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:	**Lancs14**	
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:	Richard
	Last name:	Haley
	Home institution:	Lancaster 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
	Business address:	
	Street:	Camino del Molino s/n, Edif. Biblioteca, Desp. 008
	PO Box:	
	City:	Fuenlabrada, Madrid
	Zip/Postal Code:	29843
	Country:	Spain
	Telephone:	+34 914888460
	Fax:	
	E-mail:	manuel.arrayas@urjc.es

[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)	Following the objectives of the previous visits, the primary goal was to elucidate the dynamical properties of the A-B interface 2-brane. The boundary between the A and B phases is controlled experimentally using shaped magnetic fields. In previous work we first calculated the equilibrium profiles of the interface for various field and experimental cell configurations, as well as the shape of a B phase "bubble" that is completely surrounded by A phase. Turning to the dynamics, we have been attempting to account for the dissipation that has been measured for an oscillating interface, but the experimental result remains unexplained so far. It seems that dissipation at low frequency and amplitude may be described well by a model due to Yip and Leggett, but it does not fit the behaviour of high frequency and high velocity measurements quantitatively, or even qualitatively. The main objective of this visit has been to test whether the anomalous drag can be linked to a lag in the textural realignment that must take place within the A and B order parameters close to the interface as it moves. Understanding this "friction" is crucial for assessing the growth of the instability modes of a moving interface.
Technical description of work performed: (250 words max)	In the current experiments the superfluid AB interface is stabilised and moved using a controllable magnetic field gradient provided by a stack of superconducting solenoids placed outside the container vessel, which is a vertical cylinder 6 cm long and 1.2 cm in diameter. Ramping the current to the solenoids then ramps the field gradient and moves the AB interface up and down the cylinder, converting B phase to A phase and vice versa. The motion and properties of the interface are inferred from the behaviour of vibrating wire and quartz tuning fork resonators that project into the superfluid from the top, bottom, and sidewalls of the cylinder. We have simulated the equilibrium interface profiles, and the quasi-equilibrium properties of an interface that is moved slowly through the cell and past the detectors. We have analysed measurements from a previous experimental cell, with a different solenoid stack, where it was possible to oscillate the interface. Towards the end of the visit we began considering the effect of orbital viscosity, and made order of magnitude calculations of its contribution to the dissipation process.
Project achievements (and difficulties encountered):[5] (250 words max)	In order to explain the dissipation associated with the periodic movement of the interface, measured at Lancaster, this time we started to consider an extra relaxation mechanism at the AB interface due to rearrangement of the order parameter textures on the B phase side. The idea is that the magnetic field produces a small axial distortion of the energy gap, so the quasiparticle distribution has to relax to equilibrium when the gap structure bends in the texture. Due to the finite quasiparticle scattering time, a net viscous force develops. We had a breakthough in finding a functional form for a frequency dependent damping coefficient that allowed us to make qualitative fits to the measured data for the first time. Quantitative estimations also appear to be of the right order of magnitude.
Expected publications and dates:	After some 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:	July 18, 2013

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