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)."**

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MICROKELVIN Transnational Access Project Report

1. General information

Project number:	**AALTO 42**	
Project Title:	**Soliton solutions within the vortex filament model using full Biot-Savart equation**	
Lead scientist:[1]	**Title:**	Ph.D., Lecturer
	First name:	Hayder
	Last name:	Salman
	Home institution:	University of East Anglia
Host scientist:[2]	**Title:**	Dr. (Tech)
	First name:	Risto
	Last name:	Hänninen
	Home institution:	O.V. Lounasmaa Laboratory, Aalto University
Project scientist:[3]	**Title:**	Dr
	First name:	Hayder
	Last name:	Salman
	Birth date:	6/11/2013
	Passport number:	**094315532**
	Research status/Position:	Lecturer
	New User:[4]	
	Scientific Field:	Theoretical & computational fluid dynamics
	Home institution:	School of Mathematics, University of East Anglia
	Is your home institution MICROKELVIN partner?	☐ Yes
	Business address:	Norwich, NR4 7TJ
	Street:	
	PO Box:	
	City:	
	Zip/Postal Code:	
	Country:	UK
	Telephone:	+441603591666
	Fax:	
	E-mail:	H.Salman@uea.ac.uk

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)	One major part of the Microkelvin activities is concerned with the dynamics of quantized vortices, especially in the zero temperature limit. In this limit the Kelvin wave cascade is expected to play an important role in energy dissipation. The Kelvin wave cascade is preceded by a self-reconnection driven regime in which localised large amplitude disturbances dominate the dynamics. For example, during a reconnection event, a vortex first becomes strongly distorted in the vicinity of the reconnection site. In that case, the deformation is rather described as a by-product of solitons interacting, or even breathers, as uncovered by the recent work of Hayder Salman. Both, solitons and breathers are localized disturbances with a well-defined propagation velocity. In classical fluid mechanics, solitons are much investigated objects. Within the vortex filament model, several soliton solutions have been found using the local induction appoximation (LIA). Our goal is to find exact soliton solutions numerically using the full Biot-Savart law. We plan to find the family of soliton solutions using the (non-local) full Biot-Savart equation within the vortex filament model. The solition solutions should be found for various energies and momenta associated with these large amplitude excitations. The results will be summarized and compared with the previously found (local) LIA solutions in scientific publications (e.g. Physics of Fluids).
Technical description of work performed: (250 words max)	The main task is to modify the Biot-Savart algorithm to allow us to converge to soliton solutions with the vortex filament model. Formally this corresponds to finding the zeros of a vector-valued function of several variables. The solutions with the local induction approximation (LIA) can be used as an initial starting guess, which should help the convergence of the proposed algorithm.
Project achievements (and difficulties encountered)[5]: (250 words max)	We have made significant progress in formulating the functional that needs to be minimised to find the soliton solutions. In particular, we have identified two methods working with either extrinsic vortex position coordinates or intrinsic curvature/torsion coordinates. Since the codes available are easier to adapt for the minimising of the functional in extrinsic coordinates we have focused on this problem initially. This led to a number of challenges, in particular since the soliton we seek is moving relative to the vortex points. The intrinsic formulation does not suffer from this difficulty but requires substantial changes to be made to the codes we are using. We will, therefore, continue to pursue this other approach. We have also identified another problem involving the search for breathers in current simulations of superfluid turbulence. Dr. Salman has identified the signature of these new breather excitations and we aim to understand their role in superfluid turbulence.
Expected publications and dates:	Physics of Fluids or Phys. Rev. B article, Summer of 2014

Submission date of user group questionnaire:	27/8/2013

Completed Project Reports should be returned to MICROKELVIN Management Office

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

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CAPACITIES

CERTIFICATION OF VISIT

at MICROKELVIN Transnational Access Site

I herewith confirm that the following project was carried out at our Transnational Access Site

O.V. Lounasmaa laboratory

in the context of MICROKELVIN Transnational Access:

AALTO 42 - Soliton solutions within the vortex filament model using full Biot-Savart equation.

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:	Hayder Salman		
Project user 1:	Hayder Salman	12/82013- 27/8/2013	15 days
Project user 2:			
Project user …:[3]			
Total amount of access delivered to project group:			**15 days**

Otaniemi, Espoo, 27.08.2013
Location and date

Signature of access provider
Risto Hänninen

Otaniemi, Espoo, 27.08.2013
Location and date

Signature of project leader
Hayder Salman

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.

[3] Please, expand if necessary