SFB/TRR 173 *Spin+X* Scientific Talk

**Wednesday, 30.11.2022, 10:00 a.m.**
**Location Room 76/276 TUK**

https://uni-kl-de.zoom.us/j/63341418894?pwd=TkZmaVFJam04Z3JHL3Q3dkhlWSs4Zz09
Meeting ID: 633 4141 8894
Passcode: ++6zWW?X


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# Hydrodynamic turbulence in superfluid Helium: basic ideas, experiments, and physical models

Turbulence in superfluid helium is unusual and presents a challenge to fluid dynamics because the liquid helium consists of two coupled, interpenetrating turbulent fluids: the first is inviscid with quantized vorticity, while the second is viscous with continuous vorticity. Despite this dual nature, classical and quantum fluids turbulence have much in common, although the differences sometimes are significant.

During a brief historical overview, I will remind basic ideas in classical fluids' turbulence and describe superfluid turbulence's peculiarities. Further, I will discuss the current concepts, experiments, and physical models of superfluid turbulence, presenting a physically transparent and as simple as possible description of homogeneous, isotropic turbulence of superfluid He-3 and He-4.
In particular, I will present recent analytical and numerical results of our study of statistics of stationary superfluid turbulence in mechanically driven superfluid He-3 and He-4. The focus is placed on the mechanisms of the energy transfer between the

excitation scales and between normal and superfluid components, the rates of energy dissipation by viscosity and mutual friction, and the high-order statistics of turbulent velocities, including intermittency effects.

In addition, I will describe our numerical discovery and analytical description of strong anisotropy of the energy spectra in the thermally-driven turbulent counterflow of superfluid He-4. I will show that in agreement with the experiment, the energy spectra in the direction orthogonal to the counterflow exhibit two scaling ranges: a near-classical non-universal cascade-dominated range and a universal critical regime at large wave numbers. Our theory predicts the dependence of various details of the spectra and the transition to the universal critical regime on the flow parameters.

In conclusion, I should state that many important questions remain unsolved. They include, for example, a detailed description of the vortex-reconnection dynamics and their effect on the temporal and spatial evolution of superfluid turbulence and a microscopic description of the counterflow turbulence.

Much more experimental, analytical and numerical studies are required to achieve the desired level of understanding in superfluid-turbulence research.

The guest is hosted by Dr. Aleksandr Serha
GUESTS ARE WELCOME!