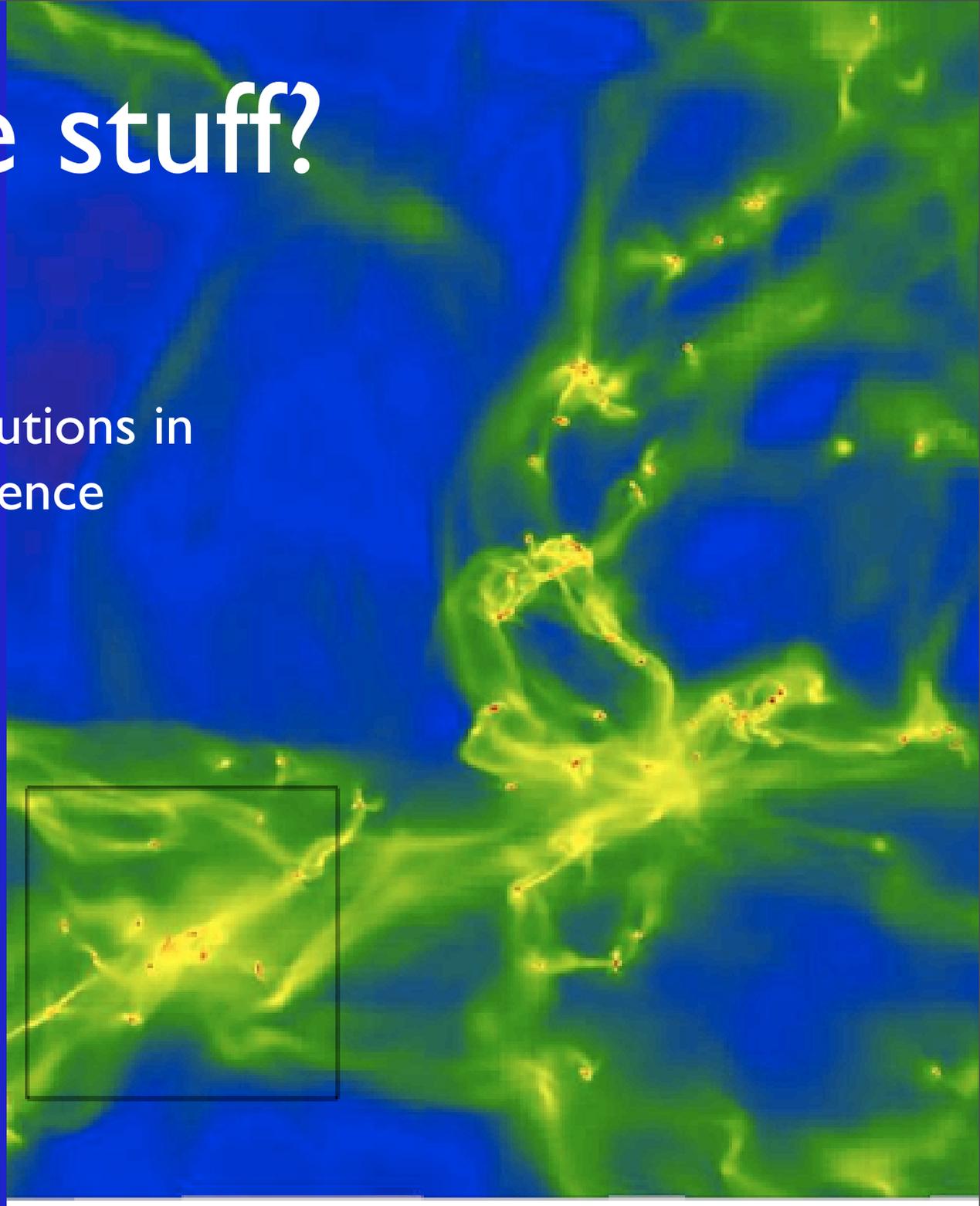


Where's the stuff?

Mass and magnetic distributions in
Self-Gravitating Turbulence
Simulations
with
AMR MHD

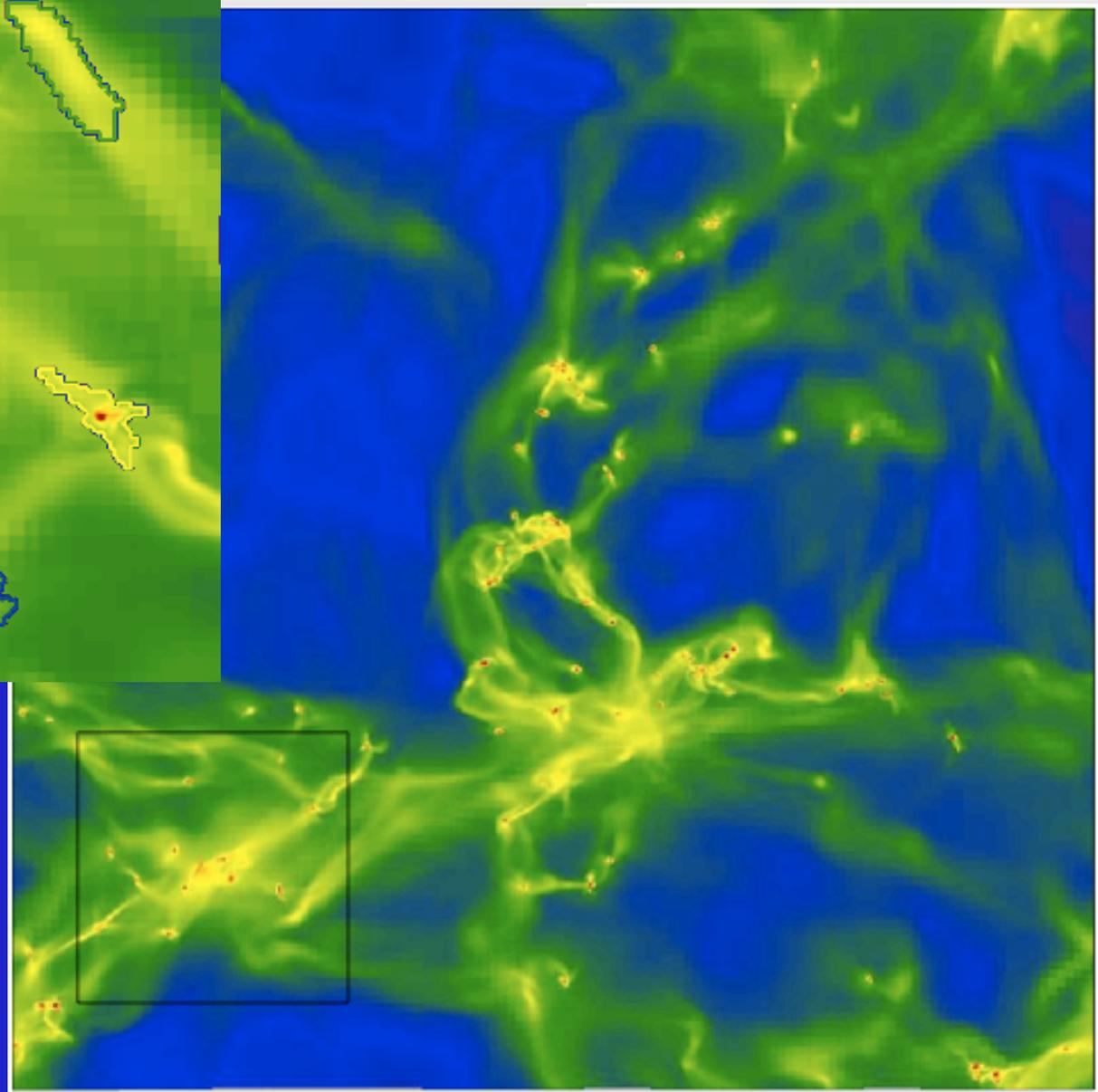
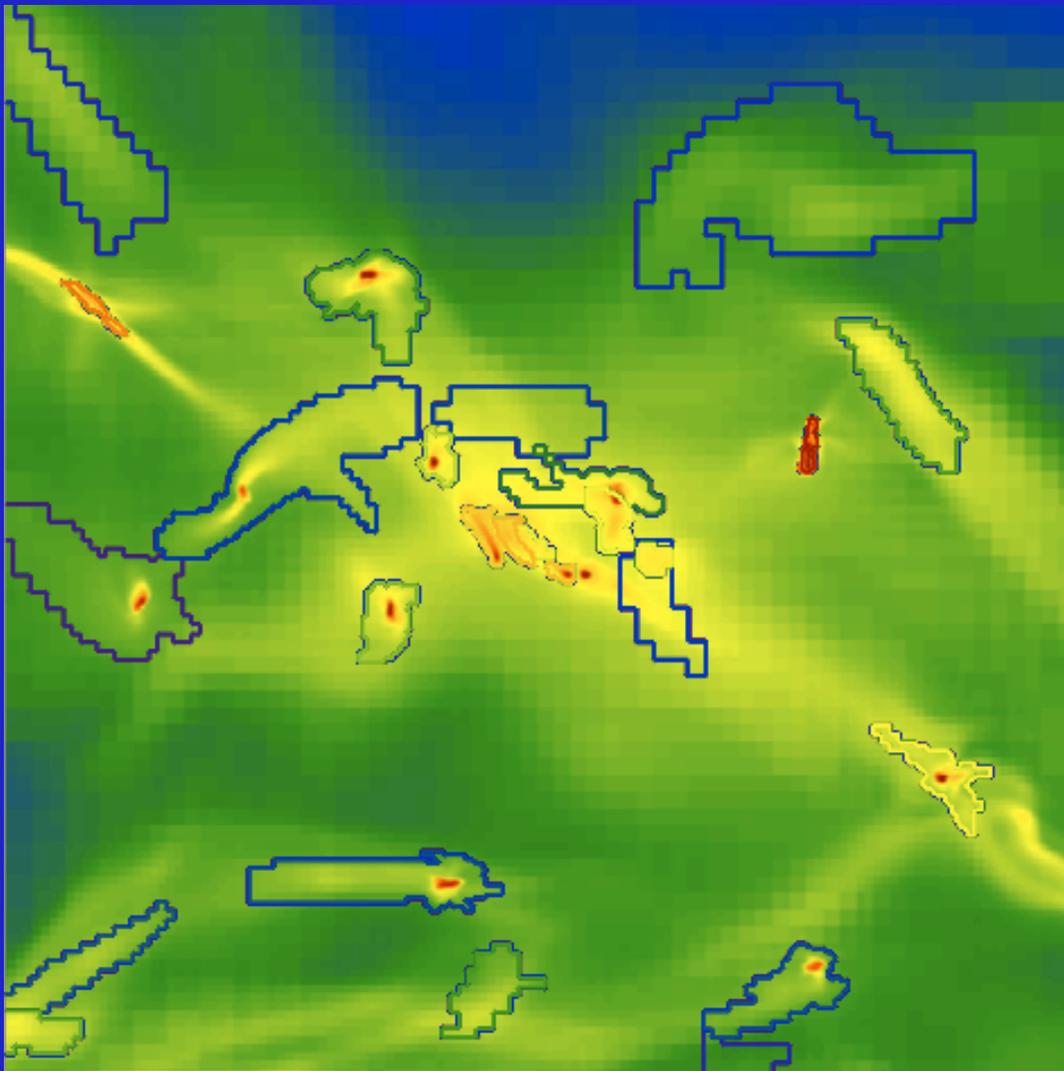
David Collins
UCSD



A story about
power-laws.

(Collins, Xu, Norman, Li, Li 2010)

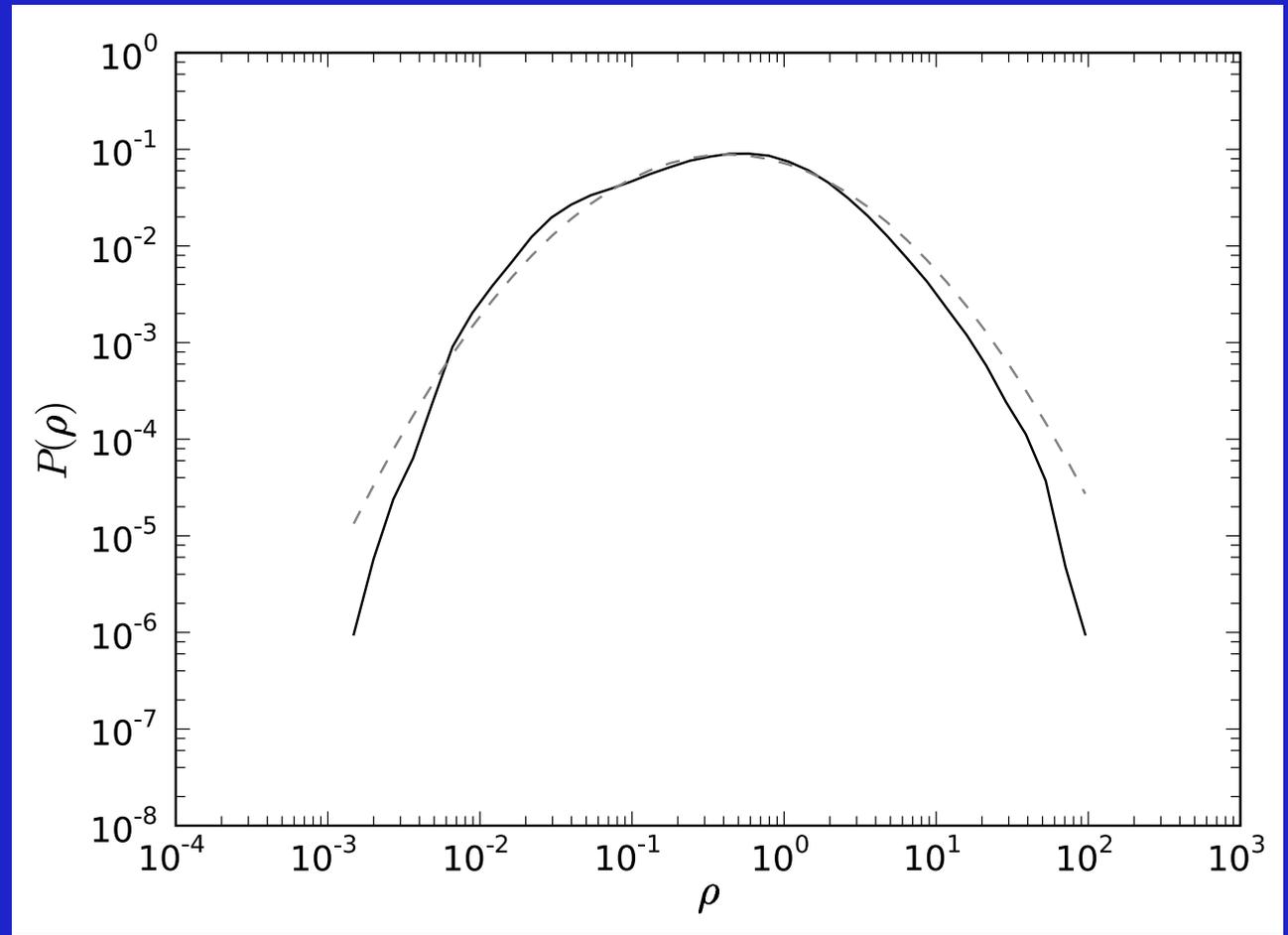
(Collins, Padoan, Norman, Xu 2010)



- AMR, MHD, Enzo
- 2048 effective

Supersonic Turbulence

- Dual Role
- Log Normal Density PDF
- Used to predict IMF, Star Formation Rate, etc.

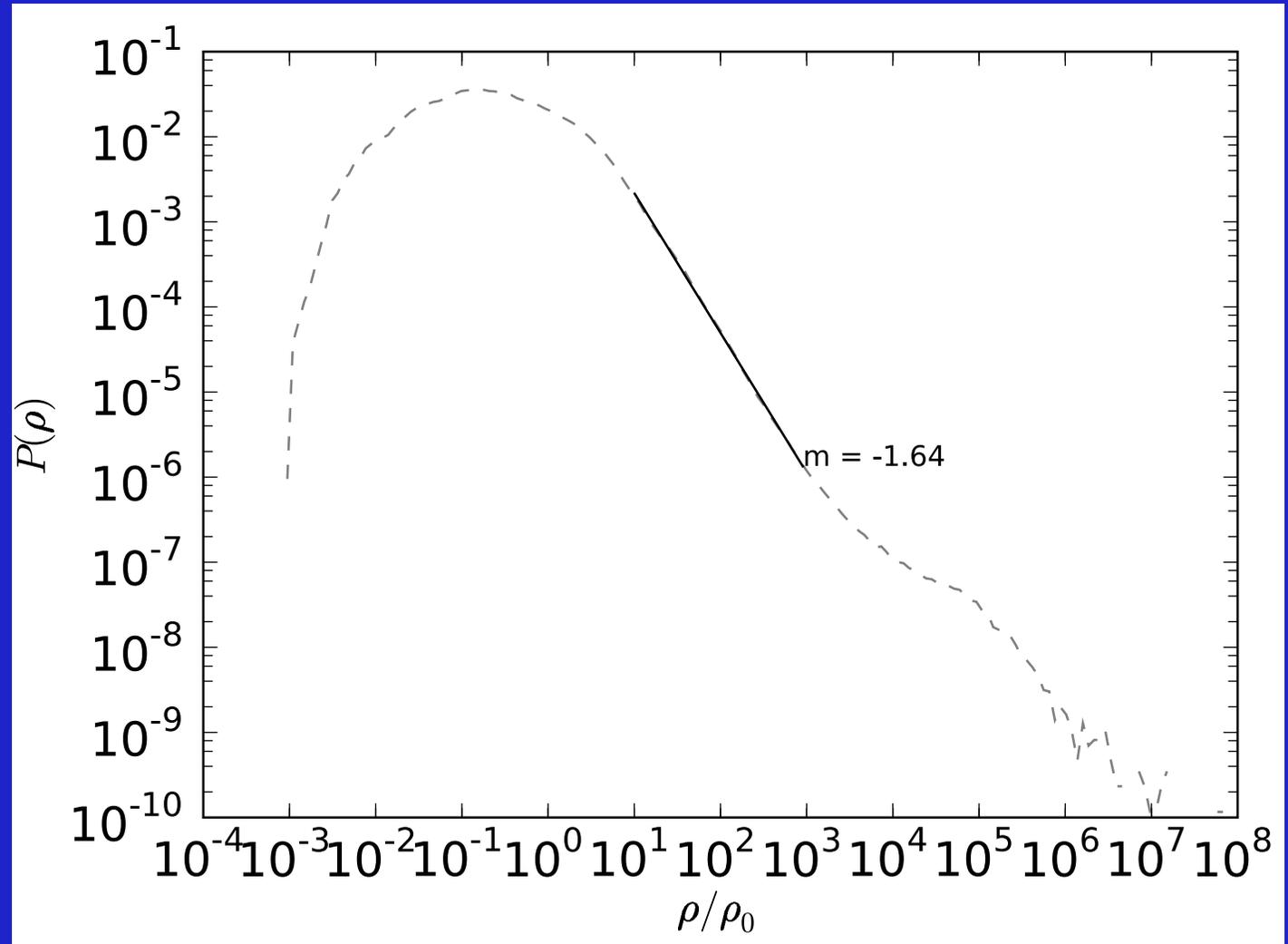


Gravity? Powerlaw

$$P(\rho) \propto \rho^{-1.6}$$

$$P_{\text{sim}}(\rho) \propto \rho^{-1.5}$$

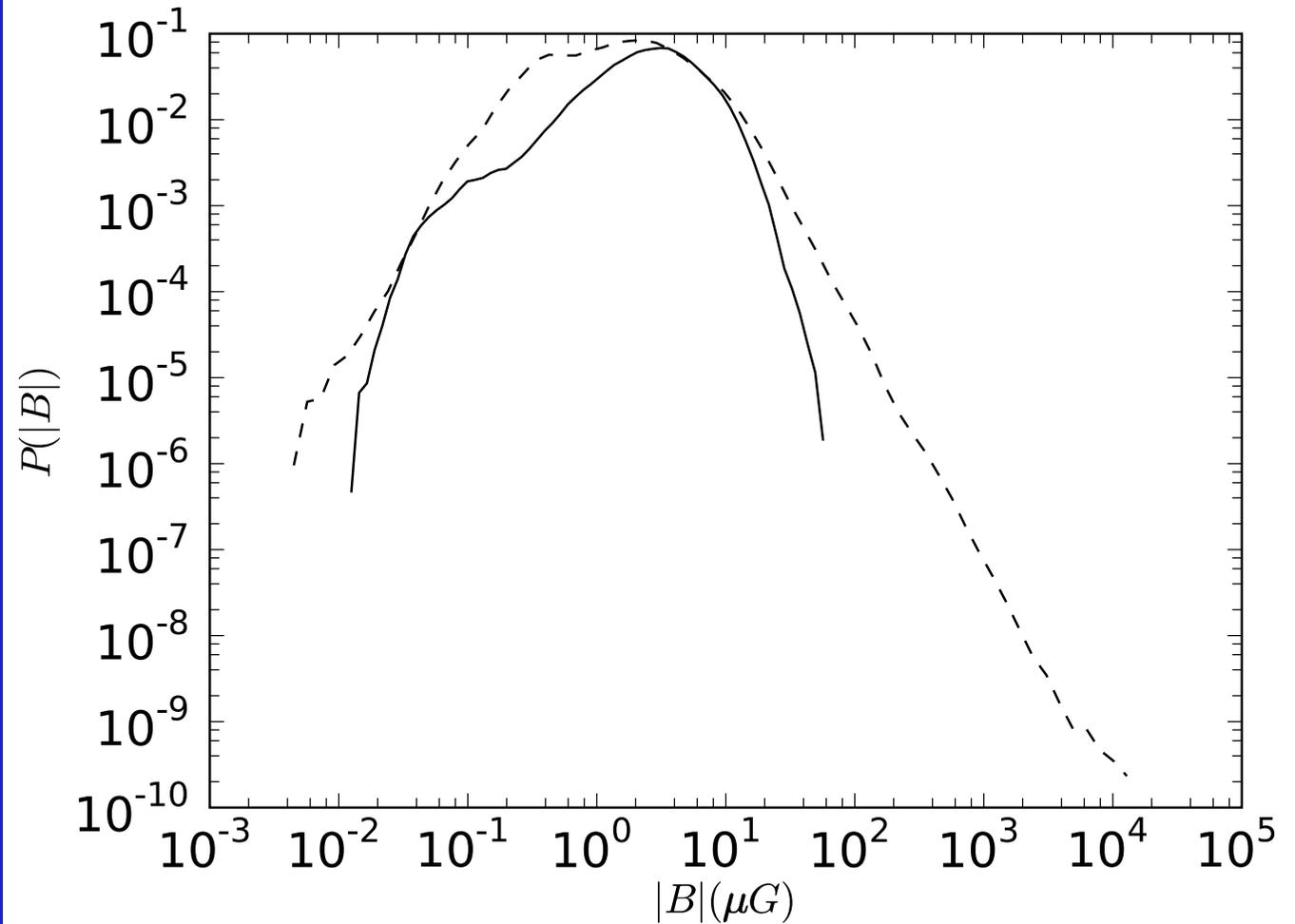
(Kritsuk, Norman, Wagner
2010)

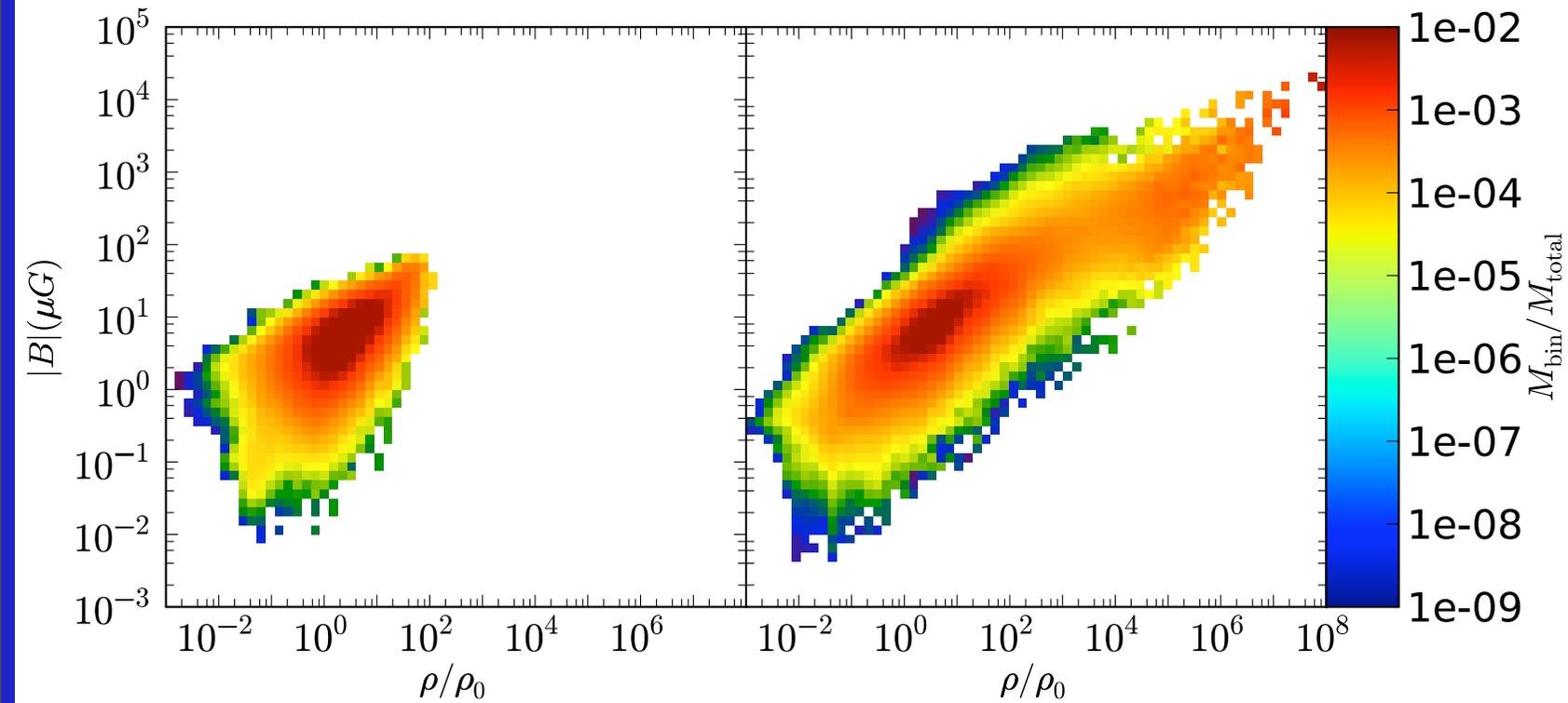


(Collins, Padoan, Norman, Xu 2010)

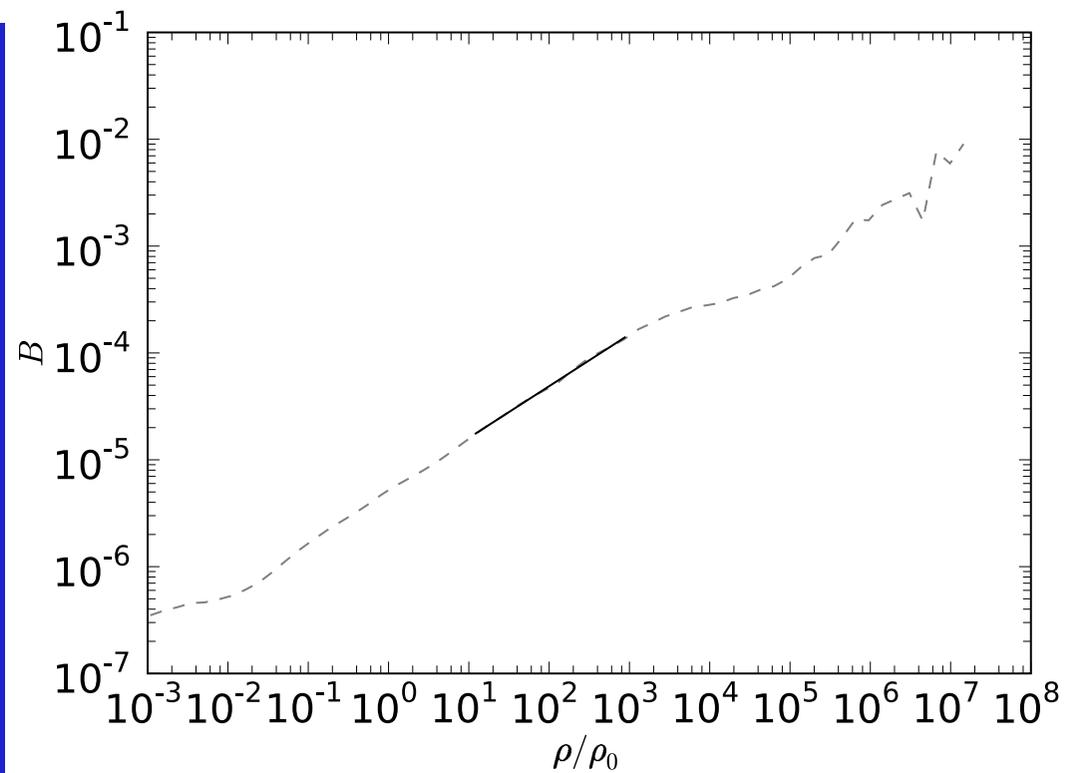
Where's the B?

$$P(B) \propto B^{-2.7}$$





$$B \propto \rho^{0.5}$$



$$P(\rho) \propto \rho^{-1.5}$$

$$\rho \propto B^2$$

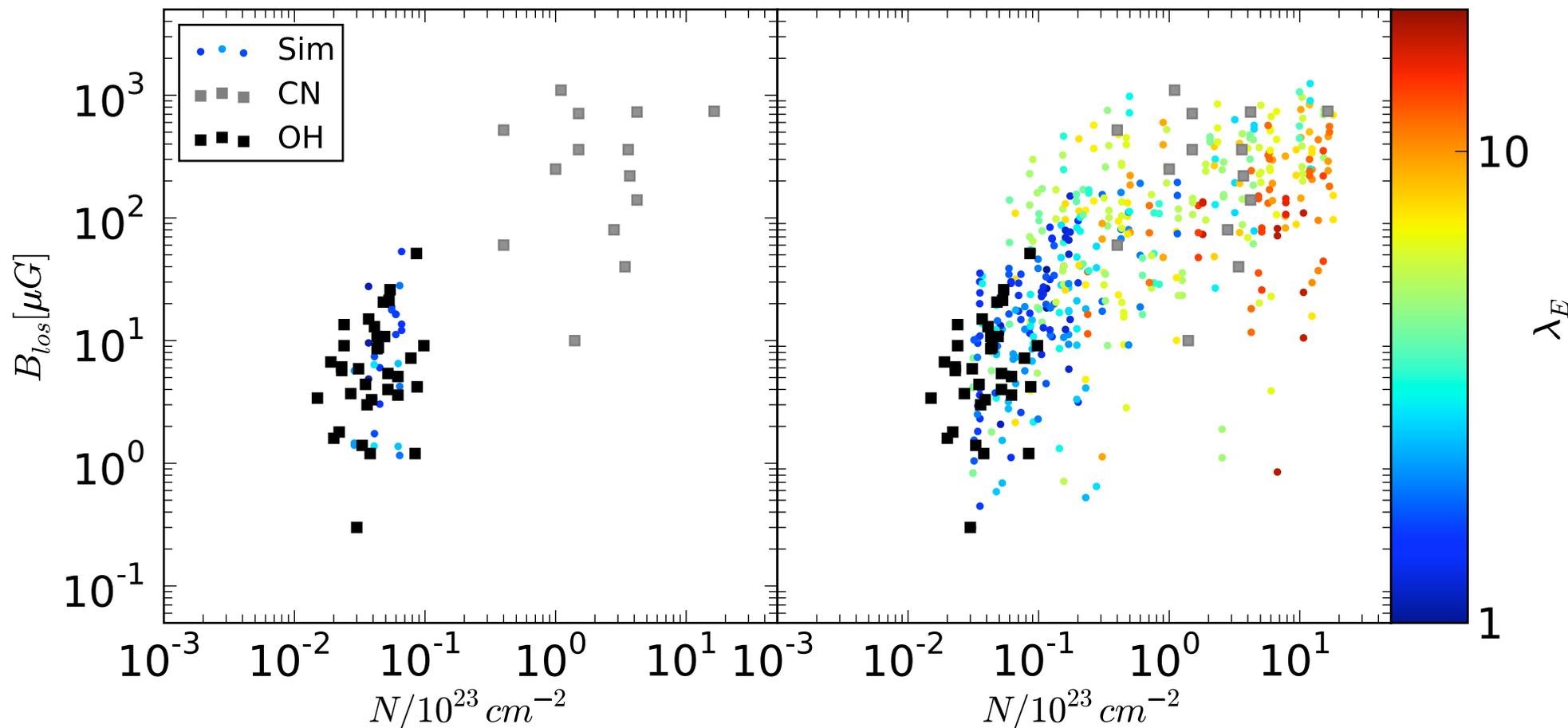
$$P(B) \propto B^{-3}$$

“Mass To Flux”

$$\frac{N}{B_{\text{los}}} \propto \frac{M}{\Phi}$$

$t=0$

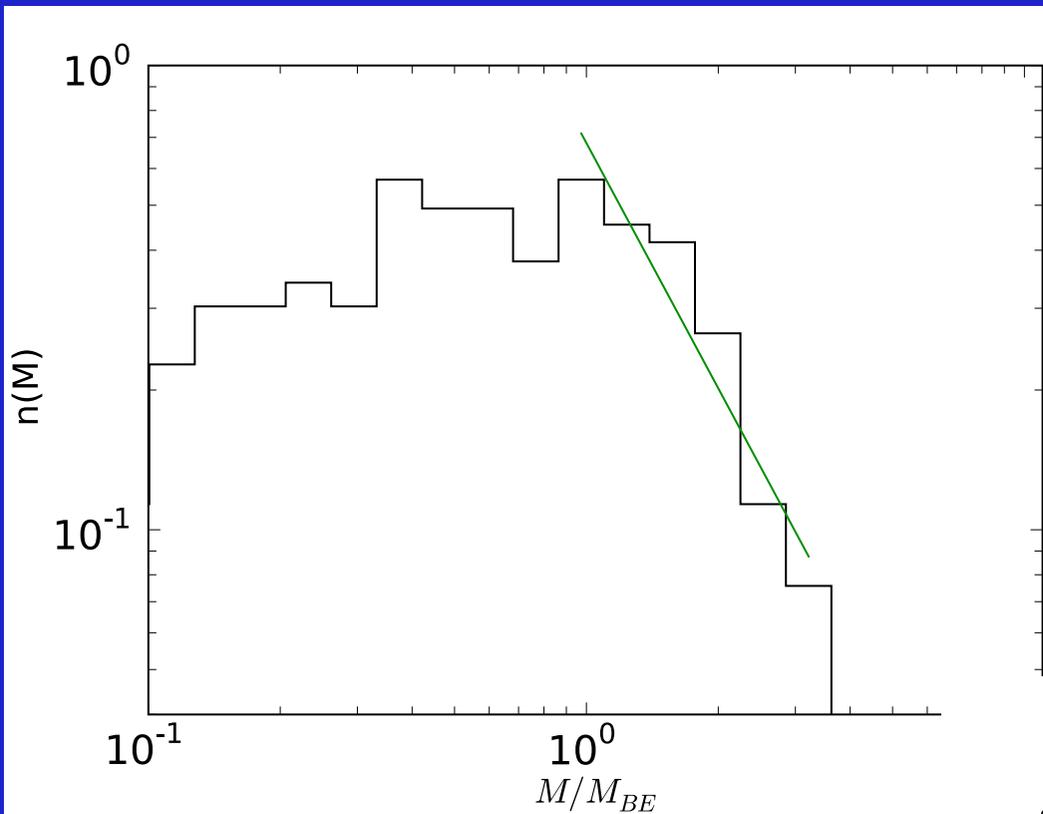
$t=0.75$



(Troland+2008)

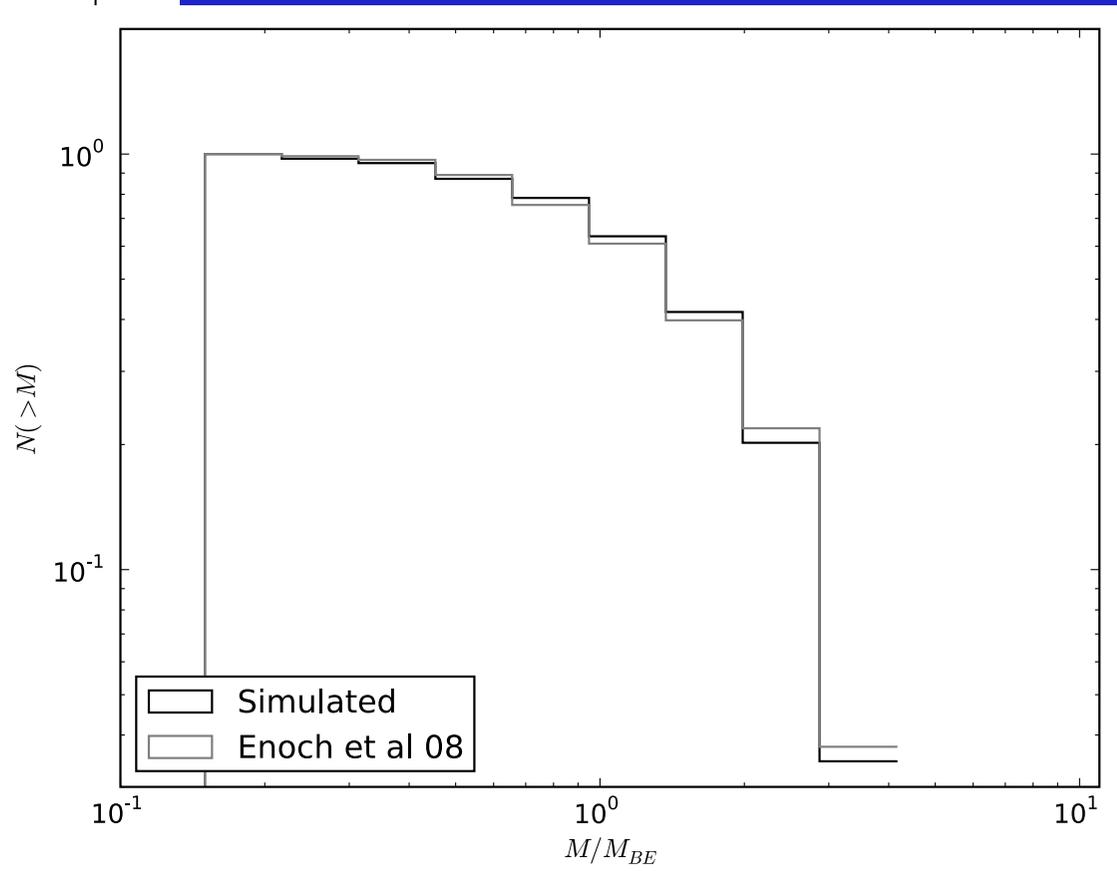
(Falgarone+2008)

$$B_{\text{los}} \propto N^{0.6}$$



$$n(M) \propto M^{-2.1 \pm 0.6}$$

Consistent with Prestellar
Cores.



Ambipolar Diffusion

- I don't have it.
- Things look pretty good.
- Do I need it?
- When do I need it?

$$R_{\text{AD}} = \frac{v}{v_{\text{AD}}}$$

$$\gamma \chi \rho^2 v_{\text{AD}} = \frac{B^2}{\ell}$$

$$R_{\text{AD}} = \gamma \chi \rho^2 v \ell B^{-2}$$

$$R_{\text{AD}} = \gamma \chi \rho^2 v \ell B^{-2}$$

Chemistry
(not simulated: guess)

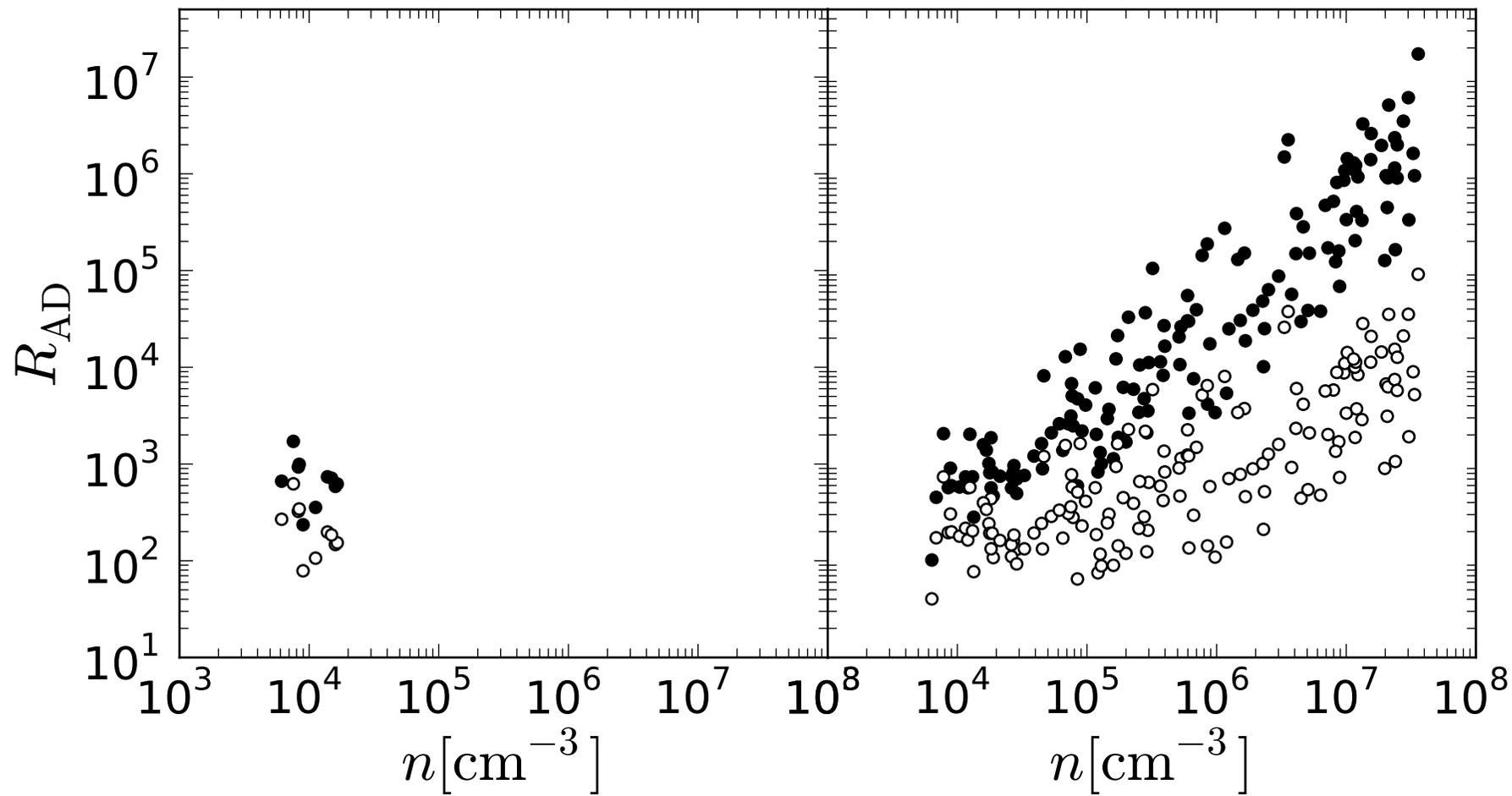
Simulated

 χ

- Dynamics \gg Recombination
 χ Constant
- Dynamics \ll Recombination
 $\chi \propto \rho^{-1/2}$

$\tau=0$

$\tau=0.75$



$$R_{\text{AD}} = \chi \rho^2 v \ell B^{-2}$$

$$R_{\text{AD}} = \chi \rho^2 \cancel{v \ell} B^{-2}$$

$$R_{AD} = \chi \rho^2 v \ell B^{-2}$$

Conclusions

- Turbulence + Gravity = Lognormal + Powerlaw
- +Magnetic Fields = Large field strengths+Powerlaw
- AMR + MHD necessary to probe Star Formation
- Excellent agreement with observed “Mass to Flux”
- Excellent agreement with observed mass distribution
- Diffusion maybe unimportant.