IC/74/76
INTERNAL REPORT
(Limited distribution)

International Atomic Energy Agency

and

United Nations Educational Scientific and Cultural Organization

INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS

T O P I C A L M E E T I N G

ON THE PHYSICS OF COLLIDING BEAMS

20 - 22 June 1974

(SUMMARIES AND CONTRIBUTIONS)

MIRAMARE - TRIESTE

July 1974

FERMILAB – PANEL

F.R. Huson

NAL, Batavia, Ill., USA.

Review of Fermilab-near future

Whereas Fermilab does not have colliding beams, it does have an energy comparable to the lower energy range of the ISR (i.e. $\sqrt{s} \leq 30$ GeV). Recently the accelerator magnetic were pulsed to 485 GeV equivalent and it is hoped that in six months the accelerator will be able to accelerate 500 GeV protons.

Fermilab presently has received 320 experimental proposals. About 30 experiments have been completed. The physics covered in these experiments are as follows:

Particle searches - quarks, monopoles, leptons
Multiplicities in small bubble chamber
Diffraction, inclusives, correlations
Large transverse momentum
Neutrino cross-sections
Neutral currents
Muon scattering
Direct muon production
Elastic scattering.

The total cross-section and large transverse momentum results were presented yesterday. All results will be presented at the London Conference.

Typical operation at Fermilab includes four experimental areas:

1) Internal target using the main accelerator beam
2) Meson area - secondary beams up to 300 GeV
3) Neutrino area - neutrinos, muons and hadrons for bubble chambers
4) Proton area - secondary beams up to 500 GeV.

There are six main proton beams and fifteen secondary beams. At any given time there are about 12-15 experiments operating. The attached programme illustrates a typical week. The accelerator nominally delivers 3×10^{17} protons per week.

During the next year the energy of 500 GeV should be achieved and the number of protons delivered to experiments should increase to a few x 10^{18} per week. The following experiments will be done:

Measure neutrino cross-section 5-10%

Increase muon beam momentum 150 → 300 GeV

Study neutrino interactions (15' B.C.)

Study p, $\bar{p}$, π^+, π^-, K^+, K^-, Σ^- in 15' B.C.

Commission γ and $e^{\pm}$ beam

Study higher energy $\mu\bar{\mu}$, $e\bar{e}$ prod.

Extend σ_{tot} and σ_{el} to 500 GeV

Extend multiparticle studies

Hyperon beams.

June 11, 1974
J. R. Sanford

FERMI NATIONAL ACCELERATOR LABORATORY
Current Operations Schedule
For Week Beginning June 12, 1974

00, Wed., 6/12 to 00, Wed., 6/12

Accel. Intensity Spill & Energy: ~1×10^{13} ppp
100/0, Slow/Fast
@300 GeV

Exptl. Area Spill & Intensity — Split Ratios (%)

Area:	Slow(100)/Fast(0)	
P-East:	ε	0
P-Central:	10	0
P-West:	0	0
Meson:	15	0
Neut.N-0:	75	0
Neut.N-7:	ε	0

(See Note 1)

Activities (Approx. Order of Pri
Muon 98 (NA)
Lepton 70 (PA)
Elastic Scattering 7
Monopole 22 (MA)
Neutrino 21A (
Calorimeter Tests
K^o Regeneration 82 (
Multiplicities 178 (
n Dissociation 305 (
Photon 63A (ITA)
P-East Beam Tests (P

00, Wed., 6/12 to 00, Wed., 6/12
Accelerator Research: Switchyard Studies
(All Experimental Areas Searched & Secured)

00, Thurs., 6/13 to 00, Thurs., 6/13
Accelerator Research and Maintenance & Development

00, Thurs., 6/13 to 00, Thurs., 6/13
Accelerator Tuneup at 300 GeV for
High Energy Physics Research

17 - 1

00, Fri., 6/14 to 00, Wed., 6/19

~1×10^{13} ppp
100/0, Slow/Fast
@300 GeV

Split Ratios (%)

Area:	Slow(100)/Fast(0)	
P-East:	5	0
P-Central:	10	0
P-West:	0	0
Meson:	15	0
Neut.N-0:	70	0
Neut.N-7:	ε	0

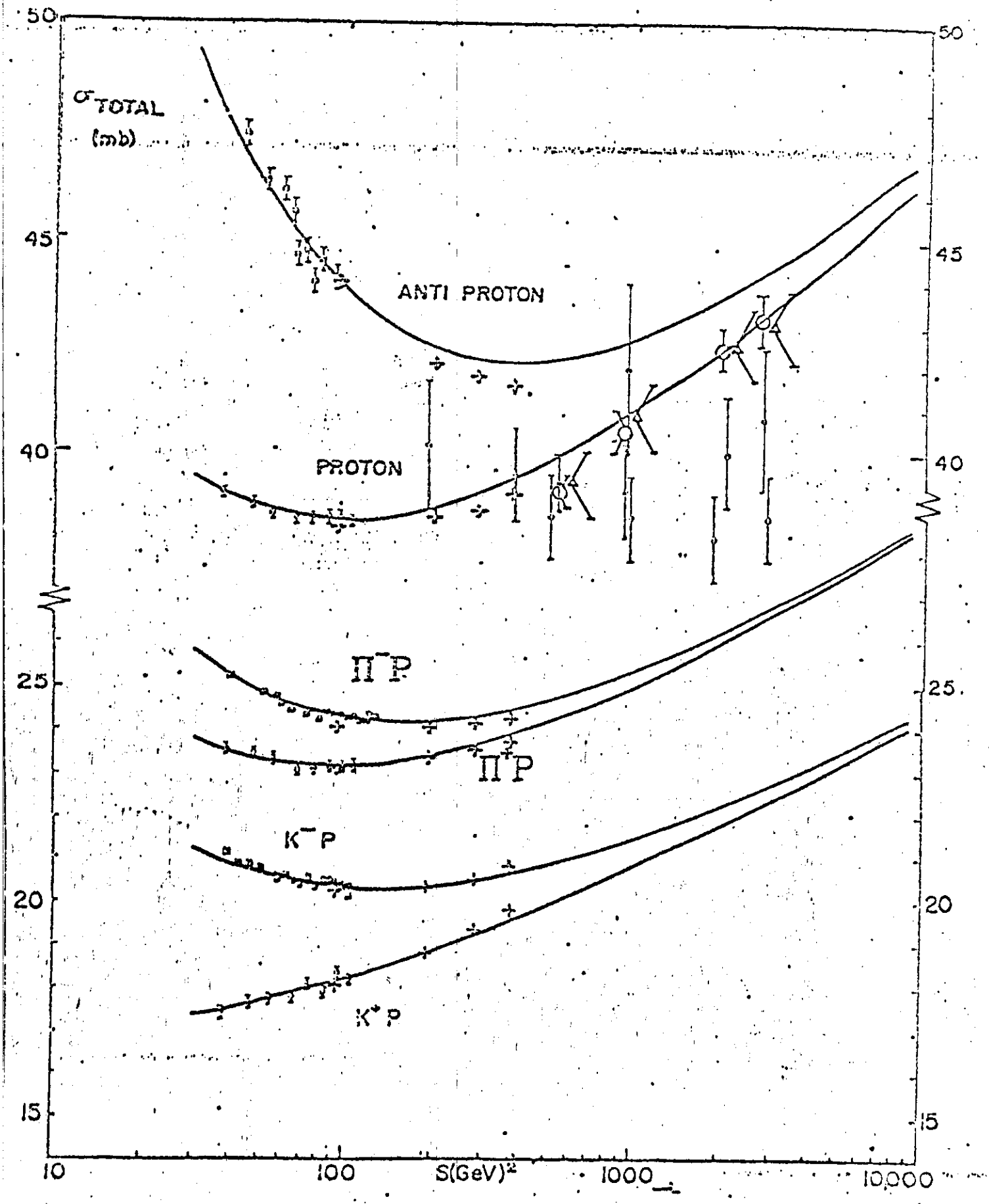
(See Note 1)

Muon 98 (NA)
Elastic Scattering 7
Lepton 70 (PA)
Monopole 22 (MA)
K^o Regeneration 82 (M
30" π^- -p & Ne @200 GeV
#163A (See Note 2)
15' B.Ch. Tests (NA) (
Photoproduction 87A (
Multiplicities 178 (M
Elastic Scattering 69A
n Dissociation 305 (M
Proton-proton 221 (ITA
Proton-deuteron 186 (I
15' E.M.I. Test 155 (N
Detector Development 2
Detector Development 2

00, Wed., 6/19 to 00, Thurs., 6/20
Accelerator Research, Maintenance & Development and
Tuneup for High Energy Physics Research

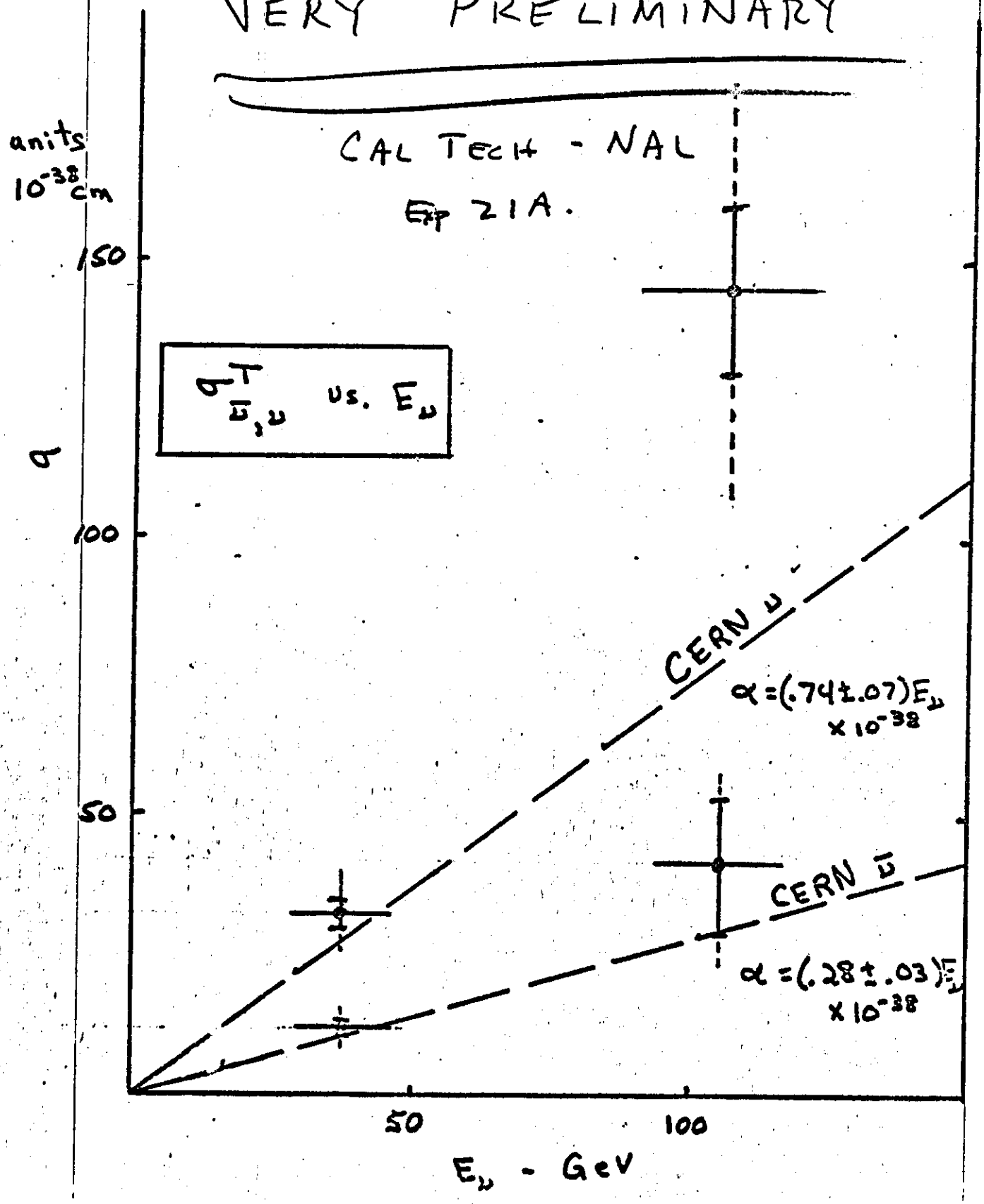
NOTE:
Nominal beam split ratios are indicated. Adjustments will be made to reflect changes in Accelerator operation and/or priorities in the HEP Research Program, if necessary.
Neutrino 21A will remain on standby for calorimeter testing as a contingency.
Hadron beam will be diverted up to one shift per day when needed for testing of the 15' bubble chamber.
A ten day period of 400 GeV running for the HEP research program is scheduled to begin on Friday, June 28.
The next General Meeting of Experimenters will be held on Monday, June 24 at 4:00 P.M. in the Central Laboratory Auditorium. Note change in regular schedule.

Footnote
The Accelerator and Experimental Areas will be off from 12:00 to 18:00 on Sunday, June 23 for the Laboratory Open House and site tours.



BNL – NAL – Rockefeller.

VERY PRELIMINARY

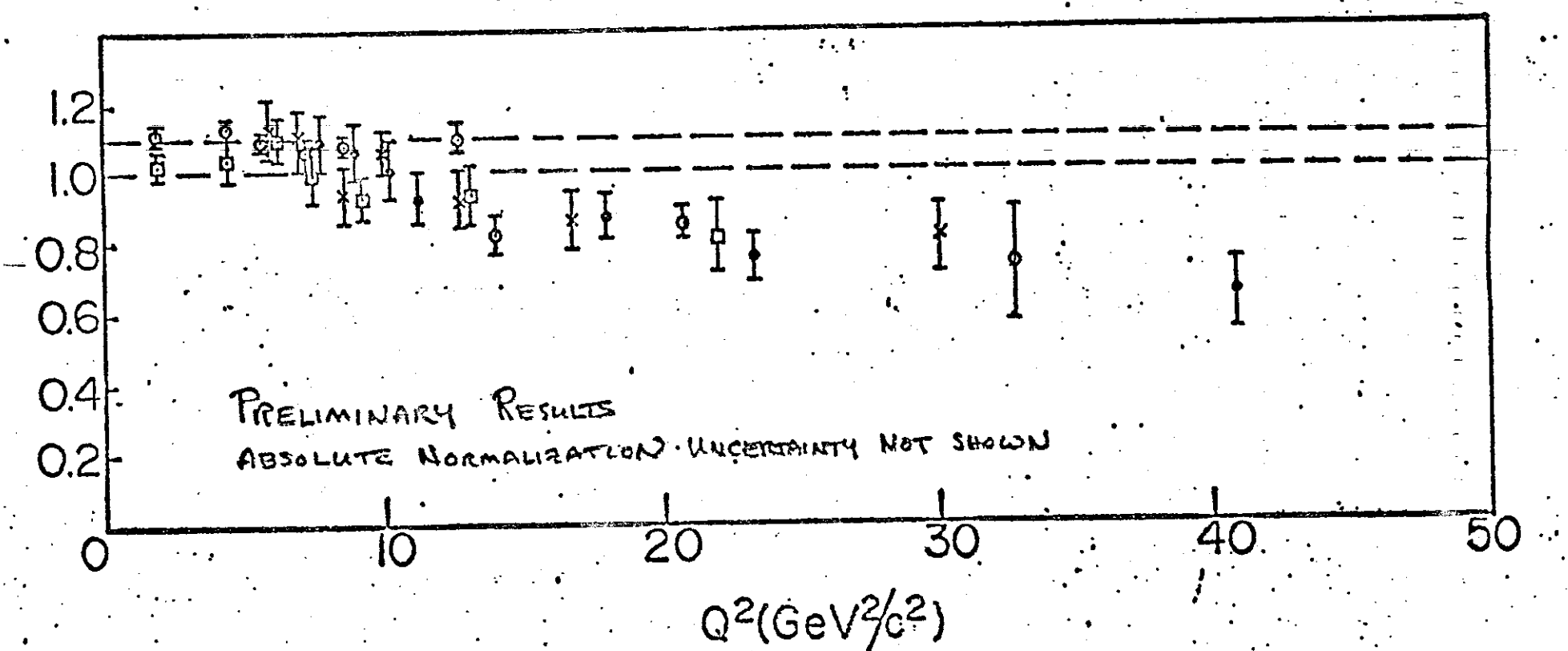


150 GeV muons

Cornell - Michigan St

DATA/PREDICTION

• 180" TARGET
× 89"
○ 0"
□ −80"



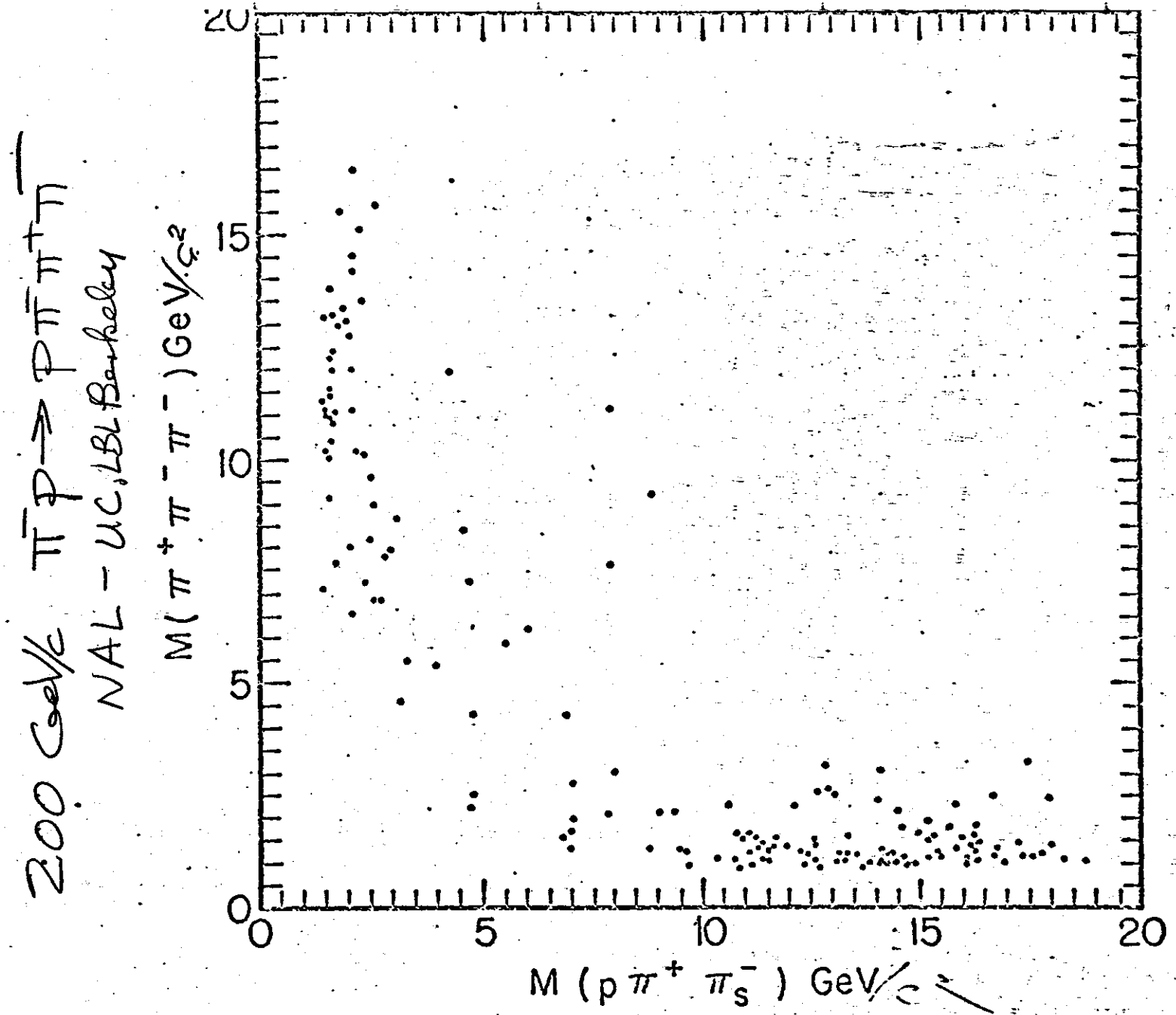
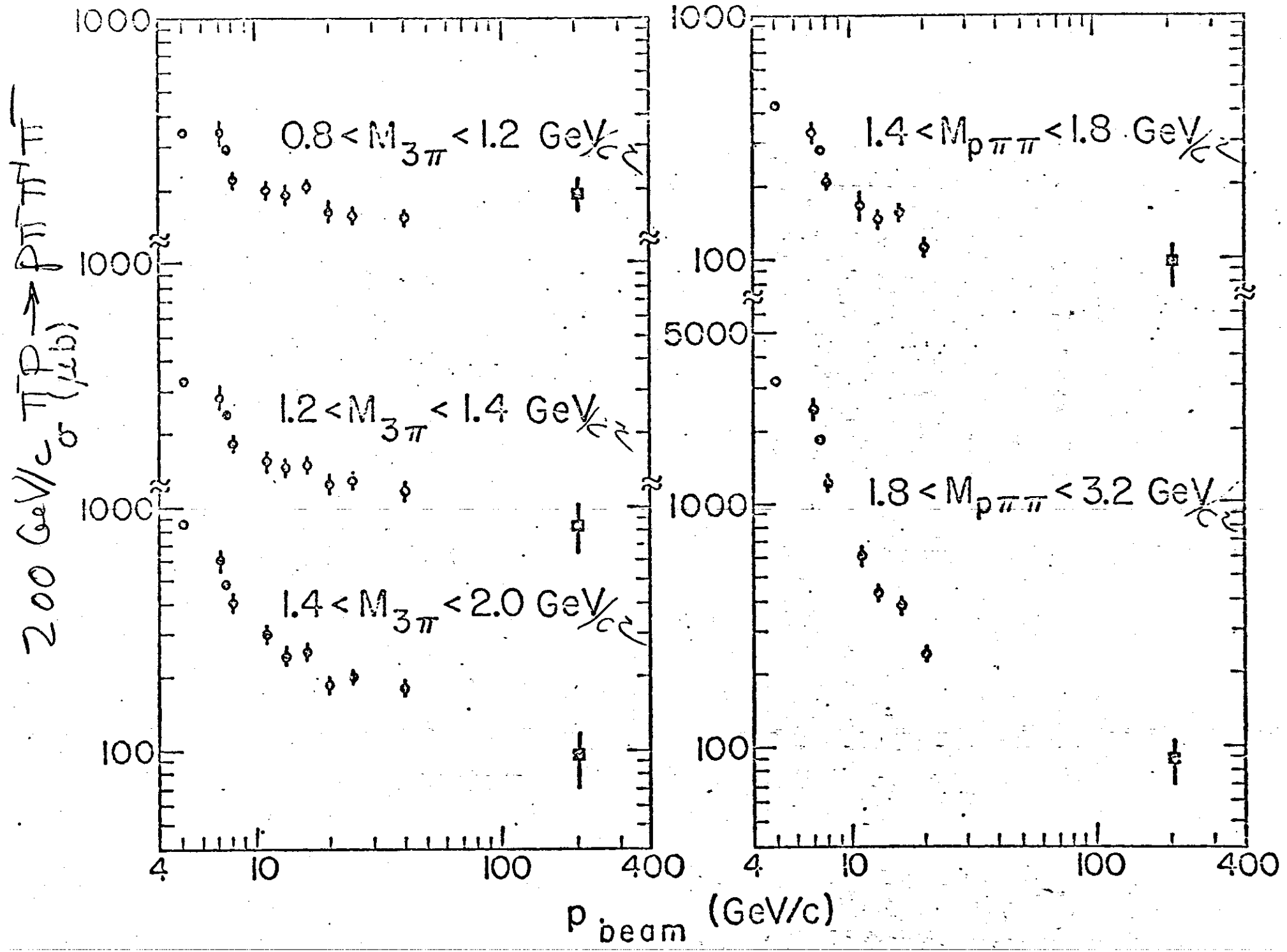


Fig. 2

XBL 745-3124


1000
1000
100
1000
100
0.8 < M3π < 1.2 GeV/c²
1.2 < M3π < 1.4 GeV/c²
1.4 < M3π < 2.0 GeV/c²
200 GeV/c σ π⁻p → pπ⁻π⁺π⁻ (μb)
4
10
100
400
1000
100
5000
1000
100
1.4 < Mpππ < 1.8 GeV/c²
1.8 < Mpππ < 3.2 GeV/c²
4
10
100
400
p beam (GeV/c)

FUTURE

In 1972, the Director of Fermilab asked a number of physicists from institutions throughout the country to act as a panel to advise him on possible goals that the Laboratory might set for the future, insofar as major projects are concerned. A Summer Study was conducted in Aspen, Colorado, last year at the suggestion of this Long Range Advisory Committee. At this study a number of alternatives were considered, among which were e-p and p-p colliding beam systems. Last December, the Long Range Advisory Committee, after considering the various possibilities, recommended that future long range planning at Fermilab center on a system of storage rings to carry out both e-p and p-p studies. The energy scale for the proton rings was proposed to be 1000 GeV and the electron ring to be 20 GeV, and they recommended that an effort begin immediately to carry out a preliminary design of such a facility. Commenting on this energy scale, they expressed the view that the largest possible step in center of mass energy be made, consistent with the realities of technology and economics.

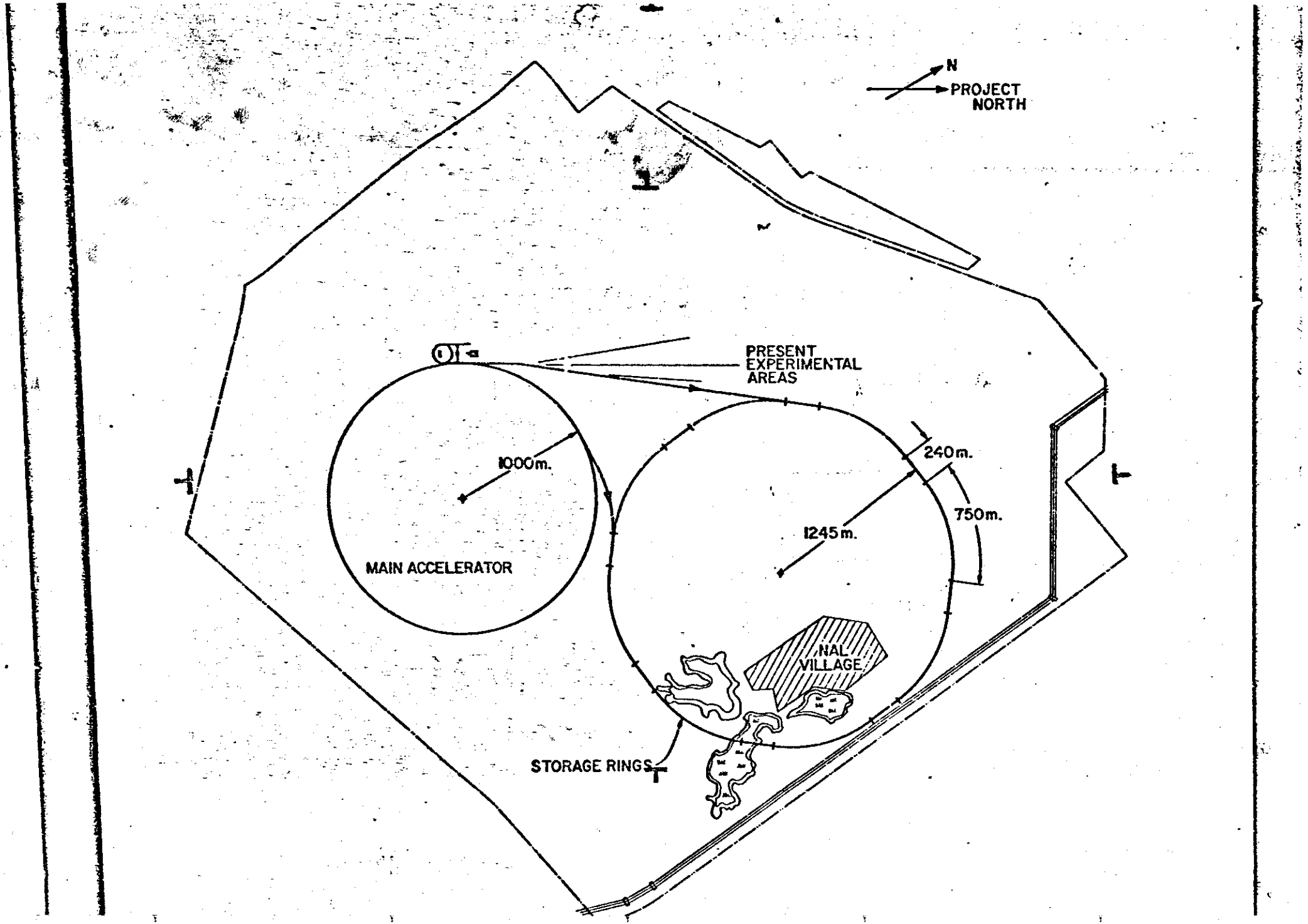
The people at the Summer Study and the members of the Advisory Committee strongly recommended that a combined e-p and p-p facility be planned in view of the complementary character of the two varieties of collisions.

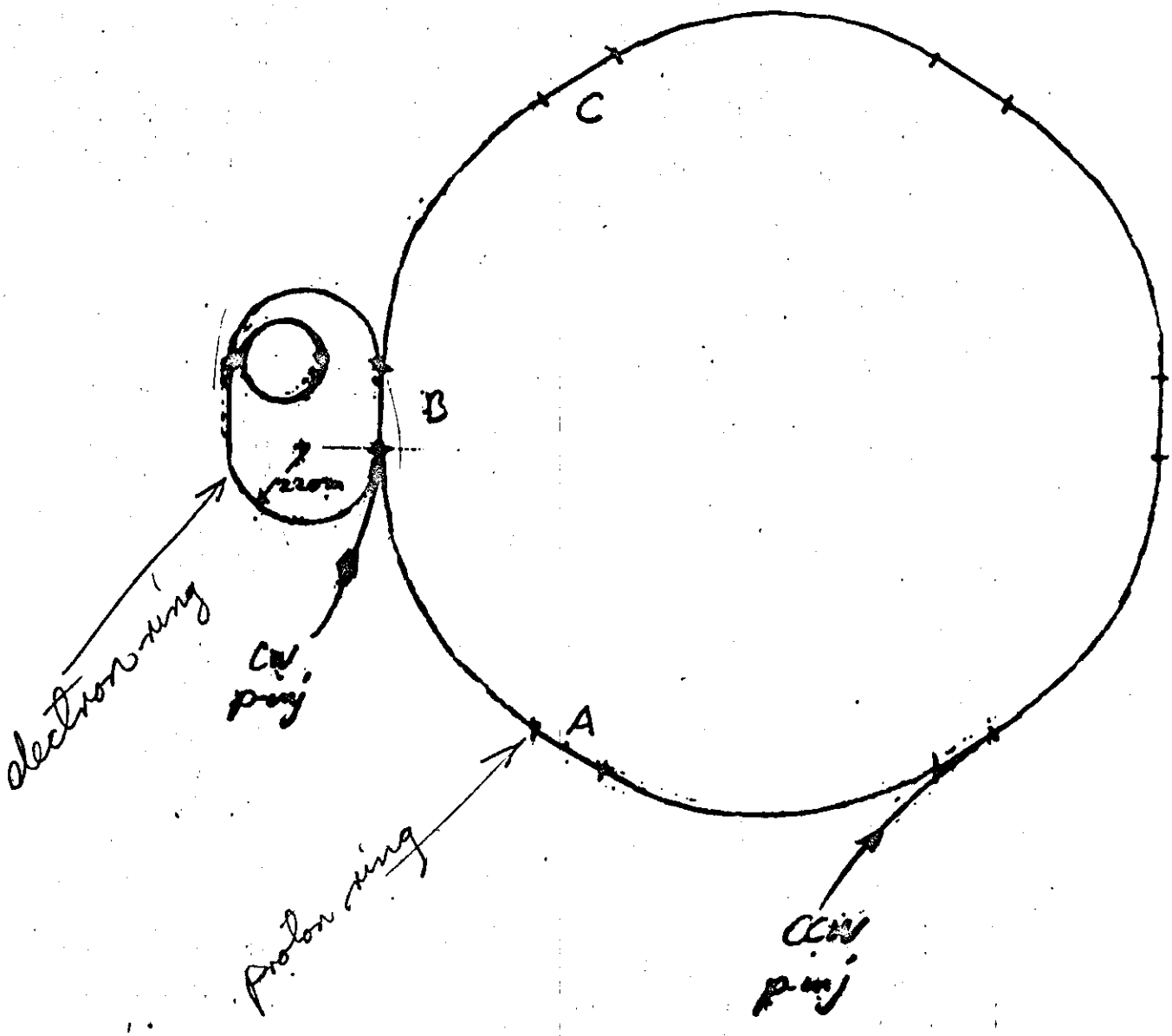
Recently a subcommittee of "The High Energy Advisory Panel" (HEPAP) to the U.S. Atomic Energy Commission met to consider future particle accelerators for high-energy physics in the U.S. The Fermilab Director felt it was the responsibility of the laboratory to submit a proposal to this committee for a future machine at Fermilab consisting of protons on protons and electrons (POPAE). A full proposal will be finalized this summer and submitted next October.

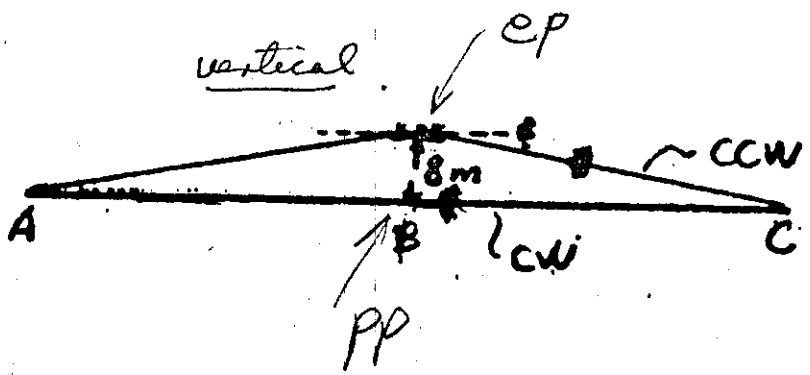
To be more conservative and to propose something that could be built immediately, 400 GeV/c proton rings have been selected. They would use 20 kG superconducting magnets with steel. Fig.1 is a possible layout of the tunnels on the Fermilab site. Note if 45 kG superconducting magnets were developed later the rings could be extended to 1000 GeV on 1000 GeV. The electron ring would have 20 GeV energy.

The number of interaction points and the electron ring have not been selected. It has been pointed out that experiments at the ISR have duration of at least two years and thus using the same ring for electrons and protons will give a large interference or the order of two years.

Another possibility would be to add a separate electron accelerator (Fig.2). This electron accelerator would add approximately 15% to the cost of the p-p machine. This facility would cost approximately 200×10^6 dollars and take four to five years to build.


N
PROJECT
NORTH
PRESENT
EXPERIMENTAL
AREAS
1000m.
240m.
750m.
1245m.
MAIN ACCELERATOR
NAL
VILLAGE
STORAGE RINGS


C
B
2 mm
A
electron ring
CW proj
proton ring
CCW proj


vertical
EP
8m
CCW
A
B
CW
C
PP