Turbulence in the magnetized ISM

Summary of round-table discussion

Perm, 2006 Sept. 7

1. Measurements of ISM magnetic helicity: in solar physics done for 15 years now, revealed promising results, should be tried also in the ISM, e.g. in supernova remnants, whose the shells will take magnetic helicity outwards. Attempts in Newcastle by a PhD student are planned to see whether observational signatures (from radio polarization and velocity data) are detectable. The Bonn/Penticton group is ready to test this.

2. Measurements of ISM turbulence spectrum: Excellent results for the solar wind exist, but little is known for the ISM (mainly the rotation measure (RM) structure functions by Marijke Haverkorn). Method of Ensslin & Vogt should be modified & extended. Cooperation between theorists and observers needed. Important questions: are the magnetic fluctuations isotropic or anisotropic along the mean field? Turbulence spectrum below ~1pc in the local cloud can be measured by LOFAR, needed to model the Galactic foreground. The power spectrum of an empty part of the sky in Stokes I may reveal (an)isotropy (see paper by Eilek AJ 1998). From observations, it is hard to distinguish turbulence from local gas flows. Turbulence exists only below a few 10pc. Observations should point at a piece of homogeneous ISM.

Warning: the existing observations are 2-D projections. The new “RM Synthesis” method will deliver a third dimension along RM, which can hopefully be transferred into the line-of-sight coordinate (tomography).

3. Galactic dynamos: only important for injection of magnetic flux via the alpha effect? Strong shear in barred galaxies dominates the generated field structures, details of alpha are unimportant. Furthermore: galaxies are not steady! Dynamo may operate in the background, but can easily be distorted by gas streaming. Are barred galaxies suited for studies of dynamo action? Other galaxies? Regular patterns are observed around edge-on galaxies, are these sufficient to prove dynamo action? RM data are hard to obtain. Dynamo models neglect multi-phase ISM. Weibel instability makes the dynamo faster. Lab dynamos often do not agree with models, even small modifications may change the dynamo completely. No measurements of beta exist in lab dynamos.

Questions to all participants: What can we hope to learn from dynamo modelling about galaxies or the ISM?