welcome to the European Microkelvin Collaboration

CAPACITIES

Application Form for MICROKELVIN Transnational Access Project

1. General Information

Project number:	**AALTO37**	
Project Title:	**Study of graphene in superfluid 3He**	
Lead scientist:[1]	**Title:**	Dr.
	First name:	Gil
	Last name:	Jannes
	Home institution:	Universidad Politechnica de Valencia
Host scientist:[2]	**Title:**	Dr.
	First name:	Grigory
	Last name:	Volovik
	Home institution:	Aalto University
Project scientist:[3]	**Title:**	Dr.
	First name:	Gil
	Last name:	Jannes
	Scientific Field:	Quantum gravity effects
	Home institution:	Universidad Politecnica de Valencia - Nanophotonics Technology Center
	Is your home institution MICROKELVIN partner?	no
	Business address:	
	Street:	Camino de Vera, s/n, Building 8F | 2nd Floor
	PO Box:	
	City:	Valencia
	Zip/Postal Code:	46022
	Country:	Spain
	Telephone:	+34 674 537 195
	Fax:	+34 96 387 78 27
	E-mail:	gil.jannes@gmail.com
	Curriculum vitae (18 lines max): PhD in Theoretical Physics, Universidad Complutense de Madrid (Spain), July 2009. M.Sc. in Physics, Katholieke Universiteit Leuven (Belgium), September 2005. B.A. in Philosophy, Katholieke Universiteit Leuven (Belgium), September 2004. M.Sc. in Electronical Engineering, Katholieke Universiteit Leuven (Belgium), September 1999. **Postdoctoral positions at:** -Universitat Politecnica de Valencia (Spain): as of Apr 2013. -O.V. Lounasmaa Laboratory, Aalto University: Sep 2010-Jul 2012. -Laboratoire J.A. Dieudonné, Université de Nice Sophia Antipolis & CNRS (France): April 2010-Dec 2010. **Research interests:** Emergent gravity in condensed-matter systems; Gravitational analogies (theoretical and experimental aspects) in classical fluids, quantum gases and Fermi liquids; Quantum gravity effects in black hole physics and Hawking radiation.	

[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.

	Publications: 12 peer-reviewed publications in international journals (2 as single author) + 2 currently under review; 3 book chapters; 6 peer-reviewed congress proceedings. Inspire citation summary: 138 citations, h-index 7 (google scholar: 157/8). 20+ presentations in international seminars and congresses, 4th prize, FQXi essay on "the nature of time" (2008)
	Five most recent publications:
	1 Experimental demonstration of the supersonic-subsonic bifurcation in the circular jump: A hydrodynamic white hole G. Jannes, R. Piquet, P. Maissa, C. Mathis, G. Rousseaux Phys.Rev.E83, 056312 (2011)
	2- He trans-Planckian problem as a guiding principle Luis C. Barbado, Carlos Barceló, Luis J. Garay, Gil Jannes JHEP 11, 112 (2011)
	3- The cosmological constant: A lesson from the effective gravity of topological Weyl media G. Jannes, G. E. Volovik JETP Lett.96, :215-221 (2012)
	4- Hawking radiation of E<m massive particles in the tunneling formalism Gil Jannes JETP Lett.94,18-21(2011)
	5- Hawking radiation and the boomerang behaviour of massive modes near a horizon Gil Jannes, Philippe Maïssa, Thomas G. Philbin, Germain Rousseaux Phys.Rev.D83,104028 (2011)

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

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

2. Project Information

Name of host infrastructure:	**Low Temperature Laboratory, Aalto University**			
Access provider / Infrastructure Director:	**Name: Matti Krusius**		**E-mail address: Matti.Krusius@aalto.fi**	
Planned project dates:	**Start date:**	**17/06/2013**	**Completion date:**	**22/06/2013**
	Start date:	**03/09/2013**	**Completion date:**	**07/09/2013**

Project description (12 lines max):

The project is devoted to studying the common properties of superfluid 3He and graphene, and to the planning of experiments with graphene in the superfluid 3He environment. Both systems are topological materials. They contain topologically protected massless fermions : 2+1 Dirac fermions in graphene; 3+1 Weyl fermions in bulk 3He-A; 2+1 Majorana fermions on the surface of 3He-B; 1+1 Majorana fermions in the cores of quantized vortices. In both systems relativistic quantum fields and gravity emerge with all the related phenomena, such as chiral anomaly, Hawking-Unruh effects and Schwinger pair production in electric fields. The combination of graphene and superfluid 3He will allow us to study the interplay of the properties of two topological materials, and the new effects, which emerge, when these materials are combined,

Scientific objectives of the project (12 lines max):

Experiments on graphene immersed in superfluid 3He may include: experiment on the spin Josephson effect in 3He-B due to a spin current through the graphene layer; exploiting oscillating graphene for the observation of Majorana fermions on the graphene boundary of 3He-B; investigation of the properties of graphene in the superfluid environment at ultralow temperatures under different conditions (in the presence of rotation, superflow, quantized vortices, external magnetic field, magnon Bose-Einstein condensate, etc.).

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

We shall discuss experiments with surface waves at the interface between 3He-A and 3He-B in a rotating vessel. For thin enough layers of these liquids, the quanta of these surface waves – ripplons - exhibit an effective relativistic metric, which can be regulated by the rotation of the liquid. This will allow us to study in detail the analogue of the ergoregion instability, which takes place around a rotating black hole. Such an instability is predicted to exist also for astrophysical black holes in quantum gravity scenarios with the most commonly expected Lorentz-symmetry-violating behaviour at ultra-high (trans-Planckian) frequencies. The relativistic analogy of the surface waves of the 3He-AB interface will allow to measure the dependence of the instability on the particular type of dispersion (superluminal, subluminal, or purely relativistic). These measurements will be performed near the zero-temperature limit in the rotating cryostat, where the influence of all sources of friction from the vessel boundaries and the normal (non-superfluid) component can be controlled. Extrapolations from these results will allow us to provide a first estimate for the upper/lower limits of the influence of such Lorentz-violating trans-Planckian scenarios on the life-time of astrophysical black holes. New physics may arise, if the phases are separated by a graphene layer.

3. Joint Proposals / Funding

Is this project in collaboration with other (concurrent) projects at the infrastructure?	**Yes**
If yes, please specify:	**AALTO38**

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