welcome to the European Microkelvin Collaboration

CAPACITIES

Application Form for MICROKELVIN Transnational Access Project

1. General Information

Project number:	AALTO 12A2	
Project Title:	**Microrefrigerator with enhanced cooling power**	
Lead scientist:[1]	**Title:**	Dr.
	First name:	Jan
	Last name:	Kolacek
	Birth date:	9. 11. 1949
	Passport number:	34262515
	Research status/Position:	senior researcher
	New User:[2]	yes
	Scientific Field:	Superconductivity
	Home institution:	Institute of Physics, Academy of Sciences, Prague
	Is your home institution MICROKELVIN partner?	no
	Business address:	Institute of Physics ASCR
	Street:	Cukrovarnická 10
	PO Box:	
	City:	Prague
	Zip/Postal Code:	162 53
	Country:	Czech Republic
	Telephone:	+420-220 318 505
	Fax:	+420-233 343 184
	E-mail:	kolacek@fzu.cz
	Curriculum vitae (18 lines max): **Born**: Prague, Czech Republic, November 9, 1949 Education: 1972 graduated with honors at Charles University, Prague, Faculty of Mathematics and Physics, Postgraduate studies in the Institute of Physics CSAS, Prague, Ph.D. 1981 (Candidate of Sciences) **Positions:** Researcher and Senior Resarcher **Scientific interest and activity:** experiment – far infrared magnetospectroscopy, laser based laboratory FIRM, superconductivity ; theory – vortex dynamics, extended Ginzburg Landau theory, modified Josephson relation	
	Five most recent publications:	
	M. Šindler, R. Tesař, J. Koláček, L. Skrbek and Z. Šimša: *Far infrared transmission of a superconducting NbN film*, Phys. Rev. B **81** 184529 (2010)	
	R. Cao, Lance Horng, T. C. Wu, J. C. Lin, J. C. Wu, T. J. Yang, and J. Kolaček: *Experimental and simulation study of missing matching peaks in Nb thin films with square pinning arrays* Jour. of Appl. Phys **109**, 083920 (2011)	
	R. Tesař J. Koláček, Z. Šimša, M. Šindler, L. Skrbek, K. Il'in, M. Siegel: *Terahertz transmission of NbN superconductor thin film*, Physica C **470** 932 (2010)	
	T. C. Wu, R. Cao, T. J. Yang, Lance Horng, J. C. Wu, Jan Kolácek: *Rectified vortex motion in a Nb film with a spacing-graded array of holes* Sol. St. Comm. 150, 210 (2010)	
	P. Lipavský, J. Koláček, K. Morawetz: *Surface superconductivity controlled by electric field,* chapter 11 in NANOSCIENCE AND ENGINEERING IN SUPERCONDUCTIVITY, Edts: V. Moshchalkov, R. Woerdenweber, W. Lang Springer (2010) Series: NanoScience and Technology ISBN: 978-3-642-15136-1	

[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'.

Other participating scientists:[3]			
	Title:	M.Sc. PhD student	
	First name:	Michal	
	Last name:	Sindler	
	Birth date:	26. 11. 1983	
	Passport number:	37790994	
	Research status/Position:	research assistant	
	New User:[4]	yes	
	Scientific Field:	Superconductivity	
	Home institution:	Institute of Physics, Academy of Sciences, Prague	
	Is your home institution MICROKELVIN partner?	no	
	Business address:	Institute of Physics ASCR	
	Street:	Cukrovarnická 10	
	PO Box:		
	City:	Prague	
	Zip/Postal Code:	162 53	
	Country:	Czech Republic	
	Telephone:		
	Fax:		
Further participating scientists:[5]	**Name:**	**Position:**	**New User:**[2]

2. Project Information

Name of host infrastructure:	**Aalto University**			
Access provider / Infrastructure Director:	**Name: Mikko Paalanen** **Jukka Pekola**		**E-mail address:** **paalanen@neuro.hut.fi** **pekola@boojum.hut.fi**	
Planned project dates:	**Start date:**	**1.3.2011**	**Completion date:**	**31.5.2011**

Project description (12 lines max):

Quantized charge pumping in superconducting circuits is a research topic which, on one side, deals with geometric phases and adiabatic evolution in quantum mechanics, and, on the other hand, possibly provides future tools in quantum metrology for the realization of unit ampere. In the proposed project Cooper pairs are transported in fully superconducting circuits with small Josephson junctions by the help of gate voltages and magnetic fluxes. The ultimate goal of the project is to test and hopefully demonstrate the robustness of the adiabatic evolution in quantum Josephson circuits against various noise sources: the adiabatic manipulation would open an alternative way for quantum information processing in superconducting circuits. Recent theoretical works yield encouraging predictions in this respect.

Scientific objectives of the project (12 lines max):

It is somewhat surprising that proper quantized plateaus of electric current at multiples of e^*f have not been demonstrated experimentally, unlike in the fully normal and in superconductor-normal hybrid devices. Here e^* is the carrier charge ($2e$ for Cooper pairs and e for electrons). In this project we plan to develop Cooper pair pumping by taking advantage of the recent advances in

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

[4] Indicate 'Yes' only if the user has never visited the infrastructure before this specific project, otherwise write 'No'.

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

controlling the circuits of small tunnel junctions. The scientific objective is to demonstrate such plateaus at various frequencies and see whether the position and the width (in control parameters) of such plateaus obey the basic prediction. If the experiment is successful, one can immediately test the limits of adiabatic pumping against Landau-Zener type transitions into excited states at increased pumping frequencies. This will yield direct information about how the system (the pump) couples to its environment.

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

The visitor (Mr. Michal Sindler) will take part in fabrication and perform measurements of Cooper pair pumps (« sluice »), with three new ingredients in the design. 1. The pump will be voltage (V = 0) biased with the help of capacitive shunting across it. This will be realized by on-chip ground planes fabricated with the help of an atomic layer deposited (ALD) aluminium oxide film between the shunting structure and the superconducting circuit. 2. Coupling of the flux-input into the SQUIDs will be enhanced by one to two orders of magnitude by placing the input coils directly under the coils (again with the help of ALD techniques). This is important in order to avoid parasitic couplings in the circuit. 3. If time allows, a balanced SQUID design, developed at LTL will be implemented to avoid direct supercurrent (« dynamic » current), which arises due to only partial closing of the SQUIDs. In the pumping experiment such a dynamic current adds up and masks the pumped « geometric » current. All these three techniques have been developed at LTL but they have not yet been implemented in a pumping experiment. The structures will be fabricated at MICRONOVA clean rooms and the experiments will be performed in a dilution refrigerator at LTL.

3. Joint Proposals / Funding

Is this project in collaboration with other (concurrent) projects at the infrastructure?	**No**
If yes, please specify: GEOMDISS, EU FP7 FET Open strep project where LTL participates.	

Is this proposal submitted to any funding programmes?	**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)