External Beam Focusing System

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I want to describe very briefly our external beam system which I mentioned only in passing this morning. The design of our external beam system is due principally to G. W. Farwell and T. J. Morgan. In the interest of time I will not give many operating characteristics. You may ask me questions individually afterwards if you want to know particular numbers.

Figure 251 is a diagram of our external system. We see the cyclotron which ejects the beam through first a target chamber, next through a focusing magnet, then through a water-filled shielding room. In the target box and in the shutter box just ahead of the focusing magnet there is a system of remotely adjustable beam delimiting slits. The focusing magnet employs "edge focusing" so that it focuses in both the horizontal and vertical planes. The beam traverses a vacuum duct through the water-filled room, which can be emptied for servicing the duct. The beam is focused upon a slit just in advance of the exit from the water room. An analyzing magnet--again incorporating vertical and horizontal focusing--directs the beam into one or another of two scattering chambers. One of these, 24 in. in diameter, was obtained from MIT when they discarded it. Most of our scattering work to date has been done utilizing this chamber. The new large chamber, 60 in. in diameter, will be in use very soon.

A photograph of the controversial exit strip, or septum, on our cyclotron is shown in Figure 252. It is a thin graphite strip, 1/32 in. thick. It has operated successfully without replacement for about two and one-half years.

Figure 253 shows the beam as it passes through the target chamber. I bring this up in particular because it is a very flexible arrangement, and there have been

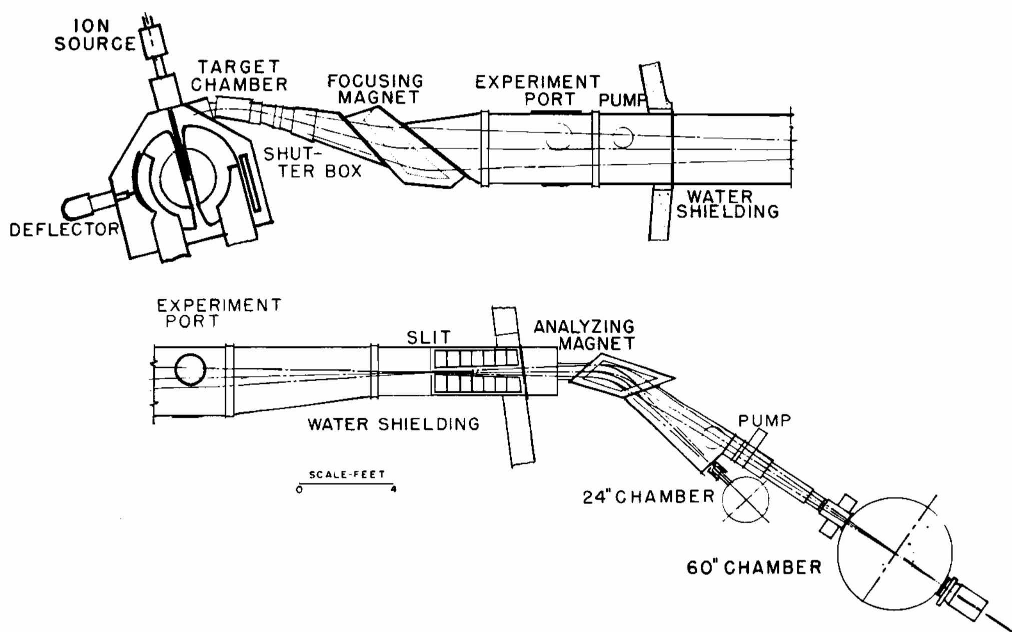

Fig. 251. External beam system.

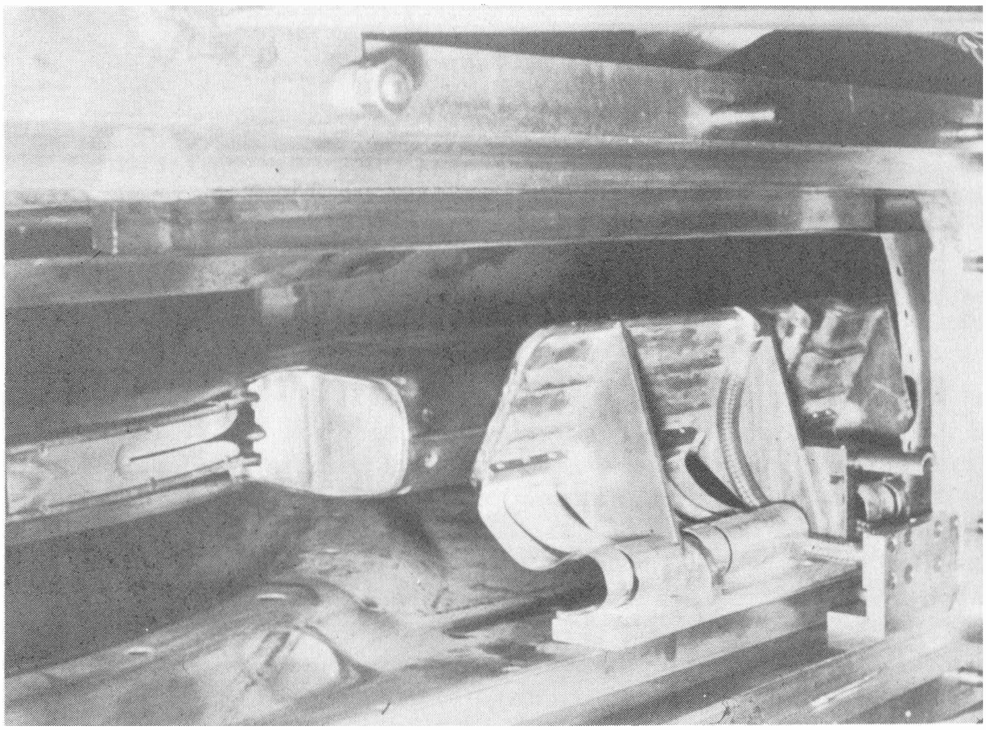

Fig. 252. Cyclotron exit strip.

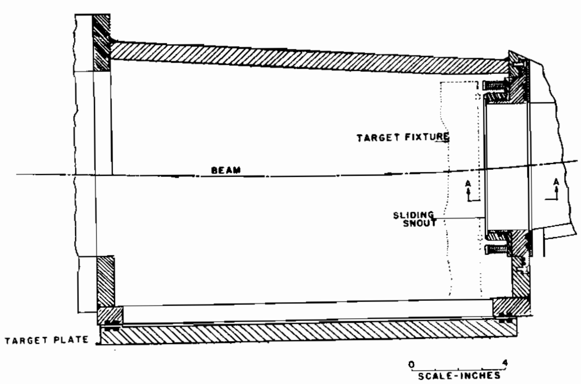

Fig. 253. Side-loading target chamber.

a number of questions about it. It is what we call a side-loading target chamber, so that the target may be placed in sideways. If desired, a blank plate may be substituted so that the beam can pass on through to the external system. An O-ring sliding seal, which operates pneumatically, forms the vacuum seal between the cyclotron snout and the target fixture.

Figure 254 is a photograph showing the target box opening and a typical target mounted on a carriage and track. The beam passes from right to left in the photograph. Any electrical, gas, or water connections that the experimentalist might desire are made automatically by the seals when the target is rolled into place. The one shown is rather simple, incorporating only a couple of water cooling lines. Most operations are performed remotely, so that the experimenter is not seriously exposed to radiation.

The details of the target box and the mechanism incorporating the sliding O-ring seal are shown in Figure 255. When the target is placed in the box, the sliding snout is pushed out by motion of the ball bearing retaining ring. The vacuum seal is then made to the target as shown. The sealing operation is performed by remote control.

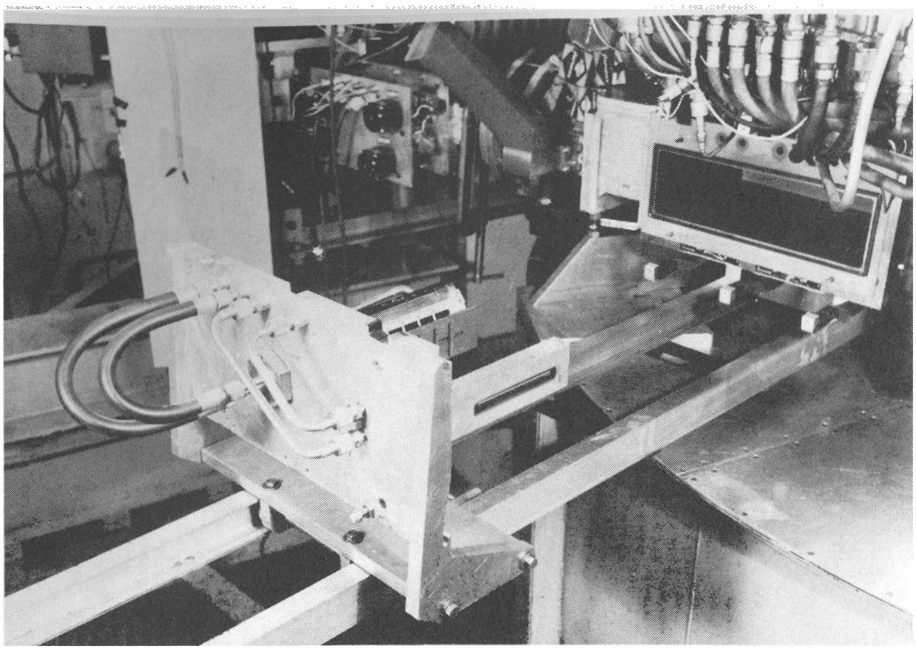

Fig. 254. Typical target ready to be rolled into target chamber.

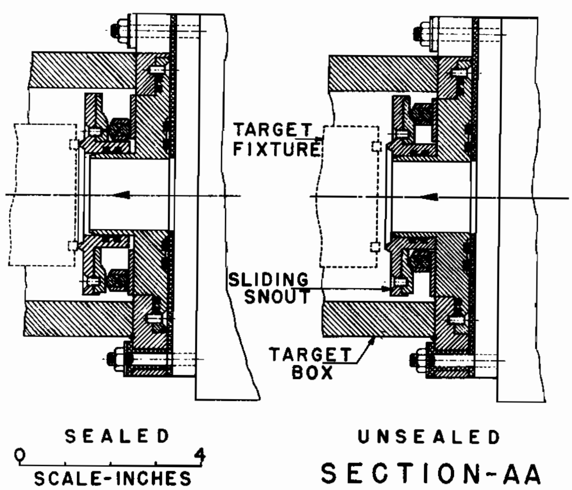

Fig. 255. Details of target sealing mechanism.

Figure 256 is a photograph of the interior of the target chamber showing the sliding snout. Note that the sliding seal is oval rather than round. I might comment that the design of this is due entirely to Ted Morgan.

One can change targets on the machine in less than five minutes; we can change from a beam in the external scattering chamber to a chemistry bombardment with the beam on a target in the target chamber in a matter of a few minutes. We have found this rapid flexibility of enormous value. Many research groups have developed specialized target assemblies peculiar to their own work. These can be inserted with only a few minutes interruption of cyclotron operation.

Our new 60-in. scattering chamber is shown in Figure 257. The beam enters through the collimator tube at the center of the photograph. Two remotely controlled arms are shown on which one may mount particle detectors. In addition, a circular table is provided below the arms. Each of the three can be moved independently of the other. The lid of the chamber is raised by hydraulic pressure.

Figure 258 shows the 60-in. chamber with the lid in position. Hydraulic clamps around the periphery serve to clamp the lid securely down upon the bacuum gaskets.

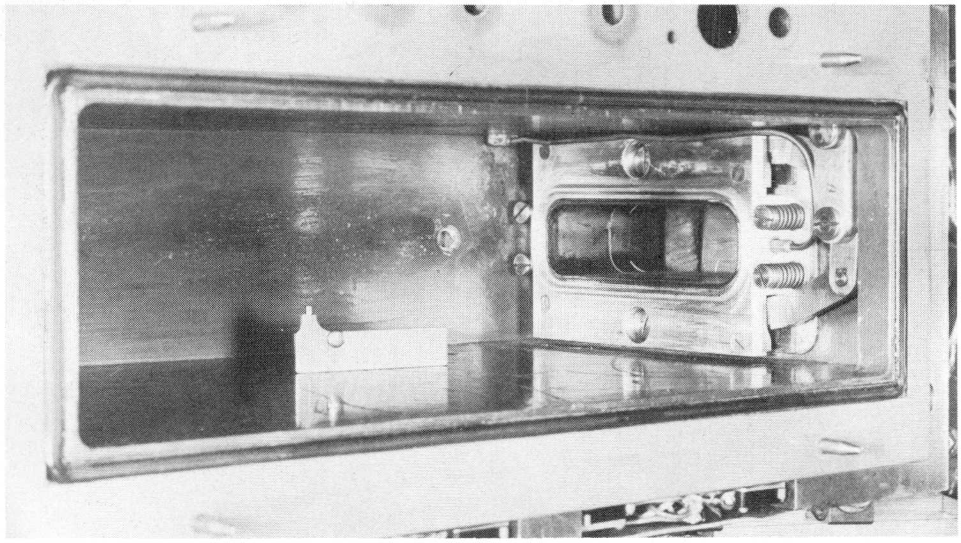

Fig. 256. Interior of target chamber, showing sliding snout.

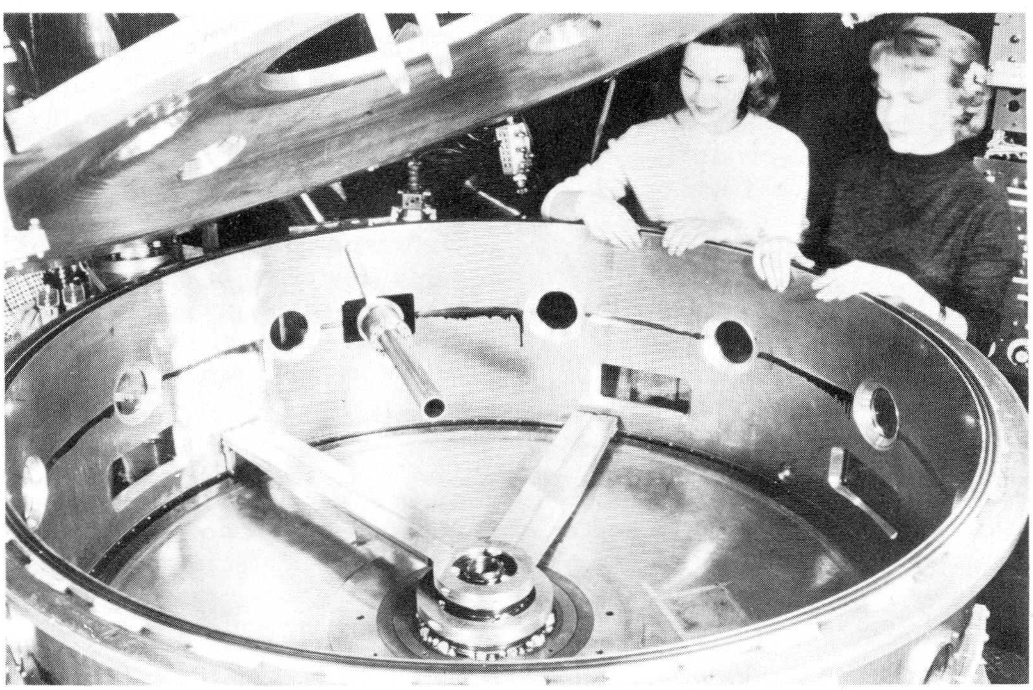

Fig. 257. 60-inch scattering chamber, lid removed.

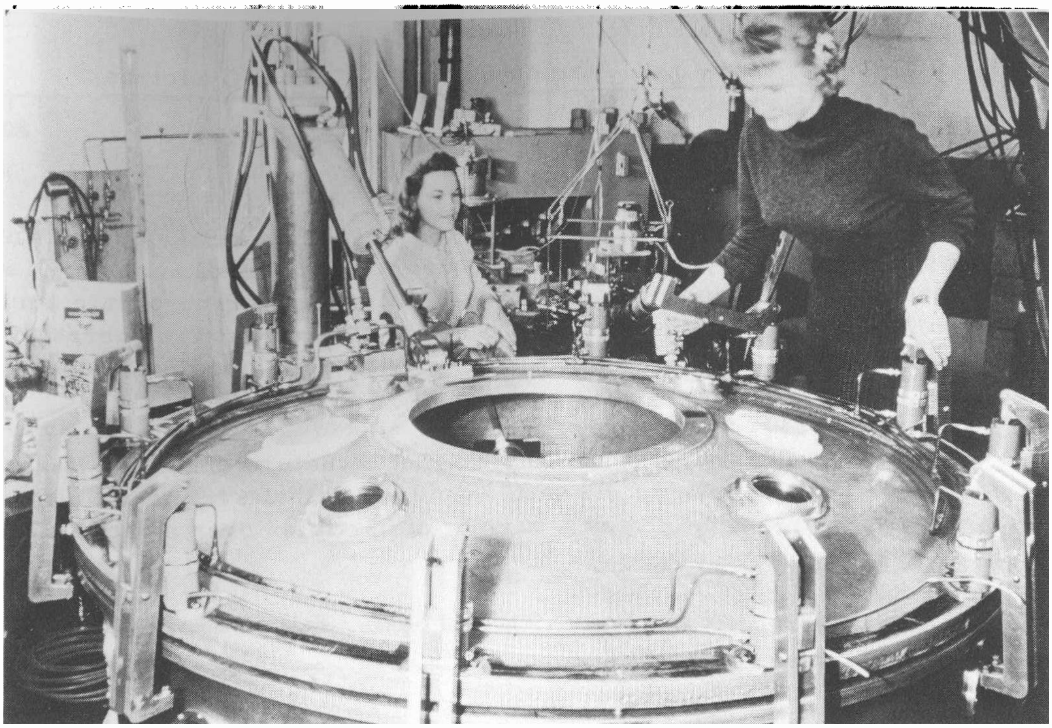

Fig. 258. 60-inch scattering chamber, lid closed.

PARKINSON: I am curious as to what kind of energy spread in the resolution you have--if you have energy spread or dispersion coming into the scattering chamber?

SCHMIDT: The system is so arranged that we can make it as tight or as loose as we wish, and the general arrangement is perhaps, say, about 500-kv tightness for 44-Mev alpha particles. It depends on the experimenter and how much beam he likes. If he can do with less beam, then he generally gets it by tightening up the shutter box.

PARKINSON: You don't have figures for your magnets as such?

SCHMIDT: For the magnets as such, no. They have been trimmed to some extent, but let me emphasize that our cyclotron is very much like a child holding on to a hose and sort of squirting around. It hits the hole and it goes through. On the other side there are a bunch of physicists. They find that they can use what comes through and they are happy. When that happens, you don't generally do much more than keep on doing experiments with the system as it is.

YAVIN: In my experience with the University of Washington cyclotron, I found that through a hole of about 3/8 in. you get about 100 mμa. When nothing shifted, and sometimes several things can shift at the same time, but on good days we had about 0.5% at half-width. The energy spread is a little better than just a half-Mev.