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Publication Date
1966-10-18

UCRL-17213

University of California

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Berkeley, California

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Submitted as a Note to
Review of Scientific Instruments

UCRL-17213
Preprint

UNIVERSITY OF CALIFORNIA

Lawrence Radiation Laboratory
Berkeley, California

AEC Contract No. W-7405-eng-48

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ABSTRACT

A system is described for oscilloscope display of a particle-beam profile, which was built for an experiment at the Stanford Linear Accelerator Center.

We have constructed a novel beam-profile system for use in a beam experiment at the Stanford Linear Accelerator Center (see Fig. 1). The system displays single-particle spark-chamber events on the face of a storage oscilloscope, accumulating the events to give a beam profile at the plane where the spark chamber is placed. This allows the experimenter to find easily the exact position and focus of his particle beam when setting up his experiment.

When a particle passes through the spark chamber, a trigger pulse fires the spark gap (Fig. 2), which puts a high-voltage, 200-nsec pulse on the spark chamber (Fig. 3).

The top conducting surface of the chamber has small copper wires in a parallel array 1 mm apart and connected to a common bus on only one end. The bottom conducting surface is similarly constructed (see Fig. 4), but its wires are oriented at 90 deg to those on the top surface. The two faces are ~1 cm apart. The particle-sensing area of the chamber is 25.4 cm square. Cloth made of wire in one axis and fiberglass thread in the other is used for the chamber faces. This cloth was glued with epoxy adhesive to laminated fiberglass sheets for backing, and the chamber faces were glued with epoxy cement to plastic spacers. The space between the faces is filled with neon gas. (See Figs. 4 and 5.)

When the chamber is pulsed, arcs occur in the neon along the ionized path left by the particle, and a large current of 25 to 50 A flows through one wire in the top face, or X axis, and through a wire in the bottom face, or Y axis. This current flows past an iron-cobalt metal strip in the X and Y axis, as it flows from the top face common bus to the bottom face common bus.[1] The iron-cobalt wires, which are electrically insulated from the chamber-face wires, connect to magnetostrictive sensors. The current pulse in the chamber-face wires creates a sonic pulse in the iron-cobalt wire where the current passes under the magnetostrictive wire. This sonic pulse is detected by a magnetostrictive sensor, as are the fiducial sonic pulses.

Reference wires are run under the iron-cobalt wire near the first and last copper chamber wire. These wires are pulsed with current when the chamber is pulsed, and are used for fiducials to start the coordinate and fiducial scalers, and to stop the fiducial scalers.

The X and Y coordinate and fiducial counters start counting at a 10-MHz rate when the magnetostrictive sensor and pulse center-finder circuit detect the first X and Y fiducial sonic pulses, respectively; the X and Y coordinate counters stop on the second X and Y pulses, respectively; the X and Y fiducial counters stop on the third pulses, respectively.[2] If the fiducial counters are not at the right count after the third detected pulse, the logic prevents display of the X- and Y-axis coordinates. More than one spark, or a chamber misfire, will cause the fiducial counters to have an incorrect value, because a second spark functions in the same way as the second fiducial pulse.

The X and Y counters feed a digital-to-analog-converter resistor ladder, and display lights. The X and Y digital-to-analog-converter outputs go to the X and Y storage-oscilloscope deflection amplifiers, respectively, and when the fiducial counts are correct after the spark chamber is fired, the oscilloscope intensity input is pusled, storing the spot on the oscilloscope face in direct relationship to the X and Y position of the particle path (see Fig. 5). The counter display lights are an aid to the operator.

The cables from the main control rack are long enough to allow the beam-profile spark chamber to be placed 15 meters from the control electronics.

FOOTNOTE AND REFERENCES

*This work was done under the auspices of the U. S. Atomic Energy Commission.

1. Frederick A. Kirsten, Victor Perez-Mendez, and James M. Pfab, Development of Magnetostrictive Chamber Readouts, Lawrence Radiation Laboratory report UCID-2629, August 19, 1965.

2. Kai L. Lee and James M. Pfab, Magnetostrictive Pick-up Preamplifier, Lawrence Radiation Laboratory report UCID-2750, February 7, 1966.

FIGURE LEGENDS

Fig. 1. Beam profile control electronic rack, with the spark chamber and magnetostrictive sensors shown on the top of a stand at the right, and the spark gap shown on the bottom shelf of the stand.

Fig. 2. Spark gap and capacitor box for high-voltage-pulse distribution.

Fig. 3. Spark chamber with magnetostrictive sensors.

Fig. 4. Spark chamber and magnetostrictive sensor diagram.

Fig. 5. Beam profile system block diagram.

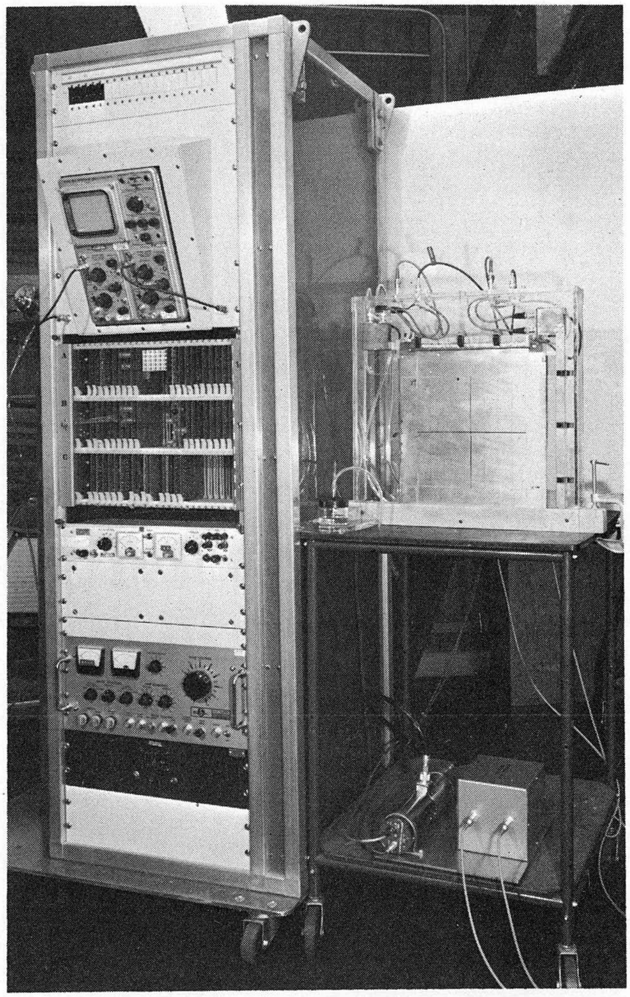

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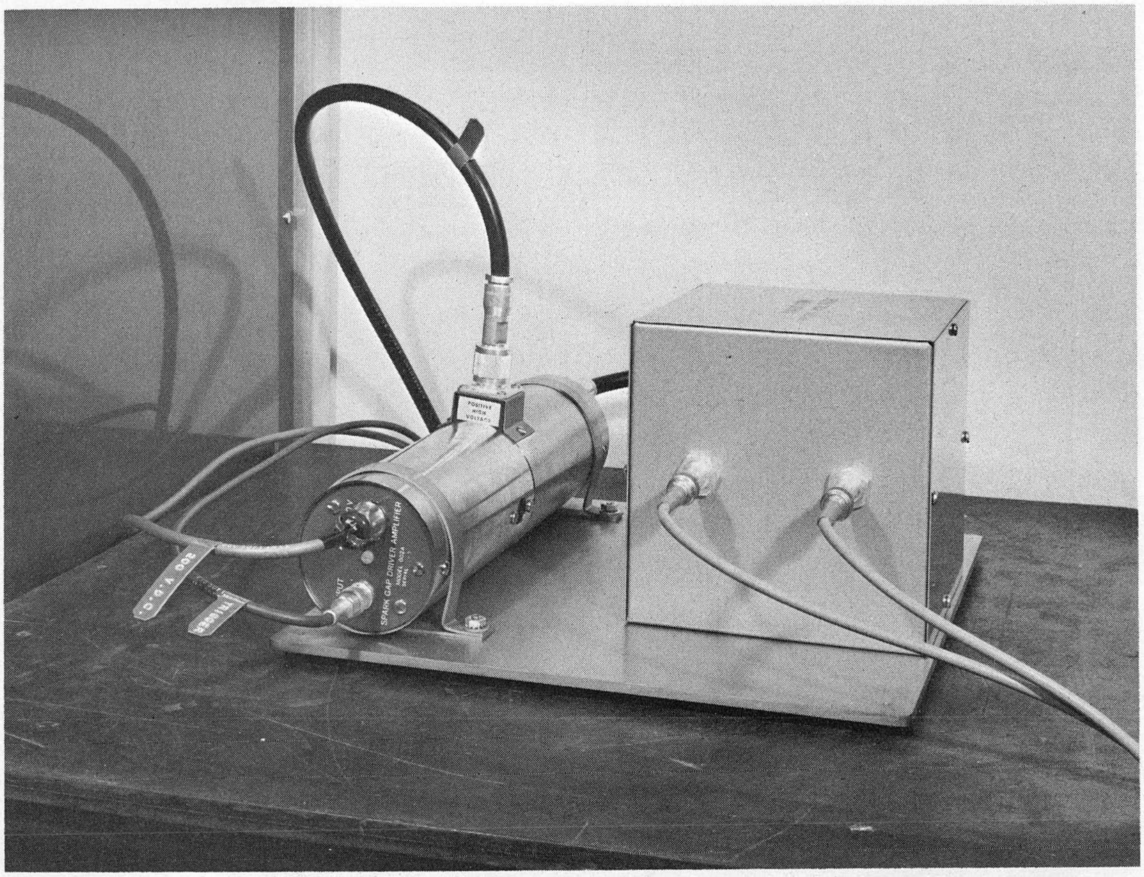
Fig. 1


POSITIVE
HIGH
VOLTAGE
SPARK GAP DRIVER AMPLIFIER
OUT
TRIGGER
300 V D.C.

ZN-5986

Fig. 2

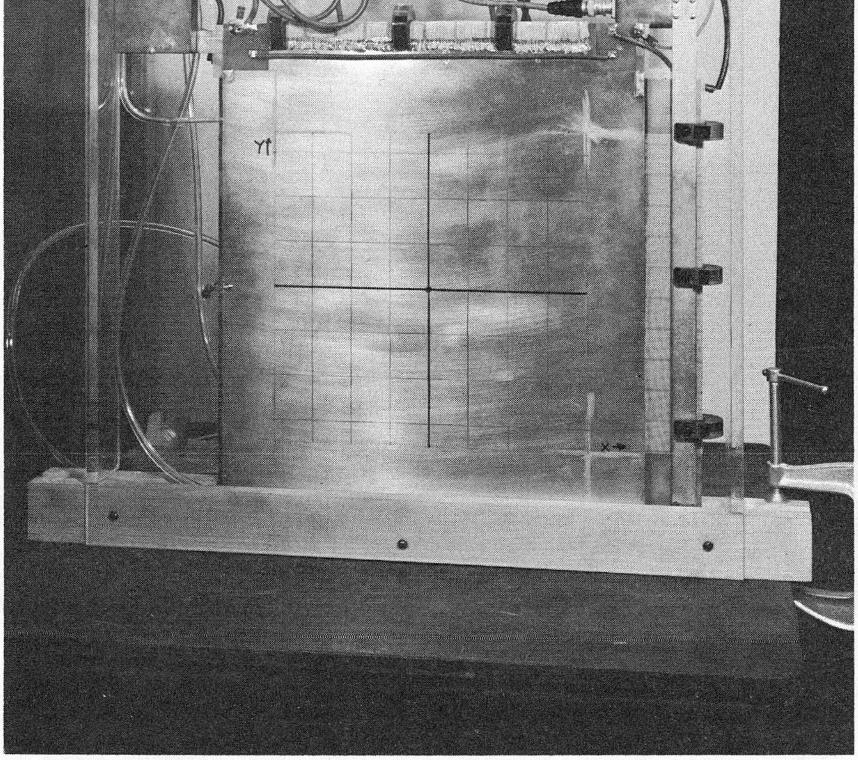


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Fig. 3

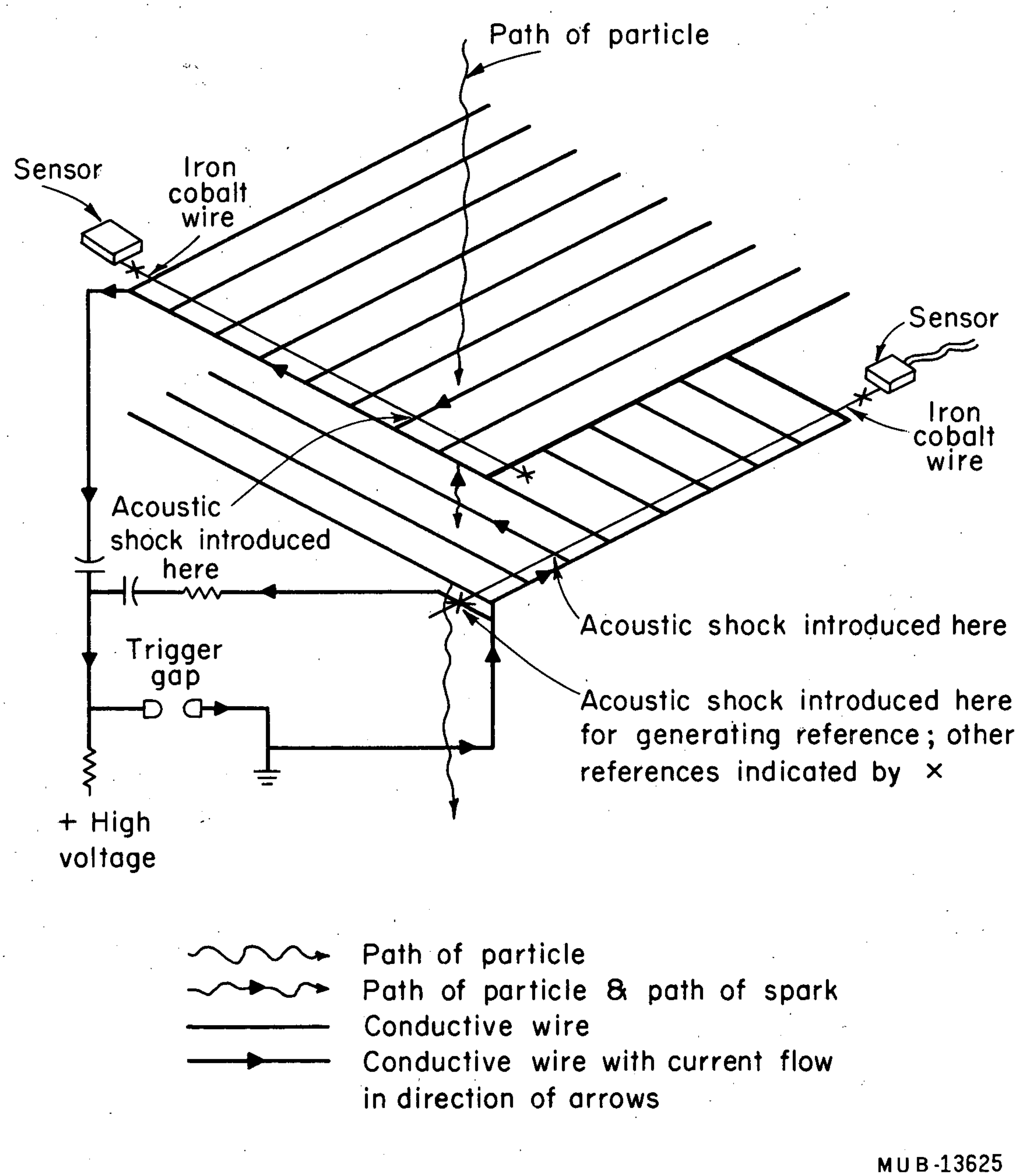
Path of particle
Sensor
Iron cobalt wire
Sensor
Iron cobalt wire
Acoustic shock introduced here
Acoustic shock introduced here
Acoustic shock introduced here for generating reference; other references indicated by ×
Trigger gap
+ High voltage
Path of particle
Path of particle & path of spark
Conductive wire
Conductive wire with current flow in direction of arrows
MUB-13625

Fig. 4

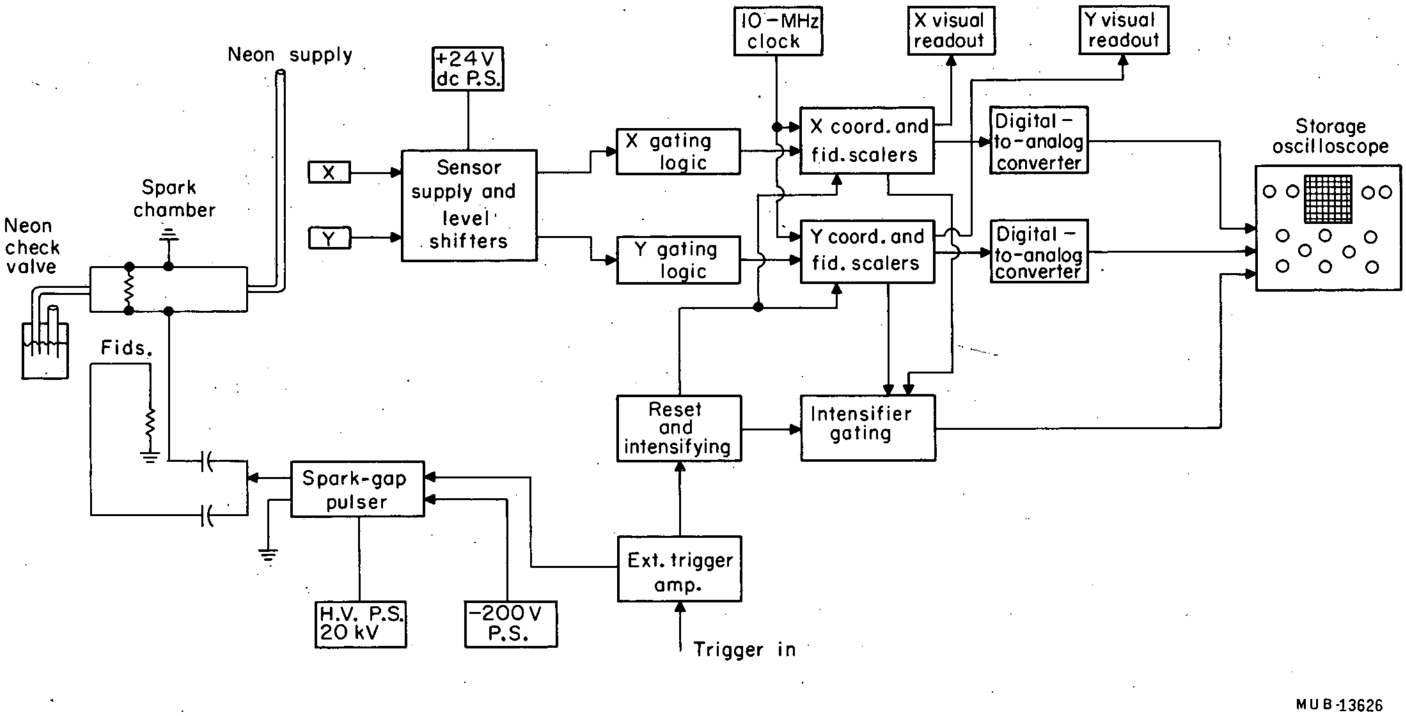
Neon supply
+24V dc P.S.
10-MHz clock
X visual readout
Y visual readout
Spark chamber
Neon check valve
X
Y
Sensor supply and level shifters
X gating logic
Y gating logic
X coord. and fid. scalers
Y coord. and fid. scalers
Digital-to-analog converter
Digital-to-analog converter
Storage oscilloscope
Fids.
Reset and intensifying
Intensifier gating
Spark-gap pulser
Ext. trigger amp.
H.V. P.S. 20 kV
-200V P.S.
Trigger in
MUB-13626

Fig. 5