SOME CONSIDERATIONS ON THE DESIGN OF A MINIMAL NAL TARGET STATION, BASED ON EXPERIENCE AT SLAC

Martin L. Perl
Stanford Linear Accelerator Center

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The most inexpensive single target station for NAL would be one or more target positions, sufficiently close together to use a single narrow muon shield; these target positions being illuminated by the external beam with only small deflections, from target to target. Of course, several beams could come from each target. The purpose of this note is to argue against such a design even at machine turn on. For the arguments, I draw on experience at SLAC where one of the target areas (End Station B) by itself is just that design. Figure 1 is a schematic of the SLAC target areas.

The End Station B target area consists of three target points about 1 meter apart at the end of the external electron beam. At each of these points, the target can be of any type or a port can be opened to allow the external beam to go out into the experimental area. A switching magnet upstream of the three targets allows the electron beam to be directed to any target. At first this magnet was fixed field but now pulse-to-pulse switching can be done. At present the three target points are used for a neutral kaon beam, a muon beam and as an exit port for a proton beam.

Now, in the first two years of accelerator operation, there are three problems which must be expected:

1. A great deal of work must be done on the parts of the beam transport systems near the targets or on the targets themselves. Some reasons for this work are experimental design errors, failures of new instrumentation like monitors and interlocks, damage to apparatus from high power, surveying errors, and the need to periodically check that area. Also, frequent front end beam changes may be expected due to the number of short experiments which occur in the early period of accelerator operation.

2. Experiments themselves do not run smoothly because of the newness of the equipment or the newness of the experimental designs. This means that frequently experiments which are scheduled to use accelerator time cannot use it.

3. The accelerator does not run smoothly. The result of 2 and 3 is that unless three or four experiments are running or ready to run, there are wasteful periods when the accelerator can run, but none of the available experiments can run.

At SLAC there are two other target areas (A and C) which are far removed from B. Then when Problem 1 exists in B (work on the front end of any beam from B shuts down all beams from B). A and C can still be used. If SLAC had only target area B, we would have had a great deal of trouble from Problems 1, 2 and 3.

It would therefore seem useful to set the following conditions on an NAL target station design:

1. There should be two target positions which are sufficiently well separated to allow adequate between target shielding at the targets. Adequate means that people can work at one while the other is used.

2. At least two beams from each target should go to running experiments.

3. One of the target positions should not require any technology in advance of that now used at the AGS, ZGS or SLAC. This condition is introduced in order to prevent a further decrease in the overlap time of accelerator on time and experiments on time.

To look at condition 1 in more detail, I will use the estimate of 1. Maschke that the overhead transverse shield at a target should be 20 feet of heavy concrete or 12 feet of iron. Then to fit condition 1 we need 20 feet of concrete or 12 feet of iron between the two target points. Of course, another problem is that the inside of the walls of the shielding near a target may become too radioactive to permit immediate entry. Also the target itself and closely magnets may be radioactive. New technological ideas, such as the "railroad car" idea of A. Maschke's, can solve this problem, but to do so at both target positions would violate condition 3.

Therefore, I am led to a minimum design such as shown in Fig. 2. The two target positions are not adjacent, because if they were, a much larger external beam deflection would be required. The upstream target position 1 L (L for low intensity) would be limited to an average power equal to the maximum power used at the AGS now. Using 3×10^{11} protons/sec for the AGS this leads to 4×10^{10} protons/sec for NAL or about 1/100 of the maximum beam. Position 1 L meets condition 3. In addition, when 1 L is being used people can work at 1 H because the background from 1 L will be small. 1 H is the maximum intensity target position and will require new technology.

From 1 L and 1 H, three or more beams will diverge. There is an additional advantage in the spatial and angular separation of 1 L and 1 H; the background from 1 H will not be as bothersome at the larger angle beams from 1 L.

1 L and 1 H can either be illuminated on alternate pulses, or a pulsed magnet used to split the pulse in time. The use of a septum magnet to feed both targets simultaneously seems difficult because of the 100:1 intensity split.

Of course, this design is just a very minimal version of the three target station design of the NAL proposal. With more money, one can proceed toward that goal. This design is a minimum one and I see no way to eliminate the need for two muon shields. The double cost may easily be made up in money saved by overcoming the simultaneous occurrence of Problems 1 and 2.

SLAC Target Area System

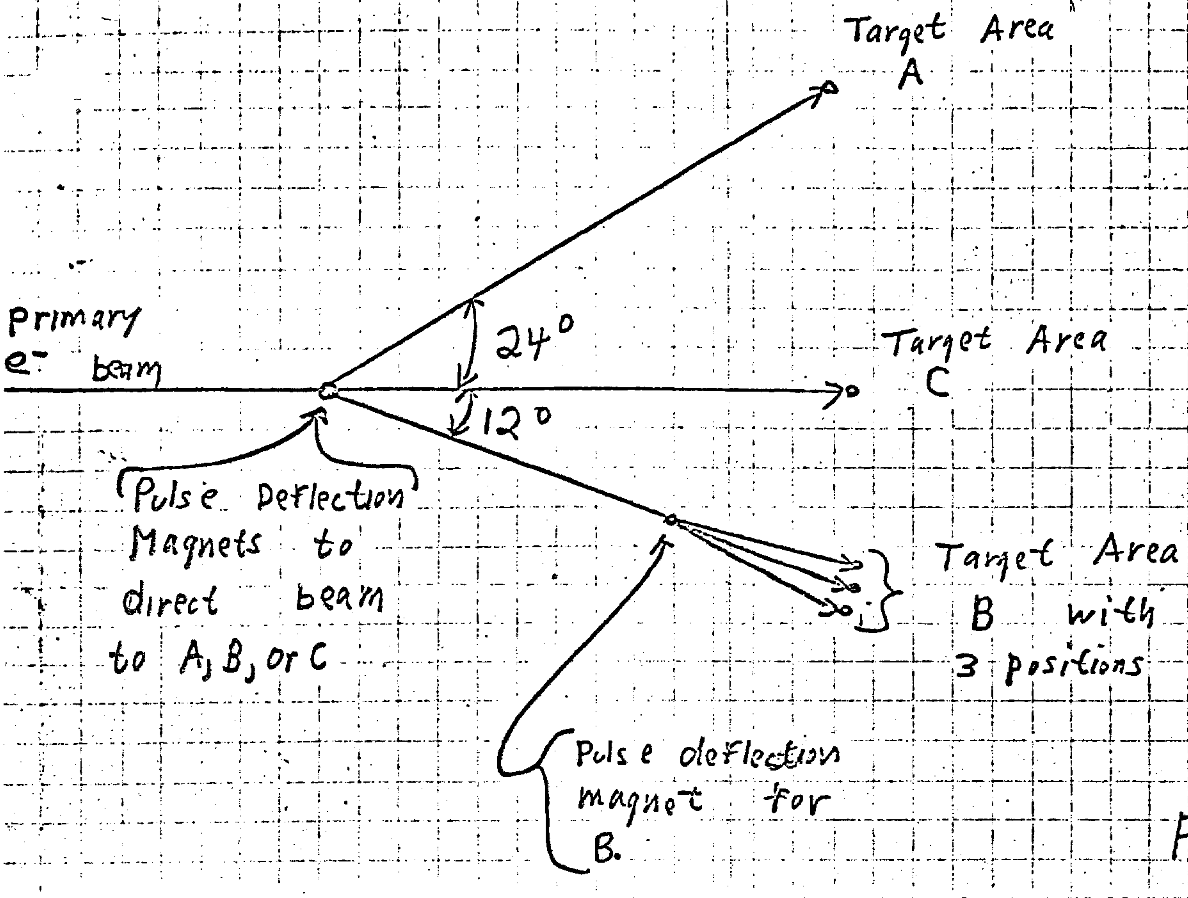

Fig. 1

Schematic Minimal NAL Target Station.

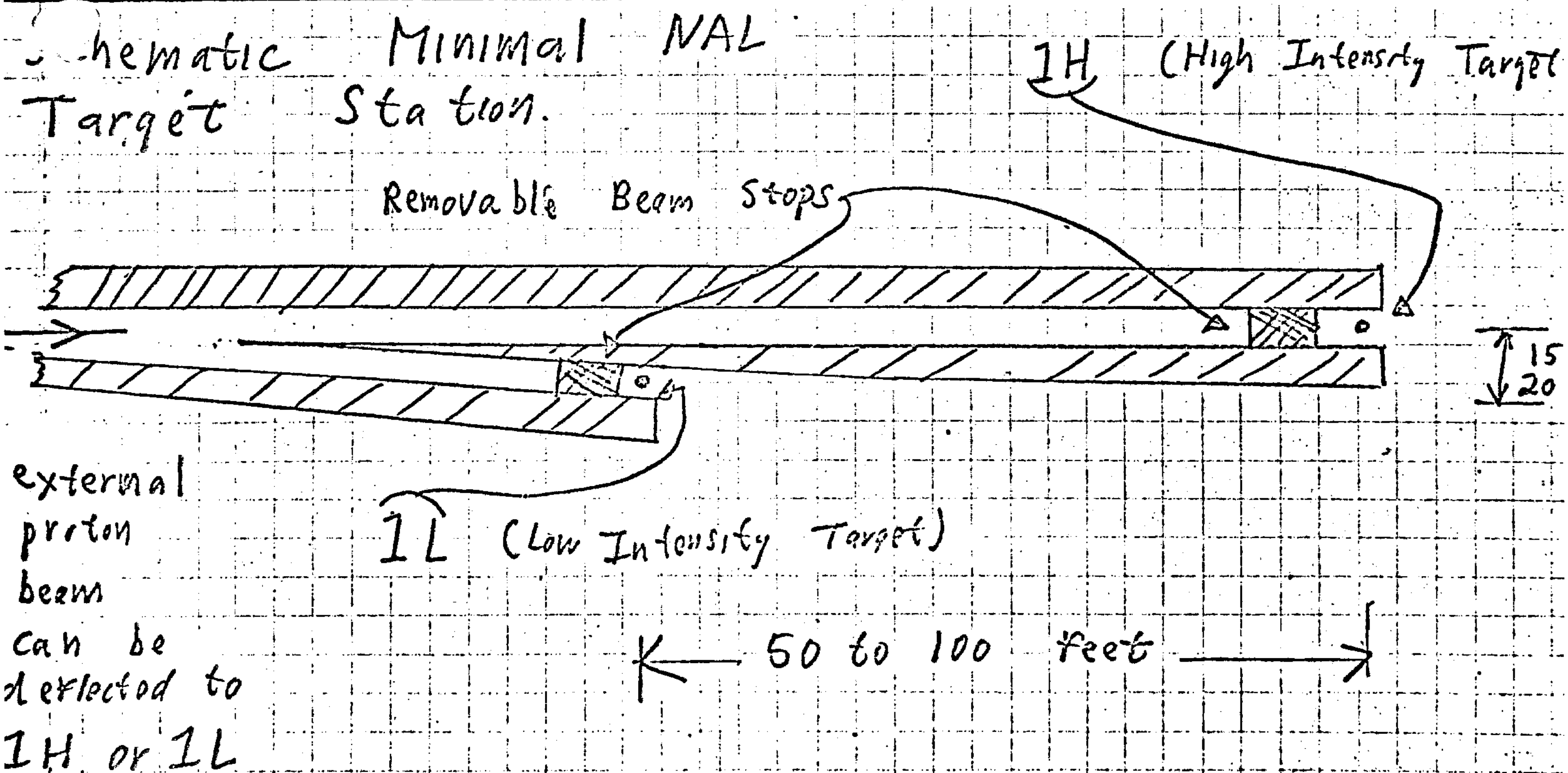

Fig 2