Geophysical & Astrophysical Fluid Dynamics

Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/ggaf20

Introduction

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Version of record first published: 01 Mar 2013.

To cite this article: Axel Brandenburg & Igor Rogachevskii (2013): Introduction, Geophysical & Astrophysical Fluid Dynamics, 107:1-2, 1-2

To link to this article: http://dx.doi.org/10.1080/03091929.2013.764770

Geophysical and Astrophysical Fluid Dynamics, 2013
Vol. 107, Nos. 1–2, 1–2, http://dx.doi.org/10.1080/03091929.2013.764770

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Introduction

"From mean-field to large-scale dynamos" is the title of this special issue related to the workshop "The RädlerFest: alpha effect and beyond" organized at Nordita in connection with the celebration of Karl-Heinz Rädler's 75th birthday. A literature search shows that the combination of the three words "mean", "field", and "dynamo" occurred first in the title of an IAU proceedings of 1971 by nobody else than Krause and Rädler. By now, there are 135 publications with these words in the title, half of them were written since 2000, and 8 in just 2012 alone. These numbers indicate a sharp growth in a research field that was initiated over 40 years ago by Max Steenbeck, Fritz Krause and Karl-Heinz Rädler from Jena in the former German Democratic Republic. This was a time when mean-field hydrodynamics, and especially mean-field electrodynamics, emerged as an important tool to understanding in a systematic way the production of large-scale magnetic and velocity fields.

In the following years, mean-field dynamo theory was applied to spherical models to determine the excitation conditions of steady and oscillatory modes of axisymmetric or non-axisymmetric nature. Again, the work of Karl-Heinz played an important role, and he was one of the first to compute nonlinear nonaxisymmetric models in spherical geometry. In addition, he was always concerned with the transport properties of turbulence, discovered the $\Omega \times \boldsymbol{J}$ effect, computed magnetic effects on the Reynolds stress, and several other properties.

Since his retirement in 2000, Karl-Heinz spent significant amounts of time at Nordita, inspired new research, and contributed to the intellectual atmosphere in the group and in the two Nordita dynamo programs that took place in 2008 and 2011. The guest editors of this issue had the pleasure of collaborating with him on many of his papers during the last 10 years.

The papers contributed to this special issue reflect the impact that the research of Karl-Heinz still has to the field, and they also reflect the interest of individuals in the community to relate their work to that of Karl-Heinz. We begin with a series of five papers considering applications of dynamo theory to galaxies, the Sun, and the Earth, as well as general properties of dynamos and their solution techniques:

D. Sokoloff and D. Moss, *What can we say about seed fields for galactic dynamos?*
A. Bonanno, *An overshoot solar dynamo with a strong return meridional flow*
C.-C. Wu and P.H. Roberts, *On a dynamo driven topographically by longitudinal libration*
A. Giesecke, F. Stefani and G. Gerbeth, *Spectral properties of oscillatory and non-oscillatory α^2-dynamos*
F. Stefani, M. Xu, G. Gerbeth and T. Wondrak, *Integral equations in MHD: theory and application*

Next, we have three papers concerned with the description of turbulence in terms of a restricted number of modes, its inverse spectral transfer properties, and attempts linking shell models of hydromagnetic turbulence to parameterizations of inverse spectral transfer in terms of an α effect:

K. Yoshimatsu, N. Okamoto, Y. Kawahara, K. Schneider and M. Farge, *Coherent vorticity and current density simulation of three-dimensional magnetohydrodynamic turbulence using orthogonal wavelets*
W.-C. Müller and S.K. Malapaka, *Role of helicities for the dynamics of turbulent magnetic fields*
G. Nigro, *A shell model for a large-scale turbulent dynamo*

Three papers are devoted to aspects of turbulent transport. These papers are concerned with cross helicity, whose presence can lead to contributions in the mean electromotive force that are proportional to mean vorticity and/or rotation:

N. Yokoi, *Cross helicity and related dynamo*
V. Pipin, *Helicity–vorticity turbulent pumping of magnetic fields in the solar convection zone*
A. Brandenburg and K.-H. Rädler, *Yoshizawa's cross-helicity effect and its quenching*

Finally, we have two papers dealing with convectively driven dynamos, and in particular the possibility of large-scale dynamos that can amplify magnetic fields on scales large compared with those of the turbulent eddies:

K.A. Mizerski and S.M. Tobias, *Large-scale convective dynamos in a stratified rotating plane layer*
P.J. Käpylä, M.J. Mantere and A. Brandenburg, *Oscillatory large-scale dynamos from Cartesian convection simulations*

With this collection of papers we hope to provide some insight into the current status of this rich field that was opened at a time when Karl-Heinz made crucial contributions.

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