welcome to the European Microkelvin Collaboration

CAPACITIES

Application Form for MICROKELVIN Transnational Access Project

1. General Information

Project number:	**AALTO09**		
Project Title:	**Surface waves at the solid-liquid interface of 3He crystal and 3He superfluid**		
Project Accronym			
Lead scientist:[1]	**Title:**	**Dr**	
	First name:	**Viktor**	
	Last name:	**Tsepelin**	
	Birth date:	**11 January 1974**	
	Passport number:	**KB0032507**	
	Research status/Position:	**Lecturer**	
	New User:[2]	**No**	
	Scientific Field:	**Quantum fluids and solids**	
	Home institution:	**Lancaster University**	
	Is your home institution MICROKELVIN partner?	Yes	
	Business address:	**Department of Physics**	
	Street:	**Lancaster University**	
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	E-mail:	**v.tsepelin@lancaster.ac.uk**	
	Curriculum vitae (18 lines max): Sep 2007 – Lecturer at Lancaster University Sep 2006 – EPSRC Advanced Research Fellow Sep 2004 – Research Associate in Low Temperature Group at Lancaster University Sep 2001 – Res. Associate in Low Temperature Group at Stanford University, USA Jun 2001 – Doctor of Sc. in Technology, Helsinki University of Technology, Finland Jun 1996 – Master Degree in Condensed Matter Physics, Tartu University, Estonia Jun 1994 – Bachelor Degree in Physics, 1994 (Cum Laude), Estonia		
	Five most recent publications:		
	The Damping of a Quartz Tuning Fork in Superfluid He-3-B at Low Temperatures, JLTP 157, 476 (2009)		
	Transition to Turbulence for a Quartz Tuning Fork in Superfluid He-4, JLTP 156, 116 (2009)		
	The Transition to Turbulent Drag for a Cylinder Oscillating in Superfluid He-4: A Comparison of Quantum and Classical Behavior, JLTP 154, 97 (2009)		
	The Annihilation of Two Phase Interfaces in Superfluid He-3: Simulated Brane Annihilation in the Laboratory, JOURNAL OF THE PHYSICAL SOCIETY OF JAPAN 77, 111005 (2008)		
	Fluctuations and correlations of pure quantum turbulence in superfluid He-3-B, PRL 101, 065302 (2008)		
Other participating scientists:[3]	**Name:**	**Position:**	**New User:**[2]
	1-		

[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'.

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

2. Project Information

Name of host infrastructure:	**Aalto University, Low Temperature Laboratory**			
Access provider / Infrastructure Director:	**Juha Tuoriniemi/ Mikko Paalanen**		**jtt@neuro.hut.fi paalanen@neuro.hut.fi**	
Planned project dates:	**Start date:**	**[16/04/2010]**	**Completion date:**	**[22/04/2010]**

Project description (12 lines max):

Helium solid-liquid interfaces at ultralow temperatures represent unique model systems to study crystallization processes as the mass and heat transport influence is minimal due to the surrounding liquid being superfluid. There are few systems where the morphology and kinetics of the crystal surface can be studied on the equilibrium shape of the crystal in real time. Helium-4 crystals have been extensively studied and have exhibited melting-freezing waves on the surface of the crystal. However, Helium-3 is very interesting as a model system due to an additional degree of freedom -- magnetism. It offers the novel possibility to see how crystal growth of the same lattice is affected by the magnetic structure of the crystal. The ultimate goal of this project is the detection and observation of melting-freezing crystallization waves on the surface of helium-3 crystals.
The Helsinki Low Temperature Laboratory has extensive expertise and experience in studies of solid-liquid interfaces in helium-4 and helium-3, as well as all the required apparatus for high pressure studies of He3. The LTL has the experience and all required components to push towards the temperature region required by the project. Lancaster has the expertise to achieve the lowest temperatures in He-3 and is ready to share it, but is not accustomed to work at high pressures near the melting curve. Helsinki is better placed to study the interfaces at high pressures and low temperatures than Lancaster, where much larger effort and timescales would be required.

Scientific objectives of the project (12 lines max):

In order to observe crystallization waves on the rough surface of the helium-3 crystal temperatures have to be on the order of 0.1Tc. The requirement of such low temperatures makes this project extremely technically demanding. In order to cool He3 liquid to 0.1-0.15Tc, nucleate and grow single He3 crystal a new approach to the experimental cell is required. In the future the direct optical observation of the surface is desired. However, to prove the concepts and to nucleate and to grow the crystal at low temperatures, at first capacitive detection techniques will be employed. After the successful completion of this stage the second generation cell with optical detection will be designed and built.

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

To design and construct a state-of-the-art nuclear stage/cell for detection of freezing-melting waves on the solid-superfluid interface of He3. The proposed nuclear stage/cell will be built on the expertise and experience of various groups that have studied helium-3 superfluid and crystals at the lowest possible temperatures. The new cell will combine several approaches into one design. The foundation of the design will be a Lancaster style double nested nuclear stage/cell, that allows for cooling of He3 towards 80 microKelvin at zero pressure. The ability to change pressure inside the cell will be adapted from Leiden Low Temperature Group design, with a flexible membrane manufactured from Kapton foil. During this project the design of the inner and outer cell volumes should be reviewed and finalised. The general design of the cell assembly including the heat-switch and connections to mixing chamber should be completed as well. The manufacturing of the inner parts of the cell (heat-exchanges, thermometers) will start taking place.
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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 (**Katariina.Toivonen@neuro.hut.fi**, fax +358-9-47022969)