"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:
  \[
  \frac{\partial}{\partial t} \mathbf{B} = \nabla \times (\mathbf{v} \times \mathbf{B}) + \eta \nabla^2 \mathbf{B}
  \]
  \[
  \rightarrow \quad \frac{\partial}{\partial t} \overline{\mathbf{B}} = \nabla \times \langle \mathbf{v} \times \mathbf{B} \rangle
  \]

- Simple model: \( \alpha \)-dynamo and turb. magnetic diffusion
  \[
  \nabla \times \langle \mathbf{v} \times \mathbf{B} \rangle \doteq \nabla \times (\mathbf{\tilde{v}} \times \overline{\mathbf{B}}) + \alpha \cdot \overline{\mathbf{B}} + \eta_{\text{turb}} \nabla^2 \overline{\mathbf{B}}
  \]

- Can we apply something like this in LES? If so, how to determine the model coefficients?
Turbulent Reconnection on Microscales

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