in the range of 5 to 1000 ppm. This experience was gained as a result of an IUCF experiment concerned with the quantification of Ir in clay soil samples. Forty clay pellets were prepared and doped with 0.5-2μl of standard solutions of Ir, Mn, Fe, Mg, Co and Ba cations. Several preparation difficulties were encountered and surmounted.

3. Special targets of ^{183}W powder on Be foil were developed and fabricated for unique Mossbauer experiments conducted jointly by Purdue and Missouri Universities. The work presented an opportunity to push air-settling and adhesion techniques at IUCF (which it did). The targets were 0.5 - 1.5mg/cm^2 ^{183}W powder uniformly distributed over an area of 1cm x 2.7cm. Pressure sensitive adhesive of 16 - 40μg/cm^2 held the powder in place on the 5 - 10mg/cm^2 Be support foils. The targets were double-sided in that the ^{183}W powder was distributed on both sides of the Be.

4. For the first time (at IUCF) $^{66,67}ZnO$ was reduced to the metal, consolidated, and rolled to make targets of ~14mg/cm^2. Overall efficiencies of 82 - 87% were achieved for the expensive isotopes and the fabricated targets were reported to have been "very clean".

NEW FACILITIES

The IUCF-Maryland Dual Spectrometer System - P. Schwandt

After nearly three years of design, fabrication and acquisition of all major components for the K600 and K300 dual spectrometer system, installation of the system in the north high-bay area of the original accelerator building (see IUCF floorplan, Fig. 4) finally began in late spring of 1985, as detailed below. Early in the year the decision had been made to concentrate efforts on bringing the K600 spectrometer into operation first and delay installation of the K300 magnet and its support carriage until some time after completion of K600 tests with beam because of limited manpower resources and the press of competing development projects. We managed to complete the major portion of the K600 installation by the end of 1985. We were unable, however, to realize our original goal of first tests with beam of the K600 system by the beginning of 1986, partly because we underestimated the magnitude of the workload represented by the multitude and complexity of all the subsystems involved, and partly because of unavoidable (and in some cases unforeseen) diversion of critical technical personnel to other high-priority projects such as readying the CSB experiment for production running and rebuilding the swinger area shielding and exterior beam dump during October, extensive cyclotron repair and development work during a prolonged, unscheduled shutdown in December caused by a major component failure, and the beginning of necessary electrical installation work in the Cooler building.

The first phase of the K600 installation process began in May 1985 with the removal of the roof beams and wall blocks comprising the beam swinger area shielding. This allowed installation of magnets for the new beam transport line (BL8) to the spectrometer area. After surveying of the beam line and construction of the new spectrometer beam dump, layout and installation of the two precision steel tracks for both the K600 and K300 spectrometer carriages proceeded during June, followed by installation of the common central hub. In parallel with these activities, the iterative process of K600 dipole magnet field measurements and magnetic shimming of entrance and exit boundaries went on and was concluded in early July.

At that time, detailed and comprehensive planning of the large number of jobs directly involved with or related to the spectrometer installation project was undertaken, along with an assessment of the required and available manpower resources. It became apparent very quickly that the magnitude of the installation job (which included, besides the critical spectrometer assembly itself, the installation of the new beam line, DC power supplies, AC and DC power distribution, a new cooling water system serving both spectrometer and Cooler ring areas, all service and cabling runs to and from the new spectrometer area, controls system installation and cabling, and a host of smaller jobs) was far too large for the work to be carried out effectively and within a reasonable time span unless most of the technical manpower of the lab could be made available exclusively to this project for some period of time. Consequently, the decision was made to shut down operation of the accelerators and terminate accelerator-related research and development efforts for a period of about seven weeks, from mid-August to the end of September, thereby freeing all cyclotron operations and maintenance staff, as well as research support technicians, for work on the spectrometer installation project.

This concentration of laboratory-wide resources turned out to be very effective and productive. A major portion of the overall spectrometer installation effort was in fact completed during these hectic seven weeks, despite disruptions and inconveniences resulting from building asbestos containment work going on at the same time. In particular, most of the large and manpower-intensive jobs such as installation of shielding walls, services, tracks, K600 carriage and most of the BL8 hardware was completed, including the dismantling, removal and reinstallation of the venerable QDDM spectrometer magnet system as a beam preparation system in the new beam line BL8.

The K600 dipole magnet support and alignment elements were installed on the carriage and the dipole bottom yoke plates put in place. After preliminary optical alignment of these magnet yoke pieces relative to each other and to the target center (using precise magnet fabrication jig plates incorporating appropriate fiducials), the first assembly of the two K600 dipole magnets, complete with vacuum chambers and poletip assemblies incorporating all shims, poleface coils and anti-scatter baffles, took place in early October. After chamber evacuation and extensive vacuum leak testing, the magnets were reassembled without vacuum chambers for final optical alignment while minor rewelding of a seam in one of the aluminum vacuum chambers to close a pin-hole leak was carried out. The final, precise alignment and leveling of the K600 dipoles, using fiducials integral to the pole tips, was completed in December. In parallel with the main magnet assembly, the mechanical assembly of the K600 "front end" system (the solid-angle defining apertures and hexapole and quadrupole magnets) on its own subframe was carried out off-line. Assembly of the large, unconventional entrance quadrupole/multipole magnet (whose steel yoke had been fabricated in-house) was held up by lack of coils and specially contoured pole tips which suffered considerable fabrication delays by outside vendors and were not delivered to IUCF until mid-December (pole tips) and late January 1986 (coils).

Design and in-house fabrication of the large, multi-focal-plane vacuum box connecting the focal-plane detectors to the dipole exit port, which had to await the outcome of final ray-trace calculations with the actual (measured) magnetic fields to establish the correct focal-plane locations, was recently completed. The old QDDM target chamber, which will serve as an interim target chamber for the K600 spectrometer, was redesigned and a new chamber mounting system for adaptation to the new spectrometer hub has been fabricated. A design for a new, dual sliding-band chamber suitable for simultaneous use of both K600 and K300 spectrometers has been carried out by an outside design firm under contract with the University of Maryland.

As of this writing (mid-February 1986) the status of the mechanical, electrical and vacuum systems for the K600 spectrometer can be summarized as follows: the dual dipole magnet assembly is in place and aligned on its motor-driven carriage; the main vacuum system (from dipole one entrance to the focal plane) is installed and vacuum leak tested; installation of two turbo-molecular pumping stations is underway. Service connections from the central overhead distribution point to the spectrometer magnets are in progress. The BL8 leg in the beam swinger area up to the neutron shutter in the shield wall separating swinger and spectrometer areas is essentially complete (awaiting AC power to vacuum pumps); all magnetic elements in the remainder of BL8 up to the spectrometer target chamber are in place. After some remachining of the target chamber itself is completed, the chamber assembly can be mounted on the central hub. The K600 entrance quadrupole is now fully assembled in preparation for immediate field mapping and shimming; its support frame with the rest of the front-end hardware is ready for mounting on the K600 carriage. Water and AC power distribution is nearly complete; all DC power supplies (except for a new multi-channel quadrupole magnet supply just received) are installed and powered. Much of the microcomputer-interfaced controls hardware and cabling is in place. All spectrometer room shielding (except for a few wall blocks outside the north building wall) has been installed so that work in the spectrometer area can proceed while beam swinger experiments are in progress.

Based on our present best estimates for completion of the remaining installation tasks, some beam time has been requested for late April 1986 for first tests of BL8 operation, and for May for initial K600 magnet tests with beam on target.

Initial operation of the K600 spectrometer for experiments with external beam dump will not be possible for scattering angles smaller than about 12.5°. The special "small-angle mode" (which will allow operation at angles as small as 4.5° with the direct beam proceding to the external dump) requires a special septum magnet and additional trimming of the K600 entrance quadrupole; the design for this mode cannot proceed until the quadrupole field measurements and requisite ray-trace calculations through the magnet system leading to an acceptable focal image have been made. The present K600 magnet design allows for direct beam passage into and through the dipoles at very small angles, however.

Some progress has also been made in recent months on the K300 magnet. Henry Chen, on leave from Maryland, spent considerable time and effort at IUCF carefully mapping the K300 dipole field in preparation for magnetic shim design currently underway at Maryland. These shims will be fabricated and installed in the magnet for remapping and shim fine tuning in late spring or early summer of 1986, consistent with availability of the X-Y magnet mapper (which in the near future will be used extensively in the Cooler building for ring dipole mapping) and manpower help from Maryland. The K300 support carriage with wheel and drive assemblies and magnet alignment mounts is in house, as are the dipole vacuum chamber and all components of the large entrance quadrupole. The magnet turn-over fixture exists and the procedure for safely rotating the assembled K300 dipole from its horizontal assembly position to its vertical operating position has been worked out. The only major piece of K300 equipment remaining to be fabricated is the superstructure for a work platform around the focal-plane region (for which an engineering design already exists). It is thus primarily the lack of technical manpower available for non-Cooler development which prevents us from proceding with the K300 installation during the latter half of 1986.

Focal-Plane Electronics - D. DuPlantis

The effort to construct the focal-plane prototype system continued during 1985. As this effort is just one of several projects undertaken by the data acquisition group, progress has been difficult. However, the goal of having a subset of the prototype electronics system ready by the fall of 1985 was achieved. The preamplifiers and front-end electronics have been tested and will be used with an MBD CAMAC system on the VAX 750. Meanwhile, the fast readout system controller and processor buffers will be designed and tested off-line.

The design for the 32-way ECL input multiplexers was completed. The multiplexer provides a five-way interleave factor for the chamber preamplifiers. Because we are using the LeCroy 4201 fast encoding TDC ($3500 per channel), the cost per wire is kept reasonable by providing fast multiplexer/wire encoder readout. The module design is conventional ECL logic, but it involved working with PC design techniques not used in our lab before; construction of a four layer board in a CAMAC module was necessary. IBM PC computer software design tools provided important support for the project. A hand-wired prototype was constructed and then the final design set to a printed circuit board (PCB). Thirteen PCB prototypes were constructed and tested, and only two minor design flaws were discovered.

The power system for the entire focal-plane was purchased and assembled. In an effort to increase the reliability of the overall system, all voltages will be monitored and a computer interrupt generated if any preamplifier or CAMAC voltage exceeds specifications. A prototype of the monitoring module has been designed and tested.

An analog threshold control module has been designed and a prototype constructed. The module provides computer control of the threshold control voltage for the LeCroy 2735B preamplifier modules. A separate channel is provided for each preamp so that remote efficiency matching is possible across the chamber.

An off-line preamp tester CAMAC module has been designed and constructed. It provides a means for closed-loop verification of the proper operation of each 16-channel preamp. When used in conjunction with the threshold module, variations from hybrid to hybrid (each preamp has four), may be minimized by a simple computerized matching process.

An on-line preamp test pulse module has been designed and a prototype is nearly finished. The module will make it feasible to provide periodic on-line testing for each wire channel.

A commercial computer-controlled high voltage power supply system has been purchased for the drift chambers. The supply, a Bertran B-Hive, provides a current limited, voltage regulated output that is computer controlled. The unit supplies a programmed ramp up, as well as a programmed over-current trip. The unit will be remotely programmed via an RS-232 serial port from a CAMAC module.

A simple CAMAC remotely-programmed delay module has been designed and a prototype built. The module provides for trimming of the overall electronics timing by computer control.

An odd-even discriminator circuit copied from one used at Los Alamos has been contructed for the "Y" position chamber. The device will be used to resolve the odd-even wire position readout ambiguity.

The entire system, as described above, has been ready to test while awaiting completion of the drift chambers. Initially, a single chamber will be read out with an MBD processor. The MBD will limit the event rate to about 1 kHz, but for initial testing speed is not a critical factor. Meanwhile, the design has nearly been completed for the high-speed readout CAMAC controller. The controller is a micro-programmed processor providing a 400 nanosecond CAMAC cycle. The device has an internal pipelined architecture along with a straightforward instruction set. Prototype construction is expected to begin within the month.

K600 Wire Chambers - K. Solberg

Due to the inconvenience associated with the asbestos treatment, the schedule for the prototype chambers has been delayed. Nonetheless, the chambers have been designed, the x-plane cleaned and assembled, and signals observed. Once the chamber is plateaued, beam tests will begin.

The prototype chamber will be single-wire readout instead of the delay-line type reported in last year's annual report.[1] All of the first-order corrections in the K600 can be made with the information available from the x-prototype.

The printed circuit layout for the y-chamber is presently being designed. The y-chamber will use odd-even amplifiers for determining which side of the sense wire the particles crossed the drift cell.[2] The detector stack is also being designed so that there will be a pair of staggered y-chambers instead of a single y-chamber per stack. This pair of staggered y-chambers will be used to sort out the left-right ambiguity independent of the odd-even circuit. This redundance will insure that unanticipated problems with the odd-even circuit will not slow up efforts to make the focal-plane system operational. Once the odd-even circuit is working properly the second y-plane will be removed from the detector configuration.

A drift-velocity monitor, modeled after a monitor used on the HRS at SLAC,[3] is being developed for measuring the drift velocity of electrons in the chamber gas. This monitor will be used to survey the gas exiting the drift chambers. The data from the velocity monitor will be read into the computer along with the other data from the focal-plane system. In the event that the gas becomes contaminated during data-taking, the data from the monitor will pinpoint when the contamination occurred and what effect the contamination had on the drift velocity.

1) 1984 IUCF Scientific & Technical Report, p. 168.

2) NIM 226 (1984), pp. 205-210.

3) Greg Baranko, private communication.

Figure 14. K600 Spectrometer system