SLAC-PUB-687
November 1969
(EXP)

SLAC-LRL MUON SPECTROMETER*

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1.6×10^6 photographs of sea level muons with zenith angles between 45° and 90° have been taken at SLAC in the high energy muon spectrometer whose properties are summarized below. Analysis of the data is in progress. A few hundred events with momenta in excess of 1000 GeV/c are expected. The MDM of the apparatus is of the order of 3000 GeV/c. The total "live time" of the run was 850 hours, and the solid-angle area product 945 cm^2 ster.

The spectrometer consists of six 8 ft × 4 ft optical spark chambers surrounding a 54-inch pole-face diameter magnet with a 36-inch air gap. The $\int Bdl$ of the magnet is 27 kilogauss meters. A seventh, smaller chamber is located in the magnet gap. The solid-angle area product of the detector is essentially flat for zenith angles in excess of 50°. The signals from three planes of hodoscope counters are fed to matrix coincidence circuits which allow any of 109 triple coincidence channels to trigger the apparatus. This system enables us to have a detection efficiency which is 100% for muons of infinite energy, but only 50% for 5 GeV/c muons, and zero below 2 GeV/c. The performance of the trigger system is monitored by an on-line P-D-P-8 computer, which also records the signals from a 1 Mc/sec gated clock, to give the "live" time of the experiment.

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*Work supported by the U. S. Atomic Energy Commission.

(Presented at the 11th Int. Conf. on Cosmic Ray Physics, Budapest, Hungary, September 1969.)

The spark chambers are "fanned" to point towards the camera, which is located 70 feet away along the axis of the main B_z field of the magnet. The deflection of the muon trajectory in the magnetic field is therefore seen in direct conical projection on the film. Optical distortions have been shown to be very small, by measurements of photographs of a target moving along a laser beam immediately in front of the apparatus. A total deflection of ≤ 0.2 mR was measured, across the 11 meter spread of the apparatus. This would correspond to the bend angle of a 4000 GeV/c muon. Measurements of the tracks of 12 GeV/c muons from the SLAC muon beam show that measurement reproducibility for sparks is of the order of 0.3 mm in real space. The results of these and other tests lead us to believe that the design goal of ≥ 3000 GeV/c for the MDM will be achieved.

Roughly half of the 400 rolls of film will be scanned using the SLAC "Hummingbird" flying spot digitizer. Every picture will be measured, so that complete data at all energies will be obtained for zenith angles $> 45^{\circ}$. The rest of the film is being hand-scanned at LRL for muons exhibiting small deflection angles. These events are then measured on Vanguard measuring machines. In four rolls of film so far scanned and measured in this fashion, we have found 4 events with muons of > 1000 GeV/c momentum.

Figure 1 is a photograph, taken with the room lights on, of a typical high energy event.

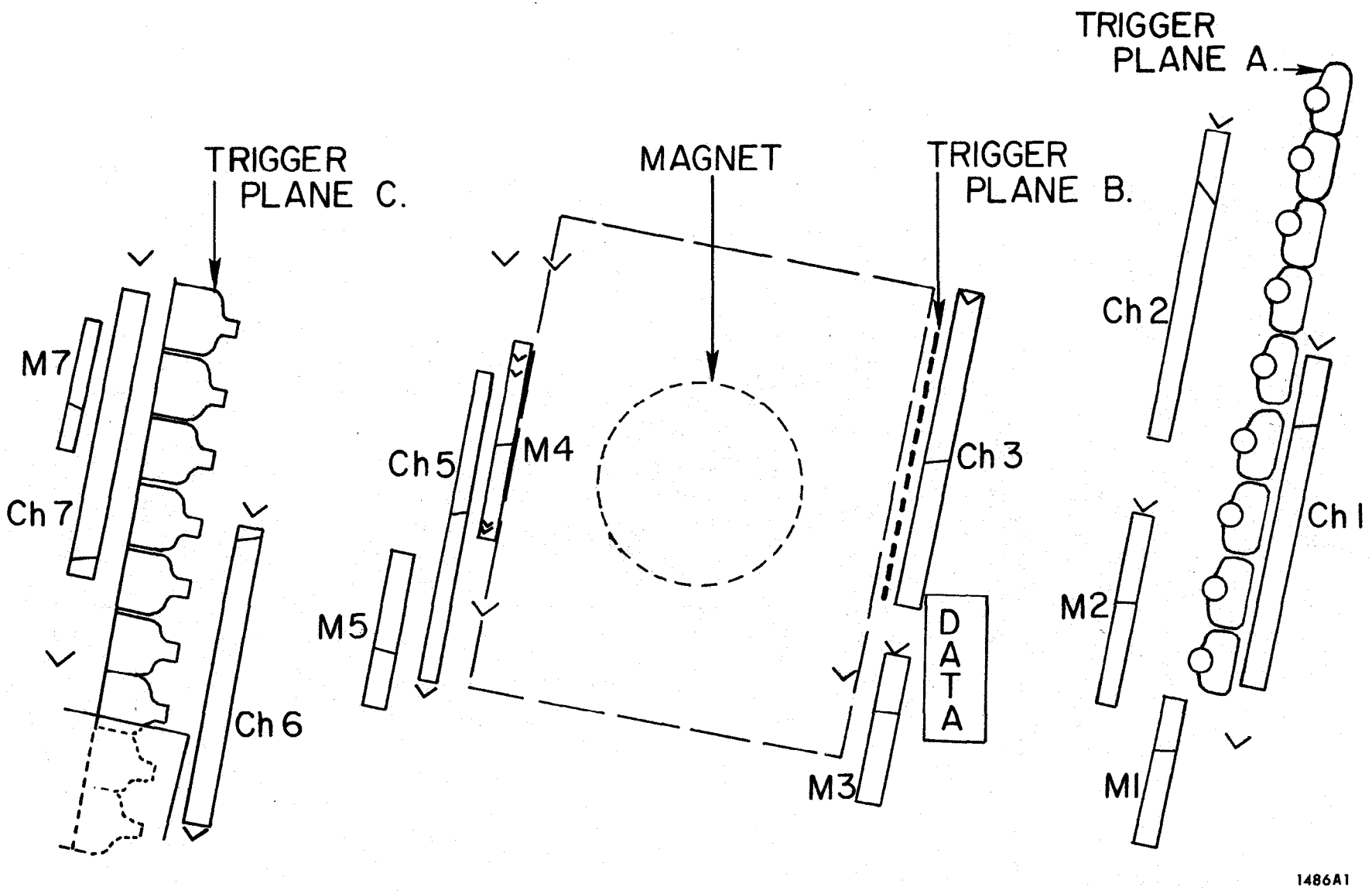

Fig. 1(a)--Overlay for photograph of apparatus in Fig. 1(b).

Ch 1, etc: spark chamber No. 1, etc.
Chamber 4 is inside the magnet, and cannot be seen directly.
M 1, etc: mirror view of chamber 1, etc.
⌄ Fiducial mark.

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Fig. 1(b)--Camera-eye view of the apparatus. The camera is tilted 11^{o} to accommodate the whole picture on one frame. The track is of a muon of roughly 200 GeV energy.