Addendum to NAL PROPOSAL No. 37-A

Correspondent: E. Malamud
Main Ring
National Accelerator Lab.
Batavia, Ill. 60510

FTS/Commercial 312-231-6600 Ext. 701

MULTIBODY FINAL STATES IN pp COLLISIONS UP TO 500 GEV

Ernest Malamud, David Gordon, and Joseph Lach
National Accelerator Laboratory

Peter E. Schlein and William Slater
University of California
Los Angeles, California

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Correspondent: Ernest Malamud,
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Multibody Final States In pp Collisions Up to 500 GeV

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The authors of proposal 37 request an exposure of 100,000 photographs in the 30" hydrogen filled bubble chamber to a high energy proton beam.

Counting Rate and Proposed Exposure

The run proposed is a continuation of the engineering tests of the 30" chamber when it is first put into operation. Downstream triggering or detection is not needed.

The run is requested at a fixed proton energy as high as is possible from the accelerator and external beams at the date the chamber first becomes operational. This might, for example, be 350 GeV. Requirements on momentum and angular spread of the incident beam are not stringent since kinematic fits will not be attempted on the events. $\Delta p/p$ is expected to be about 0.1%. This is adequate for rough missing mass measurements.

A conservative estimate of flux is 3 tracks/picture. Scanning will be simultaneous with the run and the flux will be increased if it seems feasible. If higher flux can be used and the number of photographs is fixed then we will probably run at more than one proton energy.

Comparison of proposals 37 and 37A

	37A	37
Chamber	30"	15 foot
fill	hydrogen	hydrogen
incident beam	protons	protons
incident energy	fixed, e.g. 350 GeV/c	100, 200, 300, 400, 500 GeV/c
assumed fiducial length (conservative)	1 foot	10 feet
assumed flux	3/picture	3/picture
number of pictures	100,000	250,000
μb equivalent	0.3 ev/μb	7.5 ev/μb
number of events for σ_{tot} inelastic = 30 mb	10,000	225,000

Physics Justification

The physics justification detailed in proposal 37 can be summarized in the following two goals:

1. A search for new particles: unstable with mean free path 1 - 10 cm, anomolous ionization (quarks) or anomolous trajectories (monopoles). This is essentially a scanning experiment.

2. A study of the statistical properties of inelastic pp collisions. The emphasis in trying to unravel these complex events is to work with measured quantities and not attempt to kinematically separate individual channels.

Comparison of physics that can be done in proposal 37A (30") and 37 (15')

1. Search for new particles can be done, although sensitivity is reduced by ∿ 1/20 over proposal 37.

2. The symmetry of pp collisions means that particles in the forward hemisphere can be inferred by measuring particles in the backward hemisphere. Strange mesons and hyperons produced backward in the center-of-mass can probably be identified.

3. Missing mass plots can be made using the measured 4 vectors for slow moving particles in the laboratory frame and a search made for any new high mass structure in the baryon or meson spectra.

4. The average charged multiplicity, $\langle n^{\pm} \rangle$, can be measured.

5. The prong distribution can be measured in the 30" chamber proposal and compared with predictions of the various multiperipheral models. This distribution can be carried out to 12 - 14 prongs whereas it can be carried out to 16 - 18 prongs in proposal 37.

6. The 30" "bare" chamber will not be very useful for measuring the average number of π°'s and neutrons produced.

7. The reaction $pp \rightarrow \Delta^{++} + MM$ can be studied for those events where the Δ^{++} is produced with small t relative to the target proton. For a particular value of MM this O.P.E. dominated cross section will diminish as $\frac{1}{p_{lab}^2}$ and be undetectable at NAL energies except by electronics experiments. However, as p_{lab} increases, the available range of MM also increases and the cross section integrated over MM (the inclusive Δ^{++} cross section) should remain large. Several hundred "slow Δ^{++}" events are expected in proposal 37A and permit a rough measurement of σ_{π^+p} total on virtual π's at high π+p C.M. energy.

8. Finally, proposal 37A will yield useful data on diffraction dissociation processes, $pp \rightarrow p +$ anything, where the event is identified by a slow (stopping or a very heavy ionization) recoiling proton.

Analysis

The proposed plan is to split the film evenly between NAL and UCLA. Both institutions already have the capability to handle the scanning and measuring requirements of this proposal.

Conclusions

Some of the proposers of this exposure are also working on experiment 110, the large multiparticle detector system which will study high energy inelastic hadron produced interactions using electronic detection. The data from this exposure will come early enough to influence the design of experiment 110. It will be useful to know the angular distribution of particles in the forward and backward cores. It also would be useful to take a small amount of film with 80 GeV protons, the presently planned energy for the beam that experiment 110 will use.

Techniques - both experimental and theoretical (phenomenological) - for understanding the physics of high energy multiparticle final states need to be developed. So besides the obvious physics interest, an exploratory exposure of this kind can also be regarded as a means of learning how to most efficiently deal with the film requested in proposal 37 when it becomes available approximately a year later.