

# How goes ISABELLE?

*Recent aerial view of ISABELLE construction at Brookhaven. The ring tunnel and half the experimental halls are in place. The injection links with the existing Alternating Gradient Synchrotron are also ready to receive magnets.*

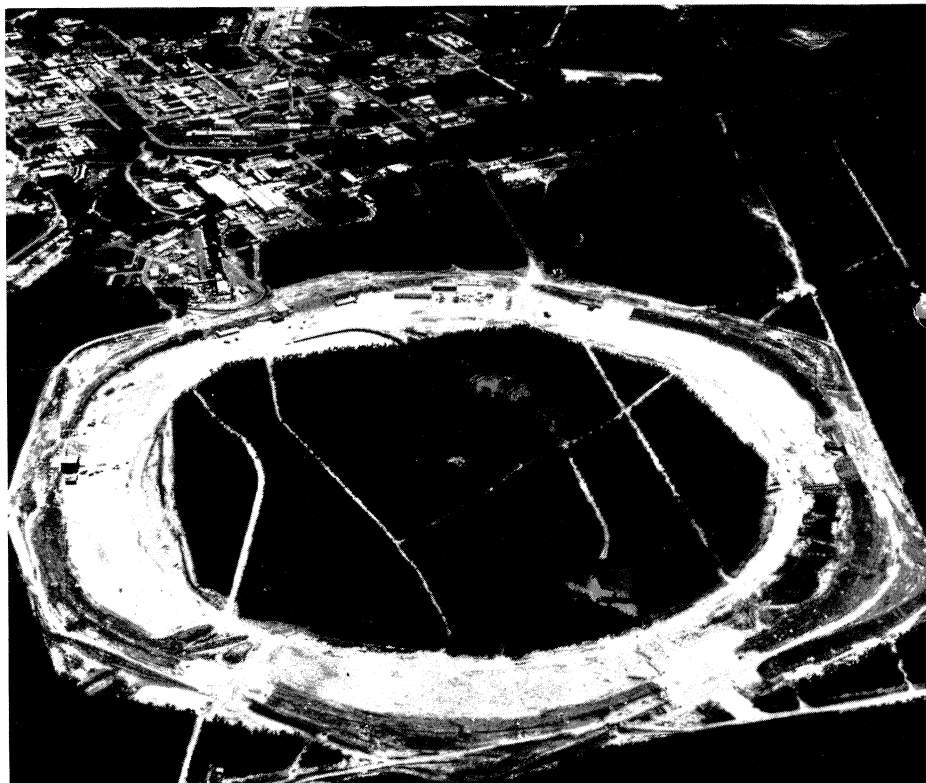
*(Photo Brookhaven)*

well as Fermilab are involved in the work. The aim is to achieve colliding beams by 1986.

Plans for the Collider Detector Facility, CDF, for proton-antiproton physics aim to have a usable detector ready to observe the first collisions. Assembly should start in the B-O hall next year. Design and use of the detector have been greatly simplified by the decision to build an overpass for the Main Ring so that only the Energy Saver vacuum tube will pass through the CDF. The experiment now involves some hundred physicists from about fifteen research centres including some in Japan and Italy who are contributing greatly to detector components. For example, the superconducting coil is being built in Japan; an excellent design has emerged providing a 1.5 T field with a thickness of less than one radiation length.

Letters of intent for an experiment to use a second colliding beam area (in the D-O position) have been called for by 1 November and proposals are required by 1 February next year. The possible hall volume is about 750 m<sup>3</sup> and the detector it accommodates must be easily removable. Two proposals to use the D-O area are already under consideration. One involves a large lead glass array. The other involves the construction of an electron ring to observe electron-proton collisions.

After all the frustrations of recent years with the development of pulsed superconducting dipoles, it is very satisfying to see the world's first superconducting synchrotron coming together. Its operation within the next year will be another demonstration of Fermilab's innovative work in accelerator design and construction.



There cannot be many people in the high energy physics community unaware that the ISABELLE project to build 400 GeV proton storage rings at Brookhaven has been in trouble for several years. The design incorporates two rings of 5 T superconducting magnets and, until late last year, the fabrication of these dipoles to the required quality was proving an intractable problem.

This year a long range planning report on the high energy physics programme for the USA concluded that, unless there is additional funding for the programme, it is difficult to see how the ISABELLE project, as at present conceived, can continue. This has frustratingly come at a time when the magnet problems seem to be convincingly overcome and when new management is reinjecting enthusiasm and confidence.

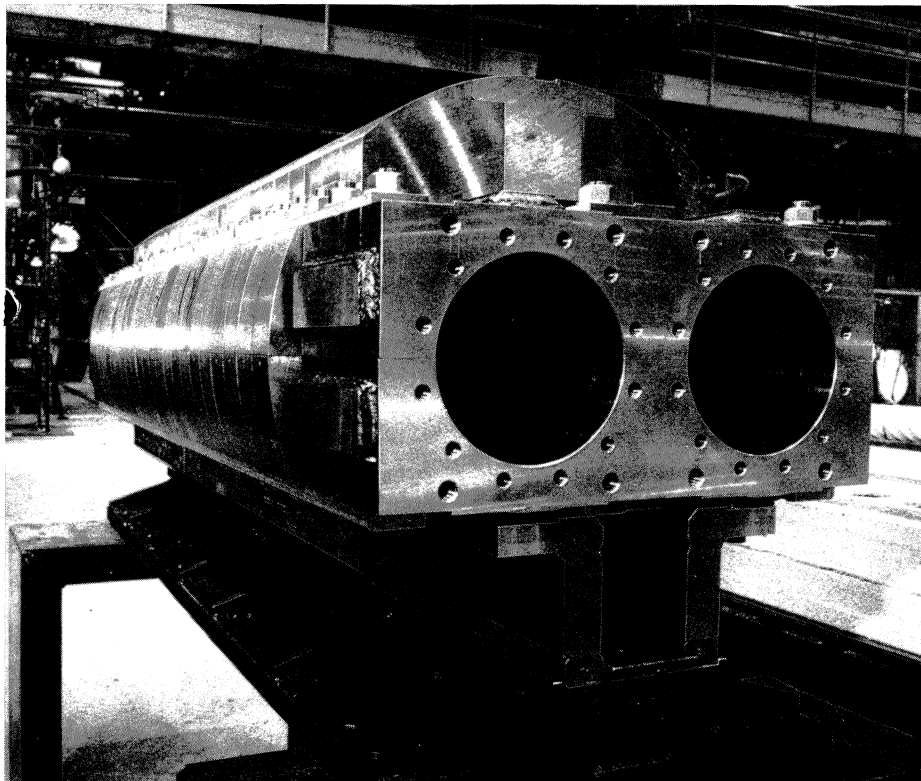
The dipole design consists of two layers of superconducting coil

around a 'warm bore' vacuum chamber and constructed inside a cold laminated iron. The yoke is immersed in a cryostat and force-cooled by supercritical helium at a maximum temperature of 3.8 K. The dipoles are 4.75 m long. A major contributor to the magnet problems was the initial choice to use braid for the superconducting coils. Since the change to cable in 1981, performance has improved. The flat cable has 23 multifilamentary twisted superconducting wires of the type developed at Rutherford and Fermilab. Another factor in the improved performance seems to be the introduction of a layer of teflon in addition to the kapton insulation between the inner and outer coils providing a low friction slip plane.

After the success of the first full size revamped magnet in November of last year, it was decided to complete six by the end of March 1982.

*Yoke of the first 5 foot 'two in one' magnet built to test the idea of incorporating the two ISABELLE rings in one magnet structure. The magnet operated as expected and a full length version is now being built. The aim is to trim back ISABELLE costs in case of funding shortfalls in funding the US high energy physics programme.*

*(Photo Brookhaven)*



This was successfully done and in tests in a bath of liquid helium at 4.5 K they all surpassed 5 T before their first quench, and exhibited very little subsequent training. The magnets were also tested at lower temperatures under forced cooling conditions and reached fields of 6 T which put them ahead of all other full size dipoles in terms of peak field performance. A first quadrupole has also been built and operated successfully.

Investigations of field quality were initially carried out on shorter 5 foot magnets. Progress is good and the 5 foot series is being concluded while quality studies are moving to the full size magnets. Previous troublesome eddy current effects have also gone away. Two features remain to be mastered — the trim coils to be incorporated into the dipole and an understanding of the mechanisms of quench propagation. The propaga-

tion is slower in supercritical helium; nevertheless, at the time of writing, all attempts to burn out a magnet because of inadequate propagation (so as to find where the limits are) have failed.

The next major aim of the dipole programme is to install and operate a fully equipped cell of the magnet lattice (six dipoles and two quadrupoles) in the ISABELLE tunnel by March of next year. Meanwhile the magnet assembly and testing facilities are being extended so that they will be able to cope with the production of a thousand magnets within five years.

The civil engineering work for the project is not far from completion. The ring tunnel and the injection tunnels are ready, three of the six experimental halls are built (inside angle hall, major facility hall and narrow angle hall). The cryogenic systems (including the building of the largest

helium refrigerator) and r.f. acceleration systems are well advanced. Only the controls system has not yet received much attention.

Though the technical aspects of the project are now in very much better shape, there is still concern for the future of ISABELLE. This is because of doubt about the funding level for high energy physics which is likely to be obtained from the US government during the remaining years foreseen for construction of the machine. An examination of this situation was a major task of the 'Subpanel on long range planning' set up by HEPAP (High Energy Physics Advisory Panel) and chaired by George Trilling. Its report, presented earlier this year and usually referred to simply as the 'Trilling report', is now taken by the Department of Energy as its bible in determining use of high energy physics money.

The Trilling report recognized that the US programme needs a new facility, providing front-line physics and supporting a large number of users, to be in action by the end of this decade. At present ISABELLE is that facility. It would be unique in allowing high energy hadron experiments with high intensity (luminosities of some  $10^{33}$  per  $\text{cm}^2$  per s). Nevertheless completion of ISABELLE, as at present conceived, will require a further \$500 million (in fiscal year 1982 dollars). The report maintains that to provide this money, while also sustaining viable programmes at the other USA Laboratories, and allowing completion of Fermilab and SLAC projects, requires an annual USA high energy physics budget rising to \$440 million in 1984 or 1985. If the present level of \$395 million cannot be increased, the report regretfully recommends termination of the ISABELLE project.

To complete a significant new fa-

cility by the end of the decade would require construction beginning in 1985. There is therefore not much time to review the various possibilities. At Brookhaven the aims are first to demonstrate the viability of the magnet system so as to confirm that ISABELLE can be built. At the same time, ways of cutting magnet cost are being investigated.

One of these is what is known as the 'two in one' magnet where two of the present coil configurations sit side by side in a single double aperture iron yoke. The machine would then have a single ring of double magnets rather than two separate rings. This would cut the number of yokes to be built by two and also halve the number of cryostats. A 5 foot model was rapidly put together and performed well in line with expectations. There are obvious concerns about magnetic and mechanical asymmetries, quench protection

is more serious and the machine lattice is more difficult. Nevertheless, the potential saving on the magnet system may be as high as 20 per cent and the idea is being pursued. Construction of a full length 'two in one' magnet was authorized in July. The decision as to whether to adopt the approach will be needed by March of next year. A second magnet cost saving idea is to build a quadrupole and dipole into the same cryostat, eliminating quadrupoles, as separate units. This could save over 10 per cent of the magnet system costs.

To be ready for alternatives to ISABELLE, two working groups have been set up to look at an electron-proton option (chaired by Kjell Johnsen) and a heavy ion collider option (chaired by Mark Barton). The e-p option is required to allow extension to p-p at a later stage. The heavy ion option is conceived as a missing

magnet ISABELLE and would use beam from the very successful Brookhaven tandem Van de Graaff boosted in energy by an intermediate cyclotron. In any of these scenarios a ring of superconducting magnets would find its way into the ISABELLE tunnel.

Despite these uncertainties there is no doubt that the Brookhaven team has found fresh enthusiasm since the success of the new magnet design. They have also been helped by the fresh stimulus of the appointment of Nick Samios as Laboratory Director. Samios has an ability to identify the silver linings in all situations and makes it difficult to remember the existence of the cloud. The whole world-wide high energy physics community is certainly behind him in hoping that the full unique abilities of ISABELLE will be realized.

## Cornell: CESR and beyond

The electron-positron storage ring CESR, at Cornell is now operating regularly with a luminosity of over  $10^{31}$  per  $\text{cm}^2$  per s (400 inverse nanobarns) and, thanks to the money saved by operating the magnet of the CLEO detector with a superconducting coil, the number of hours available for physics is not restricted. The research remains concentrated around the upsilon resonances (operating the storage ring at just over 5 GeV per beam). After skimming the cream in this energy region, where CESR had unique access with good luminosity, extracting further physics is more difficult but there remain several years of good work in front of CLEO and the CUSB detec-

tor doing gamma spectroscopy in the machine's North area.

It is believed that the luminosity can be pushed higher by a factor of two or three. Machine physics experiments have reduced the mini-beta from 3 cm to 2 cm with further increase in luminosity but the CLEO magnet was not in operation and the existing magnet compensation scheme cannot cope. There are schemes for going to micro-beta by installing new quadrupoles at the interaction region, though these would probably limit peak energy to 6 GeV. A new injector for the Linac, using the triode gun developed at SLAC, will soon be in operation and should make it possible to put more parti-

cles in each bunch and possibly avoid the vernier filling scheme (see April 1976 issue, page 129) presently necessary to build up positron bunch intensity. There are also ideas on having more than one bunch per beam using electrostatic separators.

The CLEO detector will probably run in its present configuration for another year after which the inner detector is likely to be modified to give better particle identification, for example by installing a time projection chamber or some other energy loss measurement system. The CUSB detector may also replace its sodium iodide modules by the better BGO material to improve resolution.