welcome to the European Microkelvin Collaboration

CAPACITIES

Application Form for MICROKELVIN Transnational Access Project

1. General Information

Project number:	Lancs09	
Project Title:	**Detailed study of quantum turbulence from vibrating objects in superfluid Helium-4**	
Lead scientist:[1]	**Title:**	Prof.
	First name:	Ladislav
	Last name:	Skrbek
	Home institution:	Charles University in Prague
Host scientist:[2]	**Title:**	Prof.
	First name:	Shaun
	Last name:	Fisher
	Home institution:	Lancaster University
Project scientist:[3]	**Title:**	Dr.
	First name:	David
	Last name:	Schmoranzer
	Scientific Field:	Low Temperature Physics, Superfluidity
	Home institution:	Charles University in Prague
	Is your home institution MICROKELVIN partner?	No
	Business address:	
	Street:	V Holešovičkách 2
	PO Box:	-
	City:	Prague
	Zip/Postal Code:	18000 Prague 8
	Country:	Czech Republic
	Telephone:	+420 221 91 2716 (lab), +420 777 586 939 (mobile)
	Fax:	-
	E-mail:	david.sch@seznam.cz

Curriculum vitae (18 lines max):

Date and Place of Birth: 28/11/1981, Šumperk, 787 01, Czech Republic

Education

2002 - 2011 Faculty of Math. & Phys., Charles Univeristy, Prague (MSc. 2007, PhD. 2011)
Condensed matter physics, Low temperature physics, Superfluidity

Master's Thesis: *Vibrating quartz crystal as a tool for studying the flow of cryogenic fluids*
Doctoral Thesis*: Investigation of cryogenic helium flows using mechanical oscillators*

1996 - 2002 Olomouc – Hejčín Grammar School, English Section (bilingual education)

Employment History

since 2012 Academic assistant, Low Temp. Phys. Department, Charles University
2008 - now Research assistant, Low Temp. Phys. Department, Charles University
2004 - 2008 translator Czech <-> English, agencies ATP CZ, s.r.o., Panorama ILA, s.r.o. mostly business and technical translations
2008 translator English -> Czech, Volvox Globator publishing house (Prague)

Internships

LTL, Aalto University, Helsinki (Andreev reflection in 3He-B, tuning forks)
Institut Neel, CNRS, Grenoble (Micro- and nano- oscillators)

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1 The lead scientist indicated here is expected to participate in the campaign as a user of the infrastructure.
2 The host scientist is supervising the work of the visiting project scientist at the infrastructure.
3 The project scientist is the person who will be visiting the infrastructure.

	Five most recent publications:		
	1- Bradley D. I., Človečko M., Fisher S. N., et al., *Crossover from hydrodynamic to acoustic drag on quartz tuning forks in normal and superfluid He-4*, Phys. Rev. B **85**, Issue 1, 014501		
	2- Hosio J. J., Eltsov V. B., de Graaf R., et al., *Propagation of thermal excitations in a cluster of vortices in superfluid He-3-B*, Phys. Rev. B **84**, Issue 22, 224501 (2011).		
	3- Schmoranzer D., La Mantia M., Sheshin G., et al., *Acoustic Emission by Quartz Tuning Forks and Other Oscillating Structures in Cryogenic He-4 Fluids*, J. Low. Temp. Phys. **163**, Issue 5-6, 317-344		
	4- Schmoranzer D., Král'ová M., Pilcová V., et al., *Experiments relating to the flow induced by a vibrating quartz tuning fork and similar structures in a classical fluid*, Phys. Rev. E **81**, Issue 6, 066316		
	5- Prchal Jiří, Šantavá Eva, Schmoranzer David, *Spin-glass behavior of RNi1-xCuxAl compounds*, Physica B - Cond. Matt. **404**, Issue 19, 3056-3058		
Other participating scientists:[4]	**Name:**	**Position:**	**New User:**
	1-		

[4] Please list all participating user group members. Expand the table, if necessary.

2. Project Information

Name of host infrastructure:	Lancaster University			
Access provider / Infrastructure Director:	**Name: Prof. S.N. Fisher**		**E-mail address: s.fisher@lancaster.ac.uk**	
Planned project dates:	**Start date:**	**28/05/2012**	**Completion date:**	**11/06/2012**

Project description (12 lines max):

This project is aimed at studying the generation of quantum turbulence from different objects in normal and superfluid 4He over the full range of accessible temperatures, and over a very wide range of oscillation frequencies. The experiments will be performed on the advanced refrigerator at Lancaster. At the time of writing this application, the cell has been installed on the refrigerator and is currently running at a temperature of around 2.5 mK. Measurements have already been made to characterise the oscillating devices in vacuum, and the cell has since been filled with isotopically pure Helium 4. Preliminary measurements have been made in the superfluid down to the lowest temperatures. We now plan to acquire detailed measurements over the full temperature range, and we plan to study the effects of the turbulence generated from the different devices. Substantial amounts of detailed data analysis and modelling are required to interpret the experimental results.

Scientific objectives of the project (12 lines max):

There has been much interest in quantum turbulence in recent years. This is interesting in its own right, as well as for its many analogies with classical turbulence and other less accessible systems. The simplest way to generate turbulence at very low temperatures is by vibrating objects at sufficiently large amplitudes. This experiment will allow us the study the generation of quantum turbulence from vibrating objects over a very broad range of conditions. In the zero temperature limit there is no normal fluid so the behaviour is governed by quantum vortices in the pure superfluid. At intermediate temperatures we have coupled normal and superfluid turbulence. At high temperatures we have pure classical turbulence in a normal liquid. The low frequency vibrating wire will allows us to study the behaviour in the zero frequency limit which we can compare directly with many published results on classical fluids. The various tuning forks will allow us to study frequency dependent behaviour expected at higher velocities, as well as the interplay between turbulence and acoustic emission.

Technical description of work to be performed (20 lines max):

We will investigate quantum turbulence produced by a low frequency (~60Hz) vibrating wire and several quartz tuning forks covering a wide range of frequencies from a few kHz up to more than 100 kHz. Measurements will be made in superfluid 4He over the full range of accessible temperatures, from just below the superfluid transition temperature ~2.2 K down to temperatures of just a few mK. We will also compare the results with measurements in normal liquid Helium above 2.2 K. On each vibrating object we will measure the force-velocity relationship at the resonant frequency. Measurements will be made from velocities of order 1 mm/s up to around 1 m/s. This will allow us to extract the dissipative drag coefficient which should be dominated by turbulence at the highest velocities. Simultaneously we will measure the shift in the resonant frequency as a function of velocity which, together with similar measurements in vacuum, will allow us to extract the non-dissipative inertial drag force for the different types of turbulence. For the tuning forks at higher frequencies, we anticipate that the drag at low velocities will be dominated by acoustic emission.

3. Joint Proposals / Funding

Is this project in collaboration with other (concurrent) projects at the infrastructure? Yes

If yes, please specify:

The measuring cell was built for both turbulence experiments and for experiments on the possible supersolidity of helium 4. These latter experiments will be conducted separately, after the turbulence experiments have been completed.

Is this proposal submitted to any funding programmes?	**No**
If yes, please specify:	

The completed Application Form should be submitted to MICROKELVIN Management Office (**Sari.Laitila@aalto.fi**, fax +358-9-47022969)