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:	Lancs04	
Project Title:	**Quantum turbulence generated and detected using a floppy wire**	
Lead scientist:[1]	**Title:**	Prof.
	First name:	Peter
	Last name:	Skyba
	Home institution:	Institute of Experimental Physics, Slovak Academy of Sciences, Kosice
Host scientist:[2]	**Title:**	Prof.
	First name:	Shaun
	Last name:	Fisher
	Home institution:	Lancaster University
Project scientist:[3]	**Title:**	Dr.
	First name:	Marcel
	Last name:	Clovecko
	Birth date:	9/12/1981
	Passport number:	SL 507115
	Research status/Position:	Researcher
	New User:[4]	NO
	Scientific Field:	Quantum fluids, quantum turbulence
	Home institution:	Department of Low Temperature Physics, Institute of Experimental Physics, Slovak Academy of Sciences, Watsonova 47, 040 01 Kosice
	Is your home institution MICROKELVIN partner?	X Yes ☐ No
	Business address:	
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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 goal of this project is to develop a new 'floppy wire' device, along with the associated measurement techniques and instrumentation, to study superfluid flow over a very broad range of temperature, velocity and frequency, to optimize the potential applications, and to maximize the sensitivity (and hence the information which can be obtained from experiments). A large device, with a grid mesh attached, will be constructed and tested in superfluid 4He to develop techniques to accurately measure the drag force on the moving device, for both transient and oscillatory motion. Superfluid 4He is an ideal medium for developing the technique and will also allow us to make a preliminary study of superfluid turbulence generation by the grid at high velocities. Using the unique cooling facilities at Lancaster, we then hope to apply the techniques to obtain some preliminary results in superfluid 3He-B at the lowest achievable temperatures. The project will also require some development of the measurement instrumentation (in particular, we need to develop a controllable current source which is needed to produce stable steady currents with superimposed high frequency probe currents, as was designed by Peter Skyba from the Kosice group).
Technical description of work performed: (250 words max)	A large 'floppy wire' device (25 mm wide and 39 mm tall) with a grid mesh (25 mm x 10 mm) was constructed, with a new brass holder to simplify the assembly of the 4He experimental probe. The device was cooled to temperatures of around 1.5 K in a 4He glass cryostat. With the newly designed experimental probe, we were able to directly see the grid and its motion at low temperatures, by looking through the inspection slits in the silver coating of the glass dewar. We made a video to give a more visual demonstration of the new technique. We measured the force versus velocity response, comparing the conventional ac measurements with our new dc measurement technique, to develop and optimize the new measurement and analysis techniques. Several experimental runs were made to collect data using a wide range of measurement parameters and conditions. This also provided us with some interesting preliminary measurements of the response of superfluid 4He to quasi-static flows. We also wrote a computer program to simulate the response of the device to help better develop and check our analysis and data taking software. A new controllable current source, designed and built at Lancaster, was tested and was used to take the later measurements. The 3He experiment, incorporating the earlier floppy wire device, was installed and the initial cooling commenced (unfortunately, owing to leaks, we were not able to take measurements of this during the project, but the system has

	since been cooled and the device works very well).
Project achievements (and difficulties encountered):[5] (250 words max)	In summary, we successfully made a large 'floppy wire' with an attached grid and associated measurement coils. We modified the experimental test probe and cooled the device to liquid Helium temperatures. We made various measurements in normal 4He at 4K and in superfluid 4He at 1.5K, and recorded some video pictures of the working device. We tested and used the new current source, which worked extremely well, producing a wide range of ac currents superimposed on a very steady dc current. We demonstrated that the technique allows a very accurate measurement of the position of loop with good time resolution. The dc measurements were compared with the wire's ac response, which we measured using conventional techniques, at its resonant frequency of 17 Hz. A program (using Matlab) was developed to simulate the device response. Very good agreement was obtained with the dc measurements with only one fitting parameter: the effective mass of the wire. The simulations were used to predict the result of the ac measurements. Preliminary results suggest that there is a clear difference between the dc and ac drag force in 4He. This suggests that there is a significant frequency dependence of the response. This will be studied in more detail in future experiments. Of particular interest is the frequency dependence of the turbulent drag at high velocities and the critical velocity for turbulence. Also in 3He-B we will measure the frequency dependence of the drag force at ultra-low temperatures to study surface states/Majorana fermions.
Expected publications and dates:	We expect to publish preliminary results in the next few months.
Submission date of user group questionnaire:	16/11/2010

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