EXPERIMENTAL AREA C

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In contrast to A and B the thin target and general purpose areas, target station C is designed for special purpose beams and is sufficiently different from A and B to serve as a model for cost estimates, etc. The main characteristics of the area are

a) 0° production angle; high intensity secondary beams

b) long dispersing magnet downstream from the target producing a muon shielding problem

c) long emergent beam lines (~4000 ft.)

Beams

The position of C with respect to the main ring and other target stations is shown on the master plan (Fig. 1). The following beams have been indicated:

C-1: 50-150 GeV/c RF separated beam designed by Lach (Y1-223, UCRL-16830) with branches for a bubble chamber and a counter experiment. The beam has been designed to separate 100 GeV/c kaons but can separate antiprotons at 140 GeV/c

C-2: Narrow band neutrino beam-Toohig (Y1-409, UCRL-16830) ν or $\bar{\nu}$ can be selected and a branch for a muon experiment is shown. The siting of the bubble chamber is such that it can accept particles from the channel, the long RF beam and also from the short RF beam (15-50 GeV/c) from target station B.

C-3: 50-175 GeV/c good momentum resolution, unseparated beam for diffraction scattering experiments (Manning-G1-253, CERN/ECFA 67/16)

All three beams could, in principle, operate simultaneously, the only limitations being that a) the momenta in C1 and C3 have to be equal and opposite and b) the neutrino target would be at a lower level than the other target with the EPB split and bent down to the target.

Shielding Requirements

No calculations are available yet from Kuhlmann and Wuster (KW) or Keefe on the size of the muon shield in the vicinity of a dispersive magnetic field. I have assumed that "the amount of shielding required in a given direction Θp coming from the dispersing magnet is given by the KW curves (G2-343, CERN/ECFA 67/16) for a proton beam of the same momentum P as the muons in the direction Θp"

The KW calculations are based on a) 10^{12} primary interactions per second and b) a differential momentum spectrum of muons of decreasing intensity extending up to full primary momentum. In the present situation we have in a given direction a mono-energetic flux of muons some orders of magnitude less than 10^{12}. The present assumption is, clearly very crude, the only justifications are that there is no other guess and it is, at least, fairly accurate at $\Theta p = 0^{\circ}$. The shielding requirements should be revised as soon as reliable calculations are available.

The following sizes of muon shields resulted

a) iron--5 m thick and 65 m long

b) heavy concrete--10 m thick and 125 m long

c) earth--15 m wide and 230 m long

Iron has been chosen as being most suitable but a mound of earth on one side with iron on the other may also allow the access that will be required for servicing, repair and modifications. Since the dispersion is in a narrow horizontal plane the shielding need only be, say, 12 feet high with, say, a 3 ft roof overall. High rise buildings nearby have an additional protection factor due to the inverse square law.

Sub-Areas

The disposition of beam-line elements is shown on Fig. 2 (note the exaggerated lateral scale). The area can be divided into four sub-areas, namely

1. Target area--a region with a high density of elements and large quantities of modular shielding.

2. Beam shaping area--a region with a moderate density of elements and shielding.

3. Beam transport area--low density of elements and little if any shielding.

4. Experimental area--high density of elements and equipment

Target Area

This is shown in Fig. 3. The building covers an area of 125 × 400 square feet and contains 250,000 cubic feet of iron ($5M at $20 per cubic foot). A 30-50 ton overhead crane will be required. Utilities can be fed into the beam lines at 100 ft intervals and directed along the lines.

Beam-Shaping Area

The beams emerge into 400 ft. long tunnels (cheap versions of main ring tunnel). Earth is used as shielding. The quantity required can be determined by operational experience since it is quick and cheap to add more if the beams are already in tunnels. The start of the low density shielding corresponds to the position of momentum slits in the beam lines. The transition region from earth shielding to none occurs naturally at 750 ft. from the target for beams 1 and 3 make a large angle bend there. Some heavy shielding will be required to absorb off-momentum particles. On-momentum particles will be contained with the beam transport.

Transport Region

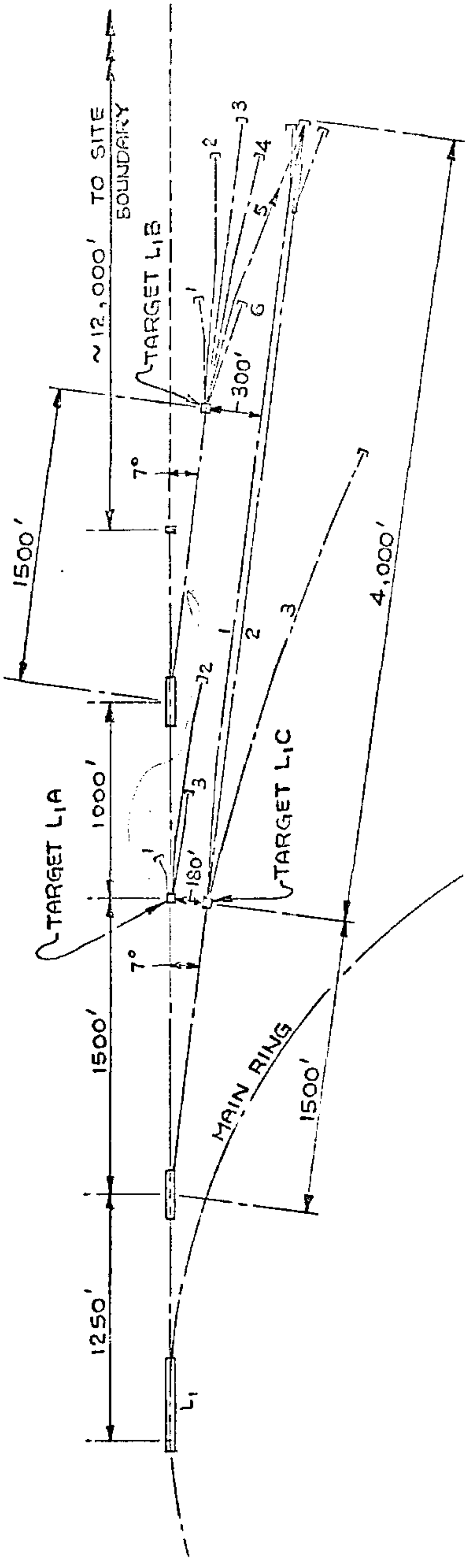
This region accounts for some 2500 feet of the beam lines and can consist of long concrete roads 10 feet wide with a light weather-proof buildings over the components which typically are 100 to 400 feet apart. Personnel fences can be erected along the roads to keep people away from the beam channels. Since the neutrino beam is very close to the 0° line it may be necessary to continue earth shielding along this line for some distance into the transport region.

Experimental Area

A building 250 × 650 square feet is envisaged to house the two counter experiments, neutrino shield and large bubble chamber. For hydrogen safety the bubble chamber may be installed in a separate building.

Power Requirements

The power requirements of the area depends on how many beams are running, what momentum they are studying, the number of elements in the beam and the apertures of these elements. C-1 contains 300 feet of magnet and 300 feet of quadrupole. The maximum power consumption for a 10 foot magnet with a 4" × 12" aperture is 750 KW (UCRL-10000) and for a 4" × 4" quadrupole, 10 feet long is 350 KW. Many of the components of the beams have larger apertures than these but in many cases this is unnecessary. For example, in the design of C-1 there appears 30 feet of magnet with 8" aperture immediately downstream from the target. For 150 GeV/c in C-1 the magnets are running half power and the quadrupoles at full power so that the total power consumption is 22 MW. The consumption in the ν-μ beam is 17 MW and in the beam C-3 the total consumption a full momentum is ~17 MW of which 7 MW is in common with beam C-1. Some 10 MW of power will be required for special spectrometers and spark chamber magnets. The total power consumption is therefore 60 MW for area C. About 25% of this is within the first 600 feet.



EXTERNAL EXPERIMENTAL AREAS

SCALE: 1" = 800'

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