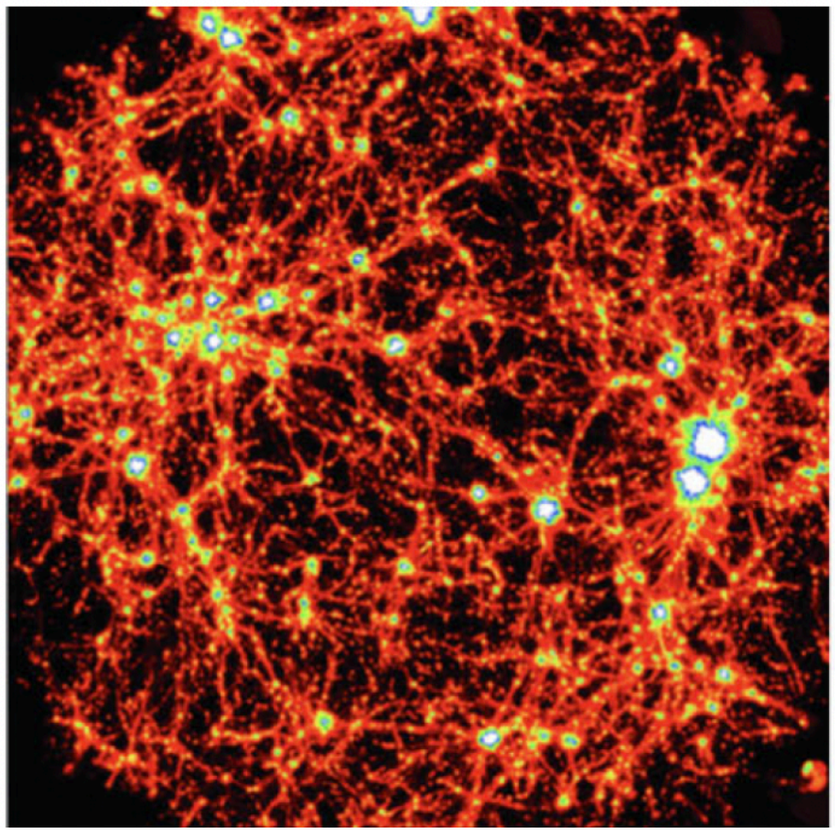
Discussion (2)

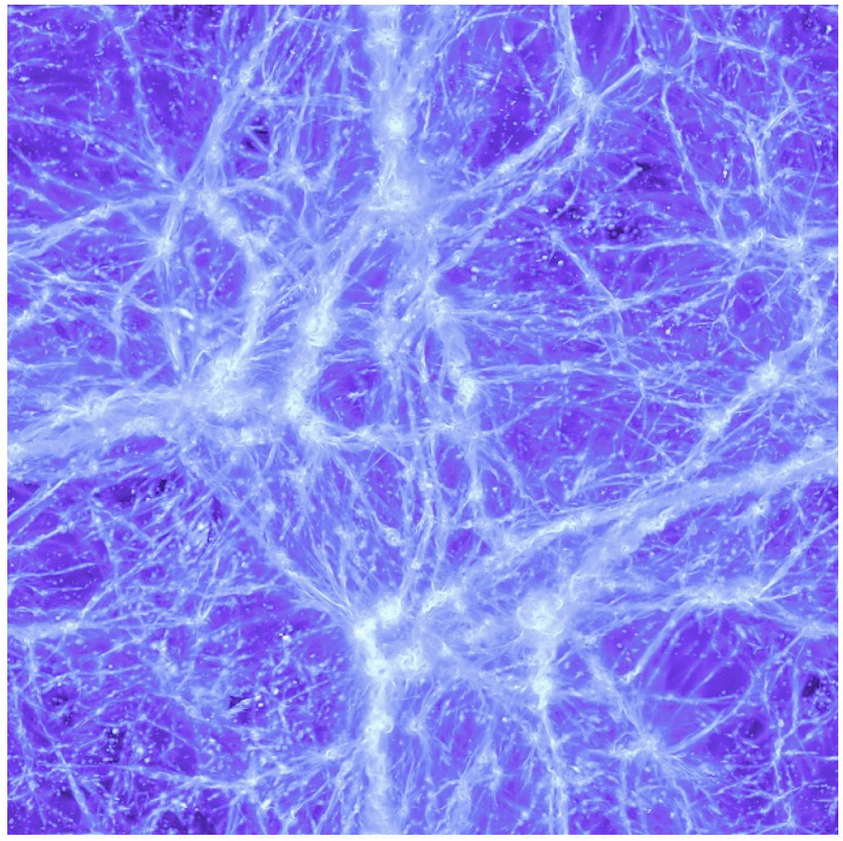
What can we trust and what we still do not trust in numerical predictions of cosmic magnetism?

MHD cosmological simulations

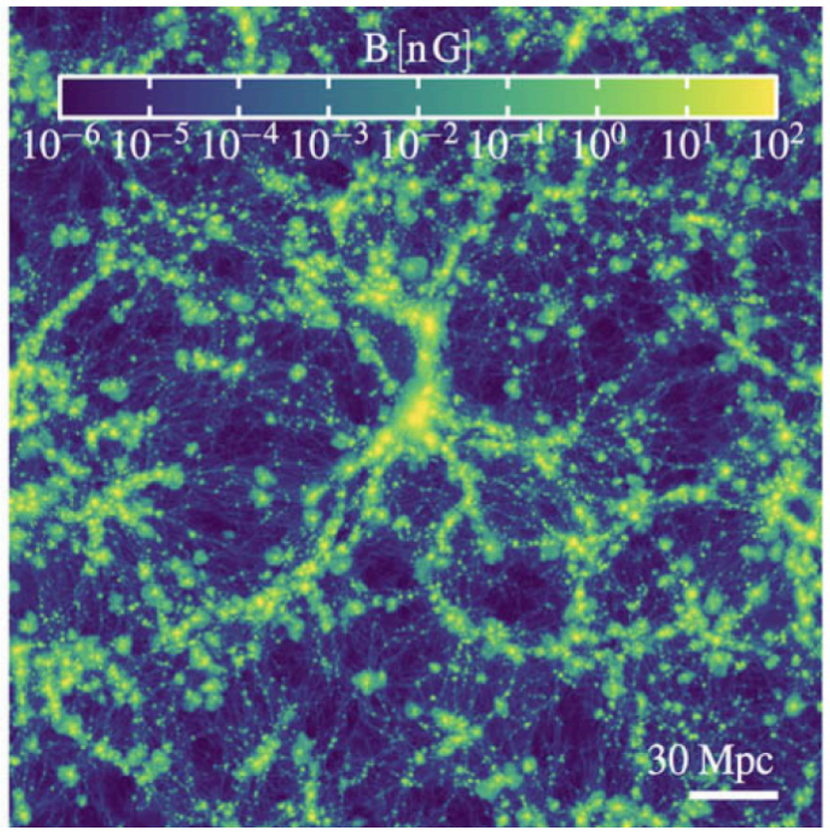
Broad agreement between MHD simulations of simple initial B fields evolving in large scale structures



Donnert+08 (Gadget - SPH)



Vazza+14 (ENZO-Eulerian)



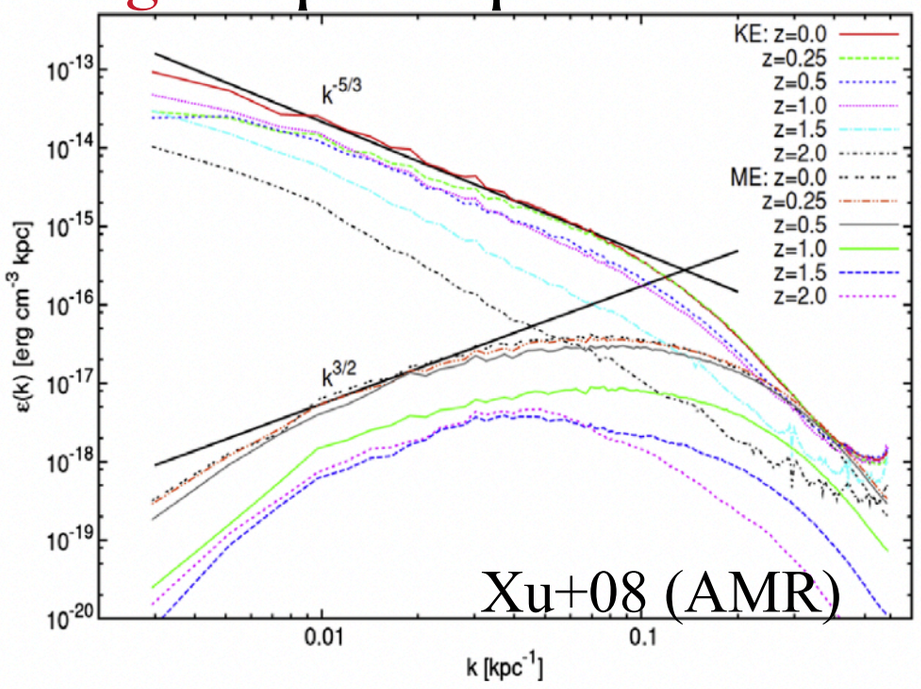
Marinacci+15 (AREPO-Moving Mesh)

But, what is the level of agreement by cosmological simulations on these facts:

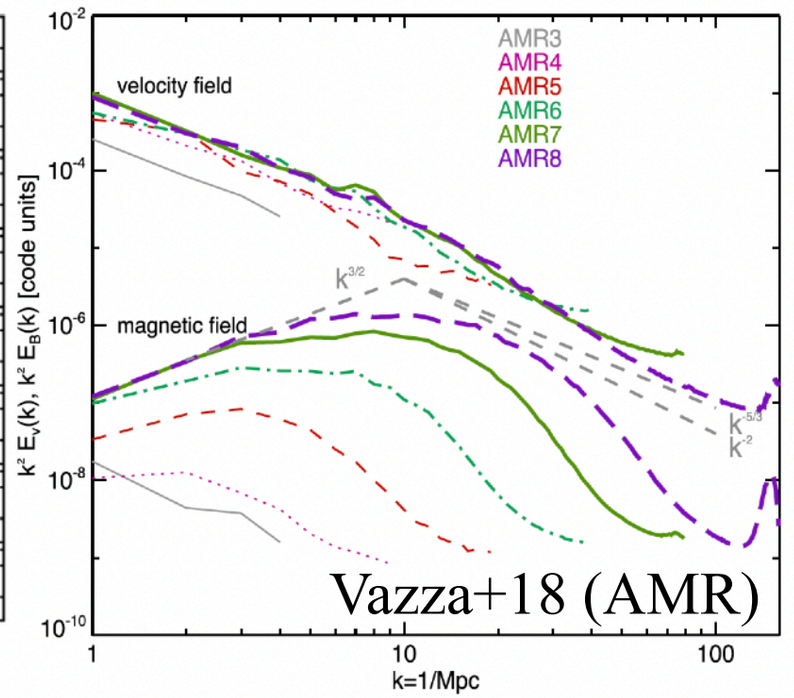
- galaxies and clusters of galaxies do not retain memory of primordial seed fields
- voids (also filaments?) are the best place to look for primordial magnetic fields

Intra Cluster Medium: dynamo

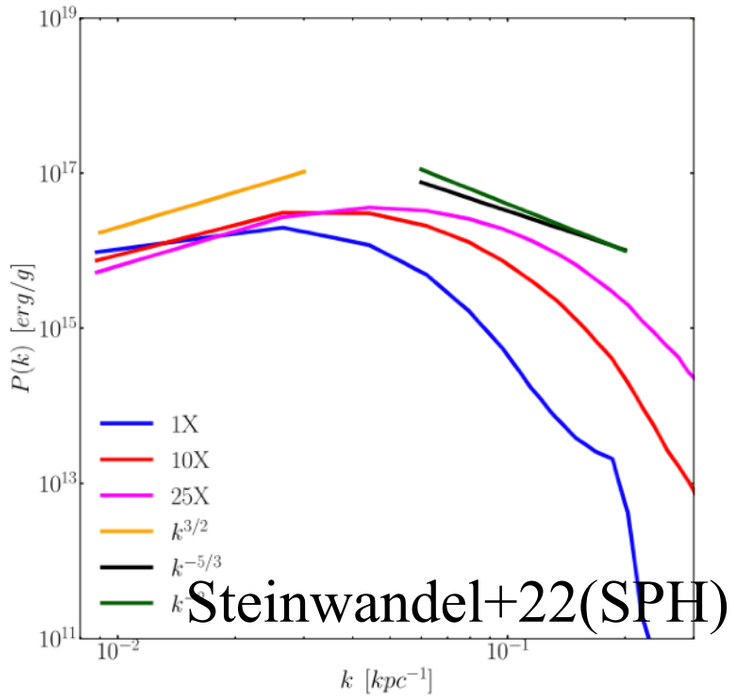
magnetic power spectra within clusters:



Xu+08 (AMR)

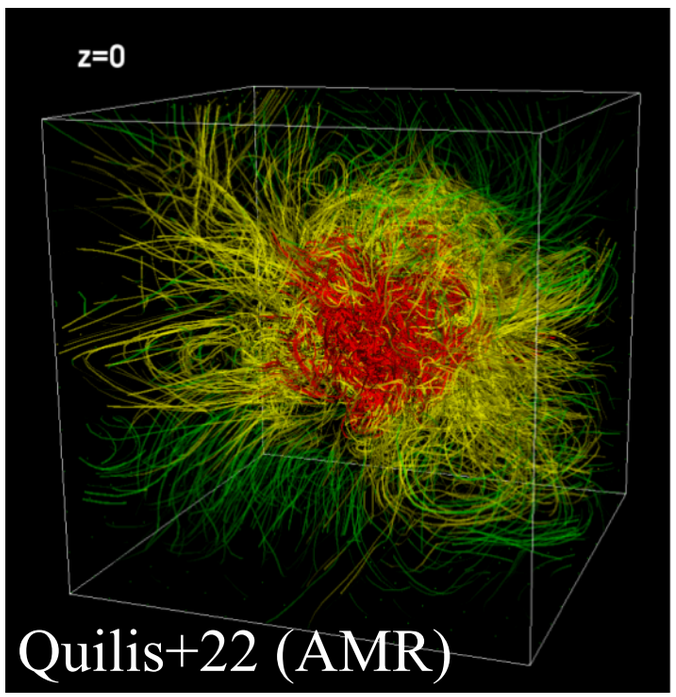


Vazza+18 (AMR)



Steinwandel+22(SPH)

Small scale dynamo in the ICM:

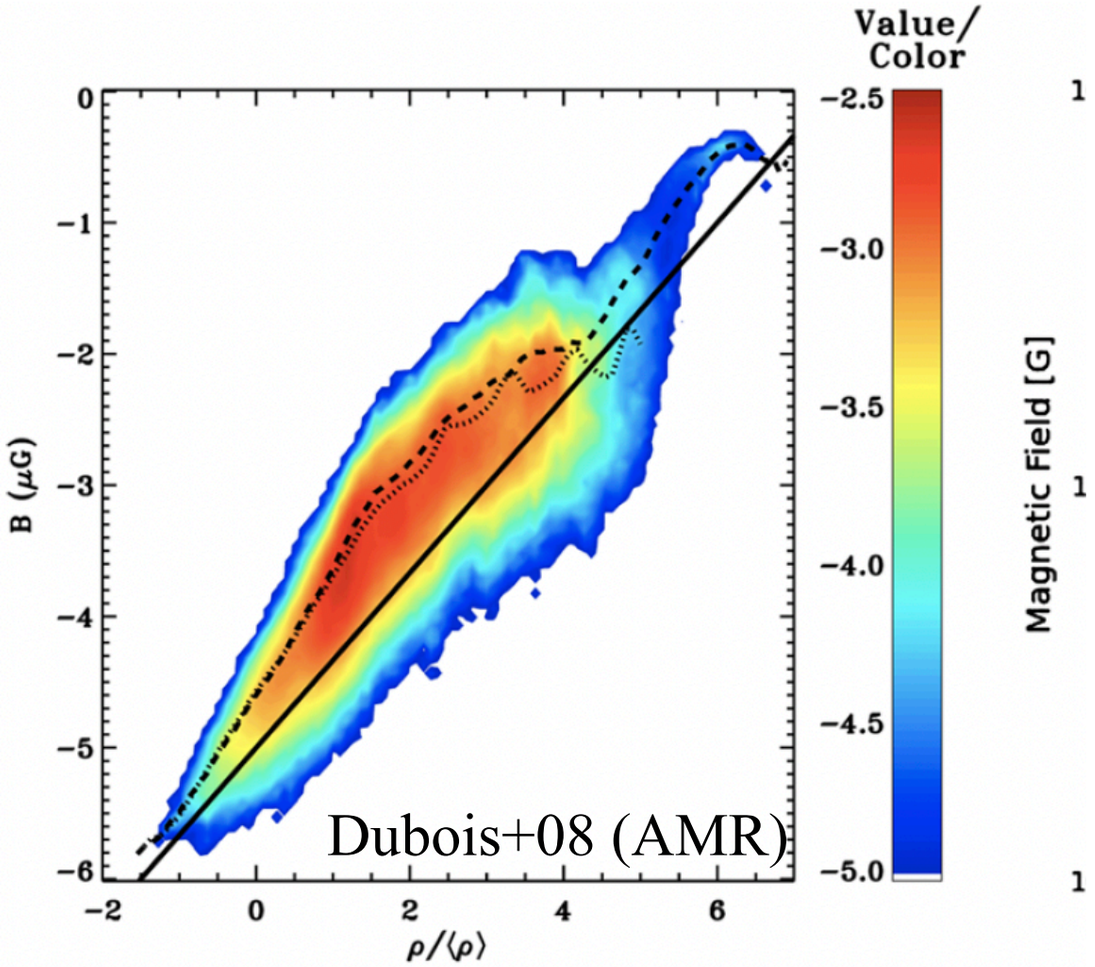


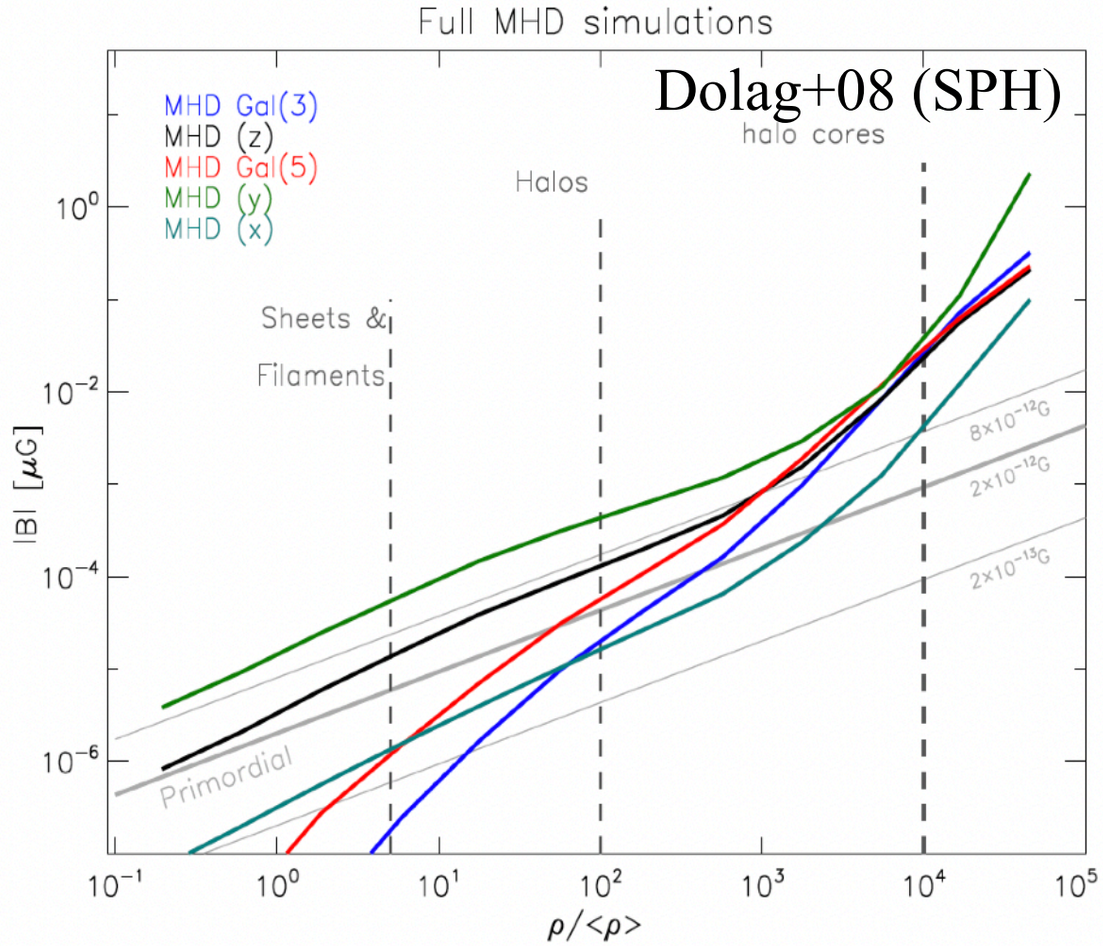
Quilis+22 (AMR)

- seen by all (?) ideal MHD simulations with high res. ($\leq$ 10 kpc)
- a few % of conversion kinetic → magnetic energy (Beresnyak+, Ryu+)
- ~compatible with radio observations of clusters
- memory of seed fields is erased.

Do we agree?
Is there are critical radius for this (R_{100})?
Different story with helical fields?

Beyond clusters: no dynamo (?)





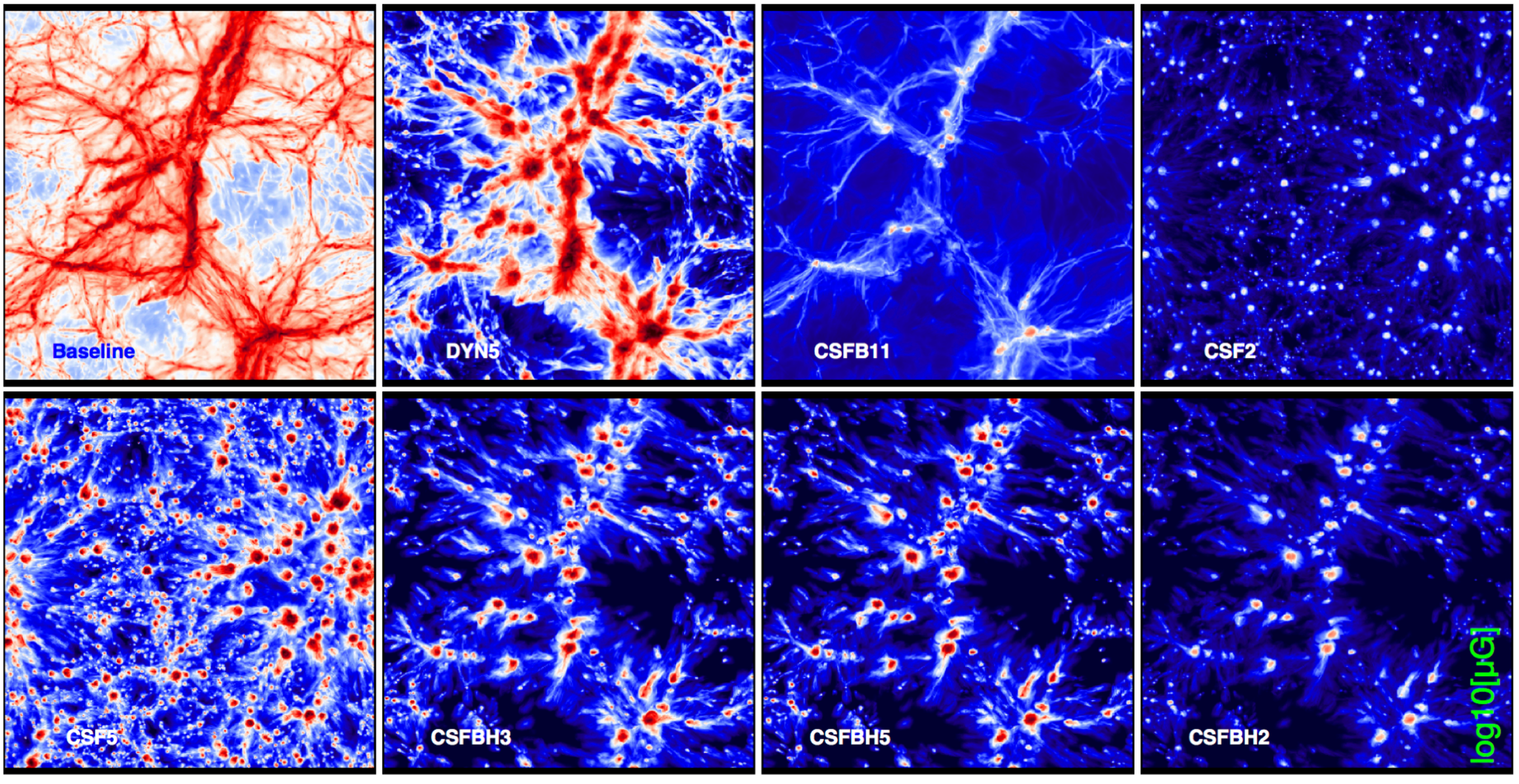
Magnetic field distribution in the cosmic web:

- mostly follow the $B \sim B_{seed}\ (\rho/\rho_0)^{\alpha}$ scaling $(\alpha \sim 2/3)$
- memory of seed fields is conserved

How much do "astrophysical B-fields" contaminate primordial B-fields?

Astroph. vs Primordial seeding

Vazza+17,21



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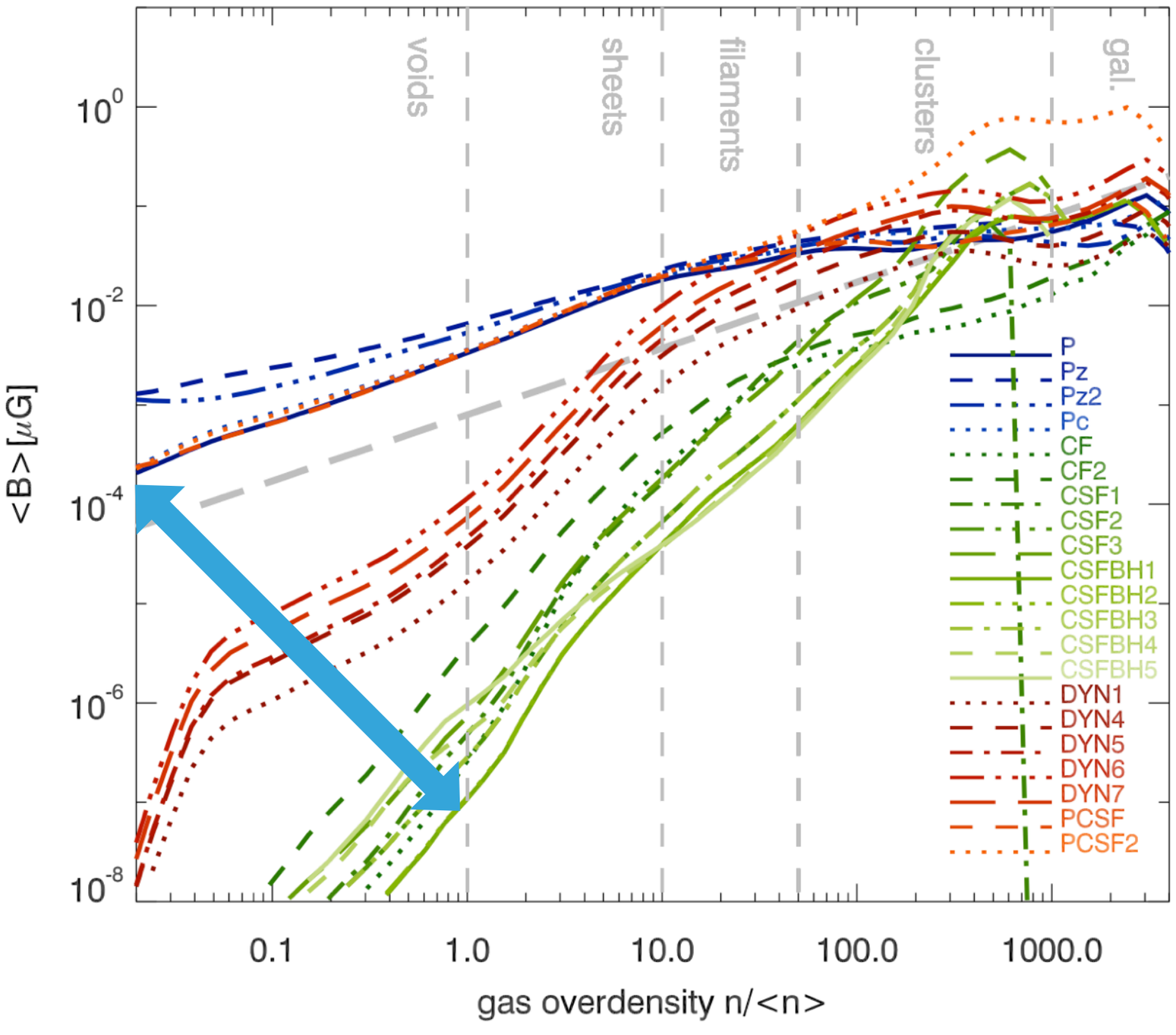


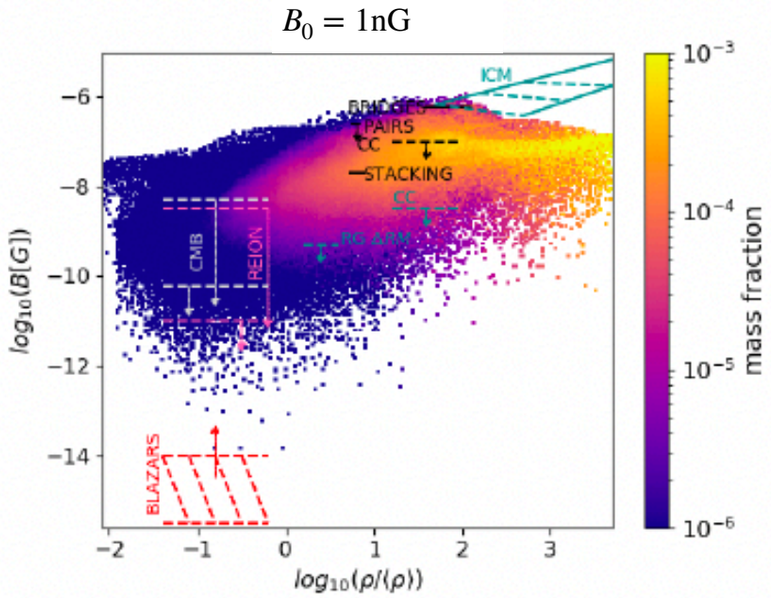
How much do "astrophysical B-fields" contaminate primordial B-fields?

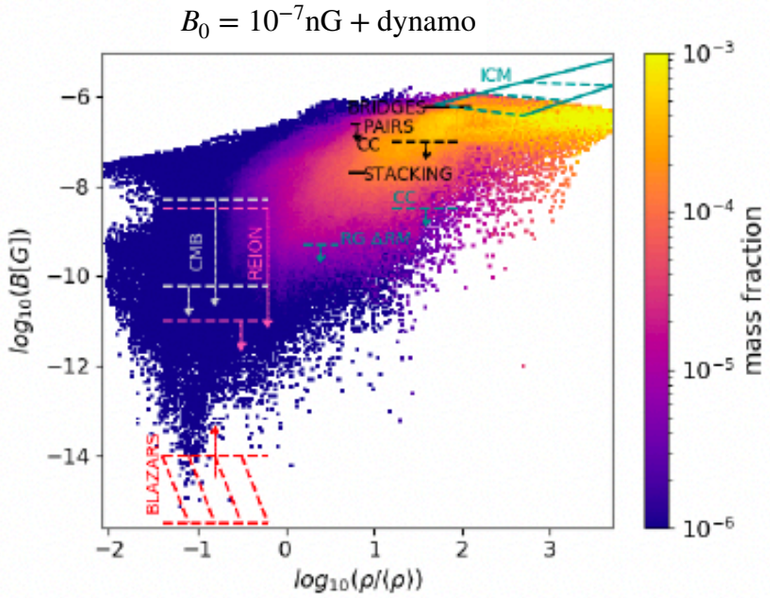
Vazza+17,21

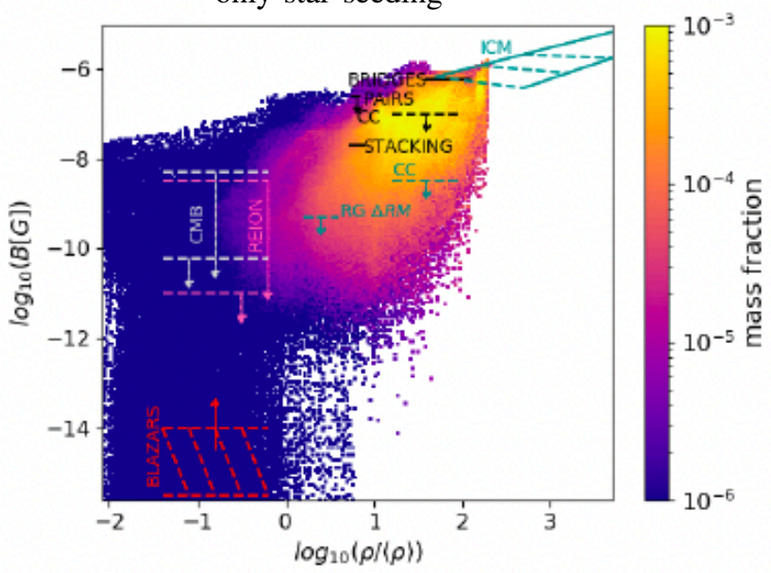
Compared with obs. limits, simple uniform primordial fields or purely astrophysical scenarios fail (somewhere).

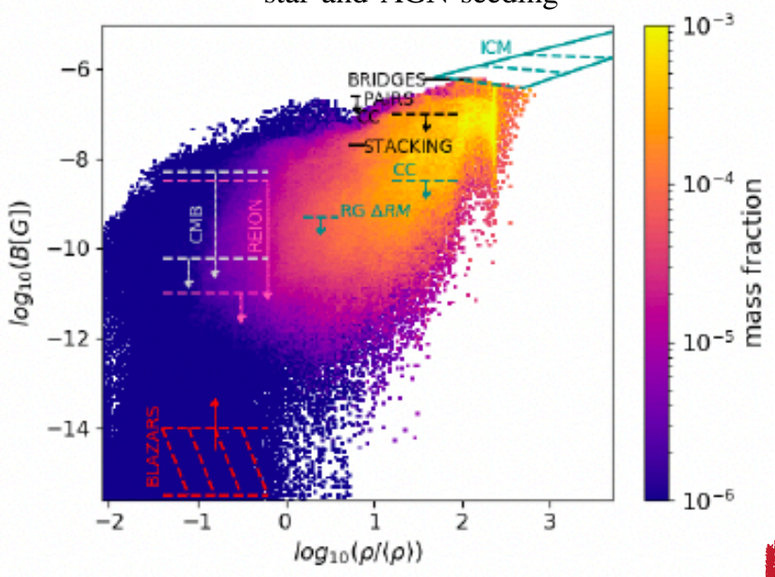
$P_B(k) \propto k^{1.0-2.0}$ primordial B-fields give the best match to low-z observables

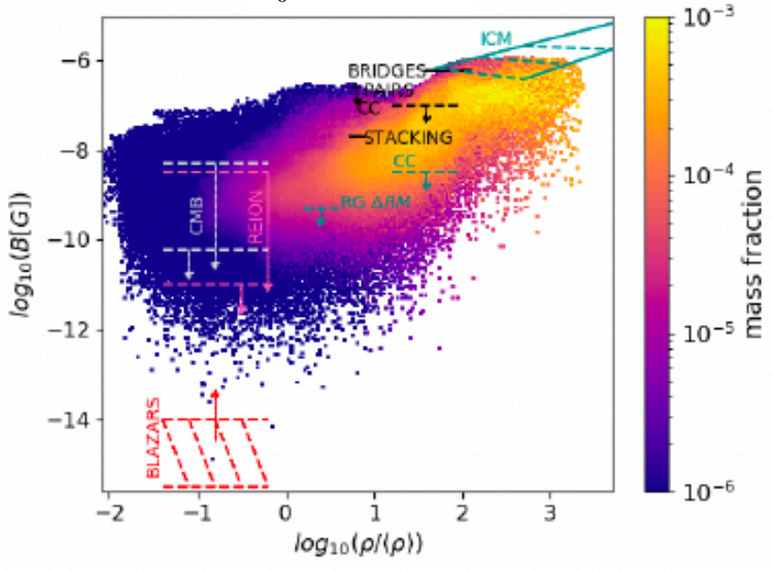
This relies on a simple ~MHD evolution of B in voids!

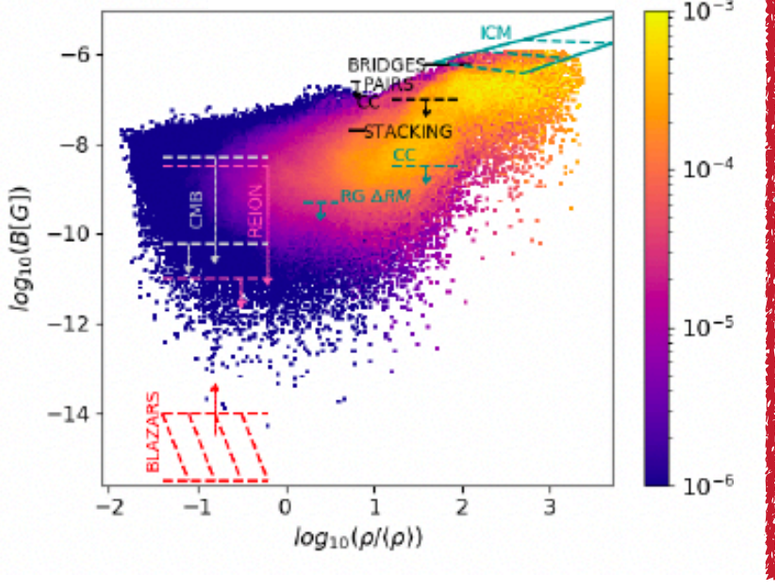


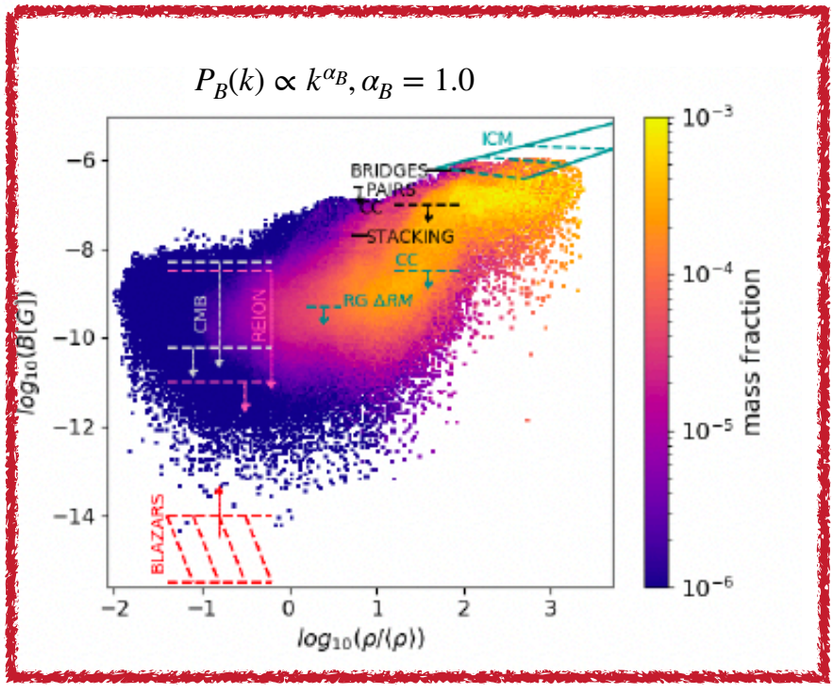












Vazza+17,21

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