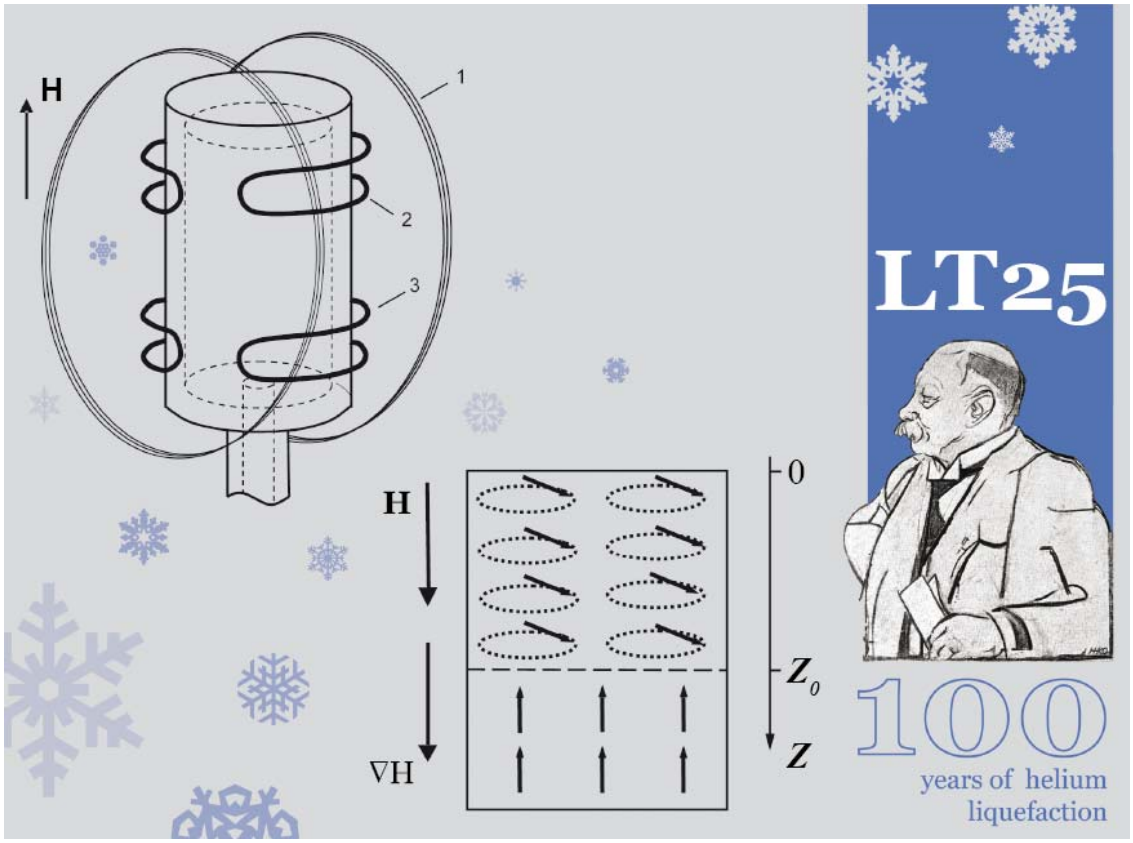
FINAL REPORT



Kamerlingh Onnes watching London Prize winning results

REPORT FROM THE ORGANIZERS

The 25th International Conference on Low Temperature Physics (LT25) was hosted by the Kamerlingh Onnes Laboratorium of the Leiden Institute of Physics and held in the RAI Convention Center in Amsterdam, The Netherlands, 6-13 August 2008. It was the second time that the Kamerlingh Onnes Laboratory had the privilege of organizing an LT conference. In 1958, at LT6, 50 years of liquid helium temperatures were commemorated; in 2008 we celebrated the 100th anniversary of the remarkable achievements of Heike Kamerlingh Onnes and his collaborators in Leiden. In 1958 there were 323 participants and 145 papers appeared in the proceedings; in 2008 these numbers had increased to 1390 participants and 900 papers, of which eventually 849 were accepted. This large participation required adequate conference and housing facilities. These could not be found in Leiden, but were conveniently available in Amsterdam.

The triennial International Low Temperature Conferences are organized under the auspices of the International Union of Pure and Applied Physics (IUPAP) through Commission C5 on Low Temperature Physics. It is the most important global meeting that brings together the international scientific community in the broad field of Low Temperature Physics. Because the meeting is held only every third year the 11 plenary and 22 half plenary talks (of 45 or 30 min.) generally provide an overview of important new discoveries over the last few years, whereas the 161 short oral presentations (20 min.) are mainly focused on very recent developments. Since the field is broad, embracing a large section of condensed matter physics, the program is divided into five parallel program lines:

A. Quantum Gases, Fluids and Solids,
B. Superconductivity,
C. Quantum Phase Transitions and Magnetism,
D. Electronic Quantum Transport in Condensed Matter,
E. Cryogenic Techniques and Applications.

This distinction was used both to group the 1625 accepted abstracts, and the short-oral and poster presentations; the number of oral sessions per program line was made in proportion to the number of accepted abstracts per category (A: 323, B: 526, C: 404, D: 276, and E: 96, about the same distribution as at previous LT conferences, e.g. LT22 in Helsinki). Also the papers appearing in the on-line part of the proceedings are grouped according to this classification. From the 877 submitted papers 826 were accepted, 41 rejected, and 10 were withdrawn. In the 5 poster sessions altogether 1479 posters were presented (A: 311, B: 463, C: 370, D: 249 and E: 86).

Two special evening sessions were organized to address (very) recent developments. In the first place there was a *romp* session about the surprising discovery of high temperature superconductivity in iron-based compounds with 7 rounds of about 5 short presentations concluded with 10 min. discussion each. In a parallel session the concern about the demand for and price of liquid helium was discussed in relation to future trends in cryocoolers which may considerably reduce the need for liquid helium. In an outreach evening session, open to the general public, we had two distinguished speakers: Dr. Philppe Lebrun (CERN, Geneva), who talked about the cryotechnology of the Large Hadron Collider at CERN and Prof. Allan Griffin (University of Toronto) about the intriguing history of superfluidity.

The centenary of liquid helium and the birth of low temperature physics were celebrated at the conference excursion to Leiden on Sunday 10 August 2008. Lack of space forced us to limit the number of participants to 643, but many others went on their own initiative. They could attend 3 historical lectures in the former Kamerlingh Onnes Laboratory, and visit several museums where special expositions related to “100 years of liquid helium” were arranged. The conference dinner in the center of Amsterdam on Monday evening was attended by 555 people.

Traditionally, at the opening session of the LT conferences time is reserved for prize ceremonies.
- The recipients of the most important prize in low temperature physics, the *Fritz London Memorial Prize 2008*, were Yuriy M. Bunkov (Institute Neël, Grenoble), Vladimir V. Dmitriev, and Igor A. Fomin (both Kapitza Institute, Moscow). They got the prize for their discovery and understanding of the "Phase Coherent Spin Precession and Spin Superfluidity of ^{3}He-B".
- The *Simon Prize 2008* of The Physical Society went to Yasunobu Nakamura and Jaw-Shen Tsai (NEC Laboratories, Tsukuba) for their "Pioneering demonstration of quantum coherent behaviour in a macroscopic object and for their subsequent explorations of quantum coherent physics in a series of novel superconducting devices".
- The *Nicholas Kurti European Science Prize* (sponsored by Oxford Instruments) was awarded to Lieven Vandersypen (Delft University of Technology) for his "Ground-breaking work on the coherent control of nuclear and electron spins, with possible application to quantum information processing".
- Finally, the first *IUPAP Young Scientist Prizes in Low Temperature Physics* went to
Kostya Novoselov (University of Manchester) for his "Contribution in the discovery of graphene and for pioneering studies of its extraordinary properties", to Dai Aoki (Tohuko University, Sendai) for his "Discovery of novel heavy fermion superconductivity in actinide compounds", and to Viktor Tsepelin (Lancaster University) for "The development of new experimental techniques and key discoveries in the fields of ^{3}He crystals and quantum turbulence".
All prize recipients got the opportunity to present their work in an invited oral contribution.

As is common practice nowadays all announcements, registrations, paper submissions and communications regarding program and practical matters were done electronically, either by email or via internet. Nevertheless, the program book was still printed and handed out to all participants at registration and they received an electronic version on a USB stick as well. The stick also contained all the submitted (but not yet refereed) papers received before July 15, 2008. The final decisions about the scientific program were made in Leiden at a meeting of the program committee members in April 2008. This turned out to be a very efficient and pleasant procedure. The decision to split up the Proceedings in two parts had been taken much earlier in consultation with the Chair of C5 and the IUPAP. In order to optimize impact factors it has become common policy of publishing companies to publish proceedings of big conferences like the LT conference in special on-line journals (open access), such as *Journal of Physics: Conference Series*. We were pleased with the possibility to publish the most important contributions to the program of LT25 in a special issue of *Journal of Physics: Condensed Matter*. The latter will not only appear in print, but will also be available on-line for a period of 1 year from publication (31 March 2009).

Organizing a conference like LT25 could not have been accomplished without the help of many enthusiastic and dedicated colleagues. I like to extend my sincere thanks to all of them, but above all, to my colleagues of the organizing committee.

Peter Kes
Chairman LT25

NEW DEVELOPMENTS IN LOW TEMPERATURE PHYSICS

Below you find part of the Activity Report to the IUPAP General Assembly, October 2008, by the present and previous Chairmen of C5. It provides an overview of the most important and recent developments in low temperature physics, much in line with the program of LT25.

For the field of experimental low temperature physics, the ability to conduct research has been damaged by the dramatic increase in the price of liquid helium. In the United States for example, the price of liquid helium has approximately doubled over the past two years. This has led to a reduction in activity in many laboratories as the funding agencies have not quickly increased support in proportion.

The increase in price of liquid helium has accelerated interest in the development and use of alternative cooling systems. In particular, pulse tube coolers are now available that will allow cryostats with modest cooling needs to operate dilution refrigerators without the need for repeated refills of liquid helium from external supply sources.

Solid helium research has seen a dramatic resurgence. Torsional oscillator experiments have been interpreted to show that solid helium may undergo a transition to a state in which some of the atoms in the container do not follow the motion of the container, e.g. may be "supersolid." The observation is robust, but the interpretation is controversial. The shear modulus of solid helium undergoes a similar signature with respect to temperature. Experiments that should be expected to cause helium to flow give conflicting results. Theory predicts that a perfect solid cannot show supersolid behavior, but novel superfluid-like behavior should be seen in various defects that can exist in the solid, and vorticity may play a significant role. And, recently there have been reports of unusual mass decoupling in films of pure ^{4}He on graphite surfaces as well as ^{3}He-^{4}He mixture films on solid hydrogen surfaces. These may be other examples of unusual superfluid-like behavior.

There is continued interest in superfluid turbulence, where there has been progress in the use of very sensitive ultra-cold detectors as well as the use of injected ions. Interesting progress is being made in understanding how quantum turbulence resembles classical turbulence. New evidence shows that turbulence can develop by the entanglement of vortex rings. It now appears possible to control the transition to quantum turbulence in ^{4}He.

High temperature and unconventional superconductivity continues to show progress. Over the past few years we have seen new work on the coexistence of superconductivity and ferromagnetism in the Uranium compounds. Discovery of superconductivity in layered iron-arsenic compounds may lead to a new generation of high temperature superconductors and holds great promise. There has also been strong progress in the possible use of layered transition metal oxide materials as the basis for the discovery of new superconductors. The visualization via STM of the electronic states of high transition temperature materials continue to provide new insights into the pairing that takes place in such materials. There is also emerging new work that shows that in a two dimensional superconducting system with patterned holes, pairing may exist in the insulating state.

Graphene has been a very hot topic due to the ability to readily create atomically thin sheets of carbon, which has given rise to investigation in a number of settings via many techniques. These thin sheets, unknown until a few years ago, reveal remarkable electronic and optical properties, which are only beginning to be understood and explored. There has also been continuing progress in the area of carbon nanotubes where there have been developments in the

study of the spin and orbital motion of electrons, which have implications for spintronics applications.

There has been progress in the area of qubits, where it now seems possible to communicate quantum information between qubits using photons. Thus emerges the possibility of using superconducting integrated circuits to carry out experimental studies in quantum optics. In addition, small Josephson junctions are being used to study quantum coherence in ways not possible previously.

Device-driven research continues to show remarkable new results. The use of SQUID detection has allowed the possibility of very low magnetic field magnetic imaging (MRI) with the ability to resolve structures to a higher degree than previously possible. There has also been work in the area of nano-mechanical resonators, which may allow future study of squeezed states in a mechanical system. In addition, there continues to be work on nanomagnets, which show self-assembly properties and unusual temperature dependence to the magnetization.

Ultra-cold gasses continue to see dramatic progress due to the unprecedented ability of the realm of cold-atom physics to manipulate atoms and their environment. Optical superlattices have allowed studies of superexchange interactions and open the possibility of further investigation of the dynamical behavior of quantum spin systems. Such cold gas experiments have allowed unprecedented opportunity to study quantum degenerate Fermi gasses and the realization of superfluidity with unusual interactions. Also in this area it has been possible to create controlled disorder and subsequently directly observe localization phenomena in one dimension, with the expectation that this can be extended to higher dimensions.

Bob Hallock
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Faculty of Science, Leiden University
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CONFERENCE STATISTICS

LT25 was attended by 1390 participants from 44 countries. This number includes the almost 350 graduate students and the representatives of the 23 exhibitors. The table below shows the distribution of nationalities. The distributions of the 125 female participants and the 199 speakers are given in bold and italic numbers, respectively. Remarkable is the big delegation from Japan: 481, among them 129 graduate students. In addition, 114 accompanying persons were registered.

Algeria	3	**1**		Kroatia	2	**1**	
Argentina	4	**2**		Mexico	4	**1**	
Australia	4			Moldavia	1	**1**	
Austria	9	**1**	*2*	Netherlands	85	**8**	*18*
Belgium	8	**1**		New Sealand	2	**1**	
Brazil	12			Norway	1		
Canada	17	**2**	*6*	Poland	10	**2**	*1*
China	10	**2**	*1*	Portugal	1		
Cyprus	1			Romenia	9		
Denmark	1		*1*	Russia	50	**8**	*6*
Estland	3			Scotland	1		
Finland	35	**3**	*1*	Slowakia	13	**5**	
France	58	**7**	*15*	Spain	15	**4**	
Georgia	3			Sweden	17	**3**	*2*
Germany	115	**16**	*21*	Swiss	24	**1**	*8*
Greek	3	**1**		Taiwan	35	**2**	
India	15	**1**	*1*	Tsjechia	8		*1*
Israel	22		*6*	Tunesia	2		
Italy	14	**3**	*2*	Ukrain	21	**4**	*1*
Japan	481	**20**	*44*	UK	104	**10**	*13*
Kazacstan	2	**1**		UAE	1		
Korea	21	**1**		USA	143	**12**	*44*

The amount of **financial assistance** requested was about four times the available budget. The Financial Assistance Committee made a selection guided by criteria, such as the recent scientific achievements of the applicant in Low Temperature Physics, or the promotion of the attendance of young scientists other then graduate students and physicists from emerging countries. Eventually, 84 participants could be supported, mainly receiving a waiver of the registration fee and in some cases also some support for travelling expenses.

Female Participation in LT25.
Several of our sponsors actively promote the role of women in physics and wanted to know how LT25 has been doing regarding this issue. You find some relevant data below.

Female participants: 125 out of 1390.
Female members of the program committee: 4 out of 28.
Female speakers (half) plenary: 3 out of 38.
Female speakers in oral presentations: 7 out of 161.
Female session chairs: 4 out of 56.

There is clearly room for improvement at the LT-conferences to come.

PREVIOUS LT CONFERENCES

	Location	Year	Chairman	Editor(s)	Papers	Participants
0	Cambridge, UK	1946	L. Bragg	J.F. Allen	26	300
1	Cambridge, Mass.	1949	F.E. Simon	J.C. Slater	77	200
2	Oxford	1951	F.E. Simon	R. Bowers	104	210
3	Houston	1953	C. Squires	?	?	?
4	Paris	1955	L. Weil	L. Weil	166	268
5	Madison	1957	J.R. Dillinger	J.R. Dillinger	225	440
6	Leiden	1958	C.J. Gorter	H. van Dijk D. de Klerk Z. Dokoupil	145	323
7	Toronto	1960	W. Watson	G.M. Graham A.C. Hollis Hallett	217	352
8	London	1962	G.O. Jones	R.O. Davies	173	321
9	Columbus	1964	J.G. Daunt	J.G. Daunt D.O. Edwards F.J. Milford M. Yakub	279	502
10	Moscow	1966	P. Kapitza	M. Malkov	564	825
11	St.Andrews	1968	J.F. Allen	J.F. Allen	281	750
12	Kyoto	1970	E. Kanda	E. Kanda	367	800
13	Boulder	1972	R.H. Kropshot	K.D. Timmerhaus W.J.O. Sullivan E.F. Hammel	568	1015
14	Otaniemi	1975	O.V. Lounasmaa	M. Krusius M.J. Vuorio	552	814
15	Grenoble	1978	R.Tournier	R. Tournier	723	1102
16	Los Angeles	1981	R. Orbach I. Rudnick	W.G. Clark	815	1054
17	Karlsruhe	1984	F. Buckel	U. Eckern A. Schmid W. Weber H. Wühl	887	1150
18	Kyoto	1987	S. Nakajima	Y. Nagaoka	957	1563
19	Brighton	1990	D.F. Brewer	D.S. Betts	1047	1212
20	Eugene	1993	R.J. Donnelly	R.J. Donnelly	1212	1229
21	Prague	1996	S. Safrata F. Pobell	S. Danis V. Gregor K. Zaveta	1456	1420
22	Otaniemi	1999	M. Paalanen	V. Gantmakher P. Hakonen J. Pekola F. Rasmussen E. Thuneberg	1232	1381
23	Hiroshima	2002	H. Fukuyama S. Kobayashi	Y Iye S. Maekawa	1313	1466
24	Orlando	2005	G. Ihas	Y. Takano S. P. Hershfield S. O. Hill P. J. Hirschfeld A. M. Goldman	770	853
25	Amsterdam	2008	P. H. Kes	R. Jochemsen P.H. Kes	849	1390