UCRL - 8275

UNIVERSITY OF CALIFORNIA

Radiation Laboratory

TWO-WEEK LOAN COPY

his is a Library Circulating Copy
hich may be borrowed for two weeks.
or a personal retention copy, call
ech. Info. Division, Ext. 5545

BERKELEY, CALIFORNIA

DISCLAIMER

This document was prepared as an account of work sponsored by the United States Government. While this document is believed to contain correct information, neither the United States Government nor any agency thereof, nor the Regents of the University of California, nor any of their employees, makes any warranty, express or implied, or assumes any legal responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by its trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof, or the Regents of the University of California. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof or the Regents of the University of California.

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 5×10^4 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

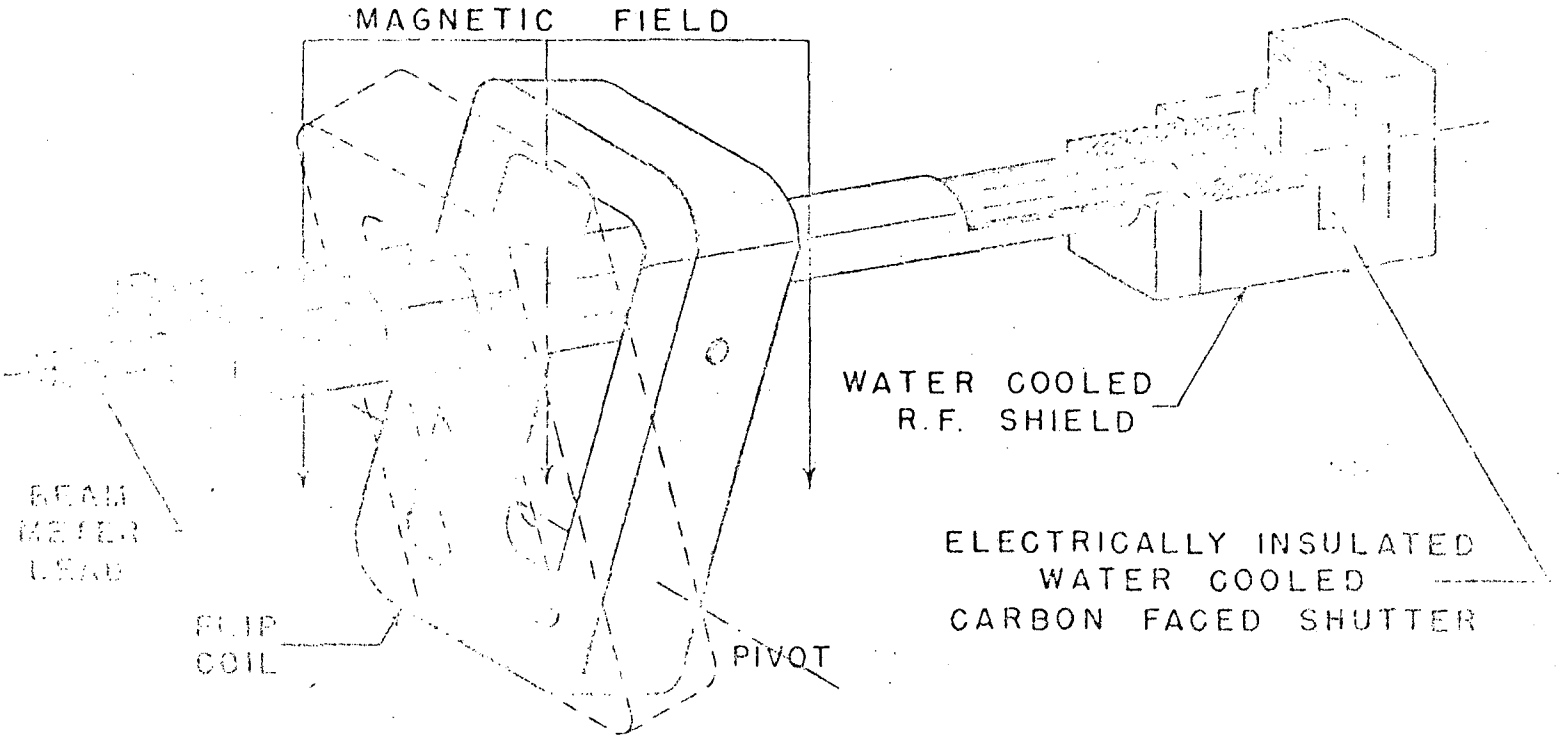
MAGNETIC FIELD
WATER COOLED
R.F. SHIELD
ELECTRICALLY INSULATED
WATER COOLED
CARBON FACED SHUTTER
FLIP
COIL
PIVOT

Figure 1.

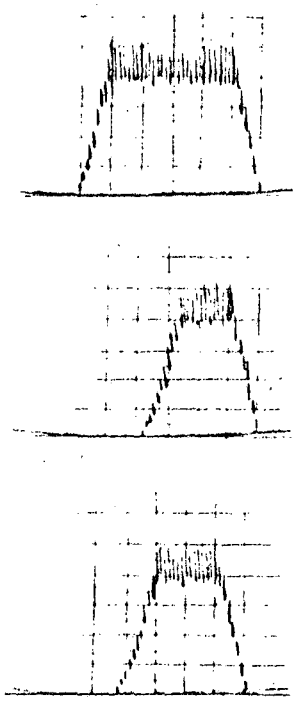

Figure 2.