"Subgrid models attempt to replace the physical processes of small scale dissipation with processes that mimic the nonlinear transfer of energy to smaller scales [...] The final goal is not to capture the dissipation processes, but to be able to preserve (with computational gains) the large-scale dynamics."

Graham et al., PRE 80 (2009)



The Filtering Approach for MHD

Induction equation for mean field:

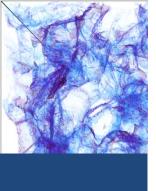
$$\frac{\partial}{\partial t} \mathbf{B} = \nabla \times (\mathbf{v} \times \mathbf{B}) + \eta \nabla^2 \mathbf{B}$$

$$\rightarrow \frac{\partial}{\partial t} \overline{\mathbf{B}} = \nabla \times (\mathbf{v} \times \mathbf{B})$$
magnetic reconnection

 Simple model: α-dynamo and turb. magnetic diffusion

$$\nabla \times \langle \mathbf{v} \times \mathbf{B} \rangle \doteq \nabla \times (\tilde{\mathbf{v}} \times \overline{\mathbf{B}}) + \alpha \cdot \overline{\mathbf{B}} + \eta_{\text{turb}} \nabla^2 \overline{\mathbf{B}}$$

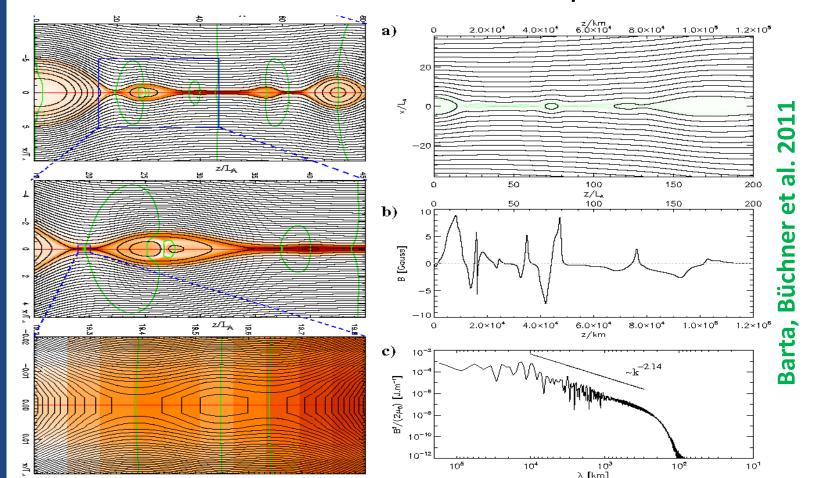
 Can we apply something like this in LES? If so, how to determine the model coefficients?



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Turbulent Reconnection on Microscales

- Determination of effective transport coefficients for microturbulent reconnection
- Kinetic simulations of small-scale processes





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From the Kinetic Regime to Magnetohydrodynamics

Kinetic description of reconnection and dissipation

Effective transport coefficients to account for kinetic plasma processes

Non-ideal magnetohydrodynamical simulations of turbulent dynamos and reconnection

Subgrid scale model to account for non-ideal effects Quasi-ideal magnetohydrodynamical turbulence