Beam Swinger Facility

No modifications of this facility which significantly affect its operation or use were completed this year. It continues to be used several times each year. Plans are nearing completion for the installation of a dipole magnet between the swinger magnets and the neutron spin precession solenoid to provide the capability of rotating the longitudinal component of scattered neutron spins into the horizontal plane so that the longitudinal component may be determined. This capability should be realized late in 1992.

K600 SEPTUM MAGNET DEVELOPMENT

G.P.A. Berg, S.P. Wells, P. Craw, J. Doskow, C. Foster,
W. Franklin, P. Schwandt, E.J. Stephenson, and V. Willcut
Indiana University Cyclotron Facility, Bloomington, Indiana 47408

The magnetic septum mode of the K600 is now in its final stages of development. The use of the septum magnet requires that the scattered particles enter the "small angle port" of the K600 entrance quadrupole. To provide enough room for the septum magnet, including a defining entrance collimator and a set of active slits at the exit of the septum magnet, the hexapole element and aperture cassette presently in this location must be removed. Since this hexapole corrects for the (x,Φ^2) aberration present in the normal mode of operation, shims were required in both the quadrupole and septum magnet to adjust the system optics to maintain the established high resolution of the K600 spectrometer while the septum magnet mode is used.

The septum magnet was built to overcome two limitations of the present K600 spectrometer which allows measurement down to 14° with the external beam dump and down to 6.5° with the internal beam dump. The septum mode will allow measurements with the external beam dump down to 4°. The maximum acceptance is circular with an opening of ± 0.9° with a solid angle $d\Omega = 0.78$ msr. The most backward angle is 18° and limited by the size of the vacuum chamber as shown in Fig. 1. The septum magnet is designed to analyse protons up to 200 MeV. In order to allow the analysis of particles up to the rigidity limit of the K600 spectrometer (e.g. 180 MeV tritons), pole piece spacers can be installed. In this configuration the vertical angle acceptance is ± 0.6° and the solid angle $d\Omega = 0.5$ msr.

In order to study the effects of the fields in the septum magnet and small-angle path through the quadrupole on the focal plane spectra, MULTI-RAY RAYTRACE calculations were carried out. In this code, which was written for this particular purpose, calculated

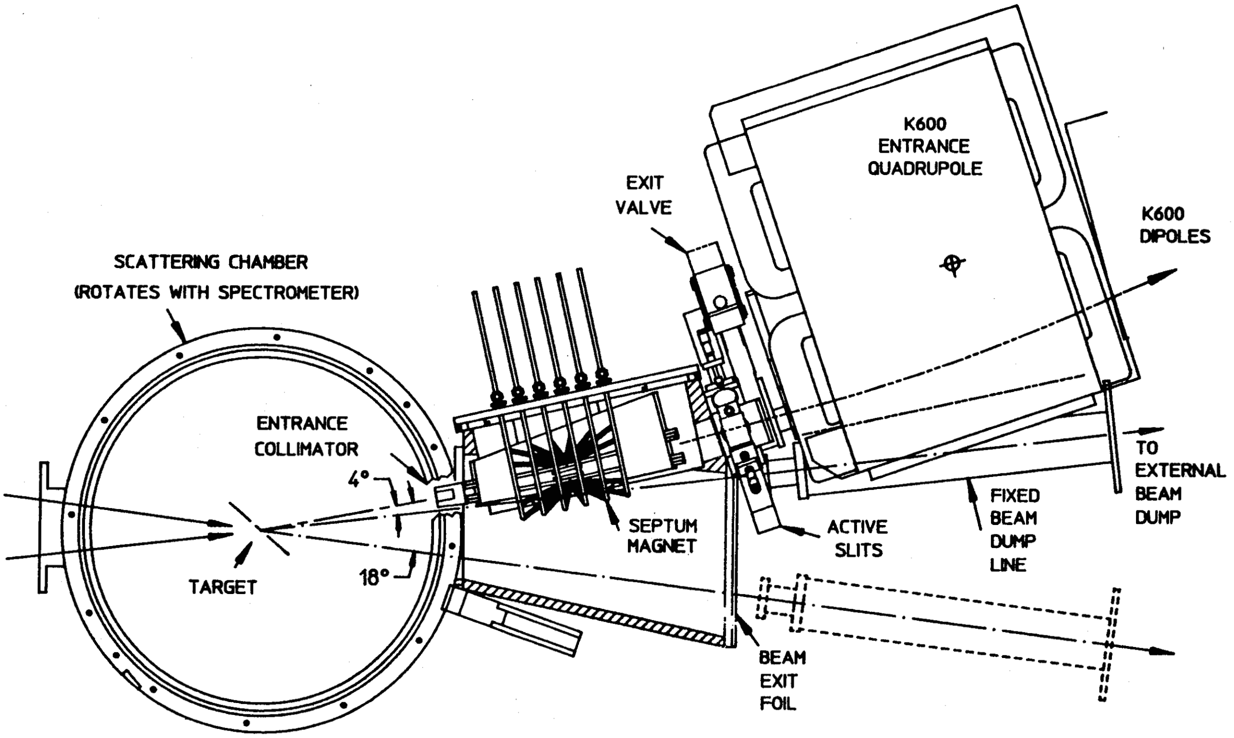

Figure 1. Schematic view of the K600 septum magnet in its vacuum enclosure. The entire assembly, including the magnet with leads, active collimator and exit valve, is positioned between the 24-inch scattering chamber and the entrance quadrupole. Not shown is the flexible vacuum coupling using a bellow arrangement at the entrance of the scattering chamber which allows the 14° rotation of the chamber relative to the fixed entrance beam pipe.

and mapped field data were used to simulate focal plane spectra (x, $x\Theta$, $y\Phi$) which allowed us to study and minimize relevant aberrations through an iterative procedure. The design of the pole tips for the septum magnet was flexible enough to allow for machining any necessary shims directly into the pole tips.

To achieve scattering angles as small as $\Theta = 4°$, design studies were made for a hybrid electromagnet and a prototype was built. The prototype included permanent magnet material in the first section of the septum magnet so that a large enough dipole field could be obtained with the least amount of coil space between beam and scattered particles. Calculations using the codes POISSON and PANDIRA, however, showed that the appropriate field strengths could be reached in each of the three septum sections without permanent magnet material by lowering the pole tips into the region between the driving coils and without sacrificing spectrometer acceptance. Field maps of the magnets constructed with this design confirmed that the correct magnetic field strength can be reached. Guided by calculations using the MULTI-RAY RAYTRACE code, we were able to achieve correct magnetic fields by optimizing the pole face shapes of the third section of the septum magnet. Similar calculations were used as a guide for determining the shape of the shims required in the entrance quadrupole to correct for the higher-order aberrations introduced in the small-angle mode. While these shims also affect the field shape in the "normal port" mode, RAYTRACE calculations and tests with beam have proven that the resulting changes do not degrade the resolution at the K600 focal plane in its normal mode of operation.

Much of the hardware associated with the vacuum enclosure for the septum magnet and support structures for this device have been machined. Included are defining entrance collimators for the septum system and a housing for a set of active slits to be placed at the exit of this magnet. Final designs for the apertures to be cut into the collimators are complete as are the designs for the mechanical assembly, optical coupling, and electrical readout of the active slits. Installation of the entire assembly, shown schematically in Fig. 1 in relation to existing K600 hardware, will occur immediately following the completion of these pieces. Tests with beam are scheduled to start in July 1992.

SCANNER FOR AUTOMATED HIGH PRECISION MEASUREMENTS OF WIRE POSITIONS IN WIRE CHAMBERS

D. Bilodeau, L. Bland, D.S. Carman, A. Eads, T. Rinckel, and K. Solberg
Indiana University Cyclotron Facility, Bloomington, Indiana 47408

Experiment E-358 requires up to 18 planes of x and y drift chambers. It is desirable to know the position of each wire in these wire planes to within about 100 microns. To measure the wire position in each detector with a traveling microscope would be tedious and time consuming. Therefore, we decided to implement a method for measuring wire position which we have been considering for years.

The basic idea is simple. Take a laser and shine it on a photodiode. When a wire passes between the laser and the photodiode, the output of the photodiode changes. If the wire is moving at a precisely known rate of speed, then the distance between two wires can be measured by measuring the time between the changes in the output of the diode. Another method is to move the wires by well known increments and measure the output of the photodiode after each increment. We used the setup shown in Fig. 1.

The linear transducer puts out a pulse every time the reading head moves one micron. The laser is an ordinary 5 milliwatt helium neon gas laser. The photodiode was an old one used by the computer controls group for optical links. The optical telescope was added to focus the laser as we found that a 20 micron wire could not be detected if the laser light