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FIVE-TARGET MECHANISM FOR BERKELEY HILAC

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ABSTRACT

A mechanical device is described for holding five foil targets that may be separately inserted into the beam of a linear accelerator. The method of operation is graphically demonstrated.

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*Work done under the auspices of the U.S. Atomic Energy Commission.

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In support of the continuing beam-foil research at the Berkeley HILAC, a requirement was presented for the design and development of a device that would allow the insertion of multiple targets, one at a time, into the beam line. Five was considered an optimum number of foils to be grouped on one target holder.

A foil target, being extremely fragile, requires very careful handling. Arranging several targets on one holder requires less handling--and offers less chance for damage--than would the insertion and removal of each separate foil from the beam and its associated vacuum system. Each target is subjected to no additional handling by having five on the target holder, but a considerable saving in time is accomplished since the access chamber is evacuated only once for each five targets.

A variety of foil thicknesses and materials can be accommodated, and, if need be, the holder itself can be altered or replaced if it were required to change the overall geometry or shape of the target.

In addition to the precise vertical indexing of the individual targets, it was also required that the targets rotate to face the beam at any predetermined angle. Such rotation has the effect of varying the actual target thickness, that is presented to the beam. For example, a displacement of 45° from normal produces an increase in target thickness--as seen by the Beam--of approximately 41%. As an independent parameter, such increase in foil thickness could significantly affect an experimental result.

All fabrication and assembly work was performed in our own mechanical shops.

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Fig. 1. The complete mechanism assembly is mounted on a standardized beam tube box (1), which is used with the HILAC wherever access to the accelerator beam is required for target insertion or other experiments. The center opening of the box is surrounded by an O-ring groove and flange mounting holes to produce a vacuum-tight connection to the beam tube. The vacuum valve (2), the target access chamber (3), the rotating sleeve (4), and target holder shaft (5) are shown. The author's right hand holds the hand-wheel (6) used to raise or lower the target shaft by means of a rack and pinion drive, while his left hand holds the spring-loaded detent pin (7), used to keep the shaft and its attached target in a fixed vertical position.

Fig. 1b

Fig. 2. The polished stainless steel actuating shaft, with target holder attached, is shown here removed from the assembly. The top portion has a gear rack and cam follower installed for control of vertical and angular positioning of the shaft and targets.

Vertical orientation: Holes in the shaft are spaced to correspond to the vertical indexing distance between targets. The detent pin engages holes to keep each target in position for exposure to the accelerator beam. The vertical drive is designed so that one revolution of the handwheel indexes the next of five targets into the beam position. Once the center of a target has been properly aligned with the beam, each successive target will assume its correct position upon the next turn of the handwheel.

Angular orientation: The cam follower rides in a slot of the rotating sleeve, which places each target into the desired angular position relative to the beam. A 1 rpm drive motor, through a 6:1 gear ratio, rotates the sleeve and shaft at the angular velocity of 1 degree/second.

Fig. 3. The five-target holder with four of the foil targets in place. One target foil holder with its foil placed over the central hole is ready for installation. The foil side of the target holders is facing the viewer—and ultimately the accelerator beam. The target foil holder is a rectangular sheet of aluminum, type:1100-0, 22.35 mm X 28.65 mm X 1.60 mm thick (0.88 in. X 1.128 in. X 0.063 in. thick).

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Fig. 4. The procedure of mounting a target foil holder is demonstrated. Note the orientation of the standard motor-mount cleats, which permit easy insertion of the foil holder. After the cleats are rotated 180° , the socket-head screws are tightened, and the target is held firmly in place.

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Fig. 5. A captive screw knob prevents release of the five-target holder during manipulation, and is used to attach it to the actuating shaft. This facilitates one-handed operation and minimizes the risk of dropping or damaging the targets during their insertion into or removal from the access chamber. During insertion the target shaft is held firmly in its highest position by the detent pin. Note the O-ring around the opening to the chamber, providing a vacuum-tight face seal when the cover is bolted in place.

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Fig. 6. The target holder is shown attached to the end of the shaft. The plane of the foil target is automatically aligned with the shaft axis. The vacuum valve below the chamber is closed, isolating the access chamber from the beam pipe vacuum system.

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Fig. 7. After the chamber cover is bolted in place and the chamber evacuated, the valve can be opened providing an aperture through which the target holder and shaft can be lowered into the beam box.

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- Fig. 8a, b The target is aligned with the center of the beam, and is facing the beam at a precise angle predetermined by the experimenter.
- a. The lowest of five targets at an angle to the beam.
 - b. The uppermost target rotated normal to the beam.

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Fig. 9. The shaft is in its lowest position with the uppermost target exposed to beam. The author's right hand is actuating the switch of the drive motor for the angular target positioning, which in actual operation is remotely controlled.