Hans Quack (left) of Sulzer and Gerhard Horlitz of DESY were the organizers of the recent 'Technology Transfer in Cryogenics' event at DESY which highlighted the increasing interplay between fundamental physics and cryogenics industry.

(Photo Petra Harms)

of CERN underlined this importance of cryogenics for particle physics with illustrations of the work at their respective Laboratories.

CERN's industrial liaison officer Oscar Barbalat encouraged representatives from smaller companies to seek contacts with major Laboratories. Over the two days of the event, many suppliers also took the platform.

The event was organized by Gerhard Horlitz and by Hans Quack of Sulzer, the company which supplied the three large helium refrigerators for HERA. The next Conference in the series will be in Kiev in June 1992.

GRAN SASSO
Enriched germanium in action

Two large crystals of carefully enriched germanium, one weighing 1 kilogram and the other 2.9 kilograms, and worth many millions of dollars, are being carefully monitored in the Italian Gran Sasso Laboratory in the continuing search for neutrinoless double beta decay.

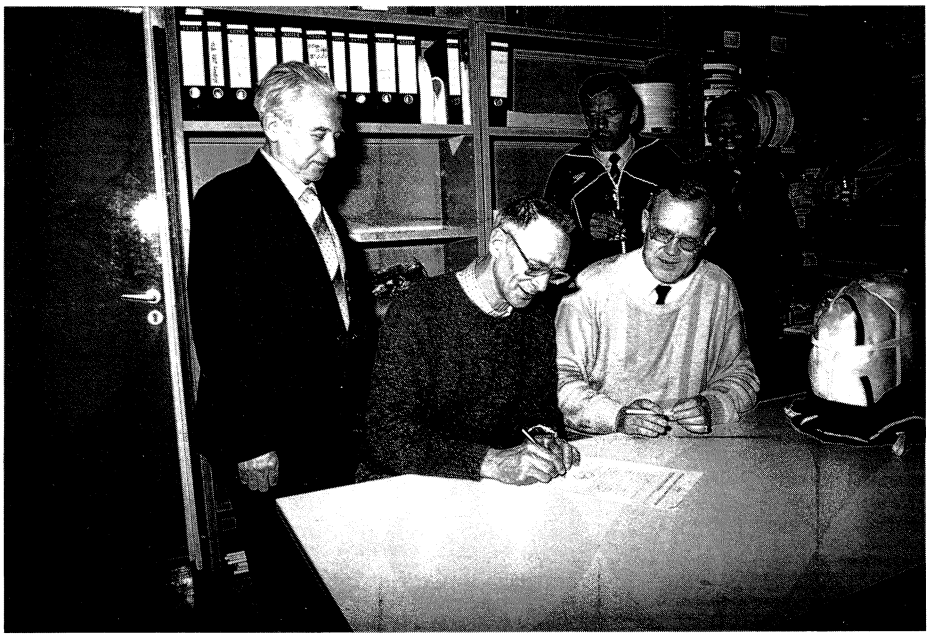
In ordinary beta decay, a nuclear neutron decays into a proton, releasing an electron and an antineutrino. The resulting nucleus, lighter but containing an extra proton, is one rung higher in the Periodic Table than its parent.

In double beta decay, the parent and daughter nuclei are two rungs apart, but the transition, involving two interlinked weak interactions, is very difficult. The tell-tale double electron signal was finally seen by an Irvine group in 1987 in the decay of selenium-82 into krypton-82, with a half-life of about 10^{20} years.

This decay is accompanied by two invisible (anti)neutrinos which carry away surplus energy. But another kind of double beta decay might also be possible, where the two neutrinos swallow each other up and are not released.

For this to happen, the normal selection rules governing beta decay and other weak interactions

Signing the agreement for the transfer of the world's largest sample of high purity germanium-76 (86 per cent) from Moscow's Kurchatov Institute for a Heidelberg/Moscow experiment in the Italian underground Gran Sasso Laboratory are (seated) the two collaboration spokesmen – S.T. Belyaev of Moscow (left) and H.V. Klapdor-Kleingrothaus of Heidelberg. Looking on (left to right) are V.I. Lebedev, A. Balish, I. Kondratenko and A. Müller.



would have to be abandoned. The neutrino would also have to behave in a special way – rather than being a conventional 'Dirac' particle with an antiparticle counterpart carrying opposite quantum numbers, it would have to be a 'Majorana' particle, with no distinct antiparticle and with only its spin direction differentiating between electron and positron processes.

However important new physics has come by looking hard for rare processes which violate established weak interaction symmetries – parity in beta decay, CP violation for neutral kaons – while the neutrino, whose very existence was a surprise in itself, has never stopped surprising physicists. So the hunt goes on.

Germanium-76 is a potential double beta decay candidate, and being an electron detector itself, is ideally suited to these studies. The isotope occurs naturally at the level of 7.8 per cent, and germanium detectors, using natural and enriched samples, have established that neutrinoless double beta decay for this isotope, if it happens at all, has a half-life longer than 10^{24} years.

A Heidelberg/Moscow collaboration now has the world's largest sample of high purity (86 per cent) germanium-76. The 17 kilograms of metal supplied by Moscow's Kurchatov Institute correspond to 14.5 kg of the rare isotope. Further refining and preparation of the final crystals and detectors was carried out in the USA and Western Europe.

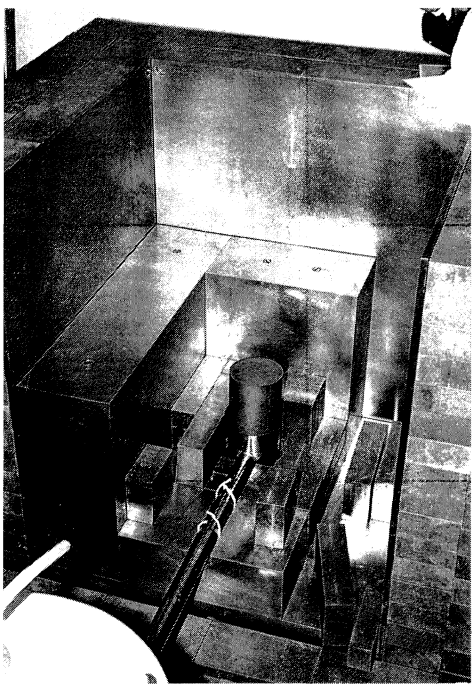
An initial 1 kilogram sample, monitored in the Gran Sasso Laboratory over 251 days, shows no characteristic two-electron spike. However several other beta decay processes show up clearly, demonstrating the clean conditions in the underground Laboratory, shielded from cosmic ray background by 1.4 kilometres of rock. The background rate is particularly low in the region where the neutrinoless double beta decay would occur.

A larger (2.9 kilogram) sample was placed in position in September, and all the enriched germanium should be in use by the end of next year.

The Heidelberg/Moscow experiment complements the Gallex and SAGE neutrino experiments now underway, the former in a neighbouring Gran Sasso cavern, the latter in the USSR.

The continued absence of neutrinoless beta decay can be used to deduce limits on the mass of the (electron-type) neutrino. These put the neutrino lighter than 2 electronvolts, a tenfold improvement on mass limits from direct measurements (less than 9.3 electronvolts).

The electron-neutrino mass may well turn out to be zero, but some physicists point out that the limits deduced from neutrinoless double beta decay searches are assumption-dependent. If neutrinoless double beta decay were to be seen, this would certainly imply a non-zero neutrino mass, and the particle would have to be Majorana-type.



A 1 kilogram detector of high purity (86 per cent) germanium-76 used in the Italian Gran Sasso Laboratory by a Heidelberg/Moscow collaboration has provided limits on neutrinoless double beta decay. With more than 10 kilograms eventually available in the enriched form – the world's largest sample of germanium-76 – the experiment will bring new precision to bear on this hunt.

CENTRAL EUROPE
Austron

For many of the countries of Central and Eastern Europe access to international research centres such as CERN, the European Space Agency (ESA), the Institut Laue-Langevin (ILL) or to national centres such as the Rutherford Appleton Laboratory in the UK or DESY in Germany, is hindered by the absence of intermediate research institutions.

Since mid-1990 this question has been studied by an 'Austron' Study Group set up under the auspices of the Austrian Academy of Sciences and which cooperates with the so-called 'Pentagonal' initiative of Austria, Czechoslovakia, Hungary, Italy and Yugoslavia to promote cooperation in the area, with which Poland is now associated.

This autumn CERN hosted a meeting of the Study Group which is now specifically investigating the possibility of establishing an international research centre in Central Europe, probably in Eastern Austria, close to the borders of Czechoslovakia, Hungary, Italy, Poland,