tion, this detector enabled a large variety of charm particle lifetimes to be measured accurately, including the only determination to date of the lifetime of the neutral charmed xsi, which lives for only 0.8 x 10^{-13} seconds.

Following that experiment, the group from the Rutherford Appleton Laboratory and Brunel University in the UK, joined by several Stanford-based physicists, extended this technology to a collider environment (the SLD detector at Stanford's SLC linear collider).

Achieving good solid angle coverage round a 25mm-radius beampipe meant increasing the number of CCDs from two to 480. The detector, consisting of 120 million independent elements, started running in May 1992, giving tracking quality as precise as in the earlier fixed target experiment.

The combination of the very small and stable SLC beam spot (just 2 microns across), the small beam pipe, the precise measurement of space points from the vertex detector, and a high quality central drift chamber, is now bringing SLD some clean physics for Z decays into heavy flavour quarks.

One advantage of CCDs for tracking detectors is that since they are widely used, new developments are continually being made. Since the design phase of the SLD vertex detector, the technology has advanced to the point where one of the 'ladders' of eight CCDs could be constructed with a single device, which furthermore could be read out ten times faster.

Such developments will allow even more powerful vertex detectors to be constructed in the future. The main areas of possible application in high energy physics will continue to be in fixed target experiments and in linear colliders.

For the high luminosity conditions of the next generation of hadron colliders, a number of groups are developing 'smart pixel' devices with a micrologic controlled silicon matrix array (January 1990, page 19). These have demonstrated detector feasibility over small surfaces (half a square centimetre) en route to the much larger areas needed for actual experiments.

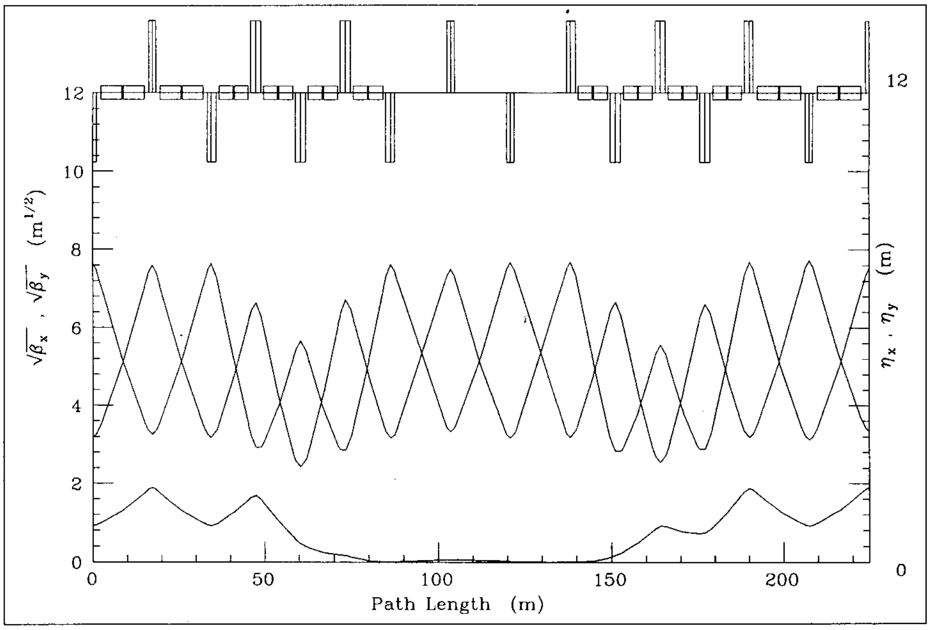
Environmental work ('wetlands mitigation') for Fermilab's planned Main Injector.

FERMILAB
Main Injector

The Fermilab Main Injector (FMI) project is the centerpiece of the Laboratory's Fermilab III programme for the 1990s. Designed to support a luminosity of at least 5×10^{31} $cm^{-2}s^{-1}$ in the Tevatron collider, it will also provide new capabilities for rare neutral kaon decay and neutrino oscillation studies.

The Fermilab Main Injector 8-150 GeV synchrotron is designed to replace the existing Main Ring which seriously limits beam intensities for the Tevatron and the antiproton

Characteristics (beta and dispersion functions) for a portion of the Fermilab Main Injector cell design. Shown here (left to right) are a normal cell, a dispersion suppressing cell, a dispersion-free straight cell, a dispersion suppressing cell and a normal cell. The horizontal blocks represent bending magnets while the vertical blocks signify focussing or correction magnets.



production target.

The project has passed several significant milestones and is now proceeding rapidly towards construction. The project received a $11.65M appropriation in 1992 and has been given $15M for the current fiscal year. Through the Energy Systems Acquisition Advisory Board (ESAAB) process, the US Department of Energy (DoE) has authorized funds for construction of the underground enclosure and service building where the Main Injector will touch the Tevatron, and to the preparation of bids for remaining project construction.

Last year, work began on filling some six acres of wetlands. Permission had been granted by the US Army Corps of Engineers contingent upon the creation of nine acres of new wetlands close by. Earth moving is complete.

The new accelerator will use 344 new conventional dipole magnets, together with quadrupoles, accelerating radiofrequency cavities and instrumentation from the Main Ring.

The lattice features two types of cells: normal (34.6 m) cells in the arcs and straight sections, and dispersion-suppressor (25.9 m) cells adjacent to the straight sections to reduce the dispersion to zero in the straight.

Tighter focussing and smaller dispersion give smaller beams than in the Main Ring, and over three times the acceptance. The standard cell consists of a FODO lattice containing two 6-metre dipoles in each half-cell. Straight section cells are the same length as normal ones. The dispersion suppressor cells require special length quadrupoles and dipoles; again, the lattice is a simple FODO array with two 4-m dipoles between quadrupoles.

The dipole magnet has been designed and two prototypes constructed and measured. Both magnets give field quality well described by computer models and within the performance specification. The magnets have four 2.54 cm x 10.16 cm turns per pole of conductor (for rapid ramping), with a peak current of 9375 A, and peak power of 75 kW. The poletip gap is 5 cm, and the good-field region exceeds ± 4.4 cm at injection. At the peak field (1.72 T) there is significant saturation producing a sextupole field which determines the required strength of the chromaticity-controlling sextupole magnets. Twelve production prototype dipoles are to be built in this year before magnet production gets underway.

Four new beamlines will link the FMI to Fermilab's accelerator complex: a 760-m 8 GeV line from the Booster injector, two 260-m beamlines to connect to the Tevatron (one for protons and one for antiprotons), and a beamline to transport 120 GeV protons to the antiproton production target or to the experimental areas. This latter beamline will utilize a remnant of the Main Ring.

The two 150 GeV lines to transfer beams to the Tevatron will be almost mirror images of one another, utilizing Main Ring magnets for all of the dipoles and quadrupoles. Beam transfers to the Main Ring remnant will utilize the same beamline as proton transfers to the Tevatron. The Lambertson magnets at the Tevatron will be turned off, allowing the beam to continue upwards.

R&D work in support of the project is also well advanced. In addition to the dipole effort, R&D for the twelve 1000V/10,000A supplies required to power the dipoles has also begun. Finally, significant progress has been made on the project's 200 kW radiofrequency power amplifier. Eighteen such units will be required.

Much work has been accomplished in technical design, in project management and in permit applications. Fermilab was awarded a State of Illinois grant, with which the architect/

engineering firm Fluor-Daniel provided advance conceptual design work for the civil construction and site mitigation. The state money was also used for environmental impact studies. All other construction permits have been secured construction of the MI-60 underground enclosure began in March.

DUBNA Update

At the annual session of the Plenipotentiaries Committee of the Joint Institute for Nuclear Research (JINR), Dubna, near Moscow in March, Institute Director Vladimir G. Kadyshevsky reported on important recent achievements.

The Nuklotron superconducting accelerator has now been completed and is in operation. (A report will feature in a forthcoming edition of the CERN Courier.)

The FOBOS multiple event spectrometer mounted in the heavy ion beam of the U-400M cyclotron is designed to record the products of nuclear reactions in the high mass and charge region with high efficiency. New experiments are envisaged.

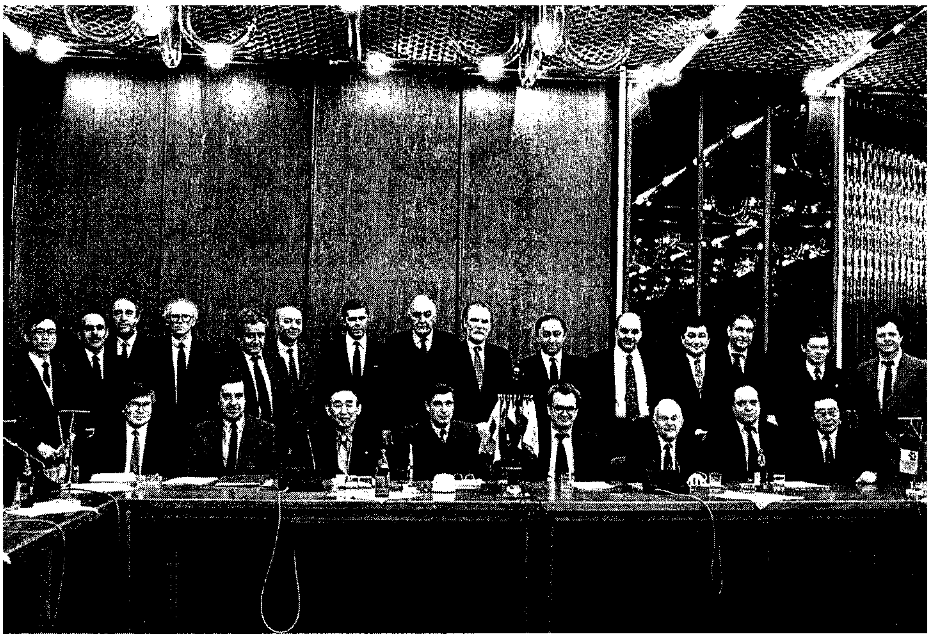
At the IBR research reactor a cryogenic moderator has been put into operation. Physics goals include generation of an impulse flux of cold neutrons. The neutron Fourier high resolution diffractometer was commissioned for polycrystal studies.

Meanwhile an imaginative scheme to establish an International University using JINR research facilities and highly qualified personnel is being implemented.

New appointments include Alexei Sissakian and Tzvetan Vylov as Vice-Directors, Nikolai Russakovitch as Chief Scientific Secretary, Vladislav Sarentzev as Chief Engineer and Alexandre Lebedev as Administrative Director.

Western physicists elected members of JINR Scientific council include Ugo Amaldi and Lucien Montanet from CERN, Claude Detraz (IN2P3, Paris), Friedrich Dydak (Munich), Guido Piragino (Italy), George Trilling (Berkeley), Herwig Schopper (Germany) and Norbert Kroo (Hungary).

Earlier this year saw the 80th birthday of Venedikt Dzhelepov, Honorary Director of JINR's Laboratory of Nuclear Problems.



At the annual session of the Plenipotentiaries Committee of the Joint Institute for Nuclear Research (JINR), Dubna, near Moscow in March.