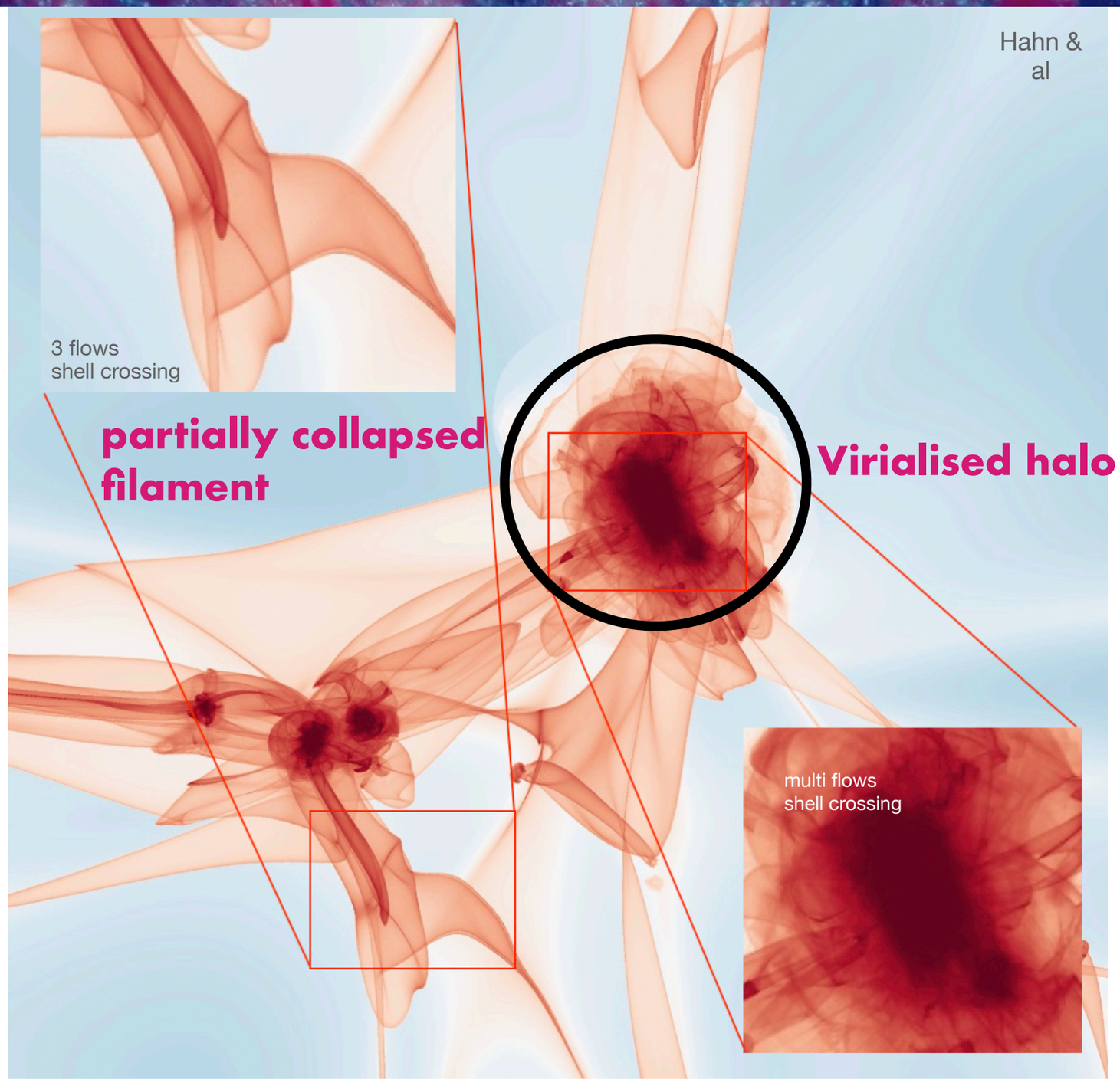
Why should we (NOT) care about the cosmic web?

• ***Why?*** Because it reflects what the universe is on **intermediate** scales, which are informative, both in terms of cosmic evolution and quantity of data.

The cosmic web also acts as a dynamically relevant intermediate-density **boundary** between cosmology and galaxy formation.



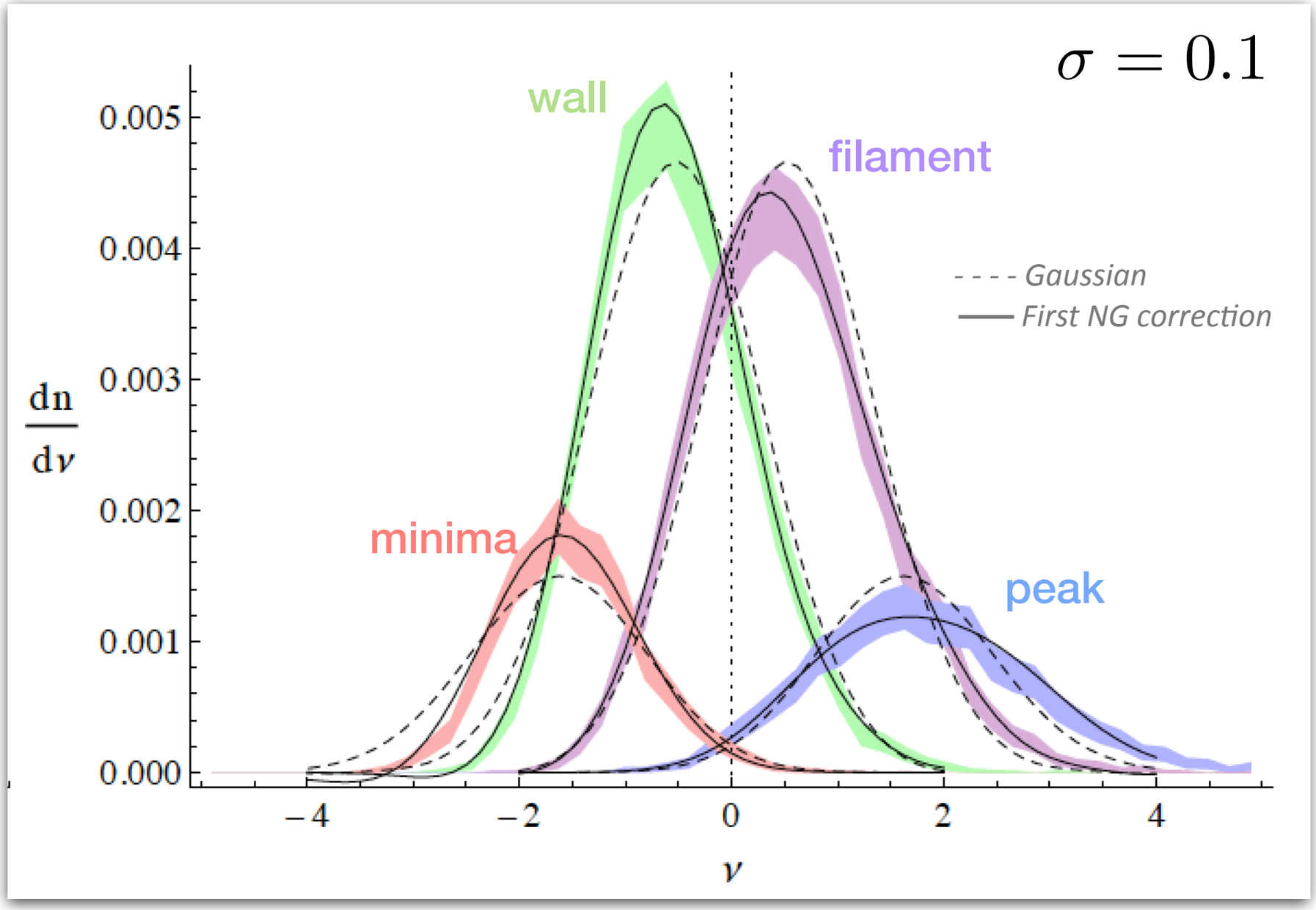
1- CW to constrain cosmological models

2- CW to constrain cosmic re-ionisation history of the Universe

3- CW dynamically impacts galactic resilience via gravity-driven top-down causation (which loops to 1&2 via bias)

Critical point counts: Non-Gaussian predictions

Gay+11



scales like D(z) × a number

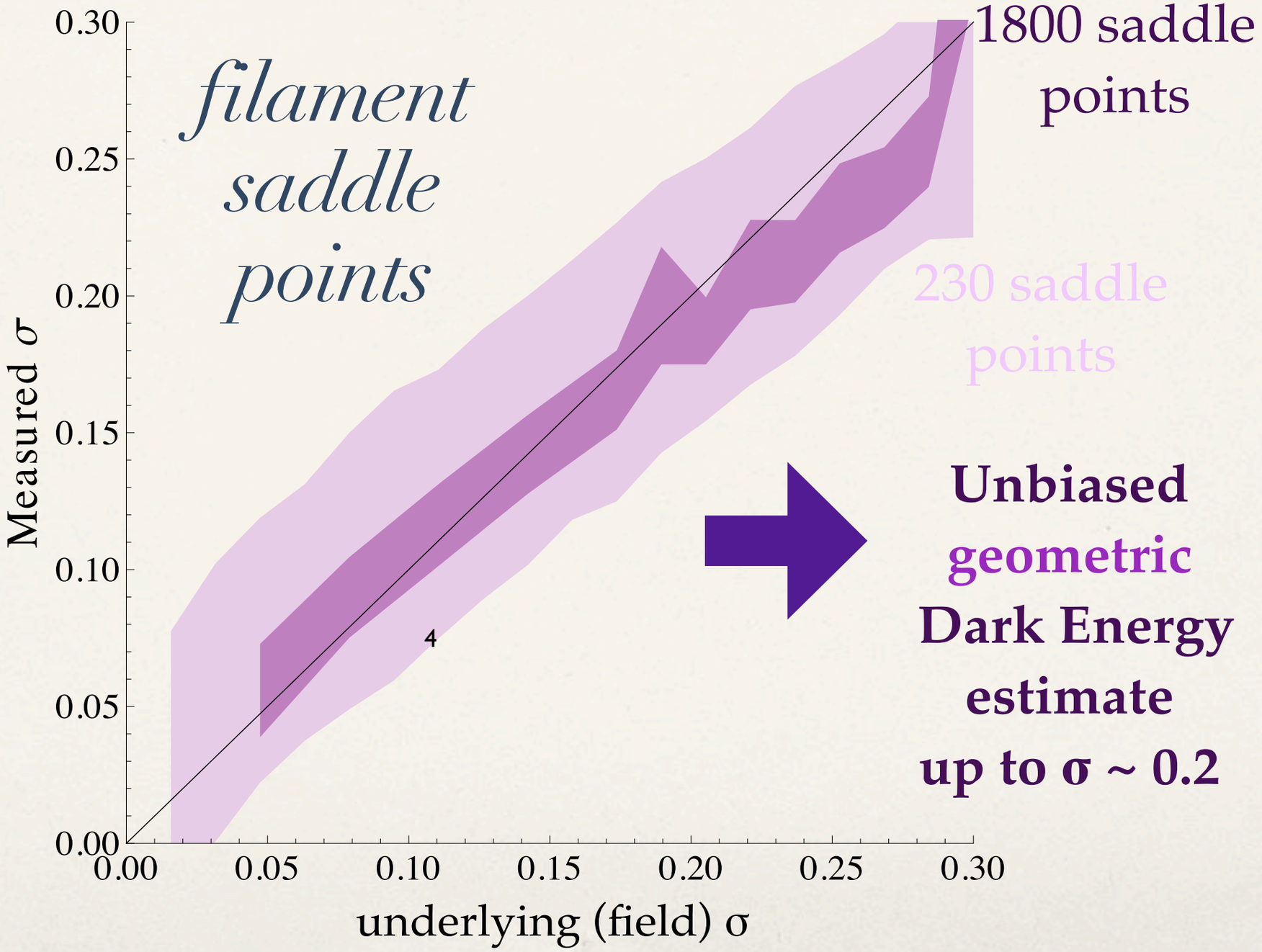
$$n_{\mp--} = \frac{29\sqrt{15} \mp 18\sqrt{10}}{1800\pi^2 R_*^3} + \frac{5\sqrt{5}}{24\pi^2\sqrt{6\pi}R_*^3}\left(\langle q^2 J_1\rangle - \frac{8}{21}\langle {J_1}^3\rangle + \frac{10}{21}\langle J_1 J_2\rangle\right)$$

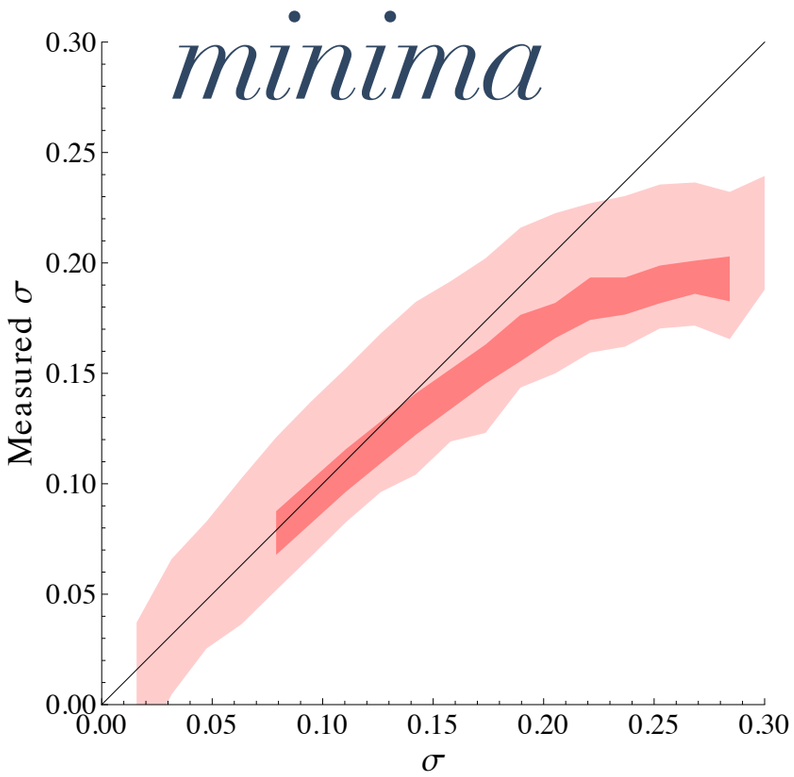
$$n_{++\pm} = \frac{29\sqrt{15} \mp 18\sqrt{10}}{1800\pi^2 R_*^3} - \frac{5\sqrt{5}}{24\pi^2\sqrt{6\pi}R_*^3}\left(\langle q^2 J_1\rangle - \frac{8}{21}\langle {J_1}^3\rangle + \frac{10}{21}\langle J_1 J_2\rangle\right)$$

Those cumulants can be predicted from PT $\propto \sigma$

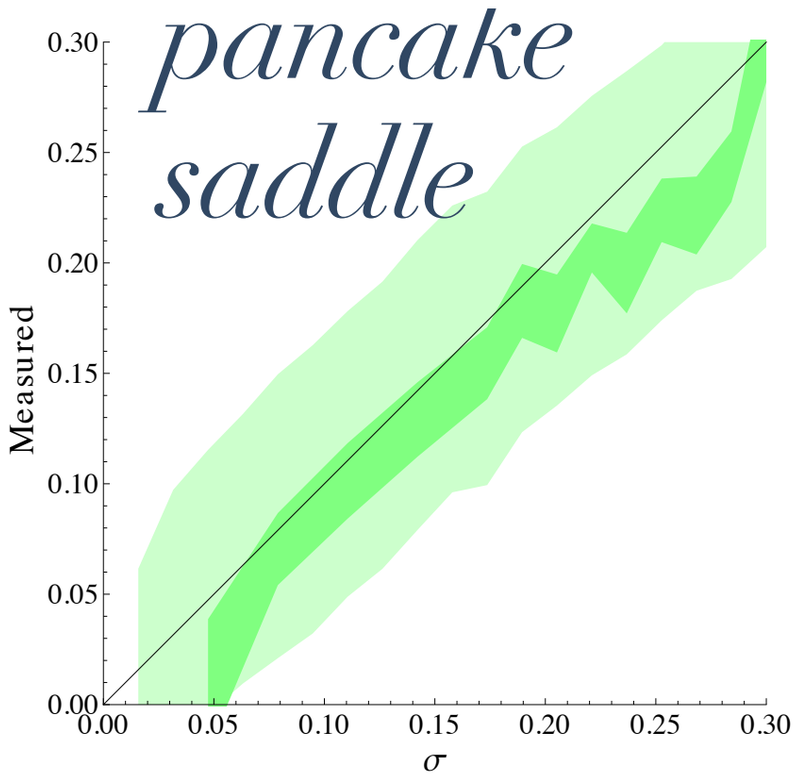
Fiducial DE experiment

- Generate scale invariant ICs
- Evolve them with gravity
- identify critical sets
- compute differential counts
- estimate amplitude of NG **distorsion** via PT
- deduce **geometric** critical set σ

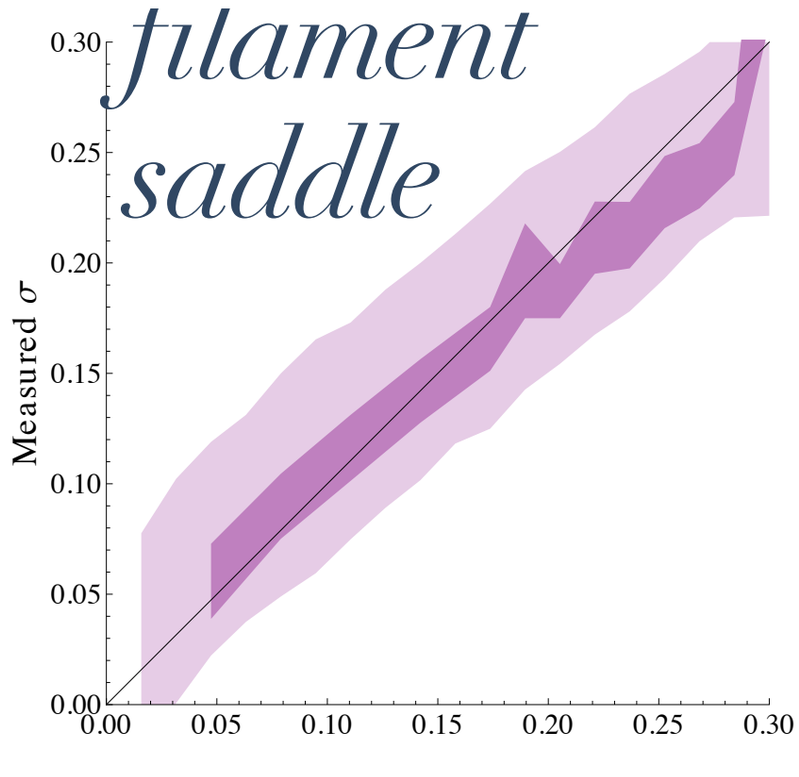




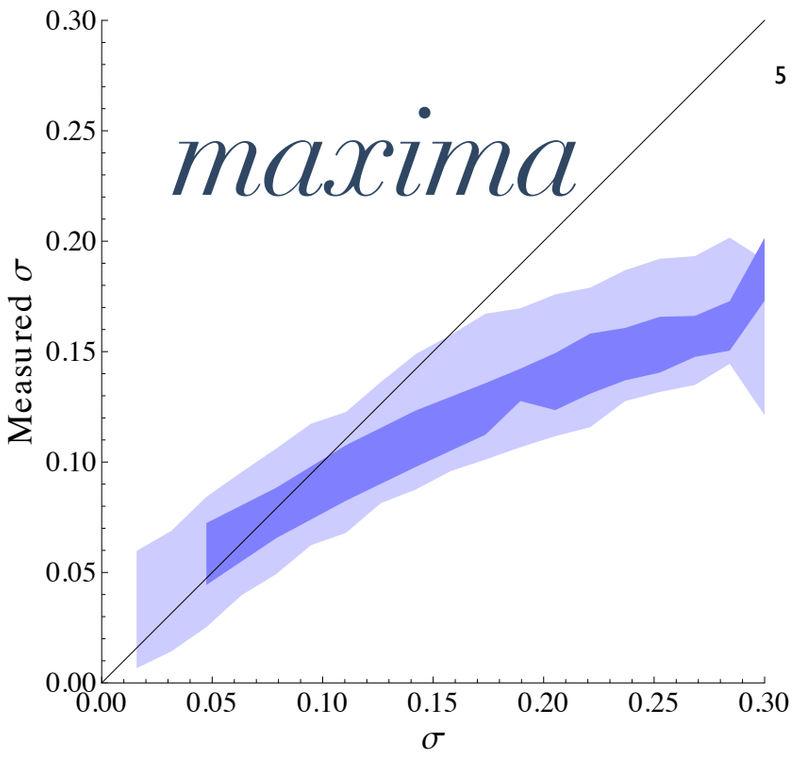
(a) Minima



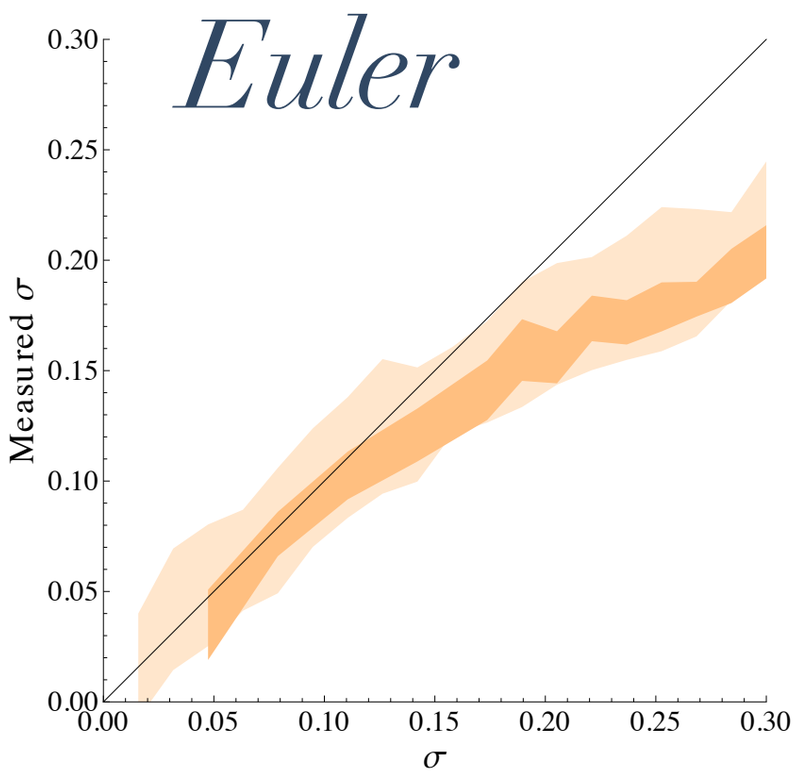
(b) Pancake-type saddle points



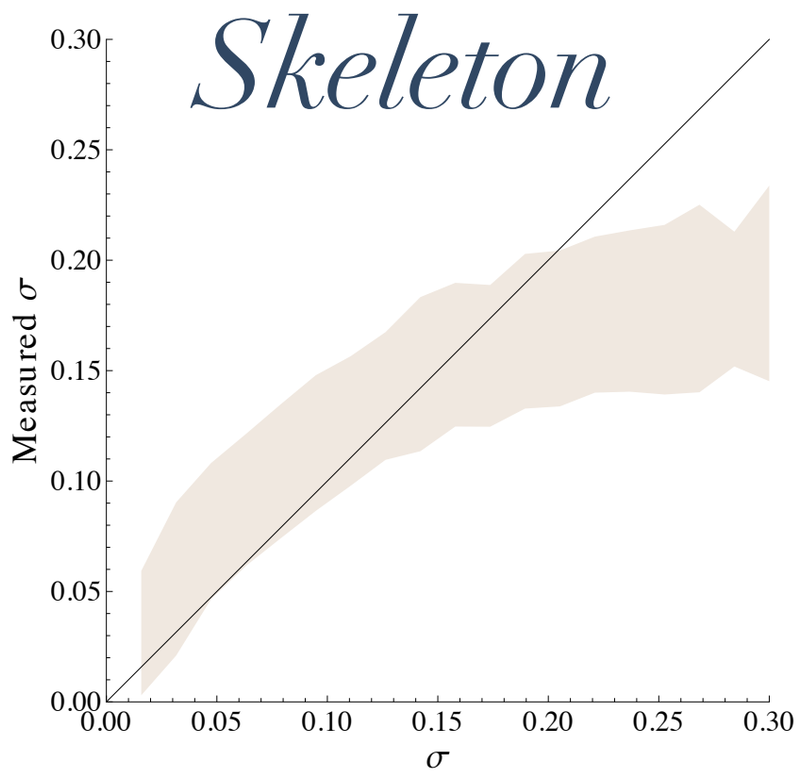
(c) Filament-type saddle points



(d) Maxima



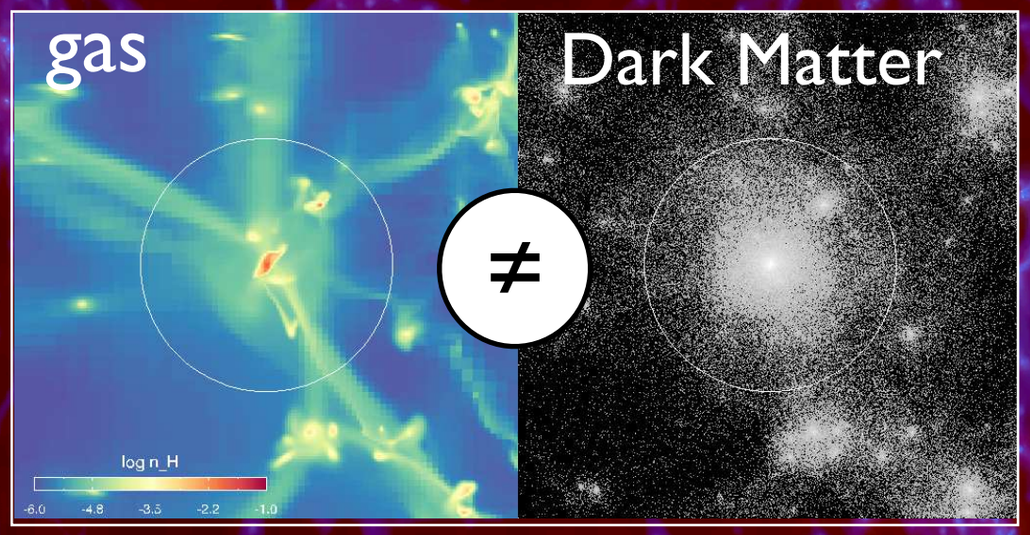
(e) Euler characteristic



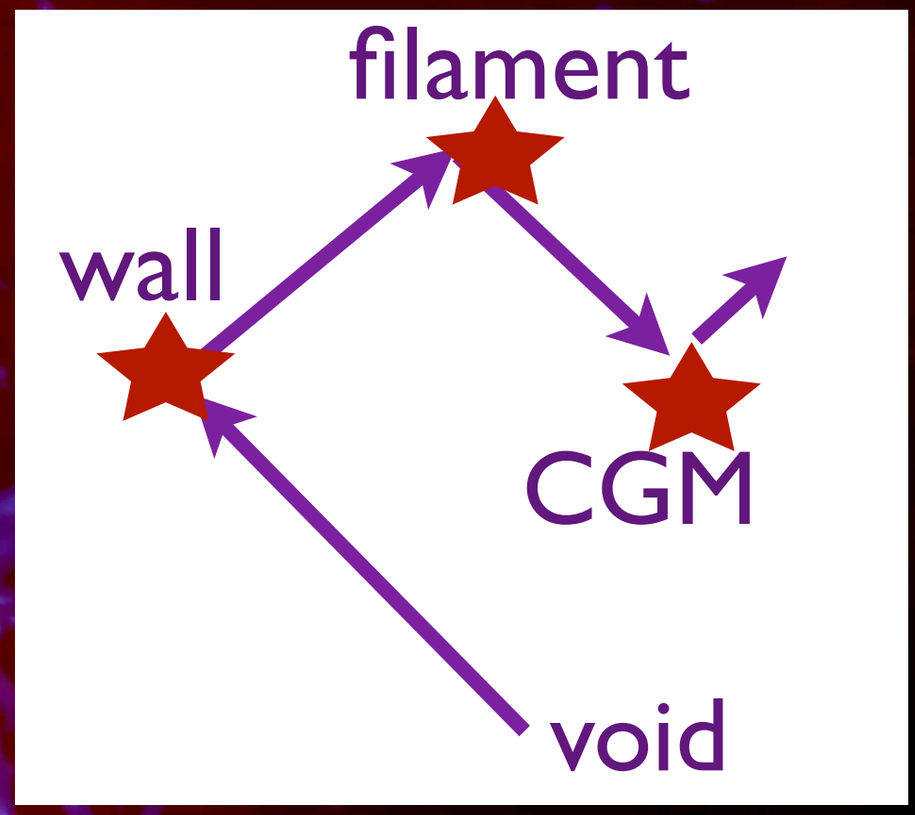
(f) Skeleton

The impact of shocks in gaseous cosmic web

LSS drives secondary infall :



$$t_{\rm dyn} \sim 1/\sqrt{\rho}$$



Disks (re)form because LSS are large (dynamically young)
and (partially) an-isotropic :
they induce persistent angular momentum advection of cold gas along filaments which stratifies accordingly.

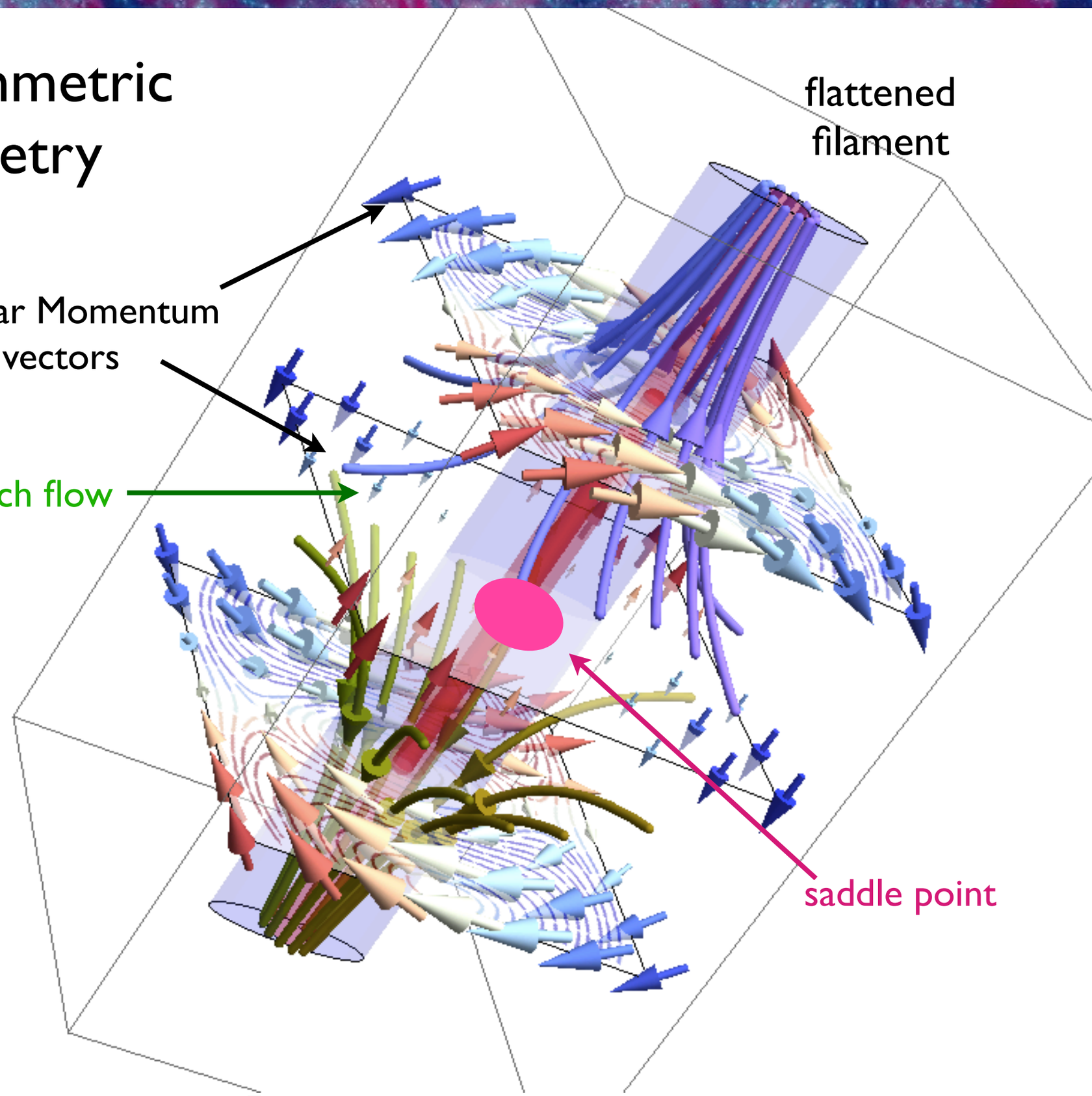
Conditional tidal torque theory

- point reflection symmetric
- vanish if no a-symmetry

perp. along e_ϕ

spin //
to filament

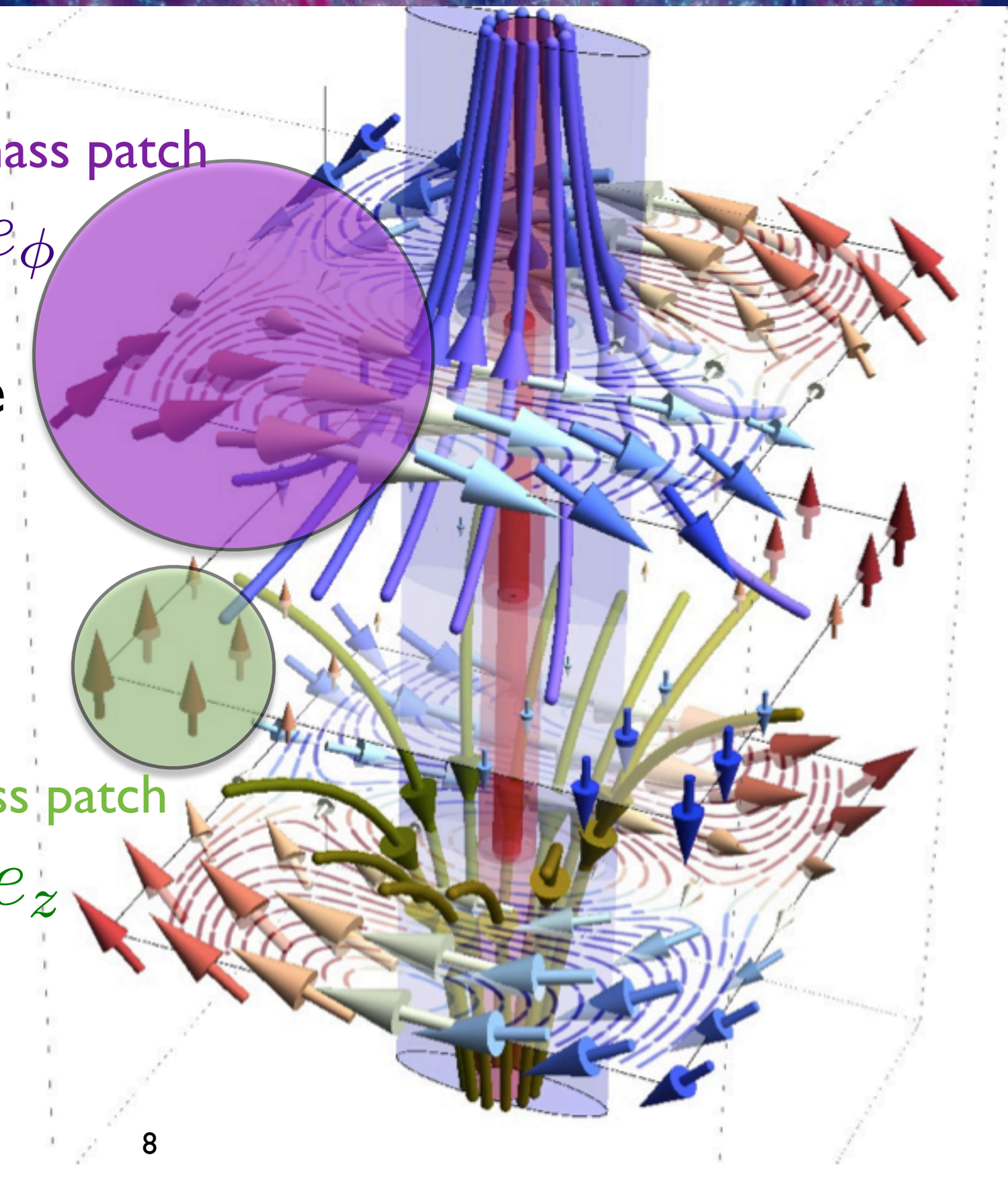
perp =
along e_ϕ



Conditional tidal torque theory

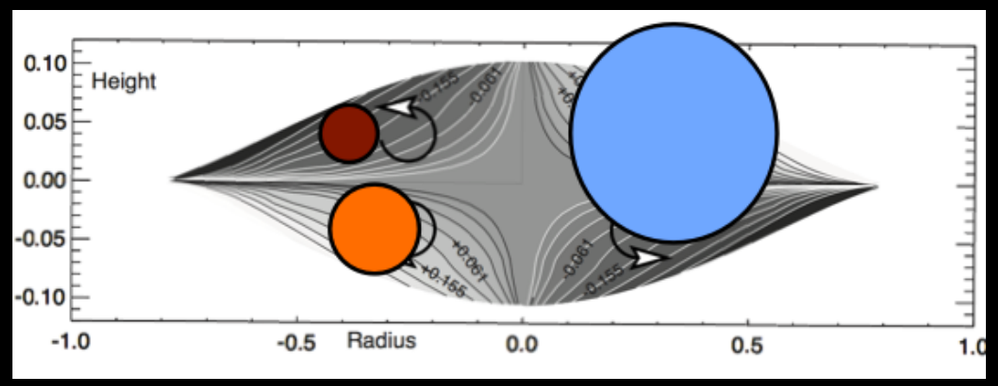
Lagrangian theory capture spin flip

Transition mass associated with **size** of quadrant

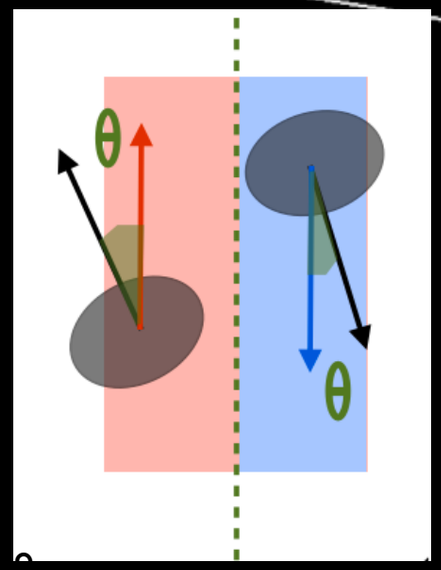


Vorticity content of filament

Alignement of vorticity with cosmic web

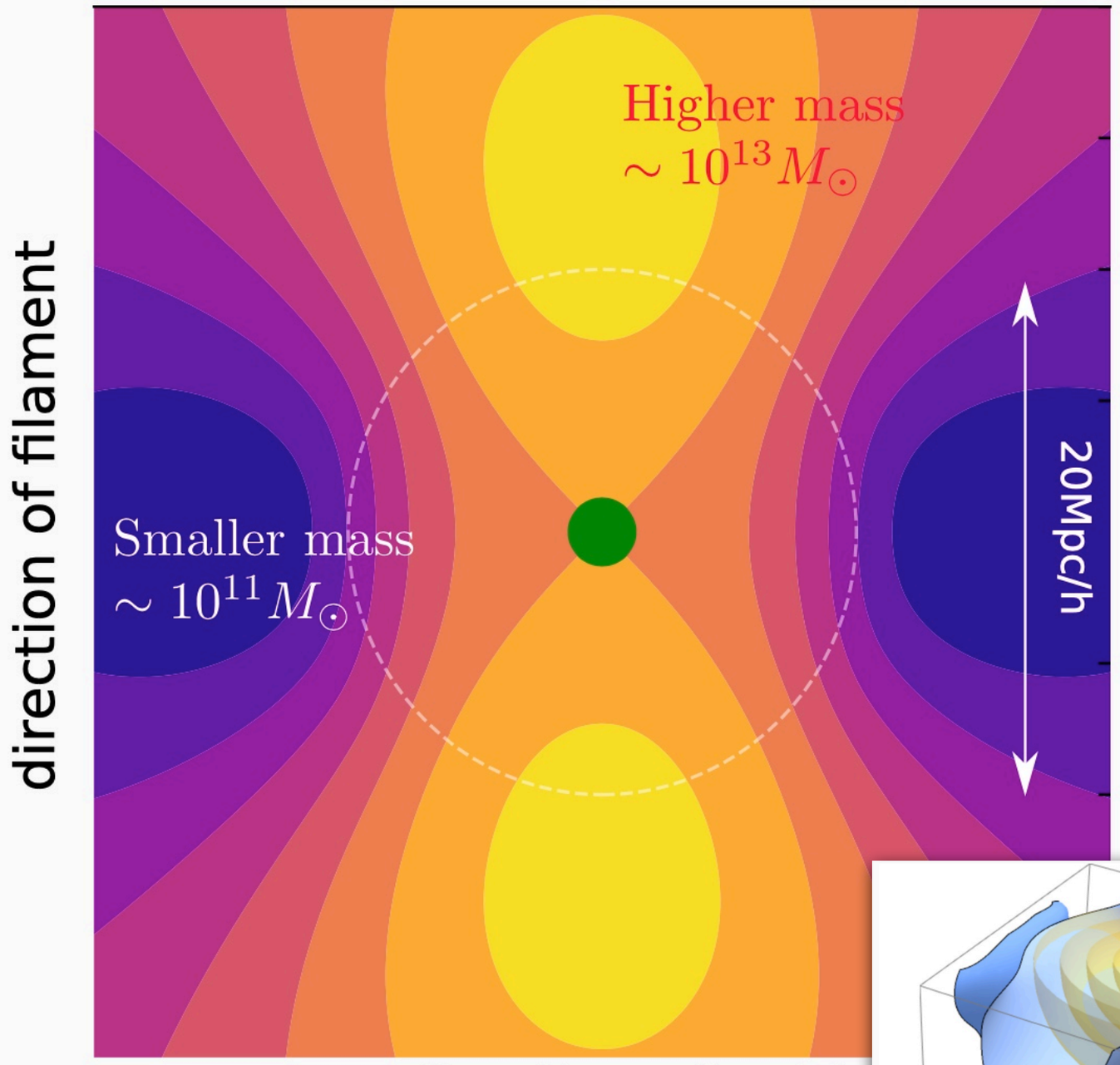


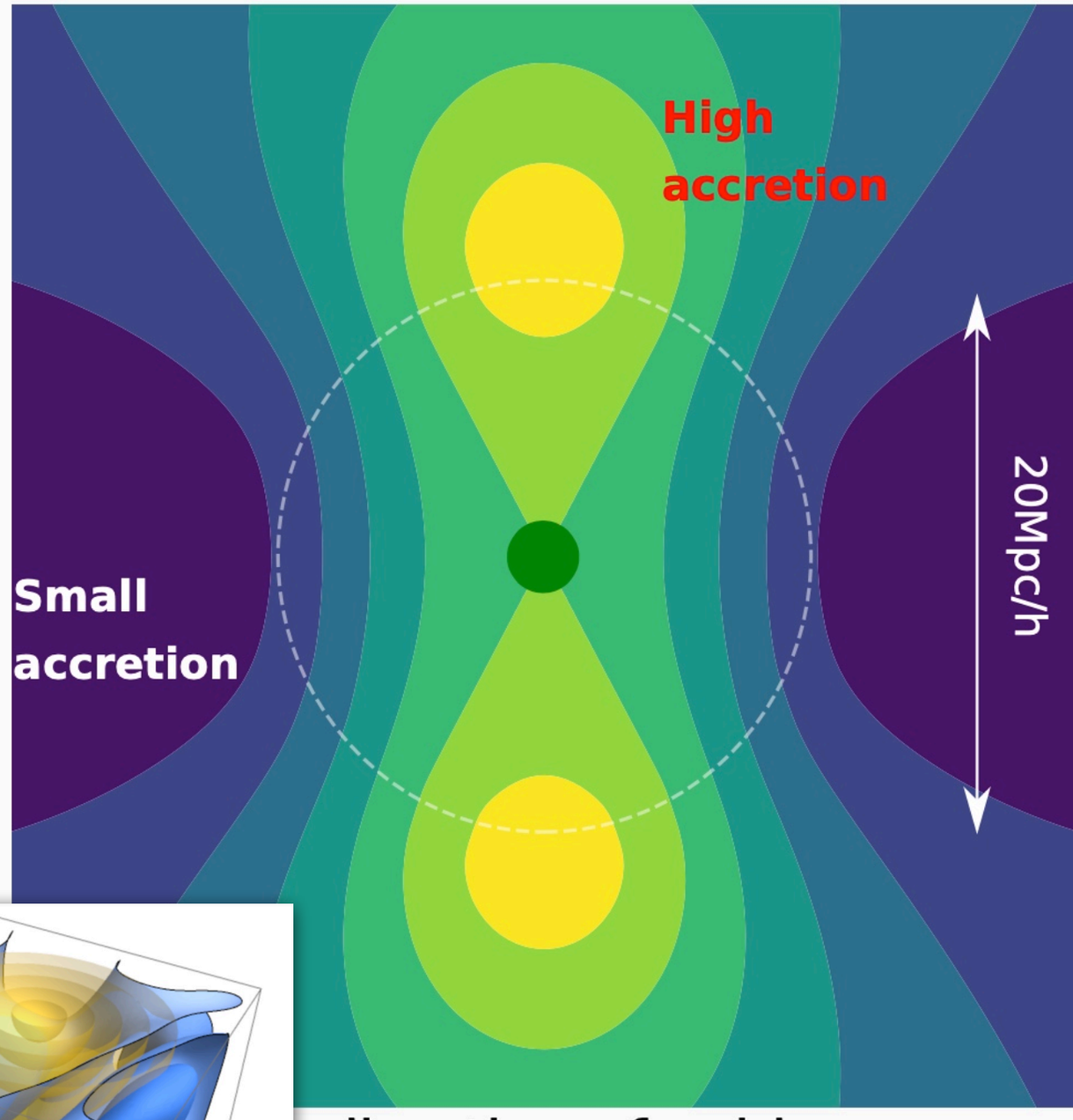
Spin flip imposed by caustic size

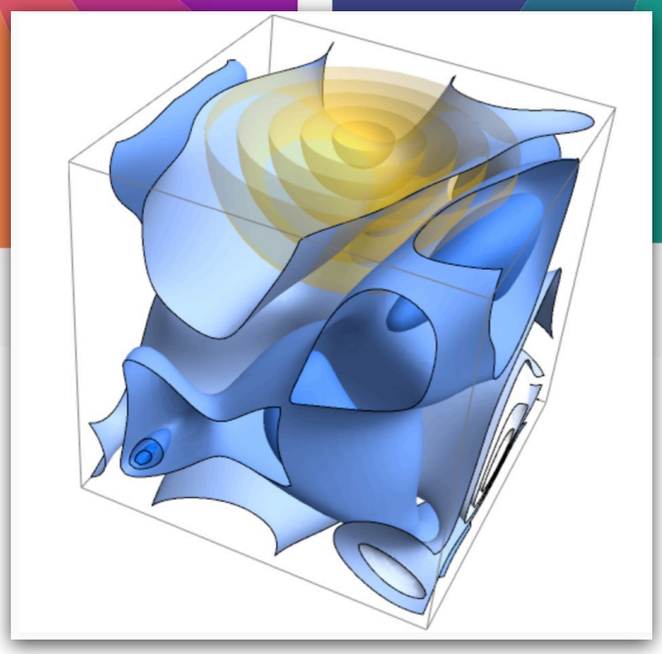


The impact of CW of assembly bias: saddles bias excursion

Musso+ 20’







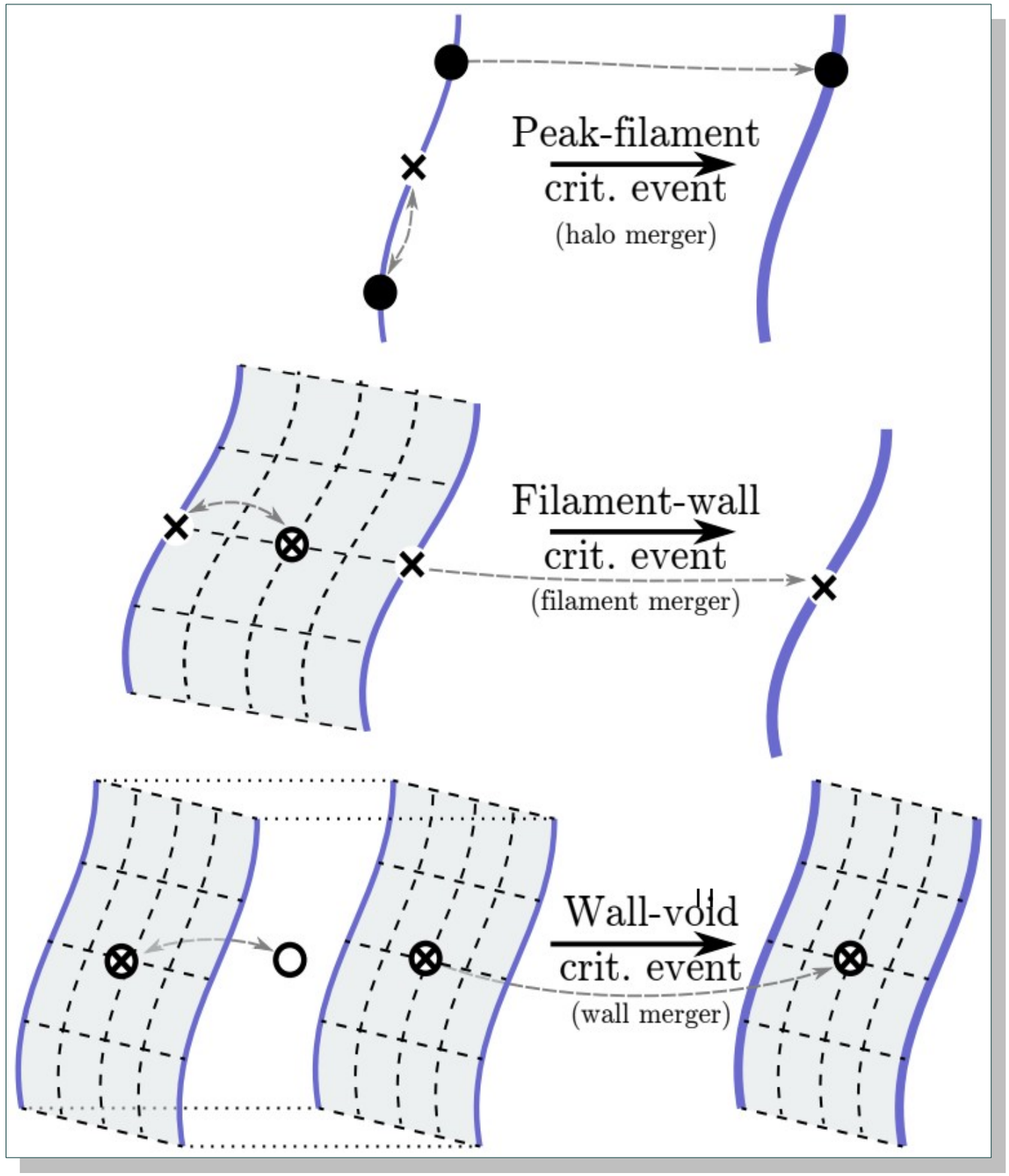
Halos in nodes ...

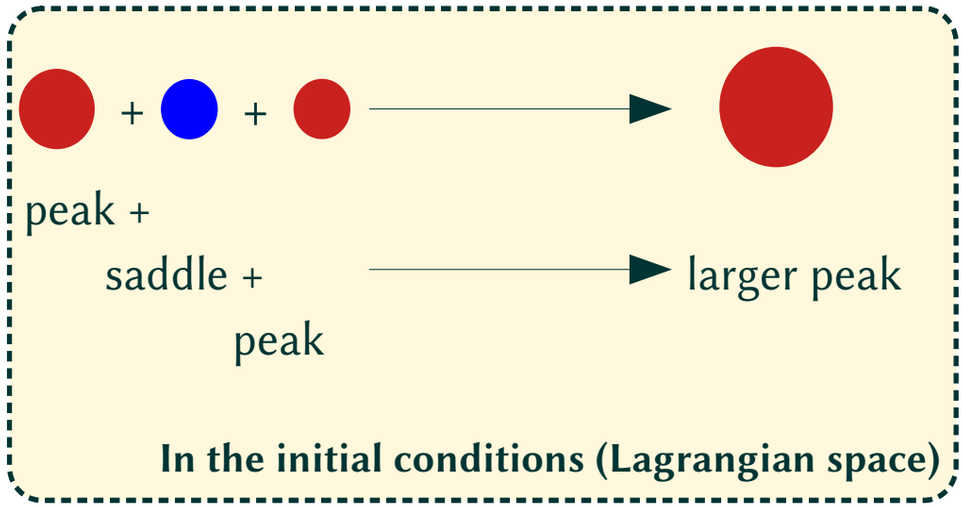
- form later,
- are accreting more,
- typically more massive,

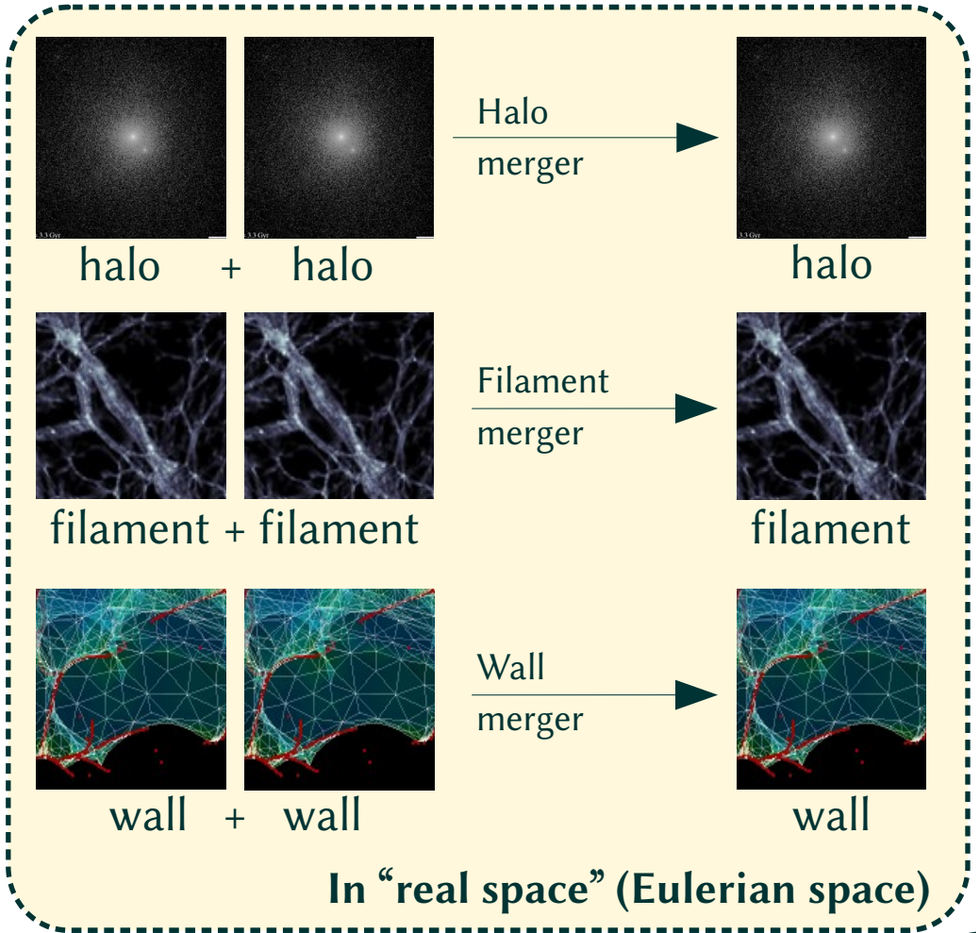
compared to those in filaments (and same from voids to filaments).

Critical events: merging walls voids and filaments

Cadiou+ 20' following Hanami 01'

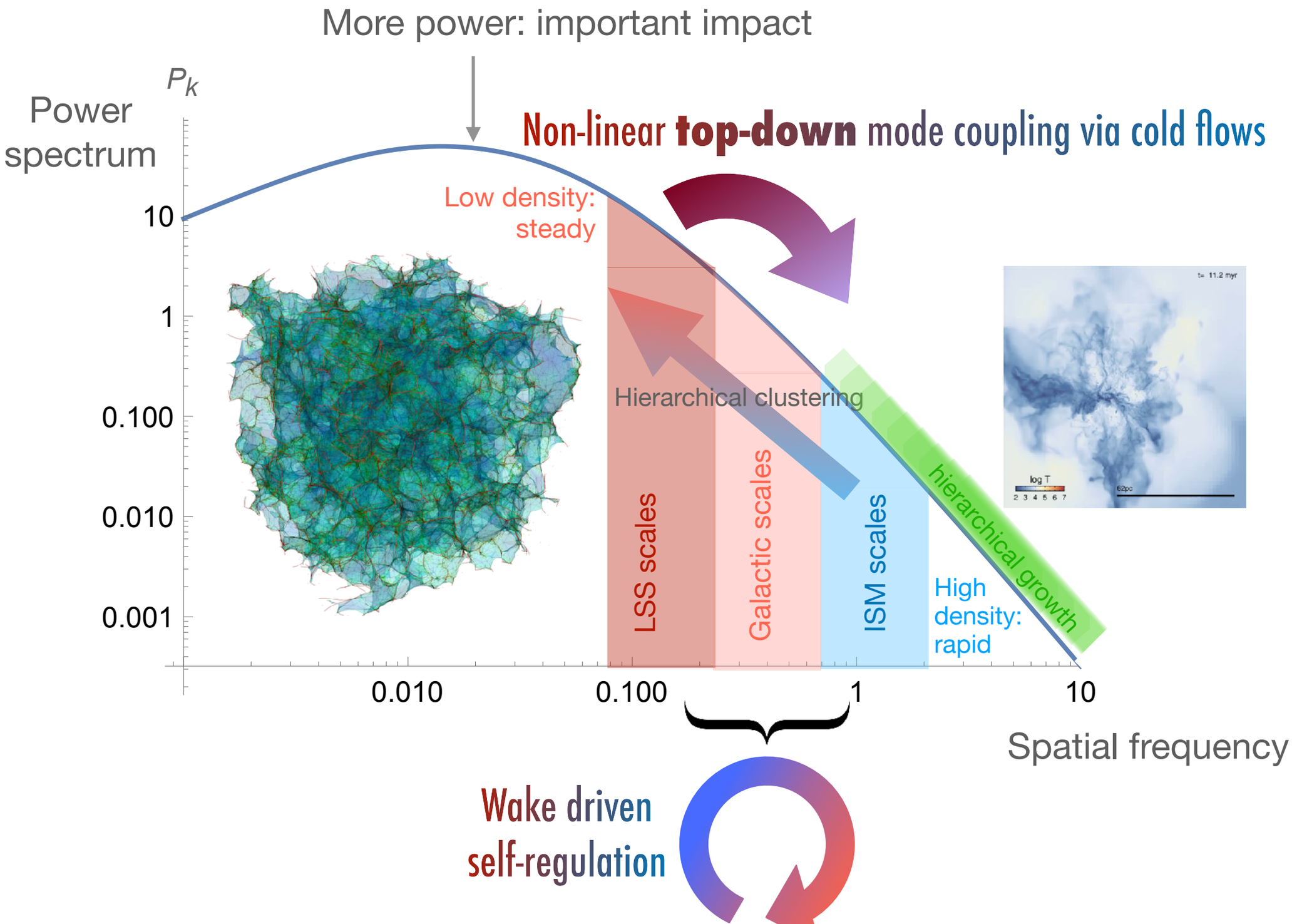




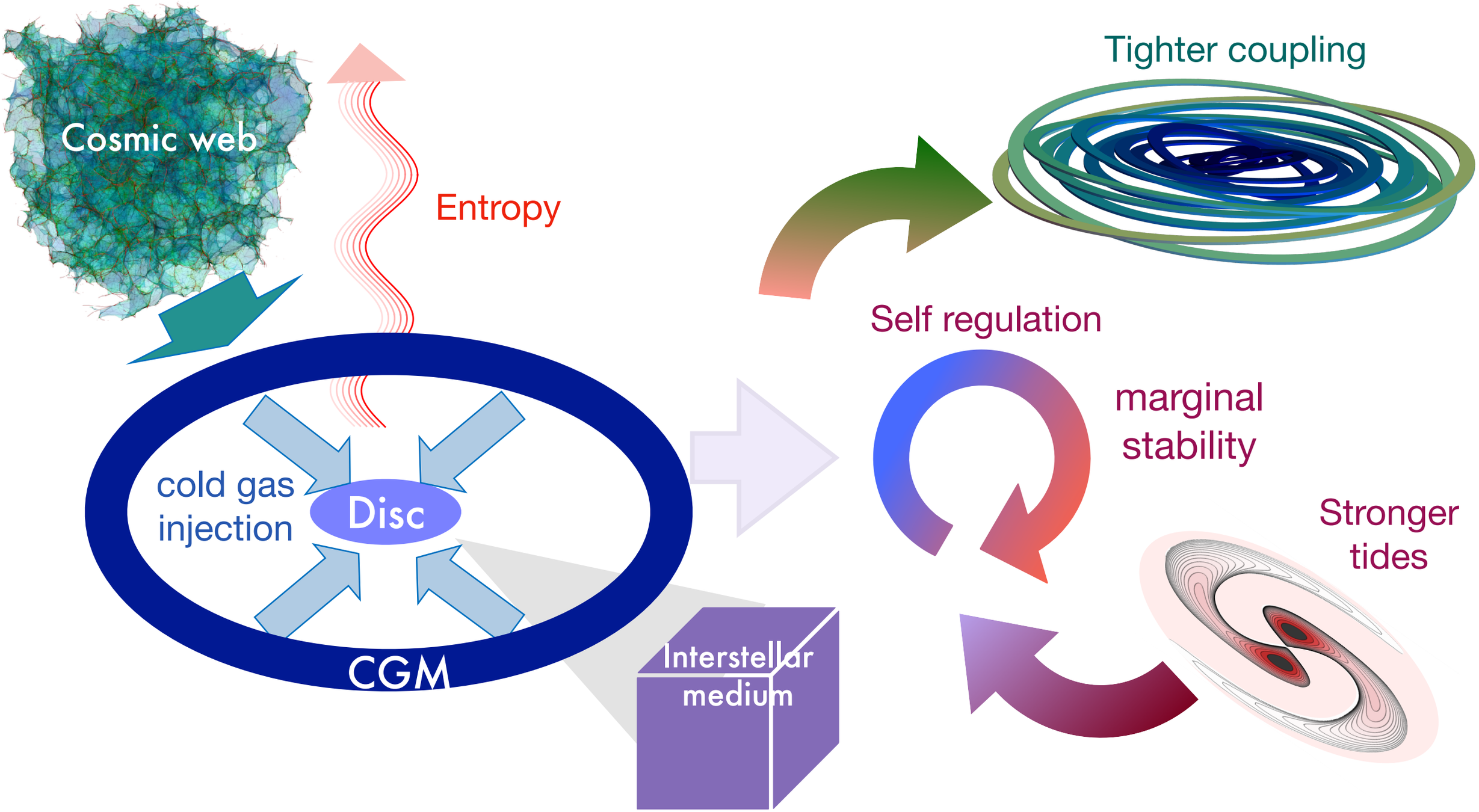


Impact of LSS on non-linear dynamics is top down

On galactic scales, the Shape of initial P_k is such that galaxies inherit stability from LSS via cold flows, which, in turn, sets up CGM engine/reservoir.



Synopsis of thin disc emergence induced by CW



- Three components system coupled by gravitation.
- A CGM reservoir fed by the large scale structures (top down *causation*)
- Convergence towards marginal stability : acceleration of dynamical control-loop by wakes
- Tightening of stellar disc by boosting of torques, & increased dissipation.

Discussion

Why should we (not) care about the cosmic web?