Title
A MECHANICAL SHUTTER FOR A CYCLOTRON BEAM



Authors
Jenkins, K.D.
Jones, W.B.

Publication Date
1958-04-01

# UNIVERSITY OF CALIFORNIA

# Radiation Laboratory



BERKELEY, CALIFORNIA

**DISCLAIMER**

UCRL-8275


UNIVERSITY OF CALIFORNIA

Radiation Laboratory
Berkeley, California



Contract No. W-7405-eng-48


# A MECHANICAL SHUTTER FOR A CYCLOTRON BEAM


K. D. Jenkins and W. B. Jones


April 1958


Printed for the U. S. Atomic Energy Commission

# A MECHANICAL SHUTTER FOR A CYCLOTRON BEAM

K. D. Jenkins and W. B. Jones

Crocker Laboratory
University of California
Berkeley, California

April 1958

It is desirable to have a method of interrupting the beam of a conventional C. W. cyclotron. Ideally, the interrupter should not disturb the tuning of the accelerator, because that could introduce variations in the cyclotron parameters which would significantly decrease the alpha beam. However, a mechanical shutter (external to the cyclotron) has the disadvantage that the neutron and the gamma fluxes can still irradiate the target area even though the charged particles are stopped. The 60-inch Cyclotron group at Crocker Laboratory has developed a shutter (internal to the cyclotron vacuum) that does not disrupt the tuning of the accelerator, and it is located at a point where the beam trajectory is still curving in the magnetic field, so the neutron and gamma fluxes are not in line of sight to the target. The trajectory of the beam is such that the shutter interrupts the beam at an angle of 45° to the final direction of the particles.

An experiment was performed to check the flux under the following conditions:

1) A shutter was placed so that the beam was moving in the direction of line of sight to the target area.

2) A shutter was placed so that the beam was curving in the magnetic field when it was intercepted.

The results of this test under condition 1 showed that $5 \times 10^4$ fast neutrons/cm$^2$/sec were transmitted into the target area, whereas, under condition 2, the neutron flux was down to background of less than 50 fast neutrons/cm$^2$/sec for that area. The difference in gamma flux is substantailly the same as the difference in neutron flux for the two conditions.

The shutter is operated by means of a flip coil (Fig. 1). This flip coil has 400 turns of #20 copper wire. When the coil was driven by a 60 volt d. c. source, the closing time was 18 millisecs (Fig. 2). We were able to discharge a capacitor through the coil with an energy of 75 watt-secs (which is about ten times as much energy as the 60 volt source offered); in this case, the rising time of the beam was 3 millisecs. We feel that it would be very practical to operate this type of shutter so that 10 millisecond beam pulses are available.

This shutter proved to be extremely useful in normal operations. It is used to intercept the beam to reduce the background radiation when beam patterns are being taken, it enables us to bombard targets with high intensity beams for short exposures without setting up complicated electronic controls, and it is useful in general cyclotron tuning. As an example, it has been used to expose a sample to the cyclotron beam for two seconds; then the sample was removed to a counting cave; then returned for re-exposure on a new cycle. This has proved very advantageous in experiments where the half-lives of the radioisotopes involved are of the order of seconds.

## Figure Captions

Fig. 1. Shutter mechanism without the vacuum mounting assembly.

Fig. 2. Closing time of the shutter. Beam intensity was 40 microamperes of alpha particles (sweep speed 20 msec/cm). The pulses are due to the 360 cycle ripple of the oscillator rectifier.

Information Division
br

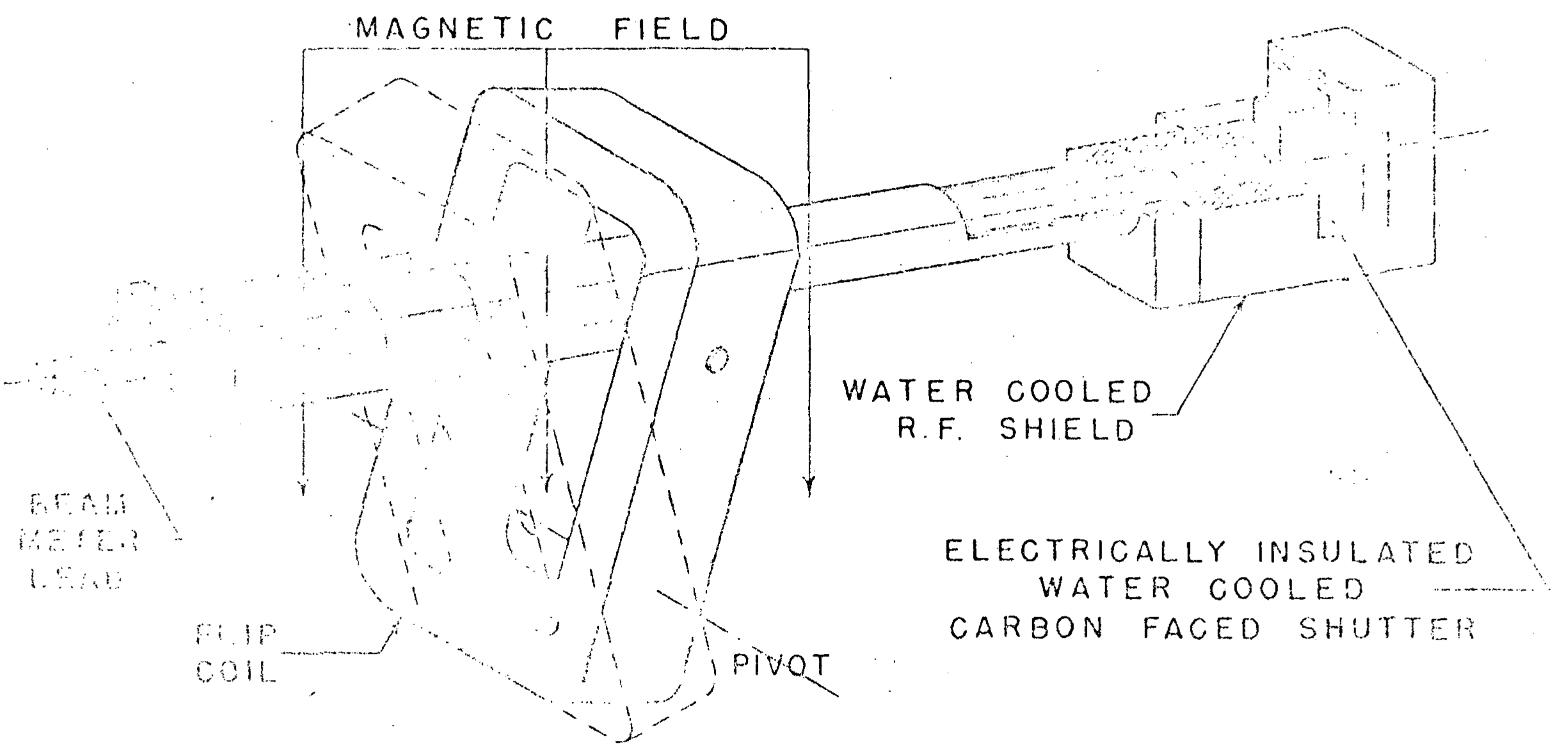
MAGNETIC FIELD
WATER COOLED
R.F. SHIELD
ELECTRICALLY INSULATED
WATER COOLED
CARBON FACED SHUTTER
BEAM
METER
LEAD
FLIP
COIL
PIVOT

Figure 1.

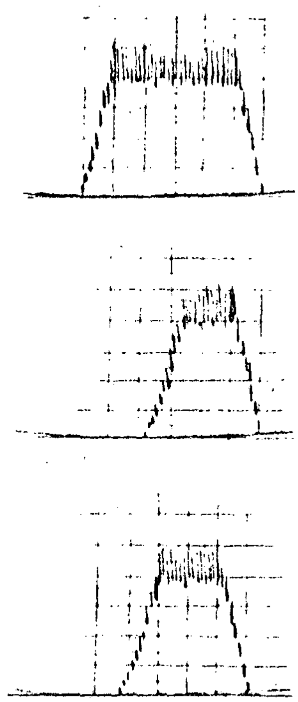

Figure 2.