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Numerical simulations and models of turbulent dynamos.

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Dynamo action is a mechanism by which a magnetic field is self generated by the turbulent flow of an electrically conducting fluid. The recent success of the VKS dynamo experiment provides a new way to investigate dynamo action in turbulent conducting flows and to understand the behavior of magnetic fields of planets and stars.

Depending on the forcing configuration, this experiment reproduces the self-generation of a magnetic field, but also shows some dynamical behaviors similar to the Earth, such as chaotic reversals of the polarity of the field.

Numerical simulations are very useful to understand what happens in the experiment. I will show that most of the experimental characteristics can be reproduced by our direct numerical simulations, like the structure or the dynamical behavior of the magnetic field. This interaction between numerical and experimental approaches allows us to understand the reversals of the magnetic field in the framework of low dimensional dynamical systems, derived by symmetry arguments. Theses models provide a simple way to describe the complex dynamics of turbulent dynamos. In this perspective, I will finally present a comparison between the reversals of the magnetic field of the Earth, obtained from geomagnetic observations, and a new model based on the interaction between two magnetic modes and one velocity mode.