Geophysical Research Abstracts
Vol. 13, EGU2011-7730, 2011
EGU General Assembly 2011

Experimental realisation of homogeneous dynamo action

Andre Giesecke, Frank Stefani, and Gunter Gerbeth
Helmholtz-Zentrum Dresden-Rossendorf

From the technical point of view the realisation of dynamo action under laboratory conditions is a demanding task because it requires magnetic Reynolds numbers of the order of Rm $\sim$100. So far only three experiments have been able to demonstrate fluid flow driven self-excitation of magnetic fields.

The dynamo experiments in Karlsruhe and Riga, based on an optimized flow geometry, have demonstrated the principal possibility of the magnetic field generation process and its saturation as it occurs e.g. in stars or planets. Both dynamos are characterized by a non-axisymmetric field mode and are theoretically very well understood.

In contrast to this the mechanism responsible for the dynamo process in the von Karman sodium (VKS) experiment is still subject of intense discussion, in particular due to the obscure influence of the flow driving soft iron impellers. Recently, it could be shown numerically that the (localized) high relative permeability of the impellers is responsible for the rather low value of the critical magnetic Reynolds number as well as for the selection of the dominating axisymmetric dynamo mode observed in the experiment (Giesecke et al. 2010, PRL 104). However, to explain a growing axisymmetric field an alpha-effect is required for which the theoretical or experimental justifications remain only vague.

Further progress in the experimental examination of dynamo action is expected from the future dynamo facility that is scheduled at the Helmholtz-Zentrum Dresden-Rossendorf. In order to avoid the influence of internal components or artificial driving mechanisms a precession driven flow of liquid sodium in a cylinder shall provide the necessary energy to exhibit dynamo action. A precession driven dynamo operating in a sphere has been presented by A. Tilgner (2005, Phys. Fl. 17). However, it remains to be shown that precessional flow driving will be possible with sufficient efficiency to overcome the dynamo threshold in a cylindrical geometry as well.