MODIFICATIONS AND EXPANSIONS OF NAL EXPERIMENTAL AREAS

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About one-third of the 1973 NAL Summer Study was devoted to consideration of possible modifications and expansions of the present experimental areas. This was particularly appropriate in view of the extensive experience that has been acquired with respect to machine operation and experimental facilities since the previous NAL Summer Studies.

Effort was directed toward improvement of the existing areas, with emphasis on the utilization of protons of the highest energy and intensity in the proton and neutrino-muon areas. Designs for a variety of secondary beams of high intensity in the proton area were studied. The main thrust of the Summer Study, however, developed from the possibility that, with an energy doubler, there might exist in the not-too-distant future protons in the energy region 0.5 to 1.0 TeV. This would make available, in addition to those protons, secondary beams in the region 0.5 to 0.8 TeV.

The physics that becomes accessible with a 1 TeV proton accelerator (energy doubler) is discussed in reports SS-73/198, 223 and 229, which also compare the features of such an energetic accelerator using stationary targets with those of various colliding beam machines. It seems likely that both of these parallel paths in particle physics will have to be pursued. The copious secondary beams at high energies are a unique feature, and probably the most valuable asset, of a high energy stationary target accelerator. Accordingly, redesign of the neutrino-muon area to accomodate neutrino and muon beams in that energy region was discussed at length in the Summer Study, and an ambitious long range plan for an expanded proton area was treated in detail. This expansion would emerge from the so-called "Q-stub" (see fig. 1 in SS-73/229); it would allow protons up to 1 TeV to be used directly in external beam experiments, and provide the widest range of intense, very energetic secondary beams.

In what follows we summarize briefly the various suggestions for modification and expansion that are discussed in greater detail in the separate Summer Study reports. To provide perspective and some degree of completeness, it is useful to include mention of certain experimental areas, e.g., the Internal Target and Meson areas, for which the suggested changes are either modest or nil.

1. Internal Target Area

The past accomplishments and some future possibilities of the Internal Target Area (ITA) are described in SS-73/195, which also suggests the construction of an enlarged internal target area suitable for somewhat more ambitious experiments than have heretofore been attempted there.

Recommendation ITA. It would seem useful to arrange one or more workshops to study the possibilities inherent in a modest expansion of the Internal Target Area. The main purpose would be to assess the interest of potential users. Some topics that might be reconsidered are, for example: (i) would such expansion relieve any of the pressure from experiments in the Proton Beam Area (PBA); (ii) are there experiments for the ITA that cannot equally as well be done in the PBA? (iii) how extensive an expansion is necessary, and how can it be accomplished without serious stoppage of accelerator operation?

2. Meson Area

The Meson Laboratory (ML) is discussed in SS-73/217 where it is recommended that the ML be left alone for the next few years. This appears to be the opinion held by most participants in the 1973 Summer Study.

3. Neutrino-Muon Area (NMA)

There are four reports - SS-73/220, 222, 227 and 243 - that treat the problem of independently optimizing muon and neutrino beams in the NMA, and suggest detailed solutions consistent with extending that area to an energy of 1 TeV. The salient feature is an upstream splitting of the proton beam to the NMA to provide independently controlled proton beam intensities and spill times with which to produce distinct secondary hadron sources for the muon and neutrino beams. Formation of a high intensity, high energy muon beam with a moderate halo, and delivery to the muon laboratory are discussed in SS-73/209, 215, 233 and 250. A resurvey of muon beam physics is presented in SS-73/218. Additional aspects of neutrino beams and detectors are treated in SS-73/224, 225 and 226.

Recommendation 1. NMA NAL should begin development of a plan to separate the muon and neutrino beams in the NMA in an effort to optimize both beams in energy and intensity. The suggestions and recommendations of SS-73/227 and 243 might form starting points in that development.

Recommendation 2. NMA A plan to increase neutrino flux and to extend the energy of the neutrino beams requires formulation by NAL. The preliminary studies in SS-73/220 and 222 need to be extended by more detailed calculations; feasibility studies of magnetic deflection as a means of shortening the muon shield and cost estimates are necessary.

4. Proton Area (PA)

There were two aspects to the study of the proton area: (i) the design of specialized secondary beams in the present proton laboratory (PL), and (ii) the development of a major addition to the PA, including secondary beams, for operation at 1 TeV. Under item (i) there are discussions of special pion beams in SS-73/216, 230 and 261, of an intense broadband muon beam in SS-73/215, and of a new K_L^o (K_S^o) beam in SS-73/231. These beams, in conjunction with a photon-electron beam, would provide a diversified complement of secondary beams from protons of energies up to 500 GeV. While the present PL might also utilize 1 TeV protons on a temporary basis, it would be inadequate to exploit the potential for new physics at the higher energy. A major addition to the PA (item ii), emanating from the "Q-stub" and designed to form a single integrated area with the present PL, is discussed in SS-73/229. This addition is the most far-reaching proposal considered in the 1973 Summer Study.

Recommendation PA The design of secondary beams in the present PL, and of a major expansion of that laboratory, both to form ultimately a single unit, requires extensive planning which should begin soon to avoid being forced to piecemeal solutions in the absence of a general plan.

The suggestions described here for modification and expansion of the experimental areas would, if carried out, appreciably enhance both the quality and the quantity of the physics at NAL. To realize any appreciable fraction of these suggestions will require major efforts in planning, design and construction. Funds comparable to or greater than those already expended for the present experimental areas will be necessary. The need to move in this direction, and particularly to incorporate immediate improvements in a larger plan, suggests the formation of a broadly-based working group of NAL and university physicists, concentrating primarily on long range planning and design of the NAL experimental areas. This group might contribute added continuity to the planning of experimental area modifications, and serve to focus future summer studies.