

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:	Lancs20	
Project Title:	Ultralow temperature properties and thermometry in mesoscopic structures	
Lead scientist: ¹	Title:	PD Dr.
	First name:	Stefan
	Last name:	Ludwig
	Home institution:	LMU Munich
Host scientist: ²	Title:	Dr.
	First name:	Richard
	Last name:	Haley
	Home institution:	University of Lancaster, Lancaster, United Kingdom
Project scientist: ³	Title:	PD Dr.
	First name:	Stefan
	Last name:	Ludwig
	Birth date:	17.01.1970
	Passport number:	CH1H71PW1
	Research status/Position:	group leader
	New User: ⁴	No
	Scientific Field:	Nanophysics, Solid State Physics
	Home institution:	LMU Munich
	Is your home institution MICROKELVIN partner?	No
	Business address:	Fakultät für Physik, Ludwig-Maximilians-Universität
	Street:	Geschwister-Scholl-Platz 1
	PO Box:	
	City:	München
	Zip/Postal Code:	80539
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	Telephone:	0049-89-2180-1457
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2. Project information

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'.

<p><u>Please, give a brief description of project objectives:</u> (250 words max)</p>	<p>A major goal of the Microkelvin project is to develop technology to better enable the cooling of electronic devices and nanocircuits to temperatures below 1mK. For this purpose a new EU Access Facility machine was recently built at Lancaster. A major obstacle to cooling electronic devices is heat generated by noise transmitted through electrical leads. To address this, sophisticated wiring/filter protocols and designs developed by Stefan Ludwig's group in Munich are being implemented in the new machine at Lancaster. The Ludwig group has also developed high quality low temperature measurement techniques for nanostructures which they produce in-house. This project aims to perform the first ultralow temperature measurements on nanostructures built in Munich. To achieve this, Stefan Ludwig and Florian Forster made several visits to the Lancaster Access Facility to develop the necessary measurement techniques and the thermometry and to perform preliminary measurements.</p> <p>The primary scientific and technological objective of this collaborative project is to investigate nanoelectronic circuits in a hitherto unrivalled range of ultralow temperatures. This will allow us to reach lower energy scales and go well beyond the present state-of-the-art to investigate collective and phase sensitive quantum phenomena such as: mesoscopic interferometry effects; quantum Hall phases; the Kondo effect in coupled quantum dots; the 0.7 anomaly in quantum point contacts; and the hyperfine interaction between confined electrons and many nuclear spins. One of our main efforts will be to study coherent dynamics and entanglement in semiconductor-based quantum information circuits at ultralow temperatures. The combination of expertise in ultralow temperature physics in Lancaster and low temperature nanoelectronic measurements in Munich provides the framework for a successful collaboration. Nanostructures are being produced and initially characterised in Munich, while the final ultralow temperature measurements will be performed in Lancaster.</p>
<p><u>Technical description of work performed:</u> (250 words max)</p>	<p>The original aim of Stefan's visit to Lancaster was to foster ongoing measurements and to actively participate in the planning of future experiments, based on the first results. Due to unforeseeable technical delays, however, the measurements of actual nanostructures had to be delayed and are not yet pursued. Stefan decided to nevertheless visit Lancaster as planned in order to boost the ongoing project.</p> <p>During this visit we have installed cables and filters, which have been prepared by Florian Forster together with Jon Prance and Rich Haley, in the newly built dilution unit at the University of Lancaster. More importantly, we examined the status of the project components (fridge, sample holder, wiring, filters), corrected the ongoing work and arranged a decent number of discussions including Stefan Ludwig, Florian Forster, Jon Prance, Ian Bradley, Rich Haley and George Picket in which we further developed our strategy to efficiently cool nanostructures to below 1mK and to accurately measure their temperature. Our first milestone will be to actually cool a mesoscopic device containing a Hall bar and a lateral double quantum dot to a few mK and measure this at low temperatures. This visit also helped to further exchange skills and technology between Munich and Lancaster.</p>
<p><u>Project achievements (and difficulties)</u></p>	<p>This visit of Stefan Ludwig in Lancaster was another important step towards the future development of the new Lancaster facility for studying nanoelectronic circuits at ultralow temperatures. Our initial goal to pursue the first</p>

encountered): ⁵ (250 words max)	experiments on ultra-cold nanostructures during this visit was not achieved owing to technical delays in getting the dilution refrigerator to work. These difficulties are now being fixed and we are about to cool the first mesoscopic sample. Instead of pursuing the first measurements together during Stefan's visit we used his visit for an assessment of the ongoing work and to plan the experiments to come in much greater detail. We expect to be able to present the first experimental results on semiconductor nanostructures at ultra-low temperatures by the end of this year.
<u>Expected publications and dates:</u>	We expect to be able to present the first publications in 2014.
<u>Submission date of user group questionnaire:</u>	25 Sep, 2013

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

CERTIFICATION OF VISIT at MICROKELVIN Transnational Access Site

I herewith confirm that the following project was carried out at our Transnational Access Site
University of Lancaster

in the context of MICROKELVIN Transnational Access:

Ultralow temperature properties and thermometry in mesoscopic structures

The amount of access¹ delivered to the project group (project users) is as follows:

	Participant name	Duration of stay (start – end date)	Amount of access ²
Project leader:	Dr Stefan Ludwig	16/9/13 - 21/9/13	
Project user 1:			6
Project user 2:			
Project user ...: ³			
Total amount of access delivered to project group:			6

LANCASTER 21/9/13
Location and date

S. Fisher
Signature of access provider
Prof Shaun Fisher

LANCASTER 21/9/13
Location and date

[Signature]
Signature of project leader
Dr Stefan Ludwig

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¹ TKK Helsinki, CNRS Crenoble, or Lancaster University

² The amount of access is defined as the time, in days, spent by the user at the infrastructure for this project, including weekends and public holidays (e.g., a scientist who spent 5 days at the infrastructure must indicate '5'). The total amount of access of the project group is the sum of access days of each project user.

³ Please, expand if necessary