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COMMENTS ON LOW-MOMENTUM HIGH-INTENSITY BEAMS AT NAL

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The experience with hadron machines at present indicates that they have more demand for beams at the low energy end of their spectrum than at the higher energy end. This phenomenon comes about for several reasons which are

1. Experimental techniques are capable of handling the low energy interactions.
2. The study of weak interaction decay processes (like $K^{\pm}$, K_S^o, K_L^o decays) is usually easier for low-momentum particles.
3. The resources which can be produced in the direct channel tend to multiply and become very difficult to untangle above 2-3 BeV/c.

With the advent of a new accelerator, it is reasonable to ask whether there will be a similar need for low energy beams (between 5-15 GeV/c). The answer to this question depends on three factors:

1. Will there continue to be more interesting physics in this region than the present accelerators can handle?
2. Are there unique properties that the new machine possesses for the study of the low energy region (like higher intensity beams)?

3. Will such beams be cheaper at NAL than at present accelerators?

In our opinion, the answer is in the affirmative to all of these questions. An affirmative answer to the first question is based more on intuition and faith than anything else and cannot be further justified. Below we give detailed answers to the other question.

<u>Low Energy Beam Intensities at NAL</u>

The production curves of Hagedorn and Ranft suggest that the following ratios of cross section for K^- and $\bar{p}$ production at 200 BeV/c and 20 BeV/c

$$\frac{\frac{d^2\sigma}{d\Omega\, dp}\ (\bar{p},\ 20\ \mathrm{BeV/c},\ \theta \sim 0°)}{\frac{d^2\sigma}{d\Omega\, dp}\ (\bar{p},\ 200\ \mathrm{BeV/c},\ \theta \sim 0°)} < 10^{-2},$$

and

$$\frac{\frac{d^2\sigma}{d\Omega\, dp}\ (K^-,\ 20\ \mathrm{BeV/c},\ \theta \sim 0°)}{\frac{d^2\sigma}{d\Omega\, dp}\ (K^-,\ 200\ \mathrm{BeV/c},\ \theta \sim 0°)} < 10^{-2},$$

for 20 BeV/c K^-'s.

For $\pi^\pm$, K^+ the ratios should be similar. While these predictions are at best qualitatively correct they do suggest that the production cross sections for low energy particles at NAL combined with the large proton flux available will make it possible to produce high intensity $\pi^\pm$, $\bar{p}$, $K^\pm$ beams with little drain on the machine.

Typical Beams

For a 10 BeV/c $\bar{p}$ beam coming from a thin target station (say 10% interaction length) at a production angle of $\sim 2°$ with a partially separated beam of solid angle $\sim 10^{-4}$ and a $\Delta p/p$ of 1% the beam intensity (with 10^{13} protons) would be $\sim 10^{6}$/pulse.

Although such a beam would be built using the improved AGS, the parasitic nature of such beams at NAL makes such beams quite attractive. Since the AGS improvement program will not be complete until 1971, it is very unlikely that there will be diminished interest in such beams only two or three years later at NAL. In addition, if several of these beams were constructed, one of the beams would be an excellent source of monochromatic $\bar{n}$'s and possibly of tagged $\bar{\Lambda}$'s. (See the report on tagged beams by Cline).

It seems quite likely that such beams might carry a large part of the early experimental program at NAL, especially if they are designed to go up to 30 BeV/c.