

Call for Proposals

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Priority Programme „Turbulent Superstructures“ (SPP 1881)

The Senate of the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) has established the Priority Programme „Turbulent Superstructures“ (SPP 1881), which is intended to run for six years. This call invites submissions of proposals for the first three-year funding period starting in 2016.

The classical picture of turbulence is that turbulent fluid motion is characterised by a cascade of vortices and swirls of different sizes that give rise to a featureless and stochastic fluid motion. Our daily experience shows, however, that turbulent flows in nature and technology are often organised in prominent large-scale and long-living structures that can cause extreme fluctuations. The focus of the Priority Programme are patterns whose coherence does not stop at the natural scale, such as the boundary layer height, but extends over much larger scales. When present, superstructures can dominate the global transport of mass, heat and momentum, act as barriers to transport, and increase the variability and fluctuations in the flow.

Currently very little is known about the origins, dynamics, and impact of superstructures on turbulent flow properties. Furthermore, their consequences for the statistical properties of turbulent flows, and their connection to the occurrence of extreme events are poorly understood. The study of superstructures is now possible due to significant advances in measurement techniques, numerical simulation, and mathematical characterisation. Tomographic laser-based measurement techniques can track the dynamics of turbulent structures with unprecedented resolution in space and time. Direct numerical simulations on massively parallel supercomputers have advanced to a level where turbulent flows in extended domains can be simulated at sufficiently high Reynolds numbers and in parameter ranges where superstructures emerge. Efficient methods to characterise dominant vortices and flow structures and to determine the transport across their boundaries as well as their dynamical evolution have been developed in applied mathematics. Computer science provides efficient algorithms for the visualisation of structures in very large data sets.

The aim of the Priority Programme is to integrate the different recent advances to arrive at a comprehensive characterisation and understanding of turbulent superstructures. Projects within the proposal should contribute to several of the following aspects:

- experimental characterisation of superstructures
- direct numerical simulations of turbulent large-scale and superstructures
- Lagrangian and Eulerian methods for detection and identification
- modelling the origin and dynamics of turbulent superstructures
- fast processing and visualisation of large data sets

In order to assist networking between applicants before the deadline for proposals, we ask everybody, who is considering applying within this call, to submit a description of the planned project (max 1 page) by **31 August 2015** to Professor Dr. Schumacher and Dr. Michael Lentze. The summaries will be provided to all potential applicants for information.

Among the specific questions that should be addressed are:

- to detect superstructures effectively and rapidly by the application of Eulerian and Lagrangian analysis tools
- to unravel the origin of superstructures from primary and secondary flow instabilities or from instabilities in fully developed turbulence
- to understand the mechanics of superstructures as well as the role of symmetries and boundary conditions
- to quantify the fluxes of mass, heat and momentum across the evolving interfaces, and the overall impact of superstructures on global transport and turbulence statistics
- to develop approaches for the control and the efficient modelling of turbulent superstructures in reduced models
- to develop reliable measures for short-term forecasts of extreme events in high-Reynolds number turbulence

In order to keep the programme focussed, it is intended to study single-phase, wall-bounded flows in simple, typically Cartesian and parallel geometries, driven by shear or buoyancy. Other flows can only be considered if they can add to the understanding of superstructures in the above group of flows.

Each participant has to submit a separate proposal which clearly indicates the planned collaboration with other applicants.

Research proposals for the first three-year funding period, to be written in English, are now invited. All proposals should follow the guidelines in DFG forms 50.05 (Priority Programmes, Part B) and 54.01 (Project Proposals). Please include a title page with your name, institution, and the title of your project in your application. The deadline for proposal submission is **25 November 2015**.

Proposals must be submitted via the DFG's electronic submission system "elan", selecting "SPP 1881". If you are using the "elan" system for the first time, please note that you need to register yourself and your institutional addresses before being able to submit a proposal. If you are planning to move to a different institution (e.g. with a Temporary Position for Principal Investigators) you need to register with the address of the new institution. Please make sure that all applicants of your project start their registration at the latest two weeks before the submission deadline as registration requests are taken care of manually by DFG staff.

The envisaged start of funding is mid-2016.

Further information

Further information on the Priority Programme is available at:
www.tu-ilmenu.de/turb spp

DFG's portal "elan":
<https://elan.dfg.de/>

Forms and guidelines can be downloaded at:
www.dfg.de/foerderung/formulare

For further scientific information, please contact the Priority Programme's coordinator:
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