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Deep Inelastic Muon Scattering at 500 and 100 GeV*

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ABSTRACT

A description of experiment E665 at Fermilab is given. Data were taken at muon energies of 500 and 100 GeV and with targets of H_2, D_2 and Xe. Initial analysis of the first run's data has commenced. Physics topics addressed by the experiment are given.

Deep inelastic scattering has been useful for studying the structure of matter for many years. Experiment E665 at Fermilab is the latest and highest energy experiment to use charged leptons in deep inelastic scattering (DIS).

A new muon beamline at Fermilab was built for the Tevatron[1]. During the 1987-88 run 4×10^{12} protons/spill and 2×10^7 μ/spill@500 GeV average muon energy were delivered to the experiment. The beam energy was determined by precisely measuring a 3 mr bend of the beam by the last dipole magnet of the beamline. 24 1-mm PWC planes arrayed in 4 stations were used for the measurement. $\Delta p/p$ for this measurement is approximately 0.5%.

A plan view of the spectrometer used in E665 is shown in Figure 1. The beam impinged on one of three targets; 1-m liquid Hydrogen, 1-m liquid Deuterium or 1-m gaseous Xe at 14 atm. The targets were located in the gap of the first of two large superconducting dipole magnets (CVM). Surrounding the target was a streamer chamber viewed by 3 cameras through image intensifiers. Downstream of the CVM a vertex spectrometer system consisting of PWC's, threshold Čerenkov counters, TOF walls and proportional tubes were used to detect and identify particles from $\sim$ 500 MeV/c to $\sim$ 30 GeV/c.

Higher momentum particles pass through the forward spectrometer which consists of the second dipole magnet (CCM), PWC planes, drift chambers, a ring imaging Čerenkov counter and a gas-sampling electromagnetic calorimeter. The forward spectrometer measures $\Delta p/p$ of approximately 0.01% $\times$ p(GeV). Particle identification is possible up to $\sim$ 100 GeV/c.

Finally, an absorber wall of 2.8-m of iron and 4 planes of detectors separated by 3 walls of concrete were used to detect the scattered muon. Each plane consists of scintillator (finely segmented in the center) and proportional tubes.

The data taking period of the 1987-88 data run can be divided into beam energy and target types. The numbers of muons and the estimated numbers of DIS events are given in Table I.

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* Representing Argonne National Laboratory, UC San Diego, Cracow, Fermilab, Freiburg, Harvard, UIC, Maryland, MIT, MPI Munich, Washington, Wuppertal, Yale

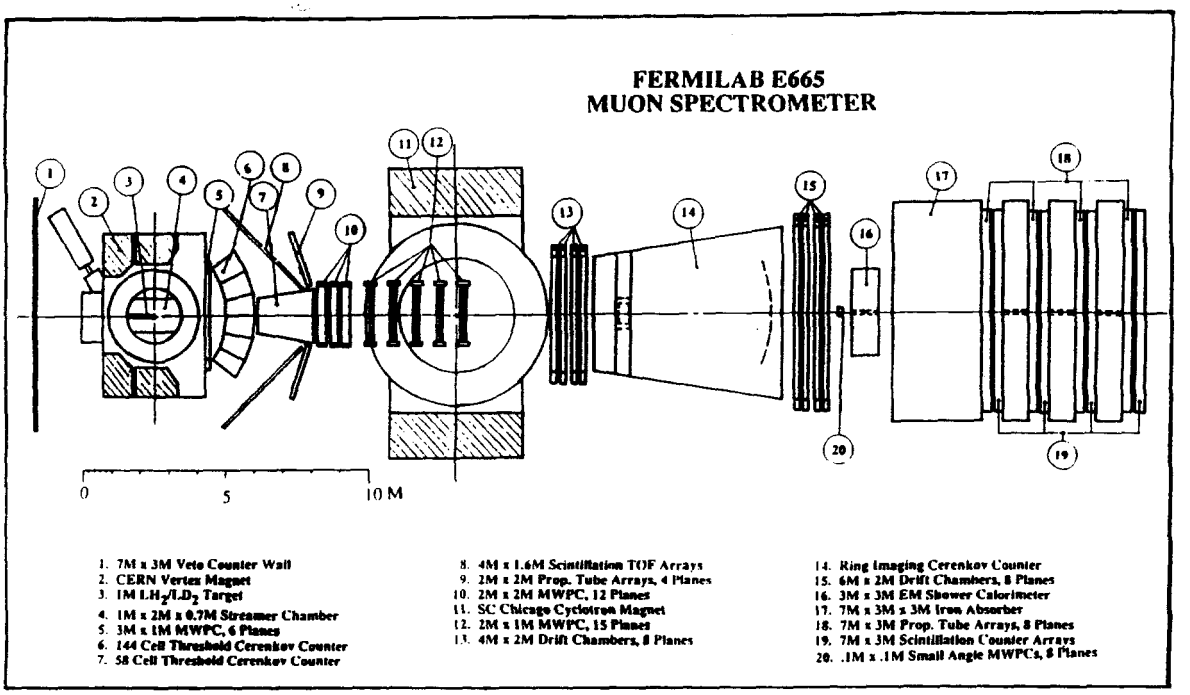

Figure 1

Table I – 1987-88 Run Statistics

Target	Energy	Muons	Est. Events	S.C. Events
D_2	500 GeV	2.5×10^{11}	1.2×10^6	73,000
H_2	500 GeV	1.5×10^{11}	5.0×10^5	19,700
Xe	500 GeV	1.5×10^{11}	4.3×10^6	54,400
D_2	100 GeV	2.6×10^{10}	1.4×10^5	5,400
Xe	100 GeV	3.5×10^{10}	9.1×10^4	15,800

The data analysis path consists of many programs written to handle the wide kinematic regions accepted by the spectrometer and for linking results from various segments of the detector. Programs are ready now to reconstruct events both from the streamer chamber measurements and from the electronic data. All of the software is being tested and full production is expected to commence about the beginning of 1989.

The physics addressable with the 1987-88 data includes a wide variety of topics. The almost 4π coverage (with streamer chamber) and good particle identification allow many studies of hadron production and fragmentation. The higher energy of this muon beam allow exploration of a range of W^2 previously unreached in DIS. The use of different targets allows studies of A-dependence. The low-x_{Bj} capabilities of the detector+trigger (x_{Bj} down to 0.001) allows new studies of F_2 and shadowing.

[1] A. Malensek and J.G. Morfín, *The Tevatron Muon Beam: A High Intensity Beam with Well Defined Polarization*, Fermilab TM1193, July, 1983.