welcome to the
European Microkelvin Collaboration

CAPACITIES

Application Form for MICROKELVIN Transnational Access Project

1. General Information

Project number:	**Lancaster 01**	
Project Title:	**Quantum turbulence generated and detected using a floppy wire**	
Lead scientist:[1]	**Title:**	**Dr.**
	First name:	**Marcel**
	Last name:	**Clovecko**
	Birth date:	**09/12/1981**
	Passport number:	**SL 507115**
	Research status/Position:	**researcher**
	New User:[2]	**YES**
	Scientific Field:	**Quantum fluids, quantum turbulence**
	Home institution:	**Department of Low Temperature Physics, Institute of Experimental Physics, Slovak Academy of Sciences, Kosice, Slovakia**
	Is your home institution MICROKELVIN partner?	☒ YES
	Business address:	
	Street:	**Watsonova 47**
	PO Box:	
	City:	**Kosice**
	Zip/Postal Code:	**040 01**
	Country:	**Slovakia**
	Telephone:	**+421 55 6228158**
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	E-mail:	**clovecko@saske.sk**
	Curriculum vitae (18 lines max): **2009- present** Department of Low Temperature Physics, Institute of Experimental Physics, Slovak Academy of Sciences, Kosice, Slovakia Current position: Scientific researcher - non-linear dynamics of excitations (e.g. Andreev scattering) and NMR in superfluid phases of 3He, participation on design and construction of experimental cells used for experiments, experience with operation of 3He-4He dilution refrigerator and nuclear adiabatic demagnetization **2005-2009** PhD. study at the Institute of Experimental Physics, Slovak Academy of Sciences, Kosice, Slovakia PhD. thesis : *The non-linear phenomena in the superfluid phases of 3He* - quartz tuning fork – new type of mechanical resonator used for the study of superfluid phases of 4He and 3He, new excited mode of HPD described as non-Goldstone mode of magnon BEC **2000-2005** P.J.Safarik University, Kosice, Slovakia, Magister degree (Mgr.) in Condensed Matter Physics	

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- Probing Andreev reflection in superfluid He-3-B using a quartz tuning fork Author(s): Bradley, DI; Clovecko, M; Gazo, E, et al. Source: JOURNAL OF LOW TEMPERATURE PHYSICS Volume: 152 Issue: 5-6 Pages: 147-155 Published: 2008
	2- New non-goldstone collective mode of BEC of magnons in superfluid He-3-B Author(s): Clovecko, M; Gazo, E; Kupka, M, et al. Source: PHYSICAL REVIEW LETTERS Volume: 100 Issue: 15 Article Number: 155301 Published: 2008
	3- Vibrating quartz fork - A tool for cryogenic helium research Author(s): Blazkova, M; Clovecko, M; Eltsov, VB, et al. Conference Information: International Symposium on Quantum Fluids and Solids (QFS-2007), Date: AUG 01-06, 2007 Kazan State Univ Kazan RUSSIA Source: JOURNAL OF LOW TEMPERATURE PHYSICS Volume: 150 Issue: 3-4 Pages: 525-535 Published: 2008
	4- Quantum turbulence generated and detected by a vibrating quartz fork Author(s): Blazkova, M; Clovecko, M; Gazo, E, et al. Conference Information: International Symposium on Quantum Fluids and Solids (QFS-2006), Date: JUL 31-AUG 06, 2006 Kyoto Univ Kyoto JAPAN Source: JOURNAL OF LOW TEMPERATURE PHYSICS Volume: 148 Issue: 3-4 Pages: 305-310 Published: 2007
	5- Quartz tuning fork: Thermometer, pressure- and viscometer for helium liquids Author(s): Blaauwgeers, R; Blazkova, M; Clovecko, M, et al. Source: JOURNAL OF LOW TEMPERATURE PHYSICS Volume: 146 Issue: 5-6 Pages: 537-562 Published: MAR 2007

Other participating scientists:[3]	**Name:**	**Position:**	**New User:**[2]
	1- Dr.Peter Skyba	**Senior scientist**	**No**
	2- Dr.Martin Kupka	**Senior scientist**	**No**
	3- Ing. Emil Gazo	**Senior scientist**	**Yes**

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

2. Project Information

Name of host infrastructure:	**Ultra low temperature laboratory, University of Lancaster, Lancaster, United Kingdom**			
Access provider / Infrastructure Director:	**Name: Shaun Fisher/George Pickett**		**E-mail address:** s.fisher@lancaster.ac.uk g.pickett@lancaster.ac.uk	
Planned project dates:	**Start date:**	[10/05/2010]	**Completion date:**	[04/06/2010]

Project description (12 lines max):

Quantum turbulence has recieved a great deal on interest in recent years, particularly following the discovery of quantum turbulence in 3He-B at low temperatures some 10 years ago at Lancaster. It is interesting to study how quantum vortices evolve in a turbulent tangle and to study analogies with classical turbulence and other systems, including cosmic strings in the early universe.

The traditional technique to create quantum turbulence in non-rotating cryostats is by means of mechanical resonators such as vibrating wires, spheres, quartz tuning forks, grids and torsional oscillators. These resonators typically have very small displacements which produce localised vortex tangles. The resulting inhomogeneity may affect the dynamics of the tangle, and understanding this is key to interpreting the experimental results. This project will develop a new technique to produce much more homogeneous quantum turbulence. A large `floppy' wire will be used to draw a grid through an enclosed region to generate homogeneous turbulence. The Lancaster ULT lab is ideally suited to this project, having a vast experience in developing similar techniques.

Scientific objectives of the project (12 lines max):

The main objective of the project is to develop the new technique of operating a `floppy' wire to make a single large-amplitude sweep through a superfluid. When attached to a grid, this will allow us to generate homogeneous turbulence discussed above, but it will also be interesting to study the response of the wire itself, particularly in ^{3}He-B at ULT, and compare the behavior with a wire resonator. A resonator in ^{3}He-B is known to break Cooper pairs above a velocity of one third of the Landau velocity, $V_L/3$, and turbulence is generated simultaneously. Pair-breaking below V_L is possible due to the transient filling of surface bound states (possibly including majorana states) around the wire, so a very different mechanism should operate for quasi-static flow, and similarly vortex production may be quite different. This visit will be used to design and manufacture the device, to develop the measurement techniques and associated electronics, and to make some preliminary tests in normal and superfluid ^{4}He. Following this, a device will be installed in a Lancaster style nuclear cooling stage to perform experiments in ^{3}He-B at ultralow temperatures.

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

A goal-post shaped `floppy' wire will be constructed from single-core superconducting wire. The device will be driven at low temperatures in a magnetic field by passing a current through it. A dc current will produce a static deflection, and stepping the current will then produce a transient motion to the new equilibrium position. A relatively large loop (~2cm) of fine wire (~0.1mm) will allow us to produce relatively large deflections of several mm.

To detect the position of the loop, a small ac current is applied, in addition to the dc current, which will induce a Faraday voltage in a near-by coil. With some development of techniques, this will provide a very accurate measure of the position of loop with good time resolution. This will allows us to determine the instantaneous velocity of the loop, for a known driving force. The techniques will first be developed and tested in a simple ^{4}He cryostat where preliminary measurements can be made in normal and superfluid ^{4}He.

We note that it will also be interesting to study vortex production in superfluid ^{4}He and compare directly the response to quasi-static flow, produced by transient motion, with the response to oscillating flow which can be measured with the same device (using conventional vibrating wire measurement techniques). However, the current visit will focus on optimizing the technique for later use in a ^{3}He-B experiment, to be performed at Lancaster. The device itself will be quite versatile and may find many applications to other areas of quantum fluids and solids research. For instance, it might be used to study supersolidity in ^{4}He at low temperatures, or a sample of aerogel could be attached to study properties of `dirty' superfluid phases of ^{3}He at ultralow temperatures.

3. Joint Proposals / Funding

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

Is this proposal submitted to any funding programmes?	**Yes ☐ No ☒**

If yes, please specify:

The completed Application Form should be submitted to MICROKELVIN Management Office (**Katariina.Toivonen@neuro.hut.fi**, fax +358-9-47022969)