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Magnetic field reversals in turbulent dynamos

STEPHAN FAUVE, Ecole Normale Supérieure

After a short review of dynamo mechanisms and their relevance for planetary and stellar magnetic fields, I will present the results of a recent experiment (the VKS experiment) displaying the generation of magnetic field by a fully turbulent flow of liquid sodium. I will then show that dynamical regimes of the magnetic field can be easily understood from the interaction of dipolar and quadrupolar modes. In particular, this interaction generates magnetic field reversals that have been observed in the experiment and display a hierarchy of time scales similar to the Earth's magnetic field: the duration of the steady phases is widely distributed, but is always much longer than the time needed to switch polarity. In addition to reversals, several other large scale dynamics of the generated magnetic field are obtained when varying the governing parameters of the flow. These results are understood in the framework of dynamical system theory.