welcome to the European Microkelvin Collaboration

CAPACITIES

Application Form for MICROKELVIN Transnational Access Project

1. General Information

Project number:	**AALTO36**	
Project Title:	**Instability of the AB interface in superfluid 3He at ultra-low temperatures**	
Lead scientist:[1]	**Title:**	Dr.
	First name:	Richard
	Last name:	Haley
	Home institution:	Lancaster University
Host scientist:[2]	**Title:**	Dr.
	First name:	Vladimir
	Last name:	Eltsov
	Home institution:	Aalto University
Project scientist:[3]	**Title:**	Dr.
	First name:	Richard
	Last name:	Haley
	Scientific Field:	Ultra Low Temperature Physics
	Home institution:	
	Is your home institution MICROKELVIN partner?	YES
	Business address:	Department of Physics
	Street:	Lancaster University
	PO Box:	
	City:	Lancaster
	Zip/Postal Code:	LA1 4YB
	Country:	United Kingdom
	Telephone:	+44 1524 593211
	Fax:	+44 1524 844037
	E-mail:	r.haley@lancaster.ac.uk
	Curriculum vitae (18 lines max): Academic 2009-present: Reader in Low Temperature Physics, Lancaster University 2002-2009: Lecturer, Lancaster University 2002-2010: Royal Society University Research Fellow, Lancaster University 1997-2002: Post Doctoral Research Associate, Lancaster University 1995-1997: Post Doctoral Research Associate, University of Florida 1992-1995: PhD, University of Manchester 1989-1992: BA, University of Cambridge Other 2011-present: Director, Lancaster Cryogenics Ltd.	
	Five most recent publications:	
	1- Superfluid helium-3 in aerogel: experiment, in Novel Superfluids, Vol 1, eds. Benneman & Ketterson, OUP, 2013 2- Turbulent drag on a low-frequency vibrating grid in superfluid He-4 at very low temperatures, Phys. Rev. B, Vol 85, 22453, 2012	
	3- Crossover from hydrodynamic to acoustic drag on quartz tuning forks in normal and superfluid He-4, Phys. Rev. B, Vol 85, 014501, 2012	

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.

	4- A new device for studying low or zero frequency mechanical motion at very low temperatures, J. Low Temp. Phys., Vol 165, 114, 2011		
	5- Direct measurement of the energy dissipated by quantum turbulence, Nat. Phys., Vol 7, 473, 2011		
Other participating scientists:[4]	**Name:**	**Position:**	**New User:**
	1- 2-		
	3-		

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

2. Project Information

Name of host infrastructure:	**Low Temperature Laboratory, Aalto University**			
Access provider / Infrastructure Director:	**Name: Vladimir Eltsov**		**E-mail address: ve@boojum.hut.fi**	
Planned project dates:	**Start date:**	**[12/05/2013]**	**Completion date:**	**[25/05/2013]**

Project description (12 lines max):

The study of topological matter is currently one of the most active areas in condensed-matter physics. In such systems the most exciting phenomena appear at the interface between two topologically distinct regions. In superfluid 3He such an interface can be realized as the interface between the A and B phases. There is a prediction that the AB interface should accommodate so-called flat-band fermions. The behaviour of such fermions, with energy independent of momentum, is a recently introduced concept in the physics of topological matter. These fermions are expected to affect the dynamics of the AB interface at ultra-low temperatures and we will try to observe this effect within this project.

Scientific objectives of the project (12 lines max):

When the AB interface is stabilized using a magnetic field gradient and a superflow is applied along it then at a certain critical velocity of flow the interface becomes unstable. A corrugation instability similar to the Kelvin-Helmholtz instability develops and eventually vortices are released into the B phase. The development rate of the instability depends on the friction in the interface motion. At temperatures above 0.3Tc the development is so fast that it was not possible to measure the rate in previous experiments. The objective of this project is to attempt to measure the development rate at temperatures below 0.2 Tc, where the dynamics should be slower. If successful, the next objective is to measure the temperature dependence of the development rate and to compare it to models of friction determined by the bulk and interface-bound quasiparticles.

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

We will stabilize the AB interface in a cylindrical container filled with 3He using a magnetic field. Flow along the interface will be applied by rotation of the sample along its axis in such a way that the B phase remains vortex-free. We will keep conditions (rotation velocity and the gradient of the magnetic field) in the under-critical region. Then we will momentarily change conditions to be over-critical for a certain time (by changing magnetic field or rotation velocity) and return them back. We will check whether the given time is sufficient for the instability to develop up to the release of vortices into the B phase by monitoring vortices using NMR techniques. By varying the time spent in the over-critical region, as a function of the strength of the perturbation and temperature, we will be able to extract the development rate of the instability.

3. Joint Proposals / Funding

Is this project in collaboration with other (concurrent) projects at the infrastructure? Yes ☒
If yes, please specify: Collaboration with Dr. M. Silaev, supported by the Academy of Finland grant

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)