NAL PROPOSAL No. 240

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A Measurement of Proton-Proton Total Cross Sections at 200 and 300 GeV

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August 1973

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The most significant new result in the physics of strong interactions over the past year is the reported rise in the pp total cross section from the ISR.

Our experiment 4I on neutron total cross sections is currently collecting data successfully. Recently, during a fifteen-hour running interval we operated our beam as a low intensity diffracted proton beam. The purpose of this exercise was to explore properties of our neutron detection calorimeter system, and this run was so used. However, we found it possible to simultaneously operate our solid-angle defining "cookie" counters as proton counters and to make four short runs of proton total cross section. These we have analyzed and reported briefly in an internal report UM HE 73-22, (sent to NAL earlier). From

this brief exercise we drew several significant conclusions:

1) Our neutron beam, containing two small (1/8" and 1/16" diameter) collimators and two sweeping magnets, may be simply modified to form a clean diffracted proton beam of comfortable intensity.

2) Our defining counter system ideally spans the solid angle range suitable for separating coulomb and nuclear elastic scattering.

3) Our measurements, although brief, were statistically good and consistent from run to run. However our result was surprisingly high (42.7±0.7 mb) and calls into question the precision of a spectrum of less direct measurements from the ISR and from NAL.

We have found no flaws in this measurement, and, deprived of further data, we would draft a serious publication based upon it. However we feel compelled to request more running time to repeat the measurements, and make various cross checks. In addition we would certainly wish to measure the pp cross section at 200 GeV at least, and if possible at other energies at which proton beams could be directed to the meson area.

We therefore request several additional periods, each of two days (e.g., between a Monday and a Wednesday accelerator development period, permitting access to the meson area tunnels for the minor component movements) during the next four months. The exact number of intervals required must remain uncertain both because of the uncertain nature of the

future results and because of the interplay with other aspects of 4I and the users of the M2 beam. It appears that at least statistics are not a limitation, and the elimination of systematic uncertainties is our dominant concern.

Three final points: The only interference between this proposal and other users of the meson area is with the M2 beams; the M2 beam must be off while M3 is tuned to protons.

Some running with protons was part of the original Experiment 4 proposal for the purpose of calorimeter calibration.

The other total cross section experiment (Experiment 104) is limited by the properties of beam M1 to below 200 GeV.