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)."**

.

welcome to the European Microkelvin Collaboration

CAPACITIES

MICROKELVIN Transnational Access Project Report

1. General information

Project number:	**CNRS 20**	
Project Title:	**Bose-Einstein condensation of quasiparticles and spin superfluidity**	
Lead scientist:[1]	**Title:**	Professor
	First name:	Grigory
	Last name:	Volovik
	Home institution:	Aalto University
Host scientist:[2]	**Title:**	Professor
	First name:	Yury
	Last name:	Bunkov
	Home institution:	Institute N´eel, CNRS, Grenoble, France
Project scientist:[3]	**Title:**	Professor
	First name:	Grigory
	Last name:	Volovik
	Birth date:	07.09.1946
	Passport number:	640833335
	Research status/Position:	Senior scientist
	New User:[4]	
	Scientific Field:	Condensed Matter
	Home institution:	Aalto University
	Is your home institution MICROKELVIN partner?	yes
	Business address:	
	Street:	Puumiehenkuja 2B
	PO Box:	15100
	City:	Espoo
	Zip/Postal Code:	00076 AALTO
	Country:	Finland
	Telephone:	+358 50 344 2858
	Fax:	+358 9 470 22969
	E-mail:	Volovik@ltl.tkk.fi

[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 spin superfluidity -- superfluidity in the magnetic subsystem of a condensed matter – is manifested as the spontaneous phase-coherent precession of spins. Spin supercurrent is one more representative of superfluid currents known or discussed in other systems, such as the superfluid current of mass and atoms in superfluid 4He; superfluid current of electric charge in superconductors; superfluid current of hypercharge in Standard Model of particle physics; superfluid baryonic current and current of chiral charge in quark matter; etc. Spin superfluidity can be described in terms of the Bose condensation of spin waves -- magnons. There are different phases of magnon superfluidity, including those in magnetic trap. The latter states have features common to the objects in high-energy physics: Q-balls and hadrons (MIT bag model of hadron). The magnon superfluidity is also manifested by spin current Josephson effect; spin current vortices -- topological defects, which are analogs of quantized vortex in superfluids, Abrikosov vortex in superconductors, and cosmic strings in relativistic theories; by Goldstone modes, etc. The task is to write a book on magnon BEC and its analogs in other physical systems (condensed matter and particle physics). The main goal of the book is to present a clear and comprehensive description of the BEC of non-equilibrium quasiparticles. The physics of spin supercurrents can perhaps find applications in spintronics. The book will be addressed to researchers working actively in magnetism, superfluidity and superconductivity, BEC, spintronics, as well as to specialists of high energy physics theory.
Technical description of work performed: (250 words max)	Several chapters of the book have been written earlier. Two new Chapters were now introduced. One of them is devoted to the geometric forces related to spin and orbital momentum in general, with applications to spin superfluidity and to spintronics. One of the geometric forces is the spin-motive force, which is at the moment under extended discussion in spintronics, where it is a force acting on an electron by the magnetization. It was introduced for metallic ferromagnets, where it reflects the conversion of the magnetic energy of a ferromagnet into the electrical energy of the conduction electrons. The same spin-motive force exists in magnon BEC, where it converts the energy of the coherent precession of magnetization to a superfluid current. The orbital-motive force is operating in superfluid 3He-A, where there are two contributions to the orbital-motive force. One contribution comes from the chiral nature of this liquid. The second contribution originates from chiral Weyl fermions living in the vicinity of the topologically protected Weyl points, and is related to the phenomenon of chiral anomaly. The second new Chapter is devoted to the modern subject of spontaneous breaking of time translation symmetry, a hot topic originated by the Nobel-Prize-winner Wilczek. The coherent spin precession of a magnon condensate gives new insight to this problem, providing a demonstration of quasi off-diagonal long-range order.
Project achievements (and difficulties encountered):[5]	The above two Chapters of the book gave rise to two papers: G.E. Volovik, Spin-motive force and orbital-motive force: from magnon BEC to chiral Weyl superfluids, arXiv:1308.6700

(250 words max)	G.E. Volovik, On the broken time translation symmetry in macroscopic systems: precessing states and ODLRO, submitted to preprint arXiv
Expected publications and dates:	The manuscript by G.E. Volovik “Spin-motive force and orbital-motive force: from magnon BEC to chiral Weyl superfluids” will be published in JETP Letters in October 2013.
Submission date of user group questionnaire:	8.9.2013

Completed Project Reports should be returned to MICROKELVIN Management Office

(Mari.Kaarni@aalto.fi, Fax: +358 9 47022969).

welcome to the
European Microkelvin Collaboration

CAPACITIES

CERTIFICATION OF VISIT

at MICROKELVIN Transnational Access Site

I herewith confirm that the following project was carried out at our Transnational Access Site *(CNRS, Grenoble)*

in the context of MICROKELVIN Transnational Access:

(Bose-Einstein condensation of quasiparticles and spin superfluidity).

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:	G. Volovik	17.08.13-31.08.13	15
Project user 1:	G. Volovik	17.08.13-31.08.13	15
Project user 2:			
Project user …:[3]			
Total amount of access delivered to project group:			**15**

Location and date

Grenoble, 31.08.2013

Signature of access provider

Yu. Bunkov

Location and date

Grenoble, 31.08.2013

G. Volovik

Signature of project leader

G. Volovik

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

[1] TKK Helsinki, CNRS Grenoble, 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.