welcome to the European Microkelvin Collaboration

CAPACITIES

Application Form for MICROKELVIN Transnational Access Project

1. General Information

Project number:	**CNRS 01**	
Project title:	Late-time dynamics of quantized vortices generated after absorption of a neutron in superfluid 3He-B	
Project acronym:	Minibang	
Lead scientist:[1]	**Title:**	Professor
	First name:	Andrei
	Last name:	GOLOV
	Birth date:	28th January, 1960
	Research status/Position:	*Reader in Low Temperature Physics*
	New User:[2]	No
	Scientific Field:	Low temperature physics
	Home institution:	University of Manchester
	Home institution is MICROKELVIN partner:	**Yes** ☐ **No** ☒
	Business address:	Schuster Laboratory, University of Manchester
	Street:	Oxford Road
	Street No.:	
	PO Box:	
	City:	Manchester
	Zip/Postal Code:	M13 9PL
	Country:	UK
	Telephone:	+44-161-2754068.
	Fax:	+44-161-2754056
	E-mail:	andrei.golov@manchester.ac.uk

Curriculum vitae (18 lines max):

Qualifications - academic and professional - and membership of bodies:

- M.Sc. thesis: *Motion of charges in solid helium*, Moscow Institute of Physics and Technology, Moscow-Chernogolovka, June 1983
- Ph.D. thesis: *Motion of charges in solid helium,* Institute of Solid State Physics, Institute of Solid State Physics, Chernogolovka, June 1989.
- Member of the *Institute of Physics* and *Chartered Physicist*.

Previous employment and appointments held:

- *Research Associate*, Institute of Solid State Physics, Russian Acad. Sci., 01/89 – 11/96;
- *Alexander von Humboldt Fellow*, Bayreuth University, 12/92 – 10/94;
- *Visiting Professor/Research Fellow,* ISSP, University of Tokyo, 01/95 – 11/96.

[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'.

	Five most recent publications:		
	1. V.B.Eltsov, R.deGraaf, R.Hänninen, M.Krusius, R.E.Solntsev, V.S.L'vov, A.I.Golov and P.M.Walmsley Progress in Low Temperature Physics (invited review article, North-Holland, Amsterdam, 2008), Vol. XVI, pp. 45-146. *Turbulent Dynamics in Rotating Helium Superfluids*		
	2. V.B.Eltsov, A.I.Golov, R.deGraaf, R.Hanninen, M.Krusius, V.S.L'vov, and R.E.Solntsev Phys. Rev. Lett. **99**, 265301 (2007). *Quantum turbulence in a propagating superfluid vortex front.*		
	3. P.M.Walmsley, A.I.Golov, H.E.Hall, A.A.Levchenko and W.F.Vinen. Phys. Rev. Lett. **99**, 265302 (2007). *Dissipation of quantum turbulence in the zero-temperature limit.*		
	4. P.M.Walmsley and A.I.Golov, Phys. Rev. Lett. **100**, 245301 (2008). *Quantum and quasiclassical types of superfluid turbulence.*		
	5. P.M.Walmsley, A.I.Golov, H.E.Hall, W.F.Vinen, A.A.Levchenko. J. Low Temp. Phys. **153**, 127-139 (2009). *Decay of turbulence generated by spin-down to rest in superfluid ^{4}He.*		
Other participating scientists:[3]	**Name:**	**Position:**	**New User:**[2]
	1-		
	2-		
	3-		

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

2. Project Information

Name of host infrastructure:	Institut Néel, CNRS, Grenoble (MICROKELVIN-Grenoble)			
Access provider / Infrastructure coordinator:	**Name:** Dr. Henri Godfrin		**E-mail address:** henri.godfrin@grenoble.cnrs.fr	
Planned project dates:	**Start date:**	20/06/2009	**Completion date:**	01/08/2009

Project description (12 lines max):

In a series of experiments Bauerle et al., Nature 382, 332 (1996), J.Elbs, PhD Thesis (2007) observed that absorption of a single neutron by superfluid ^{3}He-B results in a measured total energy release about 100 KeV smaller than the known heat of the corresponding exothermic nuclear reaction, 764 KeV.

This missing energy was attributed to the formation of a tangle of long-lived topological defects, quantized vortices, during a fast cooling into the superfluid state of a volume of liquid ^{3}He of some 20 mkm radius following its heating-up by the nuclear reaction. The total length of metastable vortices, observed in such way, was found to be in a reasonable quantitative agreement with the predictions of Kibble-Zurek model assuming uncorrelated nucleation of the phase of the superfluid order parameter in a homogeneous liquid 3He undergoing fast cooling (the process often referred to as ``mini Big Bang'' because of its direct analogy with the popular cosmological scenario of the birth of the Universe). However, some questions remain.

Firstly, the total amount of the energy stored in vortices was found to be roughly independent of pressure, while the model calculations predict it to decrease with increasing pressure. Secondly, modern understanding of the dynamics of the free decay of a developed vortex tangle contradicts the assumption that such a dense vortex tangle can survive the measurement time of 2-3 seconds while still occupying the same volume where it was nucleated. This project examines a possible solution to this problem, based on a quantum hydrodynamic interpretation.

Scientific objectives of the project (12 lines max):

The objective of this project is to improve our understanding of the processes occurring after the Kibble-Zurek “Big Bang”. We propose to conduct a thorough analysis of experimental results, and to elaborate a new ``inflationary'' model that will account for the initial spreading of the vortex tangle (and also extraction of long-lived individual vortex rings/loops) under the outward wind of thermal excitations immediately following the ``mini Big Bang''. Comparison of the specific predictions of this modified model with various existing experimental observations will hopefully help to improve the quantitative interpretation of the experiments in terms of the efficiency of Kibble-Zurek mechanism for generation of topological defects.

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

In this initial stage, a short stay (20.06.09-30.07.09) at the Grenoble Microkelvin facility is required.
The work program consists of a detailed analysis of the experimental data and making the first steps towards the establishment of a quantum hydrodynamics model. This analysis should lead to recommendations for the most appropriate conditions for our forthcoming experiments.

3. Joint Proposals / Funding

Is this project in collaboration with other (concurrent) projects at the infrastructure? Yes ☒ No ☐
Specify: Part of general effort to understand quantum turbulence in the zero temperature limit

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

The completed Application Form should be submitted to MICROKELVIN Management Office (**leena.meilahti@tkk.fi**, fax +358-9-4512969)