

## NUMERICAL SIMULATIONS AND MODELING OF MAGNETO-DYNAMO EFFECTS IN TURBULENT REGIMES

### PROJECT AIM

This project was partially funded by the EC MAGDYN project (2001-2005) dealing with experimental and numerical studies of magnetic dynamo effects. The final goal of our contribution is to have fully coupled simulations of fluid flow and magnetic fields under realistic conditions, which should capture self-excitation of the magnetic field. This fundamental study of the fluid flow, turbulence and electromagnetic fields interactions can provide new insights into mechanism of the magnetic dynamo that is believed to be behind the origins of planetary magnetic fields (including Earth's magnetic field).

### PROGRESS

The development of a fully coupled Navier-Stokes/Maxwell solver in complex 3D geometries is completed, and full-scale simulations of the Riga dynamo experimental setup have been performed. Because of the high Re number ( $3.5 \times 10^6$ ), the T-RANS approach is used. Both direct (through momentum equations) and indirect (through additional 'magnetic' terms in the turbulence transport equations) fluid flow/turbulence/electro-magnetic interactions are taken into account. Significant improvements in predictions of the magnetic field growth rate are obtained compared to the more common uncoupled solutions with kinematic solver. The fully coupled simulations captured for the very first time the saturation regime in turbulent flow, in excellent agreement with available experimentally recorded growth rates and frequencies.

### DISSERTATIONS

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### SCIENTIFIC PUBLICATIONS

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### PROJECT LEADERS

S Kenjeres, CR Kleijn

### RESEARCH THEME

Complex dynamics of fluids  
Mathematical and computational methods for fluid flow analysis

### PARTICIPANTS

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### COOPERATIONS

TU Dresden; Institute of Physics,  
Riga; FZR Rossendorf, Dresden;  
University of Grenoble; University of  
Maryland, College Park

### FUNDED

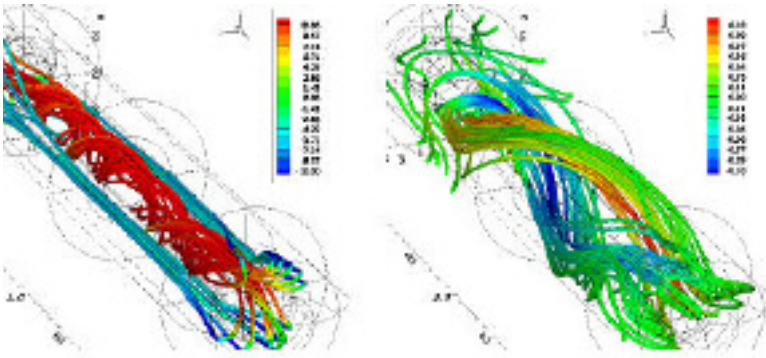
EC, KNAW, TU Delft  
1<sup>st</sup> 25% 2<sup>nd</sup> 25% 3<sup>rd</sup> 50%

### START OF THE PROJECT

2002

### INFORMATION

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Visualizations of the mean-flow (-left) and self-generated and self-sustained magnetic field (-right) in a fully two-way coupled T-RANS/DNS simulations of the Riga dynamo. Kenjeres and Hanjalic (2007).