fermi
national accelerator laboratory

April 19, 1977

To: Art Greene

From: Russ Huson, Spokesman for 459/460

Subject: PARTICIPATION ON E459/460

The physicists who have committed their support to this experiment are:

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March 10, 1977

Dr. Ned Goldwasser
Fermilab

Dear Ned:

Enclosed is a short document outlining our thoughts concerning a run in a quad-triplet beam. Russ Huson had previously prepared a summary which discusses the di-muon physics, and we thought it worthwhile to mention the other aspects of the experiment.

Sincerely,

Jack Fry

Proposal # 459/460
Master
Do File
RRW
FLG
THG
PPO
RDO

I. Introduction

Discussions between the proponents of P-459 and P-460 have led to the formation of a collaboration to study neutrino physics in the 15' chamber filled with a neon-hydrogen mix with the two plane EMI utilizing a quad-triplet beam. The groups would be Berkeley, Fermilab, Hawaii, and Wisconsin.

II. Physics

The following is a brief listing of the obvious major problems that can be studied.

1.) Di-muon physics; strange particle production, hadron energy distribution, $\langle p_\mu / p_{\mu 2} \rangle$, equal sign μ's etc.

2.) Tri-lepton physics μμμ μee μμe

3.) μ-e events. Although these are similar to μμ events, there is one major difference; namely in μe events one can separate which lepton is associated with the incoming ν and hence clearly separate ν from $\bar{\nu}$ interactions. All the problems can be studied with μe or with μμ.

4.) μ + (Energetic K_s^o or $\pi^{\pm}$) This class of events is of great interest in investigating the production of heavy leptons at the leptonic vertex.

5.) High Y anomolies which arise from special classes of events such as in 4.) and μe etc.

6.) Neutral currents production at high energies. Although this includes a mixture of ν and $\bar{\nu}_\mu$ strange particle production, W distributions, etc. it would be of considerable interest.

III. Flux

A total of 5×10^{18} protons (in several packages) would yield a significantly large number of di-lepton events so that a detailed study of associated phenomena could be made. Also this experiment would yield enough tri-leptons to permit a study of associated strange particles.

In the following table is given the number of <u>observed</u> events for a proton flux of 5×10^{18} and a neon-hydrogen mix of 60%.

Table I

μ (Charg. Curr.)	80,000	
$\mu\mu(\nu_\mu)$	200	20 with $p_1 \cong p_2$
$\mu\mu(\bar{\nu}_\mu)$	20	
$\mu^- e^+(\nu_\mu)$	500	
$\mu^+ e^-(\bar{\nu}_\mu)$	50	
$\mu\mu\mu$	6	
μee	10	
ν_e	2,000	
$\bar{\nu}_e$	400	
N.C.	20,000	

IV. <u>Ne-H Mix</u>

The film from P-460 is being studied quantitatively. The problems associated with high energy and low energy electrons will be studied. A decision as to the mix will be made in a few weeks.

W. F. Fry
March 10, 1977

Russ Hanson is to be the principal Investigator

F. R. Huson
March 8, 1977

One-Page Summary

E460 - HIGH-ENERGY NEUTRINOS AND ANTINEUTRINOS IN A BUBBLE CHAMBER PLUS 2-PLANE EMI

The unique feature of this experiment is the positive muon identification made possible by the 2-plane EMI. With the addition of 14 more chambers making a total of 39 chambers (plane 1 - 3 x 6 = 18, plane 2 - 3 x 7 = 21), the acceptance for dimuon events produced by neutrinos from the quadrupole-triplet beam is about .35 for the 25-chamber configuration used in December and is expected to be about .50 for the new 39-chamber array.

The experimenters request 5×10^{18} protons so that a clean sample of about 200 dimuon events can be obtained. Obviously, a sample of greater than 200 μe events will also be obtained. Analysis of the dimuons is easier, however, both $\mu\mu$ and μe can be analyzed. An experiment of this nature is essential to understanding dilepton production by neutrinos. Since this experiment gives a clean sample of dileptons, physics effects larger than ~10% of the sample can be observed; for example, charm, new quarks, etc.

Since there would be $\gtrsim$ 5000 antineutrino events with positive muon identification in both EMI planes, the experimenters believe they can study the high y anomaly. The EMI planes are arranged to give greater acceptance for positive muons. If the high y anomaly is due to charm production, it may be possible to observe the hadronic decay modes in mass distributions.

Whereas an experiment in this apparatus with 2×10^{18} protons will produce valuable data, 5×10^{18} protons will give a more definitive experiment. For this reason, we propose collaborating with Wisconsin, since we believe one experiment of 5×10^{18} protons is much better than 2 experiments each of 2×10^{18} protons.

F. R. Huson
March 7, 1977

E460 DATA SHEET

Data with 3-view B.C. and EMI	17,000 pictures
Total protons on target	2.5×10^{17}
Dimuon acceptance of 2-plane EMI (Monte Carlo)	.35
Target 62% Neon - 38% H. (track length ≥ 60 cm)	15 tons
Expected neutrino charged currents	4000 events
Expected antinuetrino charged currents	400 events
Expected $\mu^-\mu^+$ from ν (.01 x .35 x 4000)	~ 14 events
Expected $\mu^+\mu^-$ from $\bar{\nu}$ (.01 x .35 x 400)	~ 1 event

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Candidates.	$P\mu \geqslant 4$ GeV/c	$\mu^-\mu^+$	10 events
		$\mu^-\mu^-$	0 event
		$\mu^+\mu^+$ (EMI hit prob. for 1 tr. is .008)	1 event
		Total	11 events

Background ($\mu^-\mu^+$ events with other hits in EMI, real?)	3 events
($\mu^+\mu^+$ punch-through, decay, real?)	1 event
Good events (best estimate now available)	
4-fold coincidence in EMI: $\mu^-\mu^+$ from ν	6 events
$\mu^+\mu^-$ from $\bar{\nu}$	1 event
Total	11 events

Note: The 7 good events are clean and the expected punch-through and decay background is ≲ 10% or 1 event. One event has a K^0_S, no others have observable V's.

If the second plane is "turned" off, we pick up the following additional multimuon events, which we believe are all background, i.e., punch-through.

	11	$\mu^-\mu^+$
	3	$\mu^-\mu^-$
	2	$\mu^+\mu^+$
	1	$\mu^-\mu^-\mu^-\mu^+$
	1	$\mu^-\mu^+\mu^+\mu^+$
Total	18	