The environmental effects of the LSS: characterization of the baryonic components

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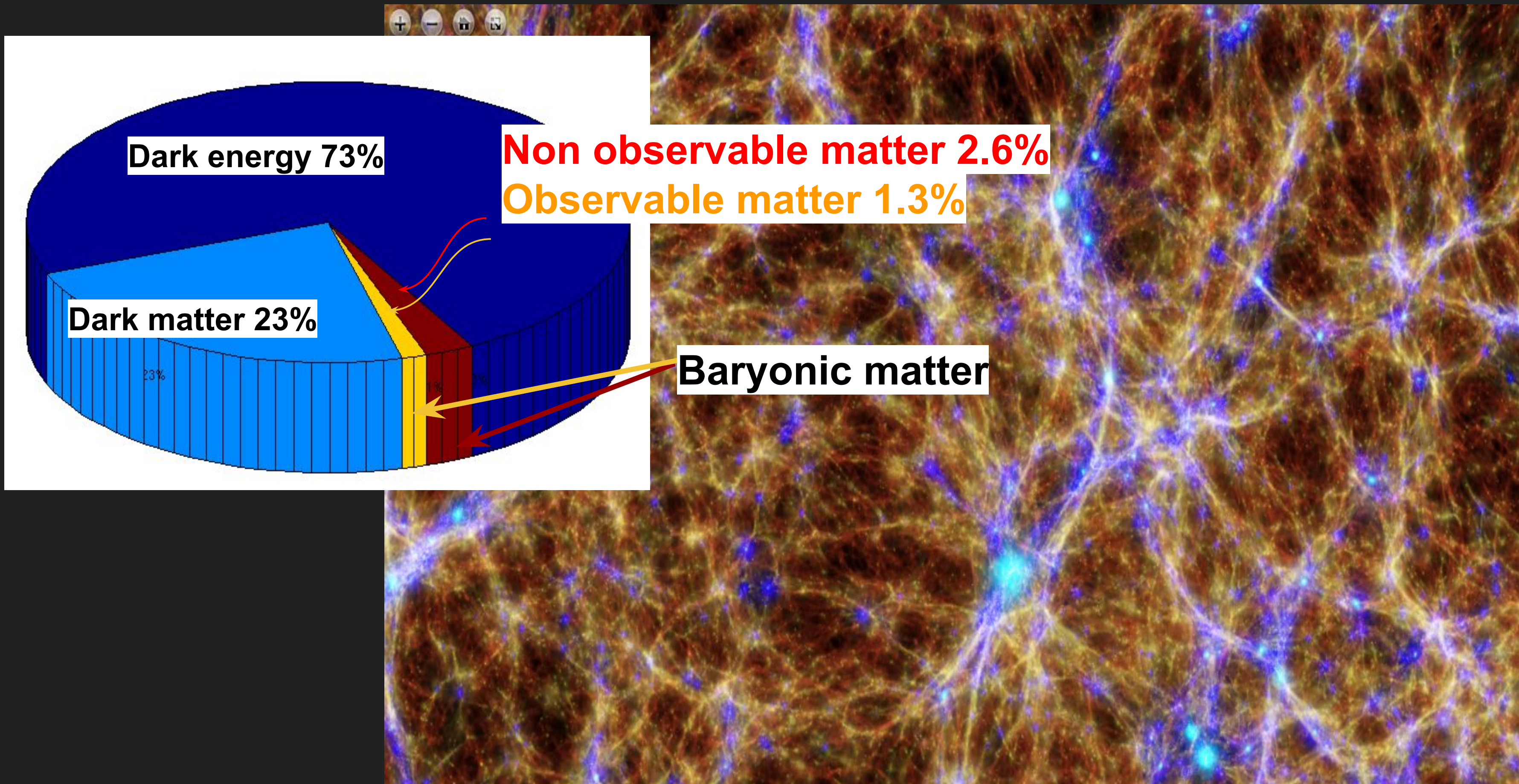
Iris Santiago-Bautista

UNIVERSIDAD DE GUANAJUATO

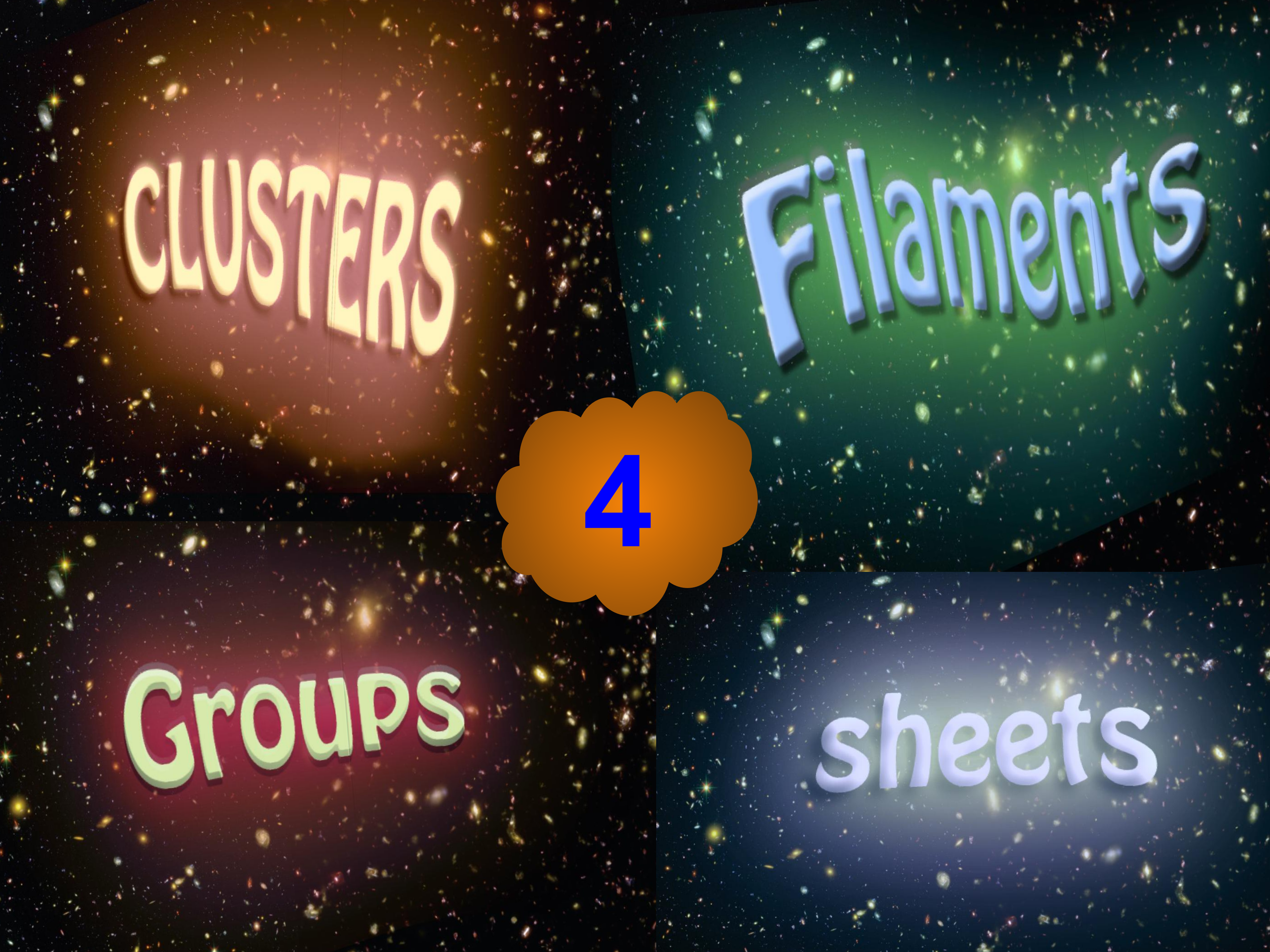
irap

UNIVERSITÉ TOULOUSE III PAUL SABATIER

Motivation: Where are the baryons?



Magneticum numerical simulation
Color coded according to the gas temperature from cold (brown) to hot (light blue). Galaxies are marked as white points.


CLUSTERS
Filaments
4
Groups
sheets

Goal

Study LSS environmental effects on the baryonic component of halos and filaments.

Filaments → galaxies → optical

Galaxy Clusters → gas → S-Z effect

2

Less dense structures: filaments and sheets

The baryons are likely in moderately hot gas phase (0.01-1 keV)

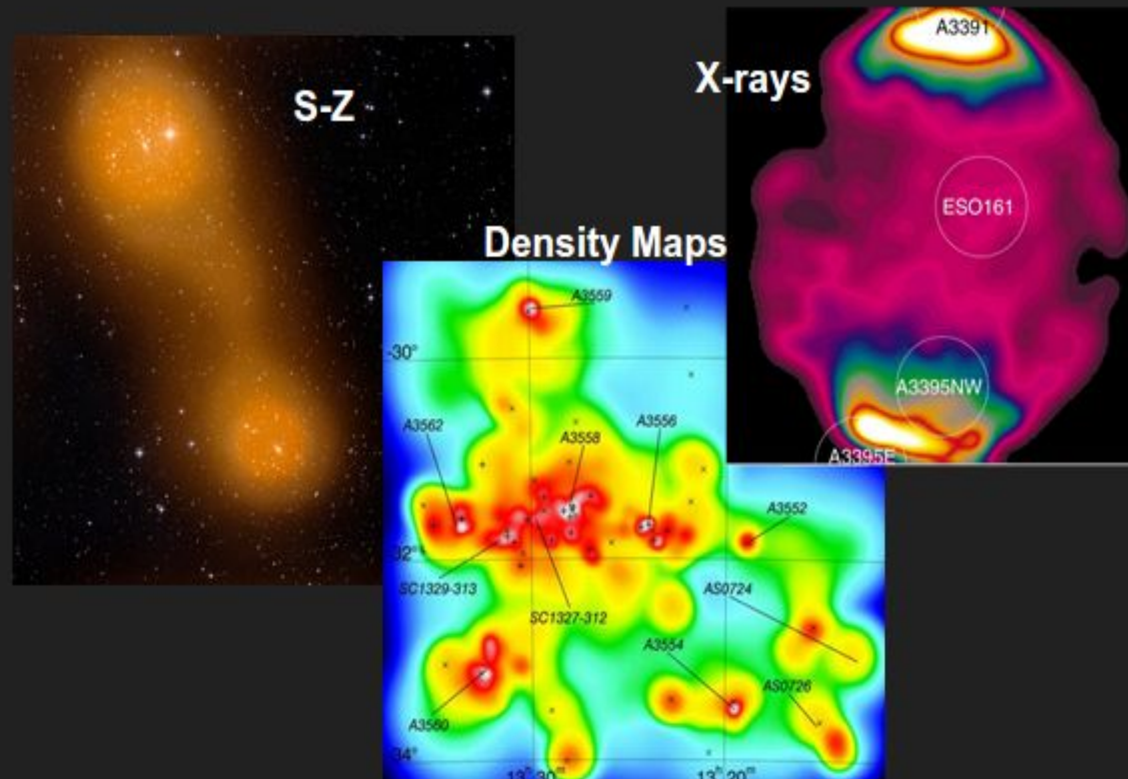
It is commonly known as warm hot intergalactic medium (WHIM).

The WHIM has been detected between pairs of clusters using X-rays and Sunyaev-Zel'dovich (S-Z) effect.

However, these detection trace the hot phase of the WHIM

The detection of the less dense and less hot WHIM is very challenging.

Longer exposures or new generation of instrumentation.



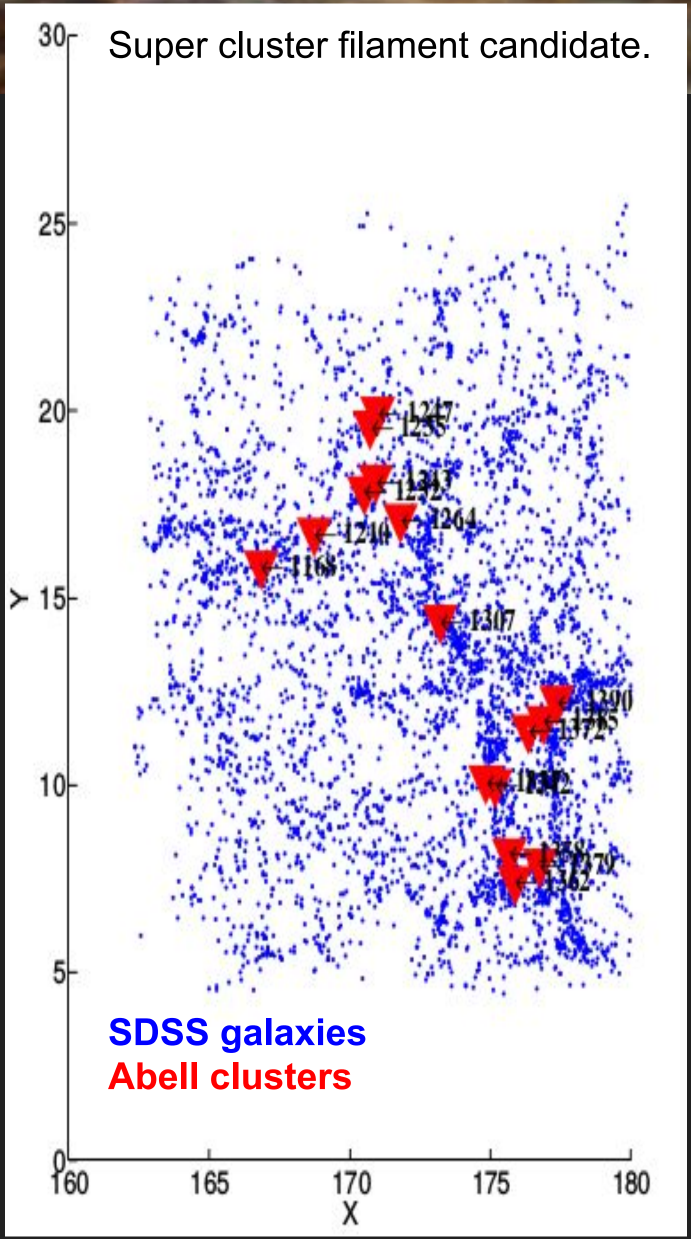
Study of filaments and sheets

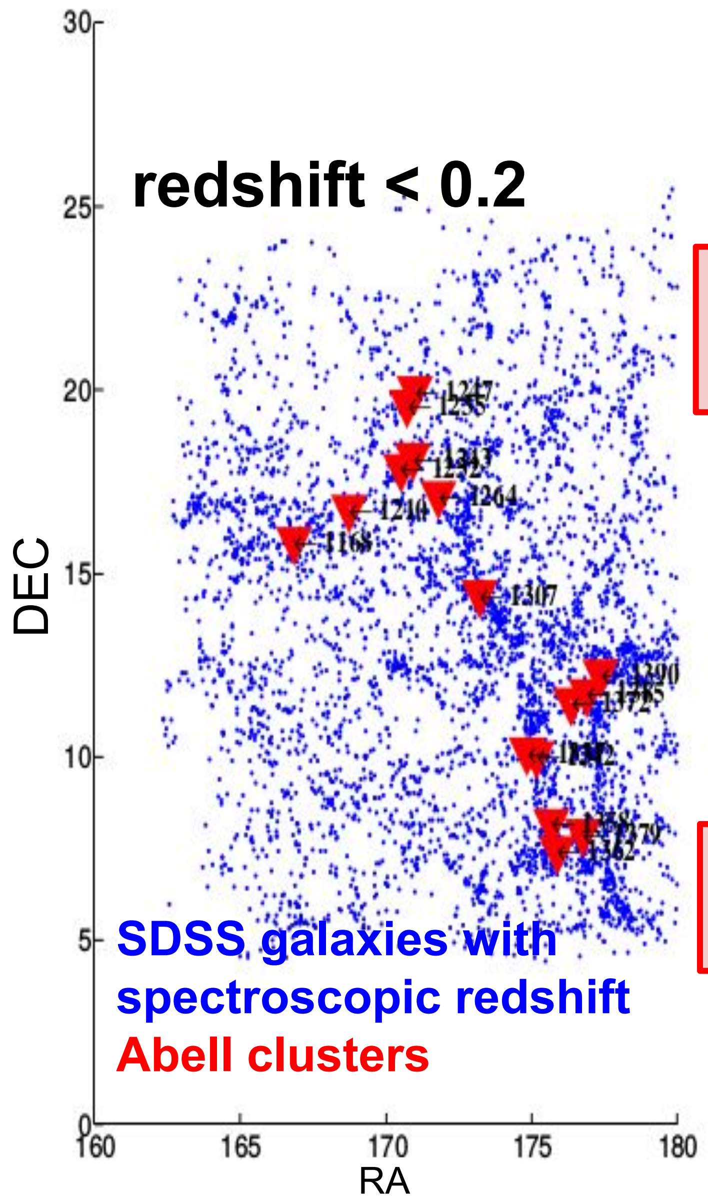
The optical galaxies can be used to trace the LSS.

Optical sky surveys are a good tool to carry out this kind of study.

The The Sloan Digital Sky Survey (SDSS) provides with photometric redshift for galaxies up to m_r~20 and spectroscopic redshifts up to m_r ~18.

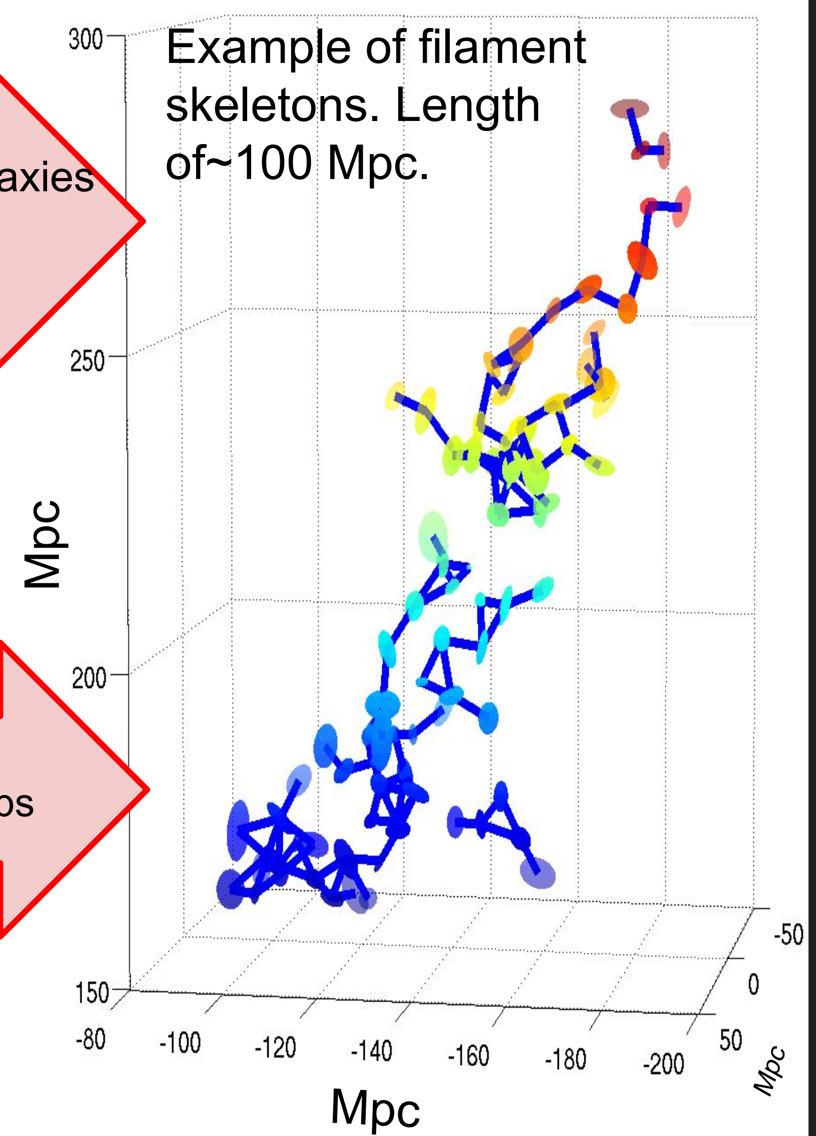
To identify large scale structures (2 - 20 Mpc) is necessary to apply computational strategies.





re-group galaxies by position

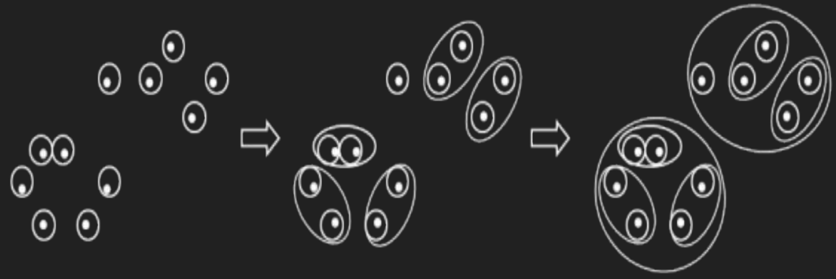
Connect nearest groups



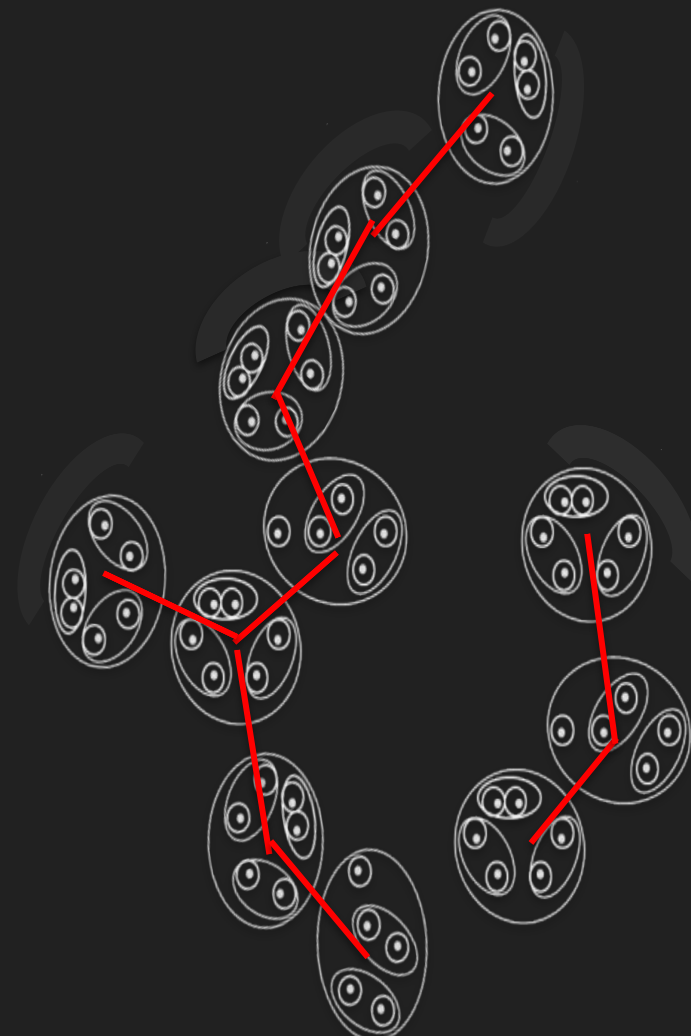
Filament characterization: re-group the galaxies

In order to search for connections between galaxies we apply a Hierarchical Clustering over the galaxy positions. This allows to:

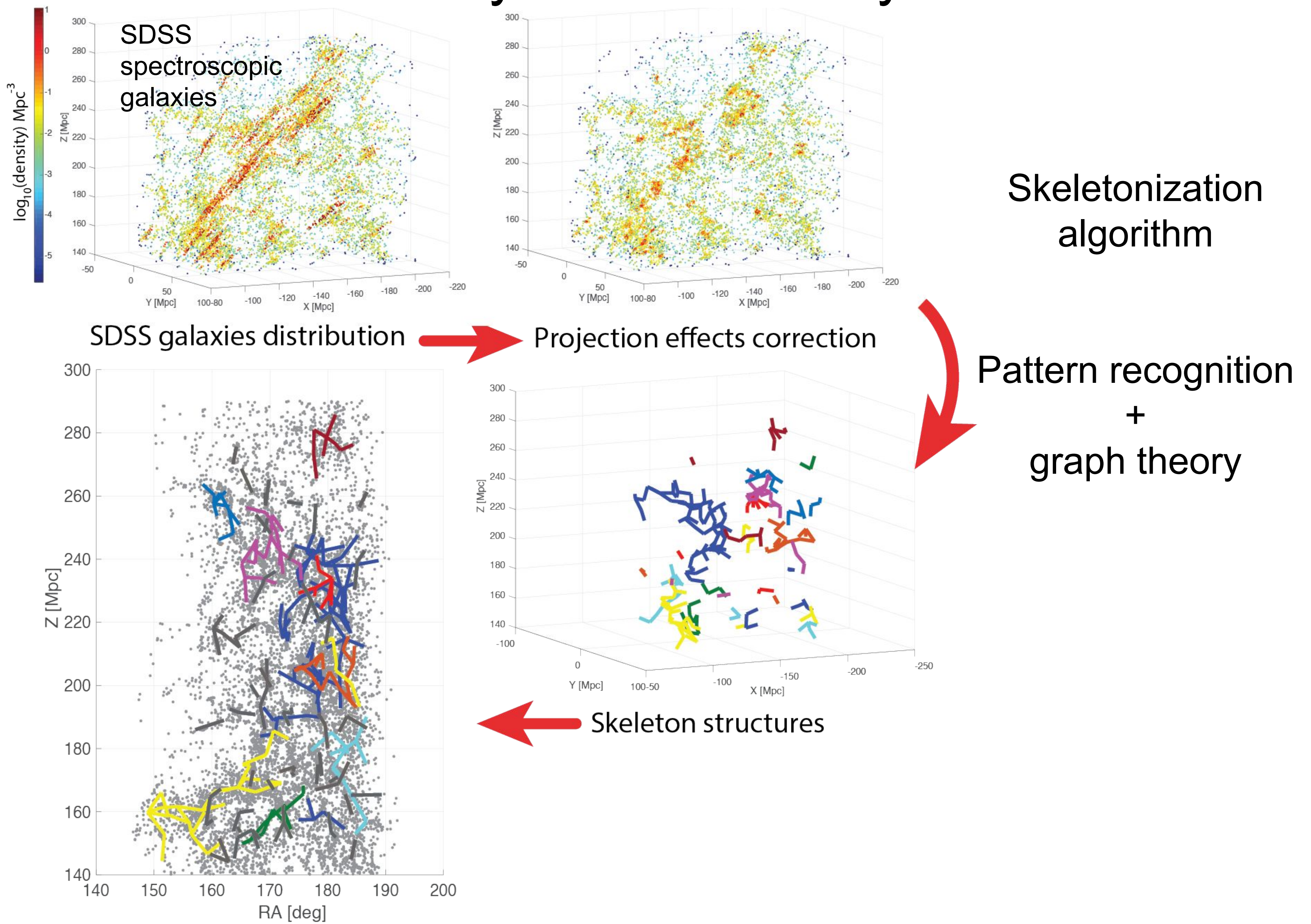
- re-group galaxies,
- find the orientations and shapes of the groups,
- search for connections between groups



Galaxy position   re-group of the galaxies



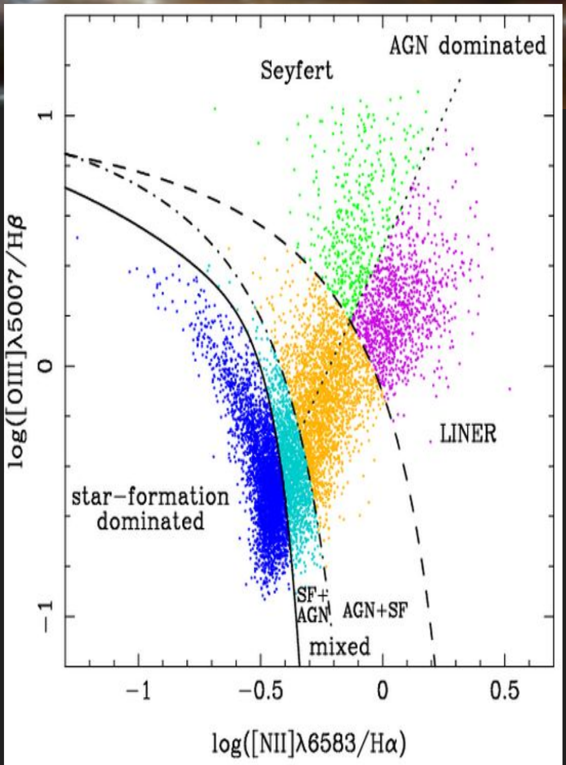
Filamentary structure analysis

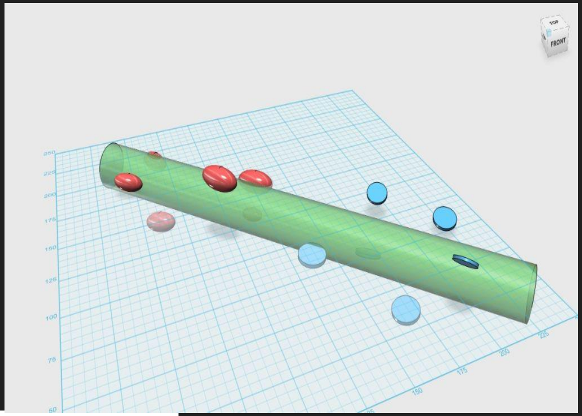


Galaxy properties

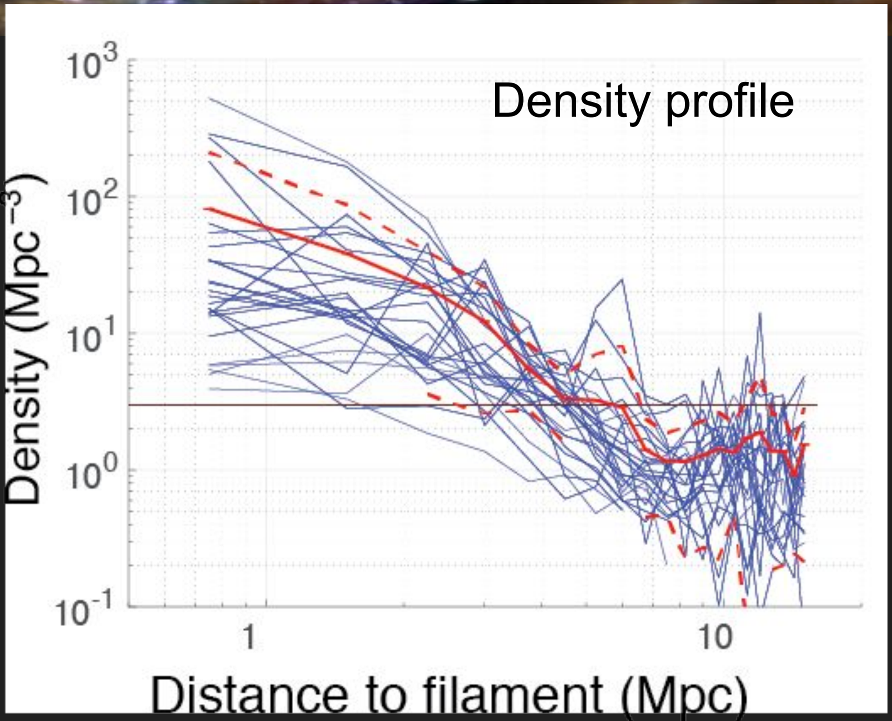
We are interested in to search for correlations between the environment and galaxy properties such as:

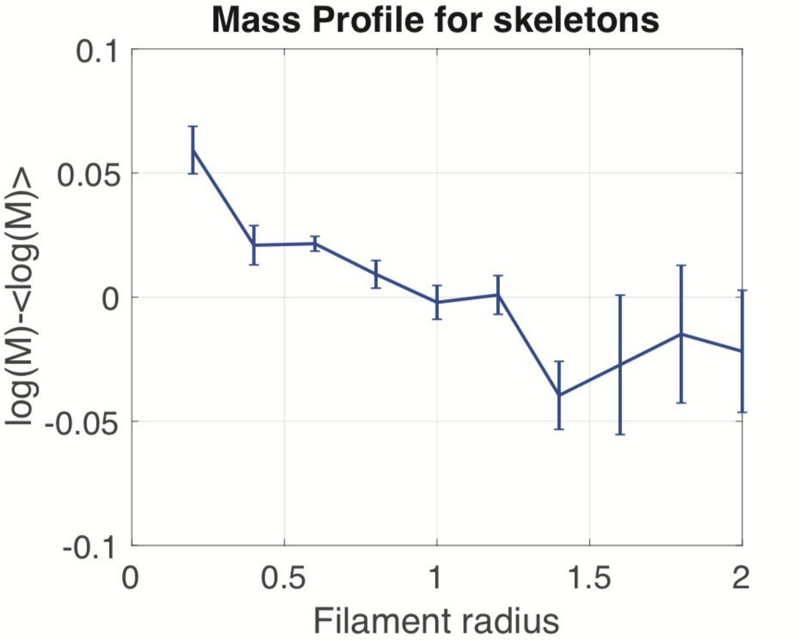
- Mass (MPA-JHU & Granada Group)
- Morphology (Huertas-Company+2011 & Galaxyzoo)
- Activity type (MPA-JHU)
- Metallicity (MPA-JHU)
- Orientation and shape (SDSS-DR13 PhotoObjAll)



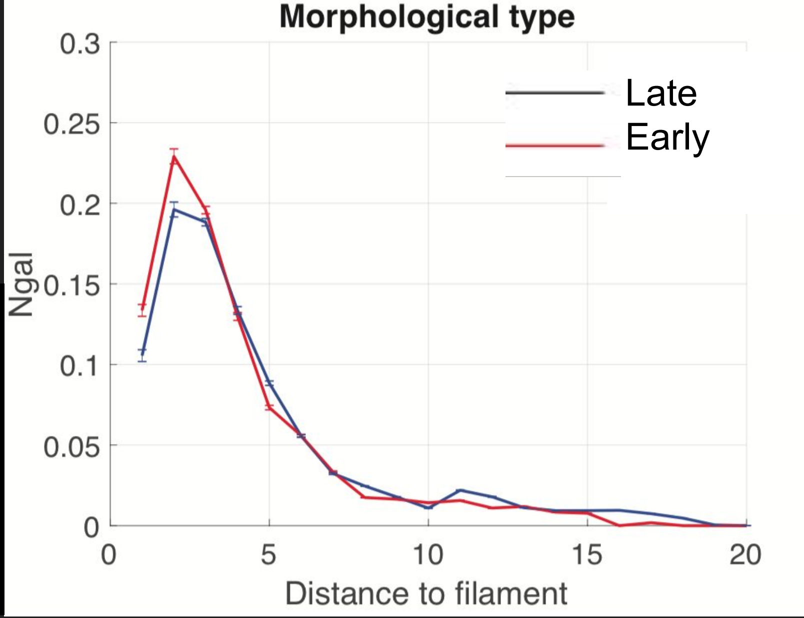


15 superclusters analysis: Galaxy properties





Santiago-Bautista et al. in prep.



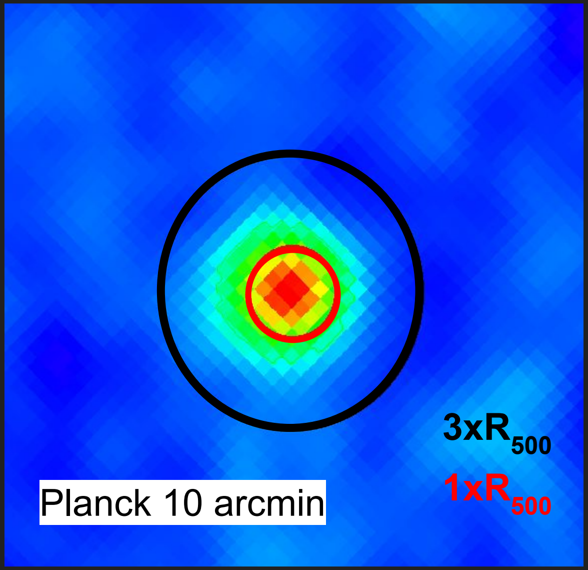
The denser regions: Galaxy Clusters

- Cools radiatively and emits at X-rays wavelengths.
- It generates a distortion of CMB spectrum named Sunyaev-Zel'dovich (SZ) effect.

The goal: extract a pressure profile from the inner regions to the outskirts of clusters → employ a Planck+ACT map composition.

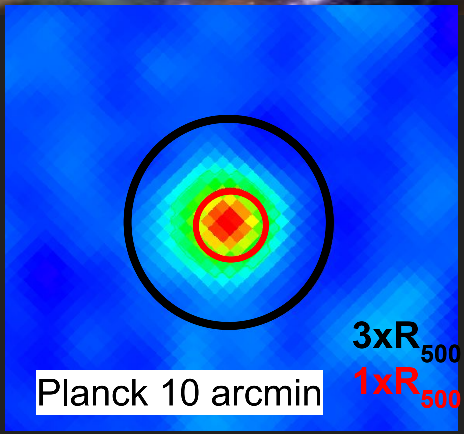
Galaxy cluster from Magneticum simulation

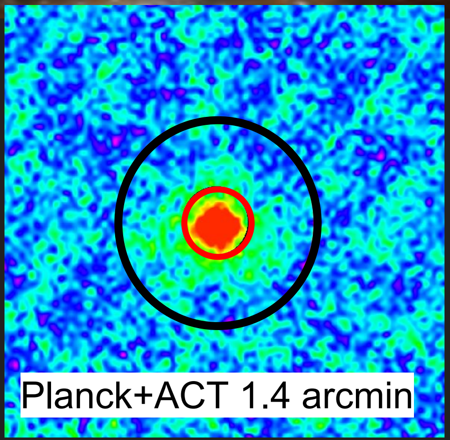
Chandra X-ray · Composite image of X-ray and optical light of galaxy cluster Abell 1835.



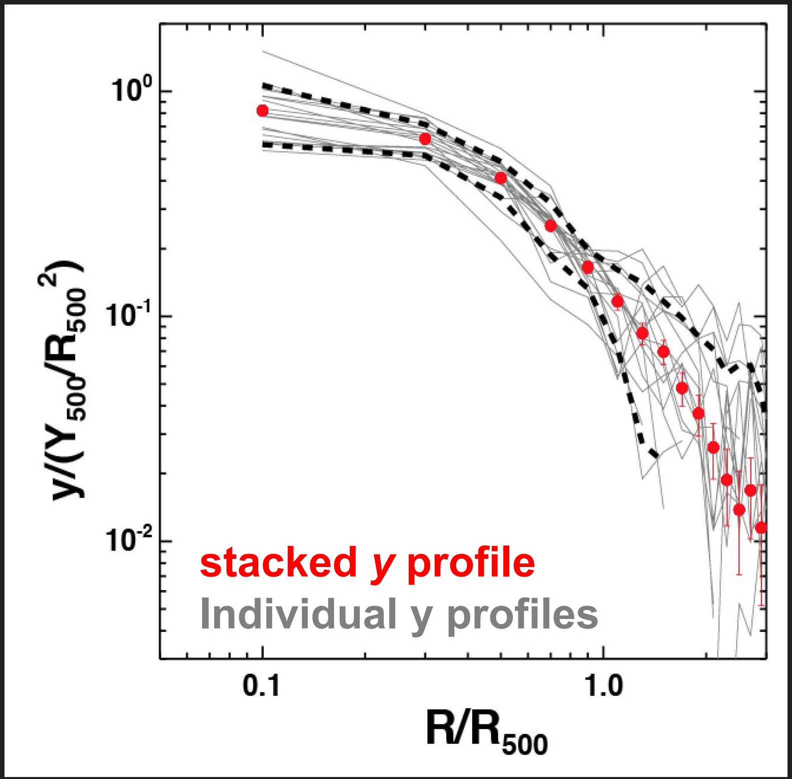
Galaxy cluster as detected by Planck 10’

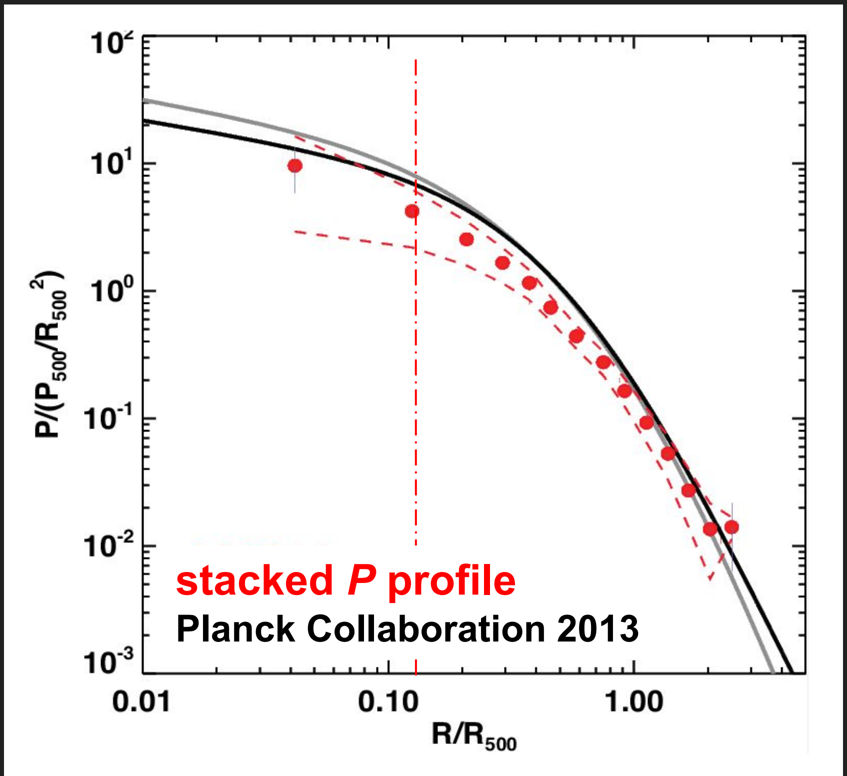
Galaxy cluster analysis: S-Z radial profile





Extraction of the *S-Z* emission and pressure profiles for the 31 clusters (PACT31 sample)





Summary and conclusions

Our principal objective is to study the impact of the LSS environment over the galaxies and gas.

- Galaxies in filaments:
  - Extraction of SDSS galaxies for 15 filament candidates
  - Extraction of galaxy properties from available databases.
  - Preliminary analysis suggest a relation between the galaxy color, activity, morphology and mass with the environment.
  - We need to study in detail the red sequence of filaments.

- Gas in clusters:
  - We reconstruct pressure profiles for a sample of 31 low S/N clusters using a Planck+ACT map.
  - A validation of the extraction method and PACT map was performed.
  - Further investigations of the shape of the pressure profile are ongoing.