welcome to the European Microkelvin Collaboration

Application Form for MICROKELVIN Transnational Access Project

1. General Information

Project number:	AALTO22	
Project Title:	**Studies of quantum turbulence in superfluid 3He under rotation**	
Lead scientist:[1]	**Title:**	Dr.
	First name:	Viktor
	Last name:	Tsepelin
	Home institution:	Lancaster University, UK
Visiting scientist:	**Title:**	Dr.
	First name:	Martin
	Last name:	Jackson
	Birth date:	18/03/85
	Passport number:	502557209
	Research status/Position:	Research associate
	New User:[2]	Yes
	Scientific Field:	Quantum turbulence, Low temperature physics
	Home institution:	Lancaster University, UK
	Is your home institution MICROKELVIN partner?	☐ Yes
	Business address:	Low Temperature Laboratory Department of Physics Lancaster University
	Street:	
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	Curriculum vitae (18 lines max): 2003-2007 MPhys (Hons) Physics, The University of Lancaster First Class Honours Awarded 2007 Lancaster University Physics Prize July 2007 - Dec 2011 PhD Ultra Low Temperature Physics, The University of Lancaster: “A Study of Quantum Turbulence in Superfluid 3He-B Using Vibrating Structures”. Supervisor: Dr. V. Tsepelin. Full Funding Awarded by the Engineering and Physical Sciences Research Council	
	Five most recent publications:	
	1- Bradley D.I. et al. - History Dependence of Turbulence Generated by a Vibrating Wire in Superfluid 4He at 1.5 K - JLTP 162 (2011) 375	
	2- Bradley D.I. et al. - The Damping of a Quartz Tuning Fork in Superfluid 3He-B at Low Temperatures - JLTP 157 (2009) 476	

1 The lead scientist indicated here is expected to participate in the campaign as a user of the infrastructure.

2 Indicate ’Yes’ only if the user has never visited the infrastructure before this specific project, otherwise write ’No’.

Other participating scientists:[3]	Name:	Position:	New User: 2
	1-		

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

2. Project Information

Name of host infrastructure:	**O.V. Lounasmaa (former Low Temperature) Laboratory, Aalto University**			
Access provider / Infrastructure Director:	**Name: Vladimir Eltsov**		**E-mail address: ve@boojum.hut.fi**	
Planned project dates:	**Start date:**	**[26/03/2012]**	**Completion date:**	**[27/04/2012]**

Project description (12 lines max):

Superfluid He3 under rotation provides a unique environment for quantum turbulence studies. Quantum turbulence in the form of a tangle of vortex lines can be noninvasively probed by ambient thermal excitations using Andreev reflection. For comprehensive studies and characterisation of turbulence, the calibration of the signal detected with a quartz tuning fork has been proven to be important. Quartz tuning forks have low intrinsic dissipation and have been shown to work well as low temperature probes.

The main topic of this project is the influence of polarization of vortex lines, which can be affected by rotation, on the behaviour of quantum turbulence at very low temperatures. The Low Temperature Laboratory at Aalto University has extensive expertise in studies of quantum turbulence in superfluid helium-3 under rotation, while at Lancaster University there is a lot of experience of working with quartz tuning forks as turbulence detectors in helium-3 at very low temperatures. The goal is to combine this expertize to study the influence of polarization in tangle formation.

Scientific objectives of the project (12 lines max):

The ultimate goal is to understand how the polarization of vortex lines in quantum turbulence affects its build-up and decay as well as the processes of energy transfer and dissipation. The immediate objective is to study two types of processes in 3He-B below 0.2Tc: spin-down to rest of a cylindrical container and turbulence, generated with a fork inside the rotating container. In the case of spin-down, it is known that it is unstable to turbulence in classical liquids, but is fully laminar in 3He-B above 0.2Tc. Does the transition to turbulent behaviour ultimately occur when T -> 0 and what is the mechanism of this transition? These are the first questions to answer. At high drives a fork can generate turbulence by itself. It can be seen from the self-screening, for example. How is the generation of such turbulence affected by rotation? This is the second question to answer. Is the generation suppressed by the polarization or facilitated by the presence of seed vortices?

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

The experiments on spin-down will be performed during the visit. The recorded thermal responses of the quartz tuning forks contain initial turbulent and later laminar parts. The laminar parts have been analysed and understood. The turbulent parts of the forks responses proved to be difficult to analyse. The task would be to apply to this data measurement and analysis techniques developed at Lancaster for bolometer calibration and turbulence detection. The methods may need to be adjusted since the current experimental setup in Helsinki does not fulfil the conditions of an ideal black-body radiator. More measurements can be performed later after the fist analysis, if necessary.

The measurements on turbulence, which is generated by the fork itself, have not been performed yet. The two forks to be used for the generation of turbulence and as a reference temperature sensor are in the same signal line. Hence an appropriate mixing/demixing circuit should be built to allow simultaneous measurements of the two forks. Then velocity-drive characteristics will be measured at different rotation velocities of the cryostat. The characteristics of the turbulence, generated by the fork will be deduced from the self-screening effect, as visible from the velocity-drive relations.

3. Joint Proposals / Funding

Is this project in collaboration with other (concurrent) projects at the infrastructure?	**No**
If yes, please specify:	

Is this proposal submitted to any funding programmes?	**No**

If yes, please specify:

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