Zeldovich and Adhesion approximations and the *real* Universe

IAU S308 “the Zeldovich Universe”

23/06/2014

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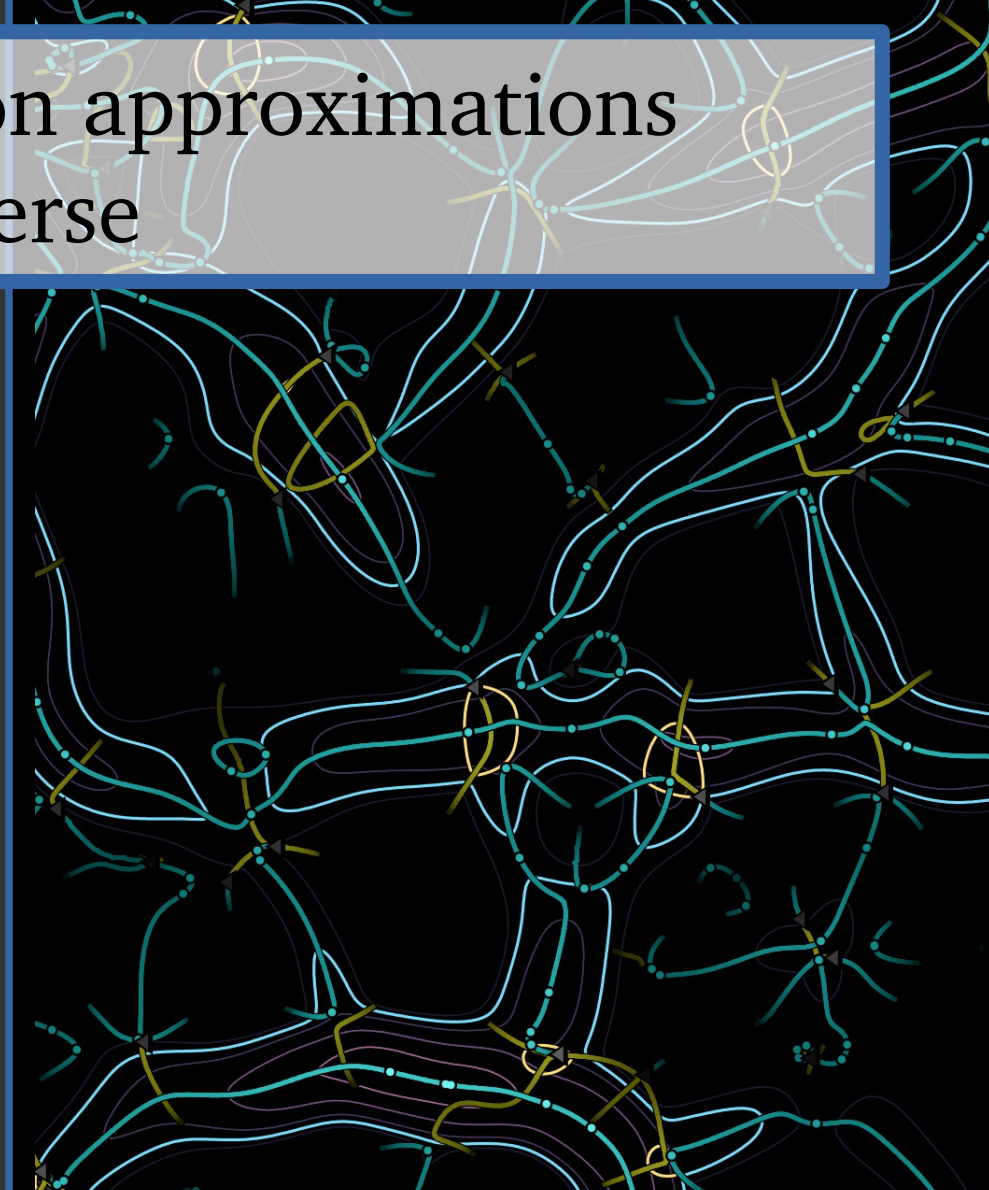
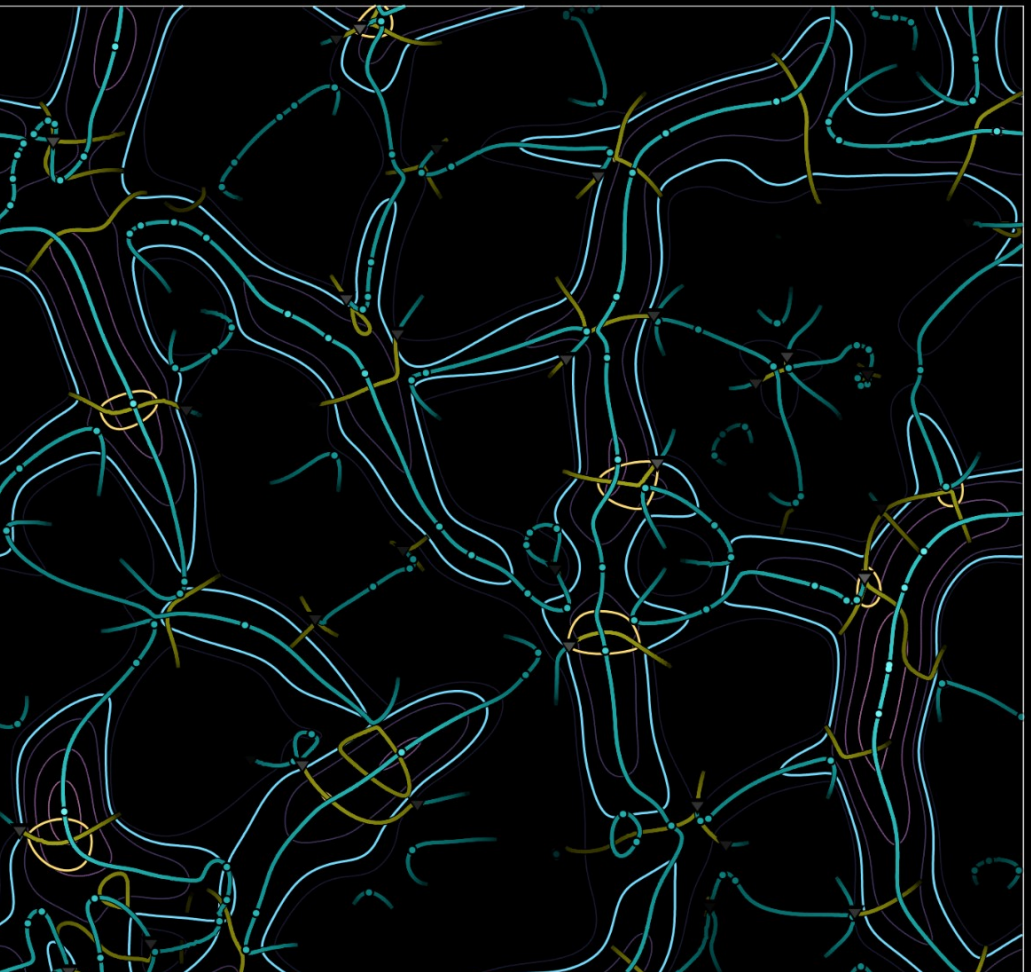
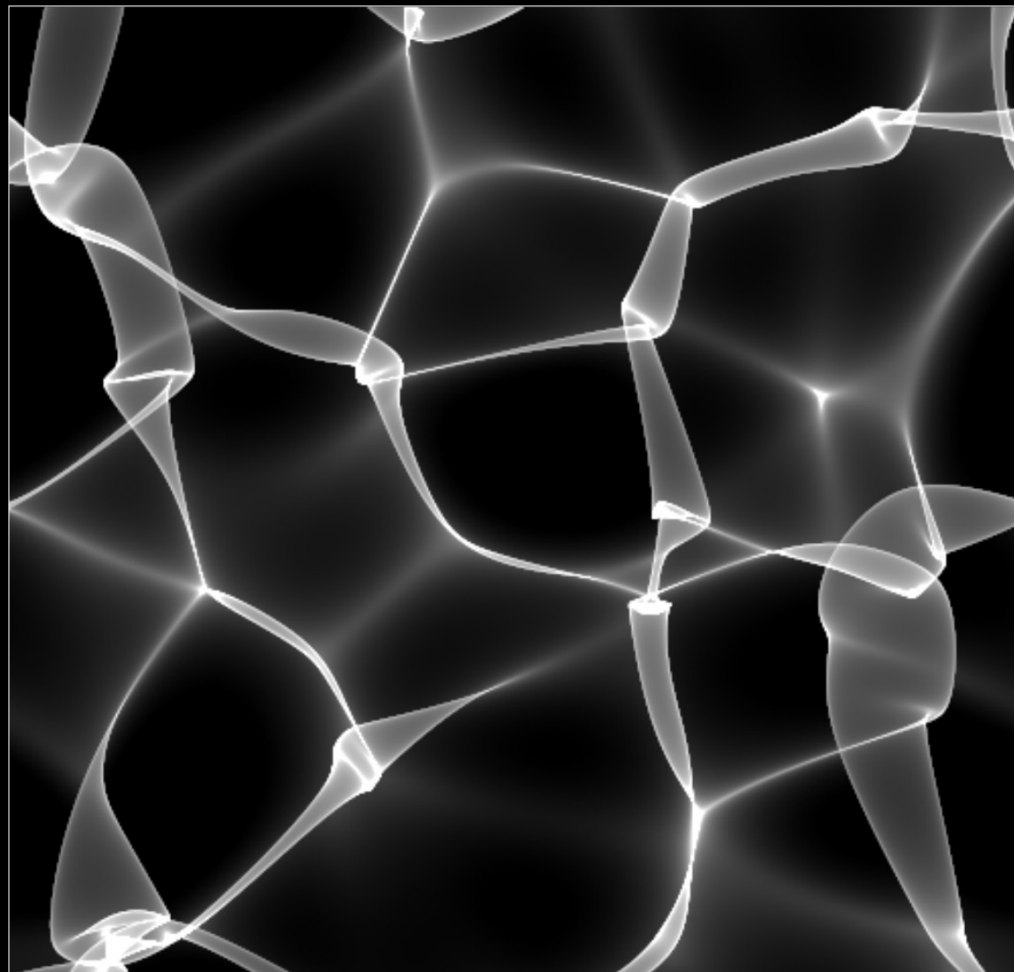


Lagrangian space

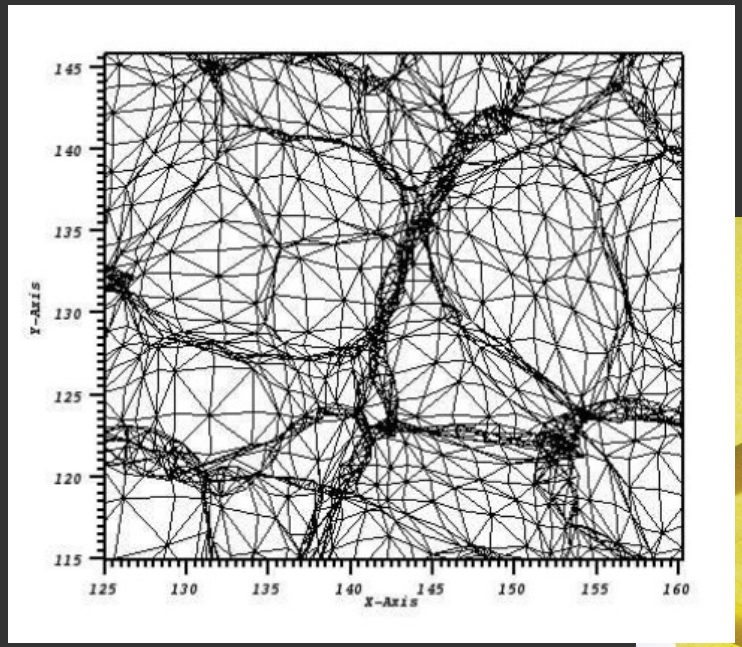
A_3-lines

Eulerian space



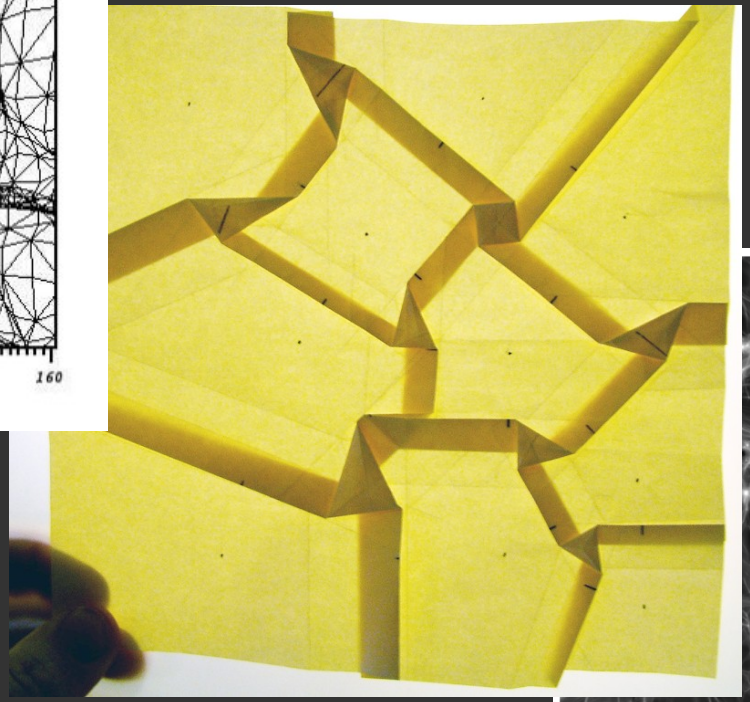


Phase-space

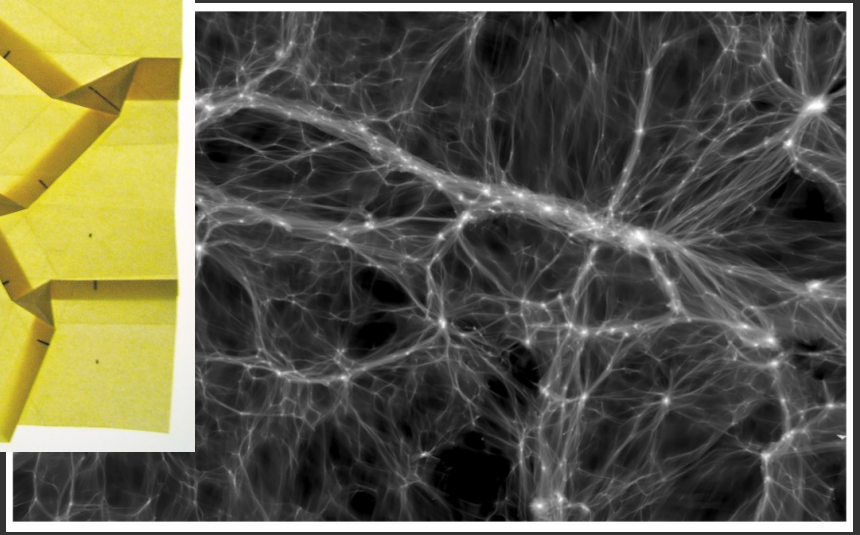


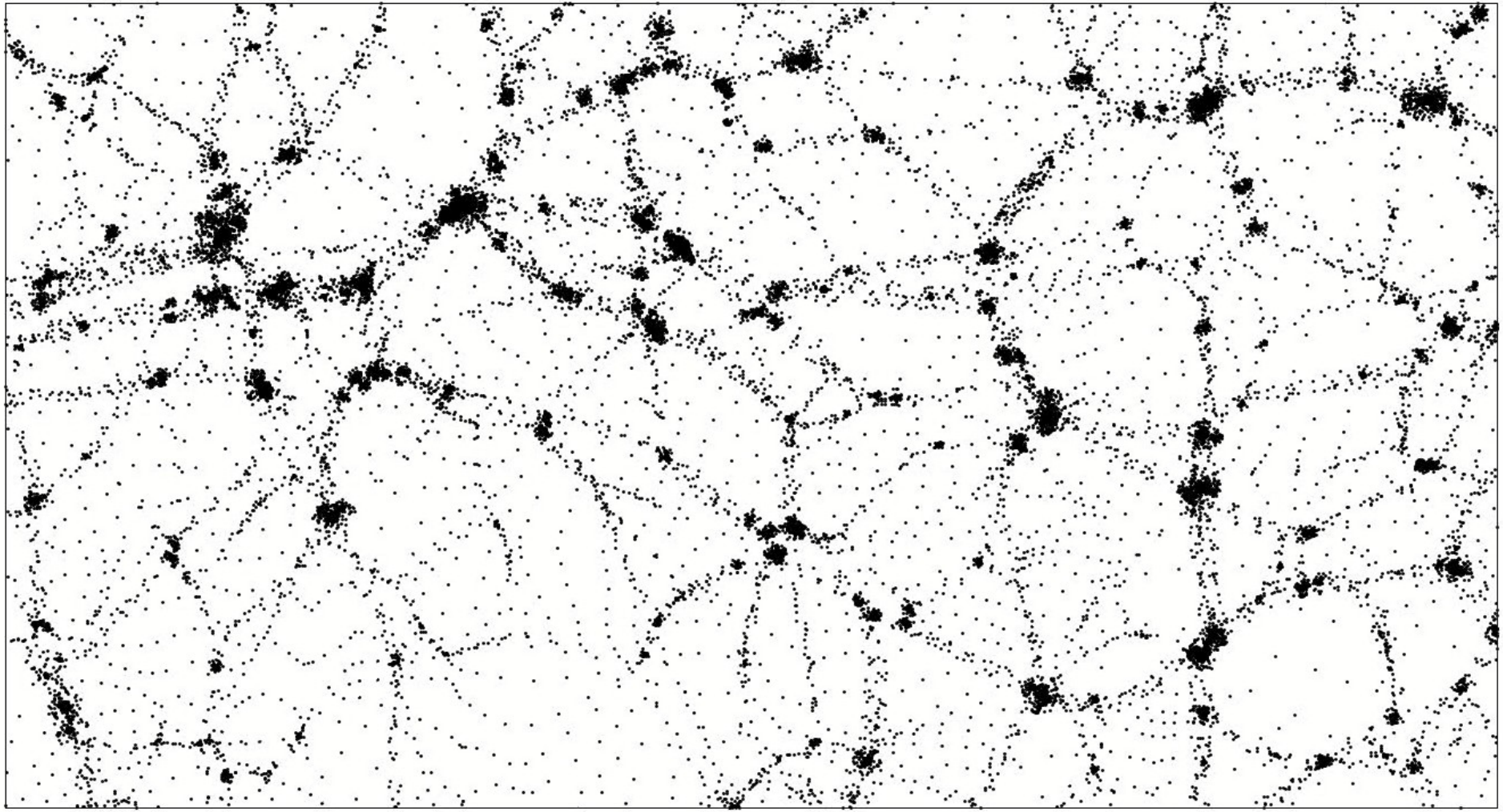
Shandarin et al. (2012)

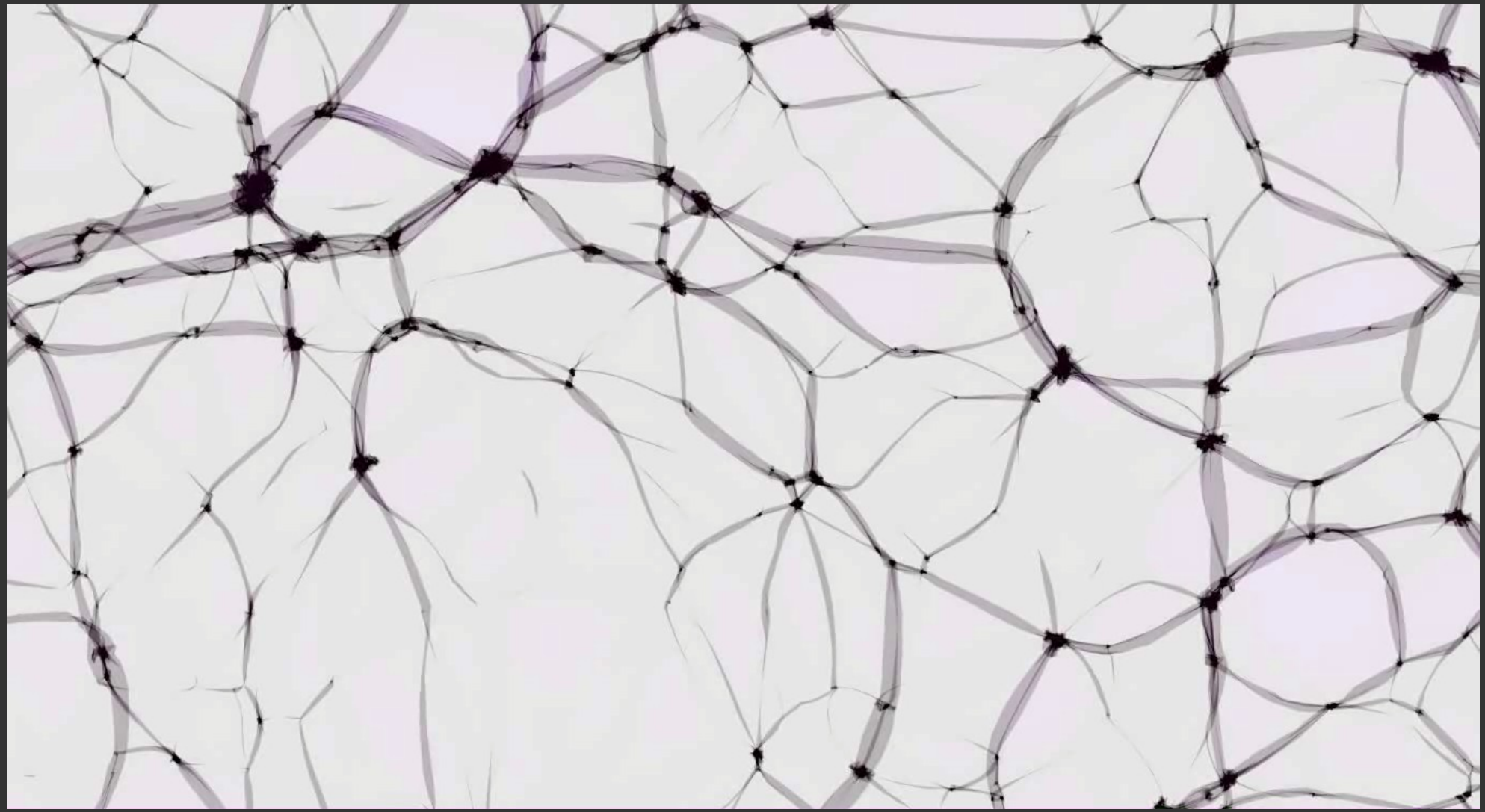
Neyrinck et al. (2012)

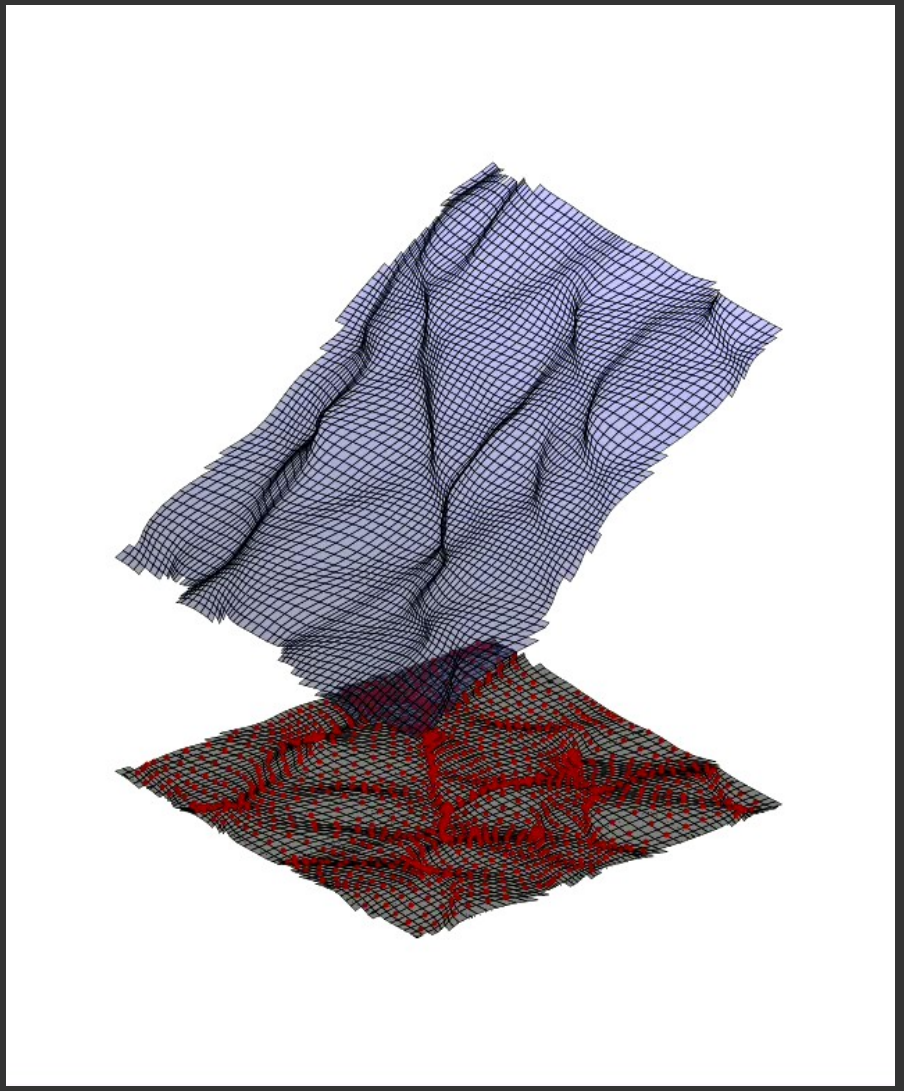


Abel et al. (2012)





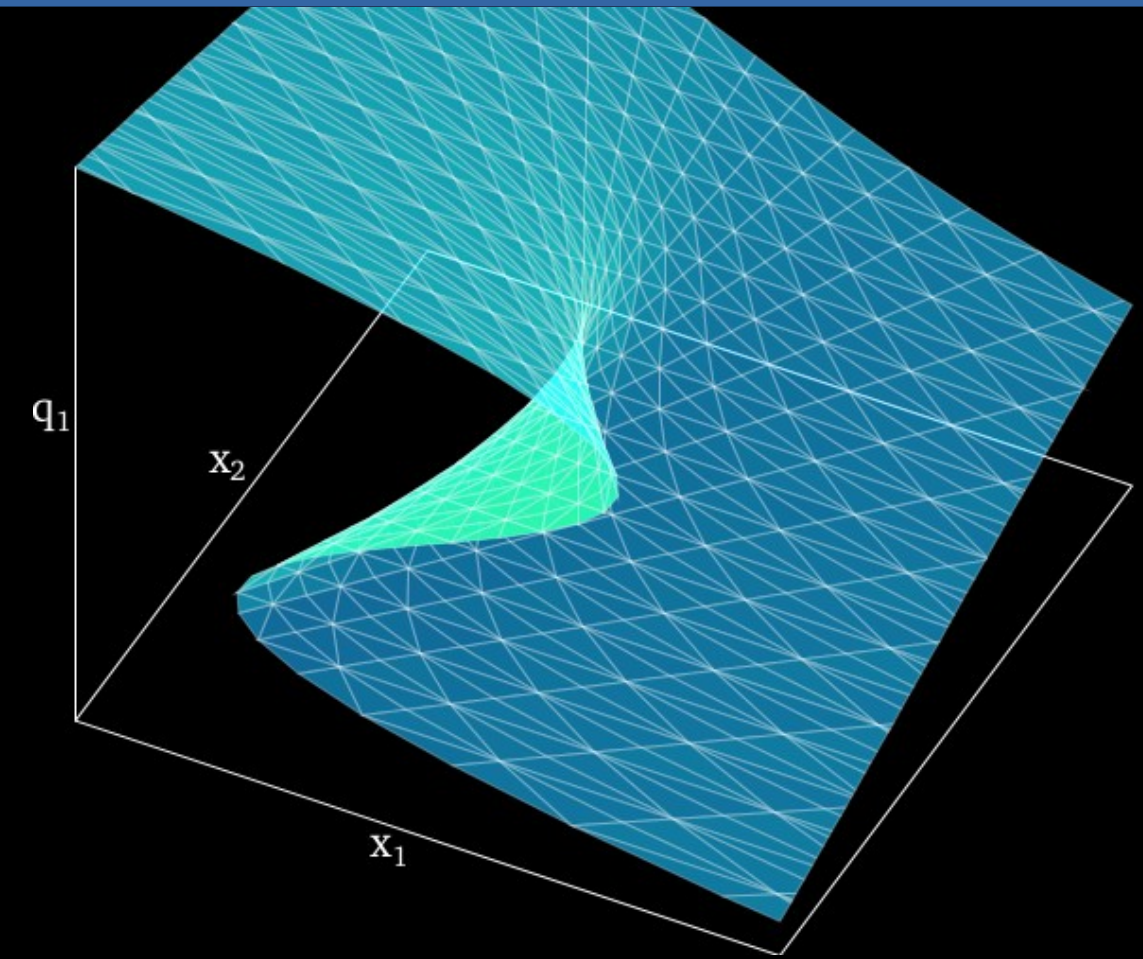


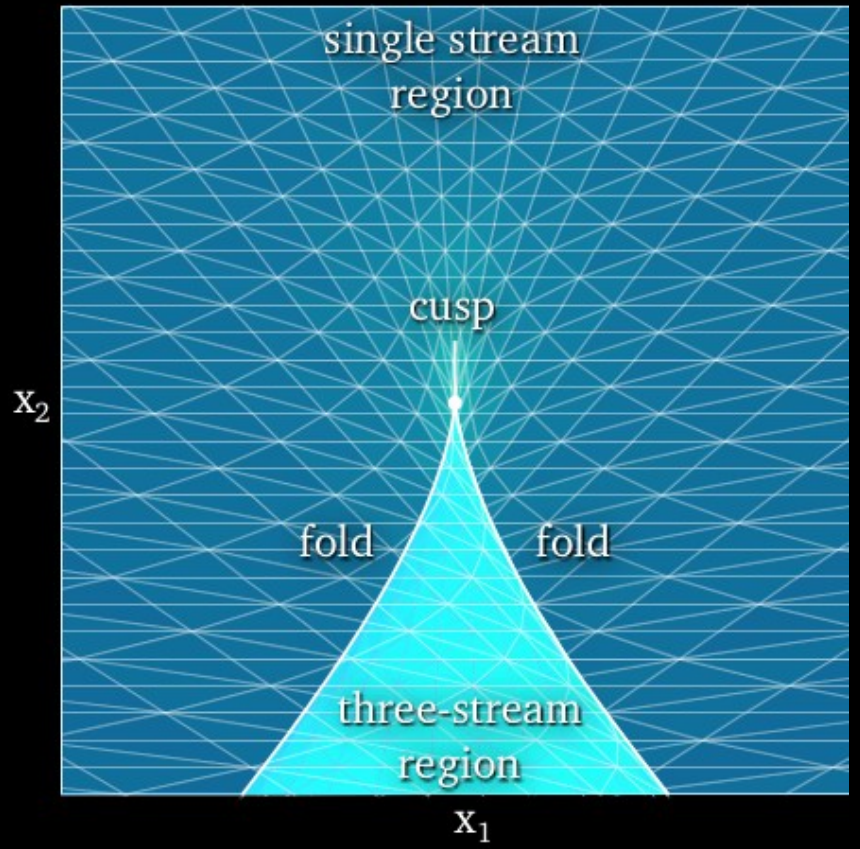


- Use Lagrangian continuity to trace the folds in phase-space
- Classify different types of potential *flow*

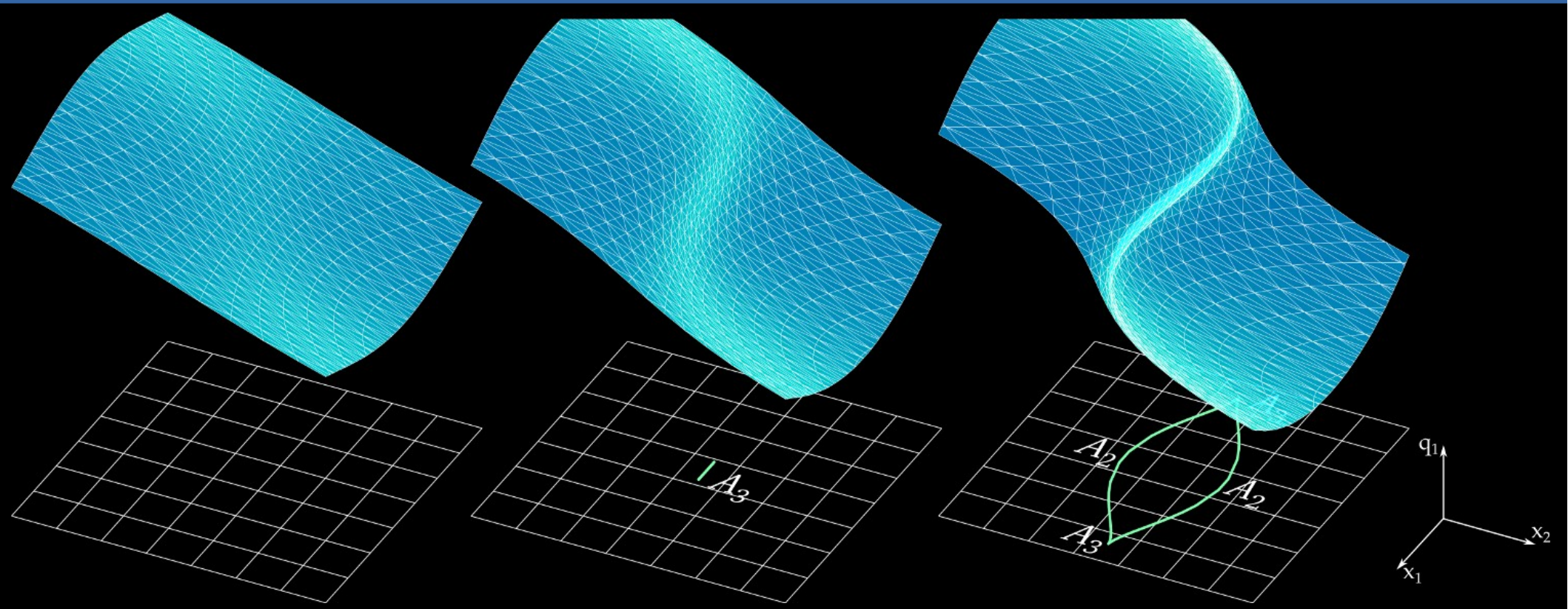
$$x = q - D\nabla\Phi$$

Mathematics of folds in phase-space

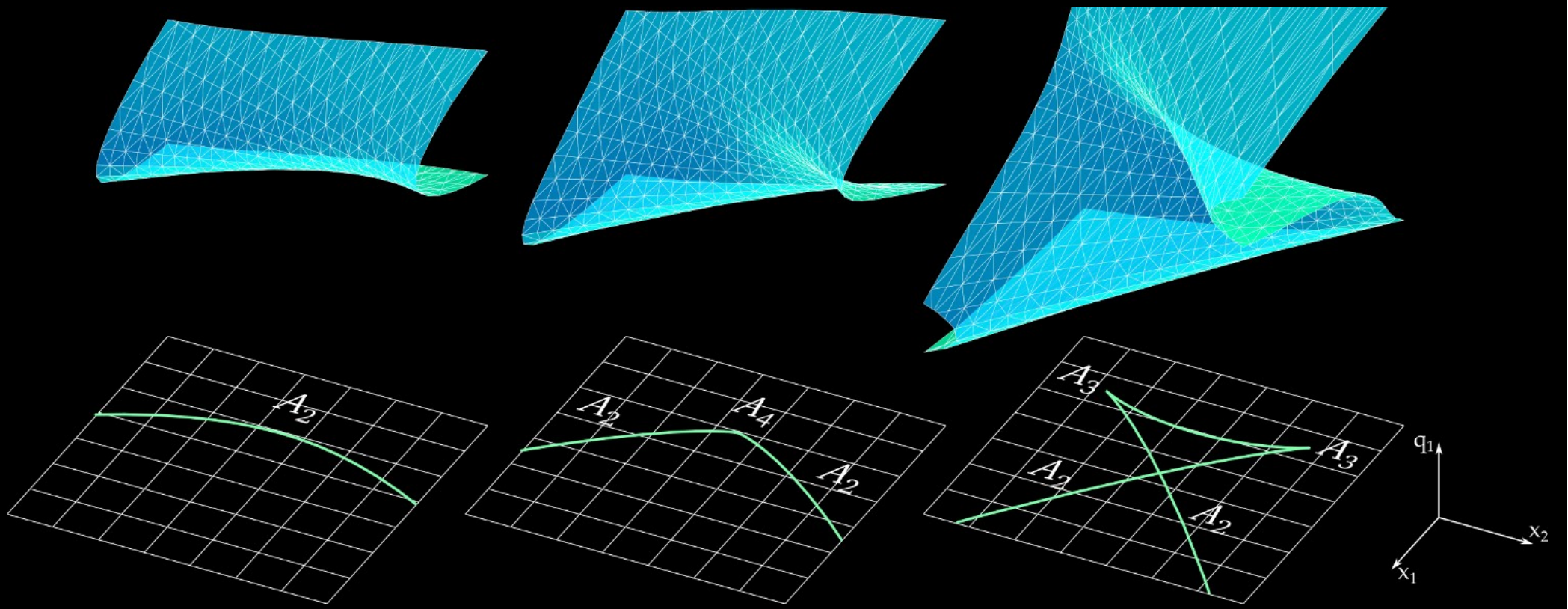




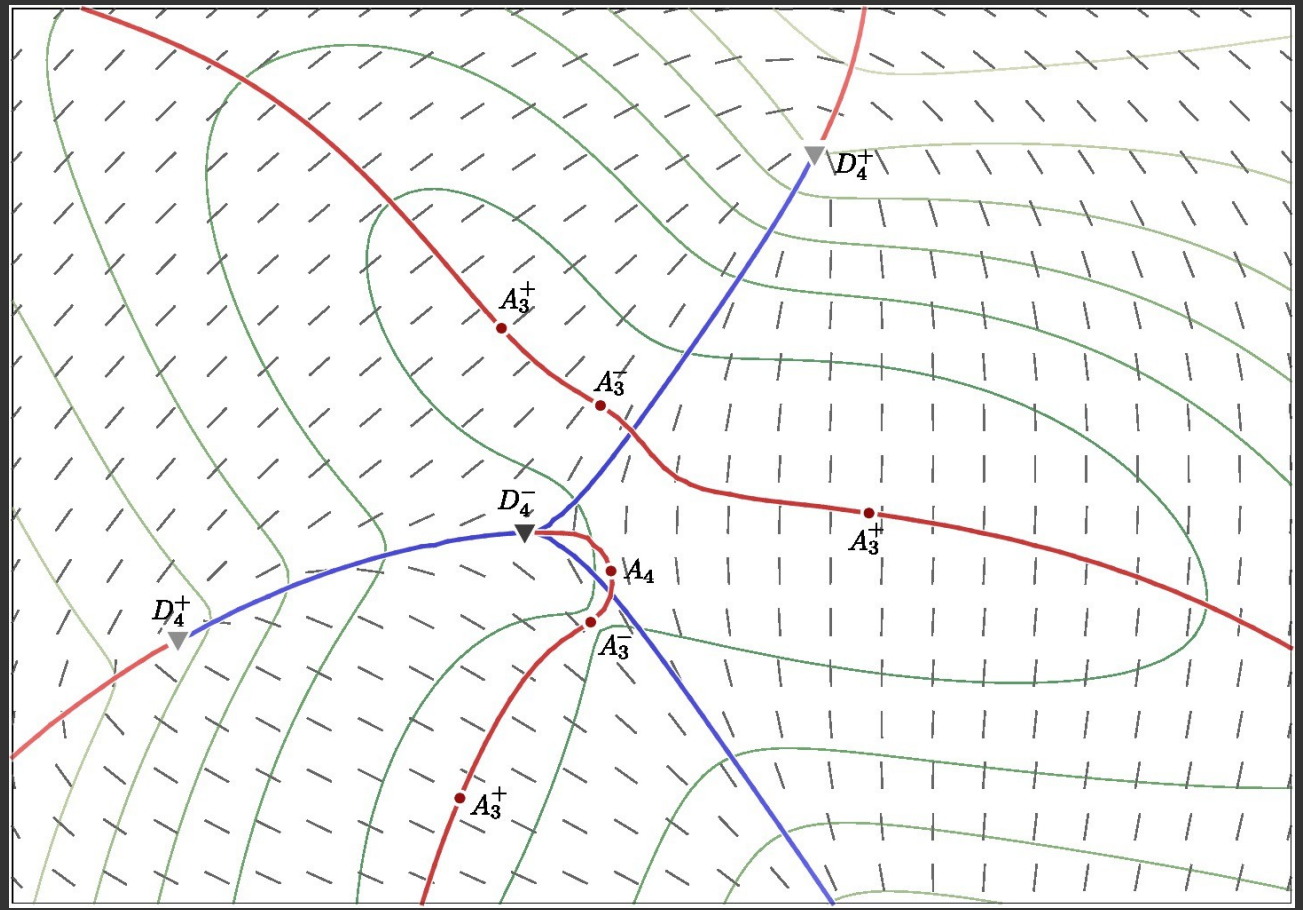
Mathematics of folds in phase-space



Mathematics of folds in phase-space



Catastrophe Theory



- Identify critical lines in tensor field
- A_3 – lines

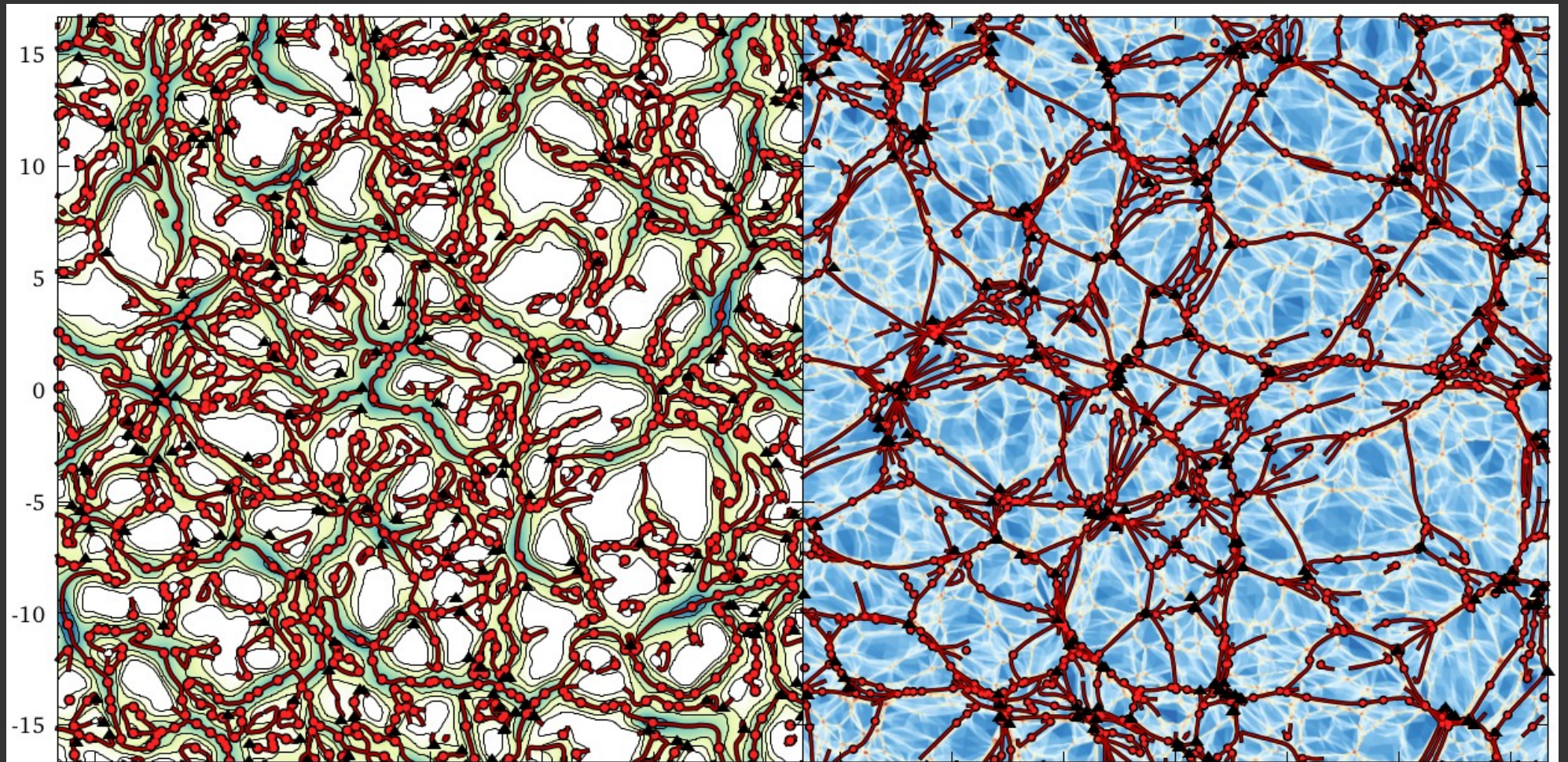
$$\nabla \lambda . e_\lambda = 0$$

Arnold, Zeldovich & Shandarin (1982)

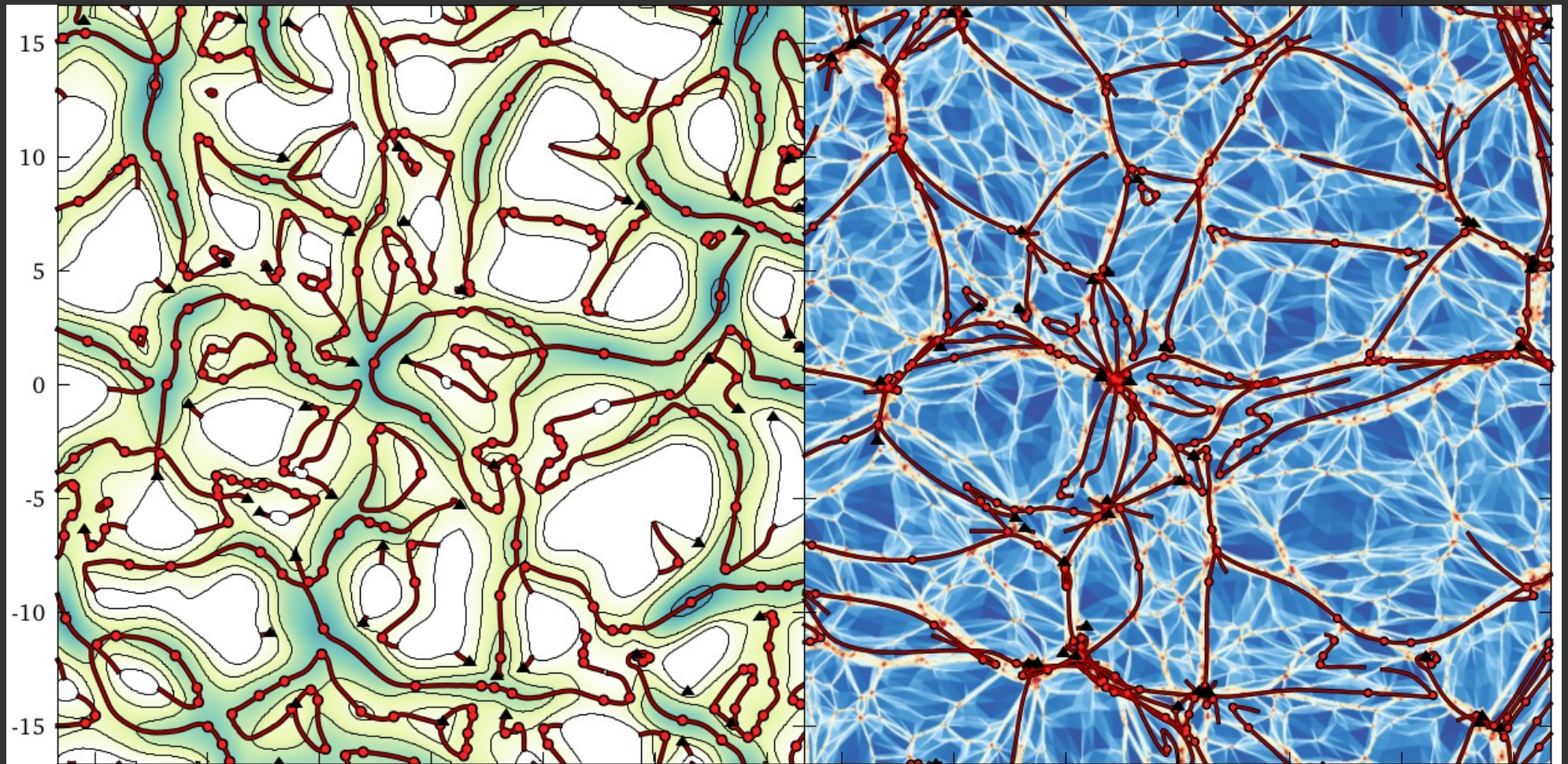
Arnold (1986)

Hidding, Shandarin & van de Weygaert (2014)

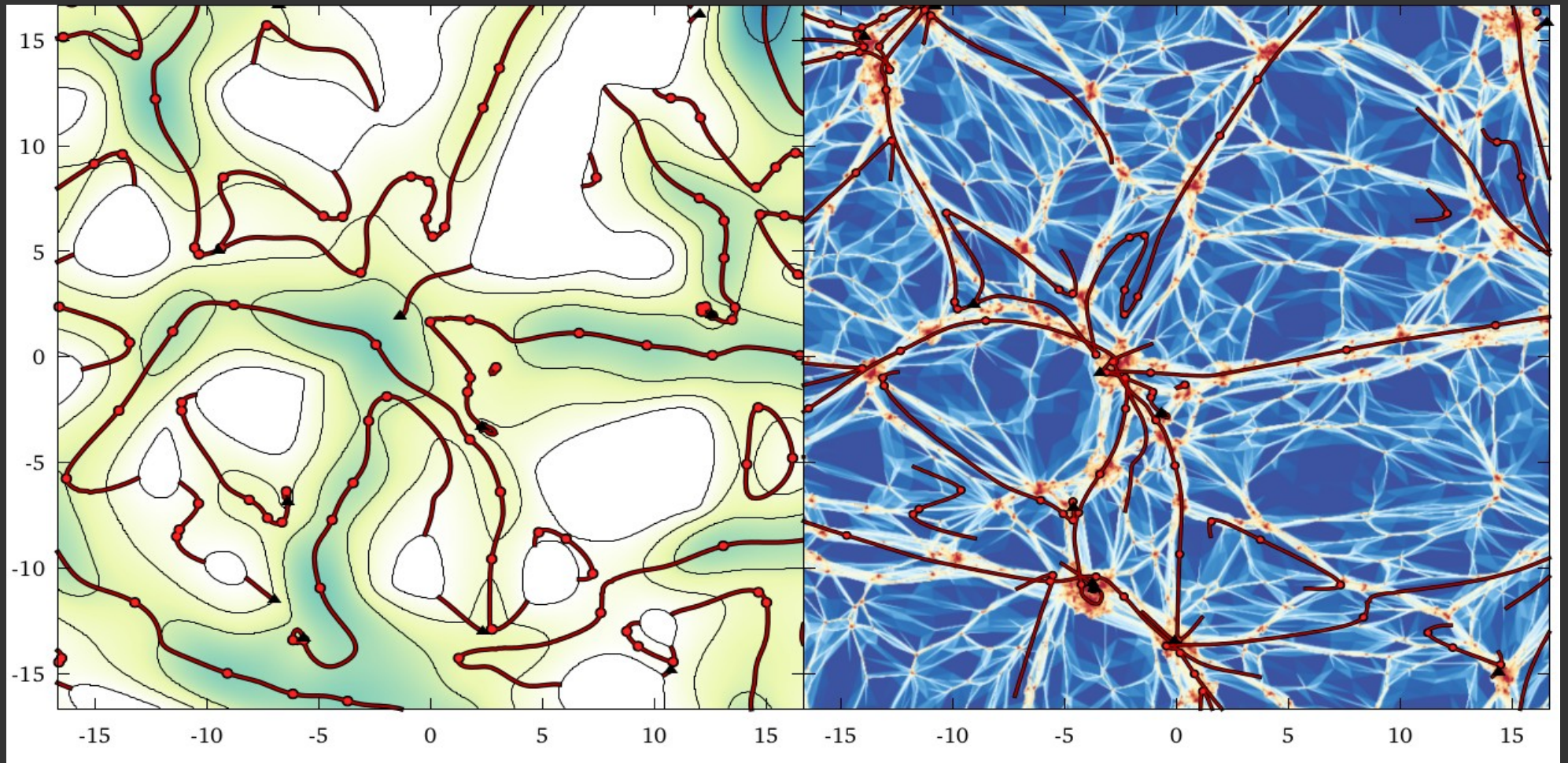
A_3-lines and N-body simulation

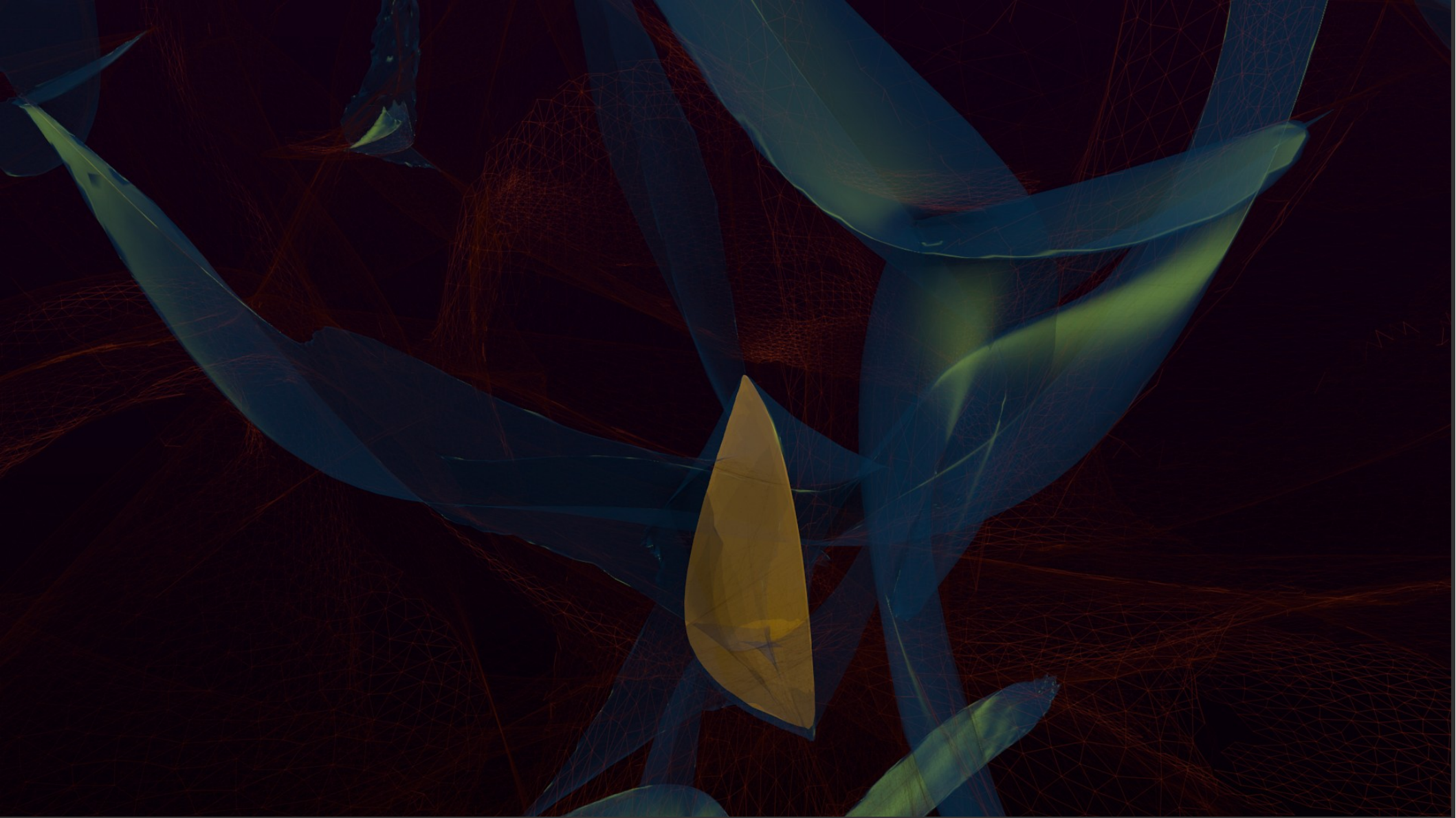


A_3-lines and N-body simulation



A_3-lines and N-body simulation





Adhesion

- Zeldovich

$$\partial_t u + (u.\nabla)u = 0$$

- Adhesion

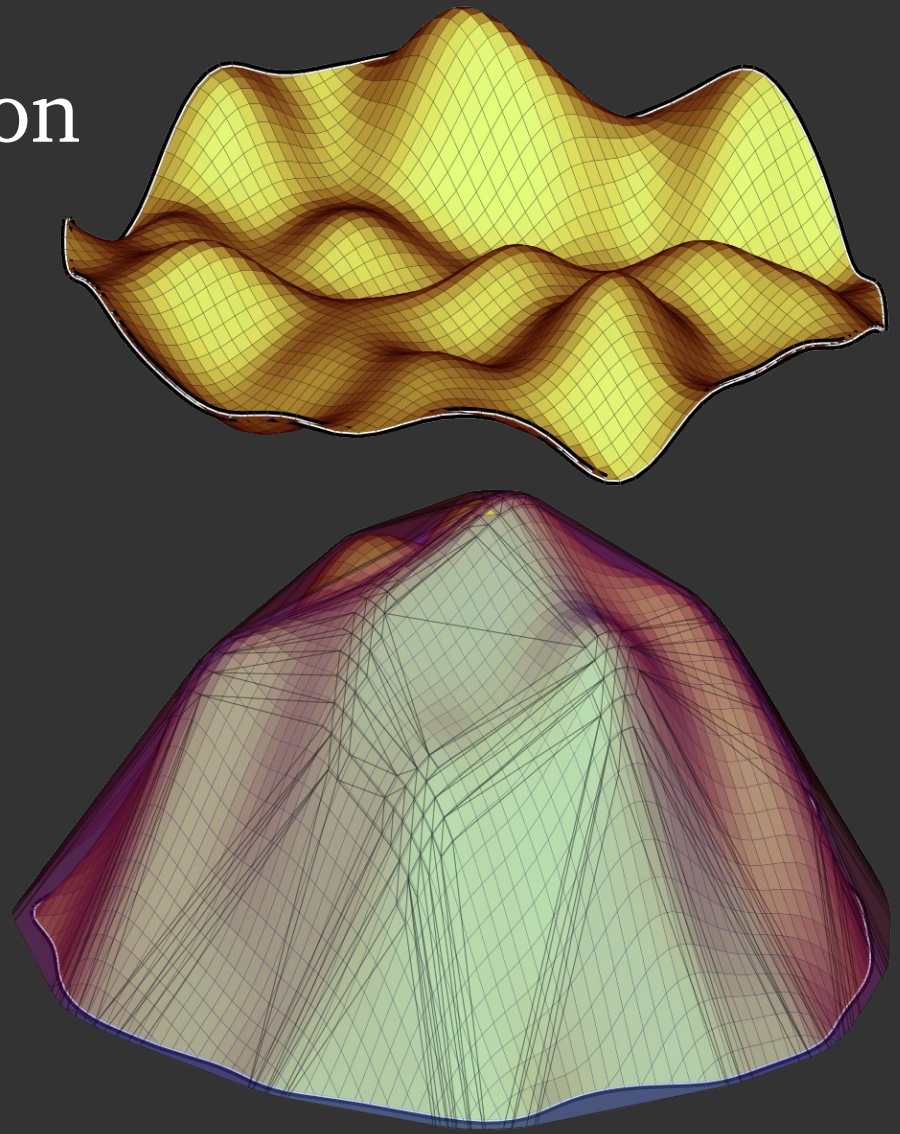
$$\partial_t u + (u.\nabla)u = \nu \nabla^2 u$$

Saichev & Gurbatov (1984)

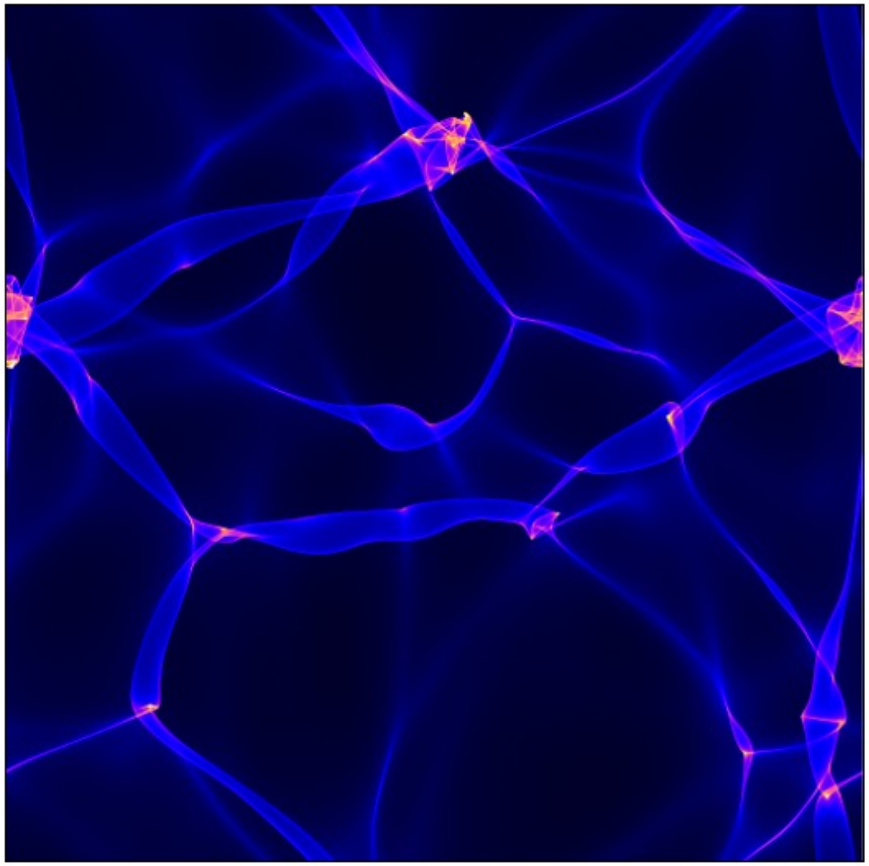
Shandarin & Zeldovich (1989)

...

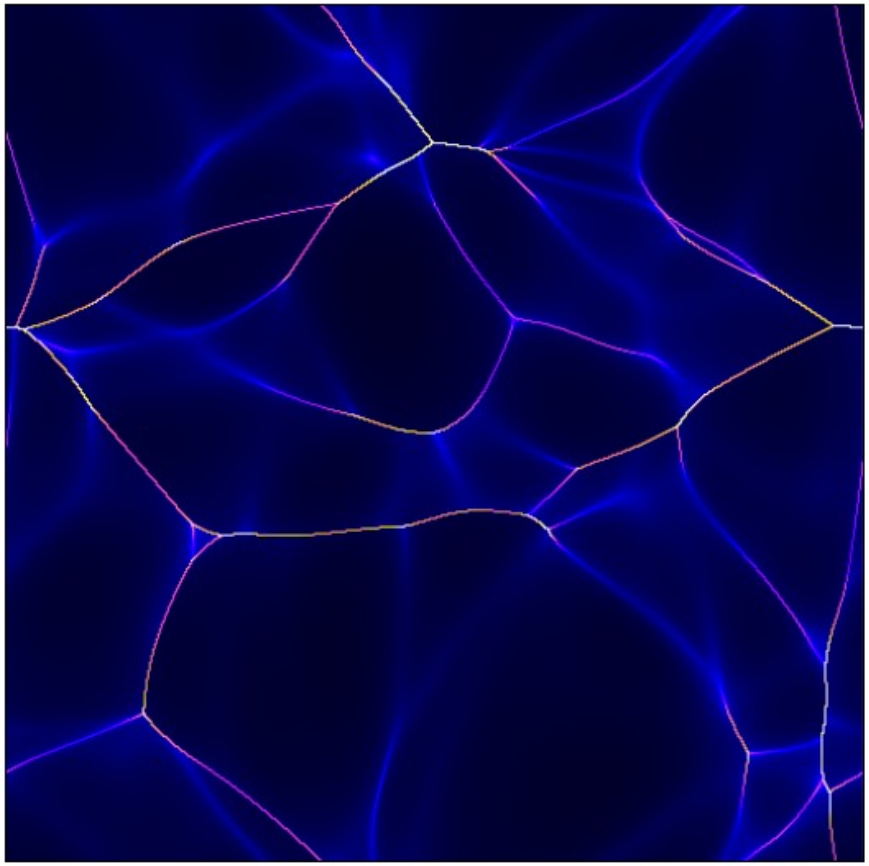
Hidding et al. (2014) in prep.



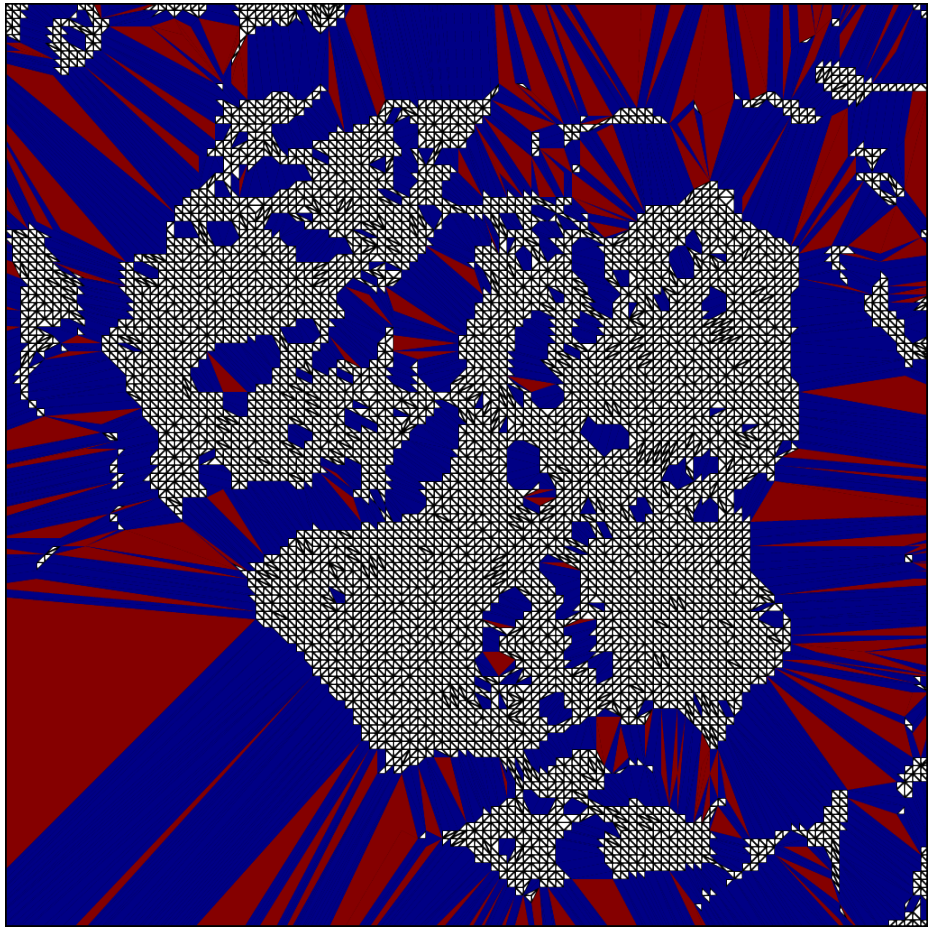
Zeldovich

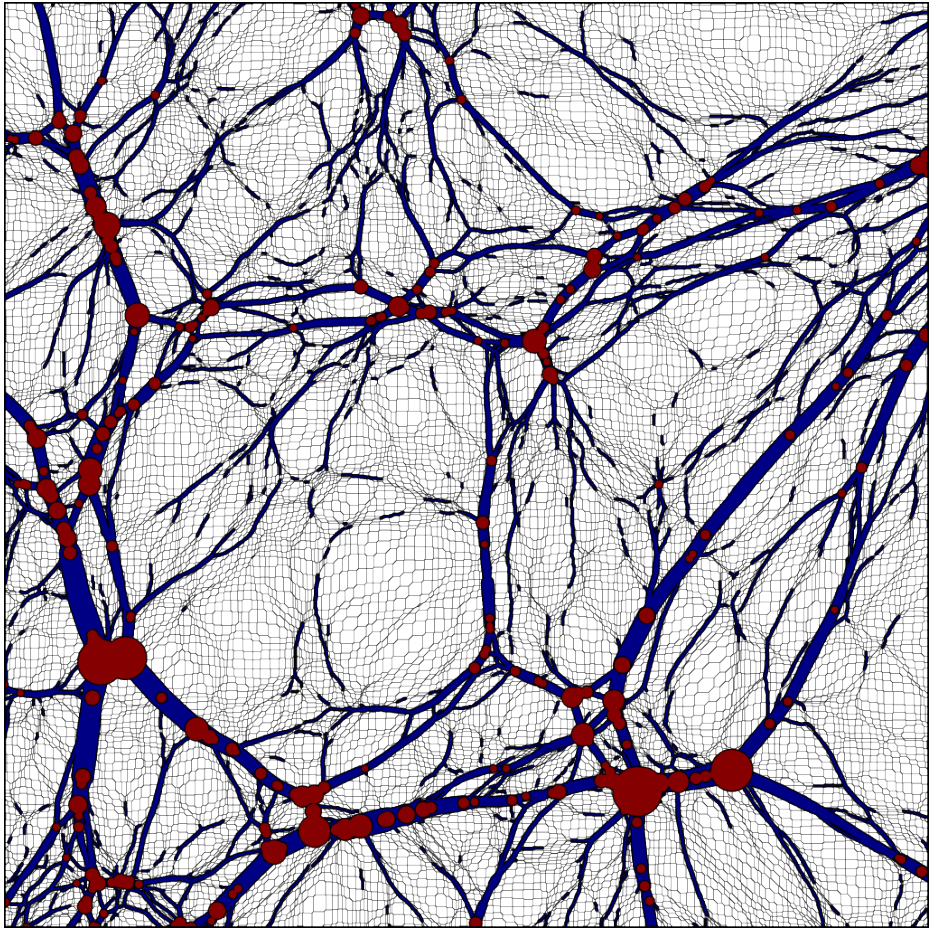


Adhesion

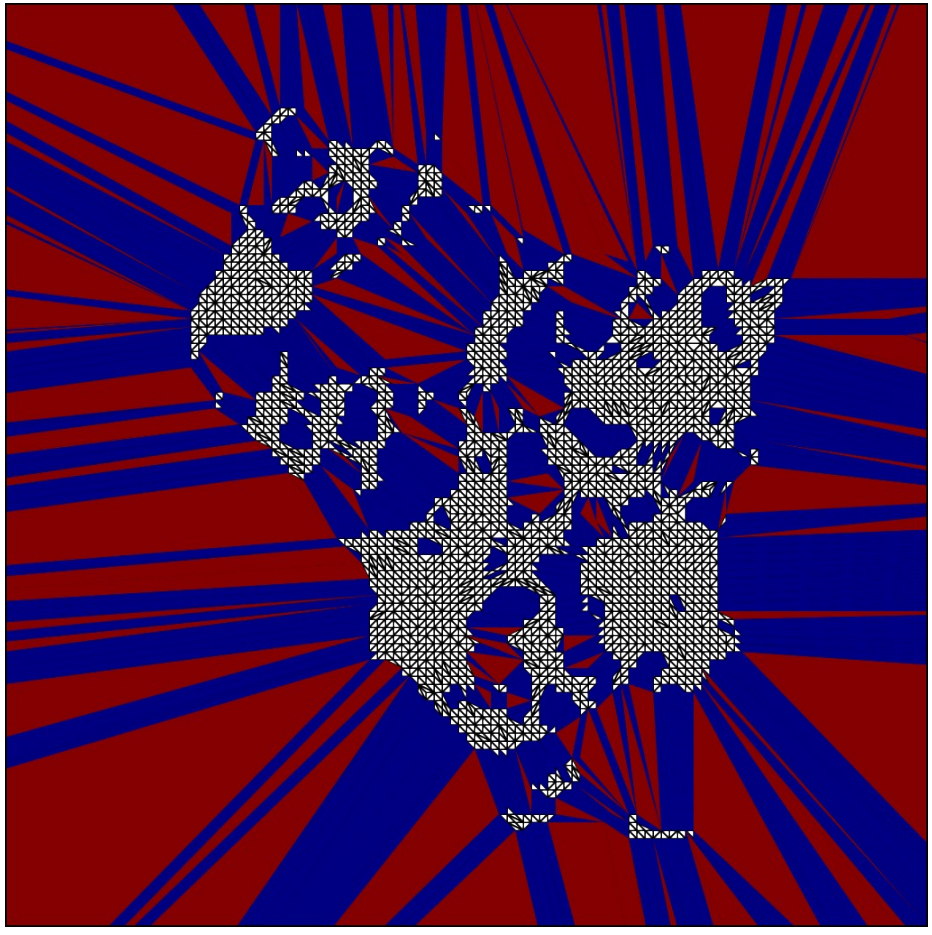


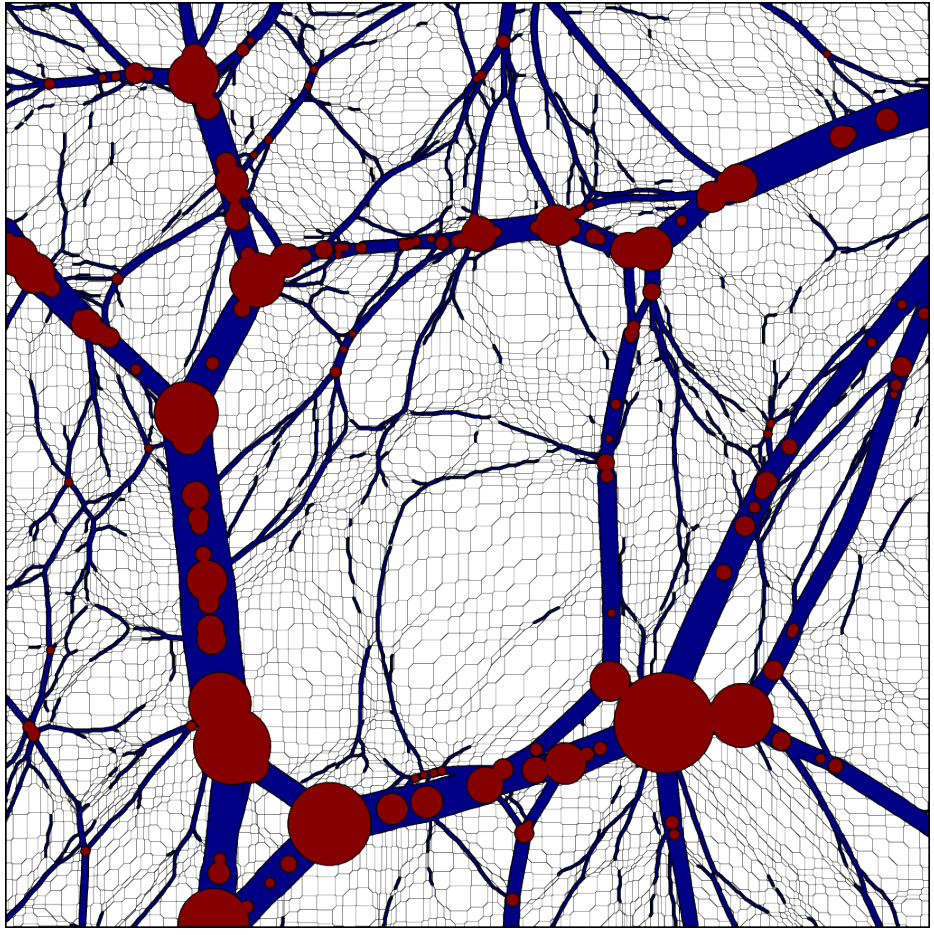
Duality between Lagrangian and Eulerian space

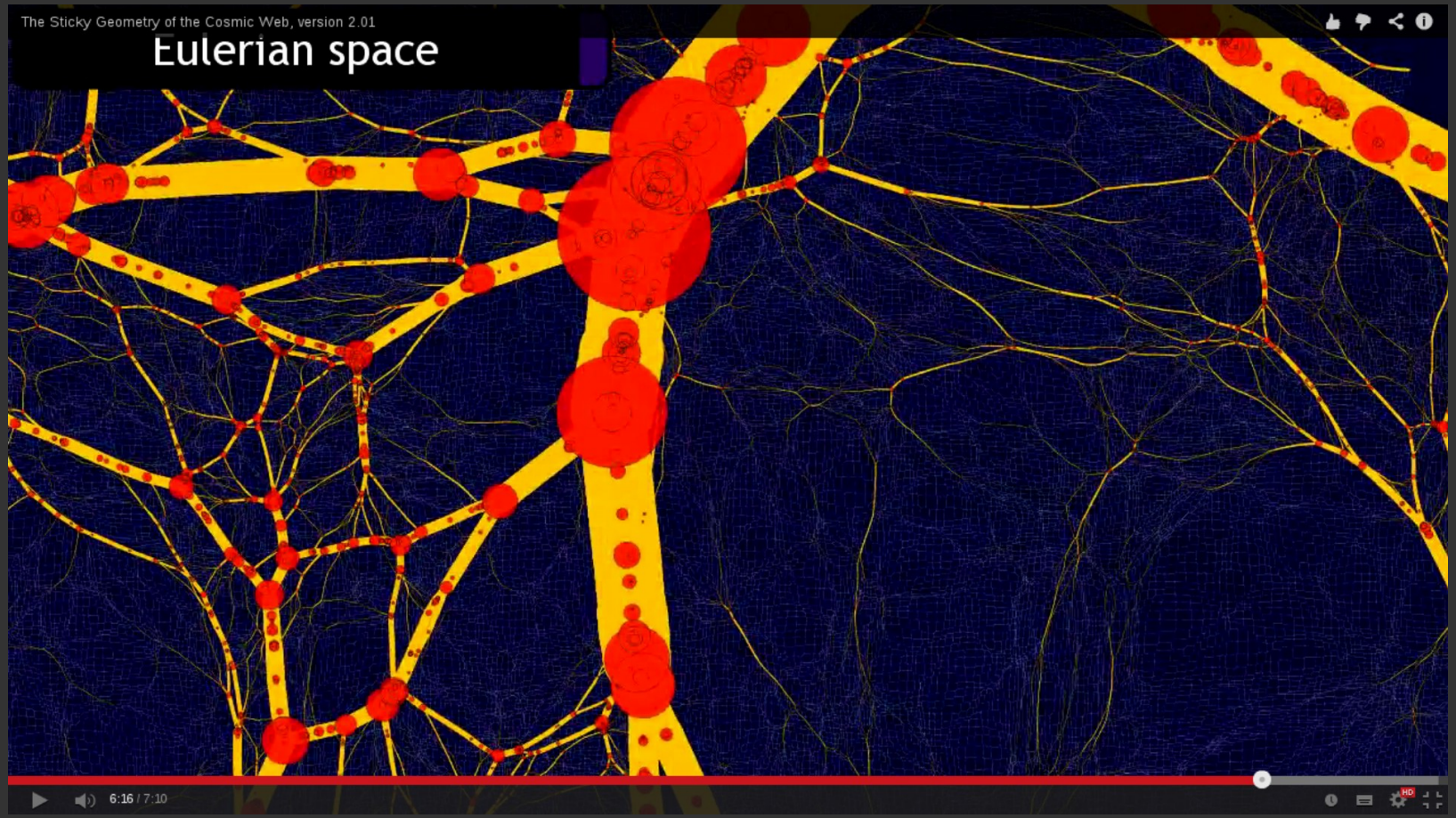




Duality between Lagrangian and Eulerian space

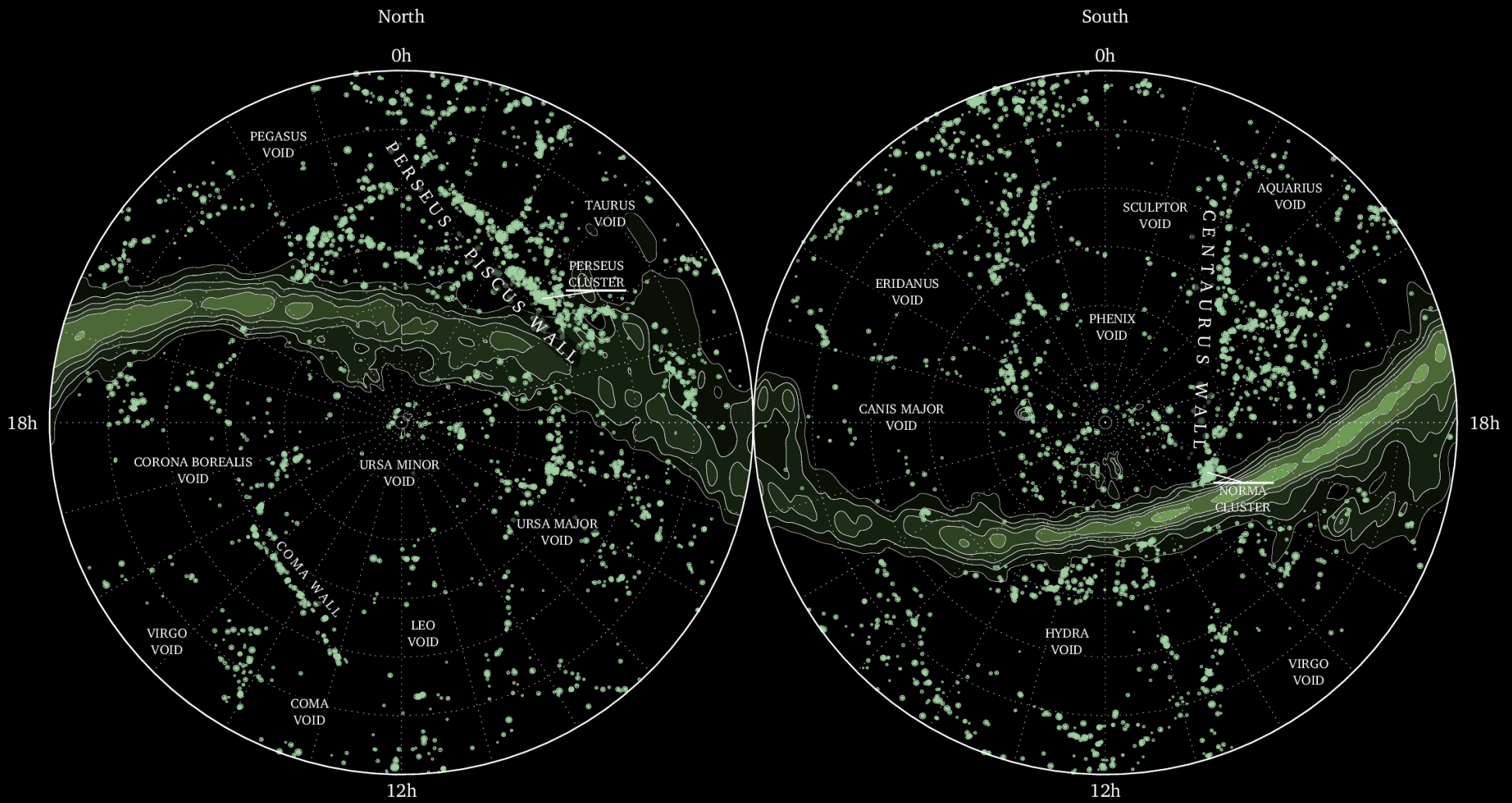






http://youtu.be/wI12X2zczqI
(or search: Geometry of Cosmic Web)

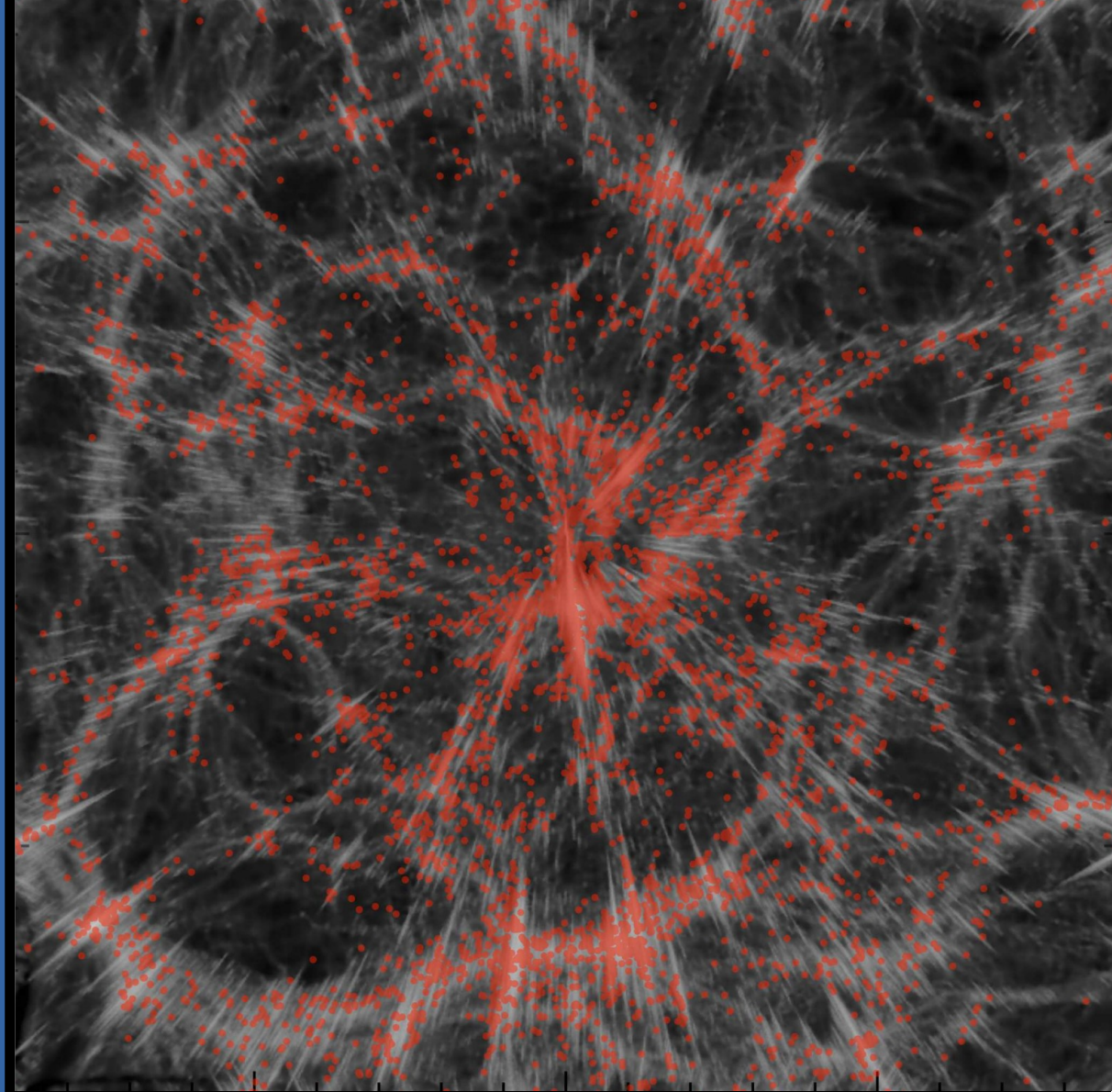
2MRS – Huchra et al. (2012)

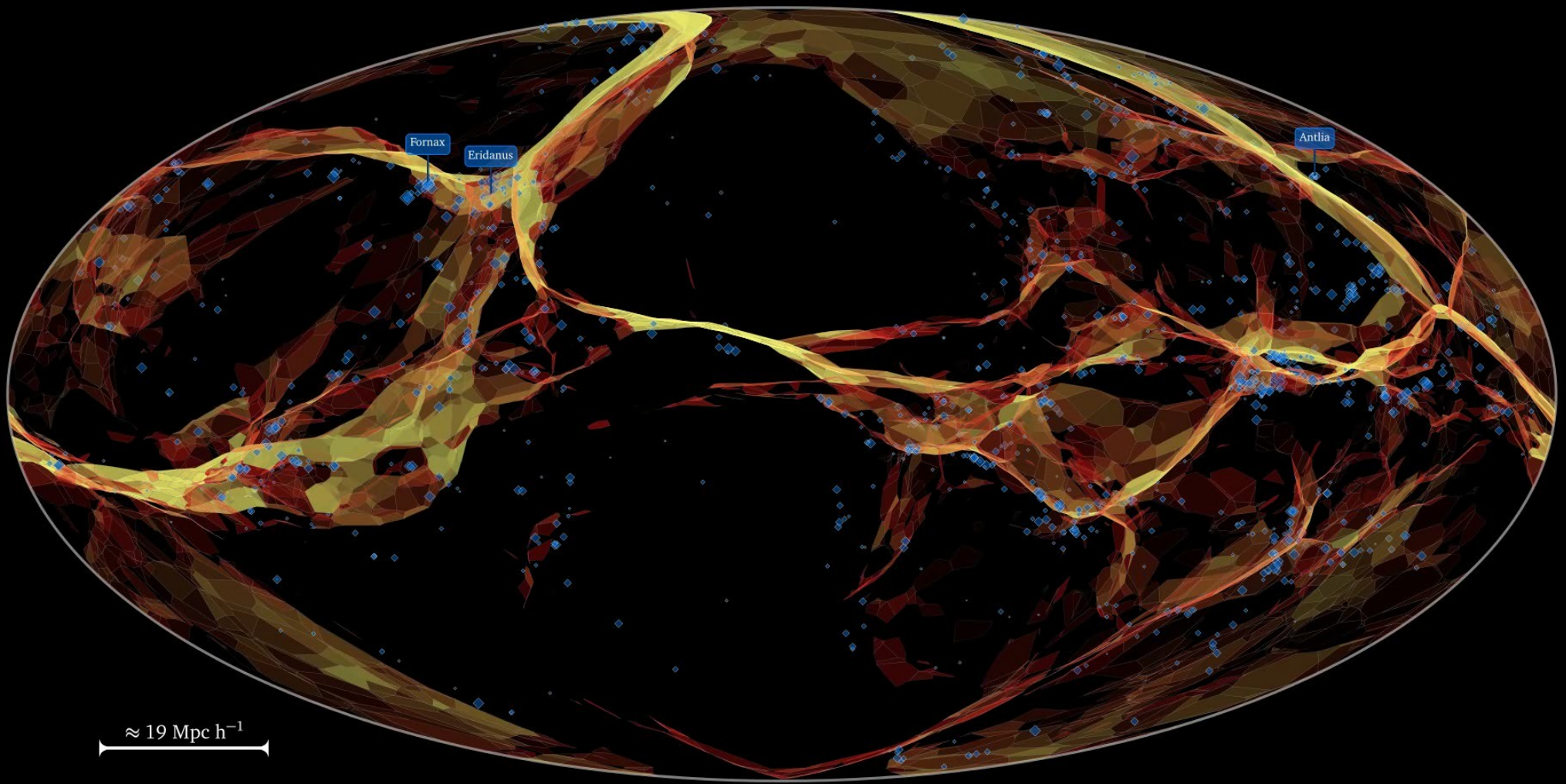


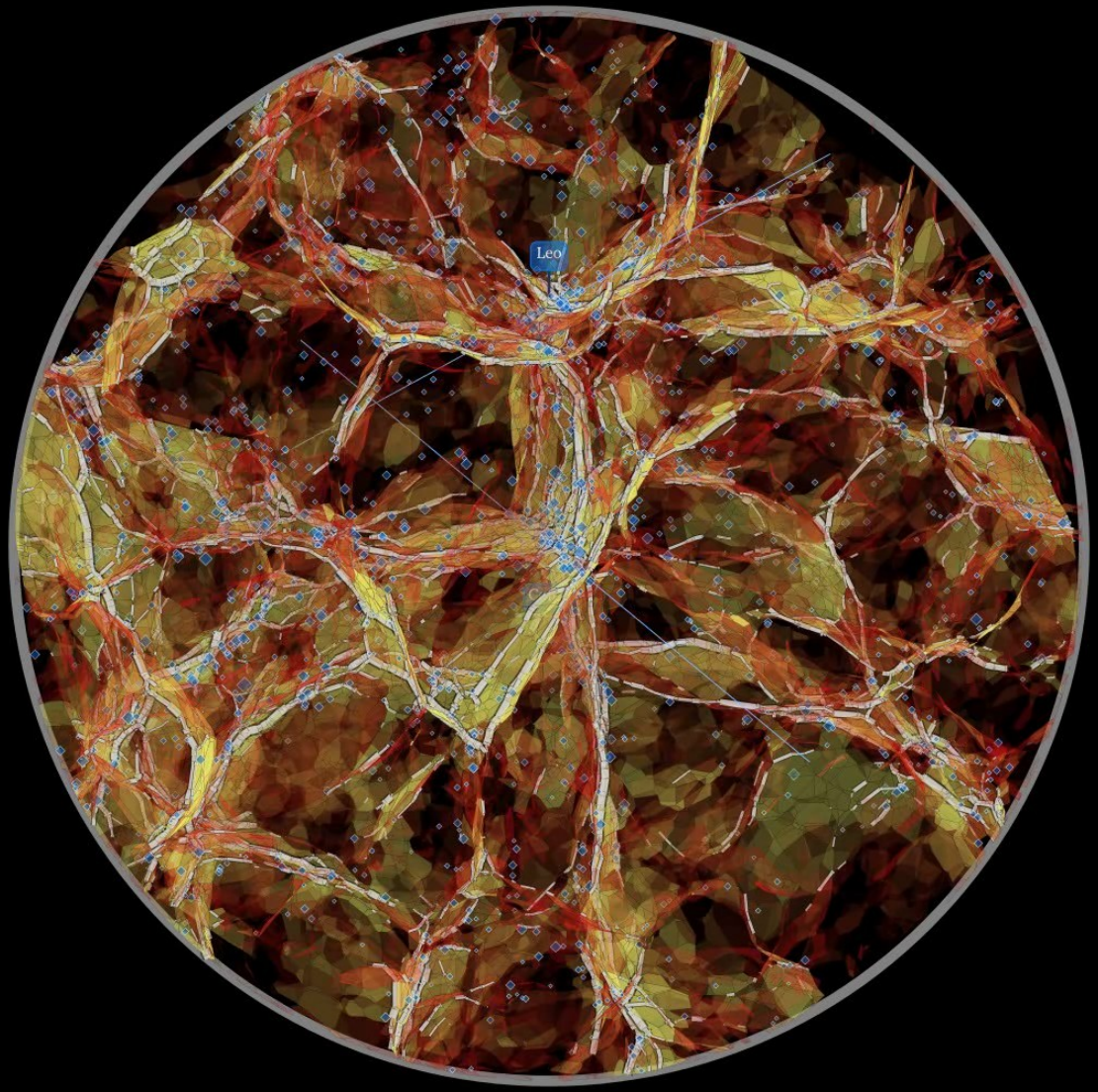
Reconstruction

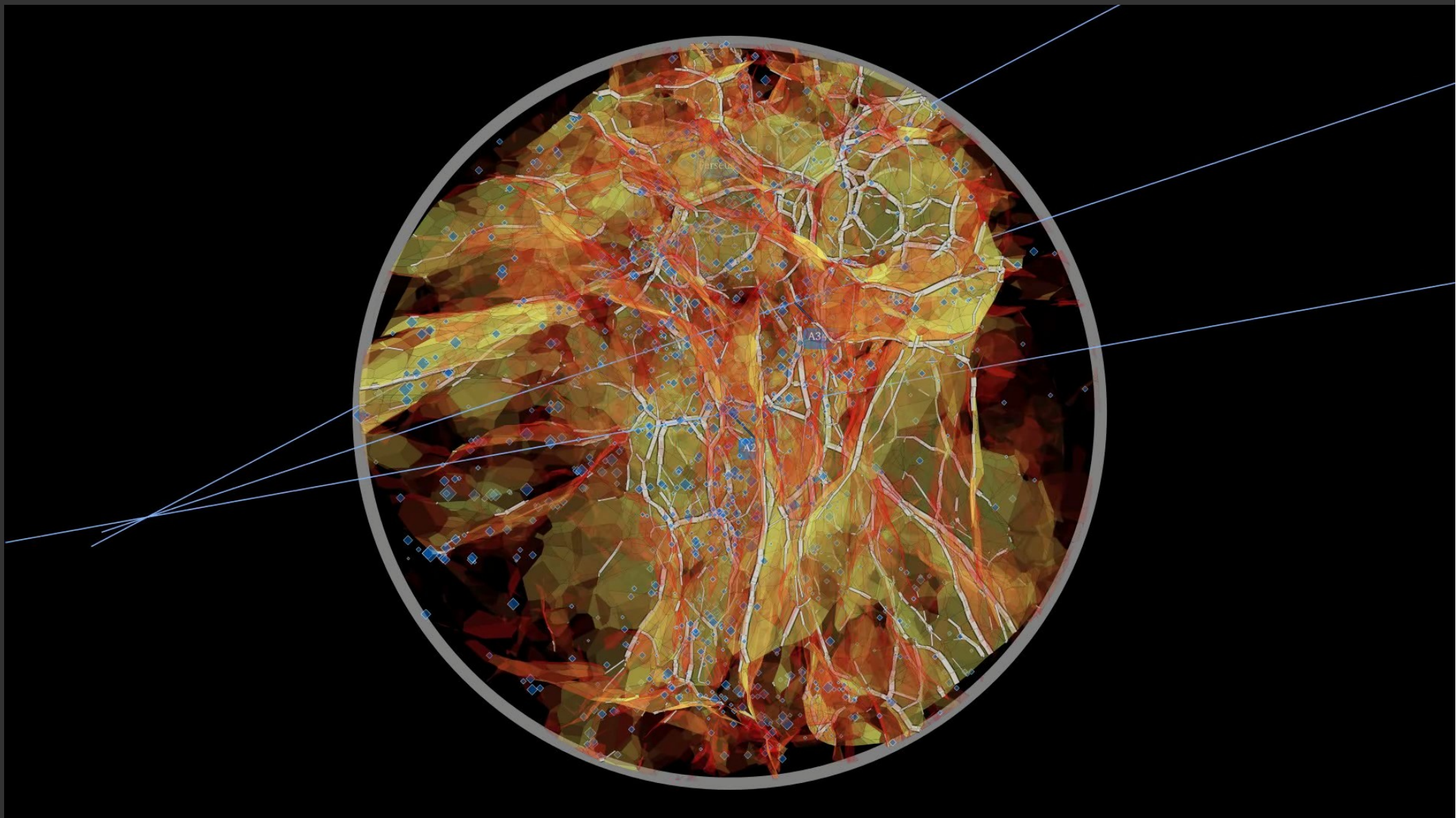
Kitaura & Enßlin (2008)

Heß, Kitaura & Gottloeber (arXiv:1304.6565)




Fornax
Eridanus
Antlia
≈ 19 Mpc h^{-1}


Leo




Virgo
Home
A8
AS805

Thanks!