THIS IS COPY 1 OF 25

THIS DOCUMENT CONTAINS 4 PAGES

MINUTES OF MEETING HELD IN OPPENHEIMER'S OFFICE WEDNESDAY, JUNE 28, 1944, FOR THE PURPOSE OF DISCUSSING THE FEASIBILITY OF USE OF THE BETATRON FOR A STUDY OF THE IMPLOSION PROCESS.

Oppenheimer opened the meeting with the statement that the first tests on imploding cylinders with a lead "squirrel-cage" construction showed a great improvement in symmetry.

Neddermeyer remarked that the time delays obtained with thin lead spacers were of the order of several microseconds.

Kerst made a summary of the properties of the betatron which are important for the suggested application, comparing these properties with those of an x-ray outfit operating at about 200 kv. The following points were mentioned:

(1) The focal spot in the betatron is of the order of 1 mm in height, which is considerably smaller than the focal spot of our x-ray tubes.

(2) The scattering of the higher energy beam from the betatron is less serious than that of 200 kv x-rays because there is only a small angular spread in the secondaries from the higher-energy beam.

(3) The intensity from the betatron is less than that from our x-ray machines. At 50 cm distance, one obrains about 0.1 R-units per pulse of x-rays, and about 0.01 R-units per pulse from the betatron. However, the transmission of the higher-energy rays is larger than that of the 200 kv x-rays by a factor which fully makes up for the loss in intensity. In a 1/3 scale gadget, the transmission through Al + HE is about ¼% for the x-rays, 37% for the betatron rays; through HE near the Al it is 5% for the x-rays, 60% for the betatron.

(4) Thin lead screens, used with the betatron in front of the detector, serve both to intensify and to clarify the images, by increasing the number and decreasing the linear spread of the secondary rays.

(5) The total "on-time" of the beam from the betatron was estimated as about $2\frac{1}{2}$ microseconds. This was not given as a precise figure, and Kerst suggested that it would not be a difficult problem to reduce this time interval. X-ray pulse durations in our outfits are of the order of 1 microsecond.

(6) The angular spread of the betatron rays is limited to a narrow cone; the width from maximum to half-maximum being 9 degrees. This sets a minimum of about 6 feet for the distance between betatron and gadget.

Rossi inquired about the sharpness of the shadow which would be cast by the sphere. Subsequent discussion indicated that the decrease in intensity due to absorption of rays by the imploded sphere in the final state; the decrease being sufficient for photographic detection but small for measurement by counters. On the other hand, the intensities will be too low for photographic measurement.

Weisskopf estimated that 8 cm Pb would decrease the intensity to about 1% of its initial value, taking $\mu_{Pb} = 0.6$ at 20 Mev.

Parratt estimated $1\frac{1}{2}$ cm for the radius of the imploded sphere.

Oppenheimer concluded that the shadow of the sphere would not be sharp enough so that the record of one counter would be meaningful. One would need to use many counters, obtaining a statistical interpretation from the fraction of them which are discharged.

Rossi suggested the use of ionization chambers instead of counters.

Parratt reminded the group that the desired resolution limits the chamber to a small size.

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Rossi suggested a long slim chamber pointed in the direction of the beam.

Kerst stated that the lower limit to the size of an ionization chamber, set by the beam intensity, is about that of a large sized Lauritsen chamber.

Oppenheimer observed that Kerst's figures, considering the absorption in the sphere, would indicate an intensity of 0.002 R-units per pulse, at 50 cm. Since the necessary distances are about 4 times this large, the intensity at the detector would be only about 10^{-4} R-units per pulse.

Oppenheimer then summarized the discussion by listing three difficulties which still needed to be overcome:

(1) The pulse time in the betatron may very likely be too great, unless there is research and development done to reduce this time.

(2) The design of detectors is a serious problem because of the lack of a sharp shadow.

(3) It may be necessary to use lead fins in the HE to achieve symmetry of implosion. These might affect the measurements adversely.

He suggested that these problems be looked into. Kerst offered to find out more precisely about the "on-time" of the betatron beam.

Parratt reminds the group that the necessity for the lead fins has been concluded on the basis of experiments with cylinders, which highly emphasize any assymmetry. Experiments on spheres to date show rather good symmetry without lead fins.

The suggestion was made that, if the detectors can be protected from destruction, it is feasible to use cloud chambers. It was considered, however, very difficult to protect the chamber from shock for as long as 1/100 second.

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which is the order of magnitude of the time required for cloud chamber operation. The chamber would be full of droplets which had condensed because of the shock rather than the ionization.

Tuck asked why we should not, instead of developing the betatron for this work, spend an equivalent time in extending the x-ray method. With x-ray intensities increased by a factor of 10, the interior of a $\frac{1}{4}$ scale sphere could be photographed. This increase in x-ray intensity is within the range of possibility.

K. Greisen

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