



## **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](http://cordis.europa.eu/fp7/capacities/questionnaire_en.html).

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► **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

<b>Project number:</b>	Lancs19	
<b>Project Title:</b>	Ultralow temperature properties and thermometry in mesoscopic structures	
<b>Lead scientist:</b> <sup>1</sup>	<b>Title:</b>	Prof.
	<b>First name:</b>	Stefan
	<b>Last name:</b>	Ludwig
	<b>Home institution:</b>	Ludwig-Maximilians Universität, München
<b>Host scientist:</b> <sup>2</sup>	<b>Title:</b>	Dr.
	<b>First name:</b>	Richard
	<b>Last name:</b>	Haley
	<b>Home institution:</b>	University of Lancaster, Lancaster, United Kingdom
<b>Project scientist:</b> <sup>3</sup>	<b>Title:</b>	Dipl. Phys.
	<b>First name:</b>	Florian
	<b>Last name:</b>	Forster
	<b>Birth date:</b>	16.10.1986
	<b>Passport number:</b>	LF08ZFKMG
	<b>Research status/Position:</b>	PhD-student
	<b>New User:</b> <sup>4</sup>	No
	<b>Scientific Field:</b>	Nanophysics, Solid State Physics
	<b>Home institution:</b>	LMU Munich
	<b>Is your home institution MICROKELVIN partner?</b>	No
	<b>Business address:</b>	Fakultät für Physik, Ludwig-Maximilians-Universität
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### 2. Project information

<sup>1</sup> The lead scientist indicated here is expected to participate in the campaign as a user of the infrastructure.

<sup>2</sup> The host scientist is supervising the work of the visiting project scientist at the infrastructure.

<sup>3</sup> The project scientist is the person who will be visiting the infrastructure.

<sup>4</sup> Indicate 'Yes' only if the user has never visited the infrastructure before this specific project, otherwise write 'No'.

<p><b><u>Please, give a brief description of project objectives:</u></b> (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 require several visits to the Lancaster Access Facility to further develop the necessary measurement techniques and thermometry and to perform the 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 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 ultralow temperature measurements will be performed in Lancaster.</p>
<p><b><u>Technical description of work performed:</u></b> (250 words max)</p>	<p>This extended visit was devoted to an exchange of skills and technology between Munich and Lancaster and included practical work of Florian Forster in the Ultra-Low-Temperature Laboratory of Lancaster University. The goal was to boost progress, to enable first measurements on semiconductor chips. Together with Jon Prance and Rich Haley, Florian produced low temperature filters, thermal couplings, and installed wires and filters in the refrigerator. This involved a great deal of technical work and test measurements. This practical work embedded in a local team turned out to be ideal for the exchange of skills and technology between Munich and Lancaster. In addition, he brought some of the specialist room temperature filtering and measurement devices that have been custom-built in Munich and are now integrated in the Lancaster set-up. The next step is to mount the device chips on a new bespoke chip holder that has been made at Lancaster. Then we will be ready for starting the investigation of nanoelectronic circuits at ultralow temperatures at the new Lancaster facility.</p>
<p><b><u>Project achievements (and difficulties encountered):</u></b><sup>5</sup> (250 words max)</p>	<p>This second visit of Florian Forster in Lancaster was an important step towards the development of the new Lancaster facility for the study of nanoelectronic circuits at ultralow temperatures. Our initial goal to pursue the first experiments on ultra-cold nanostructures during this visit was not achieved due to technical delays in getting the dilution refrigerator to work. These difficulties are now being fixed and we are about to mount and cool the first</p>

	mesoscopic sample. We expect to be able to present the first experimental results on semiconductor nanostructures at ultra-low temperatures by the end of this year.
<b><u>Expected publications and dates:</u></b>	We expect to present the first publications in 2014.
<b><u>Submission date of user group questionnaire:</u></b>	25 Sep, 2013

Completed Project Reports should be returned to MICROKELVIN Management Office  
([Sari.Laitila@aalto.fi](mailto: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 access<sup>1</sup> delivered to the project group (project users) is as follows:

	Participant name	Duration of stay (start – end date)	Amount of access <sup>2</sup>
<b>Project leader:</b>	Dr Stefan Ludwig		
<b>Project user 1:</b>	Florian Forster	14/8/13 – 8/9/13	26
<b>Project user 2:</b>			
<b>Project user ...<sup>3</sup></b>			
<b>Total amount of access delivered to project group:</b>			<b>26</b>

*LANCASTER 8/9/13*

Location and date

*SS Fisher*

Signature of access provider  
**Prof Shaun Fisher**

*LANCASTER 18/9/13*

Location and date

*Stefan Ludwig*  
Signature of project leader  
**Dr Stefan Ludwig**

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<sup>1</sup> TTK Helsinki, CNRS Crenoble, or Lancaster University

<sup>2</sup> 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.

<sup>3</sup> Please, expand if necessary