

Galaxies and galaxy groups in LSE

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General background 1/2

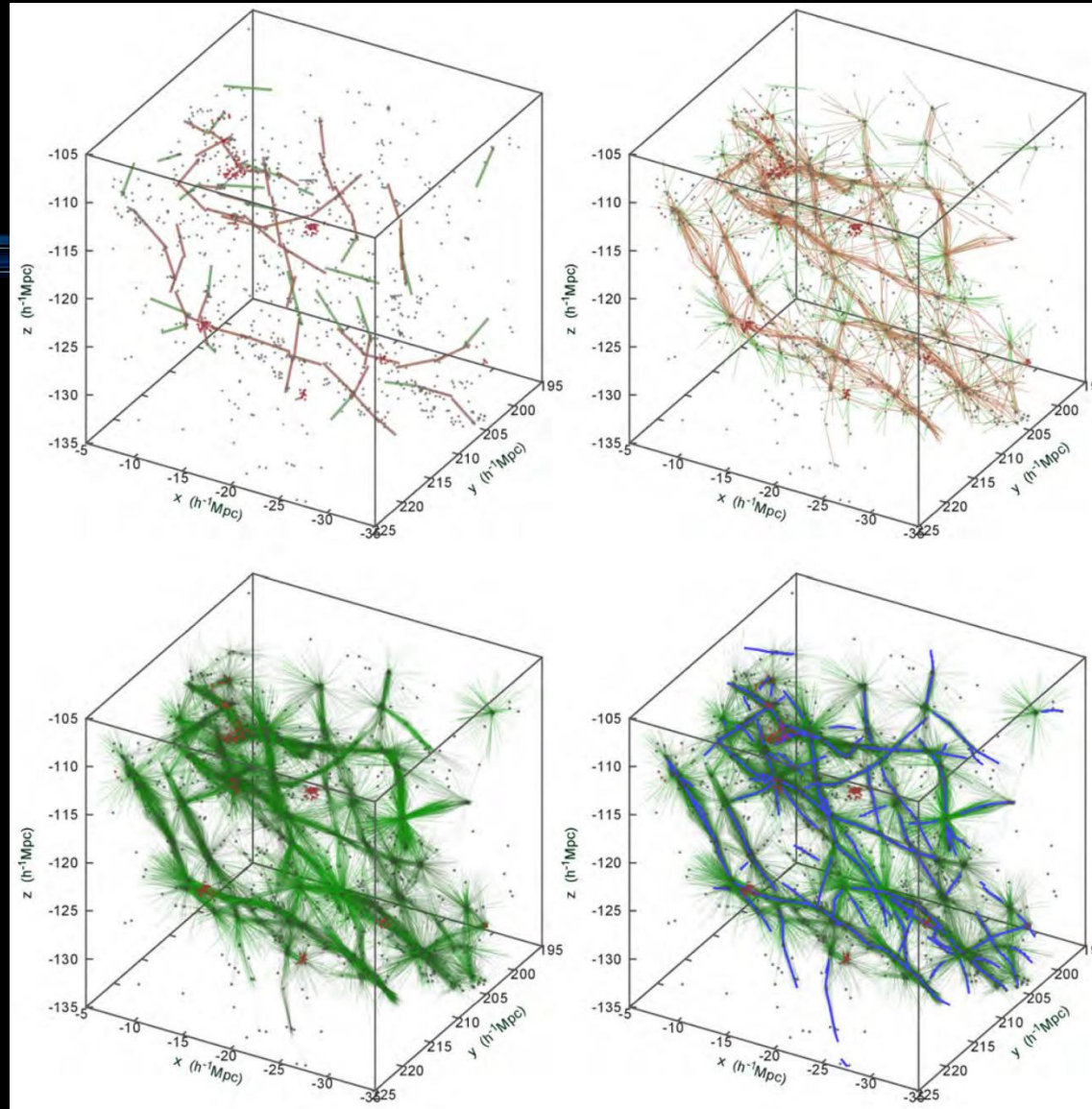
- The **halo mass** correlates with many galaxy properties: stellar mass, specific star formation rates, color, morphology (Behroozi et al. 2010, Weinmann et al. 2006, Wilman & Erwin 2012)
- Also correlations between galaxy and group properties and environments **on large scales** (Lietzen et al. 2012, Luparello et al. 2013, Einasto et al. 2014, Luparello et al. 2015)
- In Poudel et al. (2016):
 - the low mass end slope of the **stellar mass function of satellite galaxies** is steeper in high-density environments compared to low-density environments
 - **groups with similar masses** are **richer** in high-density environments compared to low-density environments, irrespective of the galaxy morphologies

General background 2/2

- In simulations, the cutoff mass at the massive end in the dark matter halo mass functions is the highest in clusters and gradually decreases toward filaments, sheets, and voids (Hahn et al. 2007; Metuki et al. 2015)
- Correlation between surrounding large-scale structure and internal galaxy properties may simply be due to the **differences in halo masses** in different cosmic web environments*is it really so?*
- High-resolution hydrodynamical simulations (Tonnesen & Cen 2015) -> central galaxies in similar mass halos in large-scale (20 Mpc) **overdense regions have higher stellar masses** than those in underdense regions.

LSE filaments: many definitions

- **Several different methods:** *minimal spanning tree algorithm* (Barrow et al. 1985; Alpaslan et al. 2014), *subspace constrained mean shift algorithm* and *tidal tensor prescription* (Hahn et al. 2007; Eardley et al. 2015)
- We use the cosmic web filament catalog from the SDSS DR10: galaxy filaments detected by marked point processes with interactions, also called *Bisous model* (Tempel et al. 2016)
 - the probability of the detected structures using the Bayesian framework



➤ Tempel et al. MNRAS 2014

Galaxies in filaments

Galaxy and group properties correlate with the filamentary structures:

- Groups in filaments are found to have **more satellites** than outside of filaments (Guo et al. 2015)
- Alpaslan et al. (2016) found that the **stellar mass** of isolated spiral galaxies decreases slightly as a function of distance from the filament axis whereas the star formation rates rises slightly with distance.
- The **spins** of bright spiral galaxies tend to have parallel alignment with filaments, while elliptical and S0 galaxies have their spins aligned perpendicular to the filament direction (Tempel et al. 2013; Tempel & Libeskind 2013)

Some results from the recent study:

- **“Effect of cosmic web filaments on the properties of groups and their central galaxies”:**
- A. Poudel, P. Heinämäki, E. Tempel, M. Einasto, H. Lietzen, P. Nurmi, A&A 2016

The group massfunction

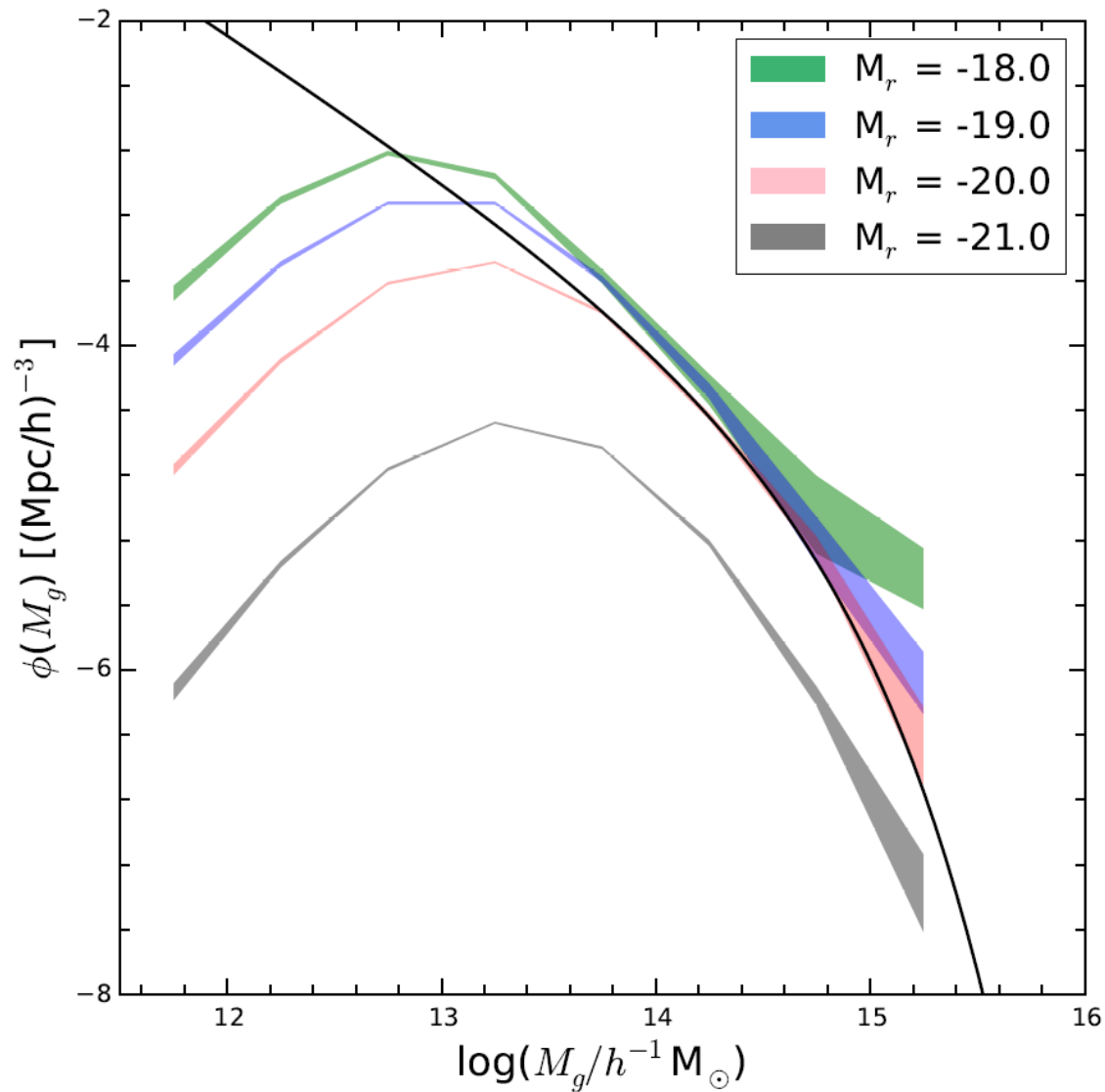
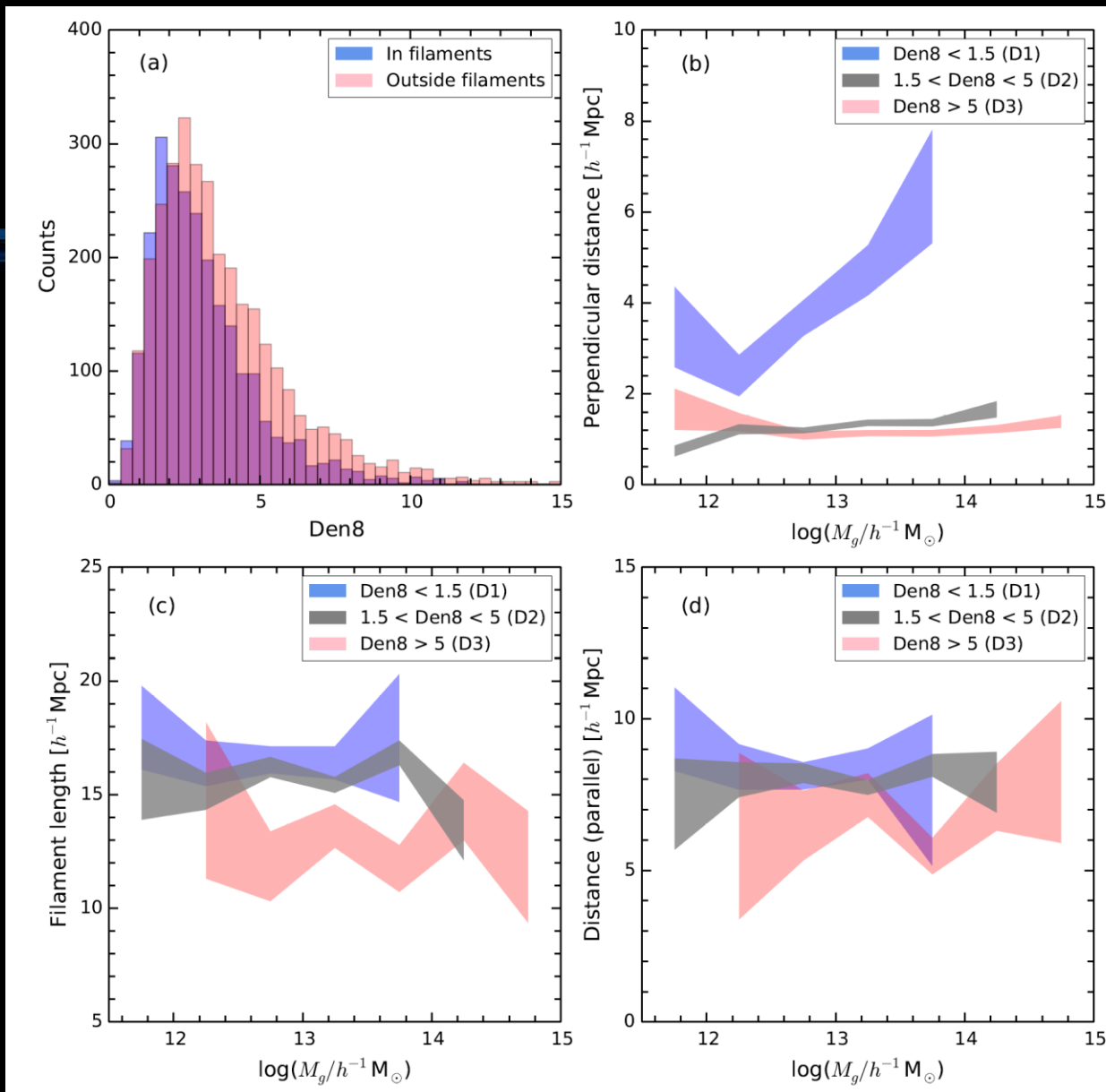
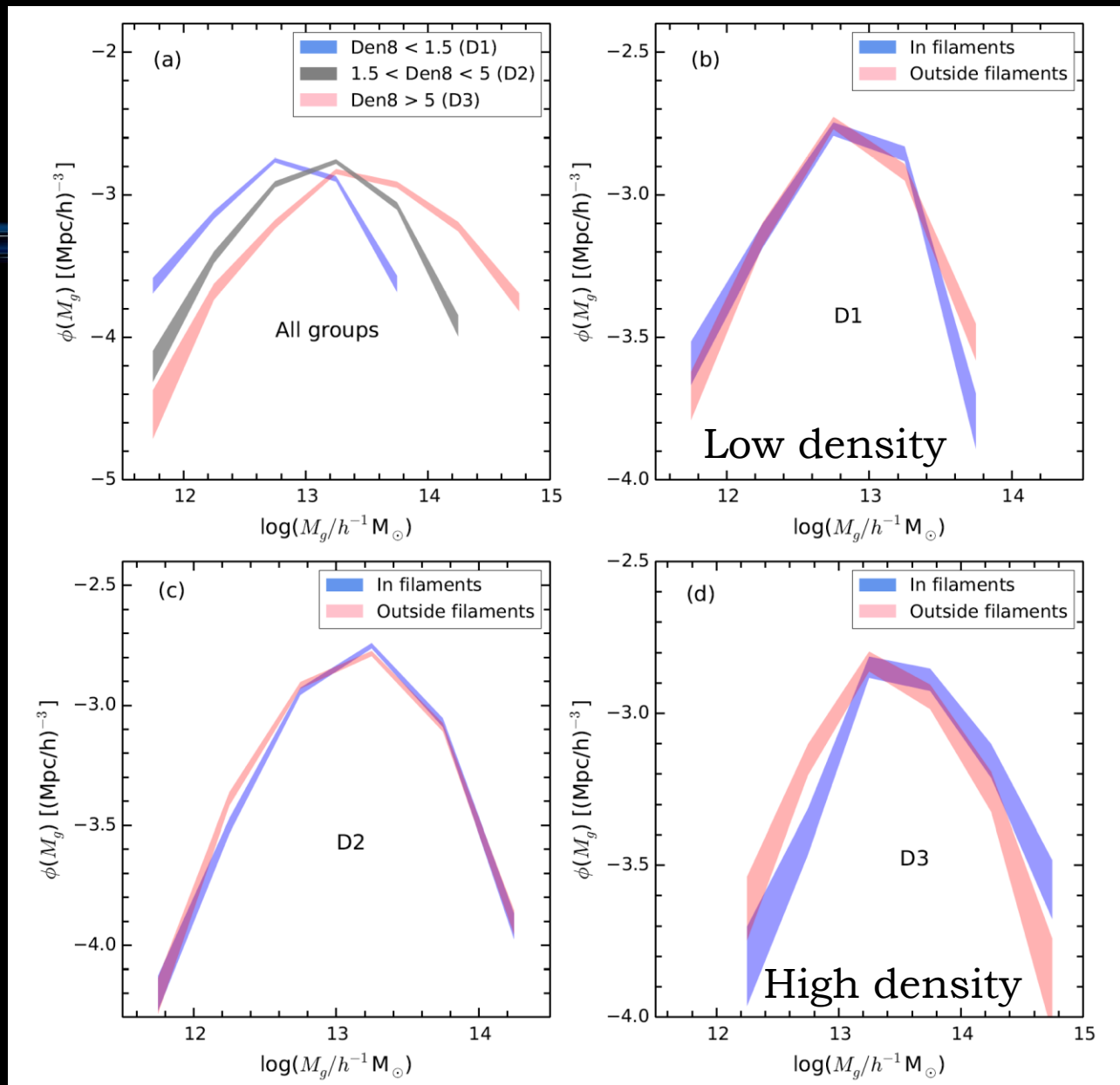


Fig. 1. The total group mass functions in different volume limited group samples. The error limits are estimated using the bootstrap resampling technique. The mass functions are incomplete at the low mass end. The solid line represents the halo mass function from N-body simulations by [Sheth et al. \(2001\)](#).

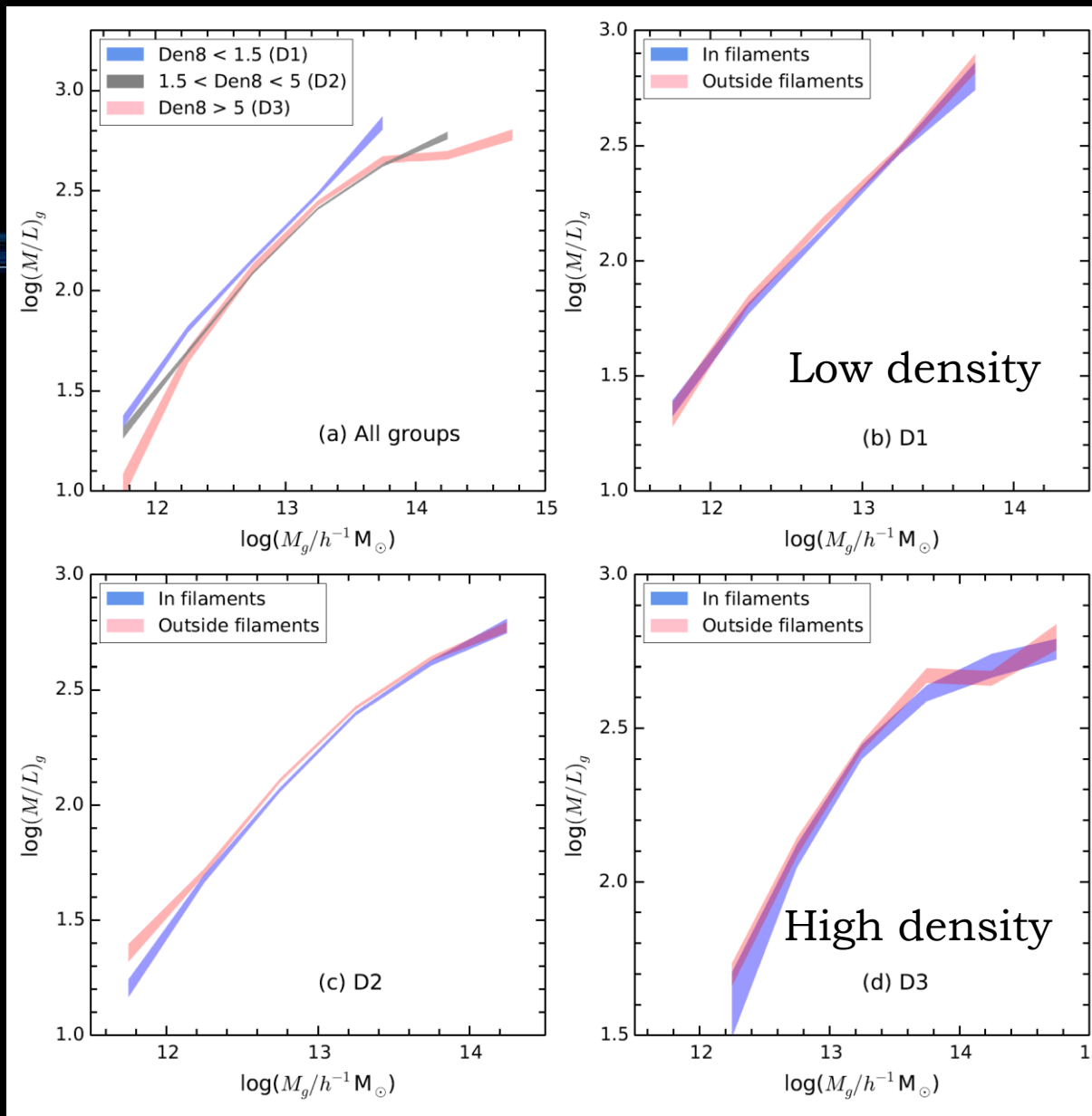


Mean values

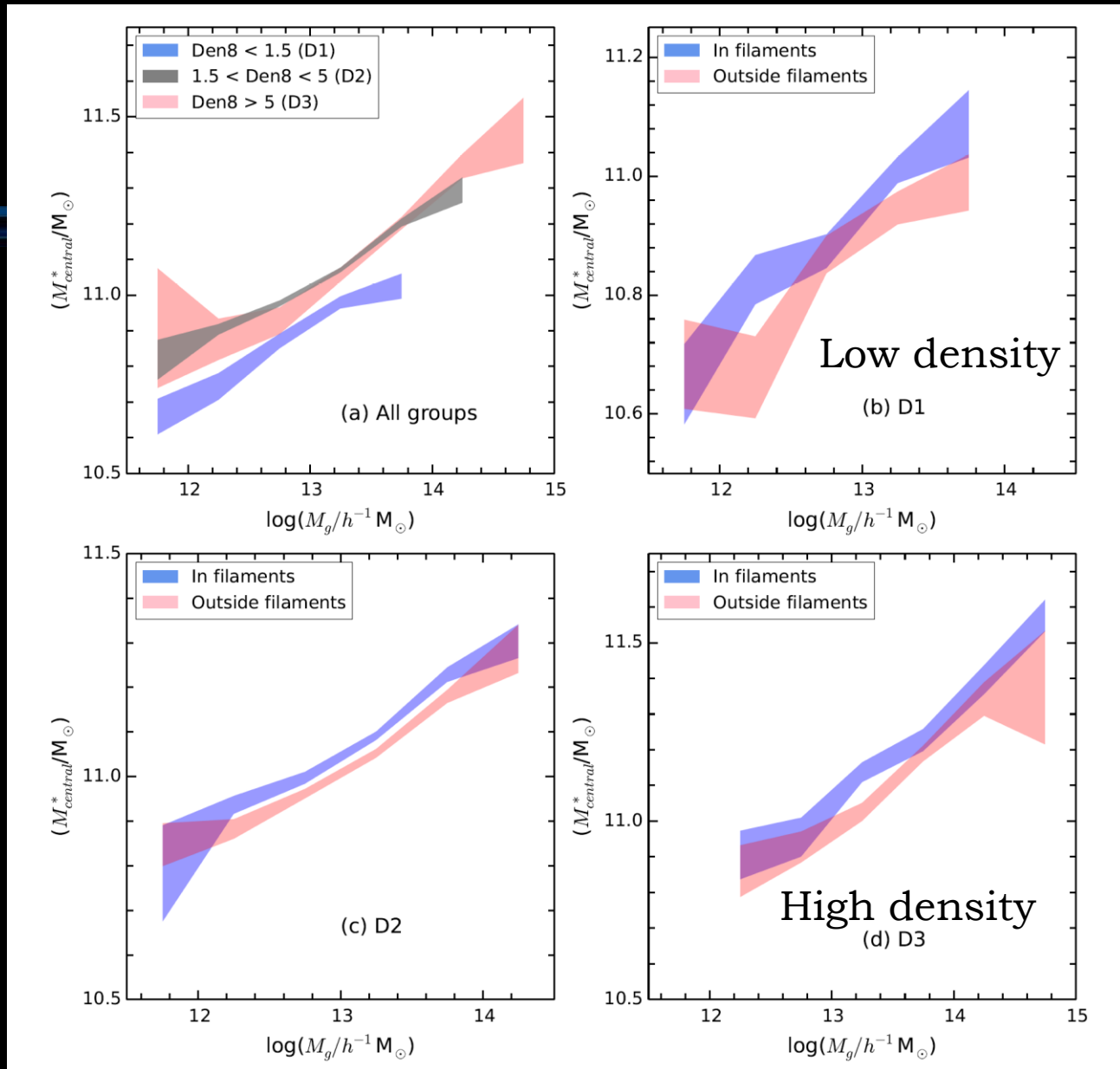
➤ Filament properties vs. group mass



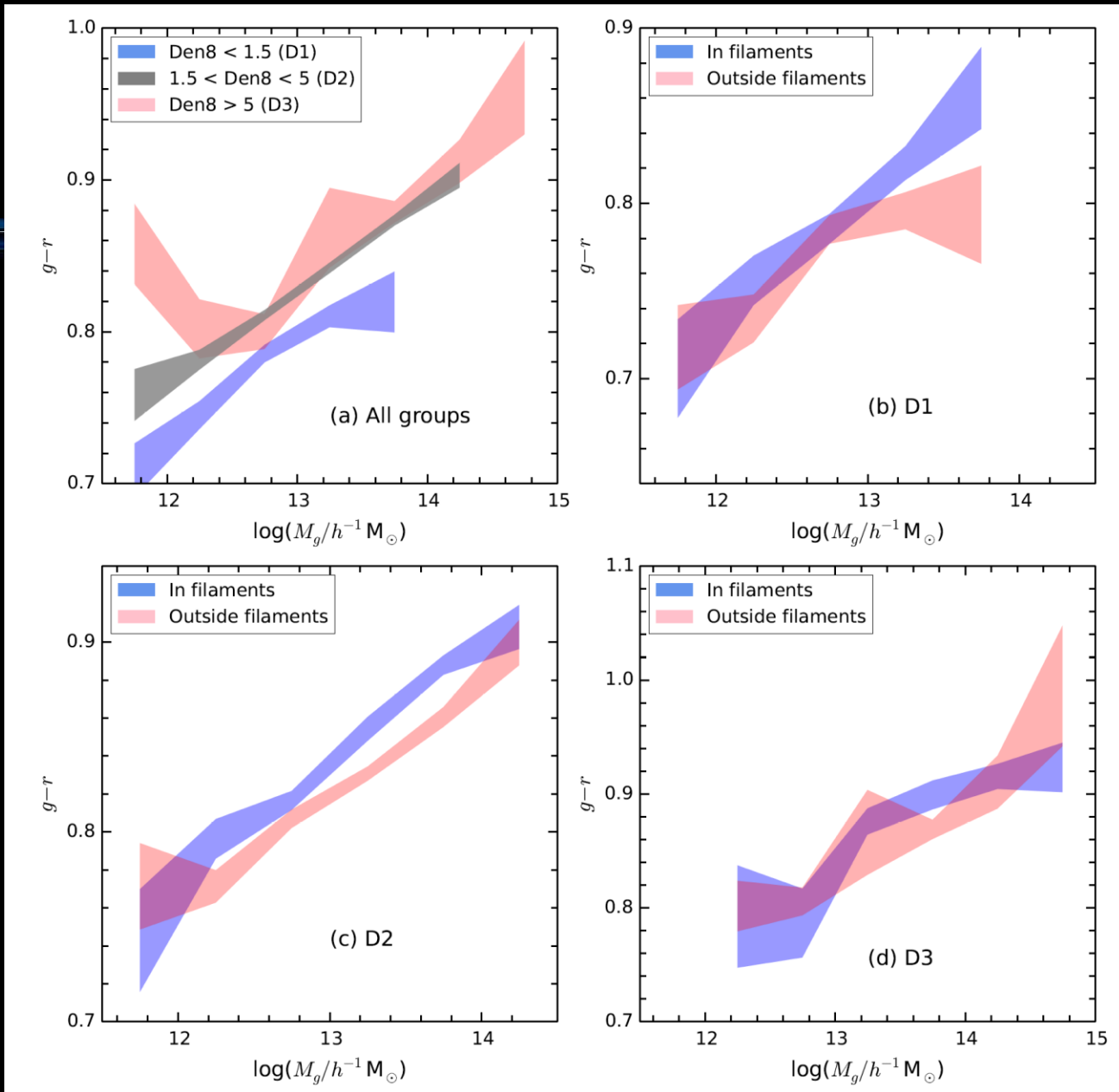
➤ Galaxy group mass functions in different LSE densities



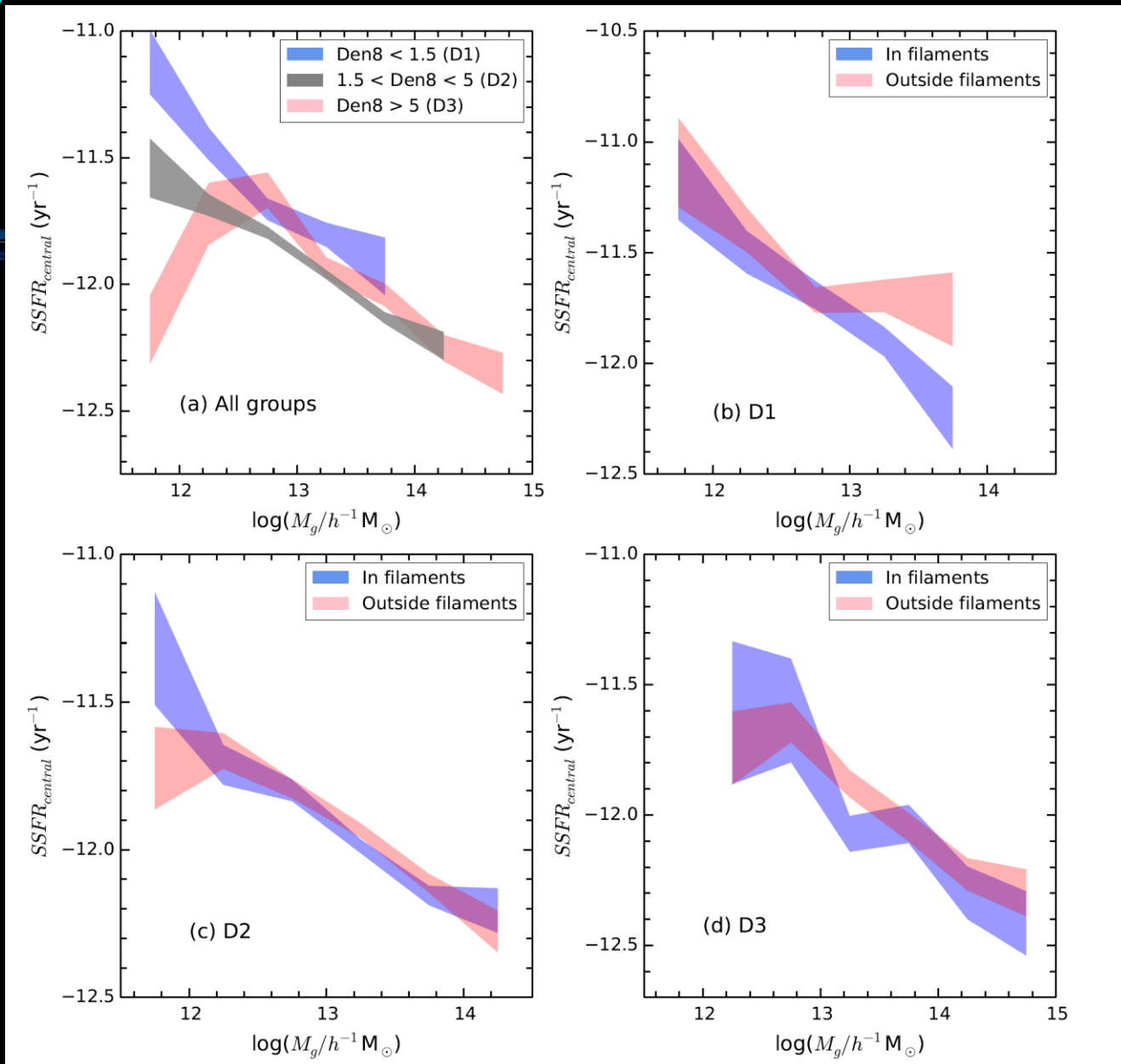
➤ M/L vs group mass in different LSE densities



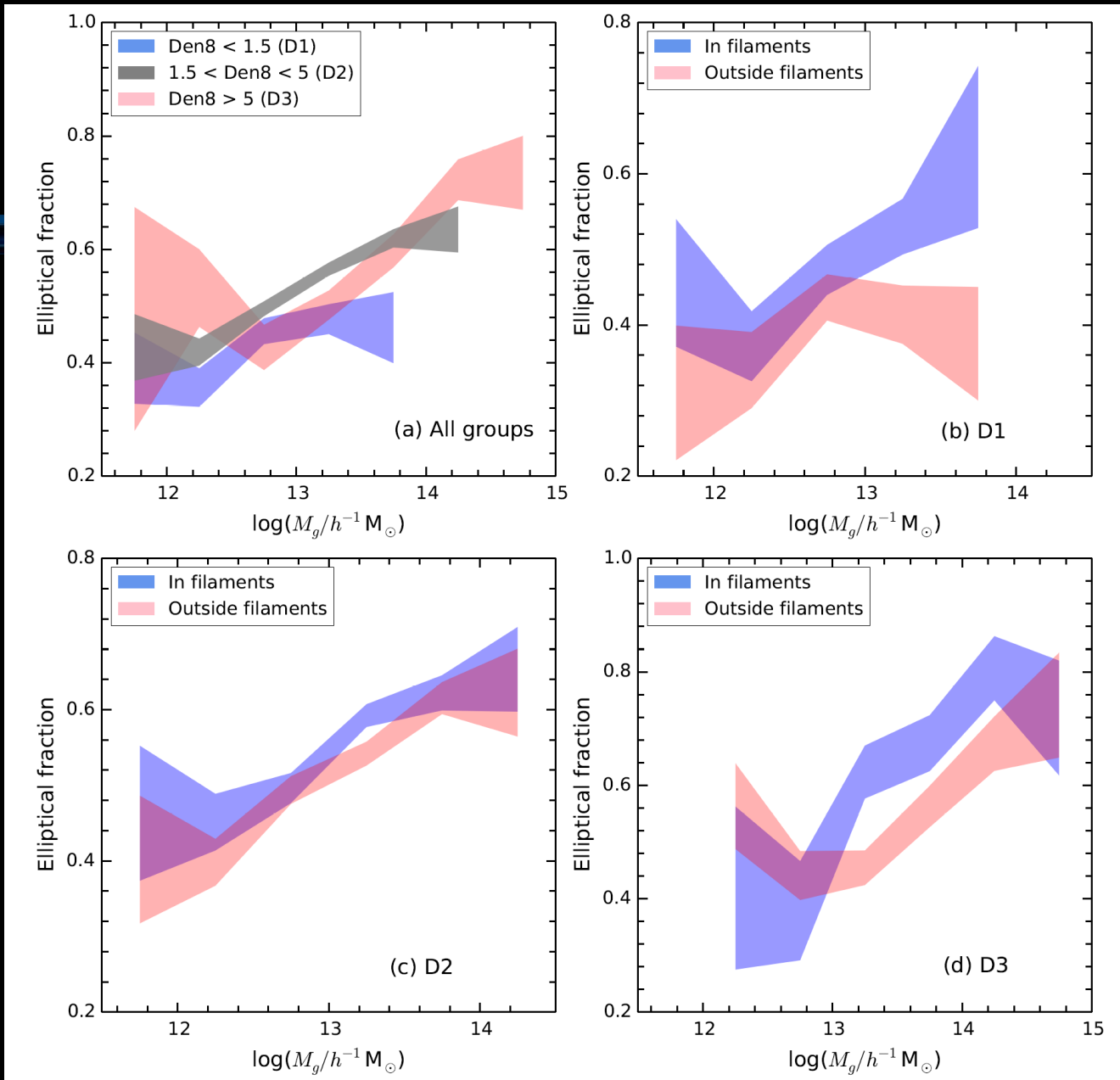
➤ Central galaxy stellar mass as a function of group mass ₁₂



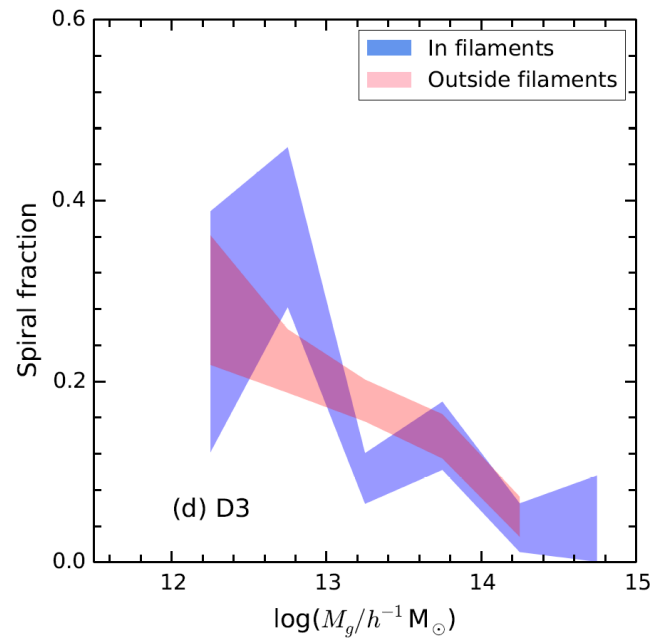
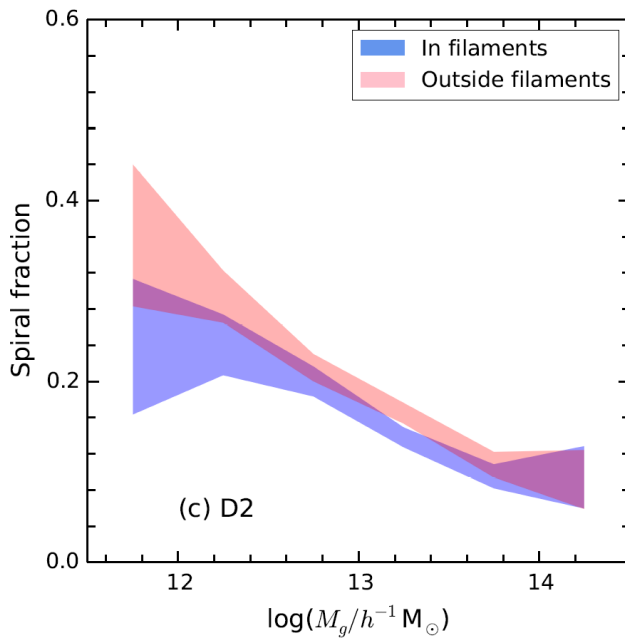
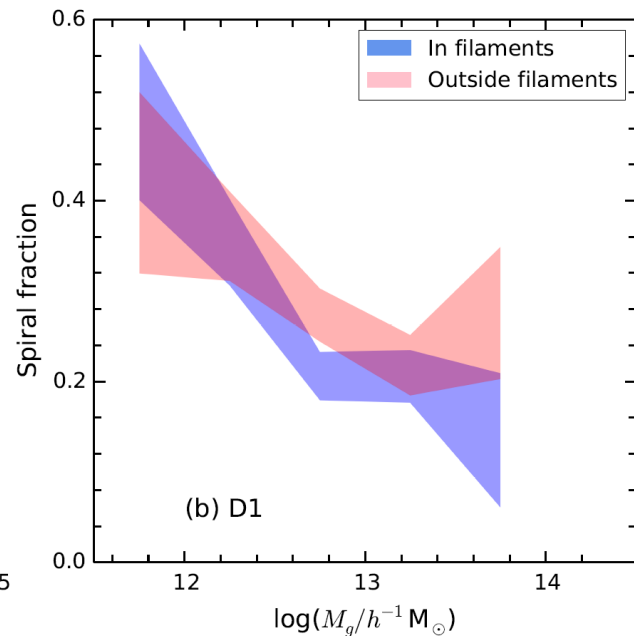
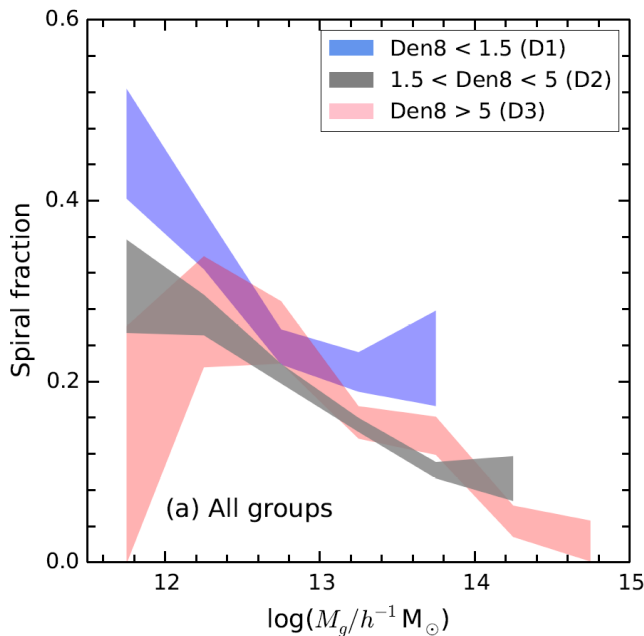
➤ $g-r$ color of central galaxies as a function of group mass



- Specific star formation rate of central galaxies as a function of group mass



➤ Elliptical galaxy fraction



➤ Spiral galaxy fraction

Main results to think about ...

- At high large-scale densities: groups in filaments are more massive than those outside of filaments
- At low large-scale densities groups in filaments are less massive than those outside of filaments (tidal effects of filaments on halos?)
- At a fixed dynamical mass (total mass):
 - groups in high-density environments are more luminous and their central galaxies have higher stellar mass than those in low-density environments
 - in environments with similar luminosity densities we find that groups in filaments are more luminous and their central galaxies have higher stellar mass than those outside of filaments (higher abundances of cold streams of gas in filaments feeding the halos and their central galaxies)
- central galaxies in groups in high density environments have redder color and lower specific star formation rates
- central galaxies in similar mass groups in high- (low-) density environments have higher abundances of elliptical (spiral) galaxies than low- (high-) density environments