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Studijni oddeleni  
Ke Karlovu 2017/3  
121 16 Praha 2  
The Czech Republic

Re: Dissertation by Mr. Emil Varga “Experimental and numerical investigation of quantum Turbulence in He II”.

Dear Sir/Madam,

This is my report on the doctoral thesis by Mr. Emil Varga “Experimental and numerical investigation of quantum Turbulence in He II”.

The thesis is an example of high-quality scientific writing. The presentation is easy to follow. All concepts and conclusions – from the general methodology and techniques to the validity and significance of experimental results – are properly introduced, explained, justified and referenced. The quality of typesetting and figures is superb.

The experimental work, on which the dissertation is based, covers several different experiments that employ a range of techniques (attenuation of second sound, precision thermometry, excimer molecule tagging velocimetry, numerical simulations). It is published in 14 refereed journals (5 Physical Review B, 5 Journal of Low Temperature Physics, 1 Europhysics Letters, 1 JETP Letters), and two further manuscripts are submitted.

All of the numerous observations and conclusions of the thesis constitute original significant contributions to the subject of quantum turbulence. I would like to single out several notable examples:

- measurements of the density of quantized vortex lines and temperature gradients in steady-state counterflow;
- studies of the evolution of the energy spectrum during the free decay of different types of quantum turbulence;
- experiments on the transient behavior of the vortex line density upon switching the counterflow on and off;
- investigation of the intermittency enhancement in the decaying grid turbulence using excimer molecule velocity tagging velocimetry;
- numerical insight into the relevance of the dynamics of tracer particles to the intrinsic properties of vortex tangles;

- numerical simulation of a novel object – a spherical vortex tangle resulting from a point source of heat – with predictions of qualitatively new phenomena which should be observable experimentally.

All of these studies are timely and very important being good examples of cutting-edge research in both quality and significance. Here we are dealing with an internationally-leading research on turbulence in superfluid  $^4\text{He}$ . Furthermore, apart from being instrumental for the immediate field of superfluid turbulence, the improved understanding of these properties will positively impact on our understanding of turbulence as a general phenomenon in classical fluids and beyond.

To conclude, the thesis fulfills the general quality requirements for doctoral dissertations. It is presented clearly, communicates a wide range of original and significant scientific findings obtained by a variety of cutting-edge techniques, for which the contribution of Mr. Varga was instrumental. The presented research follows good scientific practice and ethical principles. With this Thesis, Mr. Varga has demonstrated his ability for creative scientific work, and I am happy to recommend awarding him the doctoral degree.

Sincerely Yours,

Andrei Golov  
Professor of Condensed Matter Physics