Environmental dependence of HI-Mass functions in cosmological simulations

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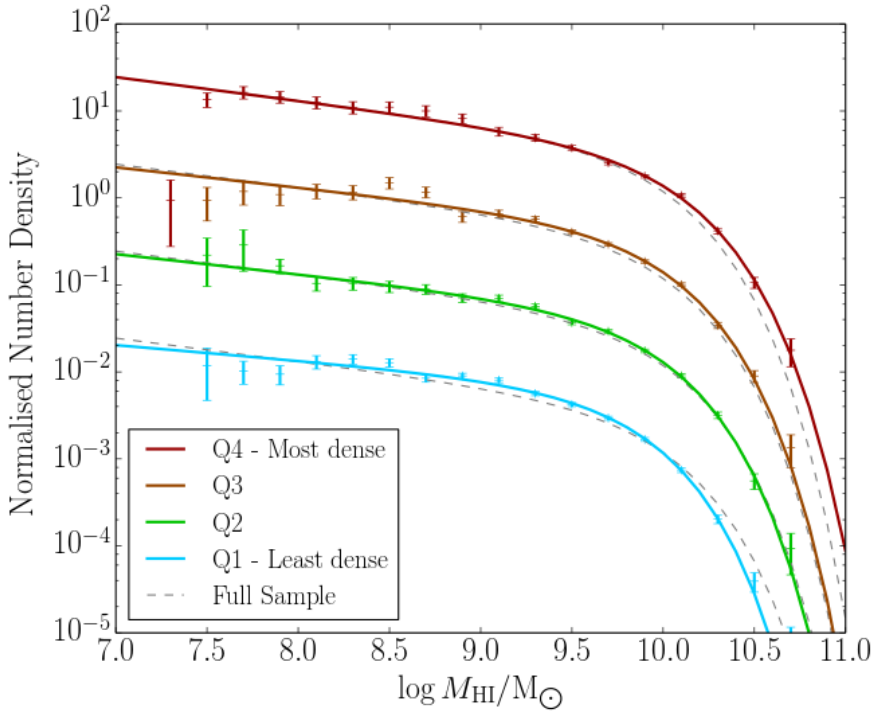
Outline

- Histogram of masses of galaxies and halos
- Logarithmic scales are needed for better interpretation
- Press-Schechter adjusts surprisingly well to observations

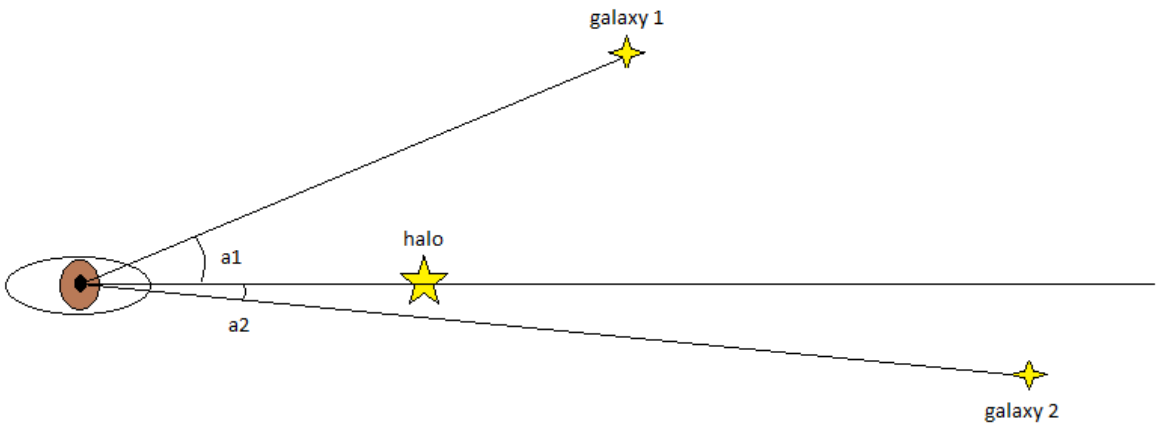
$$n(M) = \phi_* \left(\frac{M}{M_*}\right)^{\alpha+1} e^{\left(\frac{M}{M_*}\right)}$$



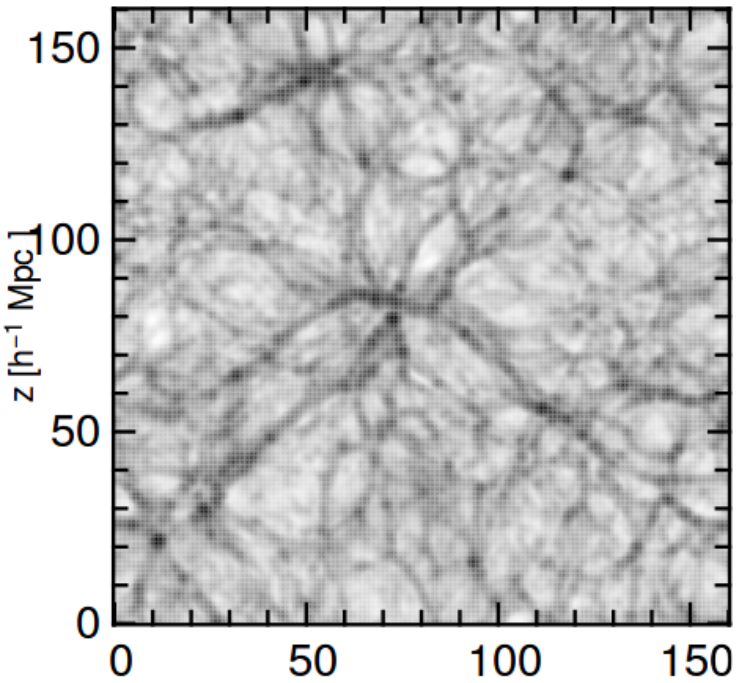
Jones et al. [1]

- Related to the mass density
- Useful to verify its effect on the physics of galaxy formation
- Great variety of methods to quantify environment
- Nearest neighbour, control volume [2].
- 3rd Nearest neighbour (Observational) [1]
- T-Web structures (Theoretical) Forero-Romero et al. [3]

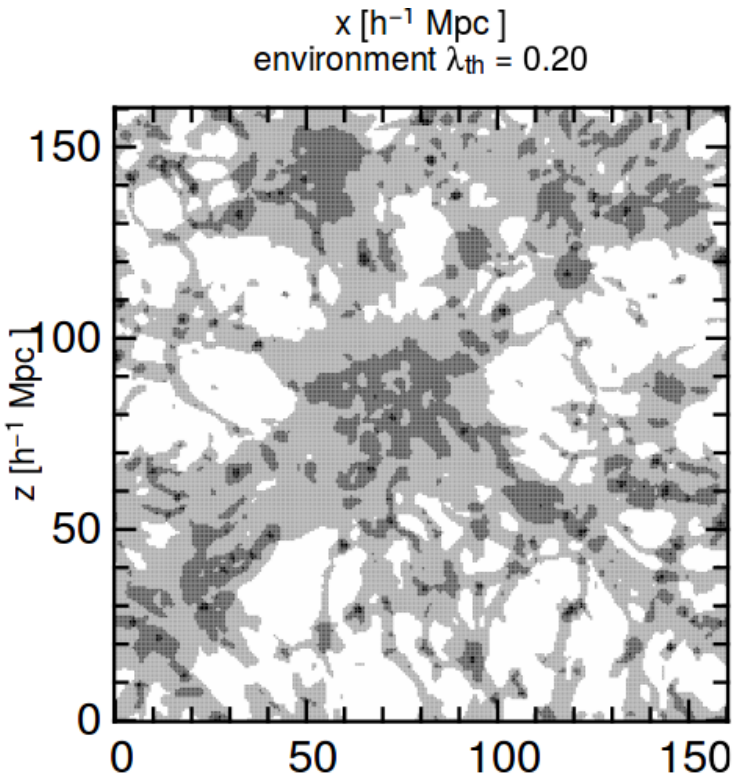
- Projected distance on sky.
- Velocity cut is needed.
- Distance to 3rd (not 1st) neighbour is required to avoid noise.



- Hessian of gravitational potential.
- 3 eigenvalues can identify 4 structures
- Clusters, sheets, filaments and voids.



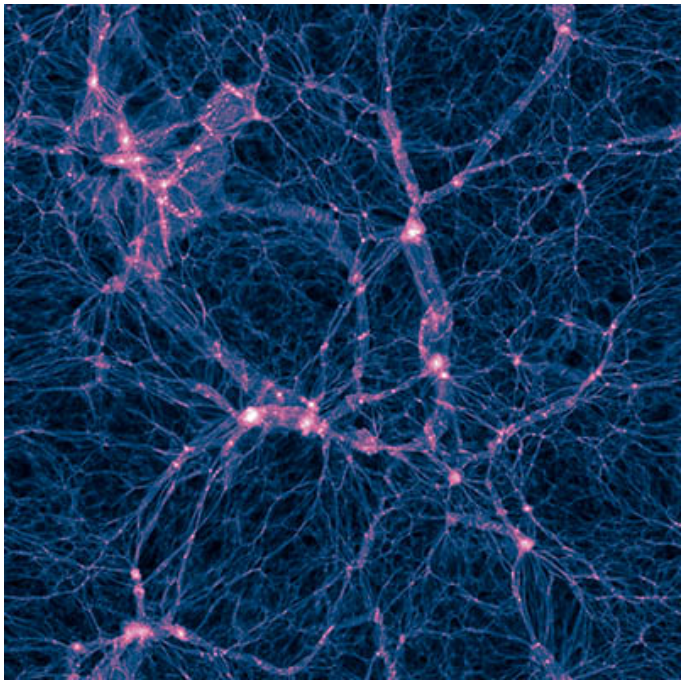
Forero-Romero et al. [3]



Forero-Romero et al. [1]

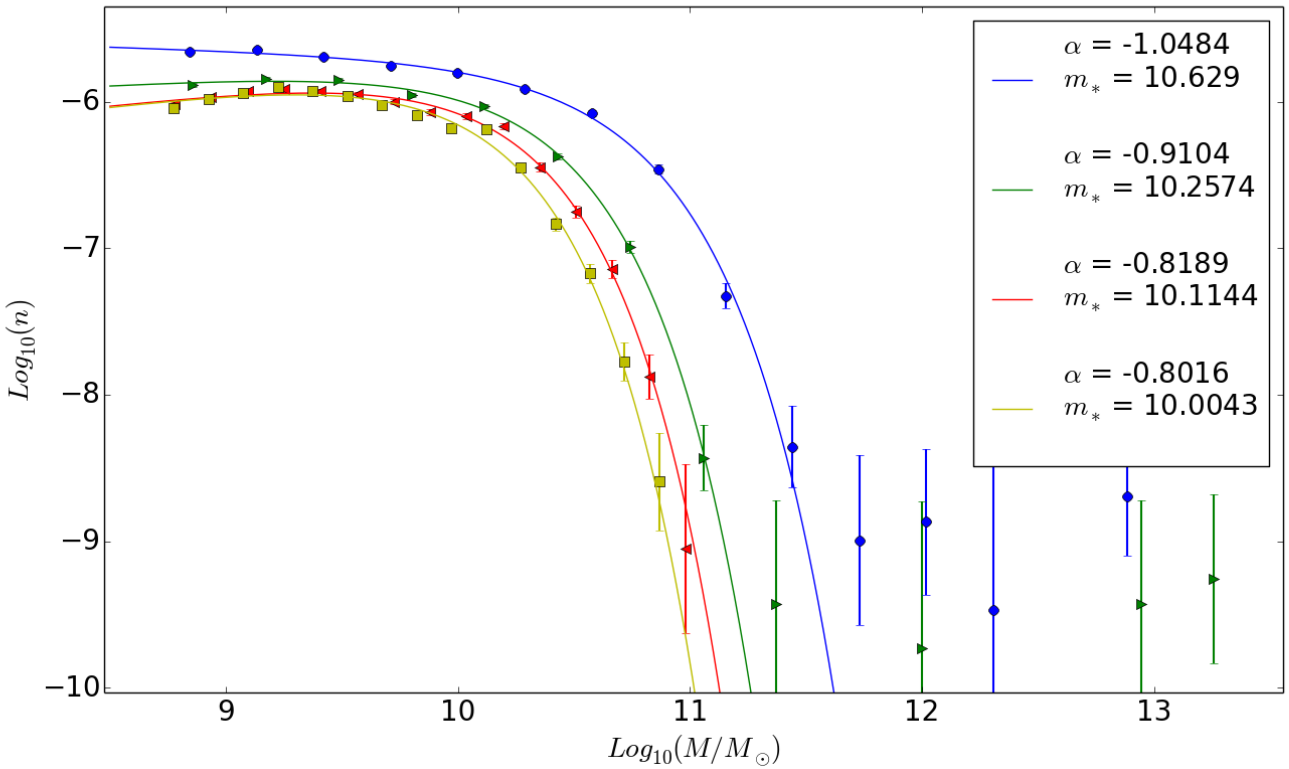
- HIPASS and ALFALFA big surveys allow the study of HI-Mass functions.
- The effect of environment on the physics of galaxy formation.
- Mass tendency to cluster.
- Voids: slow evolution. Sample HIMF at earlier times.
- Studies are so recent and sometimes contradict each others (Springob, Haynes & Giovanelli) [4] and Stierwalt et al. [5].

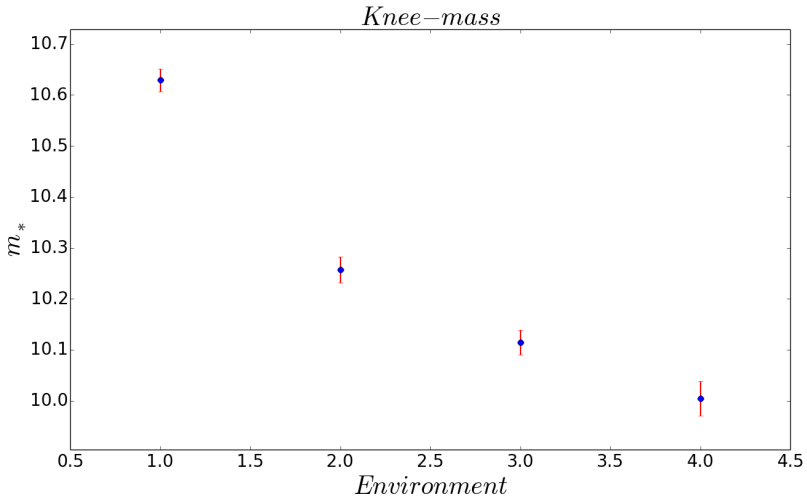
- Illustris run
- $106.5 Mpc$
- 1820^3 particles
- $6.3 \cdot 10^6 M_\odot$ DM resolution
- $1.3 \cdot 10^6 M_\odot$ Gas resolution
- Detailed galaxy characteristics

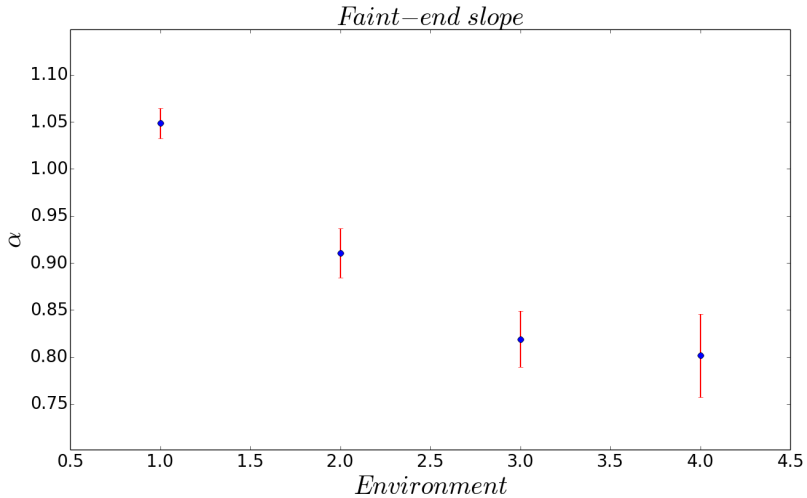


http://www.illustris-project.org/media/

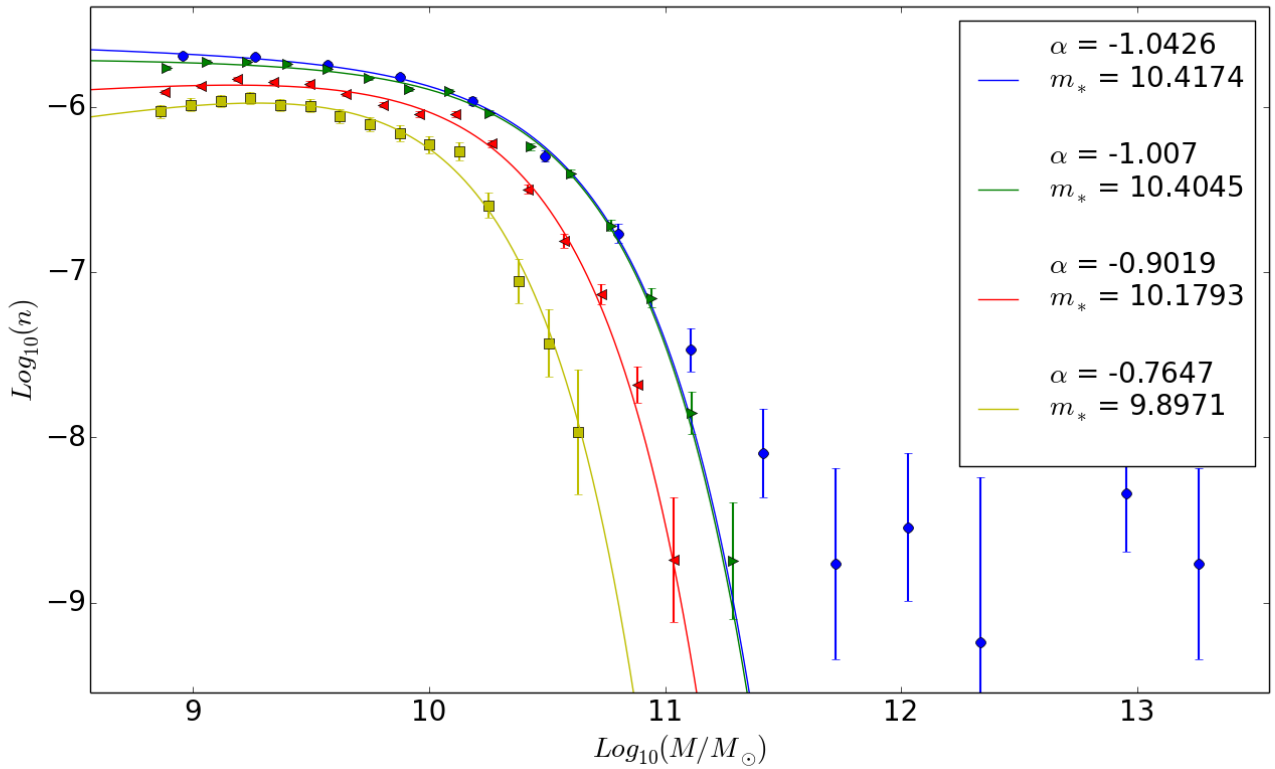
- Distance to 3rd nearest neighbour for galaxies with gas.
- Divided group in quartiles and obtained Schechter fits.

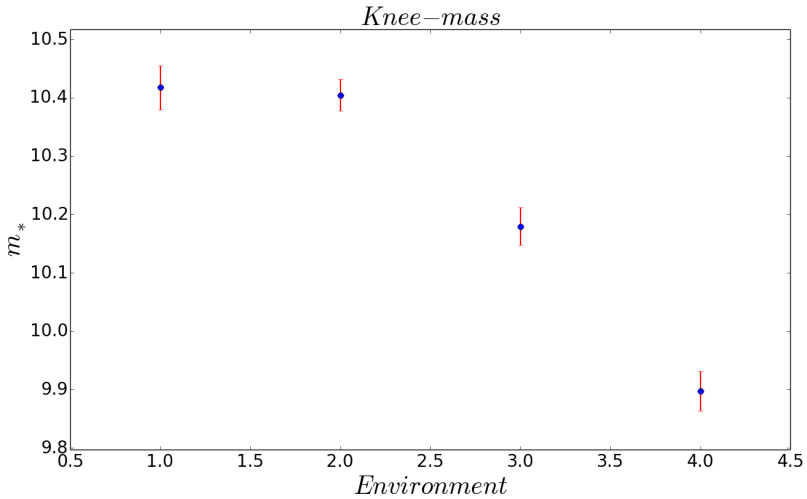


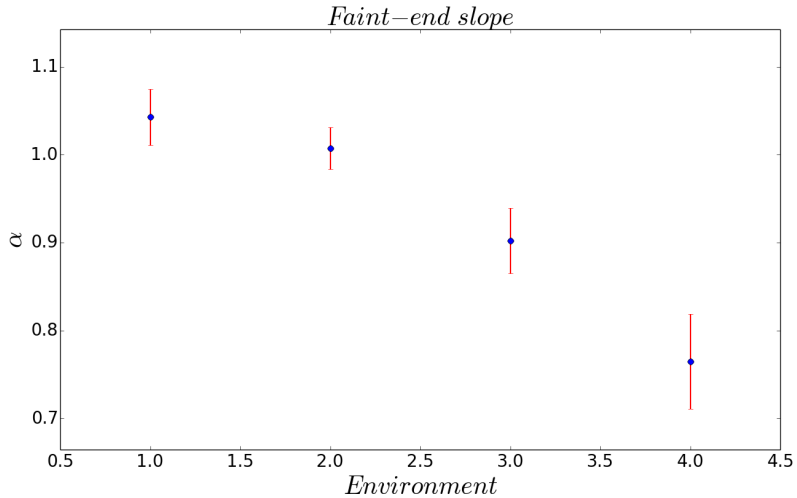

Knee−mass
m_*
10.7
10.6
10.5
10.4
10.3
10.2
10.1
10.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
Environment


Faint−end slope
α
1.10
1.05
1.00
0.95
0.90
0.85
0.80
0.75
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
Environment

- Divided galaxies into Cluster,Sheet,filament and void groups.
- Obtained Schechter fits.




Knee−mass
m_*
10.5
10.4
10.3
10.2
10.1
10.0
9.9
9.8
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
Environment


Faint−end slope
α
1.1
1.0
0.9
0.8
0.7
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
Environment

- We obtained a clear general tendency for the knee-mass and the faint-end slope in both methods.
- For high density environments from T-web, both tendencies becomes more diffuse.
- For low density neighbouring environments, the faint-end slope relation is diffuse.

- The knee-mass increases with neighbouring density in a range from 10.00 ± 0.03 to 10.62 ± 0.02.
- For Cosmic web environment the range is from 9.90 ± 0.03 to 10.41 ± 0.04.
- Faint-end ranges are $[-0.80 \pm 0.04, -1.05 \pm 0.02]$ and $[-0.76 \pm 0.05, 1.04 \pm 0.03]$.

- Detailed analysis of effects for big-scale environments using both methods.
- Relation between of different mass functions (DM-SMBH-gas).
- Incorporate a reasonable approximation for HI mass in terms of gas mass.

Referencias I

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