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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:	**AALTO 40**	
Project Title:	**Dissipation losses from Kelvin waves and the Kelvin-wave cascade**	
Lead scientist:[1]	**Title:**	Professor
	First name:	Edouard
	Last name:	Sonin
	Home institution:	Racah Institute of Physics, Hebrew University
Host scientist:[2]	**Title:**	Senior researcher, Ph.D.
	First name:	Risto
	Last name:	Hänninen
	Home institution:	O.V. Lounasmaa Laboratory, Aalto University
Project scientist:[3]	**Title:**	Professor
	First name:	Edouard
	Last name:	Sonin
	Birth date:	
	Passport number:	
	Research status/Position:	professor
	New User:[4]	No
	Scientific Field:	Condensed matter physics
	Home institution:	
	Is your home institution MICROKELVIN partner?	No
	Business address:	
	Street:	Givat Ram
	PO Box:	
	City:	Jerusalem
	Zip/Postal Code:	91904
	Country:	Israel
	Telephone:	+972-2-6586164
	Fax:	
	E-mail:	sonin@cc.huji.ac.il

[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)	Current measurements display larger dissipation in helium superfluids from vortex motion in the zero temperature limit, $T \longrightarrow 0$, than what standard mutual friction theory predicts. These measurements also extrapolate to a finite value at $T = 0$ which is not possible if simple direct mutual friction damping is considered. One current assumption is that these observations might be ascribed to a Kelvin-wave cascade propagating on individual vortex lines. However, recent numerical calculations with the vortex filament method on a single vortex reconnection event between two inter-linked vortex rings at mutual friction values down to $\alpha \sim 10^{-3}$ show no evidence for the presence of the Kelvin-wave cascade: the increased dissipation after the reconnection is explained by direct mutual friction damping of Kelvin wave excitations, without any indication for nonlinear interactions connecting different Kelvin modes. We plan to discuss how measurements and vortex filament calculations can be further extended to search for the existence of the Kelvin wave cascade. The description of vortex motion in the very low temperature limit is one of the prime goals in the Microkelvin Joint Research Activities (JRA3 Task 1). This regime is also of central interest for drafting parts of the monograph on superfluid vortex dynamics which Edouard Sonin is working on. One of the tasks is to estimate numerically the energy flux from the Kelvin-wave cascade in different physical situations (or different Kelvin spectra) and to compare this flux with theoretical predictions and the direct dissipation from mutual friction. This comparison should reveal e.g. the importance of finite size effects (due to a finite resolution of the calculation) and, more generally, guide us to find the proper parameter values for the regimes where the Kelvin-wave cascade is at its strongest, such that it might become also experimentally observable.
Technical description of work performed: (250 words max)	We analysed together with Risto Hänninen different ways how to reveal unambiguously the presence of the Kelvin-wave cascade numerically. The main challenges were: (i) to pump the energy only to large length scales avoiding pumping into the inertial interval of scales; (ii) to avoid the damaging effect of the discreteness of the wave spectrum on the emergence of the Kelvin-wave cascade. The outcome of these discussions was that an unambiguous numerical simulation of the Kelvin-wave cascade is a serious problem, and plans to solve it were considered. There were thorough discussions of the controversial problem of the transverse force on the vortex with the theoreticians of the O.V. Lounasmaa Laboratory (Kopnin, Silaev, and Volovik), in particular, during and after the talk presented by Edouard Sonin at the Laboratory seminar.
Project	Concerning the Kelvin-wave cascade, the work is in the planning stage, and

achievements (and difficulties encountered)**:**[5] (250 words max)	the goal to reveal the cascade now depends on the forthcoming simulations. Concerning the transverse force on the vortex, a new interpretation of the semi-classical result for the force was suggested, but full consensus on some conceptual issues was not reached.
Expected publications and dates:	▪ ▪
Submission date of user group questionnaire:	6 Sep, 2013

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

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CERTIFICATION OF VISIT

at MICROKELVIN Transnational Access Site

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

O.V. Lounasmaa Laboratory, Aalto University

in the context of MICROKELVIN Transnational Access:

Dissipation losses from Kelvin waves and the Kelvin wave cascade

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:	Prof. Edouard Sonin		
Project user 1:	Prof. Edouard Sonin	26.8. – 8.9.	14 days
Project user 2:			
Project user ...:[3]			
Total amount of access delivered to project group:			

Otaniemi 4 Sep, 2013

Location and date

Signature of access provider
Matti Krusius

Otaniemi 4 Sep, 2013

Location and date

Signature of project leader
Edouard Sonin

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