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A MULTIPARTICLE SPECTROMETER FOR VERY HIGH INTENSITY CHARGED PARTICLE BEAMS*

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This note briefly describes a spectrometer developed at SLAC to analyze multiparticle final states in the reaction[1]:

$$e + p \rightarrow e + p + n\pi \quad .$$

The central feature of this spectrometer is a "superconducting (SCT) tube"[2] which creates a field-free region in the magnet and spark chambers so that the electron beam can pass undeflected through the equipment without causing excessive background problems.

Figure 1 shows the electron beam striking a target up beam of the magnet and passing through the SCT and into a quantameter behind the

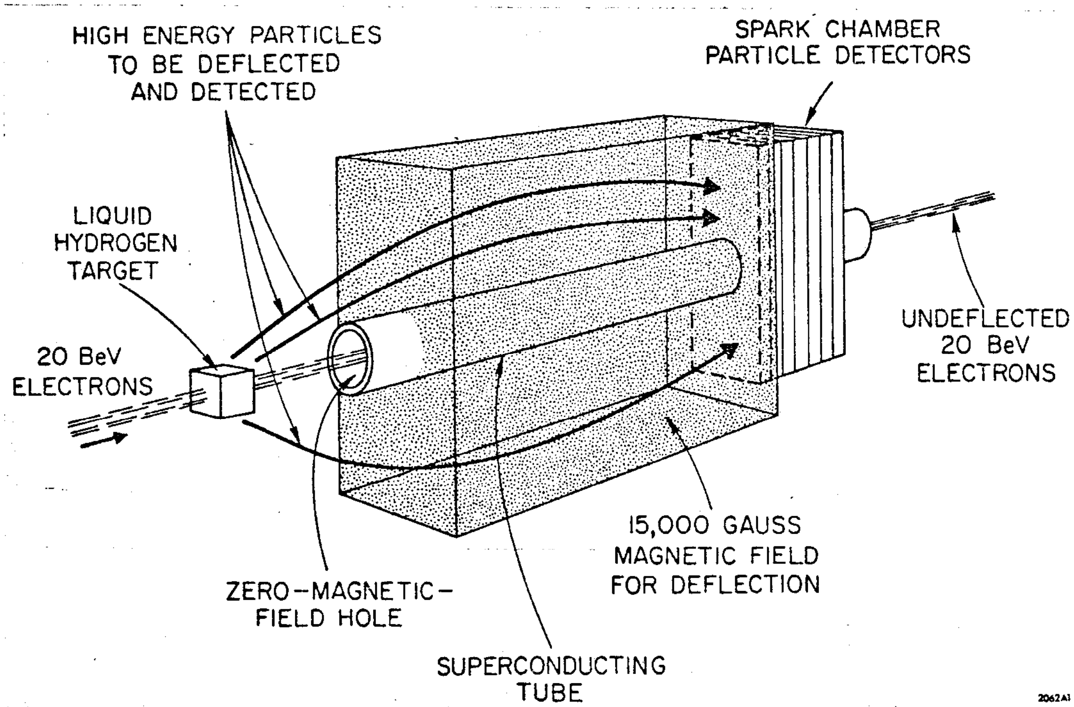

Fig. 1. Schematic layout of the spectrometer with the superconducting tube.

detectors. The particles from an inelastic collision pass outside the tube through the magnetic field and into the detectors which consist of optical spark chambers and counters. Because the beam is only 1 mm in diameter

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and the target is 4 cm long, trajectories of the scattered particles can be uniquely determined with the spark chambers down beam of the magnet.

The potential background created by the electron beam passing through the target has an angular divergence inversely proportional to the square of the beam energy. For a 20 GeV/c beam this divergence is less than 10^{-4} radians. Moreover the angular divergence of the beam is also less than 10^{-4} radians so the interior diameter of the SCT varies from 5/16" to 1" along the direction of the beam.

Figure 2 shows the kinematic acceptance of the system with a 10 kG field.

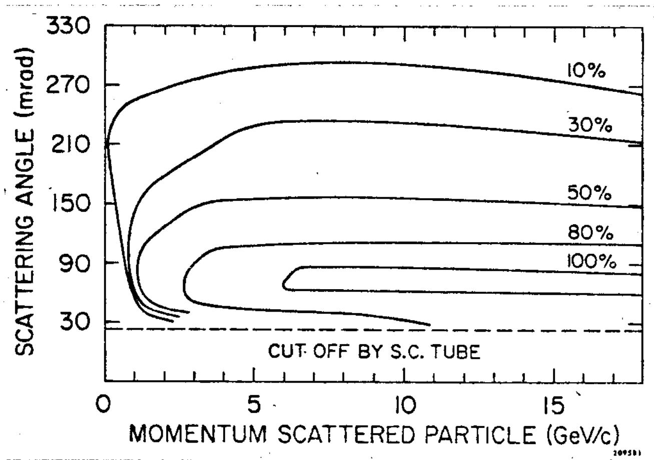

Fig. 2a. Particle detection efficiency in the P, θ plane averaged over the azimuth.

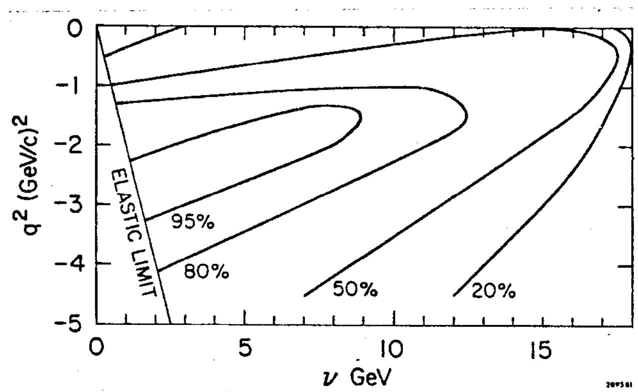

Fig. 2b. Electron detection efficiency in the q^2, ν plane.

The outside diameter of the tube including vacuum jackets and additional lead shielding was constrained to accept particles scattered at angles down to 22 milliradians. The maximum diameter of the tube and lead shielding was nine inches. The magnetic field (maximum value 15 kG) extends over a 54" poleface with a gap of 36", and the fringe field extends to 5 feet on either side. Thus the SCT is 12 feet long, and the total length of the tube is 22 feet.

This apparatus was designed for use with very intense small phase space beams, such as those produced at SLAC. We have run this system with intensities of 25,000 electrons per 1.4 microsecond pulse and have successfully taken pictures of our spark chambers with 5 clear tracks in them. Thus in principle we can analyze events with one electron and four hadrons.

REFERENCES

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2. F. Martin, S. J. St. Lorant, and W. T. Toner, "A Four Meter Long Superconducting Magnet Flux Exclusion Tube for Particle Physics Experiments," Report No. SLAC-PUB-1040, Submitted to Nuclear Instruments and Methods (April 1972).