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SCATTERING CHAMBER FOR USE WITH SOLID STATE DETECTORS*

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The chamber we are going to describe was specifically designed to work with solid state detectors, mounted internally, in a tandem assembly or in multiple arrays. The size of the chamber, which is of simple design, permits working with a large range of solid angles and the rotation assembly covers practically the whole angular range.

The chamber consists of a brass ring 26″ in dia., with upper and lower lips soldered to it, sitting on a one-inch plate of Duralumin (fig. 1). The cover, of 1½″ aluminum, rides on 16 ball bearings which provide the support and allow an easy rotation under vacuum (fig. 2). The use of a chamber whose top part, housing detectors, rotates on ball-bearings, has been previously reported[1]). Here, the rotation is accomplished by an external gear mechanism. The seals are provided by O rings that sit in the upper and lower lips of the brass ring.

A second plate provides for an easier mounting of all the solid state detectors and reduces the effect of the vertical deflections of the top cover plate under vacuum. This plate is mounted near the perimeter of the cover. The detectors can be mounted in the horizontal plane that contains the incident beam and can be positioned at convenient distances from the target.

The central deflection of the cover plate was measured to be 4.6 mm. The reduction of this deflection by use of the second plate is better than a factor of two, causing a maximum relative error in solid angle at the detector of less than 0.5×10^{-4}. The chamber is provided with four lucite windows, to permit easy and full inspection of the chamber interior. Three of these are on the cover plate and one on the brass ring body.

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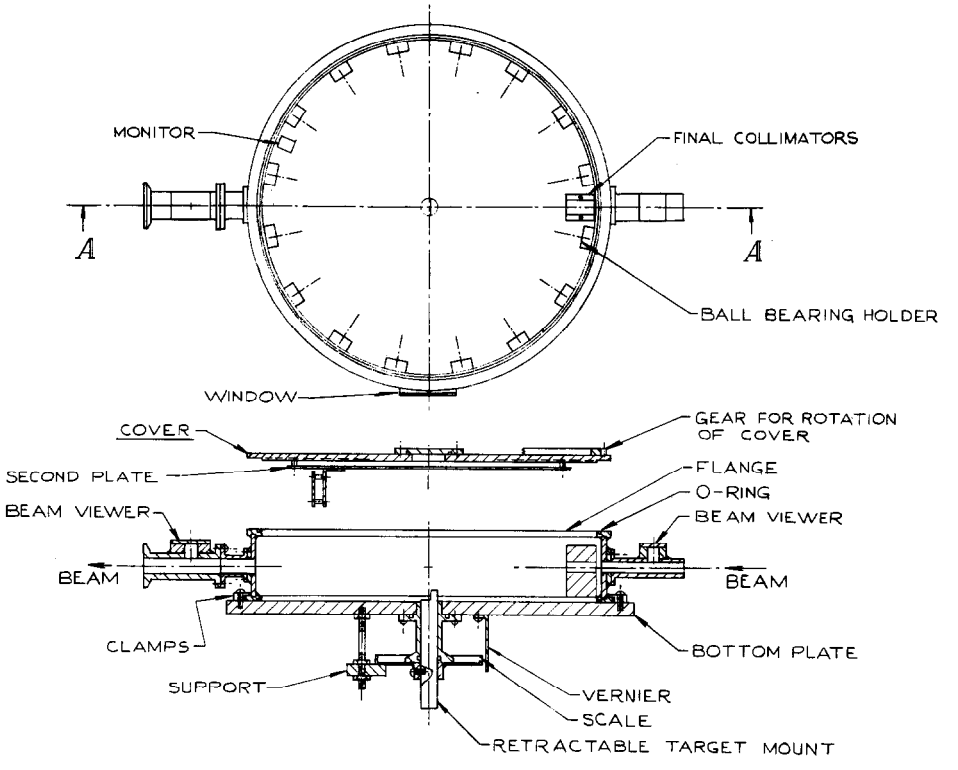

Fig. 1. Vertical cross-sectional view of chamber, target assembly, exit and entrance pipes and top view.

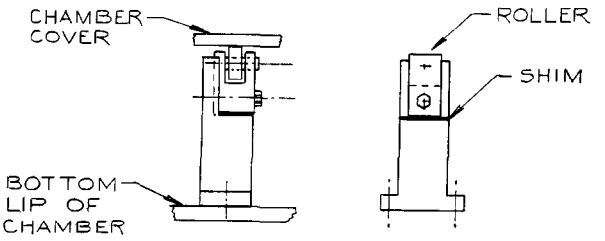

Fig. 2. Ball bearing holder.

(These have appropriate light-tight covers during detector operation.)

An etched scale on the cover with a vernier mounted on the stationary lip permits reading angles with an accuracy of 10′ and by estimation to 5′. An angular scale mounted on the target holder assembly allows target angle settings to equal accuracy. The latter is freely retractable, using a piston seal, providing the necessary target protection. We found that the height of the ball-bearing(s), as measured from the bottom plate, was critical.

The entrance and exit pipes to the chamber are provided with lucite viewers to center the chamber. The external proton beam of the Pupin Columbia University Cyclotron is under 15 MeV in energy and uses a current of ≈ 3 nA, thus safely permitting such a visual method of alignment. Appropriate collimators are located in the entrance beam pipe and the final beam-defining collimators are just inside the chamber adjacent to the entrance pipe.

Since small lateral displacement of the cover plate is possible as it rides on the ball-bearings and "O" ring, an alignment check of the cover was made after the chamber body was aligned. Since we have detectors available of resolution between 80 and 100 keV, it is possible to use a kinematic test. Proton peaks from the reactions p(H,H)p and p(^{12}C,^{12}*C)p′ resulting from the proton bombardment of a polyethylene target, cross each other at a laboratory angle of approximately 35°16′ and are 55 keV apart 0.35° to either side. The maximum absolute angular error was thus estimated to be 0.2, the relative error being 0.1.

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Reference

1) M. R. E. Tjin A Djie, F. J. Heer and L. A. Ch. Koerts, Nucl. Instr. and Meth. **9** (1960) 172.