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Radiation Laboratory

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SUMMARY OF RESEARCH PROGRESS MEETING OF SEPTEMBER 20, 1951

Sergey Shewchuck

October 16, 1951

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Berkeley, California

SUMMARY OF THE RESEARCH PROGRESS MEETING OF SEPTEMBER 20, 1951

Sergey Shewchuck

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University of California, Berkeley, California

October 16, 1951

I. Cathode Ray Pulse Analyzer Tube. William Glenn

This ten channel cathode ray differential pulse analyzer tube, described previously in reports UCRL-250, December 8, 1948, and UCRL-1432, August 21, 1951, has been fairly well perfected now and is being manufactured commercially at a price of approximately $600 apiece. The first model was built in a big brass container, then in glass and finally sent to the DuMont Company for development with definite specifications. A pulse analyzer records the number of pulses versus the pulse height. This model uses a type of tube which in itself is different from the others available on the market.

The shape of the pulses from the detector are amplified and, with the original height preserved, are squared off as shown in Fig. 1, upper pulse. Then the pulses are applied to the deflection plate of the tube where the beam is aimed at one of the ten collector plates, the pulses striking the particular plate corresponding to their height. See Fig. 2. Each plate, in turn, is attached to a counter, or recording device. Another pulse is applied to the intensity grid. The gate pulse, see lower pulse Fig. 1, functions as a "trigger" to turn on the electron beam during the maximum flat portion of the pulse.

The deflection versus collector plate current for two adjacent plates is shown in Fig. 3. This type of discriminator proves quite satisfactory here. The overlap is only 1/10 % of the pulse height. The level at which

the counter is sensitive is set at a point just above the common region of overlap. The pulse widths in the present instrument are about 30μs. The upper limit on the tube on pulse width is 1/100μs. The limits are the transit time of electrons and the current in the tube. The tube is capable of handling much faster pulses than are now being used for it. It has been used with alpha counting and with scintillation counters for gamma pulse analysis. It is also being considered for use with beta scintillation counting.

By applying a coincidence pulse to the intensity grid the tube has a built-in coincidence circuit, so that it can be used as a coincidence counter. Now there is being considered a 60 channel analyzer with a six tube setup as a matrix.

The tube can be used for plotting short half lives. The sweep would be triggered by the cyclotron in the case of bombardments or by the parent activity and the intensity grid triggered by the pulse from the daughter product. The half life would be given by the time it takes for sweep to reach a particular channel.

II. Growing of Stilbene Crystals. Calvin Andre

At this laboratory there is need for larger stilbene crystals than the 2 in. x 2 in. ones available commercially, which cost about $200 each (at $2 per gram). The procedure for producing the crystals is to melt stilbene, to immerse a circular metallic copper plate in the melt, and to let cool slowly. The crystal grows on the copper plate. A diagram of the apparatus is shown in Fig. 4. The copper plate is ½in. thick and 8 in. in diameter, and it is suspended inside a pyrex beaker in such a way that it may be lowered into or raised out of the melted stilbene. This beaker is airtight except for a copper cooling tube which is soldered to the copper plate and extends through the cover to an air pump outside. Another beaker encloses the

pyrex beaker with a glycerine bath. Then both beakers, in turn, are enclosed in an airtight box within which the air temperature may be regulated.

The operation is started by turning on the heat and melting the stilbene, which takes about six hours. Next the plate is lowered into the melted stilbene. The pressure is kept at 80 lbs. and the incoming air is heated and kept at a little below the melting point. When the crystal begins to grow imperfectly it is remelted and again recrystallized. When the crystal reaches 3/4 in. in thickness it is melted off the plate and removed. Generally the stilbene crystal disc, which is 8 in. in diameter, has poor edges and contains visible cracks. The desired size crystals are cut from the best crack-free portions of the disc with a jig saw. Sometimes these cracks are not too objectionable depending on the use made of the crystal. The unused stilbene is saved for the remelting and recrystallization process. The raw material for the stilbene costs about five cents per gram, whereas some of the larger commercial stilbene crystals used by this laboratory cost about $4 per gram. Hence, the cost is nominal.

III. <u>4' x 8' Continuous Cloud Chamber</u>. Kenneth Relf.

The exact dimensions of the diffusion chamber are 4' x 8' x 7", with a sensitive area of about 3" over which there is some control. It would be most desirable to reduce this sensitive area to one inch for photographing purposes. This chamber is described briefly also in report UCRL-1474, September 24, 1951. The objective of this cloud chamber is to attempt to photograph the core of a large cosmic ray shower and, if possible, to determine whether the core is composed of smaller cores within itself or whether it is simply a fine structure of heavily ionizing particles. Many other uses can also be made of a large cloud chamber as, for instance, in conjunction with the large accelerators now in existence or under construction. As yet

no definite data has been obtained from this cloud chamber.

An overall view of the cloud chamber is shown in Figure 5, with the 1/4" thick plate glass removed. The chamber is double glass walled and is housed in a 3/4" plywood outer box with dimensions of $10\frac{1}{2}$' x 6' x 13". For insulation 25 lb. sacks of a porous substance commercially called "Vermiculite" are used. The bottom of the chamber is made of dural (61 ST) with a black velvet material for covering as a background for photographing the tracks. This has not proved to be too satisfactory. At first, a Tygon paint coating was applied, but it was impractial due to peeling and other defects. It is hoped that a new aluminum paint may yet prove to be satisfactory. The bottom of the chamber is cooled ethyl alcohol, which is sent through a pressure system and sprayed through small nozzles onto the under surface, and, after falling on dry ice, is returned to the pump. About 200 pounds of dry ice is used. There is some control over the rate of evaporation of methanol inside of the cloud chamber. Temperatures of 0°C to -70°C have been measured inside of the chamber near the bottom.

When the cloud chamber is exposed to cosmic rays there may be seen at one time about 500 to 1000 tracks over the whole 32 square feet of area. Some of the tracks are as long as 8 feet, the length of the chamber. The sensitive time of the tracks is from 2 to 3 seconds. It is planned to use an ordinary cloud chamber camera with stereoscopic lenses. It will be set on the side and at an angle (not perpendicular) to the surface of the chamber. In order that the perspective be improved every attempt will be made to get one inch of sensitive depth, as the present 3" depth is too much. From the photographs it is particularly desired to be able to count per unit area the number of tracks from a core of the Auger shower.

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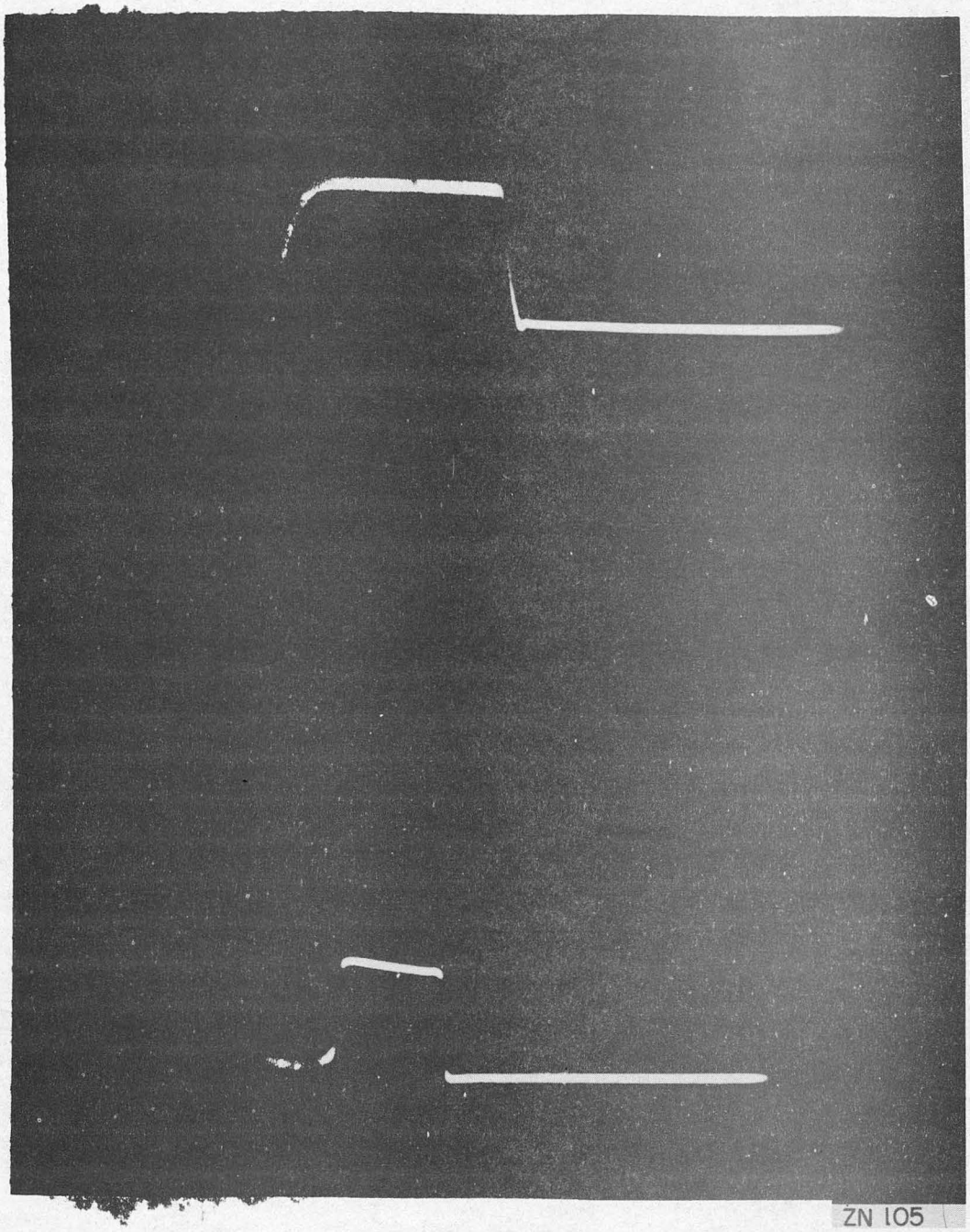

Figure 1

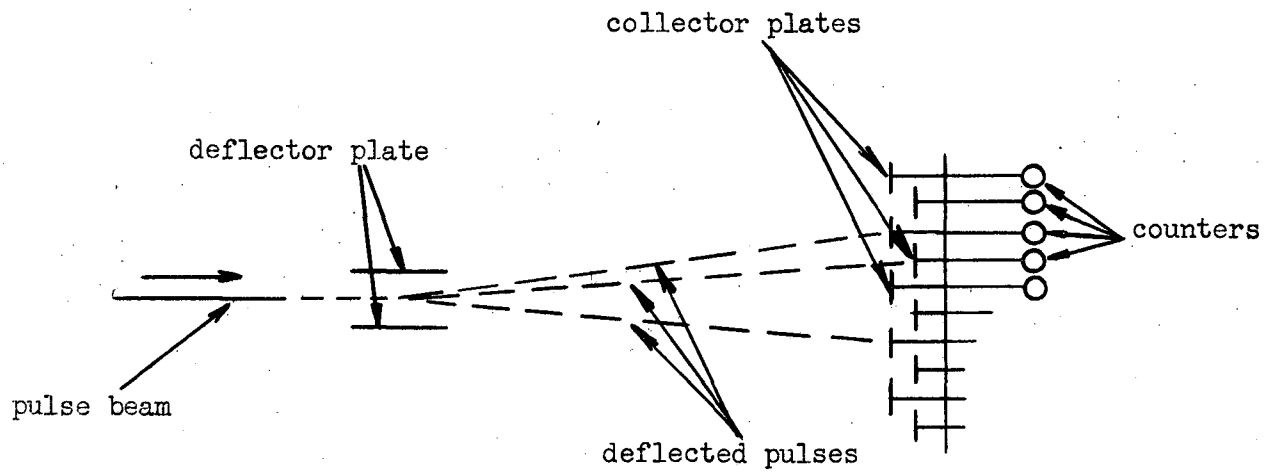

Figure 2.

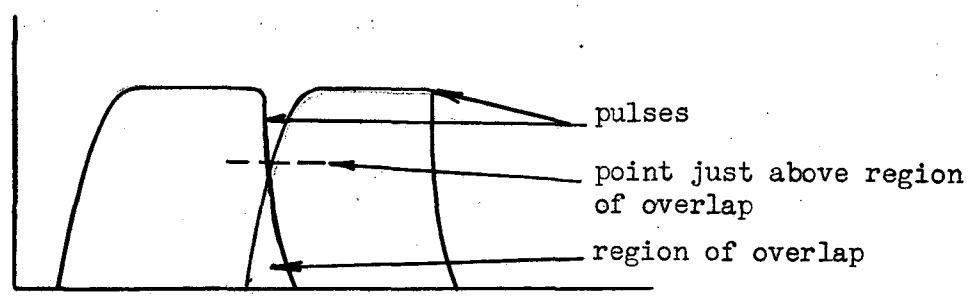

Figure 3.

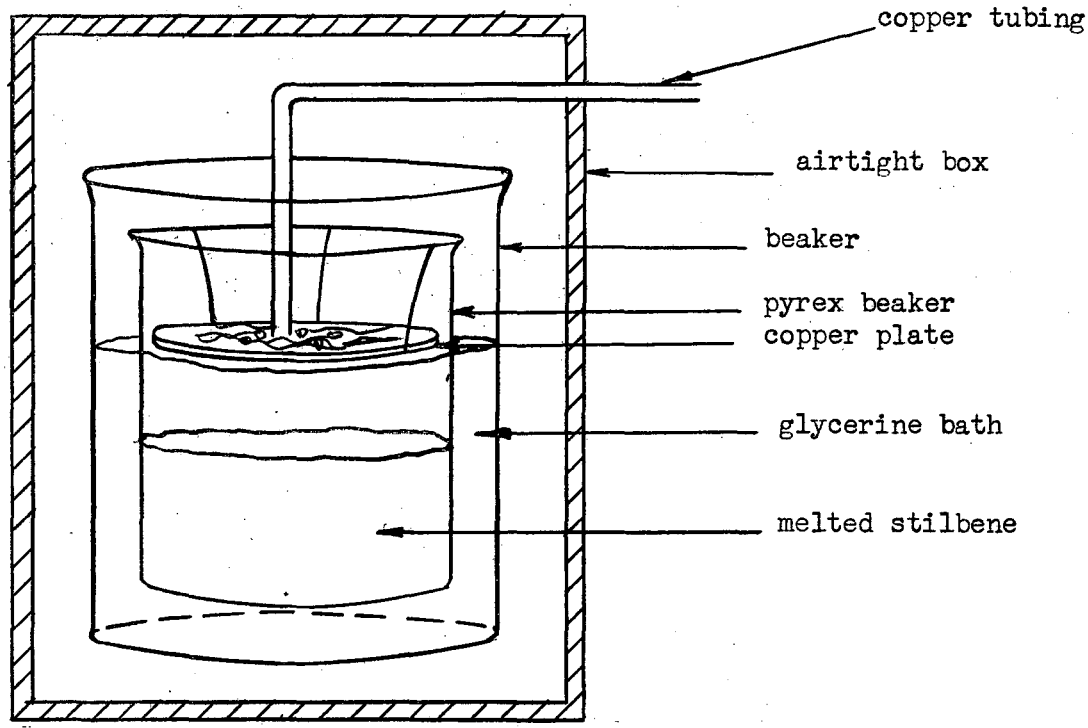
copper tubing
airtight box
beaker
pyrex beaker
copper plate
glycerine bath
melted stilbene

Figure 4.

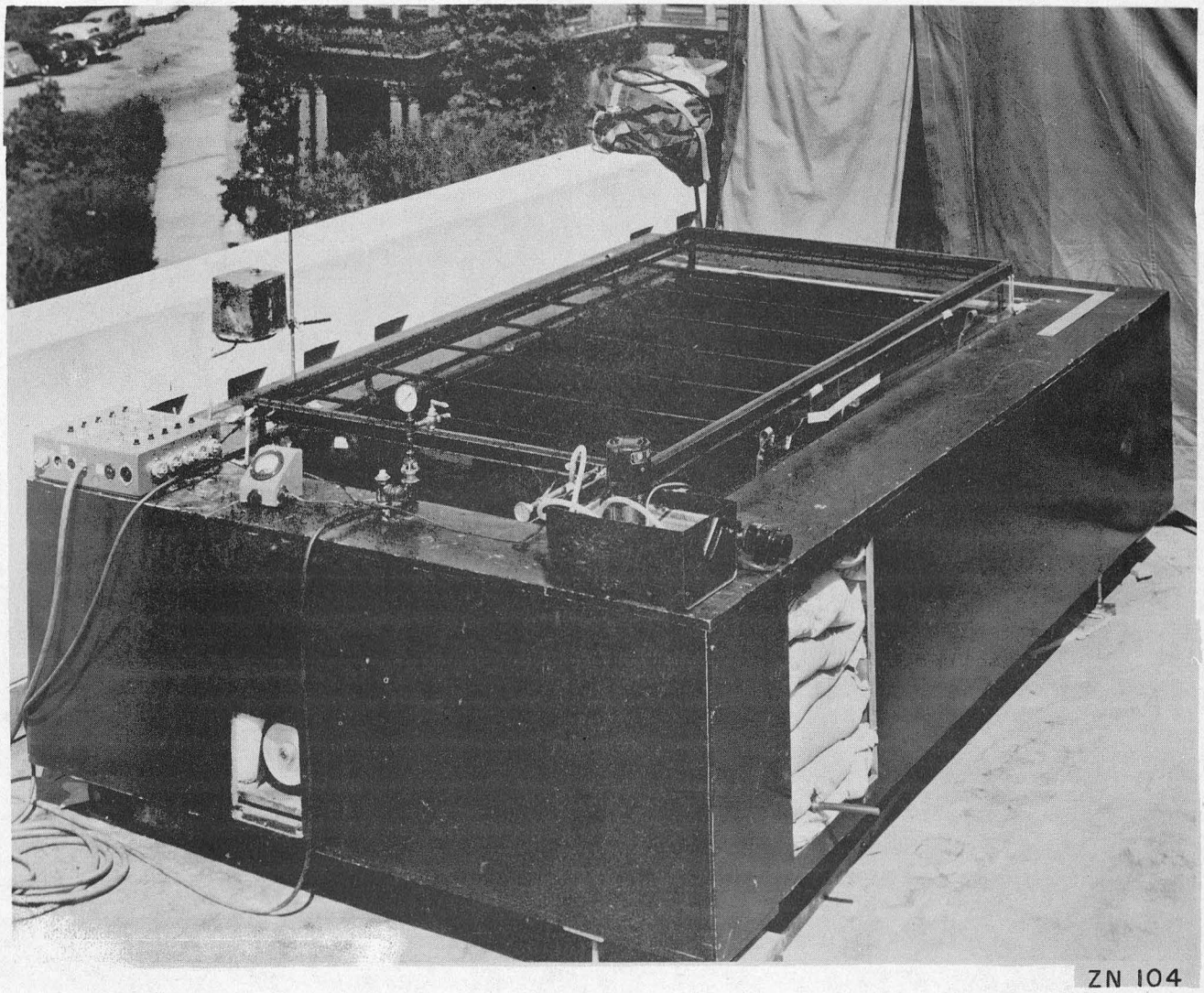

Figure 5