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PROGRESS REPORT ON MUON AND ELECTRON BEAM FOR NAL

M. L. Perl and R. Wilson

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Present: L. Read, C. Heusch, D. Luckey, M. L. Perl, and R. Wilson

Electron Beams

Toner (B. 9-68-31) has commented on the use of electron and photon beams, as has Wilson (B. 9-68-49). They conclude that the beam designs of Heusch (UCRL-16830, p. 156) are good and prefer that starting from a neutral beam (Heusch Fig. 9). No work has yet been done on how to fit this into the target area. Heusch and Read plan to do this.

Tagged γ-Ray Experiments

Wilson (B. 9-68-9) and Toner (B. 9-68-40 and B. 9-68-48) discuss what they consider to be the most important of these. No doubt Heusch and Luckey will comment.

The general conclusion is that following an electron beam we need a tagging magnet (12 ft long $\times$ 2 ft $\times$ 3 ft) and a general-purpose spectrometer magnet 10 ft $\times$ 4 ft $\times$ 2 ft for examining ρ^o and ϕ^o in a wire spark chamber spectrometer. A narrow, long area is required.

Muon Beam

A muon beam has been designed by Yamanouchi (B. 2-68-38) with the following properties:

8×10^7	μ^+	per 10^{13}	protons at 100 GeV
1.5×10^7	μ^-	per 10^{13}	protons at 100 GeV
2×10^8	μ^+	per 10^{13}	protons at 50 GeV
1×10^8	μ^-	per 10^{13}	protons at 50 GeV

The momentum bite is ± 5%. This beam is smaller, both in intensity and size, than that of Toohig (UCID-10180, 1964-5). Even so, there are problems in using this intensity. These arise because we often wish to put counters or wire chambers in the beam to measure energy and direction. Toner (B. 2-68-4) wrote a note about this. Perl (B. 2-68-47) has looked in detail at some muon experiments using a low intensity muon beam (< 10^6 μ/s). Tannenbaum (B. 2-68-32) has written about experiments on μ tridents and Lai (B. 2-68-28) about searches for various speculative processes. Both can use low-intensity beams. Earlier memos by Kirk and Blanpied discuss $\mu^{\pm}e$ scattering with a low-intensity beam. Wilson (B. 9-68-9) discussed some experiments which need 10^8 μ/sec. These are not designed; someone should design an experiment on μp elastic scatterin Yamanouchi and Lederman are believed to be interested).

Open Beam Design Questions

There remains to be studied the important question of integrating the μ beam with the rest of NAL. If the Yamanouchi beam is easy, it could be "tuned down" for Perl and Tannenbaum. On the other hand, the beams required by the estimates of Tannenbaum and Perl range from 10^7 to 5×10^5 per pulse. Tannenbaum, Toner, and Perl all stress the difficulty of exposing spark chambers to the high end of this flux range. If the flux per pulse is above 10^6, there will be need for a well-collimated beam with a small halo. Also good momentum definition may be needed and also small phase space. Some short discussions with Yamanouchi indicate that for an elastic experiment to investigate the Rosenbluth formula the maximum flux will be less than 10^7 and probably near 10^6 per pulse. The only experiment (which has not been discussed here) which could use more flux is one in which one tries to maximum q^2 elastic scattering. But a feasible design has not yet been attempted.

Therefore, the direction of further muon beam design would appear to be twofold: low intensity and high intensity. For low intensity:

1. The muon flux might be reduced by a factor of 10 to 100.
2. This reduction might be used to do some of the following:
    a. Reduce the production target area heating and radiation problems
    b. Reduce shielding costs
    c. Make a better collimated beam
    d. Make a muon beam with a smaller $\Delta p/p$
    e. Make the experiment fit in the initial NAL plans

There remains the high-intensity μ beam. Is this part of the neutrino facility or does it follow a high-intensity pion beam (designed for πp elastic scattering at high t)? One important experiment omitted by Perl and Wilson and stressed by Drell is a study, even if it has to be at low energy and angular resolution, of large t inelastic μp scattering at high virtual photon energy. Someone should roughly design this and see the implications for the beam. Read will follow some of these.