Körber European Science Prize 1987

Creating Ultralow Temperatures

Riitta Hari, Matti Krusius, Olli V. Lounasmaa, Martti Salomaa

Low temperature physics is a both fascinating and exotic area of research. The material suddenly displays fundamentally new behavior patterns such as superconductivity, in which electric current flows without any resistance whatsoever. The work conducted by the Low Temperature Laboratory in Helsinki shows that nature also has other surprises in store – and how this research can be used for medical purposes.

Information processes of the human brain can be examined using magnetic signals. (Photo: Peter Allert)

By definition, low temperature physics concerns itself with effects occurring in the vicinity of absolute zero of minus 273.15 degrees Celsius (= 0 degrees Kelvin). The Finnish laboratory of the prizewinners occupies a top position in this field, having already succeeded in 1974 in producing temperatures of 0.0007 degrees Kelvin, i.e. 0.7 thousandths of a degree above absolute zero. In these frosty temperatures, besides superconductivity, superfluidity can also occur in which a fluid no longer displays any inner friction. Superfluid helium, for example, flows without friction loss through the narrowest capillaries; if a vortex is initiated in the helium it simply continues to flow without being weakened. The group led by Professor Lounasmaa in Helsinki is primarily studying the rare helium isotope helium-3 which is particularly interesting from a theoretical point of view.

With the funding from the Körber Foundation the scientists planned to examine the vortex structure in superfluid helium-3 in greater detail, i.e. to conduct basic research in the traditional sense. In addition, however, research is also being conducted into a medical application: With the highly sensitive magnetic field sensors developed in Helsinki, the coils of which are kept superconductive with liquid helium, the magnetic fields of brainwaves and hence the brainwaves themselves can be localized and measured. The funds provided by the Körber Foundation have been used in an extremely selfless, generous way. In order to promote scientific exchange in their area of expertise, the Finnish prizewinners have themselves for the past three years awarded grants to domestic and foreign visiting researchers who they have invited to work with them in Helsinki. At the Körber Final Symposium in June 1991 on the subject of 'Superfluid Helium-3 in Rotation', which was organized by Dr. Martti Salomaa, this approach bore fruit: Over 60 scientists presented results which were directly or indirectly linked to the work with the Low Temperature Laboratory in Helsinki. Specifically, the researchers concerned themselves partly with highly specialized detailed problems such as the acoustic properties of superfluid helium-3 or its spin dynamics, as well as examining the possible relationships between the structure of the rotating superfluid helium and the cosmos. In particularly, analogies appear to exist between the superfluid helium vortices and the hypothetical cosmic strings, as well as with the structure of neutron stars.

A similar final symposium in October 1991 dealt with the results of the brainwave measurements or magnetoencephalography. The success of this working group headed by Dr. Rütta Hari is also demonstrated by the fact that Neuromag Ltd., which builds on the work of the Low Temperature Laboratory, was founded in Helsinki in 1989. In 1991, for example, this semi-government company presented a detector for magnetic brainwaves with 122 measuring channels – the first one capable of covering the entire cortex and at the same time recording the activity of different zones of the cerebral cortex.

Contact
Körber Foundation
Körber Prize
Kehrwieder 12
D-20457 Hamburg
Phone +49 40 · 80 81 92 -181
E-Mail koerberprize@koerber-stiftung.de