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PROGRESS REPORT NUMBER SIX OF THE GADGET PHYSICS DIVISION OF THE LOS ALAMOS PROJECT

JANUARY 15, 1945

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PROGRESS REPORT NUMBER SIX OF THE GADGET PHYSICS DIVISION

OF THE LOS ALAMOS PROJECT

JANUARY 15, 1945

Further assemblies of UH_{10} using U and WC tampers have been made by Group G-1. Criticality has been reached now in BeO, U, and WC and it is found that the observed results are considerably higher than those calculated. The results which for the case of U and WC must be decreased slightly for the effect of the extraneous material on the assembly are as follows: BeO predicted 2.1 kg 25, observed 3.2; U predicted 3.8, observed 6.8; WC predicted 5.1, observed 7.5. A further observation on BeO gave a 5.5 kg of 25 as critical mass when the core was surrounded by Cd. The disagreement between experimental and theoretical results indicates that our understanding of the hydride is far from complete.

In the course of these critical mass experiments, some difficulty was encountered due to changing experimental conditions when additional material was added. Introduction of detecting chambers near the core caused asymmetries which made the effect of added material depend in a rather pronounced way upon its position. Some experience was also obtained with extrapolations to the critical mass using external Geiger counters and internal fission chamber and external long counters. It was found that a fairly good prediction could be made when a long counter was used externally. It seems to be important to eliminate as much extraneous material as possible from the internal assembly. It is, of course, difficult to make measurements with an external detector, and for this

[redacted]

[redacted]

not negligible, and further attempts at shielding are being made.

Static tests using seven counters in the detector post at P Site have been completed, and it appears that while there were considerable difficulties encountered in shielding these counters from x-rays scattered through the detecting post this effect can be satisfactorily overcome. More counters are now being assembled in the post, and it is hoped within the next week to obtain a direct test.

Some further measurements have been made by Group G-3 on the study of small lenses, and the results previously reported which were in contradiction with other methods of detection appear to be erroneous. Present results indicate agreement with the other measurements and that the most accurate results can be obtained with small loops of wire in which the circuit is made when two pins are connected by contact. There appears, however, to be no advantage in this method over the direct electrical method for this work, and in the future very little work of this type is contemplated.

Considerable progress has been made with these small loops in the transmission of a signal from the inside of a hollow sphere. The method is to transmit a signal from a loop so oriented that the compensating eddy currents in the sphere would pass across the crack between the two hemispheres. It is found that with as much insulation as is furnished by a sheet of paper between the hemispheres more than 10 per cent of the signal is transmitted out from the sphere in a static test. One dynamic test has been made to obtain the signal from the inside of a copper sphere in which the hemispheres are separated by 1/8 in. of textolite. While the

[redacted]

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record is not completely understood, it is quite apparent that an appreciable signal is transmitted. We believe that the conducting material can perhaps be reasonably well matched as to shock velocity in some cases and that the development of small circuits to go inside the spheres will provide a method of obtaining information about the implosion in its later stages which at present cannot be obtained in any other way for a full sphere.

The site at Pajarito Canyon has been operating during the past month, and magnetic records which are quite free from interference effects have been obtained.

DOE b(3) Comparison of the single point detonations with x-ray photographs of Group X-1 make it seem probable that the large negative kick immediately following collapse corresponds to the jet observed in the x-ray shock opposite the detonation point.

DOE b(3) This break is interpreted as due to the reflection of the shock wave from the inner surface of the shell.

These all show breaks in the rise of the voltage curve and a very large increase in negative voltage immediately after the curve crosses the base line. This break in the curve is not clearly understood at present.

The Electronics Group, G-4, has revised the standard laboratory scalers so that all new units will work with fast pulses. A regulated supply has been introduced which gives greater stability to the discriminato

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There are now four standard scaler units which are designed for various applications. There has been considerable work in the development and repair of various health instruments, and a portable alpha counter with thin window has been built. A considerable fraction of the work of the electronics group continues to be in the development and construction of timing equipment of various degrees of resolution for use in experiments in the study of implosion.

Installation of the betatron by Group G-5 was begun about mid-December and the instrument was in operation approximately two weeks after the start of construction. After a few days of operation, difficulties were encountered with the injector which then had to be replaced. After replacement, it has taken some time to work the instrument back to the point where it gives 40 R/min.

Construction work on K Site dragged out considerably past the expected completion date, and it was necessary to leave a larger amount of electrical installation to the members of the group than had been anticipated in order to get the contractor off the Site. Installation work on the cloud chamber was begun on December 22 and is now complete.

The first pictures taken with the betatron operating at very low intensity were obtained on January 15 with a [redacted] steel mock-up with gold core. These show, due to the low intensity, a great scarcity of tracks in the region representing the tamper. There are also numerous low energy tracks. Further experiments at higher intensity and under better conditions of alignment will be necessary before it is clear how serious these difficulties may be.

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A second shot was made December 14 by Group G-6 using Ra La shipment No. 3 and an almost solid sphere.

It is planned to postpone further hollow sphere shots until electric detonators can be used to increase the simultaneity. A further shot using a small amount of Ra La from the same shipment was made without metal liner to determine the effect of absorption by the H.E.

DOE b(3)

A number of improvements are being made in the equipment for observing the Ra La shot which should increase the accuracy and the reliability of the results. A modulation scheme for the proportional

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[redacted]

Studies will be made to determine the over-all time lag in the detonator since it is likely that this may determine the degree of simultaneity which may eventually be achieved.

DOE b/3

[redacted]. For the 2L15G lens, they find that a point 70° from the axis lags behind the zenith by 1.0 μsec. The method seems to work very well in studying these lenses, and the measurements can be carried out and analyzed with great rapidity. It is now planned to use this method both in the study of single lenses and in the study of the acceleration of a metallic liner by a group of lenses.

A number of experiments have been carried out to study the motion of hemispheres accelerated by cast charges. [redacted] The records obtained on this scale are much poorer than have been obtained with smaller charges, and an investigation is being made in an effort to improve the quality of the results. [redacted]

DOE b/3

DOE b/3

Group G-10 has made plans for a new firing site in Sandia Canyon in connection with the development of the initiator. In the meantime, the

[redacted]

[redacted]

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image which moves at 4×10^5 cm/sec. and gives a resolving time of somewhat better than 10^{-7} secs.

Some further development work has been started to obtain higher speed photography of cathode ray oscilloscope traces. Various tests have been made in the development and design of equipment for the field tests of Group X-2.

R. F. Bacher

[redacted]

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Graphite. No UH_{10} has been put in this tamper since the last report.

F. Shape Factor. A rather flat assembly (7 x 7½ x 2½") in BeO was compared with an approximately cubical one (5½ x 5½ x 4½") with the result that the flat one required about 10% more active material to reach criticality.

Several assemblies were made in which a 4 x 4" square hole was made through the center of the core of hydride. An assembly with an outer cross section of 7 x 7½" and inner hole 4 x 4", required about 35% more material for criticality than an approximately cubical shape without hole. A more elongated assembly of outside cross section of 6 x 6" and 4 x 4" inner hole required the same, within experimental accuracy, as that having a 7 x 7½" outer dimension.

2. Safety Tests at Omega on Amounts of Active Material - No progress.

3. Safety Tests Outside Omega - No progress.

4. Power Hydride - Feld, Slotin

Construction of this equipment in C shop is continuing.

5. Drop Experiment - Whole Group.

Some of the parts were delivered from the shop a few days late and further delay was caused by various snags in the recording equipment. However, on January 18th, in the small hours of the morning, small bursts of radiation were observed which indicated that the system was indeed supercritical for prompt neutrons when the slug was dropped through. More UH_{10} was added during the day and strong bursts (10^{11} - 10^{12} neutrons estimated) were obtained the same evening. The temperature of the UH_{10} rose by about .001 degree C in one of these pulses. From the way the burst varied with the position of the control rod, it seems that the average time between successive fissions is 1 to 2 microseconds. Various records were taken which have not yet been analyzed. No radiation which would affect human health was observed behind

2. Magnetic Method - Wiemske (in charge), T/4 Fishbine

2.1 -- Wart Shots. No progress.

2.2 -- Central Shots. No progress.

2.3 -- Instrumentation. Further studies to eliminate pickup caused by the X-ray surge generator have been made. In particular, various positions and orientations of the pickup coil when near the wart and when near the nose of Bldg. #3 and various locations of the X-ray tube in Bldg. #3 have been tried. Conclusions to date are;

a) [redacted]

b) The wart pickup is sensitive to coil orientation and location, and to th position of X-ray tube and leads. With the tube in the wart and with th leads to tube through the single large hole in the wall of Bldg. #3, the peak pickup with the best coil orientation is approximately equal to the peak magnetic signal using a 15 gauss field.

Further tests made with the wart sealed off from Bldg. #3 by copper sheet, showed no essential improvement in pickup. From these tests it is suspected that shielding in Bldg. #3 is inadequate principally because the sheet metal on floor is not bonded to the 1/4" steel walls and ceiling. It is suspected that proper bonding would reduce the resistance in the shielding and thereby make it effective.

Additional storage batteries are being installed to provide a larger magnetic field. It is hoped to attain an 80 gauss field with present battery storage facilities. A copper box to surround the pickup coil, charge, and field coil is bei made. Both the box and the batteries will serve to increase the signal to pickup ratio.

3. Counter and Ion Chamber Development - Allen (in charge), Hudson, T/3 Schluter, T/4 MacCaughey, T/4 Everhart, T/4 O'Gorman

3.1 -- 3-mm Counters. When the 3-mm counters were pulsed by the ignitron gate circuit recently installed at P-site numerous counters blew up as a result of large peak currents passing between the counter shell and central wire. This large current was due to the displacement current through the 50 $\mu\mu f$ condensers at the output of the counters. A resistance of 1000 ohms in series with these condensers limited the current to a safe value. The counters operated satisfactorily with the new gate circuit after the output networks had been modified.

3.2 -- 1-mm Counters. No progress. These counters have not yet been tested with X-rays.

3.3 -- Integrating Ionization Chambers. It was discovered that there was very little correlation if any between the readings of the ion chamber dosimeter installed near the X-ray tube and the number of counters fired by the same X-ray pulse. This particular ion chamber was filled with argon to a pressure of about 100 lbs/in^2. The only absorber in the X-ray beam was the end of the chamber which was of 1/8" brass. Evidently the chamber was most sensitive to the longer wavelengths whereas the counters were usually operated behind 1/8" or more of Pb and were sensitive to much shorter wavelengths.

A new ion chamber and amplifier having sufficient sensitivity to allow operation behind 1/4" or more of Pb has been tested at P-site. Preliminary results indicate some correlation between the measured dosage and the operation of the counters.

An integrating ion chamber and amplifier for the photographic studies of sphere implosions has been installed in Bldg. #5. Considerable trouble has been experienced in reducing the disturbance caused by the impulse generator operating the X-ray tube. We hope that this disturbance will be reduced when the amplifier has been placed at a greater distance from the part

sitions of the counter assembly. A sharp maximum is found but the intensity on either side of maximum intensity remains about half the peak value indicating scattering from the collimators or incomplete collimation. This is probably not serious.

J. Keller of the Theoretical Division is now assisting in the scattering and counter studies.

4.3 -- Detector Post. A new removable iron front part of the cross has been made from a single piece of steel plate to replace the part broken by the explosion of last month.

5. X-Ray Equipment - Cuykendall (in charge), Finlayson, Wangsness, T/4 Whitworth, T/3 Ritner, T/3 Burditt, T/5 Pettis, T/4 Kilburg, T/4 Price

5.1 -- X-Ray Tubes. Five tubes were consumed in the work of the project during the past month. 18 new "standard" tubes are on hand. 4 experimental tubes for magnetic focussing studies were received.

One new tube was installed in the P-site wart and found to give only 50% of the normal intensity through 1/2" steel (see section 1.2 of this report).

A tube which has passed its useful life was cast in a block of paraffin and installed in the wart, P-site, to be used as surge generator load for all testing of circuits, pick-up and other non-X-ray use. This device will prolong the useful life of good tubes.

Conference was held with Westinghouse personnel concerning progress on tube development. Report of the conference was prepared and distributed to interested parties.

Implosion model tests were made in cooperation with Greisen's section of Group X-1, comparing a new and a used (826 flashes total, 156 > 400 KV) tube each at 360 and at 400 KV. Intensity (average of 20 flashes) through 5 inches of dural plus 1/8 inch steel was about the same for the new tube at 360 KV as for the old tube at

5.4 -- Magnetic Focussing. An oil case large enough to hold a "belly" coil around an X-ray tube has been constructed, for "parallel" focussing. A coil has been wound designed to give 4000 gauss field strength at center. The design of the coil and current pulsing equipment were taken over from Group X-1A and at present trouble is being experienced in obtaining the design current in the coil.

Design of a ferromagnetic core to insert within the hollow anode for "convergent" focussing is under way. The same coil and pulsing equipment as above will be used.

Reines of the Theoretical Division is assisting in the analysis of the magnetic focussing problems. He has concluded that a field strength at the cathode of 7000 gauss is more than ample.

Discussions have been held concerning the advantages and feasibility of separate excitation (perhaps by an auxiliary Marx generator) of the metallic arc in the cathode structure which is believed to be the source of electrons forming the tub current. Preliminary measurements of the voltage required to establish the arc have been made.

Small resistors consisting of short straight lengths of resistance wire hav been placed in series in the surge circuit. The latest design is a 1/5" length of #3 constantan wire having a resistance of 0.095 ohms and negligible inductance effect be low 5 Mc. The voltage across this resistor is fed through a cable directly to the plates of an oscilloscope. Preliminary curves show a lag of 2 to 5 microseconds in the peak current in the surge circuit. Rough calibration shows the peak current to l approximately 2000 amperes. This work has been done in cooperation with Kieneke.

6. General Facilities at P-Site - Crocker (in charge)

Heavy, all steel doors have been installed in Bldgs. #3 and 4 to replace tl original wooden doors that were damaged in early explosive tests.

GROUP G-3 - E. M. McMillan, Group Leader

January 19, 1945

Personnel: Section 1 - Fowler (Section Leader), Clancy, Daly, Miller, Rosen, Smith, Thompson.

Section 2 - Creutz (Section Leader), Foss, Frankel, Klein, Hobday, Kratz, Lanahan, Mallinckrodt, Peterson, Shank, Stark, Wenner, Young, Major, Fuller, Stone, Feder, Hershey, Davisson.

Section 1.

1. Instrumentation. All.

A. New equipment installed and in operation. Simultaneous records with new and old equipment are in agreement.

B. An order for a newly designed pin-primacord initiator circuit has been placed in the electronics shop.

C. Standard calibration coil for absolute calibrations has been designed and put into operation.

2. Attenuation and HE Conductivity Experiments. Rosen

A new attenuation experiment has been designed and the equipment and one charge have been assembled.

3. [redacted] Rosen Det by

A. Timing results reported last month appear to be in error. Examination of the tamping data on these lens-charges revealed large non-uniformities of density in the direction of the discrepancies. Subsequent tests with pulse loops on charges of more uniform TNT density yielded the following data:

[redacted]

detected outside of [redacted] Copper tamper, the two halves of which are separated by thin insulation (paper or tape). This attenuation factor is approximately the same with 100 and 200 KC sine wave signals.

B. Dynamic. One shot of [redacted] has been made but the scope trace is somewhat ambiguous.

C. Thought has been given to various schemes for applying this technique to the study of inside tamper surfaces.

Section 2.

1. Summary.

[redacted] Experiments indicating the possibility of determining something about symmetry by the magnetic method are mentioned. Work with a slow explosive with a detonation velocity of less than 3600 meters per second is discussed.

2. Organization.

Some slight changes in responsibility have been made. Kratz, in charge of Pajarito lab and shop, is now also responsible for the small firing site and the part of Gamma lab assigned to our section. The work at the small site will be concentrated on precision measurements.

Frankel is foreman of a permanent firing crew for the medium site which will be on call at all times to give their highest priority to see that the necessary shots are fired on schedule.

Shank will spend as much time as necessary to make all pick-ups. All orders will be placed through him and he will follow them up. Three

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machinists, Hobday, Klein and Wenner, have been added.

3. Experimental work.

A.

It then crosses the baseline a second time and becomes jagged as breakup of the sphere occurs. When the detonation was made at a single point, the negative voltage part of the curve, corresponding to the expansion of the sphere after the implosion, is always jagged and does not return to the base line in a smooth manner.

Again, some evidence of asymmetry could be seen on the magnetic record. In the case of 1-point detonation, there is a very characteristic difference depending on whether the detonation point is on a line perpendicular or parallel to the field. In the former case, there is a larger negative kick immediately following the collapse; this can be correlated with a jet observed by Greisen in X-ray photographs, which comes out opposite to the detonation point. This kick appears weakly in the parallel detonations; the difference is what one would expect, since the magnet record depends primarily on the projected area as seen along the field.

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[redacted] DOE b/3)

B.

They all show a break in the voltage curve during the rise at about 3 μsec. a ter the start of the implosion. This may be interpreted as the reflection of the shock wave from the inner surface of the shell. One of them shows a very irregular rise. After this shot, the field coil was found pushed 6 feet to the side, indicating that the detonation had been asymmetric.

These records are similar to the preceding except that the break in the voltage curve during the initial stage of the implosion is more pronounced. DOE b/3)

This also shows the break in the rise of the curve.

C.

These both show 2 steps in the rise of the voltage curve at about 2 μsec. intervals after the start of the implosion.

There is evidence of poor symmetry or bad mixing of the steatite with copper. DOE b/3)

D. RaLa size shots.

Fair records were obtained on the first two.

Irregularity of the records during the explosion appears to be partly due to interference

[redacted]

[redacted]

from the HE and partly due to successive shocks from the interaction of waves from neighboring detonation points.

The third charge detonated at least 50 μsec. before it was expected so only the last part of the record was obtained on the oscilloscope. Another peculiarity of this shot was the finding of a fragment weighing 550 grams lying on the ground, indicating it was blown in the air almost vertically. Possibly a tetryl pellet was hit by a fragment of the cap or of lucite causing the bottom pentagon of the charge to detonate before the explosion wave reached it through the primacord. This made the shot similar to a one-point detonation and spoiled the timing which was dependent on the primacord.

DOE b(3)

E. Torpex. [redacted] Interference during the explosion of the charge was so bad in each case that the start of the implosion of copper could not be determined on the records. Three torpex charges were prepared with about 1/4" of Comp. C. on the outside, as proposed by Mr. Marley. The interference was about equally bad. Three torpex charges were prepared with about 1/8" of paraffin on the outside. In two cases, the interference was appreciably less and the start of the implosion could be determined with fair accuracy. In the third case, the interference was about as bad as usual.

F. Pick-up coil axis perpendicular to the magnetic field.

DOE b(3)

The single point detonation in this case was made parallel to the magnetic field. No signal

[redacted]

above background was observed during the implosion. However, during the time when the sphere was expanding, a signal was observed about one-half as great as was obtained with the coil in the regular position. A similar result was obtained when the coil axis perpendicular to the magnetic field and the single point detonation was perpendicular to both the coil axis and the magnetic field. In one experiment when the pick-up coil axis was perpendicular to the field and the detonation was in a line parallel to the axis of the pick-up coil, some voltage was generated. This probably is due to imperfect orientation of the pick-up coil since this was done only visually.

G. Exploding spheres.

In 6 shots, 4 of which were made with the detonation line parallel to the magnetic field and 2 with it perpendicular to the magnetic field, the voltage curve shows a rapidly increasing rise up to about 6 μsec., at which point there is a sharp change of slope to a smaller value, which then remains nearly constant. The first part can be explained as a shock wave acceleration, and the latter as the acceleration by the residual gas pressure. In two other cases the voltage dropped to zero at about 6 μsec.; this is probably connected with the breaking up of the sphere.

H. Slow explosive. Mallinckrodt has measured the detonation

[redacted]

velocities of a mixture of 50 per cent TNT and 50 per cent red mercuric oxide by weight. Material was tamped by hand and an attempt was made to reach a high density in each case so that it would not settle. The following velocities were measured:

Velocity M/sec.	Density of 50-50 mixture	Inside Diam. of cylinder containing explosive	Length of Cylinder	Method of Detonation
3580	1.50 g/cm^3	1-1/2"	14.1 cm	Pentolite 1 in. thic
3610	1.56	1-1/2"	14.35 cm	Pentolite 1 in. thic
3400	1.60	3/4"	24.68 cm	M-6 tetryl pellet
3420	1.65	3/4"	29.85 cm	M-6 tetryl pellet
3420	1.67	3/4"	25.60 cm	M-6 tetryl pellet

Further experiments await evaluation by Marley of the hazard involved.

[redacted]

[redacted]

GROUP G-4 - W. A. Higinbotham, Group Leader

January 18, 1945

Personnel - Membership of group as of 1/15/45 - 69

1. Construction

100 pieces of equipment were constructed in this period. 64 pieces of equipment were repaired.

4. Scalers and discriminators - Higinbotham, Sands

The standard laboratory scalers have been revised. They now have a regulated supply, giving high stability to the discriminators. The discriminator and all new units will work on fast pulses. The discriminator dial is calibrated to read 0-100 volts. Unless otherwise specified, these are designed for positive input. The output for Brower Register is relative to ground. There is an output jack on the rear for a counting rate meter described below. The Model 200 Scale of 64 uses 2 6SN7 scaler units and 4 6SL7. The Model 300 Scale of 256 has two additional 6SL7 stages. The power throughout has been reduced and the life and stability should be correspondingly increased.

A portable counting rate meter for use with the above has been designed. It will be useful for quick counts or for running preliminary bias curves. Eight ranges are provided for 1000 to 200,000 counts per min. Accuracy 5%.

The Model 400 scaler contains an R.F. power supply, 1500 v, for G.M. tubes. This uses 6SL7 units and has a regulated power supply. It can be furnished with a W.E. register mounted on the panel.

Model 500 scaler and discriminator is designed for applications requiring very high resolving time. A discriminator consisting of 2 6AG7s feeds an inverter which goes to a fast scale of 8 made with 6AK5 and 6AL5 tubes. This is designed to feed in to a Model 200 or Model 300 scaler. Resolving time is less than 1 microsec.

[redacted]

[redacted]

[redacted]

X-2C Informer - Titterton

A "yes - no" informer is completed and under test. It is supposed to determin whether or not all detonators fire within a given time interval. The time interval the test unit is 4 microsecs, but this interval can be made anything desired.

[redacted]

[redacted]

[redacted]

GROUP G-5 - S. H. Neddermeyer, Group Leader

January 18, 1945

1. Construction

Completed. The contractor was unable to meet his last completion date, December 22, which left a great deal of electrical wiring to be done by our own men. Installation of the cloud chamber was nevertheless begun on December 22, a week after the beginning of installation of the betatron. Considerable difficulty was experienced with plugged water lines, incorrectly constructed DC circuits, and wrong intercomm circuits; otherwise the construction job was fiarly satisfactor except for a few items including an incorrectly located I-beam, which dislocated the betatron installation, and rather poor floor construction in Buildings 2 and 3.

2. Betatron

X-rays were first obtained approximately two weeks after the beginning of installation, but the betatron is not yet functioning reliably. The maximum output so far obtained is approximately 30 R/min. compared to an expected output of about 50. The special timing controls for locking the betatron injector into the rest of the time sequence are under construction and will be completed in about two days.

3. Cloud Chamber

Installation was begun on December 22 and is now complete. The chamber itself is functioning satisfactorily, but some difficulties are now being had in making completely reproducible and reliable light

[redacted]

[redacted]

sources. One of the first sources made has been functioning reliably for several months without a single failure, but the exact procedure for repeating this performance has not been found. A second complete cloud chamber setup is being constructed, including an air solenoid which will produce a flux density of 1800 gauss. (See 5 below.) A third complete set of cloud chamber parts has been constructed for replacement purposes. This was thought necessary as the cloud chamber is subjected to considerably greater hazard from possible fragment or jet penetration than is the betatron.

4. Electronic Equipment

Complete, except for the injector timing circuits mentioned above. A 16 channel pin circuit has been constructed by the electronics group and tested with primacord using the fast sweep.

5. Experimental Results

A few cloud chamber photographs have been taken of a [redacted] steel mockup with gold core, with the betatron synchronized to give a single pulse on completion of the cloud chamber expansion. Both the X-ray beam and the mockup were out of line so that it was not possible to observe the core. The photographs indicate, however, that there are enough very low energy scattered tracks traversing the image laterally so that one could expect to obtain a very great improvement in definition by using a magnetic field to curl up the low energy particles. Plans for doing this are well under way; the magnet coils are now being tested and so far satisfy the specifications, but it will be at least

[redacted]

a month before the new cloud chamber-magnet assembly can be installed at the site. The immediate future program calls for extensive mockup tests to establish empirical criteria for analyzing the data. A few preliminary H.E. shots may be fired before the end of January.

[redacted]

GROUP G-6 - B. Rossi, Group Leader

January 15th, 1945

[redacted]

DOE b(3)

[redacted]

[redacted]

[redacted]

2. Improvements in the experimental methods for Ra La tests

A. Installation of new scopes and cameras

B. Installation of new calibrator

C. Addition of synchronous time marks on the Ra La records

D. Investigation of a photocell circuit for the determination of the time of detonation of the H.E. Preliminary tests have shown that the detection of the light evolution may provide an accuracy in timing of the order of 1/2 microsecond.

E. Investigation of explosive switches to cut off the ion current shortly after the occurrence of the minimum transmission. Preliminary tests indicate that good timing in the operation of the switches can be obtained. However, serious troubles seem to arise, as expected, from contact potentials.

F. Replacements of expendable preamplifiers by cathode followers. Tests show that this can be done without increasing unduly the noise level. With appropriate shielding the electric

[redacted]

[redacted]

C. Preparation of shots in Bayo Site

(including H.E., source transfer devices, etc.)

Diven, Menz, Fredricks, Kissee

D. Construction of expendable electronic equipment

Harper, Hartig, Komich

E. Design and construction of new electronic circuits

Staub, Miller, Jurney, Harper, Hartig

F. Development, Construction and testing of ion chambers

Nicodemus, Dellenbaugh, Powers, Volpe, Lustgarten

G. Static absorption measurements

Koontz, Hall

H. Evaluation of data

Koontz, E. Staub

I. Proportional counters modulation scheme

Koontz, Hall, with the collaboration of Hane and Elmore of G-4

J. Time scale experiment

Nereson, LaBarge (in collaboration with G-1)

K. Construction of G-M counters

E. Staub, R. Haley

[redacted]

DOE b(3)

[redacted]

[redacted] Until improvements in detonators and measurement technique have been made, there is no possibility of doing significant switch research.

One problem which has to be solved is the shorting of condensers after firing, to cut down magnetic interferences in Ra-La and magnetic shots.

4. Measurements

DOE b(3)

A. [redacted] Some improvements have been made; marks on stainless steel can be read to ± .002".

DOE b(3)

B. [redacted]

C. [redacted]

D. Detonator currents can be measured by placing a small loop of wire near a cathode ray tube and observing the magnetic deflection of the beam.

5. Production

A. Wire detonator shipments to us from Cal Tech have reached approximately 30 per day, with promise of achieving 1000 per day in one to two weeks.

B. Spark detonator shipments to Hercules from Cal Tech have reached approximately 150 per day. None have been received here from Hercules.

C. The production section of Group G-7 can load and prepare 200 detonators pe day. Their eventual capacity is expected to be 400 per day.

[redacted]

[redacted]

GROUP G-8 - D. Freman, Group Leader

January 17, 1945

1. Straight Contacts

The method is now in good shape for use with small charges. Most of the useful data obtained in the group is obtained by means of this method, and the results are reported below under separate numbers. It has not yet been possible to obtain good clear records with large charges (of the order of 100 lbs.) and further development work is under way.

2. Condenser Microphone

The distortions described previously in low resistance condenser records led to an investigation of the signals received when no potential difference was applied to the condenser. Signals of the order of a hundredth of a volt were recorded. These appeared to be characteristic of the metal constituting the surface of the moving plate which was nearest to the other plate of the condenser. Distortions of the same general character as with the low resistance method have been observed in the high resistance method.

9. Simultaneity of Detonation

Series of timing experiments were made of 1-6 primacord branches. Initial primacord split into six primacords by tetryl booster. Each of these six primacords detonated a tetryl booster and a final primacord. Timing was accomplished by putting pins in these final primacords. Half of these shots were set up with small tetryl pellets pressed in the ends of the primacord, the primacord then going to a tetryl booster in the ordinary way. The root mean square timing error observed was

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[redacted]

About 14" of primacord contribute to these erro s. Since these measurements are in reasonable agreement with those of Greisen one concludes that two boosters do not add an appreciable variable error.

DOE b(3)

10. Imploding Hemispheres

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12. Lens Testing With Liner

Three 2 L 15G lenses were tested. A point 70° from center of lens lags behind a point at center of lens by 1.0 ± 0.1 μsec.

Several shots were made with the 1 C1 30 Z conical lenses above 1" and 2" of pentolite to accelerate 1/8" steel plates. From the contact times below the plates it appears that a point 1" from the axis of the lens lags behind a point on the axis by 0.1 or 0.2 μsec.

13. Velocity of Shock Waves in Metals

Of the several experimental arrangements for the measurement of the shock velocity in steel that were tried, the following was found to give reasonably reproducible results. Steel plates 4" x 4" and of thicknesses between 1/8" and 1" were used. The arrival of the detonation wave at the top surface of the steel plate was recorded by the shorting of a 1/2 mil Cu foil to the steel plate through 1 mil polystyrene tape. The arrival of the shock wave at the bottom surface was recorded by the shorting of a pin (separated from the plate by less than 1 mil) to the lower surface of the plate.

Since the two contacts are made in different ways, the time interval recorded by them does not necessarily give the time it

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would take a shock wave to traverse the plate. Consequently, in an attempt to avoid this difficulty the velocities were computed in the following way. If t(1/8) was the time interval observed between the two contacts for an 1/8" plate and t(1/2) that for a 1/2" plate, then the correct velocity was assumed to be given by $(1/2 - 1/8)/[t(1/2) - t(1/8)]$. Using data obtained from 1/8" plates and 1/2" plates one gets a value of 5.4 ± 0.2 km/sec., but using 1/8" and 1" plate data one obtains 5.9 ± 0.2 km/sec. So there seems to be some indication of a change of velocity with thickness of plate. The reality of this variation is being checked with further shots.

14. Velocity of Plates, Radius Effect and Jets

A. The velocity observed for 1/2" thick steel plates accelerated by 2-1/2" dia x 3" pentolite cylinders was 0.92 km/sec. over the first cm of motion of the plate.

The velocity imparted to 1/8" steel plates using the 1 CL 30 Z lens was measured: Four shots were fired to measure the velocity of a 1/8" steel plate when 1" of pentolite was placed between the base of the lens and the plate. The initial velocity was apparently about 1.2 mm/μsec., but it was difficult to know where to draw the curve in this region. During the first microsecond there was considerable acceleration. Then the velocity remained constant during the observed motion of the plate (10 mm.) and was 1.8 mm/μsec. The probable error in the time measurements was less than ± 0.1 μsec.

Two shots were then fired with 2" of pentolite between the lens and the 1/8" steel plate. Excellent agreement between the two shots

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was obtained. For this arrangement the initial velocity was about 1.5 mm/μsec. There was considerable acceleration during the first three μseconds, and the velocity then remained constant for the remaining observed motion of the plate (to 13.5 mm). This final velocity was 2.6 mm/μsec.

B. Radius Effect. The curvature and velocity imparted to 1/8" steel plates by pentolite 1/2 and 1 inch high have been measured. The pentolite charges were cylindrical 3-3/4" in diameter. The charges were detonated at the center of one cylindrical surface by a solid tetryl pellet over which was placed a ring pellet into which the primacord was inserted. The pellets were of 7/8" diameter. Twelve pins were placed under the 1/8" steel plate at distances varying from zero to 10 mm from the plate. Four were placed near the center on a circle of 3/16" radius, four at 1" radius, and four at 1-1/2" radius. The velocity imparted to the plate was nearly the same (within 4 per cent) for the various positions of the pins. It averaged about 0.94 mm/μsec. for the 1/2" pentolite charge, and about 1.4 mm/μsec. for the 1" pentolite.

The displacement of the distance time curves for the portion of the plate at the 1" and 1-1/2" radius from the curve for the 3/16" radius for the 1/2" pentolite were 1.4 and 2.7 μsec. respectively at the time the plate started to move. Their displacement remained constant within the experimental error for all the time that the motion of the plate was observed. The corresponding displacements for the curves obtained when 1" pentolite was used were 0.9 and 1.8 μsec.

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respectively at the time the plate began to move, and also remained nearly constant.

C. Jet Detection. A preliminary shot has been fired to show that the velocity of a jet can be measured by bending the pins so that they are parallel to the plate. It is planned to fire more shots to detect jets with this arrangement.

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GROUP G-10 - C. L. Critchfield, Group Leader

January 20, 1945

The members of G-10 have been principally concerned with the plans for installations at Sandia Canyon. Developments in our investigations may be summarized as follows:

I. Initiators

A. Supply of Radioactivity - Sherr

1. Three targets have been received from DTM and committed to Segre's group for measurement.

2. Dodson has verified the existence of a long-lived, high-energy gamma emitter among the fragments other than La. This emitter is among the rare earths, has an energy in the neighborhood of 2 Mev and is considerably more effective than La in producing neutrons from Be.

3. A report from the pile irradiation of Sb is expected in a few days.

B. Design of Alpha-Neutron Sources - Serduke, Sherr

1. Numerous granular systems have been tried under gun impact and sections studied. No conclusions as yet.

2. Two types of "gun" initiators have been made and await recovery success with dummies.

3. Design development on the recoil type of mechanical initiator is progressing using 20 mm impacts.

4. No progress on the gold wedge "topological" idea.

5. If sufficiently deep and pure layers of polonium can be deposited, a "geometrical" initiator will be tested for mechanical action, activity migration, etc.

[redacted]

[redacted]

problem is at present being attacked by Monsanto at the request of the Director, it was agreed to postpone the other two problems until they can be discussed with Mr. Thomas.

A brief discussion of the present status of inside initiator designs has been prepared by Rubby Sherr. This is presented below.

V. Initiator Designs

Broadly speaking, our designs can be divided into two groups: Group A consists of initiators requiring good or very good symmetry of implosion. Group B initiators do not require symmetry, but will work even with good symmetry. We shall consider fabrication problems, efficiency of operation, and required testing problems.

A. Group A Initiators

1. Omega Initiator

DOE b(2)

[redacted] No shielding is required in this initiator. The fabrication is simple, and the testing should be directed toward discovering the effects of asymmetrical implosions.

DOE b(2)

[redacted]

[redacted]

The fabrication would be very difficult. The symmetry requirements would be high for the particular action postulated, but the source may work with poor symmetry as a Group B initiator.

B. Group B. Initiators

The chief characteristic of this group of sources is that they are supposed to operate when they are stuck regardless of symmetry. A number of mechanisms have been suggested.

5. Grapenuts Initiator

DOE 6/3

This requirement makes the fabrication very difficult.

6. Iron Maiden Initiator

DOE 6/3

The fabrication is straightforward, avoiding the plating difficulties to a la extent.

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An alternative method would be to use disks of a hypothetical Po alloy. This would require about 10 times the mixing required to make the above source work.

7. Disk Initiator

DOE b/3

A single disk may require reasonable symmetry. The fabrication is simplest for this case.

8. Cube Initiator (Little Joe)

The ideas contained in the disk initiator can be extended to make it more fool proof against asymmetry.

The fabrication is straightforward.

DOE b/3

C. Discussion of Group B Initiators

The mechanisms whereby these initiators are activated are

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DOE b/3

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[redacted]

There appear to be three criteria which should be satisfied.

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GROUP G-11 - J. E. Mack, Group Leader

January 16, 1945

1. Photographic service - Thompson, service manager

The darkroom load is approximately constant (staff of 4).

2. Kingman test instrumentation - Brixner

Apparatus for the high-speed motion-picture study release has been sent to Kingman.

3. Trinity test instrumentation - Mack

The present prospects are that apparatus for all the approved experiments will be laboratory tested in ample time, with the following possible exceptions:

6) Following spectrograph for 10^3 seconds (Geiger, Bifano). To test our solution of the difficult problem of obtaining a smoothly varying film velocity in the ratio of 1000 to 1, we must await the arrival of a hydraulic transmission in February.

12) Camera for close-in shock (Benjamin). The success of this unit depends upon the behavior of a pressure switch which has been built, but not tested for lack of a firing site.

14) Camera for air-motion study (Economou, Bloom). Experiments are in progress on a line light source of proper duration for this study.

4. Sweeping-image cameras - Brixner, Geiger

A. Rotating mirror cameras

3. Shutter mechanism: The Kerr cell pulsing device has

[redacted]

for the primacord shutter reduces the speed of the camera to an effective value of about f:30. Shadow pictures with HE candles show tolerable density, but the density for reflection pictures is not yet sufficient. On the basis of these tests and Koski's expectation of enhancing the flux from his sources, we have started the manufacture of three more lever cameras designed for use with lenses of 47-1/2" focal length at an object distance of about 70 feet.

10. Special Record Photography

A. High-speed water drop study - Wahlen

Preliminary exposures on a high-speed water drop study, undertaken at the request of Penney, indicate that the work can be completed without any major difficulties.

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