

Chinese Premier Deng Xiaoping participates in the groundbreaking ceremony for the new Beijing electron-positron collider, scheduled to provide 5.2 GeV collisions in 1988.



the part of the highest levels of the Chinese government. In the various addresses, continuing reference was made to the desirability of completing BEPC on schedule, which means beam by 1988. There was a major banquet in the evening attended by about 400 people including many from the Chinese leadership. State Counsellor Feng Yi and George Keyworth presented toasts to the success of BEPC and similar sentiments were expressed by James Leiss of the US Department of Energy and the President of the Chinese Academy of Science Lu Jiaxi.

As is often the case with groundbreaking ceremonies, ground had already been broken prior to the occasion, in fact the excavation for the injector section is well advanced and work on many of the components and sub-systems had been in progress for

some time. Subsequent to the groundbreaking ceremony the 5th Cooperative Agreement between the US and China was signed by James Leiss for the US and Madam Gu Yu, Counsellor to the Academy of Sciences, representing the Chinese government. This agreement provides for a large number of specific items in which US physicists and engineers will be involved in support work for BEPC.

BEPC is to operate up to 5.2 GeV collision energy, hopefully at luminosities in excess of that now obtained at the SPEAR ring at Stanford, which is the only Western machine operating at this energy region. The reason for this choice of energy was the observation that with the exception of SPEAR all other electron-positron colliders in the world were operating either below or above the BEPC

energy, while at the same time the fields of investigation accessible in that energy region are demonstrating continuing richness. Since SPEAR is only operating for high energy physics half-time, with the other half dedicated to synchrotron radiation, the work at SPEAR has uncovered new physics questions more rapidly than it has answered them.

BEPC will also have numerous external beams for synchrotron radiation and its linear accelerator injector could be used for nuclear physics. However, the primary goal is high energy particle physics and work on the construction of a detector is proceeding in parallel with the machine construction.

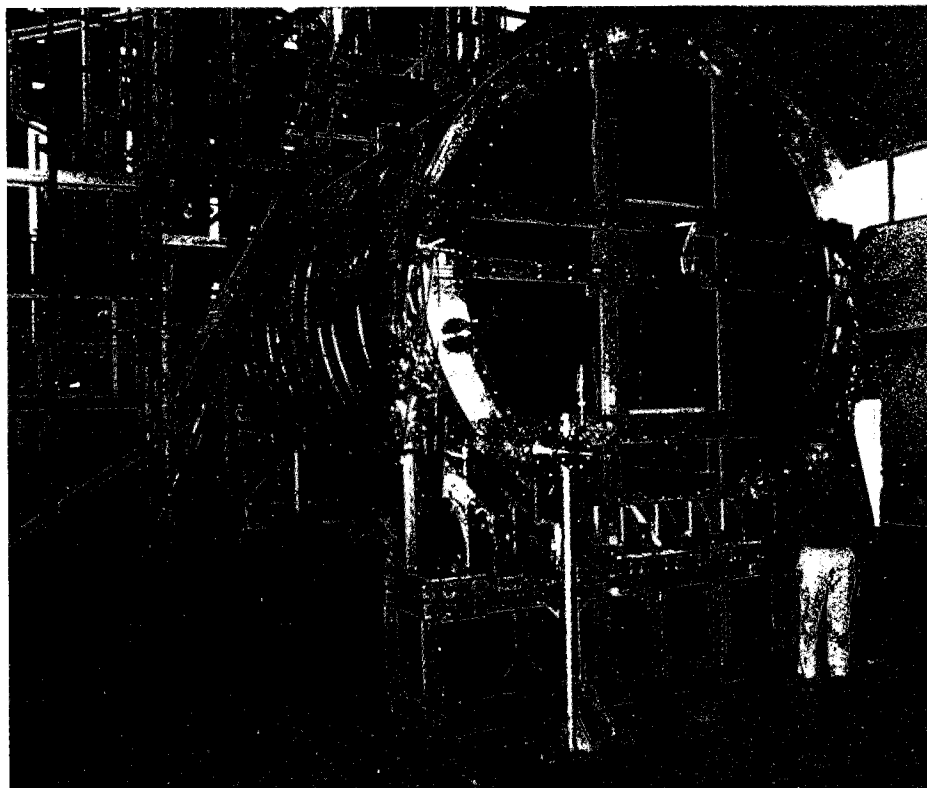
KEK Testing TOPAZ

KEK, the Japanese National Laboratory for High Energy Physics, recently carried out successful tests of a thin shell superconducting solenoid of 2.9 m in diameter and 5.1 m in length with only 0.71 radiation length thickness. The solenoid is for the TOPAZ electron-positron colliding beam detector, one of three major detectors currently being built at TRISTAN.

TOPAZ is a general purpose detector, which features an improved version of a Time Projection Chamber (TPC) to record three dimensional tracks and ionization densities for emerging charged particles. This solenoid, when used with iron-yoke structure, provides a very uniform magnetic field of 1.2 Tesla and enables the TPC to make a good momentum measurement. Outside the solenoid, there will be a lead glass barrel calorimeter, which requires the solenoid

Designer A. Yamamoto of KEK stands beside the thin shell superconducting solenoid for the TOPAZ experiment at the TRISTAN electron-positron collider now under construction at KEK. In the background can be seen the cryogenic assembly used in testing the new solenoid.

(Photo KEK)



be as thin as possible. A newly-developed 'internal winding method' for the coil was an essential step in fabricating this solenoid.

The TOPAZ thin superconducting solenoid was built jointly by Furukawa Electric and KEK in cooperation with Ishikawajima-Harima Heavy Industries and Fuji Electric. The single layer coil is designed to produce a maximum magnetic field of 1.2 Tesla with a stored energy of 19 MJ at 3650A when operated with an iron return yoke. The niobium-titanium/copper superconductor, stabilized by high-purity aluminium, was wound on the inside of a 9 mm-thick high strength aluminium alloy cylinder.

This 'internal winding method' developed at KEK has many advantages over the conventional fabrication technique of winding a coil on a cylindrical bobbin. A strong electromagnetic force causes the

coil to swell outwards. With the conventional design, an additional banding of the coil is needed to withstand this force. With the internal winding method, an outer cylinder naturally provides reinforcement against this force. The 0.71 radiation length 'thinness' of the coil was a direct result of this technique, together with the adoption of design criteria for aerospace applications to reduce the thickness of the cryostat wall, while still meeting the safety requirements. The internal winding method also allows cooling pipes to be welded to the surface of the outer cylinder before the coil is fabricated. This guarantees far better reliability in the cooling characteristics than conventionally epoxied cooling pipes.

The test of the solenoid was performed without an iron yoke during September and October

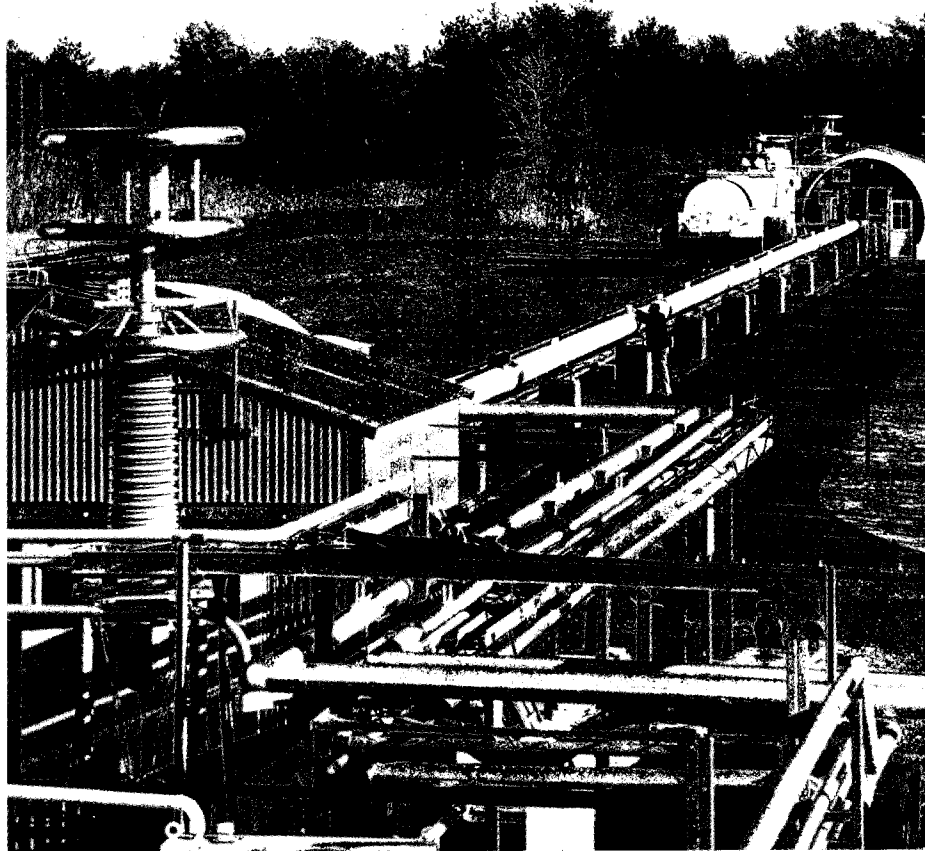
1984 at the Furukawa-Teisan Cryogenic Test Facility. A central magnetic field of 0.86 Tesla was obtained in air at a current of 3000 A, in agreement with the design values. The coil was indirectly cooled down by a forced flow of two-phase helium at a rate of about 2 K/hour from 300 K to 130 K and 4 K/hour from 100 K to 4.2 K in order to avoid thermal stress and mechanical damage. The temperature difference within the coil was kept within 50 K. It took about five days to cool down the coil from room temperature to 4.2 K. Under the stable operating condition at a coil temperature of less than 4.5 K, the total amount of refrigeration power required was less than 42.6 W with a helium mass flow of 2.23 g/s.

A number of tests were repeated to measure the quench behaviour of the coil. Sudden switch-off at 3000 A showed that a quench occurred within 1-1.5 sec after cutting off the power and the entire coil went back to normal without creating any hot spot. Forced quench tests were also made with use of a heater at excitation currents of 1000, 1500 and 2500 A. Equivalent quench propagation speeds of 2.6, 5.0 and 7.7 cm/s along the axis of the coil were obtained from these tests. All these results show that the coil is well protected against possible damages due to quenching, and that the design criteria for safety are satisfied.

The TOPAZ solenoid is now transferred to KEK and will be put into an iron return yoke which is under construction at the Tsukuba experimental hall, where the TOPAZ detector is to be installed. A magnetic field measurement with the return yoke is scheduled in June.

A view of the superconducting power transmission system at Brookhaven, with the pipe containing the superconducting cables seen in the centre. In the left foreground is one of the four terminations which make the transition from the 7 K environment of the cable to the ambient temperature electrical bus bars connected to the power supplies.

(Photo Brookhaven)



BROOKHAVEN Superconducting power transmission

Back in the early 1970s members of the Accelerator Department at Brookhaven began to apply the expertise gained in the development of superconducting magnets to the problem of using supercon-

ductors in other power engineering devices such as underground transmission lines and synchronous alternators.

Since 1972 Brookhaven has been developing an underground superconducting power transmission system. The technical characteristics of the system are comparable to overhead transmission lines, i.e., the power transmitted is very large and such a system

could carry power for hundreds of kilometres without electrical network problems or big losses. Of course, the big attraction of a superconducting system is that the physical size is orders of magnitude less than overhead lines carrying the same power. The difference in size is illustrated by the demonstration test facility at Brookhaven. This site tests cable rated for 1000 MVA (three-phase) in a pipe with an outside diameter of 40 cm, whereas the towers for an overhead three-phase line of this power rating would be about 30 m wide and 40 m high. Construction of the test facility began in 1975. Prior to this the emphasis was on the development of superconducting and insulating materials for a cable operating at 60 Hz. A considerable effort also went into cryogenic and systems engineering.

The cables under test at Brookhaven are rated for a maximum continuous current of 4100 A and line-to-ground voltage of 80 kV (60 Hz), corresponding to 1000 MVA on a three-phase basis. The cable was made at Brookhaven in one length of about 300 m in 1981, then cut and installed in a vacuum-insulated pipe in two lengths of 150 m each. After the terminations were added at each end, the system was operated for the first time in 1982. The Brookhaven site is the only one in the world designed to test cables with simultaneous voltage and current excitation at the 1000 MVA level. More than 2000 hours of operating time have been accumulated since 1982. In October 1984, the sixth run at the site was performed. It lasted for 27 days, of which about two weeks formed an electrical life test, one week was run at 3000 A and 80 kV per