International Union of Theoretical and Applied Mechanics

Warsaw University

IUTAM Symposium on

TUBES, SHEETS and SINGULARITIES in FLUID DYNAMICS

2-7 September 2001, Zakopane, Poland

International Scientific Committee

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Some fifty years ago coherent structures in turbulence were discovered by statistical analysis of the velocity measurements, but their geometrical form remained unknown for more than three decades. Direct numerical simulations (DNS) and skilful visualisation show them to be elongated vortices whose cross-sectional structure seems to be controlled by viscosity, but the dynamics of their creation still remains a puzzle. Filaments can result from instabilities of vortex sheets and various aspects of this process in both steady and unsteady sheets, possibly stretched in either direction, are of great interest. The new evidence (from DNS) inspired much theoretical work, both on the steady state, and on the interaction and stability of vortices. Interaction of vortex filaments results in spirals, which are the structures in physical space that can be associated with the spectral power laws of turbulence. Such interactions also produce extremely strong gradients of either velocity or its derivatives which, in the high Reynolds number limit, control the process of viscous energy dissipation, and which may lead to the formation of singularities.

Vortex filaments are in many ways analogous to the magnetic flux tubes which are coherent structures found in magnetohydrodynamics (MHD), especially prominent in the solar dynamo process. Interacting flux tubes create current sheets and, in the ideal limit, tangential discontinuities - the generic MHD singularities which form in the process of relaxation towards magnetostatic equilibrium. The conditions in the solar photosphere are nearly ideal, so the topological constraints imposed by non-dissipative MHD are important, as are the singularities where these constraints are most easily broken.

Both slender vortices and flux tubes can have topologically complex form (e.g. knotted or linked) and the mathematical apparatus necessary to describe and classify the topology is the same. Their steady states are mathematically equivalent, but there are important differences in their evolution. The influence of the topology on the dynamics provides an important common ground.

The goal of the proposed Symposium would be to bring together those who work on various aspects of the fundamental structures in hydrodynamics and MHD, so that both communities can explore natural similarities and understand their limitations. We will encourage papers on the following specific topics:

- Formation, structure and disruption of vortices and flux tubes
- Topology and minimal energy states
- Formation of singularities
- Spiral structures and enhanced dissipation
- Stability of tubes and sheets

The Symposium which will be in the tradition of an important series of previous IUTAM Symposia:

- IUTAM Symp. on Concentrated Vortex Motion in 1964,
- IUTAM Symp. on Fundamental Aspects of Vortex Motion in 1987,
- IUTAM Symp. on Topological Fluid Mechanics in 1989,
- IUTAM Symp. on Dynamics of Slender Vortices in 1997.

We also expect that new results on the small-scale structures in turbulence will be announced at the Programme on Geometry and Topology of Fluid Flows to be held Sept–Dec 2000 at the Isaac Newton Institute in Cambridge. This will give new boost to the field and create ideal conditions for a follow-up Symposium in 2001.

Please post

Deadline for sending abstracts 31 March 2001

For list of invited speakers and pre-registration form please see `www.igf.fuw.edu.pl/IUTAM`

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