SLAC-PUB-1122
(EXPI)
September 1972

THE SPEAR MAGNETIC DETECTOR*

R. F. Schwitters
Stanford Linear Accelerator Center
Stanford University, Stanford, California 94305

A large magnetic detector is being built for the SPEAR electron-positron storage ring facility by a group of physicists from the Stanford Linear Accelerator Center and the Lawrence Berkeley Laboratory. The detector, described in this report, is presently under construction and is scheduled for completion late in 1972 with the experimental physics program commencing early in 1973.

The major design criteria evolved from the desire to emphasize the study of hadronic final states produced by single-photon annihilation of e^+-e^- pairs and are summarized in the following requirements: (1) Large solid-angle acceptance in order to minimize systematic errors in estimating total cross sections and to insure maximum trigger efficiency; (2) A magnetic field to identify specific two-body final states, to put additional constraints on multiparticle final states, and to allow measurement of single-particle inclusive spectra; (3) Provision for particle identification so that electromagnetic final states can be separated from hadronic ones and for the separation of specific hadronic final states; (4) A selective trigger system capable of rejecting beam-gas backgrounds, cosmic rays, and elastic e^+e^- events so that the overall data rate is kept to an acceptably low level; (5) Flexibility in the apparatus to be able to exploit any important new processes encountered at the higher energies of SPEAR.

---

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

(Talk presented at the XVI International Conference on High Energy Physics, NAL, Batavia, Illinois, September 6-13, 1972)

The final design for the detector involves a large solenoidal magnet (the average magnetic field is 4 kG) containing a system of wire spark chambers and scintillation counters. The detector will be interfaced to an XDS Sigma-5 computer which will log event data on magnetic tape and will provide on-line data analysis. A schematic drawing of the detector is given in the attached figure; important design parameters are summarized in the table.

A particle emanating from the interaction region within the polar angle interval $45^{\circ} \rightarrow 135^{\circ}$, traverses in sequence: (1) The beam vacuum chamber; (2) A cylindrical multiwire proportional chamber which is used in the trigger; (3) Eight gaps of small-angle stereo, cylindrical wire spark chambers furnishing the momentum measurements; (4) A cylindrical array of scintillation counters providing the basic trigger and time-of-flight information; (5) The aluminum coil of the magnet; (6) A cylindrical array of Pb-scintillator shower counters; (7) The 20-cm-thick flux return iron; (8) Two gaps of planar wire spark chambers normally used for muon identification. Overlapping spark chambers, constructed using printed-circuit techniques, are mounted near the ends of the cylindrical spark chambers to detect particles with polar angles as small as 15°.

Unique design features of the detector include the large octagonal iron box that serves as magnetic flux return, hadron filter, and support structure and the cylindrical wire spark chambers which have a common external support structure, eliminating massive support structures within the region of momentum measurement, thus giving complete azimuthal coverage.

TABLE

DESIGN PARAMETERS FOR THE SPEAR MAGNETIC DETECTOR

Magnet   B = 4 kG   ± 1% over the region $\begin{cases} 45^\circ \leq \theta \leq 135^\circ \\ 0^\circ \leq \phi \leq 360^\circ \end{cases}$

Coil Diameter   3.2 m   Coil Length   3.56 m

Acceptance   Trigger and Particle Identification System:

$0^\circ \leq \phi \leq 360^\circ$

$45^\circ \leq \phi \leq 135^\circ$ $\frac{\Delta\Omega}{4\pi} \approx 0.70$

Charged Tracks

$0^\circ \leq \phi \leq 360^\circ$

$15^\circ \leq \theta \leq 165^\circ$ $\frac{\Delta\Omega}{4\pi} \approx 0.95$

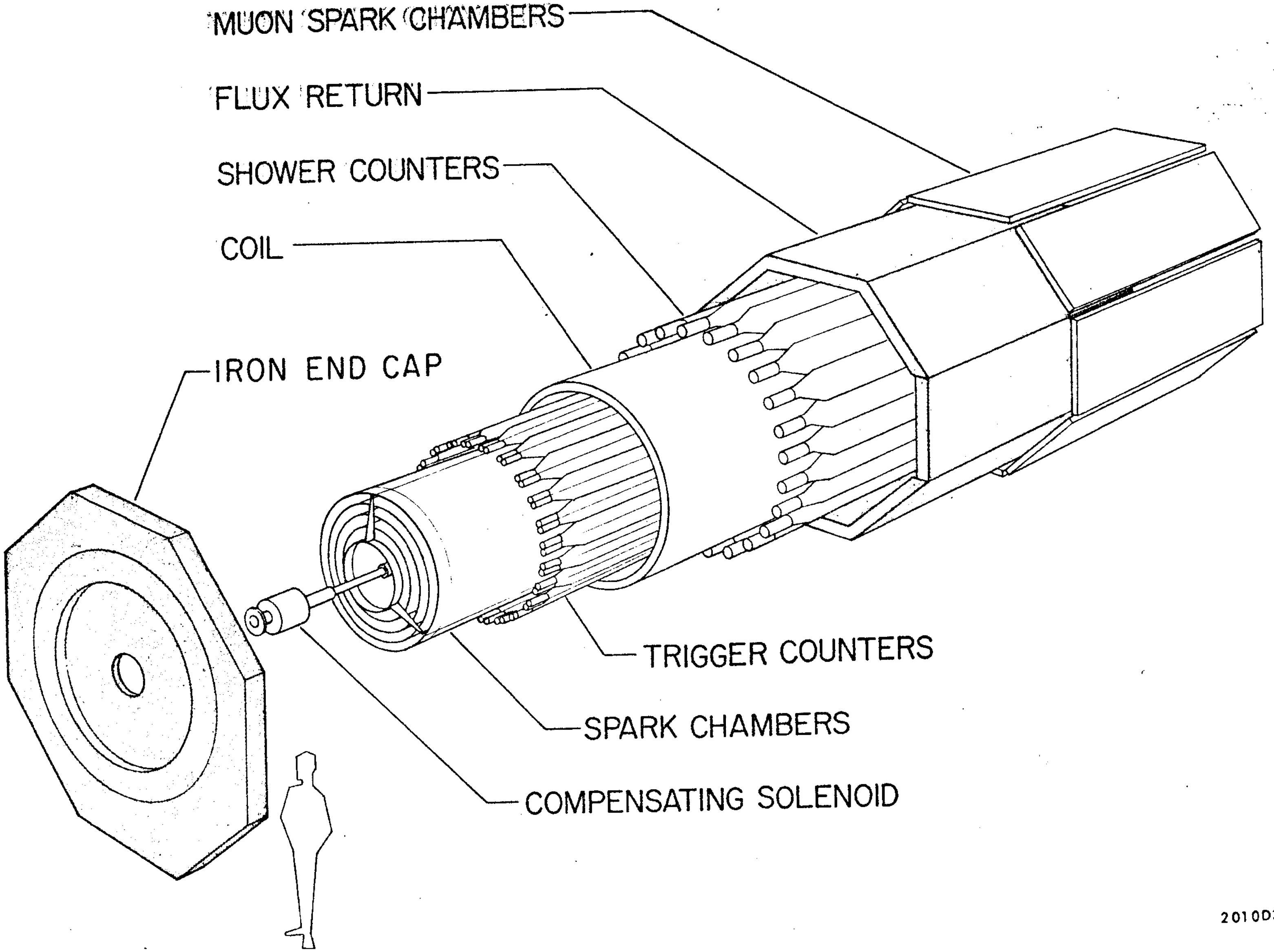
Momentum Resolution   (45° - 135°)

Single Tracks $\frac{\Delta p}{p} \approx 2\% \rightarrow 6\%$ for $p \sim 1$ GeV/c $\rightarrow 3$ GeV/c

Global Fit to Two-Body Final State $\frac{\Delta p}{p} \approx 2\%$

Particle Identification   (45° - 135°)   (3 Standard Deviation Separation)

Single Tracks (Time of Flight)	π-K	$p \lesssim 0.7$ GeV/c
	K-p	$p \lesssim 1.2$ GeV/c
Two-Body Final State (Momentum)	π-K	$p \lesssim 1.5$ GeV/c
	K-p	All momenta encountered at SPEAR


MUON SPARK CHAMBERS
FLUX RETURN
SHOWER COUNTERS
COIL
IRON END CAP
TRIGGER COUNTERS
SPARK CHAMBERS
COMPENSATING SOLENOID

2010D3