The cosmic web in hydrodynamical simulations

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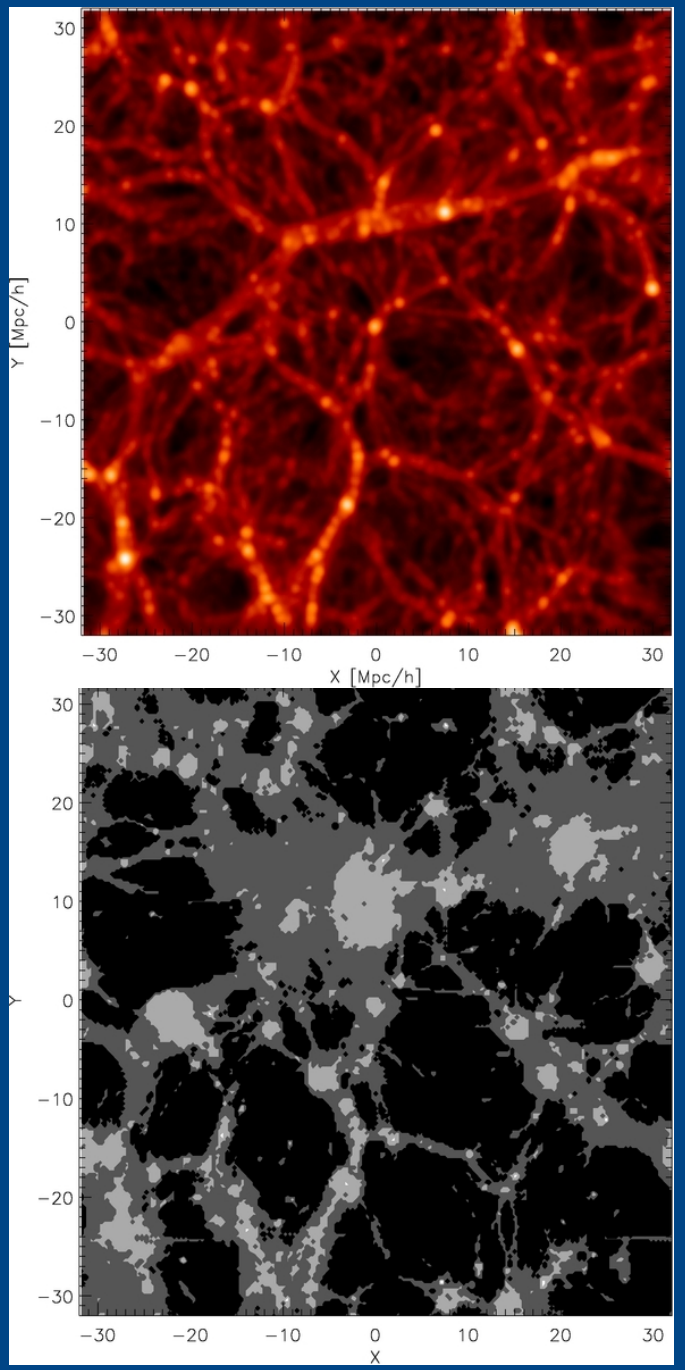
The Tweb

- Based on Hahn et al. 2007; Mathematical way to classify the density field into four web elements, not based on density thresholds
- Counting number of eigenvalues of the shear tensor larger than some threshold
- Gives fairly good agreement with density field

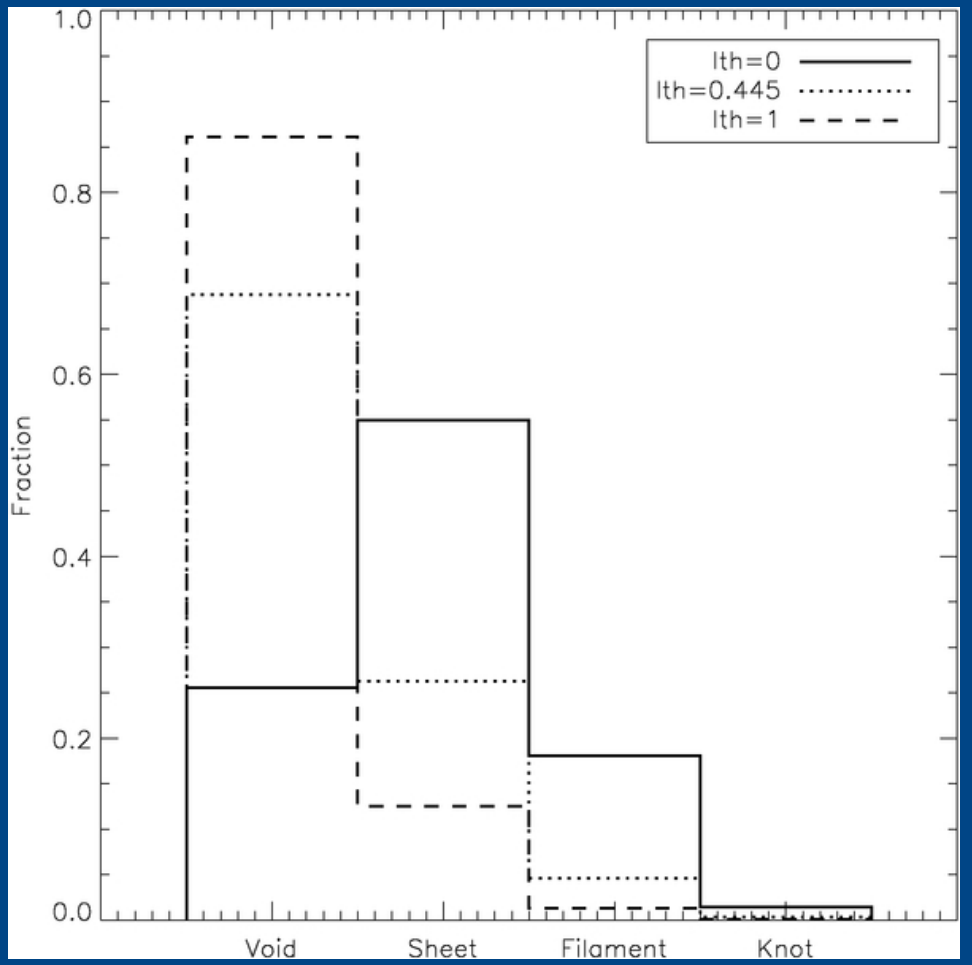


The Vweb

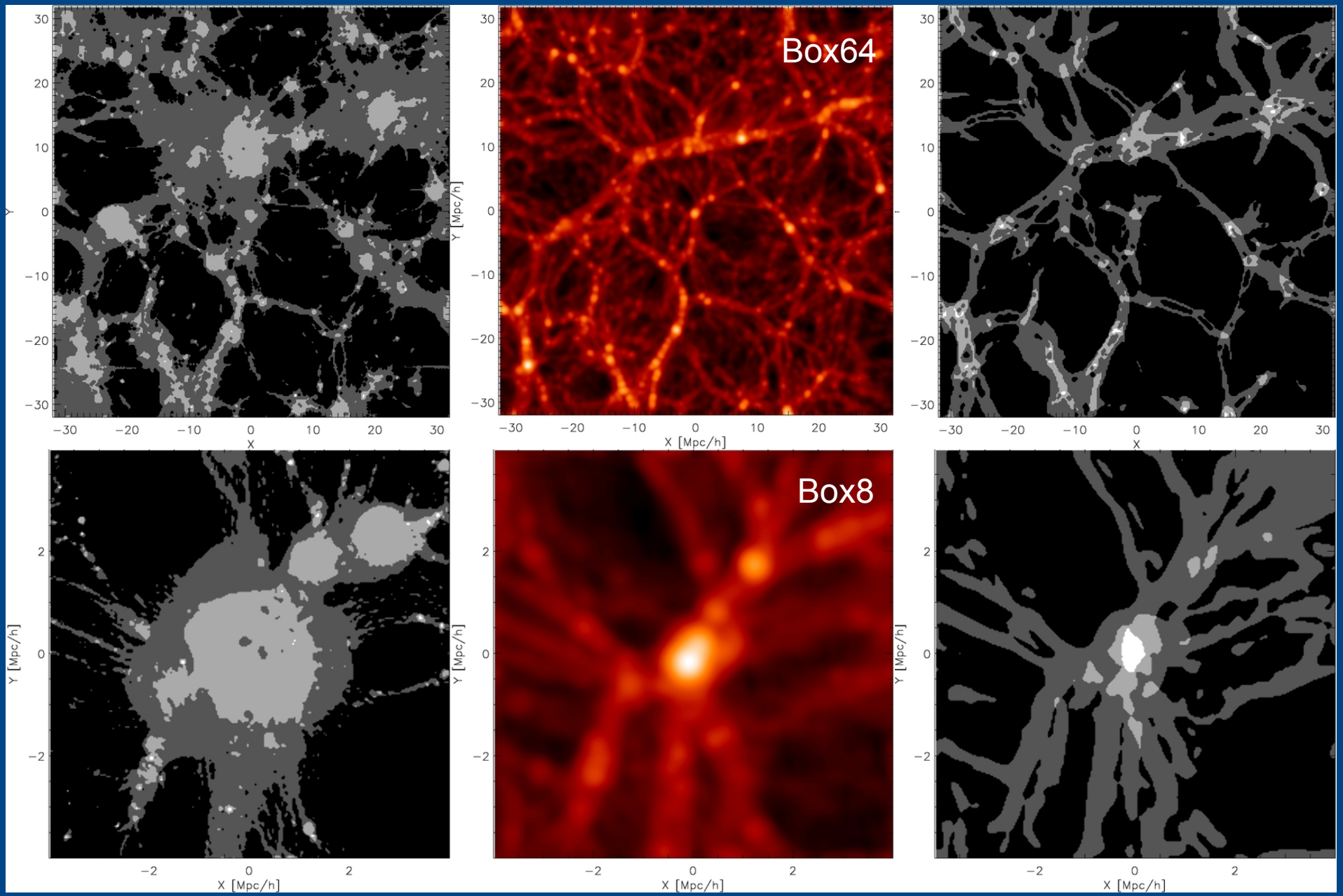
- Tweb hits a wall at small scales
- Vweb picks up from the Tweb. From linear theory

$$E_{\alpha\beta} = \frac{\partial \Phi}{\partial X_\alpha \partial X_\beta} = \frac{\partial v_\alpha}{dX_\beta}$$

- Threshold still under discussion

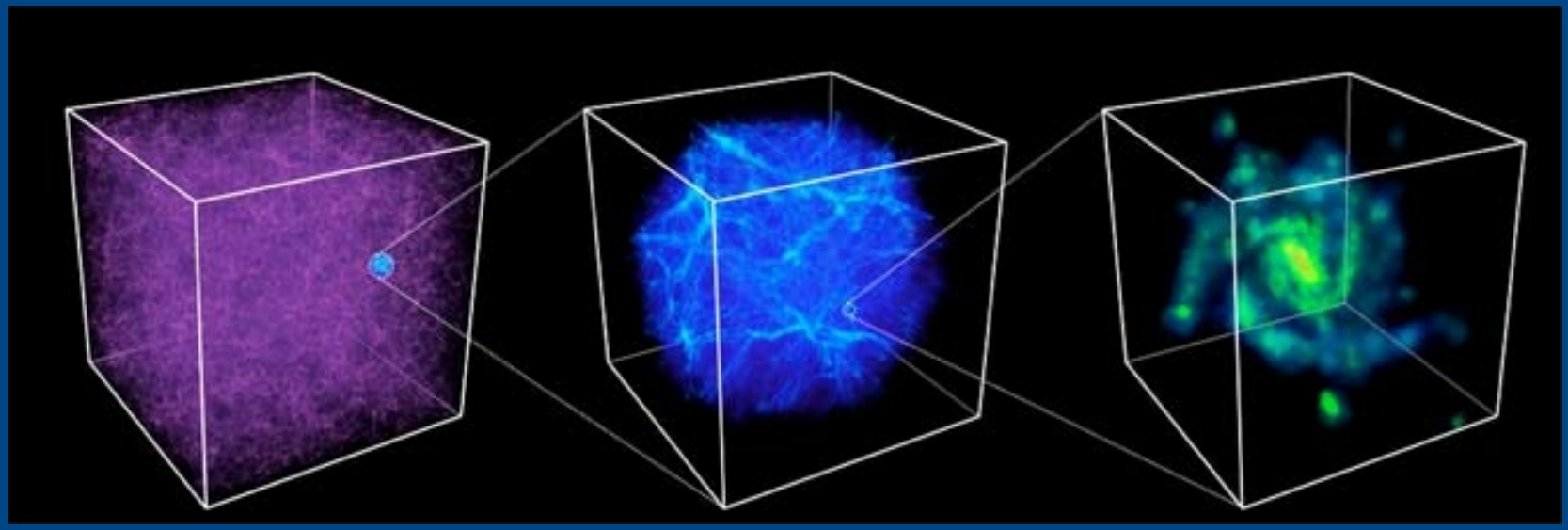


The Vweb



The GIMIC simulations

- 5 resimulated regions from the Millenium, with densities at z=1.5 in the range [-2σ,+2σ] in 18-25 Mpc/h spheres, most are not centered on a feature
- Intermediate resolution - goes to z=0, has mass resolution 5.3*10^7 Msun/h

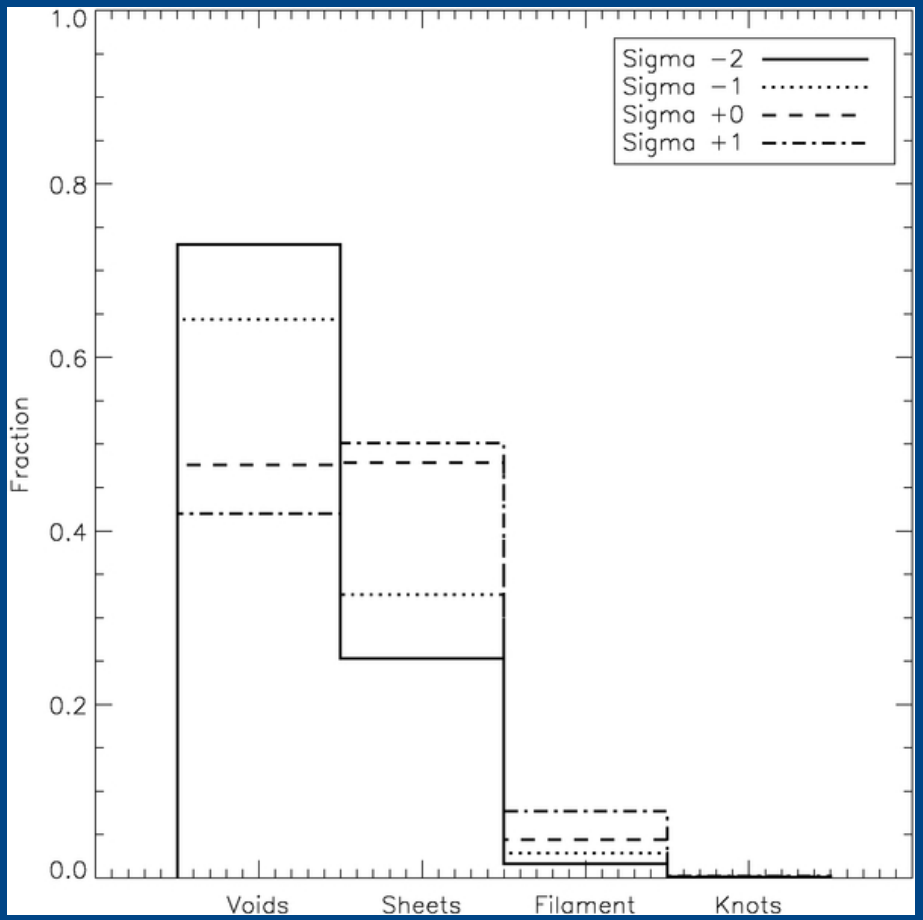


The GIMIC simulations

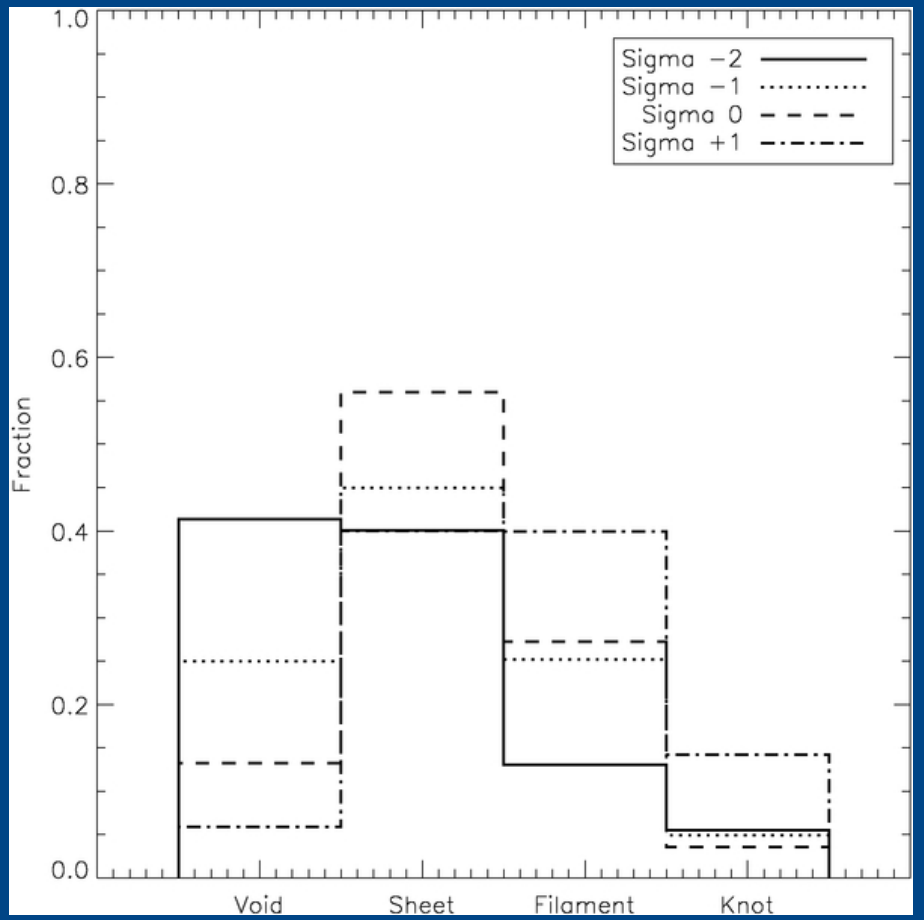
- High resolution - only 3 simulations go to z=0, has mass resolution 6.6*10^6 Msun/h
- We take 16 Mpc/h boxes to avoid contamination from higher mass particles
- Boxes cause problems
  - Much smaller than resimulation spheres, densities not necessarily the same as in spheres
  - Halo content may differ significantly from the spheres, especially since the spheres aren't centered on anything specific

Results - DM

Volume

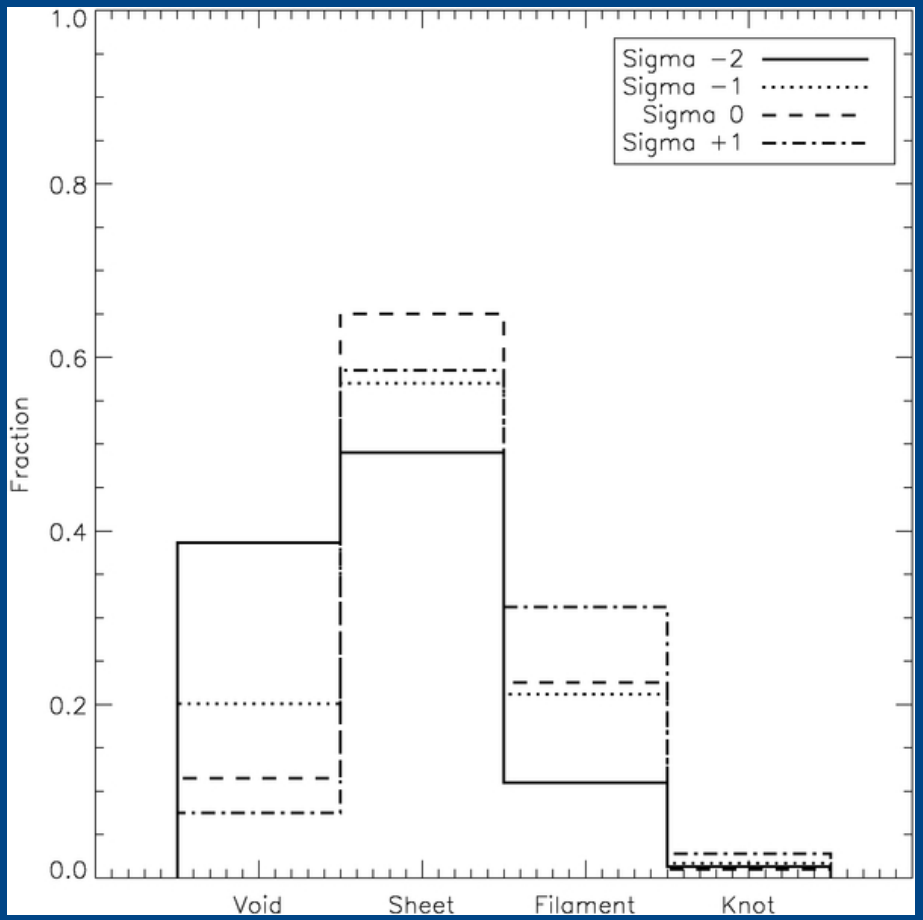


Mass

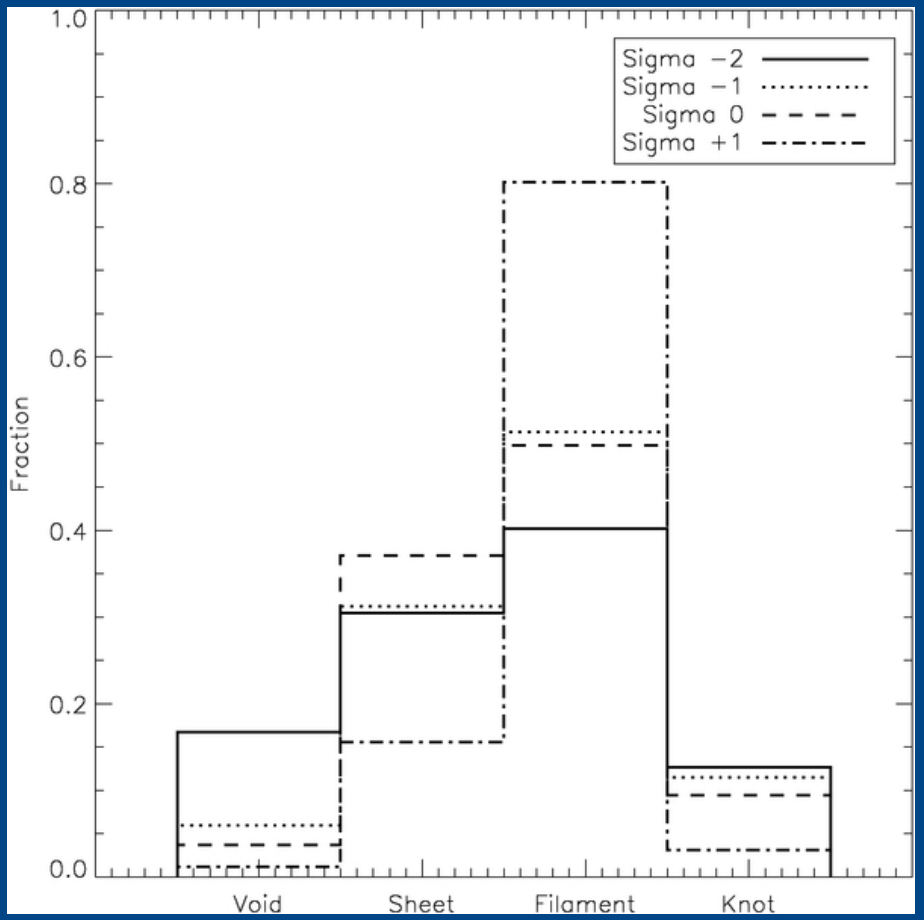


Results - halos

Number

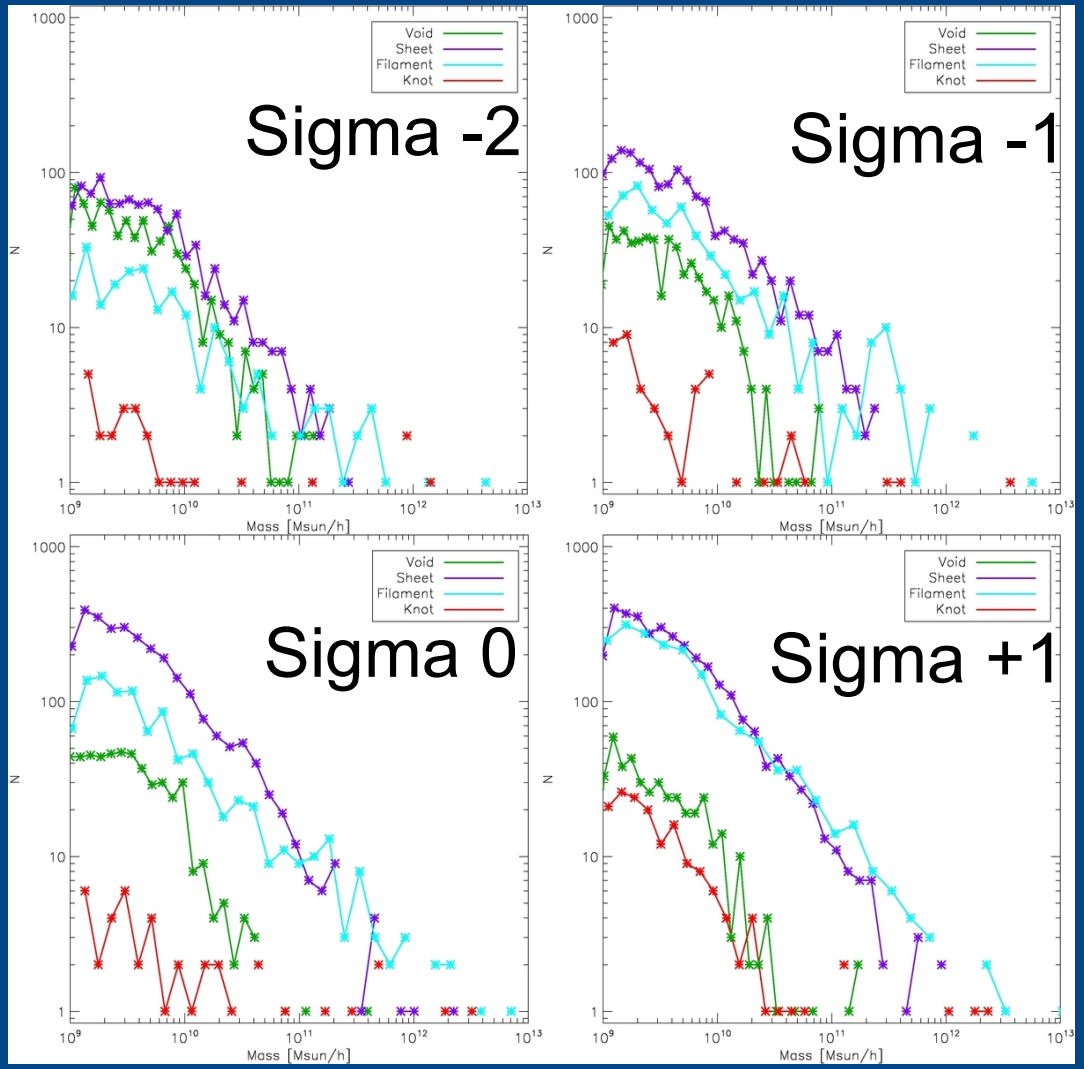


Mass



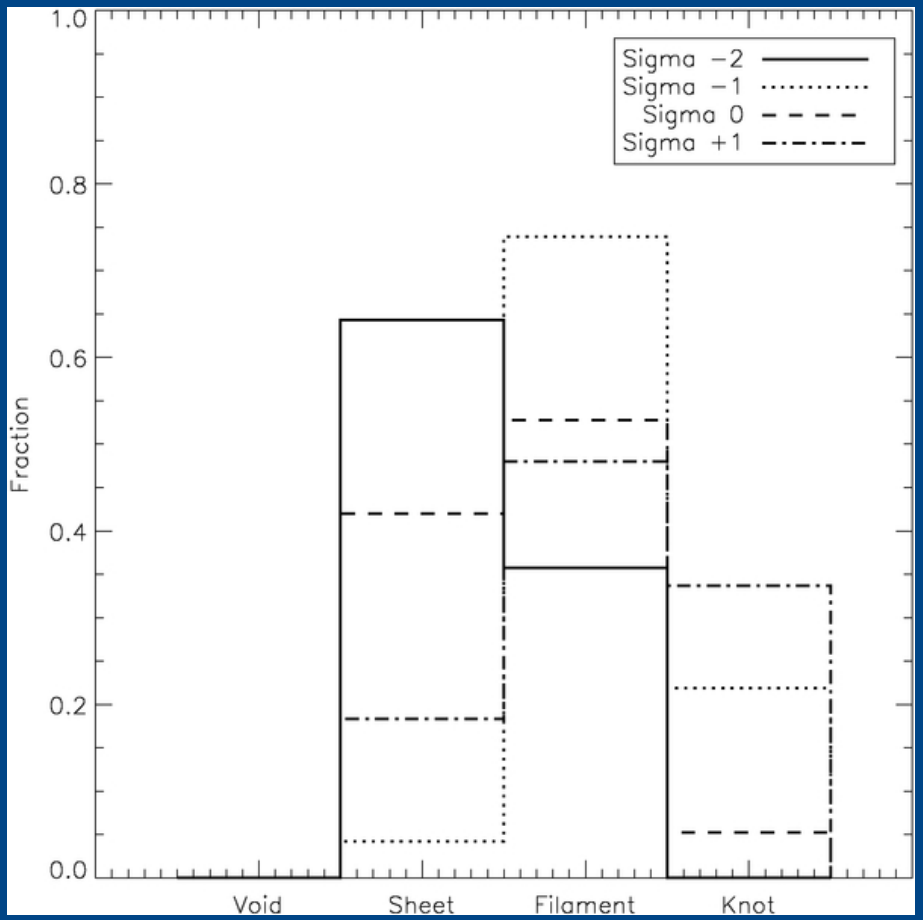
Results - halos

- Very few knot halos
- Sheet halos dominate low mass halos
- Filament halos dominate high mass (with contribution from knots)

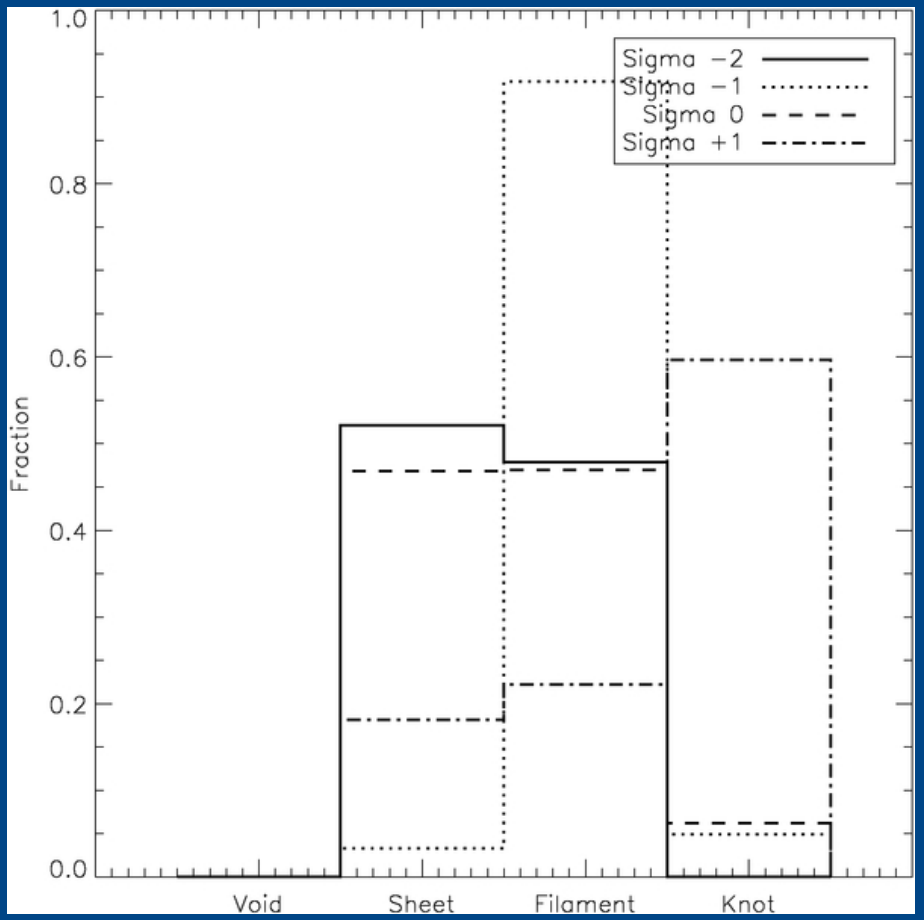


Results - galaxies

Number



Light



Conclusions

- The Vweb gives very good visual agreement with the density field
- Light in knots appears to go up significantly with density
- The average local density shows some trends, but may not be the right property to look at for our purposes