**European Microkelvin Collaboration**

# Microkelvin General Assembly

**Meeting at the International Conference on Quantum Fluids and Solids – QFS2012**
**Friday, 17 August, 2012, at 20:30**
**Charles Carter building, Lancaster University**

**Members present at the meeting:**

George Pickett ULANC (Chair)
Rob Blaauwgeers BLUEFORS
Christian Enss HEID
Shaun Fisher ULANC
Francesco Giazotto SNS
Henri Godfrin CNRS
Teun Klapwijk DELFT
Matti Krusius AALTO (Coordinator)
Tjerk Oosterkamp UL
John Saunders RHUL
Thomas Schurig PTB
Peter Skyba SAS
Dominik Zumbuhl BASEL

**Not represented:** BLUEFORS, SNS, DELFT, UL, SAS, and BASEL

# MINUTES OF GENERAL ASSEMBLY

1. ***Amendment Request #3***. The Request is currently processed at the EU Project Office, but because of vacations progress has been held up. We are proceeding with the assumption that a 6-month extension until the end of September 2013 will ultimately be granted, as indicated by the EU Project Officer. This will have the following implications:
   - visits within the TNA programmes can be hosted until end of September 2013
   - meetings within the coordination budget can be organized until end of September 2013
   - final Review and Users Meeting will be organized in September 2013
   - deadlines of the JRA work packages are not postponed; the RTD budgets reserved for these activities have to be closed at the end of March 2013.
2. ***Coordination budget***. The coordination budget of Aalto has been exceeded by 11 000 Euros, in Lancaster the coordination funds will be used up if the current plan of meetings is carried through, while in Grenoble an uncommitted reserve exists. The Lancaster budget will cover for the commitments to the QFS-2012 and EPS-CMD24 Conferences as well as for the final Review and Users Meeting in September 2013. At the time of the GA meeting the amount of uncommitted funds in the Grenoble budget is not accurately known.
3. ***2012 PTB Workshop***. The PTB workshop in December 2012 (see announcement in addenda) asks for travel and accommodation support for its Microkelvin participants. This money will come from the Grenoble budget.

4. ***Future items in coordination budget.*** No further commitments are imminent, but Microkelvin makes an effort to respond to new modest initiatives as needed. The final Review and Users Meeting will be paid from the Lancaster coordination budget. The Meeting will take place in September 2013, unless a permission is granted to postpone it until later in October. This would be preferable to leave more time between the QFS2013 Conference Aug 1 – 6 and the Microkelvin Workshop. The venue will be either Helsinki or Lancaster. If additional reserves exist in the coordination budget, preference is given to topical meetings on each of the four JRA packages. These can be organized during late 2012 or early 2013 with 1 – 3 day duration.

5. ***Deadlines in JRA.*** The proposed extension of the grant period does not affect the timetable for milestones and deliverables. Can we expect to achieve these deadlines as foreseen, with roughly 80 % success rate as has been the case in our earlier Periodic Project Reviews? The construction of new refrigerators in JRA1, to be readied for general vsitor access within the Microkelvin consortium, is the most delicate case. This is because of delays in equipment deliveries from various sub-contractors (such as suppliers of liquid helium dewars or superconducting magnets). The general opinion was that we are still well on track, in spite of delays, and will be able to finish the construction work in time.

6. ***TNA services.*** Activity in the TNA programmes of both Grenoble and Lancaster will be stepped up. Permission will be requested from the EU Project Office to transfer part of the funding for TNA to Aalto so that visitor programmes there can be continued beyond September 2012.

7. ***Management budget for the 6*-month extension in 2013.** The budget for managing the Microkelvin collaboration will be exceeded if the request for the 6-month extension of the grant period is accepted. When this happens, the management deficit will be discussed with the EU Project Office, to locate a budget item from where a sum of order 30 000 Euros can be transferred for management.

8. ***Future of Microkelvin.*** The collaboration has started preparations for the time after the finish of the current grant period. A roadmap of the steps to be taken has been drafted by Professor Enss. The plan calls for establishing a joint European low temperature laboratory without walls which will continue working for the goals of the Microkelvin Project as much as possible in the absence of a common grant. The Collaboration will speak out for the need to acquire funding for the common cause and prepare applications for a new grant, to support the infrastructure and the services for European research in need of the lowest temperatures.

9. ***News from the EU Project Office***. No urgent matters needed to be discussed.

10. ***Collaborative projects with industrial partners***. A meeting with industrial partners is planned to be organized by Professor Godfrin in Paris in late 2012 or early 2013. A list of the companies and their invitations is in preparation.

11. ***Any other business.*** Because of the late hour and early start of the Conference programme next morning, no further topics were taken up.

12. ***Closing of meeting*.**

Lancaster August 17, 2012

Matti Krusius
Coordinator

George Pickett
Chairman

***Addenda:***

1. **The case for the European Microkelvin network.** A statement promoting the need to continue support for maintaining the European research infrastructure and the further development of the microkelvin regime (draft by George Pickett).
2. **Towards a European Ultra-Low-Temperature Laboratory.** A roadmap for starting a Europe-wide collaboration between existing Low Temperature Laboratories (draft by Christian Enss).
3. Announcement of the workshop **"Physics and Metrology at Low Temperatures"** to be organized by the Physikalisch-Technische Bundesanstalt in Berlin 13 – 14 December, 2012.

## THE CASE FOR THE EUROPEAN "MICROKELVIN" NETWORK

The ever-increasing complexity of current electronics is rapidly bringing us to the limit when typical component sizes finally reach atomic dimensions and no further miniaturization is possible. At that point we will need something entirely new.

Electronics based on coherent electron behaviour promises to provide the new way forward. In nanocircuits, the electrons can behave coherently over the circuit dimension and thus follow the quantum rules of wave motion rather than Ohm's law. This will open up a whole range of new devices based on quantum electronics.

The major difficulty standing in way of this advance is the achievement of the coherence needed. The electrons must be able to move through the circuit without scattering. But to achieve scattering lengths larger than the sample size, we need to minimise both impurity scattering and thermal scattering. The former demands extremely high purity materials which we already have the technology to produce. The latter, to limit *thermal* scattering, requires low temperatures. For this, even at the more easily accessible millikelvin temperatures, the circuits need to be of nanoscale.

This severe size restriction provides the motivation for exploiting the implicit imperative in nanoscience that there are enormous advantages to be gained by working at much lower microkelvin temperatures. Despite this clear demand, nanoscience in general is inhibited from advancing below the millikelvin temperature regime by a lack of appropriate expertise and facilities.

In Europe we *already* have the greatest concentration of microkelvin infrastructure and expertise in the world, developed by our quantum-fluids community. Over the last three years the MICROKELVIN network has been putting this existing infrastructure at the disposal of the wider nanoscience community, developing together new techniques to bring coherent structures into a completely new temperature regime. This is leading to the creation of a European microkelvin "laboratory without walls" to exploit this necessary work. The activity is also encouraging European commercial interest in the opportunities in this new emerging area which should give European technology a lead.

The UK has two microkelvin facilities intimately associated with this work, and both taking leading roles in the endeavour. (Replace with your own appropriate "national" comment to suit).

We are asking you, as a decision maker in influencing the programme of Horizons 2020, to be aware that this vitally important activity is continued by being included in the future road map.

The advance toward smaller sizes and lower temperatures is inevitable in the long term, but the European lead in the microkelvin field gives us now the opportunity to be first with this new development.

The infrastructure is now coming together. The need is manifest. We simply have to ensure that the opportunities continue in Europe.

**Background Information**

Research at the frontier near absolute zero has long been a powerhouse for generating ideas in physics and beyond, from concepts in particle physics to practical ultrasensitive devices for application in technology and medicine. One in four Nobel prizes over the last century has gone to a low-temperature physicist. In the same period the lowest accessible temperatures have fallen by 10 orders of magnitude (4 K to 100 pK) far exceeding the rate of miniaturization of microcircuits (Moore's law) over recent decades. Today some 250 (1000) low temperature research groups (researchers) in Europe work at sub-Kelvin temperatures. Ten major companies and 15 SME's have cryoengineering groups. Their total annual turnover is about 1 000 000 000 € and 50 000 000 €, respectively. There is a European need for around 100 low temperature scientist and cryoengineers per year.

While Europe is the current world leader in microkelvin physics, in terms of research workers, records held and research output, the effort is fragmented between universities and government laboratories and lacks the critical mass for high quality research and training programs. Industrial exploitation is also very low with no commercially available refrigerators able to reach the microkelvin regime. Only 20 laboratories worldwide can build their own microkelvin refrigerators with 12 located in Europe, almost all of which are involved in this action. Many current world low temperature records are held by partners of the MICROKELVIN collaboration.

Recently interest in the sub 10 mK regime has increased, with the emergence of two frontiers, nanoscale dimensions and microkelvin temperatures. Nanocircuits behave as quantum objects which can be incorporated *directly* into conventional electronic circuits, thus allowing engineering to tap directly this whole new range of quantum possibilities with clearly very great economic implications. To make full advantage of such systems we need to increase the coherence time of the nanocircuits. This obviously requires increased purity of the materials, improved architecture of the circuits, but also a large reduction in the influence of the surrounding thermal 'outside world'. Consequently, operation at lower temperatures has a great impact on this field.

In summary, more efficient research work in the microkelvin regime, although demanding, will open new opportunities. This demands a higher level of networking and integration of the European low-temperature community. The MICROKELVIN Collaboration is opening the microkelvin temperature regime to a wider range of scientists. It will counteract European fragmentation, bring nanoscience into the microkelvin arena, and stimulate industrial entry into the field.

## Memorandum of Understanding

## TOWARDS A EUROPEAN ULTRA-LOW-TEMPERATURE LABORATORY

Research at the frontier near absolute zero has long been a powerhouse of new ideas in physics and beyond. Physics at ultralow temperatures requires elaborate large-scale infrastructure that is difficult to build and maintain by a single academic research unit. Over the past two decades several groups in Europe have established large-scale cryogenic facilities that are unique on the worldwide scale. Today, several of these laboratories are leading the research in the fundamental physics of quantum fluids and solids, as well as in nano-science at ultra-low temperatures. In order to preserve and further develop these special complementary infrastructures we agree to establish a unified *European Ultralow Temperature Laboratory* **(EUTL).** As a first step towards this unified laboratory without walls, the *European Microkelvin Collaboration* has formed a close coalition among the leading European ultra-low temperature laboratories, with the purpose to develop together common infrastructures and to open up the microkelvin regime to nano-sciences. Within this Microkelvin Collaboration three of the twelve partner laboratories were chosen to provide trans-national access to external users of their facilities. In addition, frontline research in the form of joint projects have been carried out among the partner laboratories. As a further step, the Collaboration aims to formally establish EULT, as a distributed infrastructure with complementary instrumentation.

The European Ultralow Temperature Laboratory will have the following attributes:

- It gives European research wide open access to its unique facilities. A scientific board will steer the access policy and handle the applications.
- It will operate as a close and formal collaboration of the individual units without establishing an administrative superstructure above them. In this way high flexibility can be maintained by obtaining maximum synergy effects.
- The individual units of the unified laboratory work closely together to develop new instrumentation and cryogenic techniques. They collaborate in graduate student education and establish a flexible exchange program for scientists and students between the units.
- The units will carry out joint research projects and will have regular collaboration meetings. They will discuss and decide on a common research roadmap for microkelvin physics on a biannual basis.
- The members of the EUTL jointly administer the European funding to maintain and develop the infrastructure of the units, as well as for international access, scientific exchange and joint research projects.

The institutions signing this memorandum of understanding aim to establish The European Ultralow Temperature Laboratory by 2014 under the umbrella of the European Framework Programme HORIZON 2020.

Basel, Berlin, Grenoble, Heidelberg, Helsinki, Kosice, Lancaster, London, ...

# Physics and Metrology at Low Temperatures

13-14 December 2012
Berlin

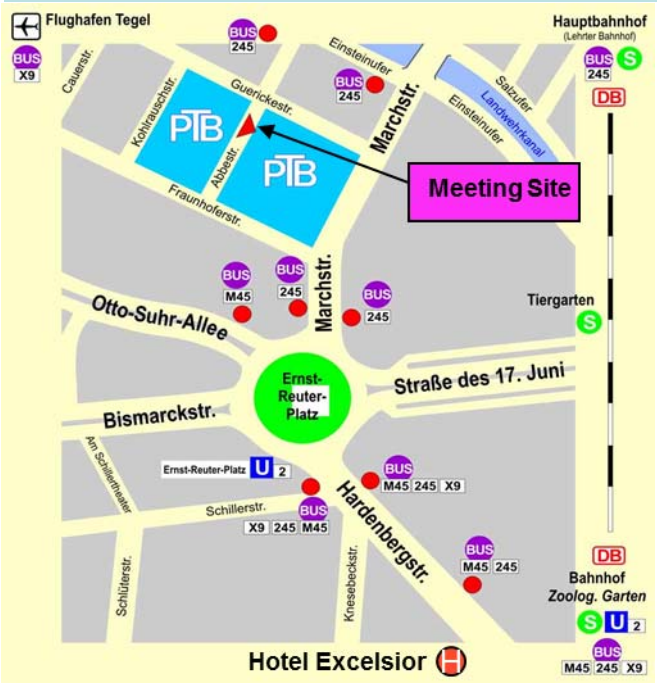
Physikalisch-Technische Bundesanstalt
www.ptb.de/berlin

welcome to the
European Microkelvin Collaboration

PTB 125 Jahre genau

HELMHOLTZ ZENTRUM BERLIN für Materialien und Energie

## Access




By train: Berlin Main Station (Hauptbahnhof), take S-Bahn railway S5, S7 or S75 to Zoologischer Garten station. From there it is a 20-min. walk to PTB campus. Subway U2 (destination Ruhleben), buses 145 and 245, and express bus X9 connect to Ernst- Reuter-Platz.

By plane: Berlin-Tegel airport is connected to Ernst-Reuter-Platz and the train station Berlin Zoologischer Garten by express bus X9. The airport Berlin-Schönefeld is connected to the train station Berlin Zoologischer Garten by railway (Regionalexpress) and by the S-Bahn S9.

By car: The PTB campus is located in Berlin's "City West", close to the train station Berlin Zoologischer Garten and the Technical University.

Invitation

13 -14 December 2012
Physikalisch-Technische Bundesanstalt
Campus Berlin

# Physics and Metrology at Low Temperatures

## The Workshop

25 years ago, the Berlin low-temperature groups at the Physikalisch-Technische Bundesanstalt (PTB), the Hahn-Meitner Institute and the Freie Universität initiated the *Berlin Low-Temperature Colloquium* to strengthen their collaboration and to discuss new developments and trends in low-temperature physics and cryogenic techniques. Several workshops have been held in the framework of this colloquium bringing together experts from academic institutes, universities and industrial companies active in the fields of low-temperature physics and metrology.

Following the low-temperature physics and metrology symposia held by PTB and the Helmholtz Zentrum Berlin HZB (founded by merging the former Hahn-Meitner Institute and BESSY) in May 2007 and December 2009, this workshop is dedicated to this anniversary.

Meanwhile, the *European Microkelvin Collaboration*, a project funded by the European Commission which was introduced in the 2009 workshop by its coor-dinator Mikko Paalanen, is in its final stages and the workshop will give an opportunity to review and disseminate results obtained so far and to discuss the activities towards creating an integrated European virtual laboratory in microkelvin physics and technology.

This workshop is intended to initiate discussions and networking activities within the European low-temperature community and to identify future demands on low-temperature metrology.

Programme

## Scope

- Cooling techniques
- Thermometry
- Sensors
- Quantum gases, fluids and solids
- Magnetism and properties of solids
- Quantum electron transport
- Superconductivity

## Presentations

Presentations will be given as talks and posters.
If you would like to give a presentation at the workshop, please submit a brief summary to margit.kleinsorge@ptb.de.
Deadline for contributions: 23 November 2012.

## Exhibition

In conjunction with the workshop we invite companies concerned with the field of low-temperature technology to exhibit their product portfolio. Please contact the workshop office for more information.

## Tentative Schedule

- Workshop starts on Thursday at noon
- Social gathering on Thursday evening
- Presentations continue on Friday
- For those interested in a lab tour and further discussions, PTB colleagues are available on Friday

## The Venue

The workshop is organized by the Physikalisch-Technische Bundesanstalt (PTB), Germany's National Metrology Institute, and the Helmholtz Zentrum Berlin. It takes place at the historical PTB campus which is located within walking distance of the Kurfürstendamm, a well-known shopping street in central Berlin, and the station Zoologischer Garten, right in the heart of Berlin's “City West”.