RADIOFREQUENCY SUPER-CONDUCTIVITY Workshop

Superconducting radiofrequency is already playing an important role in the beam acceleration system for the TRISTAN electron-positron collider at the Japanese KEK Laboratory and new such systems are being prepared for other major machines. Thus the fourth Workshop on Radiofrequency (r.f) Superconductivity, organized by KEK under the chairmanship of local specialist Yuzo Kojima and held just before the International Conference on High Energy Accelerators (see page 10), had much progress to review and even more to look forward to.

As well as TRISTAN, where 16 five-cell 500 MHz superconducting cavities have operated for more than 5000 hours (see photograph on page 13) and where 16 additional cavities are already installed to take beam energies towards 33 GeV, the new LEP electron-positron collider in operation at CERN and the HERA electron-proton collider being built at the German DESY Laboratory in Hamburg are both scheduled to benefit from superconducting r.f.

For HERA, sixteen four-cell cavities have been ordered following successful beam tests of a prototype module (January/February 1988, page 15), while at CERN, following excellent long-term performance (more than 8000 hours) of a LEP-type cavity at the SPS ring (November 1988, page 15), four superconducting cavities are being prepared for LEP and orders for 20 more niobium cavities have been placed.

Plans for the large fully superconducting CEBAF recirculating linac to be built at Newport News, US, are well advanced. The number of recirculations has been increased from 4 to 5 and 360 five-cell 1500 MHz cavities are being ordered.

The recirculating Darmstadt linac (September 1987, page 34) is steadily being upgraded. It is routinely used for nuclear physics studies, and plans for the addition of a free electron laser are advancing. The venerable Stanford (HEPL) superconducting recirculating linac is now mainly used for free electron laser physics. Plans for superconducting linacs are being worked out also at Saclay (France) and Frascati (Italy).

Although niobium sheets are still the preferred cavity material, great progress has been made in recent years, especially at CERN, in niobium-coated copper cavities. Their high quality factors at 4.2K (more than 10^{10}) and their insensitivity to thermal breakdowns make them promising candidates for future applications. At CERN, construction of an initial set of eight such cavities is advancing well.

In the field of superconducting heavy ion accelerators, more than ten projects are operational or near completion, and an impressive accumulation of operating experience has proved the reliability and flexibility of the technique. Developments and improvements include new types of cavity for use with bright proton and deuteron beams at higher velocities, while for slower particles, Argonne has shown that heavy ions leaving a high-voltage platform can be directly accelerated by a superconducting cavity.

Higher accelerating fields are needed for future linear colliders and would also be useful for high intensity particle 'factories'. Ongoing work looks at the limitations posed by field emission loading. Using high quality niobium and special surface treatments (such as high temperature annealing and helium processing) accelerating fields of the order of 25 MV/m have been reached almost routinely in monocell 1.5 and 3 GHz cavities at Cornell and Wuppertal. As well as improved performance, cost reduction is another major goal en route to increased applicability.

Superconducting r.f. specialists are also helping to develop the new high temperature superconducting materials. Many new or improved deposition methods for thin layers have been applied, such as electrophoretic depositions, epitaxial growth, plasma spraying and magnetron sputtering, sometimes using strong magnetic fields.

Progress towards lower r.f. losses and the quest for higher magnetic fields open the way for small passive r.f. devices such as filters or antennae.

R.f. probes have proved to be a diagnostic boon, enabling 'bulk' properties of thin layers to be measured, avoiding the percolative nature of d.c. measurements.

With an ever-increasing number of superconducting cavities, more investigation of large cryogenic systems at 4.2 and 2K and of non-bath cooling methods are required.

The meeting displayed the dynamism of the r.f. superconducting community. Despite impressive progress since the previous such workshop, a large range of performance parameters and materials remains to be explored. (See also following story.)

From Herbert Lengeler