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CONSTRUCTION OF LOWER INTENSITY PRIMARY PROTON BEAM

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CONSTRUCTION OF LOWER INTENSITY PRIMARY PROTON BEAM

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In recent years, there has been considerable interest for the experiments utilizing slowly extracted primary proton beams. The range of intensities interested were between 10^6 to several times 10^{12} depending on the experiment. There was proton beam of primary energy from the "old A" station intensity about 10^6 protons per pulse. The method used was to utilize the diffracted protons from the "old A" target. The intensity range was less than 10^7 protons. Another example of the primary proton beam was to finely split the slow extracted beam to the new A station for Experiment 598. The lowest intensity one can run stably was a few times 10^{10} protons pulse. There was, however, a large gap between the two methods. It should be noted also that there is no easy way to switch between the two methods. In this context, it is very desirable to have a beam designed to have a continuous intensity range of 10^6 to 10^{12} protons per pulse.

We constructed the primary proton beam covering a range of this region from the new A station to the secondary branch line to the A3 branch of the HEUB. The beam was designed primarily for Experiment 676 which measures prompt muons. The experimental requirement for the incident proton is to have an intensity of less than 10^6 to more than 10^{12} protons depends on the experimental program.

Figure 1 shows the plan view of the floor layout of the beam. The slow ejected beam from the F10 extractor magnet is split by the thin magnetic septum to A and BC stations. The details of the optics of the primary proton beam can be referred to other publications.[1] The experience shows one can stably run the A-line with the intensity down to a few times 10^{10} protons per pulse. In order to get the intensity of 10^6 protons per pulse we should limit the phase space acceptance of about 10^{-4} of the original phase space. We placed the collimator of 1 m brass. The collimator has three fixed holes, and the smallest was 1/16" X 1/16" square hole chosen by the beam stability and accuracy of alignment. The next two holes are ten and one hundred times of the area of the smallest hole. The intensity lower than 10^7 proton per pulse was adjusted by setting the primary beam to the edge of the phase space, in other words, set the hole around the halo area. In order to use the position along the phase space ellipse to control the intensity of the beam, the following condition is desirable. When the main bending and pitching magnet change the value, focusing condition should be set such that the position of the beam moves along the major axis of the phase ellipse at the collimator. The computer program was used to find such a solution. The solution was to turn both the focusing quadrupoles upstream of "A" target off. The small trimming was necessary with AQ4AB which is located downstream of the first bender.

Figure 2 shows the phase space ellipse at the "A" target station and at the Experiment 676 target. The cross hatched area represents the area of the small collimator hole.

About 10^{-3} of the original proton survives the absorption in one meter of brass collimator. They can be cleaned up in subsequent collimators. The energy loss through the one meter collimator is about 1.3 GeV and corresponding to $\sim$ 4.5% at A.G.S. energy. The difference of momentum is just enough to be cleaned up by the optical system. Since the beam A3 has two large bends 4.8° and 10°, the discrimination against different energy is quite easy. Since we are dealing with the large amount of unwanted off momentum particles, momentum recombination was not done for the downstream of the intensity defining collimator.

The operational experience for this beam has been quite successful and satisfactory for all phases of the Experiment 676.

Reference

1. See for example, AGS Technical Report 126.

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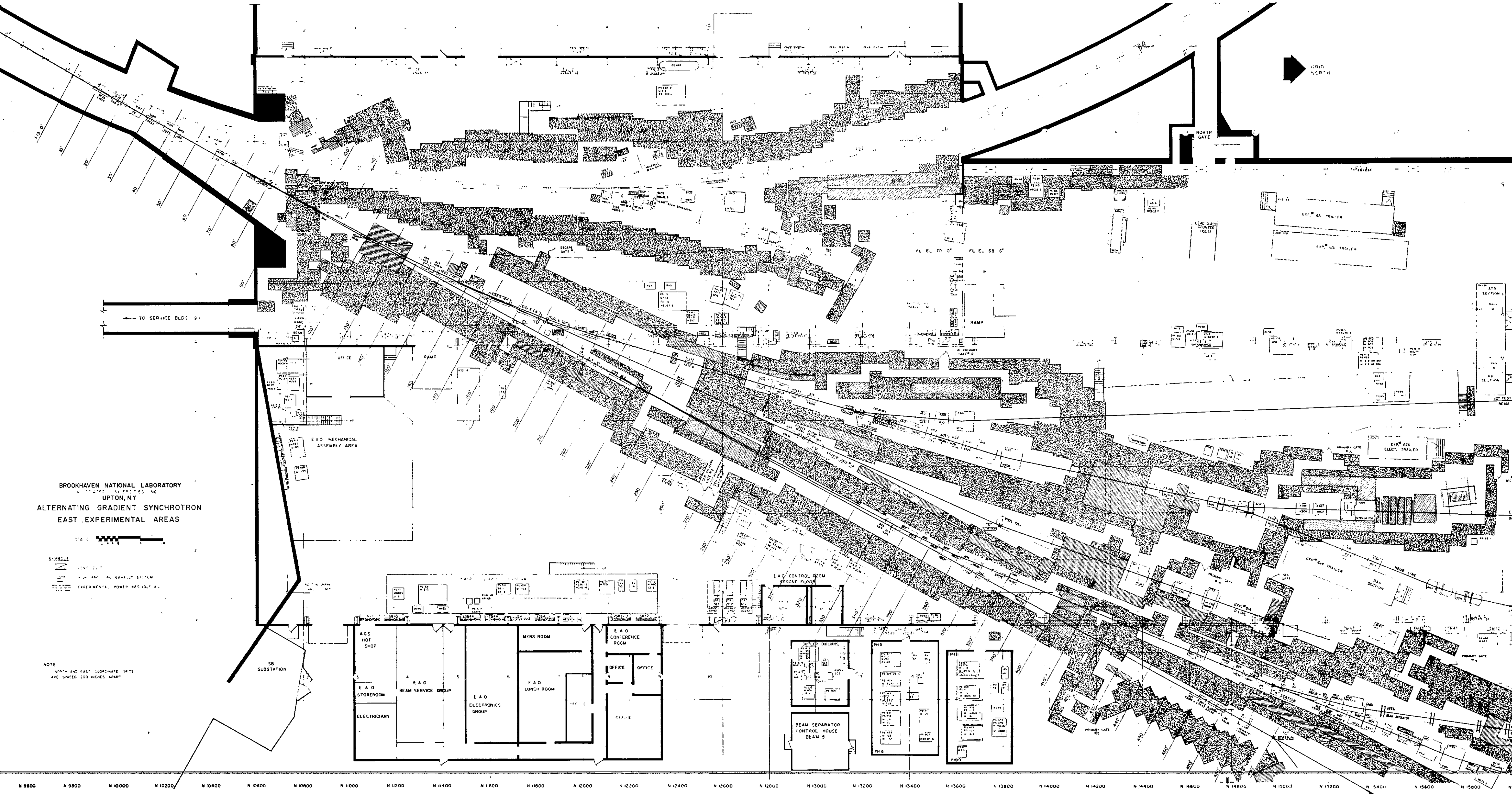
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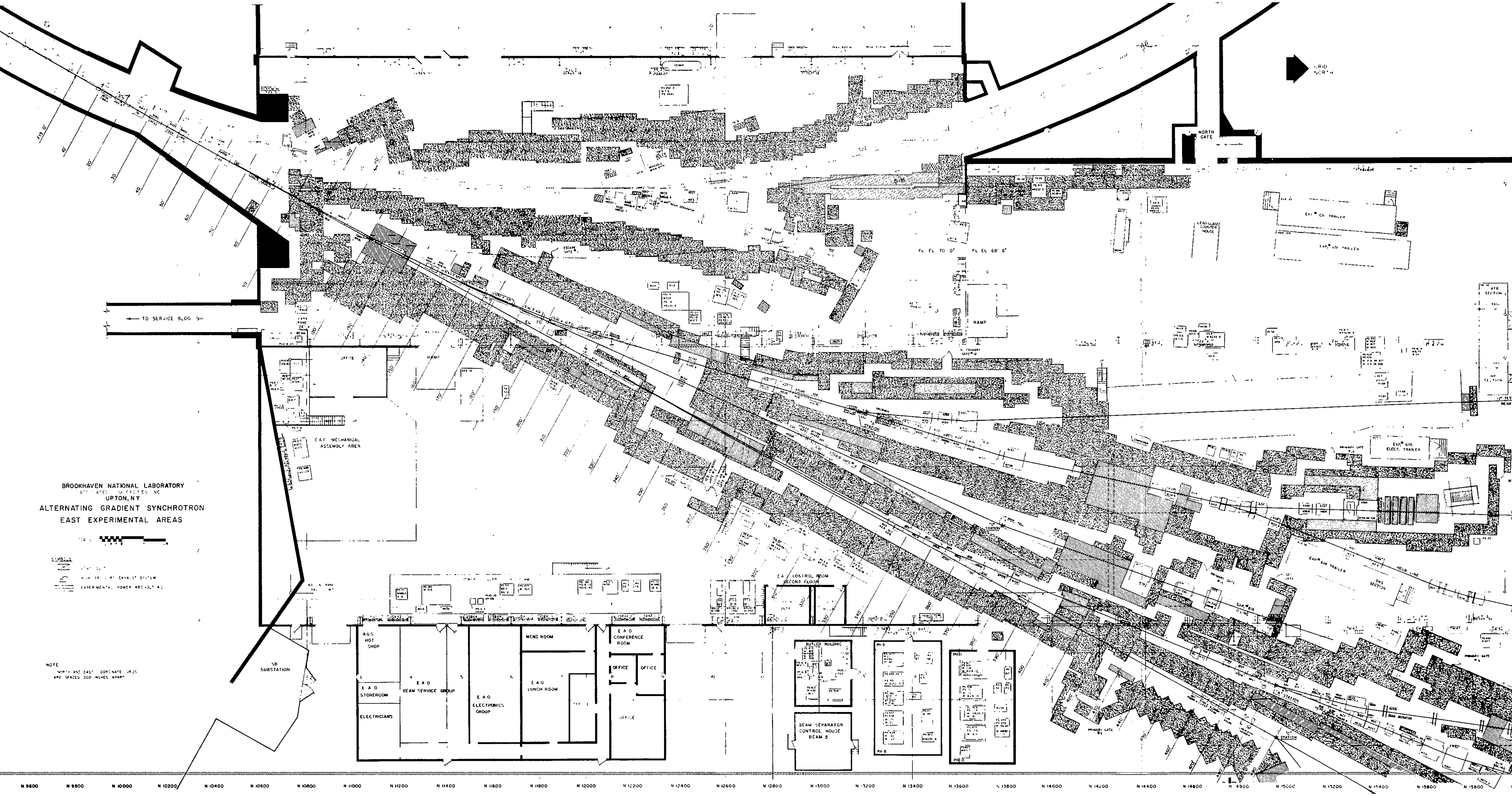
BEAM SEPARATOR CONTROL HOUSE BEAM 5
SB SUBSTATION
NORTH GATE
GRID NORTH
RAMP
ESCAPE GATE

FIG 1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NORTH GATE
GRID NORTH
ESCAPE GATE
FL EL 70' 0"
FL EL 68' 6"
PRIMARY GATE
STATION
N 9600
N 9800
N 10000
N 10200
N 10400
N 10600
N 10800
N 11000
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N 11400
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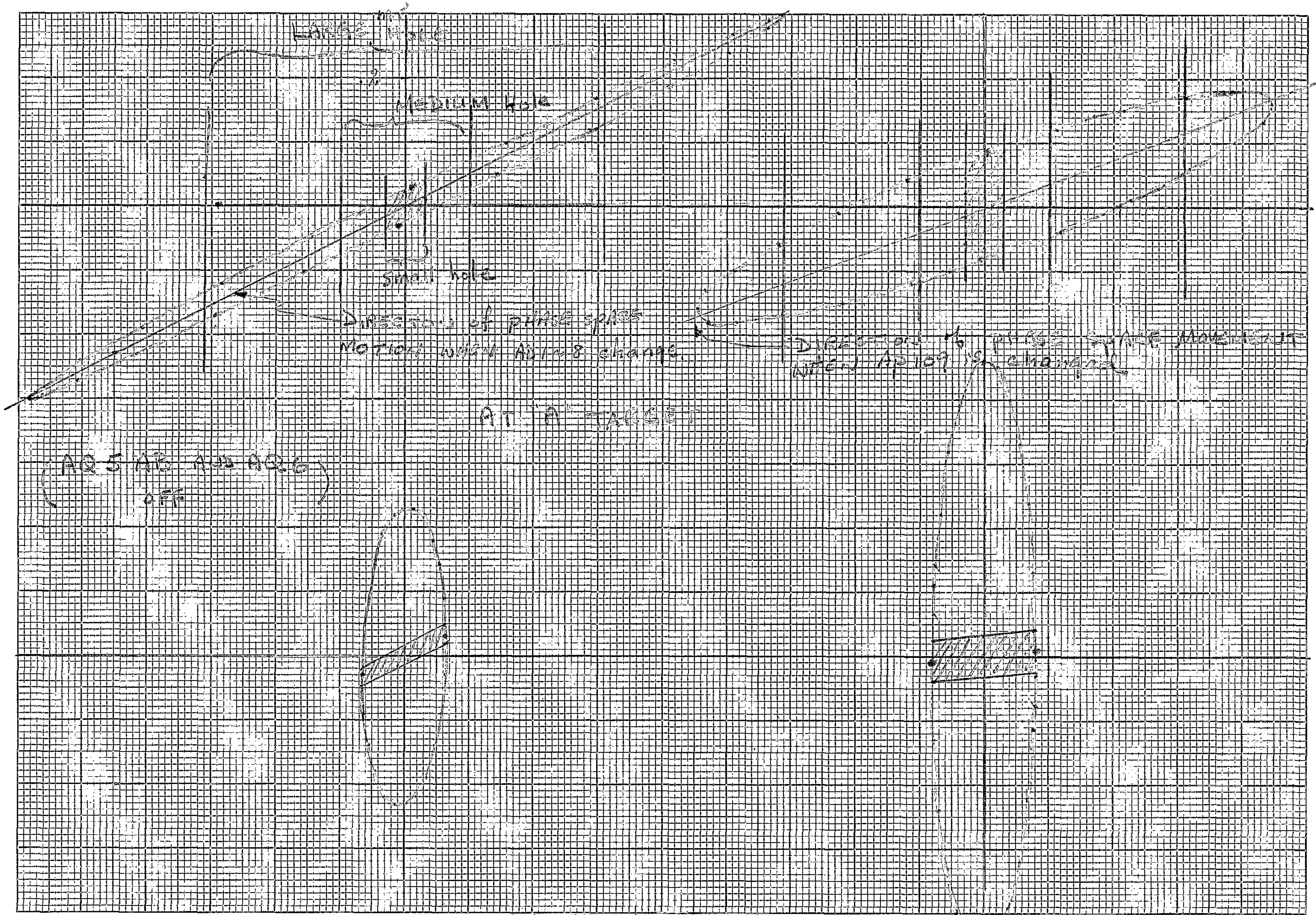
FIG 1



At Exp. 676

Fig. 2 Phase Ellipse at "A" Station and Exp. 676