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European Microkelvin Collaboration

CAPACITIES

Application Form for MICROKELVIN Transnational Access Project

1. General Information

Project number:	Aalto10	
Project title:	Bose-Einstein condensate of magnons in rotating superfluid 3He	
Project acronym:		
Lead scientist:[1]	**Title:**	Mr.
	First name:	Pierre
	Last name:	Hunger
	Birth date:	18^{th} November 1985
	Research status/Position:	PhD student
	New User:[2]	Yes
	Scientific Field:	superfluid ^{3}He, NMR
	Home institution:	Institut Néel, CNRS Grenoble
	Home institution is MICROKELVIN partner:	**Yes**
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	E-mail:	pierre.hunger@grenoble.cnrs.fr
	Curriculum vitae (18 lines max):	
	2008 – present: PhD student, Institute Néel, Grenoble. Working on the spin dynamics of superfluid ^{3}He immersed in aerogel. 2008 – present: Teaching assistant, Université Joseph Fourier, Grenoble. 2008 : Master 2 in physics (M.Sc.), École Normale Supérieure in Lyon, France, (Condensed matter physics) Pierre Hunger is currently preparing his PhD thesis under the supervision of Yuriy Bunkov and Henri Godfrin at Institute Néel in Grenoble. He works on the NMR properties of superfluid ^{3}He in aerogel, mainly on the coherent spin dynamics in this system.	
	Five most recent publications:	
	1) Evidence for Magnon BEC in Superfluid He-3-A; P. Hunger, Y.M. Bunkov, E. Collin, and H. Godfrin, Journal of Low Temperature Physics 158 (1-2):129-134 (2010)	

Other participating scientists:[3]	**Name:**	**Position:**	**New User:**[2]
	1- Yuriy Bunkov	professor	no

[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'.
[3] Please list all participating user group members. Expand the table, if necessary.

2. Project Information

Name of host infrastructure:	Low Temperature Laboratory, Helsinki University of Technology (TKK)			
Access provider / Infrastructure Director:	**Name:** Prof. Matti Krusius		**E-mail address:** krusius@cc.hut.fi	
	Prof. Mikko Paalanen		paalanen@neuro.hut.fi	
Planned project dates:	**Start date:**	23/05/2010	**Completion date:**	24/06/2010

Project description (12 lines max):

Bose-Einstein condensation of magnons in rotating superfluid ^{3}He

Pierre Hunger is preparing his thesis in Grenoble on the spin dynamics of ^{3}He in aerogel. He is focussing on the study of phase-coherent precession of magnetization in cases where the aerogel is deformed and used to orient the order parameter of ^{3}He out of its usual position. This interaction between the aerogel and the superfluid ^{3}He stabilizes different modes of coherent precession that do not exist in bulk ^{3}He. These modes are true Bose-Einstein condensates of magnons and can be created either by continuous or pulsed NMR.

In rotating superfluid ^{3}He, a magnon BEC can be trapped in the axially symmetric flare-out texture in the experimental cell [1]. The interaction between the Bose condensate and the vortices allows one to monitor quantized vortices efficiently even in the regime of ultra low temperatures (below 0.3 Tc). Presently the magnon trap is not in contact with the container walls [1]. This promises to be a better configuration for high resolution measurements of dissipation losses from vortices, than the previous trap which bordered to the top plate of the rotating cylinder and where magnetic relaxation at the wall had to be taken into account [2]. The currently running measuring setup [3] has been developed from the arrangement described in Ref. [4].

An important goal of the new measurements is to search for the vortex core contribution in the relaxation losses at the lowest temperatures. This contribution to dissipation has not been identified so far. It will provide information on the fermion states in the vortex core and would be interesting in view of present efforts to understand Andreev and Majorana fermion states.

References:

[1] ***Non-ground-state Bose-Einstein condensates of magnons in superfluid ^{3}He-B;*** Yu.M. Bunkov, V.B. Eltsov, R. de Graaf, P.J. Heikkinen, J.J. Hosio, M. Krusius, and G.E. Volovik, preprint arXiv:1002.1674v1 [cond-mat.quant-gas]

[2] ***Dynamics and turbulence in coherent quantum systems;*** V.B. Eltsov, R. de Graaf, P.J. Heikkinen, J.J. Hosio, R. Hänninen, M. Krusius, and R.E. Solntsev, Annual report of the Low Temperature Laboratory - 2007, Rota Group, page 25, https://ltl.tkk.fi/wiki/LTL/Annual_reports

[3] ***Coherent quantum matter in $T \to 0$ limit;*** V.B. Eltsov, R. de Graaf, P.J. Heikkinen, J.J. Hosio, R. Hänninen, M. Krusius, Annual report of the Low Temperature Laboratory - 2009, Rota Group, https://ltl.tkk.fi/wiki/LTL/Annual_reports

[4] ***Turbulent dynamics in rotating He superfluids;*** V.B. Eltsov, R. de Graaf, R. Hänninen, M. Krusius, R.E. Solntsev, V.S. L'vov, A.I. Golov, and P.M. Walmsley, Prog. Low Temp. Phys. Vol. 16, p. 45 – 146 (2009), arXiv:0803.3225v2 [cond-mat].

Scientific objectives of the project (12 lines max):

The different modes of coherent spin precession have proven to be important tools in the study of the ^{3}He superfluids. The persistent very low temperature magnon mode in the different eigenstates of a specially configured magnetic trap is expected to provide new opportunities to examine the $T \to 0$ limit in 3He-B. It is one of the few powerful measuring methods in this temperature regime. It is, in particular, the dynamics of quantized vortices and the structural features, which affect the zero-temperature dynamics, which are of great current interest generally in condensed matter physics.

Technical description of work to be performed (20 lines max):

During this one month visit Pierre Hunger will participate in experiments on the rotating cryostat in Helsinki to study the interaction between the Bose Einstein condensate of magnons and the vortices in superfluid ^{3}He. These experiments are closely related to his thesis work on the influence of various parameters (disorder induced by the aerogel, orbital momentum orientation) on the coherent precession phenomena. Particularly, they would be a practical application to the coherent precession modes in superfluid ^{3}He.

This stay will also allow Pierre Hunger to discuss and learn about some of the experimental techniques that are at the core of his measurements and that are also used in Helsinki, nuclear demagnetization, nuclear magnetic resonance, etc.

3. Joint Proposals / Funding

Is this project in collaboration with other (concurrent) projects at the infrastructure?	**Yes ☐ No X**
Specify: Part of general effort to understand the dynamics of quantized vortex lines in the zero temperature limit	

Is this proposal submitted to any funding programmes?	**Yes ☐ No X**
If yes, please specify:	**Only to MicroKelvin collaboration**

The completed application form should be submitted to the MICROKELVIN Management Office