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 T

A 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:	CNRS10	
Project Title:	**Adiabatic Demagnetization Stage**	
Lead scientist:[1]	**Title:**	Dr.
	First name:	Jozef
	Last name:	Kacmarcik
	Birth date:	02.03.1972
	Passport number:	BD0342689
	Research status/Position:	Researcher
	New User:[2]	NO
	Scientific Field:	superconductivity
	Home institution:	Department of Low Temperature Physics, Institute of Experimental Physics, Slovak Academy of Sciences, Kosice, Slovakia
	Is your home institution MICROKELVIN partner?	YES
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[1] The lead scientist indicated here is expected to participate in the campaign as a user of the infrastructure.

[2] 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 technical goals of this project were to design, construct, test and optimize small demagnetization stages with a paramagnetic salt coupled with standard PPMS sample pucks to cool down two samples from room temperature to typically 40 mK in less than to 2 hours. These modified pucks are intended for use in the Quantum Design PPMS (Physical Property Measurement System) device that is at disposal both in the Néel Institute, CNRS, Grenoble and in the Department of Low Temperature Physics, IEP SAS in Kosice. The scientific goal of the project was to use these demagnetization stages for the experimental research of heavily-doped silicon and diamond down to 40 mK. The aim was to determine the critical temperature of doped superconducting samples and to modulate their superconducting properties by applying an external electric field using ionic liquids. This is expected to tune the carrier concentration at the surface (interface) of the doped epilayers.
Technical description of work performed: (250 words max)	The first experiments and tests were made with a prototype demagnetization stage where a sample holder with wires is a fixed to one part of the stage, i.e. the samples have to be mounted directly on the stage. We prepared special cables for connecting external devices to the PPMS setup. First of all we calibrated a RuO2 thermometer down to the lowest temperatures. To do this, we used a Lakeshore resistance bridge as well as the PPMS internal electronics to read the resistance of the thermometer in order to avoid overheating of the thermometer. Later, we needed to find a proper regime to reach the lowest temperature possible – to optimize the initial magnetic field at 2 K at the beginning of the demagnetization process and subsequently the rate of demagnetization. We found that a starting field of 4 Tesla and a demagnetization rate of 1 Tesla/min are optimal for cooling the stage down to 44 mK. In the next step we designed and prepared for construction the second generation of the demagnetization stage compatible with the Helium-3 Resistivity sample pucks for PPMS. This new design has the great advantage that a sample can be prepared for experiment on a sample-holder separate from the stage and can then later be attached onto the stage. In addition a sample mounted this way may also be directly used for experiments with the PPMS Helium-3 Refrigerator or with the PPMS Vertical Puck for measurements of magnetically anisotropic materials performed in magnetic fields.
Project achievements (and difficulties encountered):[5]	We succeeded to cool down the demagnetization stage from 2 K to 44 mK in four minutes and from room temperature in less than two hours. We performed transport measurements of heavily-doped silicon and diamond

(250 words max)	samples to determine their critical temperature of the superconducting transition. We also performed preliminary experiments on silicon and diamond samples in order to modulate the superconducting properties by applying an external electric field using ionic liquids expected to tune the carrier concentration at the surface (interface) of the doped epilayers. We could considerably increase the conductivity of the samples, but up to now no superconductivity was observed so far. We improved the design of the inner part of the salt box in the second generation demagnetization stage – instead of using copper we used silver wires to increase the contact area between the paramagnetic salt and the cold plate of the stage. Unfortunately difficulties to grow the salt in the box precluded the tests of this new demagnetization stage during the project duration. We will continue within the next weeks.
Expected publications and dates:	- Rev. Sci. Instrum. – 2013 - results on doped silicon and diamond - 2013
Submission date of user group questionnaire:	14/06/1012

Completed Project Reports should be returned to MICROKELVIN Management Office (Leena.Meilahti@tkk.fi, Fax: +358 9 4512969).