likely to undergo an enhancement before the galaxy reaches the virial radius of the cluster.
- Similarly, Mahajan et al. (2012) reported an excess of star forming galaxies in the outskirts of dynamically unrelaxed clusters and associated this phenomenon to the infall of galaxies through straight filaments.

The clusters infall region

- Ellingson et al. 2001 found no evidence at any radius within the clusters for an excess of SF over that seen in the field (see also Rines et al. (2005); Verdugo et al. (2008)).
- The general agreement is that the galaxy properties converge to those of field galaxies at 2-3 virial radii.
- It has also been suggested that a significant fraction of galaxies at large radii have passed through the core region of the cluster and have undergone environmental transformation within the virial radius (see Muriel & Coenda (2014) and references therein).

Identification of Filaments

- Filaments are visually the most dominant structures that characterize the distribution of galaxies
- Many of the implemented algorithms make use of the fact that filaments are the bridges that connects systems of galaxies (*Pimbblet et al. 2004; Peimbblet 2005; Colberg et al. 2005; Gonzales & Padilla 2010; Smith et al. 2012; Zhang et al. 2013; Alpaslan et al. 2014*)

Filaments in the SDSS

- We use groups of galaxies identified in the SDSS-DR7 to detect the filamentary structures that connect massive groups.
- Groups of galaxies selected by Martinez & Zandivarez in the SDSS.
- 4679 Groups in the redshift range 0.05-0.15

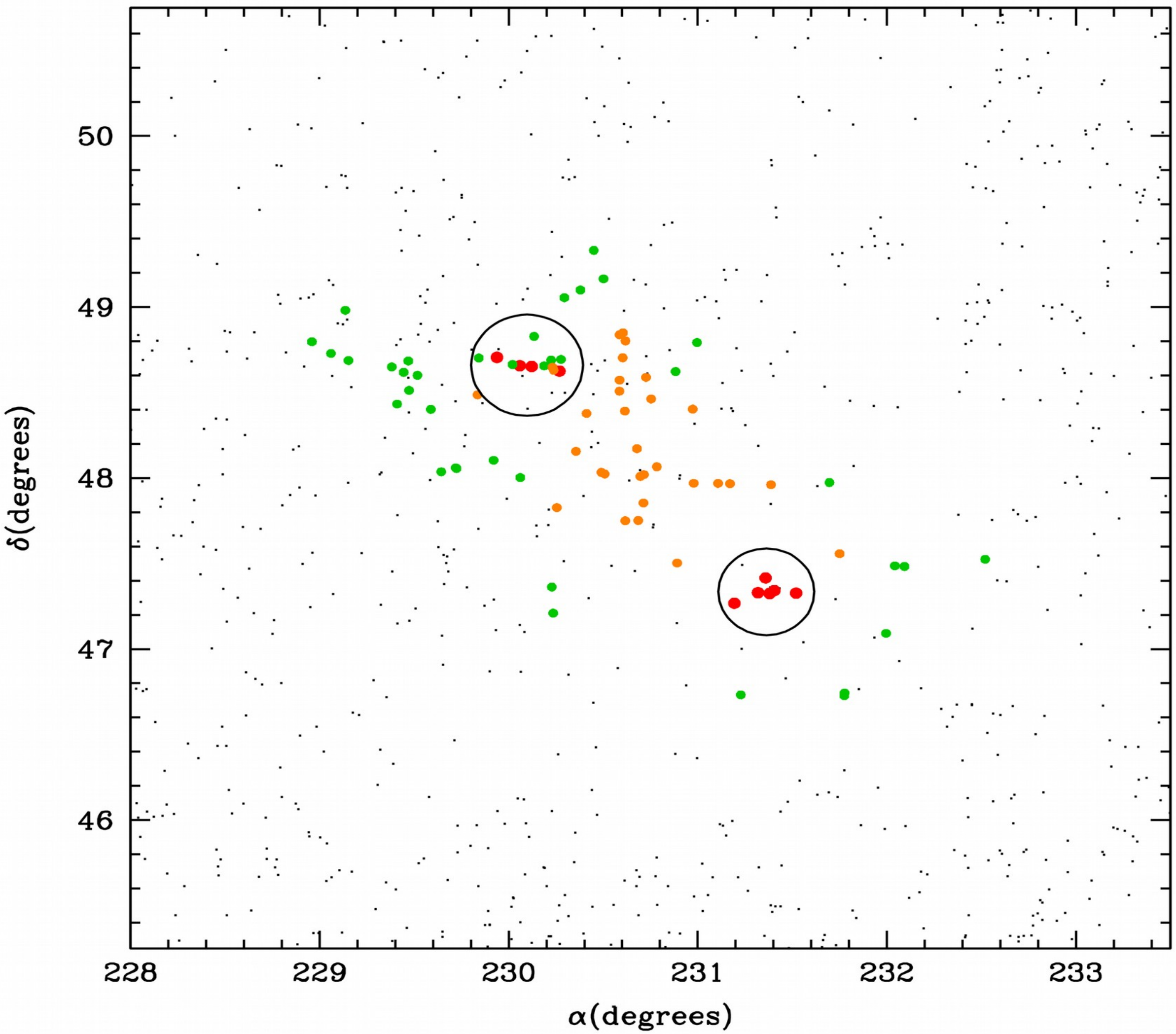
Procedure

- We identify pairs of massive groups of galaxies and then stack the galaxy population between them.

Size of the filaments:

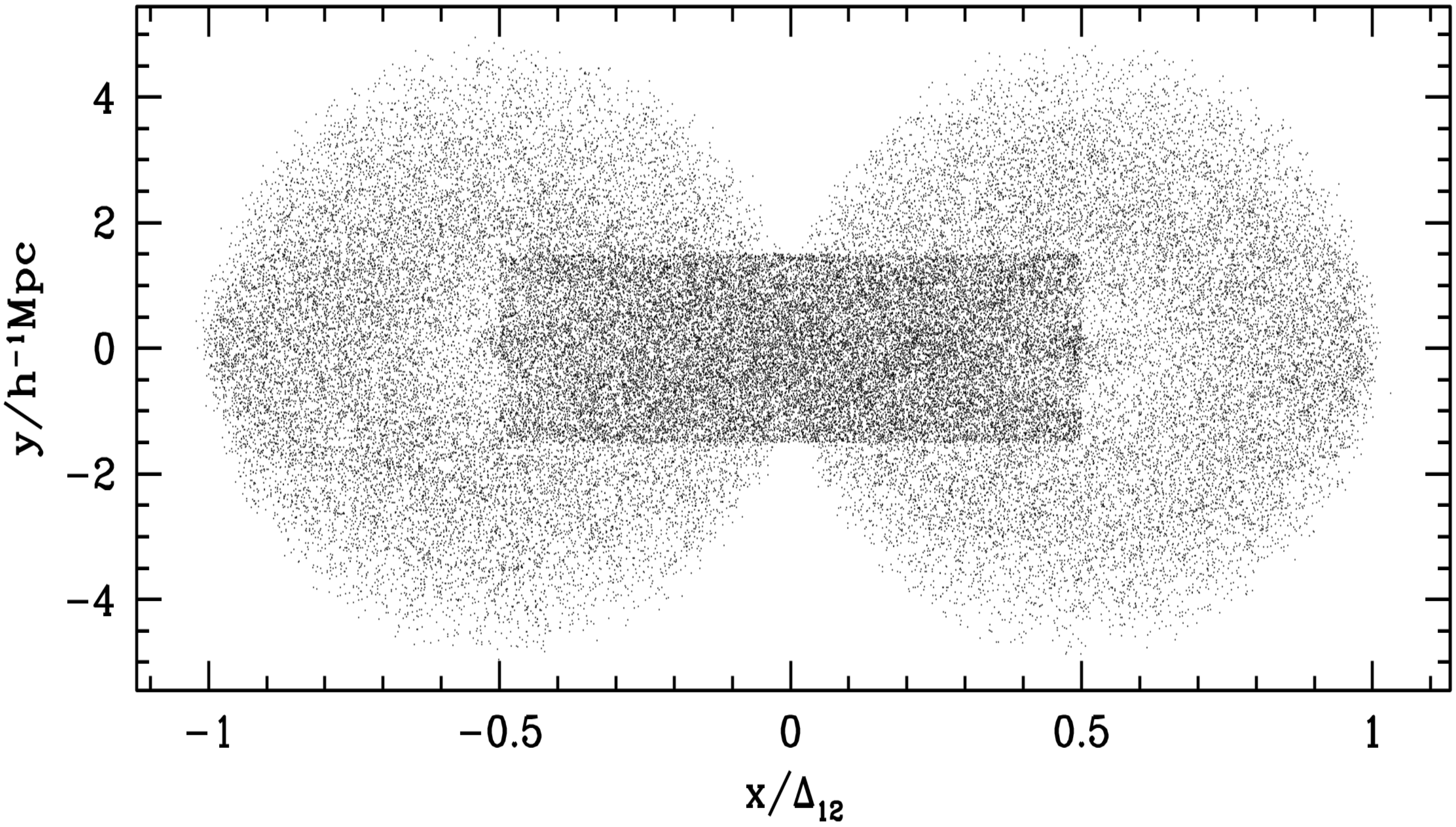
- Length: $\leq$ 10 Mpc
- Projected width: 2 Mpc
- Width in the line of sight: 2000 km/s

Procedure

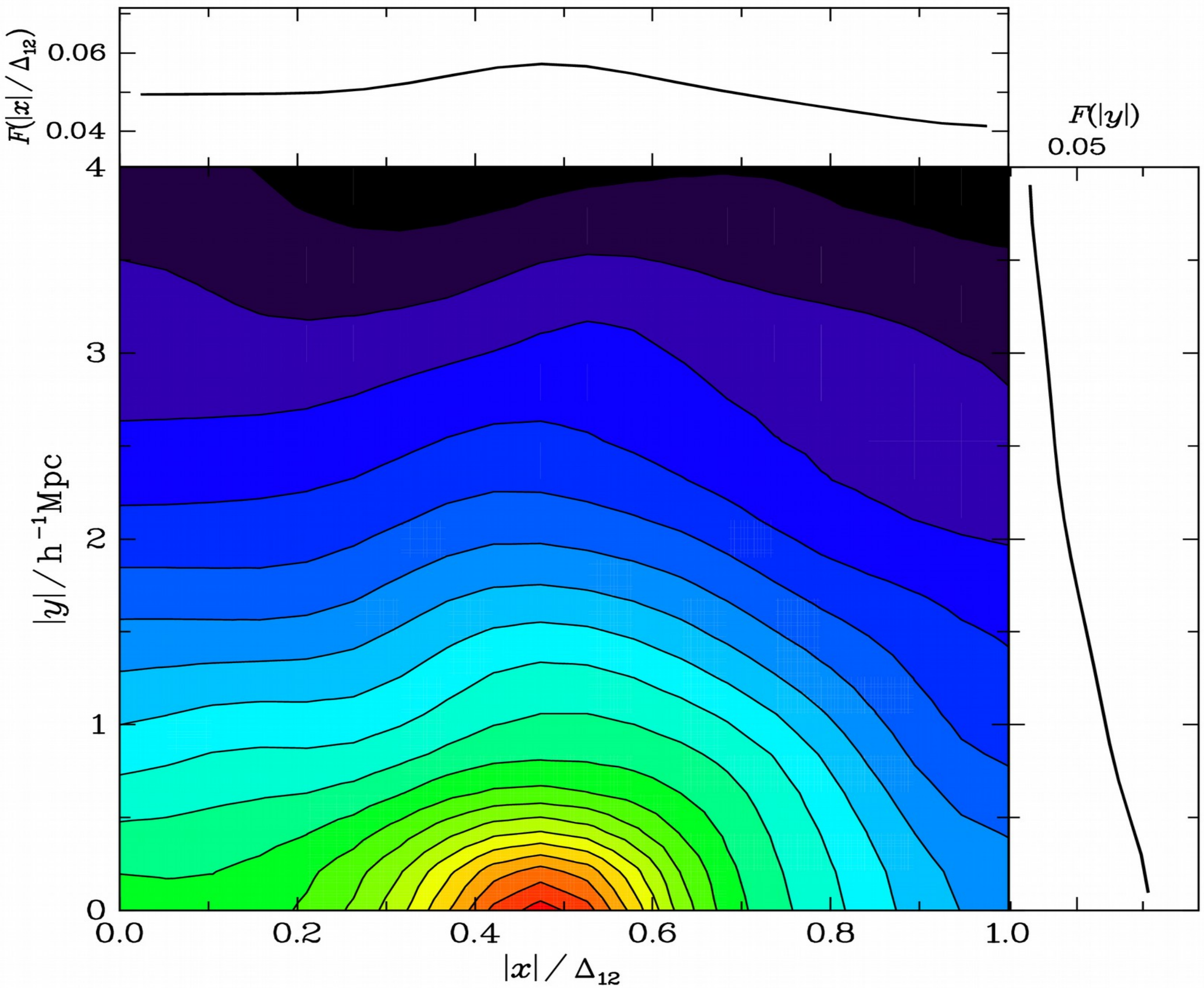


- We only consider as filaments those regions with $\Delta\rho/\rho > 1$
- Of the 3094 pairs, 2366 are "filaments"

Stacking of galaxies



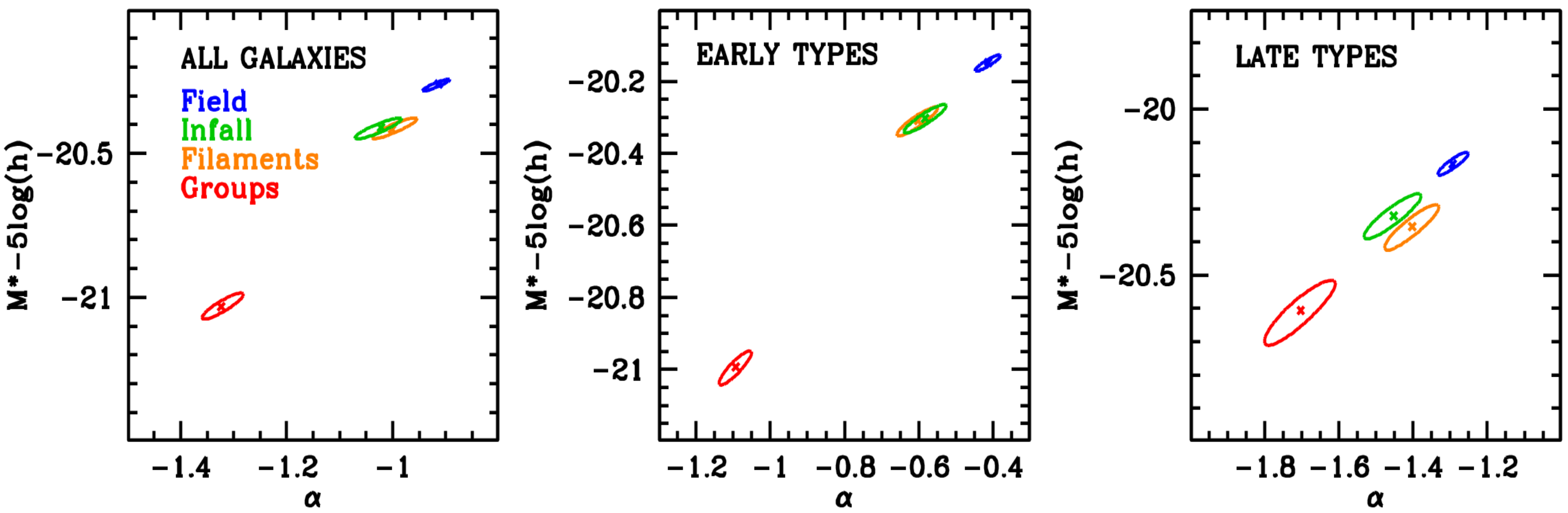
Density of Galaxies



Results: The luminosity function of galaxies

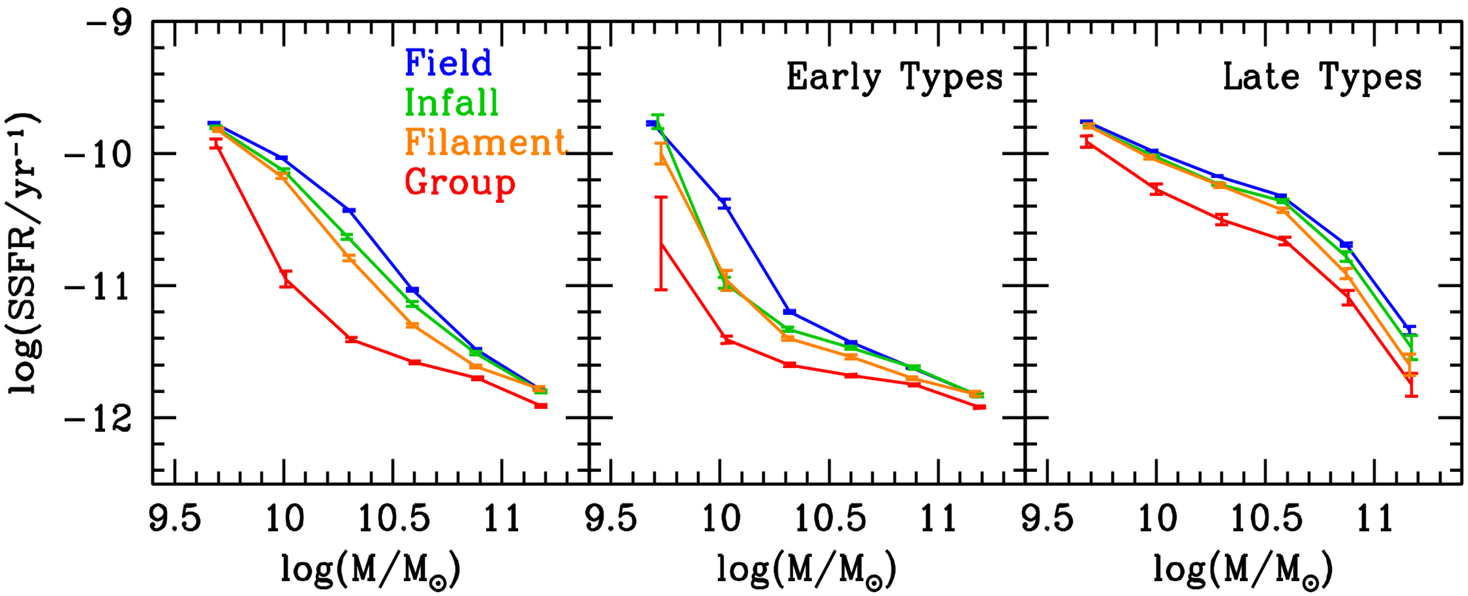
- Late and Early type galaxies are selected according to the concentration index C.

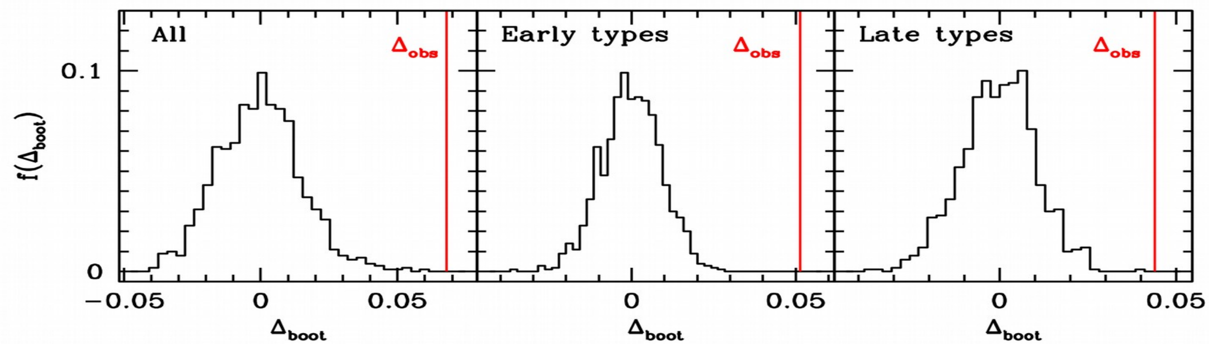
  Schechter function: $$n(L/L^*)=\phi^*(L/L^*)^{\alpha}e^{-\frac{L}{L^*}}$$



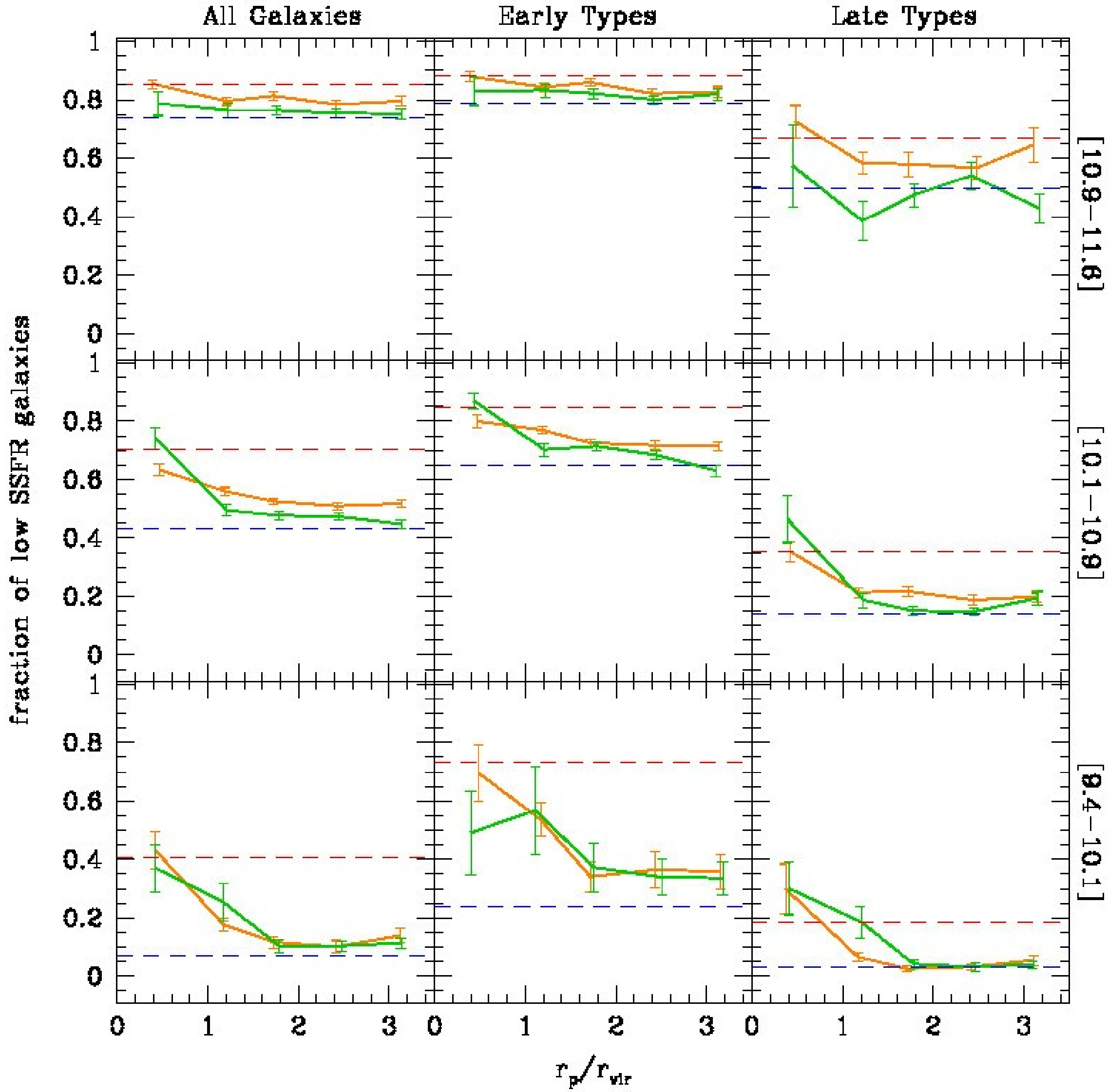
Results: SSFR as a function of the stellar mass

- Data: MPA-JHU
- Galaxy properties derived from emission lines (Brinchmann et al. 2004)





Fraction of low SSFR galaxies as a function of projected distance



← High mass galaxies

← Intermediate mass gal.

← Low mass gal.

Conclusions

- Galaxies in filaments show different LF and SSFR than those that are falling isotropically
- The LF of LT galaxies depends on whether they fall isotropically or through filaments (Late type galaxies in filaments have shallower faint end slope and a brighter M* than infalling galaxies)
- For both, ET and LT, the SSFR of galaxies in filaments is lower than in galaxies falling isotropically.
- The effect is higher for massive galaxies

- The filamentary structure of galaxies accelerates the quenching of the star formation
- We found no evidence of an excess of SF at any distance from the center of groups