The D0 Experiment Takes Shape

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The landscape at Fermilab has been changing over the past year as many visible signs of the coming D0 experiment for the proton-antiproton Collider can be seen. Equipment, both large and small, has been arriving at Fermilab as the detector begins to take shape.

The D0 experiment is designed to exploit many of the physics signatures which have been found crucial in the very-high-energy world of hadronic collisions through the experiences of UA1, UA2, and more recently, CDF. To aid in finding new states of matter and rare phenomena, particular attention has been given to both electron and muon identification. Measurement of the missing transverse energy in events has been stressed in the design of the calorimetry; three uranium-liquid argon calorimeters provide high-resolution hermetic coverage for which the electron-to-hadron response ratio was measured to be 1.1 in prototype devices. The detector is made compact by eliminating the magnetic field in the tracking region. Lepton identification is enhanced in D0 by incorporating transition radiation detectors with the tracking chambers and by requiring large thicknesses (greater than 13 absorption lengths) for muons observed after the magnetized steel toroids.

One major focal point for the collaboration is the new D0 experimental hall where the physical outlines of the detector are emerging [see photograph on page 9]. After completing the platform upon which the detector moves, work is now in progress on building the muon toroidal field magnets which will encapsulate the experiment. Concurrently, the moving house for digitizing and trigger electronics has been completed, as has the cable bridge connecting platform to electronics house, and the cryogenic, power, gas, and water utilities.

Assembly operations for detector components are found at several sites around the Laboratory. Production of the large muon proportional drift tube panels is under way with one 2.5 m x 6.5 m module being completed each week. In a separate operation, laminated G-10 signal boards for calorimeter readout and the cathode strips for muon chambers are in full production. End calorimeter modules are being built and tested in a third area. A highly visible addition to the D0 experiment occurred in September when the cryostat for the central calorimeter was delivered. This doughnut-shaped vessel (5.2 m in diameter and 3 m long with an inner hole diameter of 1.5 m) has since been vacuum- and cold-tested and is now being prepared to accept its load of 64 individual calorimeter modules.

(Fermilab photograph 87-618-10)

The platform on which the D0 detector rests is shown in this photograph, together with the start of the side walls of the muon toroid magnets. Electronics are housed on the detectors, in the floor of the platform, and in a moving counting house whose cover is visible in the right of the picture. The cable bridge connecting platform and moving house is seen in the left foreground.

Institutions collaborating on the D0 experiment are equally busy building detectors, electronics, and software for shipment to Fermilab. The transition radiation detector construction is well advanced at Saclay. Brookhaven National Laboratory is turning out the central calorimeter modules. Lawrence Berkeley Laboratory (LBL) is preparing for the fabrication of the large electromagnetic sections of the two end calorimeters. Groups from Florida State, Florida, Michigan State, New York, Rochester, Stony Brook, and Yale universities are supplying many of the components for the major calorimeter assemblies. University groups from Indiana, Maryland, and Northern Illinois are contributing in a similar way to the muon chamber effort. Tracking chambers are emerging from LBL, Northwestern University, and Stony Brook. Electronics for signal shaping, digitization, and triggering are being built and tested in laboratories at Brown, Columbia, Michigan State, New York University, and Stony Brook. Global systems for high voltage and monitoring are being prepared by the University of California, Riverside, and Fermilab. A team from IHEP (Serpukhov) in the

U.S.S.R. has recently joined the collaboration and will provide both coarse-grained calorimetry and very forward muon detection.

With so much activity dispersed within the collaborating groups, it has become essential to establish a focus for integrating the parts of the detector into a working whole before the final installation in the D0 hall. To this end, a major effort has been under way in one of the beamlines of the TEVATRON during the current fixed-target run. Most of the D0 detector elements are being given a shakedown test in order to gain experience in operating the systems together - and to test each of the components in battle conditions. A succession of both central and end calorimeter modules are under test; detailed measurements are being made of the response to electrons and pions as a function of position, angle, and energy. Signals are collected through the full chain of cables, feedthroughs, preamplifiers, shapers, and digitizers being built for the full experiment. A parallel test involves sectors of each of the final tracking chambers together with their shaping amplifiers, flash digitization, and zero suppression electronics. Both of these detector groups run together under the control of the D0 trigger, microprocessor-farm data acquisition and event filter, and on-line programs; monitoring of voltages, temperatures, and argon quality is also done with the final D0 system.

These tests have already given important verification that individual parts of the D0 detector perform to the specified levels. Even more crucial has been the chance to work with the ensemble of detectors and to work out the problems which arise from operating many sub-systems simultaneously. This test run has also forced the continuing evolution of the online and offline software to handle the challenge of controlling the experiment and informing the experimenters of the data quality. Finally, the test has brought together many of the physicists from different parts of the collaboration under conditions which simulate the future running at the Collider.

The D0 collaboration looks forward to joining the search for exciting new physics with a first run during the 1989 Collider cycle. This first round should see a portion of each of the detector systems installed; it will include the large-angle tracking and TRD, the central calorimeter, and a portion of the muon system, together with the trigger, multiple microprocessor event filter, online software, and the various support systems. The full detector is expected to be operating in the 1990 Collider cycle; with the experience gained in both test beam and first Collider runs, the experimenters look forward to a rapid start in making a large impact on our understanding of very-high-energy hadron collisions.