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)."**

welcome to the European Microkelvin Collaboration

CAPACITIES

MICROKELVIN Transnational Access Project Report

1. General information

Project number:	**AALTO29**	
Project Title:	**NMR relaxation of trapped magnon condensates in the rotating equilibrium vortex state**	
Lead scientist:[1]	**Title:**	Dr.
	First name:	Peter
	Last name:	Skyba
	Home institution:	Inst. of Exp. Physics, SAS, Kosice, Slovakia
Host scientist:[2]	**Title:**	Dr.
	First name:	Vladimir
	Last name:	Eltsov
	Home institution:	O.V. Lounasmaa Laboratory –Low Temperature section, Aalto University
Project scientist:[3]	**Title:**	Dr.
	First name:	Peter
	Last name:	Skyba
	Birth date:	16.6.1958
	Passport number:	
	Research status/Position:	Senior leading scientist
	New User:[4]	Yes
	Scientific Field:	Quantum fluids, NMR, ULT physics and techniques
	Home institution:	
	Is your home institution MICROKELVIN partner?	☒ Yes ☐ No
	Business address:	Institute of Experimental Physics, SAS
	Street:	Watsonova 47
	PO Box:	
	City:	Košice
	Zip/Postal Code:	04001
	Country:	Slovakia
	Telephone:	+421 55 6228158
	Fax:	+421 55 6228158
	E-mail:	skyba@saske.sk

[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)	The aim of the project is to study the mechanisms of energy dissipation in the magnon condensate in the presence of quantized vortices in rotating superfluid 3He-B in the ballistic temperature regime. The vortex core contains bound fermionic quaisparticles and it is assumed that they may have Majorana character. It is also expected, that these vortex-core-bound quasiparticles could affect energy dissipation in the coherently precessing NMR mode which represents condensation of magnons or spin-wave excitations to a coherent condensate state. In the rotating equilibrium vortex state this corresponds to the situation when rectilinear quantized vortex lines traverse the condensate in the configuration of a regular array. The task is to identify the mechanisms by which the vortices contribute to spin relaxation, i.e. whether it is possible to distinguish a separate contribution generated by vortices which can be subtracted from that caused by the quasiparticles which form the thermal background.
Technical description of work performed: (250 words max)	During my visit I took part in an ongoing experiment studying the interaction between the states with coherent Q-ball-like spin precession and quantized vortices in superfluid 3He-B at temperatures below 0.2 T_C. At these temperatures the density of quasiparticle excitations is so low, that they can be considered a very dilute gas with a mean free path which is determined, in principle, by the size of the experimental cell. The Q-ball state was generated by pulsed NMR techniques and its life time was determined from the free induction signal, i.e. from the time constant of exponential amplitude decay. The interaction of the Q-ball with vortices is manifested as an additional dissipation process that leads to the shortening of the Q-ball life time. However, it was found that the time constant of the Q-ball decay is a periodic function of the static applied magnetic field with a period corresponding to a frequency of 1.5 kHz. In the vortex-free state, i.e. when there are no quantized vortex lines present, the above mentioned periodicity vanishes. This periodicity is a surprising observation, and to elucidate its physical origin more measurements have to be performed. During my two-week visit I also gave a seminar on the properties of the coherent spin precession modes in superfluid 3He-B at higher temperatures around 0.5 T_C, with applications to studies of black-hole analogues.
Project achievements (and difficulties encountered):[5] (250 words max)	We studied the interaction between Q-ball states with coherent spin precession and quantized vortices in superfluid 3He-B in the ballistic regime. We found that the presence of vortices enhances the dissipation rate in the Q-ball state. This is explained as increased quasiparticle scattering, since quantized vortices introduce additional scattering centres to quasiparticles, reducing their mean free path. However, the unexpected observation of the

	periodicity of the Q-ball dissipation rate with the applied static magnetic field remained unexplained and, to understand the physics behind this phenomenon, more systematic studies are needed.
Expected publications and dates:	A manuscript about the measurements is planned in 2013.
Submission date of user group questionnaire:	12 November, 2012

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