

§Φ. Introduction.

Observations show that the Universe is filled with magnetic fields.

Most astrophysical bodies are magnetic

- Earth
 - Sun
 - Galaxies
 - Clusters
- } slides.

The problem of magnetogenesis:
where did the fields come from?

Estimates of seed fields from primordial mechanisms: $B \sim 10^{-18} \text{G}$

Observed field in galaxies & clusters: $B \sim 10^{-6} \text{G}$

This means that most of the field is generated, shaped and maintained "now."

Clue: energy of the field \sim energy of the fluid motions of plasma

Plasma: ionised gas (e's and i's) ^{hydrogen}
highly conducting

Field lines "frozen" into the flow: they move with the plasma and "slip" only a little due to very small magnetic diffusivity.

Field is not just moved around but also stretched
- this is how amplification happens.

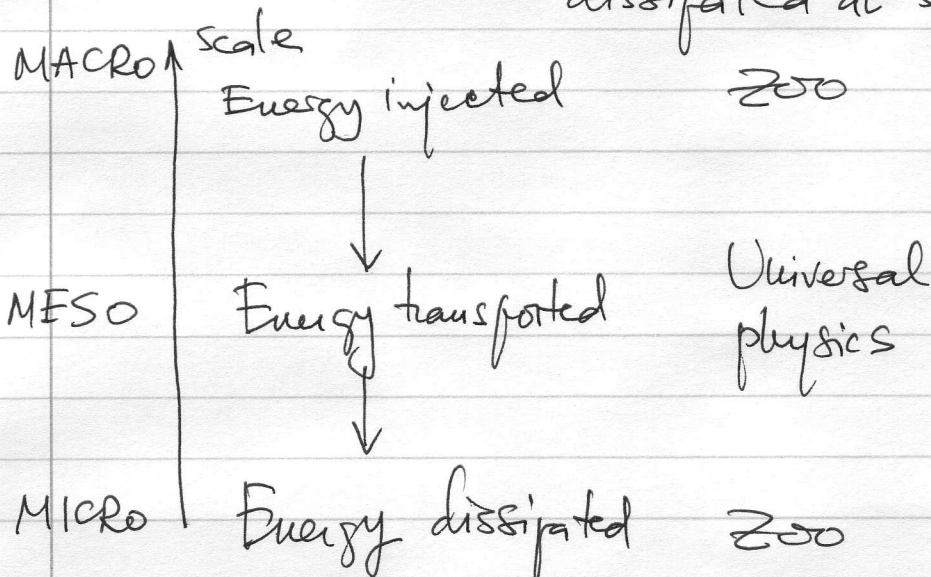
Once the field is strong, it can act back on the flow — MHD turbulence.

Turbulence: Leonardo: mean flow + eddies.

Astrophysical turbulence (slides)

Def. Multiscale disorder.

Basic philosophy: energy injected at large scales
dissipated at small scales



How ~~is~~ are the motions converted from large to small scales?

Richardson cascade large → smaller whorls...

Big whorls have little whorls

That feed on their velocity,

And little whorls have lesser whorls

And so on to viscosity.

Next lecture: K41.