welcome to the
European Microkelvin Collaboration

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)."**

MICROKELVIN Transnational Access Project Report

1. General information

Project number:	**Lancs10**	
Project Title:	**The superfluid 3He AB interface; dynamics and instability modes**	
Lead scientist:[1]	**Title:**	Dr
	First name:	Manuel
	Last name:	Arrayás
	Home institution:	Universidad Rey Juan Carlos
Host scientist:[2]	**Title:**	Dr.
	First name: **Last name:**	Richard Haley
	Home institution:	Lancster University
Project scientist:[3]	**Title:**	Dr
	First name:	Manuel
	Last name:	Arrayás
	Birth date:	21/07/1972
	Passport number:	AC899408
	Research status/Position:	Reader
	New User:[4]	No
	Scientific Field:	Low temperature plasma physics
	Home institution:	Universidad Rey Juan Carlos
	Is your home institution MICROKELVIN partner?	No
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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.

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)	The primary objective of the project is to further understand the properties of the A-B interface 2-brane. In the experiments a shaped magnetic field is used to stabilise and manipulate the phase boundary between A and B. This exploits the influence of a magnetic field on the phase transition between the two, with the B phase being stable up to a critical field of 340 mT, where-upon there is a first-order transition to the A phase. A first-order transition has an energy cost associated with the surface tension between the two phases. This must be taken into account when assessing the equilibrium shape of the interface within the magnetic field profile, as well as the differences in wetting energy between the two phases and the container walls. I have been developing numerical methods to find the equilibrium position for realistic field profiles and boundary conditions, to simulate the interface behaviour when subjected to perturbations, and to see how its properties may be modified by defects that can exist within it. My visit was planned to coincide with ongoing experiments where the Lancaster ULT planned to move the AB interface through an array of detectors and monitor its progress through the experimental cell; I was to participate in these experiments and help to interpret the results using my previously developed simulation tools.
Technical description of work performed: (250 words max)	The experiment consists of a vertical cylinder of superfluid, 6 cm long and 1.2 cm in diameter. A superconducting solenoid provides a controllable magnetic field gradient, allowing for the stabilisation of the AB interface across the cylinder. Ramping the current in the solenoids then ramps the field gradient and moves the AB interface up and down in the cylinder, converting B phase to A phase and vice versa. The passage of the AB interface is inferred from the behaviour of vibrating quartz tuning fork resonators that project into the superfluid from the sidewalls of the cylinder. These resonators are sensitive to the density of broken Cooper pair quasi-particle excitations, and are thus used to detect any changes as the inter-face is moved through the cell. It was seen that the interaction of the resonators with the interface was reproducible. Furthermore the signal depended on the relative orientation of the fork and interface. New techniques were also developed to move the interface much more quickly through the cell, using temperature steps rather than magnetic field gradients. This was to investigate whether a fast-moving interface is more susceptible to instabilities. This remains an open question.
Project achievements (and difficulties encountered):[5] (250 words max)	To explain the dissipation associated with the periodic motion of the inter-face, reported by Bartkoviak et al at Lancaster, we have made further simulations using the model proposed by Legget and Yip (see for example "Helium-3", edited by W.P Halperin and L. P Pitaevskii, Chapter 8), with coefficients for dissipation and surface tension taken from the experiments.

	They turn out to be bigger than the predicted by the theory. We have made an analysis of the effect of the inertia, and found that for low drive frequencies, the effect is negligible. We have also studied the case of a pinned interface, vibrating as a membrane, and found behaviour similar to a damped harmonic oscillator driven periodically. Some preliminary results show that the inclusion of a frequency dependent damping coefficient as proposed in the theory will not be able to account for the extra dissipation observed. There is the possibility to make it velocity-dependent, which remains to be tested. Also, the idea that at higher frequencies there is an extra relaxation mechanism increasing the dissipation, due to textural rearrangement at the interface, is being considered at present.
Expected publications and dates:	After further measurements and data analysis, we plan to publish our preliminary findings in the next few months or so.
Submission date of user group questionnaire:	10 January, 2013

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