welcome to the European Microkelvin Collaboration

CAPACITIES

Report on the Transnational Access Activity carried out within MICROKELVIN

The eligibility of transnational access to a MICROKELVIN TA site implies the submission of the following:

1) The Certification of visit

The form "Certification of visit" must be completed and signed by the access provider in charge of the infrastructure and the leader of the project.

2) A TA project report

The form for the TA project report is contained within this document. It should be completed after project end by the group leader of the project. You must respect the limited number of words specified, longer descriptions will be rejected. Figures/tables may be attached at the end of the document. The document must be submitted in an editable format (doc, rtf).

3) A User group questionnaire

To enable the Commission to evaluate the Research Infrastructures Action, to monitor the individual contracts, and to improve the services provided to the scientific community, each project leader of a user-project supported under an EC Research Infrastructure contract is requested to complete a "user group questionnaire". The questionnaire must be submitted once by each user group to the Commission as soon as the experiments on the infrastructure come to end.

The user group questionnaire is not part of this document and must be completed on-line. It is accessible at:

http://cordis.europa.eu/fp7/capacities/questionnaire_en.html.

► Please note that any publications resulting from work carried out under the MICROKELVIN TA activity must acknowledge the support of the European Community:

> **"The research leading to these results has received funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 228464 (MICROKELVIN)."**

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MICROKELVIN Transnational Access Project Report

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
	Birth date:	11 July 1971
	Passport number:	
	Research status/Position:	Reader in Low Temperature Physics
	New User:[4]	Yes
	Scientific Field:	Ultra Low Temperature Physics
	Home institution:	Lancaster University
	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

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

2. Project information

Please, give a brief description of project objectives: (250 words max)	When the AB interface is stabilized using a magnetic field gradient and 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 0.3 Tc 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 a measurement of the development rate at temperatures below 0.2 Tc, where the dynamics should be slower.
Technical description of work performed: (250 words max)	First we stabilized the AB interface in a cylindrical container filled with 3He using a magnetic field. We used NMR techniques to measure the decay time of a Bose-Einstein condensate of magnons in the B phase that was trapped between the AB interface and the closed end of the container. We used its decay time as a proxy for the density of quasiparticle excitations in the confined B phase. We then applied flow along the interface by rotating the container, and used the NMR measurements to infer the presence of vortices in the B phase, which was originally vortex-free. We also made a series of measurements where we started with only B phase in the container, and used the magnetic field to first introduce A phase, then remove it. This sequence was sometimes repeated several times. We wanted to discover if the superfluid had any “memory” of the earlier presence of the A phase, perhaps due to topological defects being left behind after its removal, as had been seen in similar experiments at Lancaster. During this visit we found that the presence of the A phase affected the magnon lifetime, and we wished to discover whether the annihilation of the A phase left any defects which also affected the lifetime.
Project achievements (and difficulties encountered):[5] (250 words max)	We discovered that the presence of the AB interface reduced the lifetime of the magnon BEC in the B phase that was confined between the A phase and the closed end of the cylindrical container. We were able to explain this in terms of an increase in the density of quasiparticle excitations in the confined B phase owing to the AB interface providing a thermal resistance to the transport of these excitations. In a series of experiments where we created and then annihilated the A phase, we were unable to determine experimentally whether this left behind any topological defects. If it did, their existence did not affect the NMR measurements and we were thus not sensitive to their possible existence. We also tried to ascertain whether the existence of defects would affect the critical velocity for the Kelvin-Helmholtz instability, but found that critical velocity is reproducible within 10%. We did the first measurements of the development rate of the AB instability

	by quickly changing the rotation velocity to be over-critical and back and found that at a temperature of 0.14 *T*c and pressure of 4 bar the time is of the order of 10 s, while previous theoretical estimates gave values of the order of hours. The reason for this discrepancy remains unclear.
Expected publications and dates:	Autumn 2013
Submission date of user group questionnaire:	20/6/2013

Completed Project Reports should be returned to MICROKELVIN Management Office (Sari.Laitila@aalto.fi, Fax: +358 9 47022969).