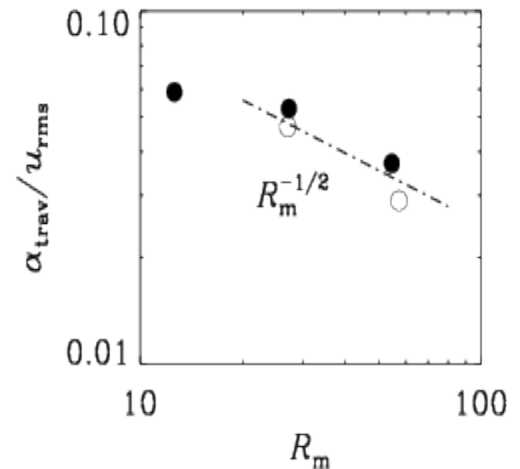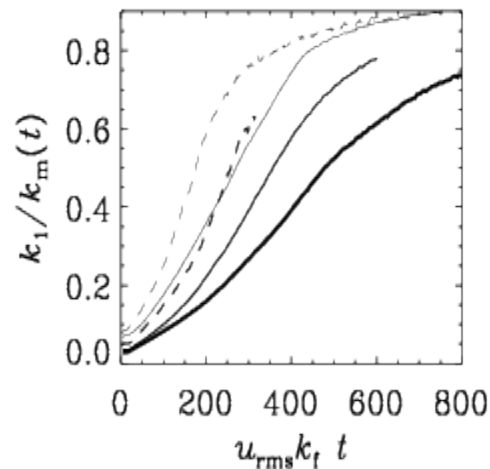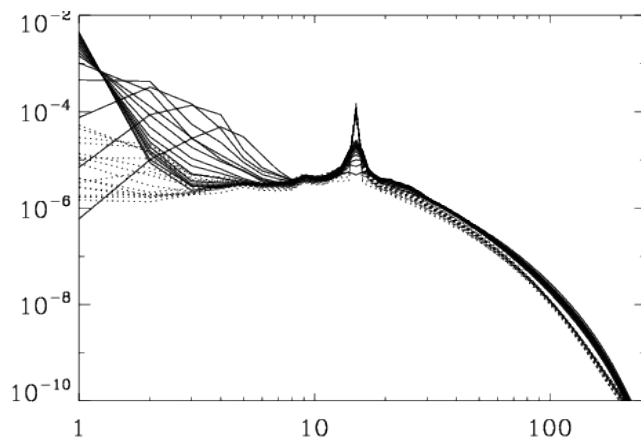# Magnetic helicity in LES

- Magnetic, kinetic, cross helicity in LES
  - physical effects caused by them
  - captured in LES? How?
- Can LES take us further than DNS
  - examples
- Mean-field simulations (MFS)
  - alpha effect dynamos
  - negative effective magnetic presssure,
  - ….

With input from…

- Eric Blackman: inverse transfer in dynamos
- Axel Brandenburg: 2 examples of Rm dependence
- Bill Matthaeus: 1/f noice as a consequence
- Annick Pouquet: what I don't understand …
- John Shebalin: rotation and helicity
- Hussein Aluie: cross helicity
- Nobu(mitsu) Yokoi: SGS model with helicity

Example 1: evidence for Rm dependence

- Similar to SS dynamo at early times
- Inverse cascade/transfer behavior
- Resistively slow saturation (!)

Example 2: magnetic helicity flux

$$\frac{d}{dt}\langle \overline{\mathbf{A}} \cdot \overline{\mathbf{B}} \rangle = +2\langle \overline{\boldsymbol{\mathcal{E}}} \cdot \overline{\mathbf{B}} \rangle - 2\eta\langle \overline{\mathbf{J}} \cdot \overline{\mathbf{B}} \rangle - \nabla \cdot \mathbf{F}_m$$

$$\frac{d}{dt}\langle \mathbf{a} \cdot \mathbf{b} \rangle = -2\langle \overline{\boldsymbol{\mathcal{E}}} \cdot \overline{\mathbf{B}} \rangle - 2\eta\langle \mathbf{j} \cdot \mathbf{b} \rangle - \nabla \cdot \mathbf{F}_f$$

Gauge-invariant in steady state!

- EMF and resistive terms still dominant

- Fluxes import at large Rm ~ 1000

- Rm based on k_f

- Smaller by 2π