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Special issue on magnetohydrodynamic flows

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The science of magnetohydrodynamics (MHD) is concerned with the behavior of flows of electrically conducting fluids and magnetic fields in the course of their mutual interactions. The magnetic fields can be externally applied or generated by the flows. The interactions involve induction of electric currents caused by fluid motion across the magnetic field lines and the Lorentz force affecting the flow. The result is not merely a modification of the principles of hydromechanics, but an entirely new set of physical phenomena that amounts to a separate and, in the opinion of the authors of this volume, appealing scientific discipline.

The papers collected in this special issue of Theoretical and Computational Fluid Dynamics represent several rapidly evolving areas of MHD:

- The dynamo theory that explains how the magnetic fields of planets, stars, and galaxies are generated. More specifically, the focus is on numerical models applied to analyze the dynamo effect and to understand the results of recent liquid metal experiments.
- The effects of the magnetic field on the properties of turbulence. Here, the attention is given not only to the flow transformation per se, but also to the optimal ways to represent this transformation in turbulence modeling.
- Flows of liquid metals in the presence of a strong applied magnetic field. This branch of MHD is primarily stimulated by technological applications in metallurgy, materials processing, and the design of lithium and lithium–lead blankets for future fusion reactors.

The concept of the special issue first appeared in 2007, in the discussions during the second MHD summer program at the Université Libre de Bruxelles. On behalf of the authors, most of whom took part in the program at some stage, I would like to thank the organizers: Daniele Carati, Bernard Knaepen, and Stavros Kassinos. I would also like to thank the staff at the TCFD editorial office, especially Michele Locke, for their support in preparation of the volume.