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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CAPACITIES

MICROKELVIN Transnational Access Project Report

1. General information

Project number:	**AALTO32**	
Project Title:	**Spin accumulation caused by triplet supercurrent**	
Lead scientist:[1]	**Title:**	Dr
	First name:	F. Sebastian
	Last name:	Bergeret
	Home institution:	Centro de Física de Materiales, San Sebastian
Host scientist:[2]	**Title:**	Dr.
	First name:	Tero
	Last name:	Heikkilä
	Home institution:	Aalto University, O.V. Lounasmaa Laboratory
Project scientist:[3]	**Title:**	Mr
	First name:	Asier
	Last name:	Ozaeta
	Birth date:	22/05/86
	Passport number:	72749229E
	Research status/Position:	PhD student.
	New User:[4]	Yes
	Scientific Field:	Theoretical condensed matter physics
	Home institution:	Centro de Física de Materiales, San Sebastian
	Is your home institution MICROKELVIN partner?	No
	Business address:	
	Street:	Paseo. Manuel de Lardizabal 5
	PO Box:	
	City:	San Sebastián
	Zip/Postal Code:	E-20018
	Country:	Spain
	Telephone:	0034 943018835
	Fax:	
	E-mail:	asier_ozaeta@ehu.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)	We planned to investigate the nonequilibrium properties of superconductor-ferromagnet-superconductor junctions with non-collinear magnetizations carrying a triplet supercurrent. In a spin-polarized magnet this triplet supercurrent also carries spin current, which will therefore induce spin accumulation inside the superconductor. From the combination of spin current and supercurrent we expect spin-thermoelectric effects that we will explore as well. These effects would be most pronounced at very low temperatures. We expect the Microkelvin low temperature groups, such as those in Pisa (Dr. Francesco Giazotto) and Delft (Prof. Teunis Klapwijk) to be capable of measuring these. As the project progressed, we discovered a simpler and much stronger spin-thermoelectric effect, taking place in a junction between a ferromagnet and a superconductor in the presence of a spin-splitting field. Also this effect should be measurable by some of the Microkelvin low temperature groups.
Technical description of work performed: (250 words max)	Our approach was based on using the quasiclassical theory and the tunnel Hamiltonian description of hybrid superconducting contacts, along with a recently formulated boundary condition applicable for such superconductor-ferromagnet junctions (F.S. Bergeret, A. Verso and A.F. Volkov, Phys. Rev. B 86, 214516 (2012)).
Project achievements (and difficulties encountered)[5]: (250 words max)	We show that a huge thermoelectric effect can be observed by contacting a superconductor whose density of states is spin-split by a Zeeman field with a ferromagnet with a non-zero polarization (P). The resulting thermopower exceeds kB/e by a large factor, and the thermoelectric figure of merit ZT can far exceed unity, leading to heat engine efficiencies close to the Carnot limit. It diverges at low temperatures in the absence of limiting effects, yielding a figure of merit ZT=P^2 /(1-P^2) and heat engine efficiencies close to the theoretical upper bounds. We also show that spin-polarized currents can be generated in the superconductor by applying a temperature bias even in the case of zero polarization. Besides, we analyze the Hanle effect in a superconductor: this consists of the rotation of the injected spin in a magnetic field non-collinear with the injector.
Expected publications and dates:	Huge thermoelectric effects in ferromagnet-superconductor junctions in the presence of a spin-splitting field, submitted to Physical Review Letters in July, 2013, arXiv:1307.4672. We also plan to submit a paper on the Hanle effect in a superconductor in the fall of 2013.
Submission date of user group questionnaire:	30/07/2013

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

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CAPACITIES

CERTIFICATION OF VISIT

at MICROKELVIN Transnational Access Site

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

Aalto University **Helsinki**

in the context of MICROKELVIN Transnational Access:

Spin accumulation caused by triplet supercurrent.

The amount of access[1] 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. F. Sebastian Bergeret	15/04/2013-18/04/2013	0
Project user 1:[3]	Mr. Asier Ozaeta	01/03/2013-31/05/2013	92
Total amount of access delivered to project group:			**92**

In Jyväskylä, 9th August 2013
Location and date

Tero Heikkilä
Signature of access provider
Tero Heikkilä

In San Sebastian, 9th August 2013
Location and date

Signature of project leader
Sebastien Bergeret

Completed Certification of Visit should be returned to MICROKELVIN Management Office
(sari.laitila@aalto.fi, fax: +358 9 47022969)

[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