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SUMMARY OF THE RESEARCH PROGRESS MEETING

April 21, 1949

H. P. Kramer

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INFORMATION DIVISION
Radiation Laboratory
Univ. of California
Berkeley, California

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Scintillation Counters. L. Wouters.

To take advantage of the short recovery time of crystals, the circuit of Fig. 1 has been designed. It is connected to the penultimate positive electrode of the photomultiplier tube. A signal from the photomultiplier causes the cathode follower to conduct through the feed back loop and thus accelerate the quenching of the signal soon after it has appeared. The pulse shape is shown in Fig. 2. It has a height of 30 volts and is .2 μ sec. in duration. There is a short rise time of perhaps .06 μ sec. However, recovery is almost instantaneous. In addition to the pulses of 30 volts, some minute pips are observed. However, no pulses of an intermediate height are produced on the oscilloscope.

An attempt is being made to simplify the circuit by using pulse transformers instead of the cathode follower.

Both anthracene and transtilbene crystals have been tested. It was found that transtilbene gives a sharp, rectangular pulse whereas pulses produced by anthracene have a tail of damped oscillations.

At the present, only one good transtilbene crystal has been grown. It gives promise that eventually very satisfactory crystals may be achieved since in a $\frac{1}{2}$ inch annular region surrounding an imperfect core, the crystal possesses the clarity of perfect glass.

P-p Scattering at 340 Mev. O. Chamberlain.

An apparatus (Fig. 3) for the measurement of p-p scattering by the deflected 340 Mev proton beam has been set up in the shielded cave outside the vacuum chamber of the 184 inch cyclotron. The beam is collimated in an 8 inch diameter lead pipe that

flares out at the end in order to avoid interaction between it and the fraction of the beam that is used for the measurements. A ten mil aluminum window allows the beam to pass out of the 2 inch diameter hole without disturbing the internal vacuum. The proton current is monitored by an ionization chamber located immediately outside the window. After passing through this monitor, the protons impinge on a polyethylene scatterer where they knock out hydrogen ions. A telescope of three proportional counters located on a radius emanating from the scatterer is used to detect these ions. By replacing the polyethylene with a piece of graphite the cross section for carbon can be determined and used to obtain the cross section for hydrogen from the polyethylene measurements by subtraction.

The chief difficulty of the experiment stems from the fact that the specific ionization of the highly energetic particles that are seen by the counters is too low for detection. For this reason, the energy must be reduced. A Cu absorber was placed in front of the first counter in order to reduce the energy of the particles sufficiently for counting. The present technique is however very unsatisfactory since at high energies and for a large mass of absorber not only the desired attenuation takes place but particle losses and other alterations of the scattered beam occur when the beam interacts with the absorber. As much as 80 percent of the beam may be lost by single and multiple Rutherford scattering in the coulomb fields of the copper nuclei and by nuclear reactions. Therefore, the absorber has the effect of introducing a good deal of uncertainty regarding the fraction of the beam that is counted by coincidences in the three tubes.

The ideal distribution of coincidence is portrayed in Fig. 4. 90 gm/cm^2 of Cu are required to stop the beam completely. Parts of this curve have been observed.

Another factor which detracts from the certainty of the measurements is the extremely high single counting rate. There are six single counts for every coincidence. One might expect a large singles count in the first tube from Rutherford scattering

in the absorber. However, the suprising observation has been made that the number of single counts in the last counter is approximately equal to that in the first. It was suggested that the source of these single counts might be particles that are scattered from the metal table on which the counters are supported. Some checks have been made. However, nothing very precise is known regarding the origin of these counts. When the scatterer is removed the coincidence rate drops to less than 3/100.

From previous work the n-p scattering cross section is well known at high energies. In order to form an idea of the extent of absorption the curves of Fig. 5 were constructed on the assumption that the p-p cross section is the same as the n-p cross section. On the basis of this assumption it was found that at least 50 percent of the beam is lost by nuclear reactions.

The first counter subtends an angle of 4° at the scattererer and the geometry of the telescope is such that only 20 percent of the protons that enter the first counter reach the third counting tube.

One additional disturbing element in the experiment is the variation by a factor of five of the intensity of the deflected proton beam as measured by the ionization chamber outside the Al window.

The audience participated actively in the discussion and the following suggestions for improvements were offered.

1. Surround the counting tubes with lead to eliminate single counts from γ-rays.

2. Very long counter tubes and coincidence arrangements of a higher order than three might make it possible to dispense with the troublesome absorber.

3. Use scintillation counters with extremely long crystals.

4. Employ a steering magnet to deflect the scattered protons and thus eliminate the γ-ray background. (See Fig. 6)

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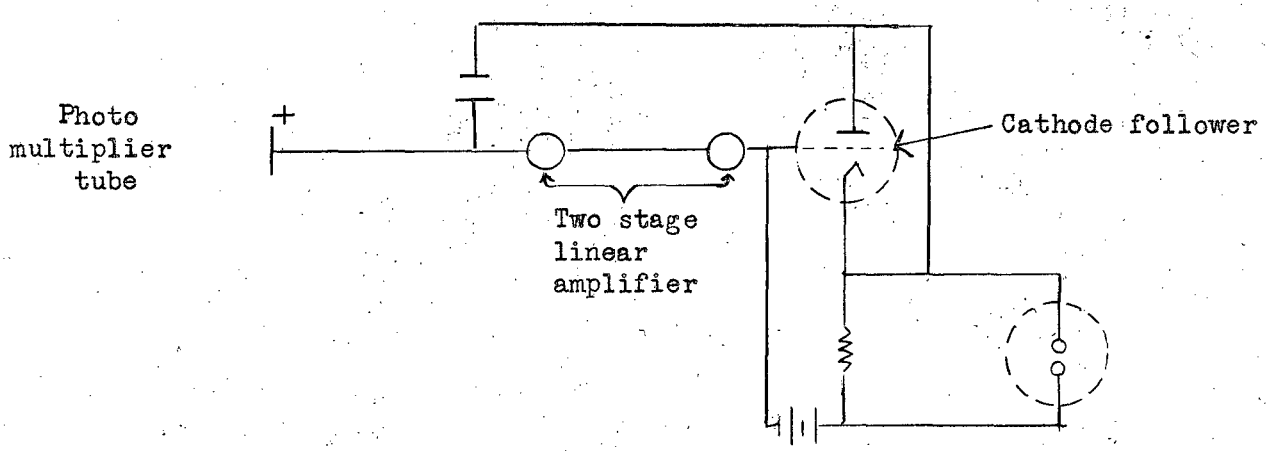


Discriminator Circuit for Use with a Crystal Counter

Fig. 1.

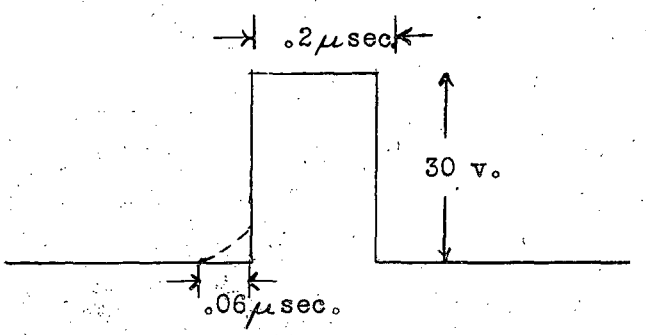
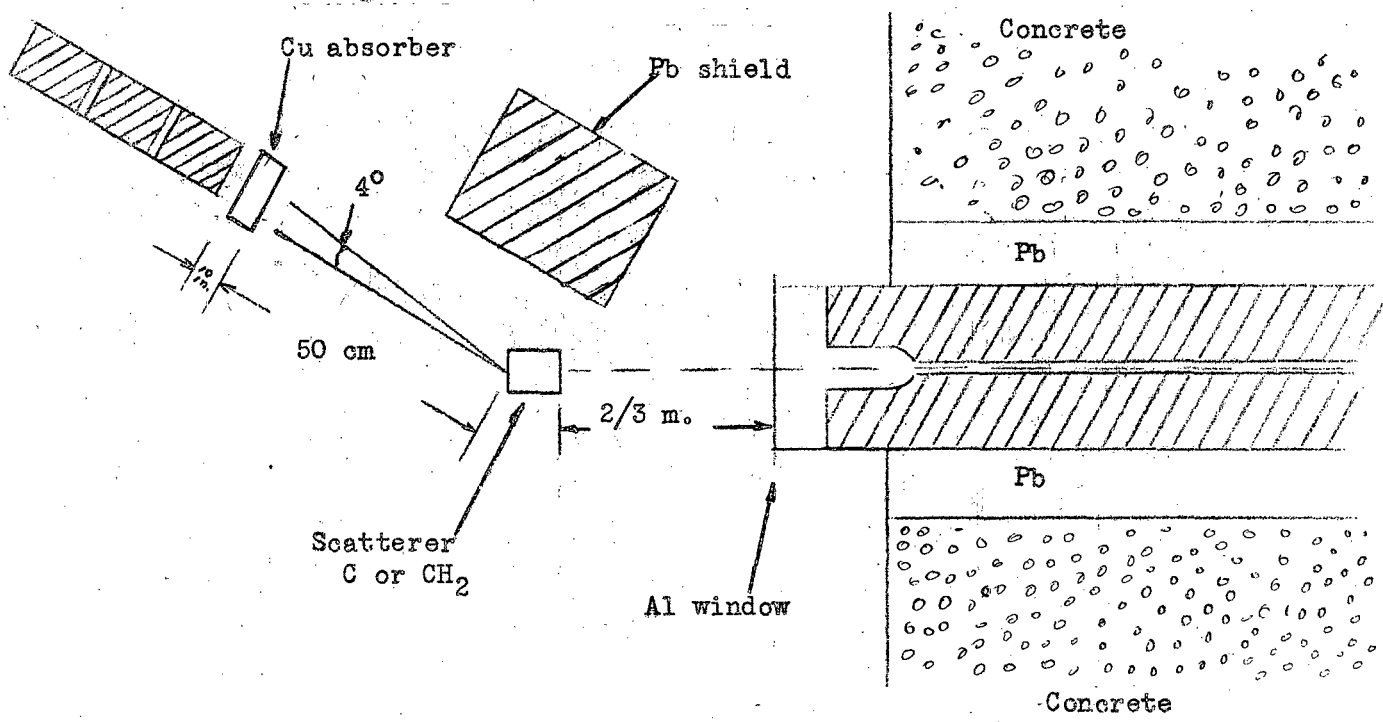


Fig. 2.



Apparatus for the Measurement of the p-p Cross Section of 340 Mev protons

Figure 3

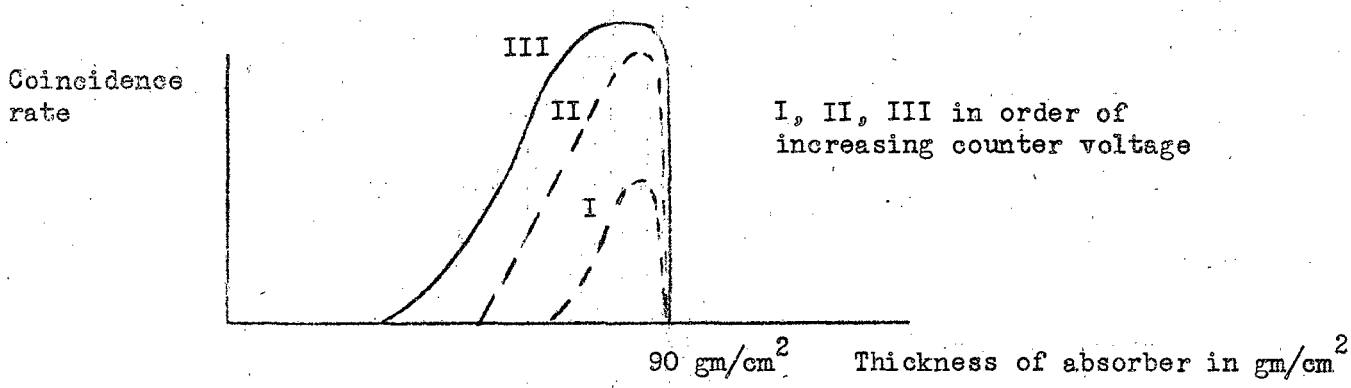


Figure 4

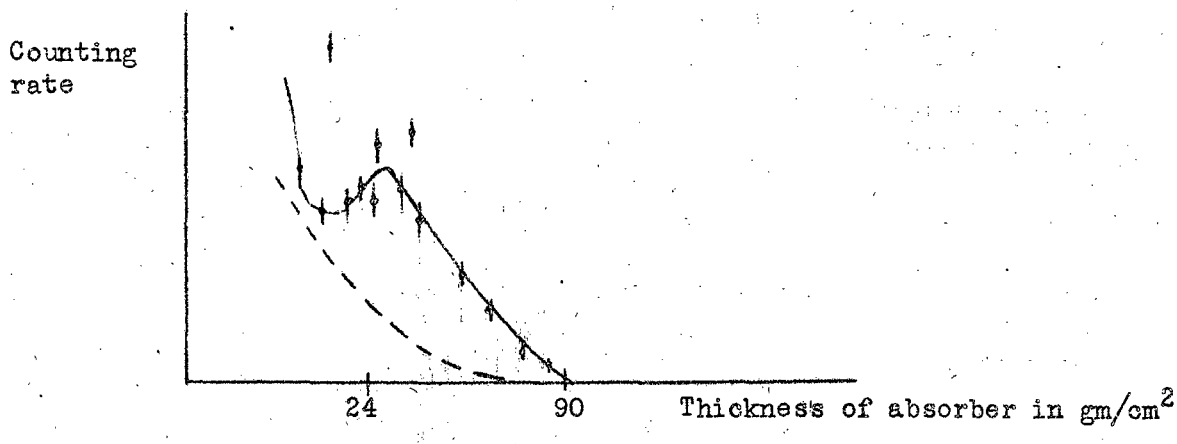


Figure 5

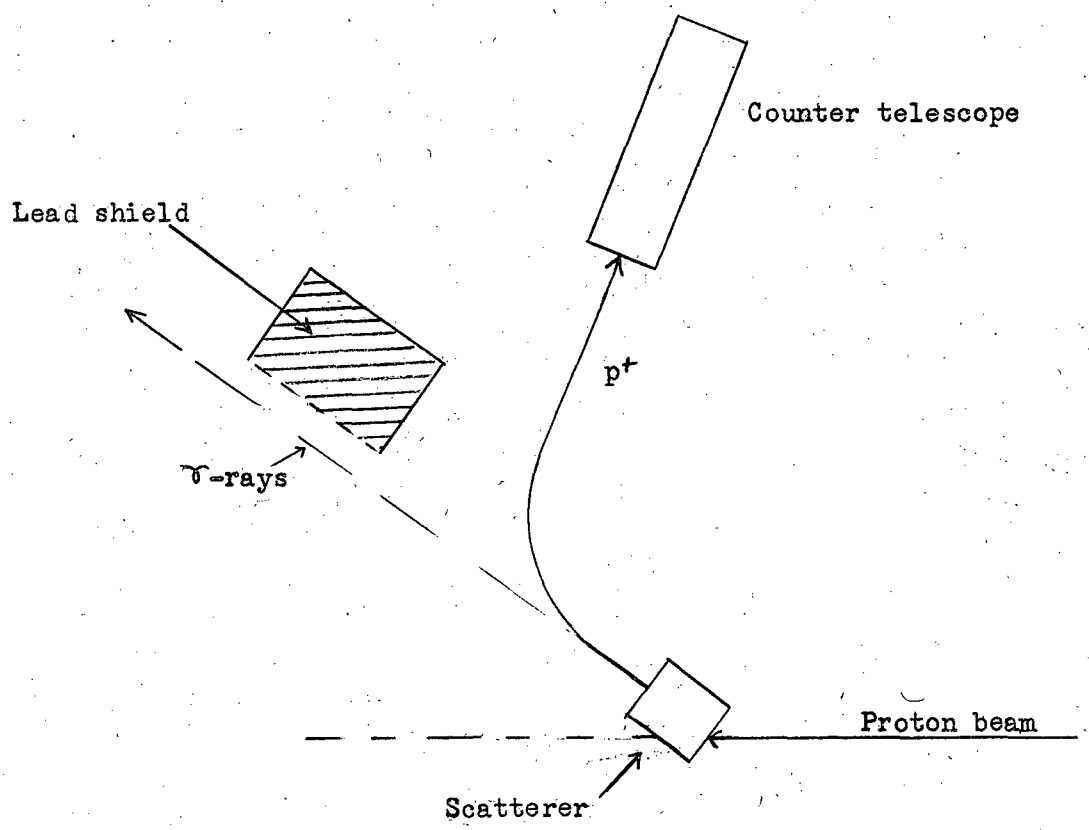

Counter telescope
Lead shield
p^+
γ-rays
Proton beam
Scatterer

Figure 6