Application Form for MICROKELVIN Transnational Access Project

1. General Information

Project number:	AALTO29	
Project Title:	**NMR relaxation of trapped magnon condensates in the rotating equilibrium vortex state: mechanism?**	
Lead scientist:[1]	**Title:**	Dr.
	First name:	Peter
	Last name:	Skyba
	Home institution:	Institute of Experimental Physics, SAS, Kosice, Slovakia
Host scientist:[2]	**Title:**	Dr.
	First name:	Vladimir
	Last name:	Eltsov
	Home institution:	Lounasmaa Laboratory – Low temperature section, Aalto University
Project scientist:[3]	**Title:**	Dr.
	First name:	Peter
	Last name:	Skyba
	Scientific Field:	quantum fluids, NMR, ULT physics and techniques
	Home institution:	Institute of Experimental Physics, SAS
	Is your home institution MICROKELVIN partner?	YES
	Business address:	Institute of Experimental Physics, SAS
	Street:	Watsonova 47
	PO Box:	
	City:	Košice
	Zip/Postal Code:	04001
	Country:	Slovakia
	Telephone:	++ 421 55 6228158
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	E-mail:	skyba@saske.sk
	Curriculum vitae (18 lines max): Co-chairman with A. Feher: CRYO 2010 conference, Maria Curie Cryo-course Myto pod Dumbierom, September 2010, Slovakia Member of Selection Panel ULTI IV (Helsinki University of Technology) 2004-2008 Visits at Lancaster University ULT laboratory - 1997/2009 Prize of Presidium of Slovak Academy of Sciences for development of experimental infrastructure for low temperature physics - 2008 Prize of Ministry of Education of Slovakia for Science - 2005 Chairman of COSLAB workshop, Smolenice, Slovakia - 2005 Member of Steering Committee of COSLAB ESF 2003-2006 Scientific secretary IEP SAS 1999-2003	

[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.

	Head of department of low temperature physics, IEP SAS 1995-1999 PhD in Condensed Matter Physics – 1994
	Five most recent publications:
	M.Kupka and P. Skyba, BEC of Magnons in Superfluid 3He-B and Symmetry Breaking Fields, Phys. Rev. B **85** 184529 (2012)
	2. D.I. Bradley et al, Magnetic Phase Transition in a Nanonetwork of Solid 3He in Aerogel, PRL **105** 125303 (2010).
	3. P. Skyba: Notes on Measurement Methods of Mechanical Resonators used in Low Temperature Physics, JLTP, **160** 219 (2010).
	4. D.I. Bradley et al, Probing Andreev Reflection in Superfluid 3He-B using a quartz tuning fork, JLTP **152** 148 (2008).
	5. M. Clovecko et al, New non-Goldstone Collective Mode of BEC of Magnons in Superfluid 3He-B, PRL **100** 155301 (2008).

Other participating scientists:[4]	**Name:**	**Position:**	**New User:**
	1-		
	2-		
	3-		

2. Project Information

Name of host infrastructure:				
Access provider / Infrastructure Director:	**Name: Vladimir Eltsov**		**E-mail address: ve@boojum.hut.fi**	
Planned project dates:	**Start date:**	**04/10/2012**	**Completion date:**	**20/10/2012**

Project description (12 lines max):

Magnons are bosonic quasiparticles in superfluid ^{3}He which represent a deflection of the magnetization from the direction of the applied magnetic field. At very low temperatures there are no thermally excited magnons. However, magnons can be excited and pumped into the system with an applied rf field. These excitations have long life times, so that they can form Bose-Einstein condensates in a suitable magnetic trap. Condensation manifests itself as long-lived coherent precession after pumping is switched off: The magnetization precesses around the applied field with a common phase in a macroscopic sample, despite inhomogeneity in the magnetic field or in the order-parameter texture. Life times of up to 15 min have been reported. Of great practical importance is that magnon condensates can be used to probe the quantum vacuum state of ^{3}He-B in the $T \to 0$ limit, where most conventional measuring techniques become insensitive.

The main motivation to study the increase in relaxation of the magnon condensate in the presence of quantized vortices is the possibility to find a contribution of the vortex-core-bound fermionic quasiparticles to the relaxation. These bounds states have attracted a lot of interest recently owing to the expectation that they should have Majorana character. Current measurements of the relaxation rate as a function of temperature and rotation velocity show that rotation in the equilibrium vortex state increases the relaxation rate as $\tau\,(T,\Omega)^{-1} = 1/\tau_0(\Omega) + C(\Omega)\,\exp(-\Delta/T)$. Now the task is to identify the mechanisms which contribute to this relaxation, to find out whether excitations with a linear energy spectrum might be involved and become distinguishable.

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

Scientific objectives of the project (12 lines max):
The relaxation rate can be measured in different rotational states, in vortex-free rotating counterflow, in the equilibrium vortex state, or in the presence of moving vortices when the rotation velocity is modulated. This makes it possible to separate the influence of different features in the texture on the relaxation. The temperature-dependent term in the relaxation rate, $\tau(T,\Omega)^{-1} = 1/\tau_0(\Omega) + C(\Omega)\exp(-\Delta/T)$, is evidently connected with the density of thermal quasiparticles and can possibly be attributed to the relaxation by spin diffusion through the normal component. The effect of vortices on the prefactor $C(\Omega)$ is related to the changes in the order-parameter texture with increasing vortex density: the magnon trap becomes narrower, the gradient of the magnon wave function increases and that enhances the spin diffusion. This effect can be studied as a function of the magnon number which controls via self-trapping the texture and the shape of the magnetic trap. The zero-temperature value of the relaxation rate $1/\tau_0(\Omega)$ depends linearly on the rotation velocity and thus on the density of vortex lines, i.e. it can be ascribed to the contribution from vortex cores.
Technical description of work to be performed (20 lines max):
So far measurements have been performed in the equilibrium vortex state. More studies need to be carried to establish whether spin diffusion plays an important role and if eg. oscillations around the equilibrium value of the rotation angle $\Theta \approx 104°$, which controls the dipolar spin-orbit interaction, might have to be considered.

3. Joint Proposals / Funding

Is this project in collaboration with other (concurrent) projects at the infrastructure?	No
If yes, please specify:	

Is this proposal submitted to any funding programmes?	No
If yes, please specify:	

The completed Application Form should be submitted to MICROKELVIN Management Office (**Sari.Laitila@aalto.fi**, fax +358-9-47022969)