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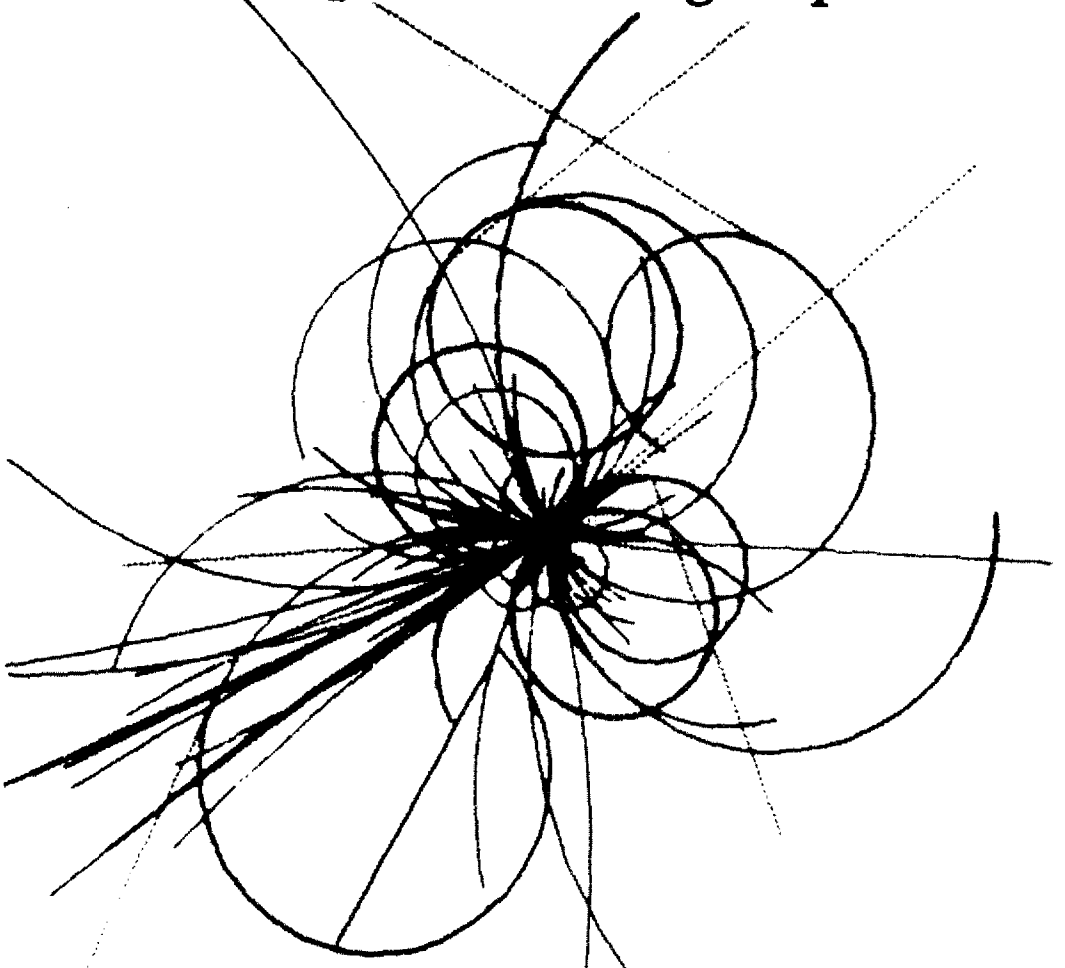
The Superconducting Super Collider



Conventional Facilities Considerations in the Configuration of a Major Accelerator Laboratory

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CONVENTIONAL FACILITIES CONSIDERATIONS IN THE CONFIGURATION OF A MAJOR ACCELERATOR LABORATORY*

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Summary

Configuration studies for conventional facilities associated with major accelerators involving communications, maintenance and operations can have significant impact on overall design. A proposed revision to the Test Beam Facility at the SSC is given as an example.

Introduction

In the Conceptual Design Report (CDR) for the SSC, the Test Beam Facility was aligned with the clockwise injection line into the High Energy Booster from the 100 GeV Medium Energy Booster (MEB). This arrangement provides the possibility of test beams from 100 GeV protons in the event that the MEB and Test Beam Facility were completed and commissioned substantially earlier than the 1 TeV High Energy Booster (HEB). Another factor influencing this arrangement was the apparent consensus that for test purposes there is no reason to use particles with energies above 1 TeV. The Facility as envisioned in the CDR is illustrated in Fig. 1 with the injection angles and separation of the HEB ring and Collider exaggerated for clarity.

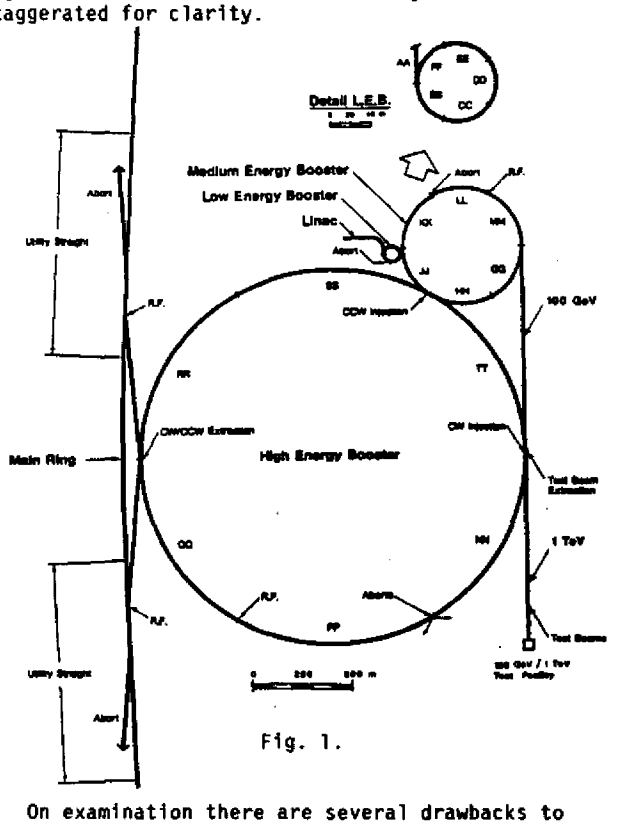

Fig. 1.

On examination there are several drawbacks to the proposed arrangement. The extraction line from the MEB shares an enclosure with the HEB at the injection point for the HEB. Operation of the extraction line could then interfere with construction and installation of the HEB because of the radiation hazard involved. The 100 GeV option for the facility does not seem to be, therefore, a viable early option.

"Civilizing" the otherwise undeveloped, relatively remote area where the Facility would be located would involve substantial costs for roads, utilities, monitoring and control systems, etc. If the Facility were sited in an already developed area these ancillary costs would be eliminated. In addition, from the point of view of operations the remoteness of the Test Beam Facility from the detector fabrication site, presumably the Heavy Works Buildings, is undesirable in the opinion of the participants in the 4-pi detector group at the 1986 Snowmass Summer Study. This observation is primarily based on the experience of constructing the Colliding Detector Facility at Fermilab.

An additional factor that emerged at the Snowmass Study was the desire for test beams with energies in excess of 1 TeV to study some aspects of calorimetry which don't seem to extrapolate simply from data below 1 TeV.

Step 1: Relocation of the 1 TeV Facility

Many of the drawbacks cited above could be alleviated, at the expense of some complication of beam handling, by moving the Test Beam Facility 180 degrees around the HEB. It would then use the same extraction straight section as is used for injection into the Collider Ring. Figure 2 is an elevation showing the relative locations of the Collider Ring, the HEB and the transfer line between them at this location. The downward projection of the 1 TeV transfer line required by the vertical offset of the HEB and Collider, which is desirable for radiation safety reasons, leaves open the possibility of a second branch of the 1 TeV extraction line. By reversing the field of the Lambertson extraction magnets the 1 TeV protons are pitched up where they can be directed into the transport line to the Test Beam Facility. Assuming this mode of extraction, the reconfigured Test Beam Facility is illustrated in Fig. 3.

The reconfigured Test Beam Facility has several advantages over the CDR configuration. First, it places the Facility in reasonable proximity to the Heavy Works Buildings where the elements to be tested would, presumably, be assembled. Personnel working on the assembly would be able to monitor and take part in the tests more easily. Second, it results in an economy of utilities and roads, making use of those already required for the Collider Ring facilities, like the rf and injection lines. Finally, it results in a concentration of the radiation burden and radiation safety surveillance concerns. The primary abort lines and dumps already exist in this area, and access to the region of the extraction and injection line, which are inherently radioactive, must be monitored and controlled. With the test beams also in this vicinity rather than in a different, remote area, the problems of surveillance and control (and the size of staff required) are lessened.

Step 2: >1 TeV Test Beams

The reconfiguration of the Test Beam Facility described above opens the possibility of providing

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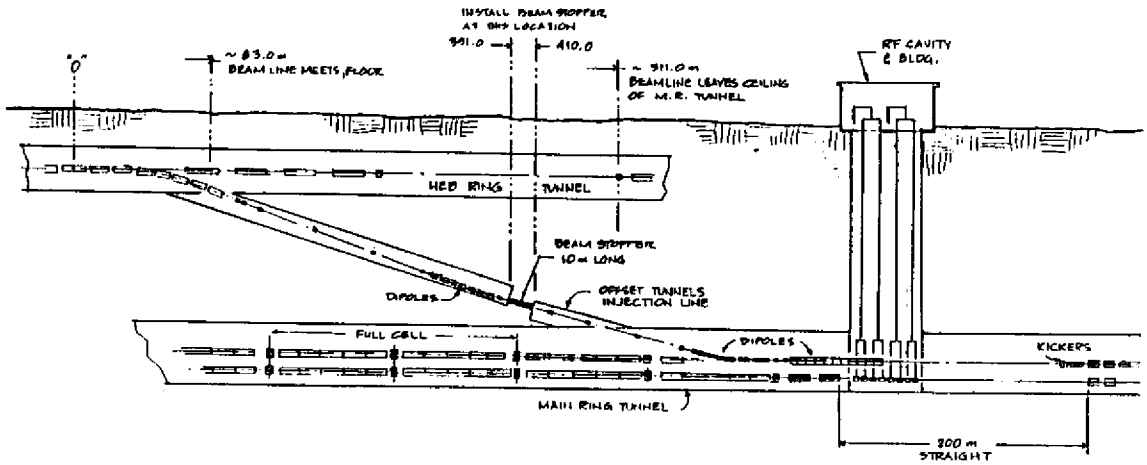

Fig. 2

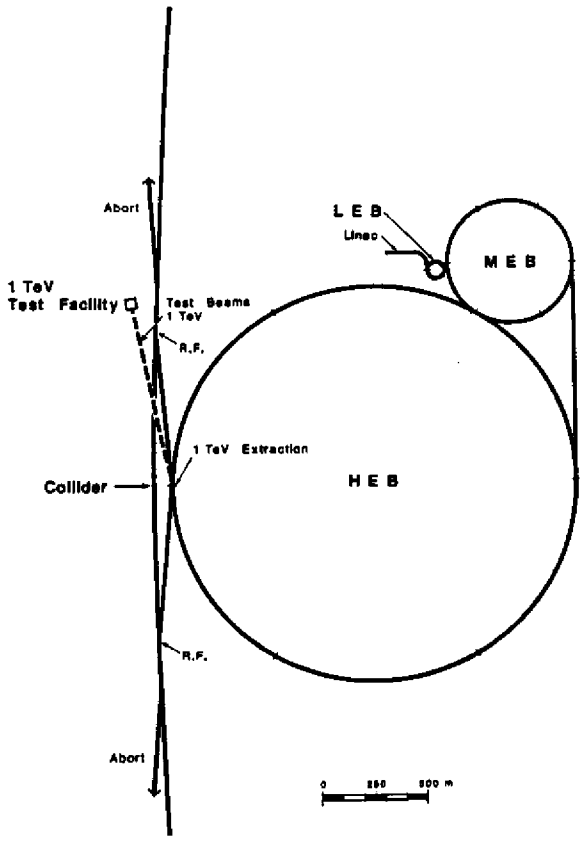

Fig. 3

particles of energy >1 TeV, derived from 20 TeV protons, in the same facility. Figure 4 illustrates the Injection/Abort region of the Collider Ring. A Lambertson magnet dogleg is shown in straight section Q for the counterclockwise abort. The clockwise beam as designed passes undeviated across this region. A Lambertson dogleg can also be installed in the clockwise beam. A 95 microradian deflection would be required to inject protons into the field-free region of the Lambertson if an extraction device were placed at the same relative location as the abort kickers. An appropriately bent crystal could be used as the extraction device to channel halo protons into this aperture as is being done at the Synchrophasotron at Dubna. There has also been some analogous success with providing protons into the M-bottom line at Fermilab. With no further bending the 20 TeV proton beam line would be separated from the Collider Ring beams by approximately 60 meters at the position of the counterclockwise rf. Recalling Fig. 2, this beam, assuming the CDR offset, would still be approximately 7 meters below the 1 TeV proton beam facility at the position of the Test Facility. By appropriate steering both beams could be directed into the same Facility.

Conclusion

Figure 5 illustrates a combined 1 TeV/20 TeV Test Facility which could alleviate some of the drawbacks of the CDR design and at the same time respond to some of the requests of the detector groups at Snowmass. The design to substantial savings in costs for initial construction and for maintenance. It also leads to operational efficiencies while providing enhanced capabilities.

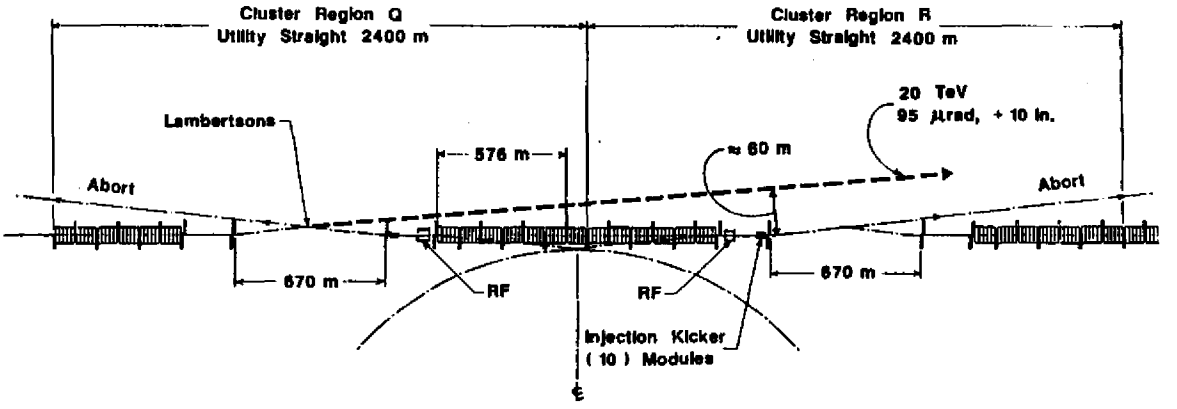
Cluster Region Q
Utility Straight 2400 m
Cluster Region R
Utility Straight 2400 m
20 TeV
95 µrad, + 10 in.
Lambertsons
576 m
≈ 60 m
Abort
Abort
670 m
RF
RF
670 m
Injection Kicker
(10) Modules
HIGH ENERGY BOOSTER

Fig. 4

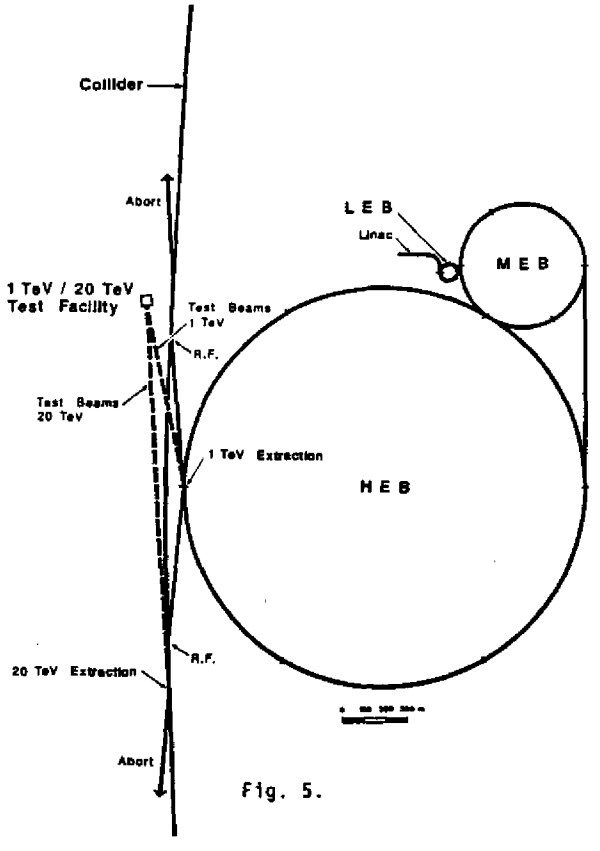
Collider
Abort
L E B
Linac
M E B
1 TeV / 20 TeV
Test Facility
Test Beams
1 TeV
R.F.
Test Beams
20 TeV
1 TeV Extraction
H E B
R.F.
20 TeV Extraction
Abort

Fig. 5.