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AMUSE

The cosmic web in CosmoGrid void regions

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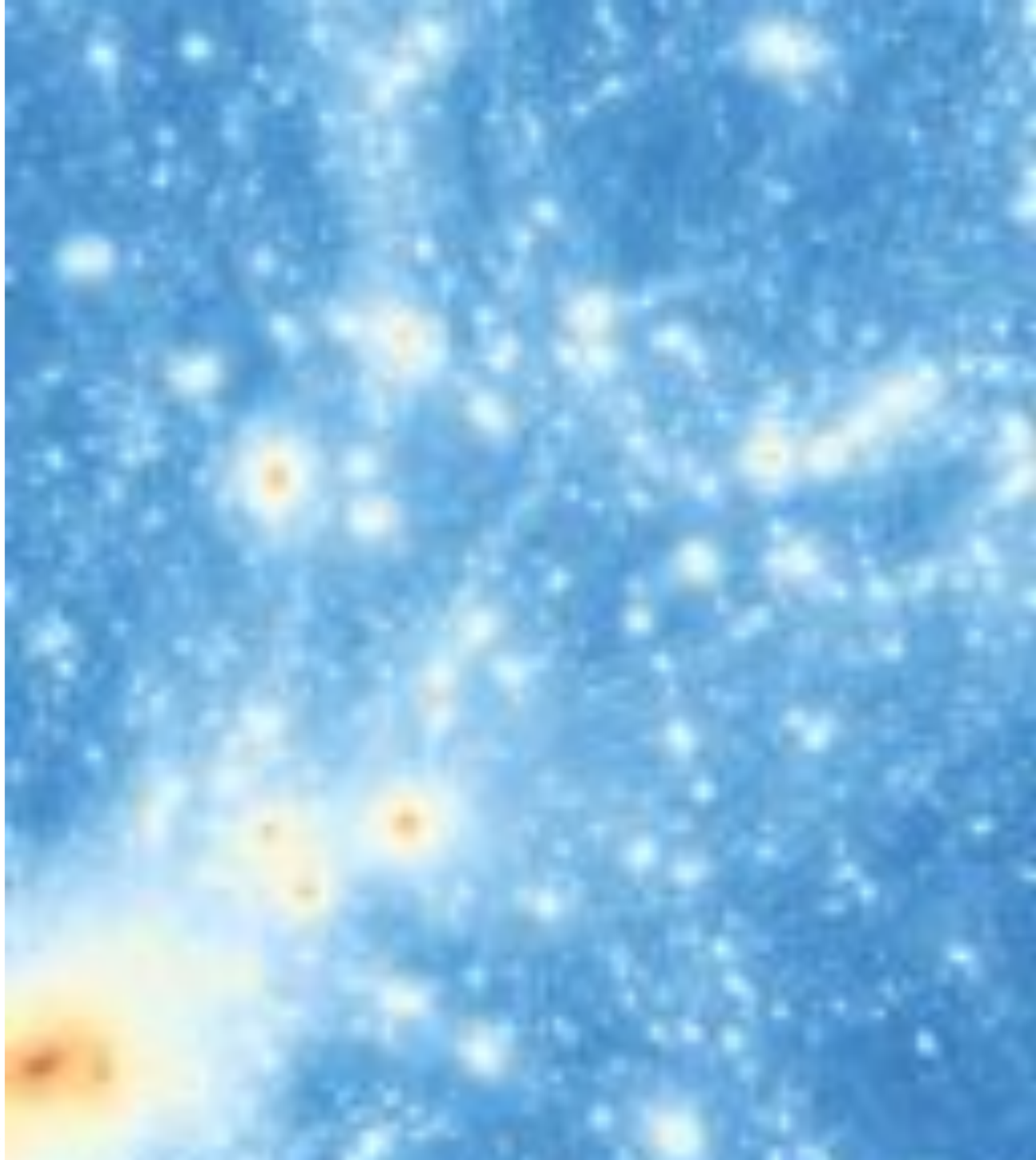
Rieder et al. 2013

CosmoGrid

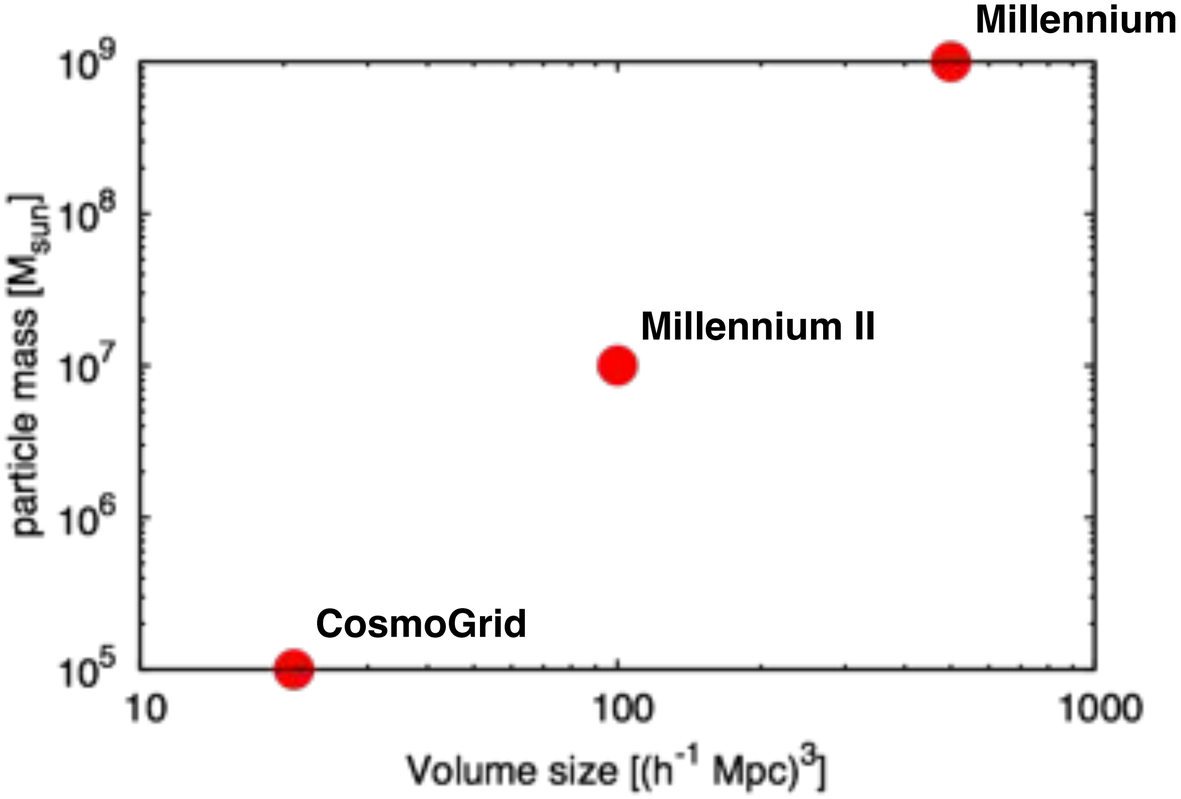
- ΛCDM simulation, no baryons
  (Portegies Zwart et al. 2010, Ishiyama et al. 2013)
- GreeM code (Ishiyama et al. 2009)
- 2048^3 particles (also 1024^3, 512^3)
- $(30\ \mathrm{Mpc})^3$ volume
- $10^5\ M_\odot$ per particle
- 175 pc softening
- ~500 snapshots over a Hubble time ($z = 65 - 0$)

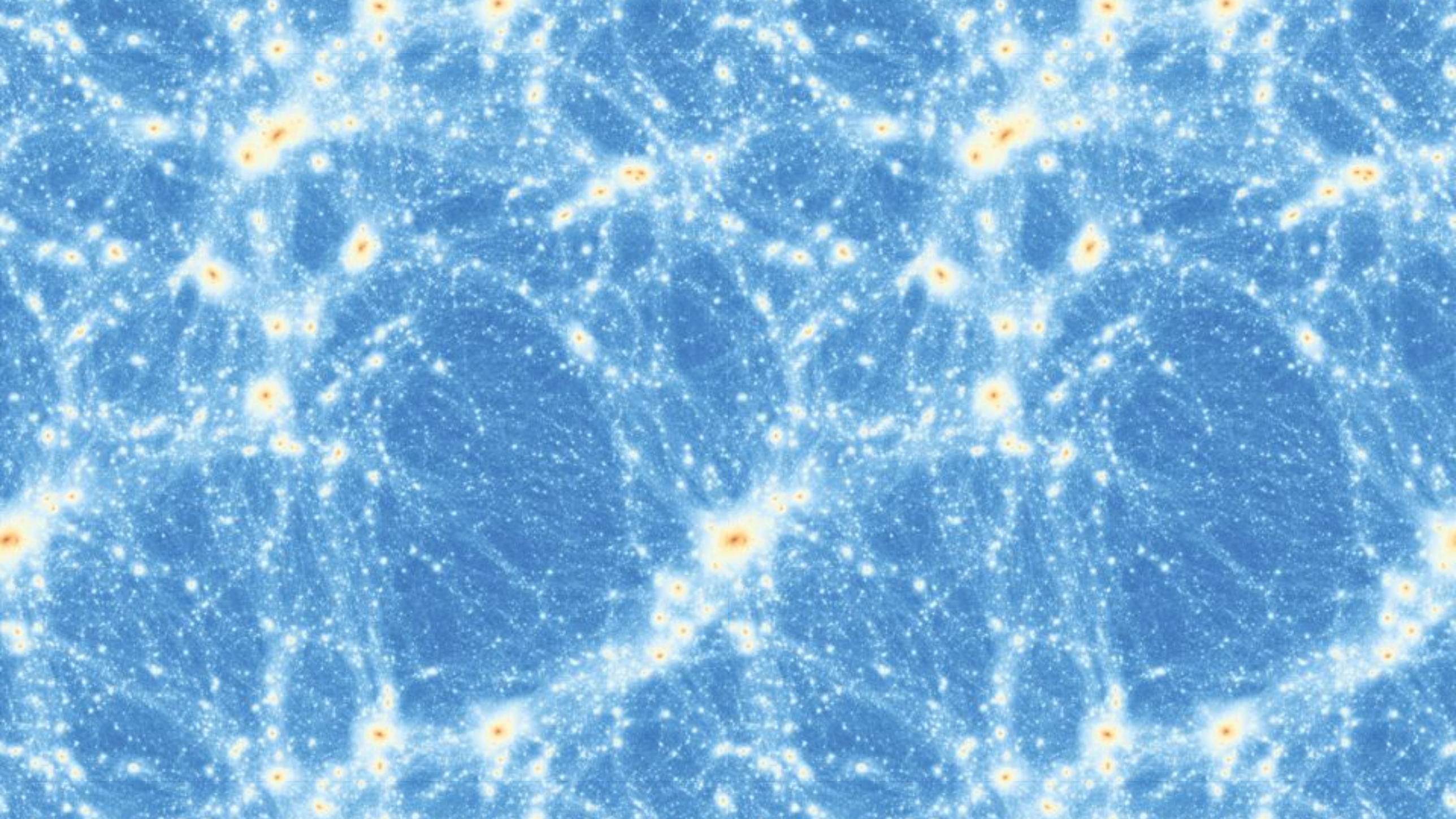
Colour scheme (idl, gnuplot, matplotlib): http://www.sron.nl/~pault/



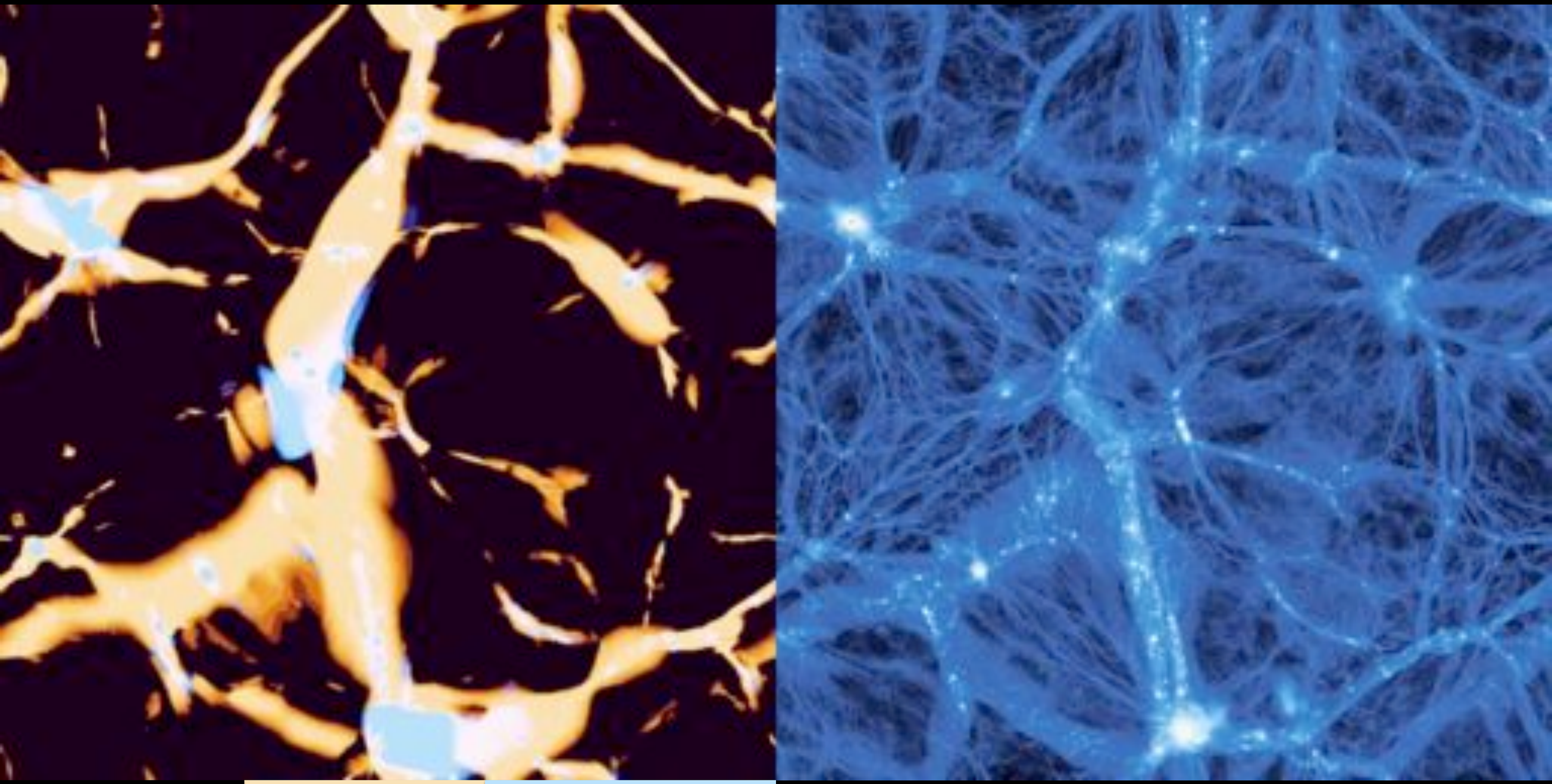
CosmoGrid

- very high mass & spatial resolution
- limited large scale coverage
- very useful for case studies (not for precise statistical purposes)





Nexus+ 600 kpc thick CosmoGrid slice Particles



Voids Walls Filaments and clusters

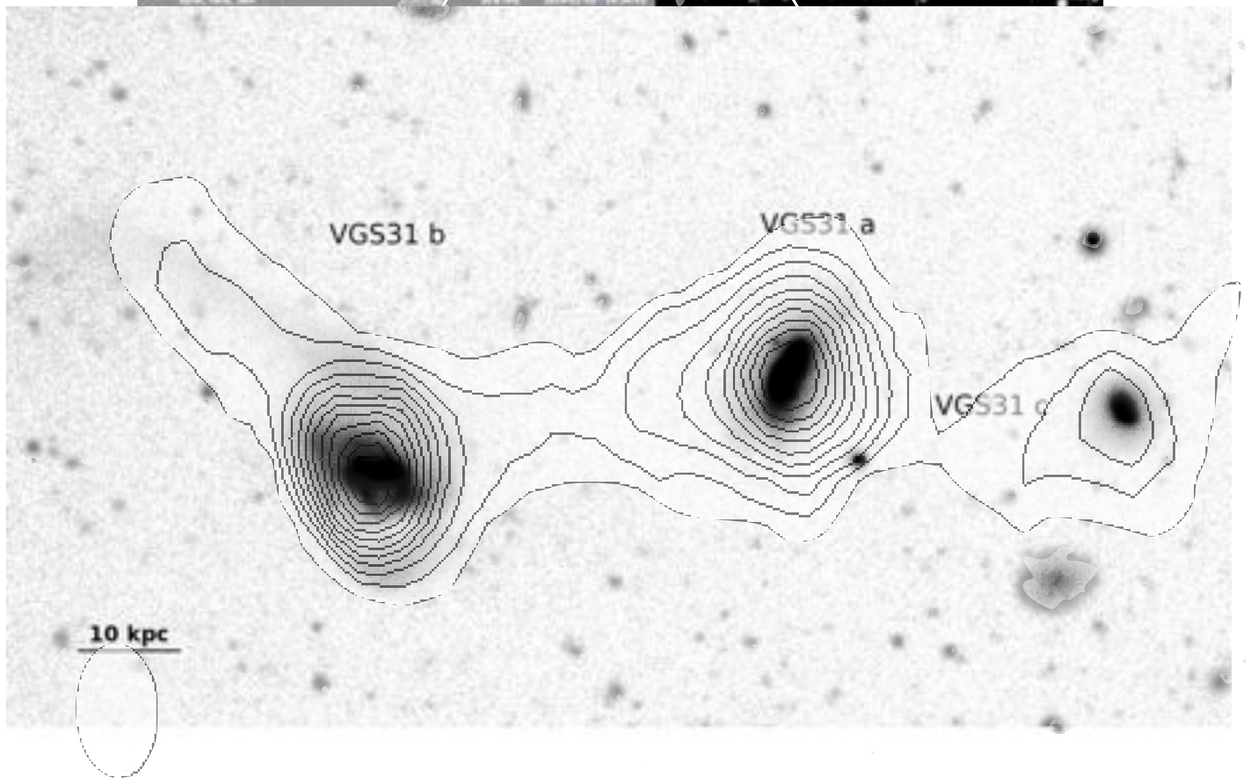
VGS-31:

"An Interacting Galaxy System Along a Filament in a Void"

- Beygu et al. 2013, Kreckel et al. 2013:

  "VGS_31 is one of the first observed examples of a filamentary structure in a void."

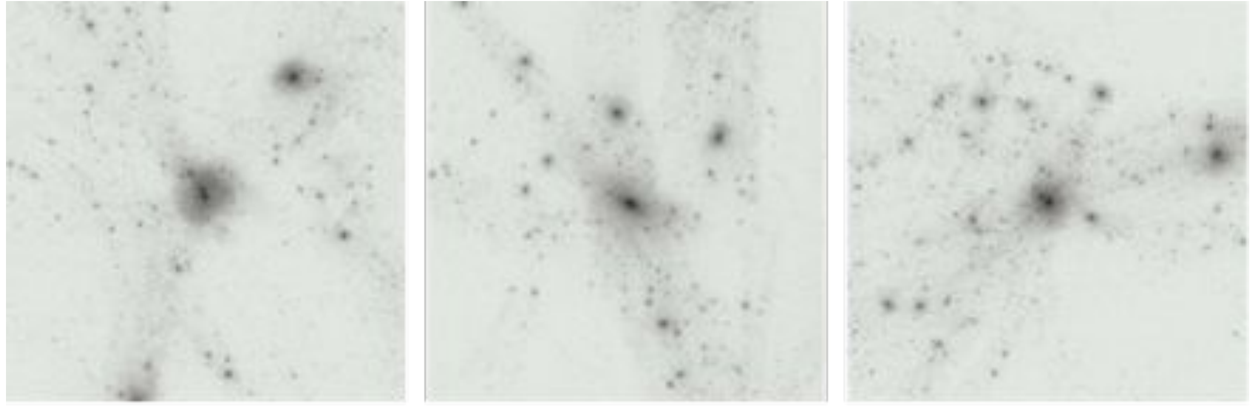
- Is the filamentary structure expected or coincidental?



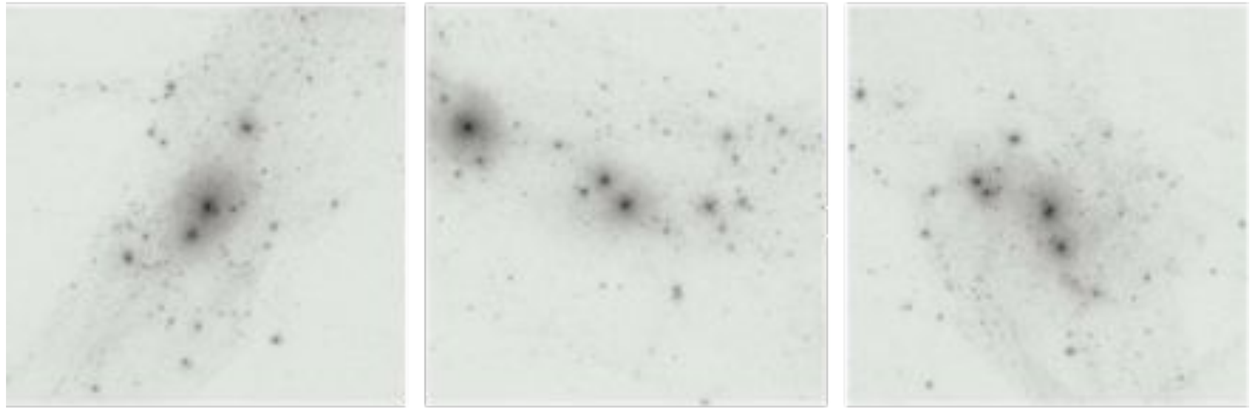
Systems like VGS31

- Selection based on:
  - similar void environment
    (1 Mpc/h smoothed density contrast of $\delta < -0.5$)
  - similar halo mass
    ($<1 \times 10^{11}$ Msun)
  - similar system size
    (<200 kpc/h)

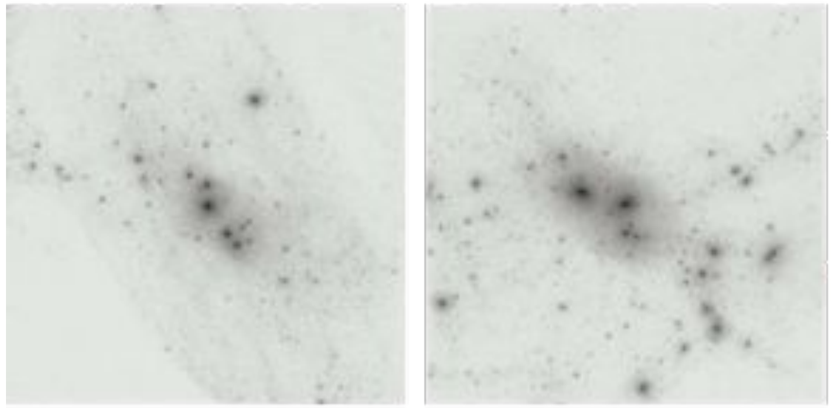
- 8 systems similar to VGS31 in CosmoGrid



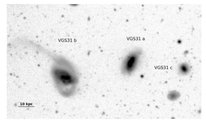
(a) CGV-A (b) CGV-B (c) CGV-C



(d) CGV-D (e) CGV-E (f) CGV-F

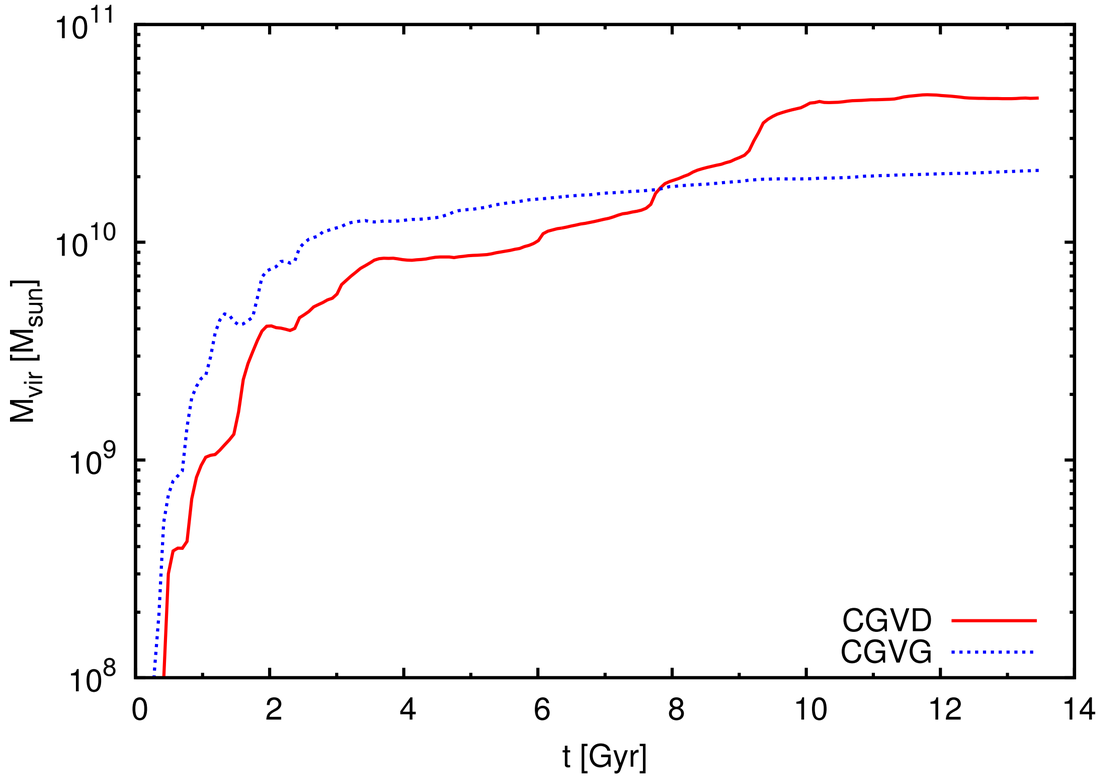


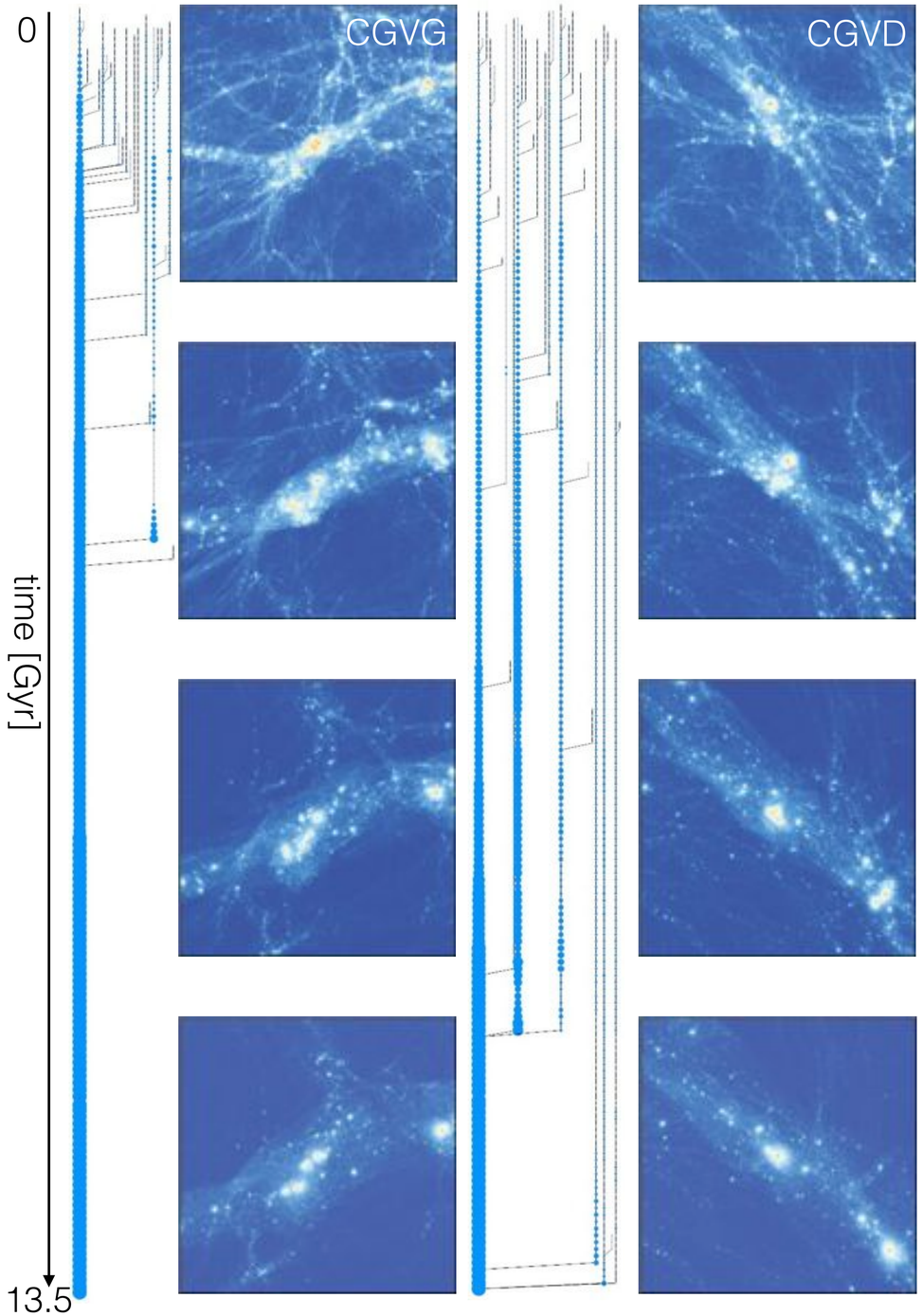
(g) CGV-G (h) CGV-H



VGS31

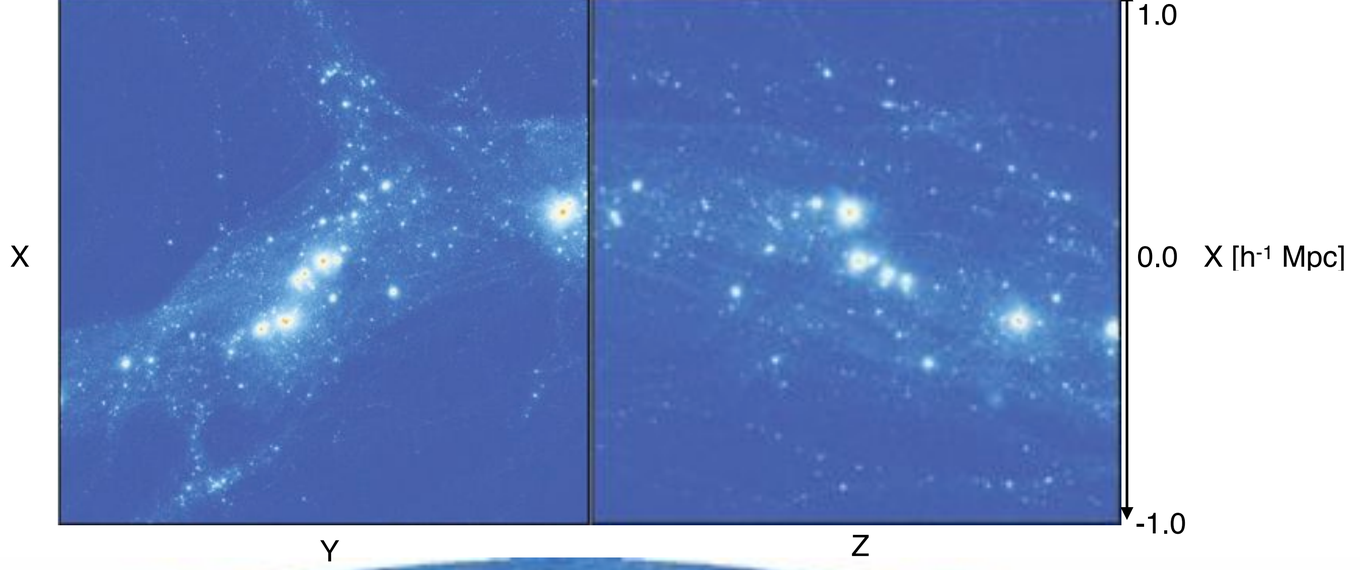
Formation history

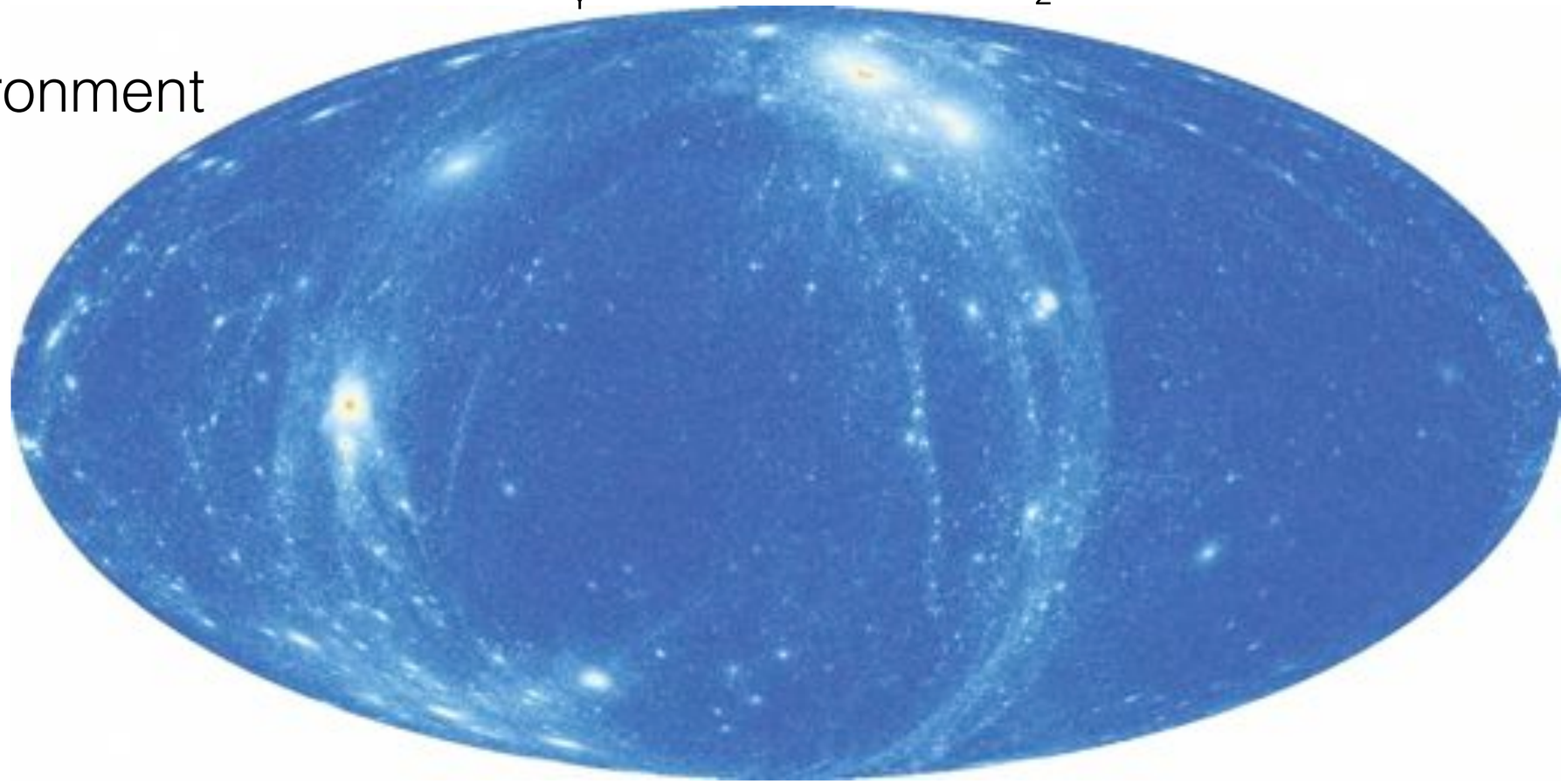




Environment of CGVG

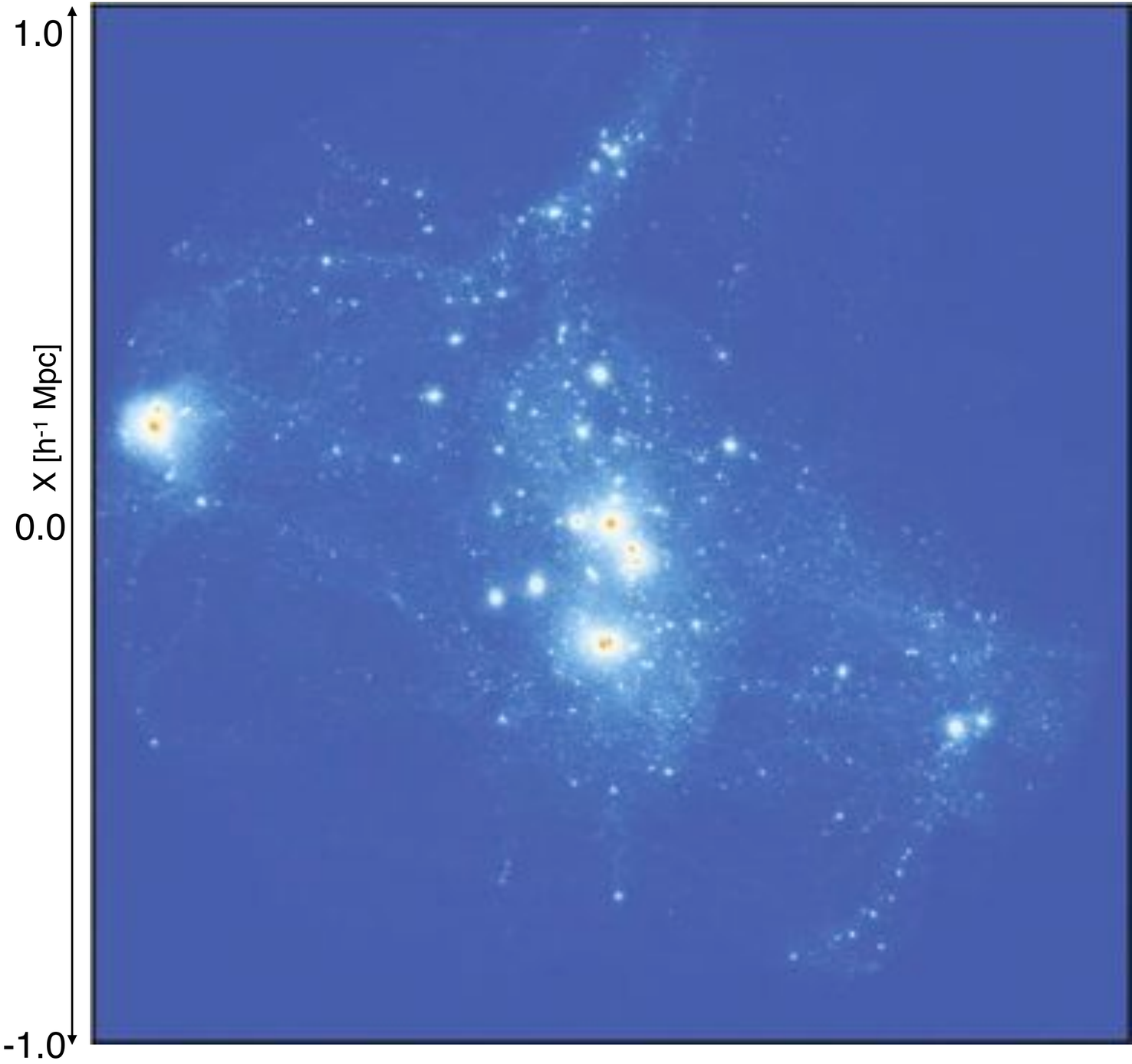
- We see the environment collapse into a wall + filament





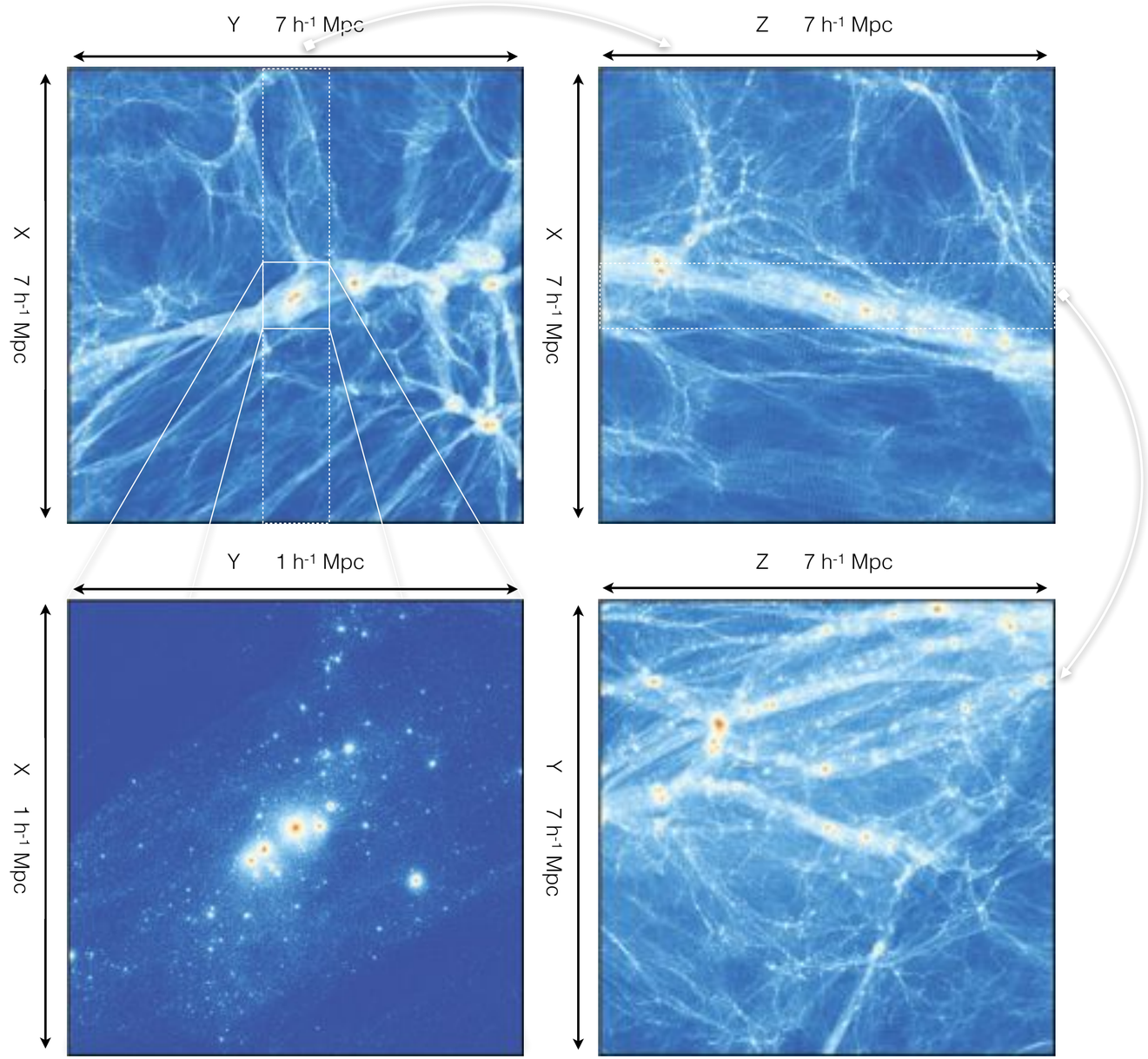
Environment of CGVG

- System is embedded in a filament
- Filament is embedded in a wall



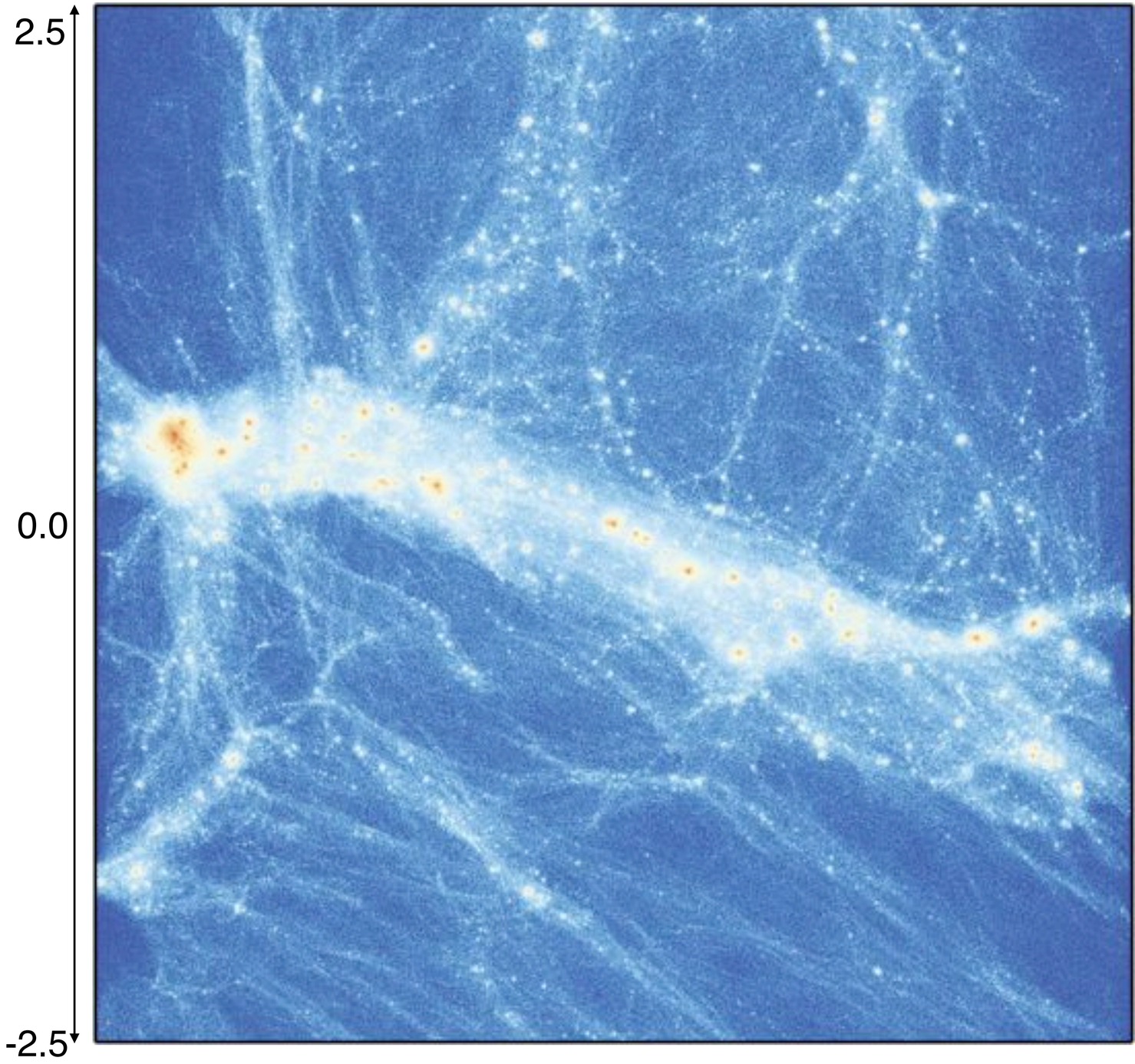
Large scale environment

CGVG



Large-scale environment of CGVG

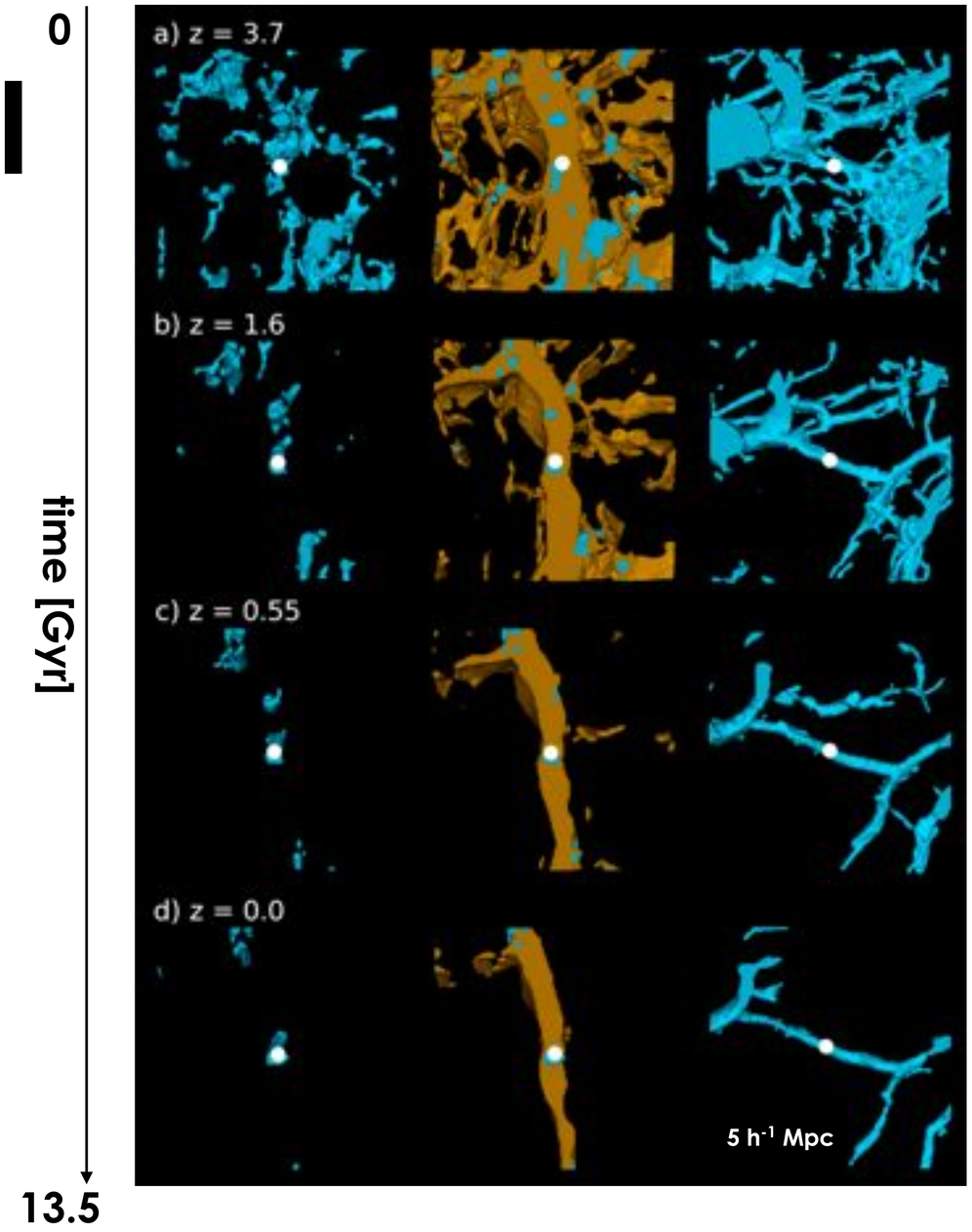
- Filament/wall structure is visible up to a scale of 5Mpc/h
- Tenuous structure still visible outside the wall region



Environmental evolution

- *Nexus+* (Cautun et al 2013) environmental analysis
- Blue: filaments,
  Orange: walls

- All void halo groups form in tenuous wall, most also in a thin filament



The cosmic web in CosmoGrid void regions - summary:

- Halo groups in voids form along tenuous filaments
- These filaments are embedded in walls
- Towards z=0, structure in the voids becomes more tenuous