

Physics monitor

Prototype construction at Saclay and tests in a 5 GeV beam at the CERN PS proton synchrotron allowed both an optimal choice of parameters for the final version, and the refinement of the electron/pion discrimination.

The D0 TRD consists of concentric cylinders. First is a radiator of 390 18-micron polypropylene sheets with 150 micron separation in nitrogen. Then comes a two-stage xenon/methane (9:1) filled drift chamber detector – in the first stage electrons drift 1.5 cm radially, while the second, separated by a 2 mm grid of 70-micron wires, acts as amplifier, using 256 drift cells each 8 mm square and 185 cm long. A 20 micron aluminized mylar double window separates the radiator from the chamber and acts as cathode.

Using measurements of the total energy deposited by a particle in the xenon chambers together with the energy spread along the particle trajectory, the prototype tests achieved a rejection factor of 70 for 5 GeV pions with 90 per cent efficient electron detection.

In June, the complete assembly was set up in the PS test beam and initial results confirm the behaviour seen with the prototype. Next year the TRD unit will be shipped to Fermilab for installation in the central tracker of the D0 experiment.

Superconducted tour

Superconductivity – the dramatic drop in electrical resistance in certain materials at very low temperatures – has grown rapidly in importance over the past two or three decades to become a key technology for high energy particle accelerators.

Physics detectors have long relied on superconductivity and for many years it has been recognized that multi-TeV (thousands of GeV) proton colliders need superconducting magnets. More recently, superconductivity has come of age for the radiofrequency accelerating cavities for electron machines. In step with these applications, the size and sophistication of liquid helium refrigeration plants has also increased, as has the need for trained personnel.

It was in this setting that a hundred students and 15 lecturers met in Hamburg in June for a week's course on superconductivity

in particle accelerators, organized by the CERN Accelerator School and the nearby DESY Laboratory.

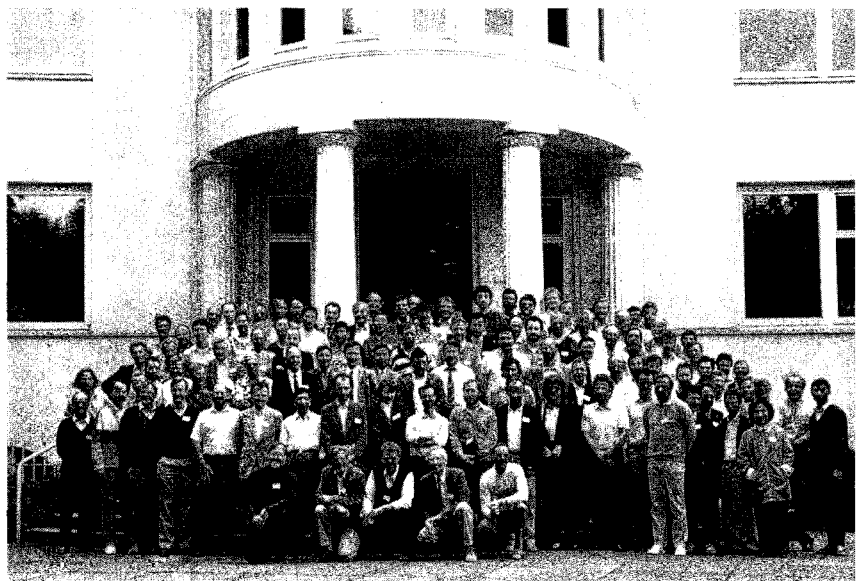
'Conventional' superconductivity is now a mature field and Peter Schmuser (DESY) used the recent results from CERN's prototype dipole for the proposed LHC proton collider in the LEP tunnel (June issue, page 13) to illustrate the state of the art and how well theory and numerical calculations can guide the designer working close to the performance limits of materials.

The beautiful temperature maps of the internal surfaces of r.f. cavities shown by Helmut Piel (Wuppertal) demonstrated the level of refinement being reached for diagnostics. Herbert Lengeler of CERN described the equally sophisticated design of cavities and couplers.

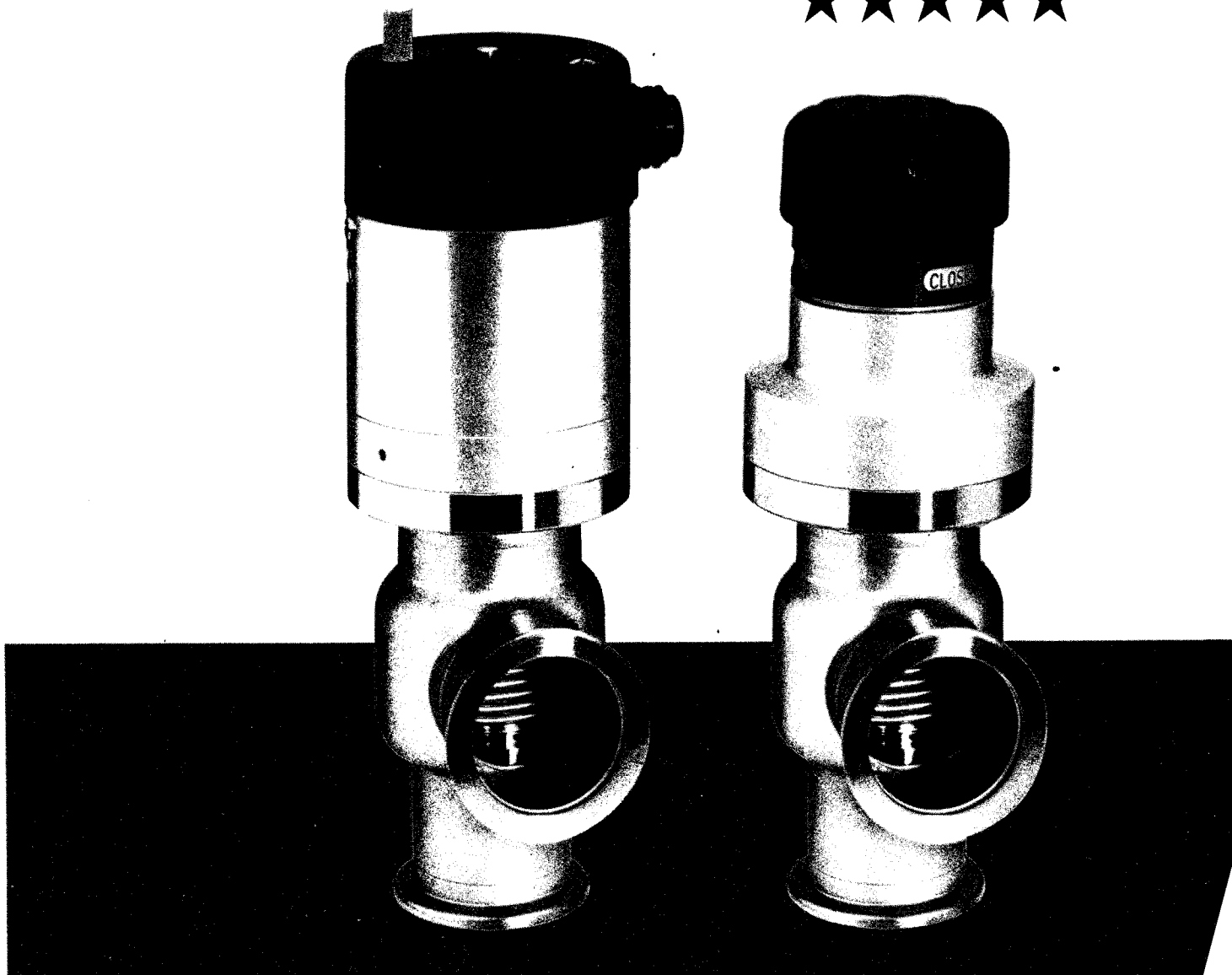
Mid-way through the course, a visit to the DESY Laboratory, scene of construction and installation work for the HERA electron-proton collider, provided a chance to view practical examples and admire large scale cryogenic engineering.

Students and lecturers at the superconductivity in particle accelerators course in Hamburg in June, organized by the CERN Accelerator School and the DESY Laboratory.

(Photo S. Turner)



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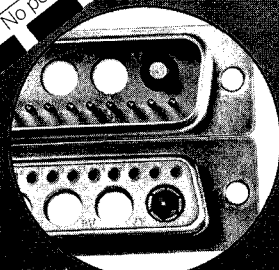
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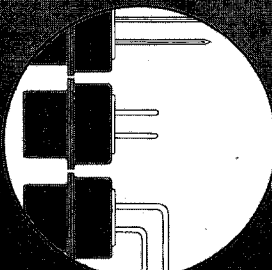
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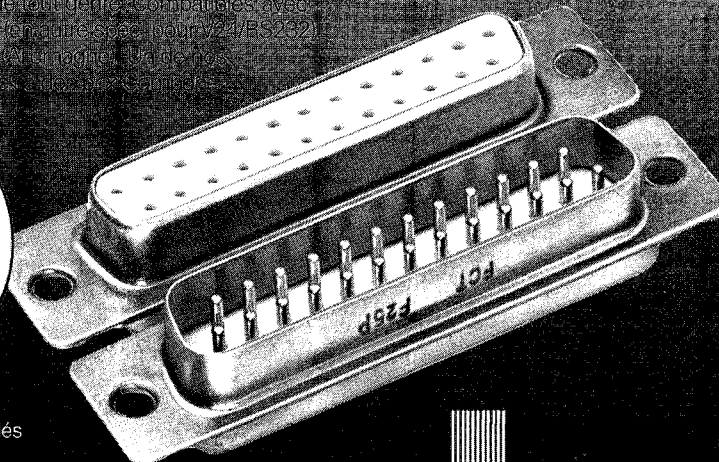


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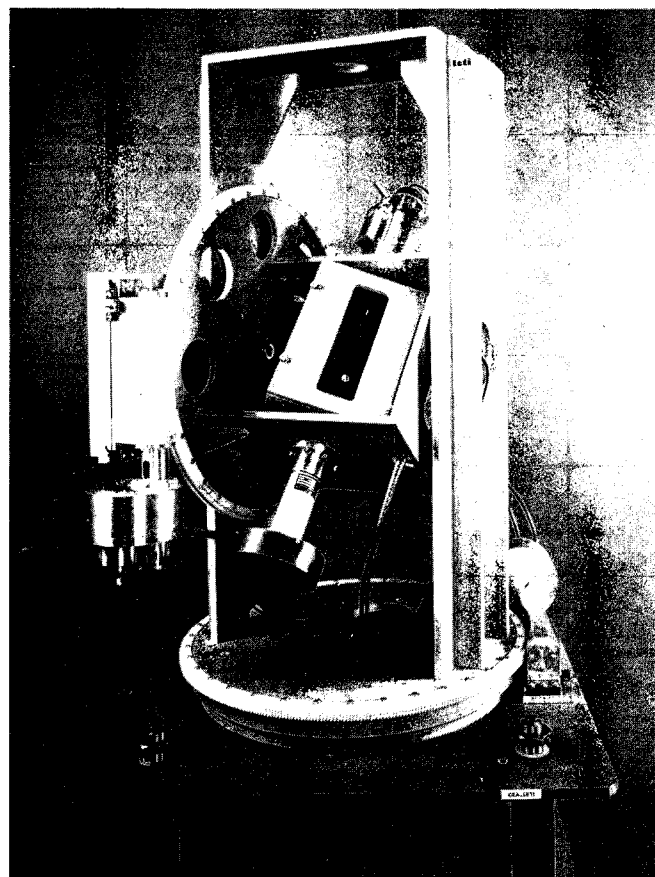
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The final day of the course was given over to the ever-warmer new superconductors. While the steady rise in the temperatures at which these materials go superconducting elicited the remark that soon all helium liquifiers could be discarded in favour of air-conditioners, summarizer Peter Komarek (KfK Karlsruhe) preferred to be prudent. Even with optimistic assumptions about the development of the new materials, the potential gains for electrical engineering were not large, he claimed, although the easier availability of liquid nitrogen compared to liquid helium would favour applications in more remote areas.

Low temperatures – hot topic

Neutrino mass measurements, next-generation double beta experiments, solar neutrino detection, searches for magnetic monopoles and the challenge of discovering what most of the Universe is made of (dark matter), not to mention axions (cosmic and solar), supersymmetric neutral particles and cosmic neutrinos. All this physics could use cryogenic techniques.

Thus the second European Workshop on Low Temperature Devices for the Detection of Low Energy Neutrinos and Dark Matter, held at LAPP (Annecy) in May, covered an active and promising field.

P. de Bernardis, G. Fritz and K.H. Gundlach, described how astronomers have been using cryogenic devices for years to detect very low energy photons, such as the microwave background radiation. Small bolometers and superconducting tunneling junctions (STJ)

Low temperature detectors at work. Energy spectra of alpha particles from an implanted source of radium-228 in radioactive equilibrium with its daughters, obtained by the Milan group with a germanium bolometer at 44 millikelvin. The first alpha decay implants the radium daughter nucleus in the crystal. Above, the initial satellite peaks are broadened by nuclear recoil energy. Two weeks later, most of the implanted nuclei have decayed and the 1% energy resolution of the bolometer is seen.

