SSCL-565

Superconducting Super Collider Laboratory

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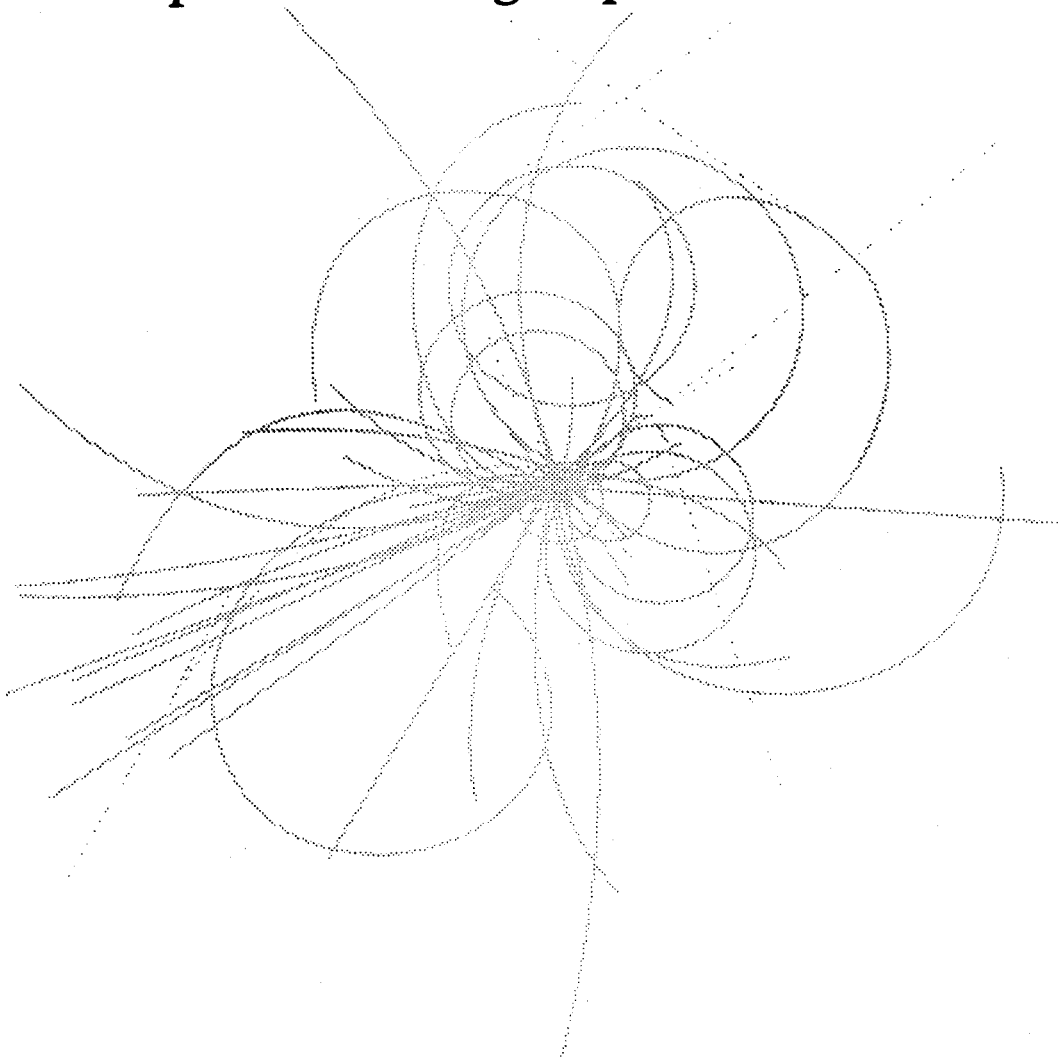

Collider Lattice Position Changes from the "Blue Book" to the 10F Lattice

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1.0 INTRODUCTION

GREV4 was the lattice used by RTK to generate the numbers that appear in the "blue book"[1] which is the basis for the present footprint. The 1000 foot wide band allows for inevitable design iterations. The first iteration, GREV5 was the lattice used for the baseline costs and descriptions. If the west utility region (at which point the Collider is tied to the injector chain) is held fixed, the coordinates of the GREV4 and GREV5 rings differ by several tens of meters in some places. This is all within the footprint defined in the "blue book."

2.0 LATTICE POSITIONING

The origin for the Site Cartesian Coordinate System (SCCS), up to and initially including GREV5, was defined as the intersection of the diagonals of the parallelogram produced by connecting both the start and end points of the north and south arcs. The +X axis was defined as the easterly direction of the side of the parallelogram subtended by the northern arc. As a result the definition of the SCCS changed with the generation of successive lattices. To avoid this problem it was decided to define the origin of the SCCS as the mid point of the west utility straight with the XY plane coincident with the bottom collider beam. The +Y axis of the SCCS system was defined as being coincident with the northern section of the west utility straight of the lattice and positive in the northerly direction. The +Z axis is perpendicular to the XY plane with direction towards the upper collider beam. By constraining the origin to be the middle of the straight section region where the HEB and Collider rings join up, design of the Collider and the various injector accelerators could proceed without interference from each other.

It was assumed for the original calculations that the ellipsoid defining the NAD27 datum (best fit computational model for N. America) is coincident to the geoid (a "real" equipotential surface of the earth) over the entire SSC footprint. The latest geoidal model (GEOID90) developed by the National Geodetic Survey (NGS) suggests there exists a differential separation of approximately 0.6 meters from east to west between the RTK NAD27 datum and the geoid. It was felt that coordinates generated in the future should incorporate this information.

A second design iteration of the Collider took place in 1991 in an attempt to finalize the horizontal bending arrangement. Throughout the entire 35 km of each Collider arc, there was no free space to put in any future equipment should that ever be deemed desirable, nor was there any place where the beam pipe was directly accessible. As the design of the Collider has matured and implications of the baseline design have been studied, the next level of detail and knowledge suggested that space in the arcs of the Collider was desired. This is viewed as a relatively small perturbation in the overall design of the accelerator. It is felt, however, that free space in the 35 km arcs would greatly enhance the potential use of the Collider as well as providing contingency which cannot be added later for meeting design requirements.

Over 30 different lattices were examined during a four month period. The design chosen, referred to as SSC10F, is one in which dipoles are left out of the regular arc pattern at strategic locations which ensure proper beam characteristics. In addition, attempts were made to allow for utility shaft locations on the land being offered by the State of Texas, a feature that the baseline lattice could not accommodate without extra tunneling costs.

Originally, the physical location of the new Collider design was contained in the same plane as GREV4 and GREV5. For stability and improved tunneling conditions (better geology) it was proposed to change the geographical location of the Collider.

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[1] *Computer-Aided Design of the Digital Footprint*, Revision 1, SSC-SR-1049, March 1990.

The 10F lattice was raised in a parallel plane to the point that the minimum cover required for radiation protection on fee simple laboratory property is achieved at the Waxahachie Creek crossing. At this position the creek crossing at Chambers Creek is approximately 1.0 meters deeper than the Waxahachie Creek crossing.

This plane is then rotated about an axis between the two creek crossings to a maximum slope specification at the center of the ring of 0.2 degrees sloping downwards in an easterly direction. The compound tilt angle created by the angle between the original strike axis and the rotation axis between the two creeks results in a slight re-definition of the strike axis of the machine plane.

The result of this change of elevation and slope of the collider plane is a raising of the ring of around 5.5 meters at the western IR hall area and a lowering of the ring approximately 7.2 meters at the eastern IR hall region. These changes introduce only small perturbations in the horizontal coordinates, of the order of several millimeters that are insignificant for horizontal land acquisition and design purposes.

The differences in location between GREV4 and the proposed 10F lattice are illustrated in the accompanying figures (1 and 2).

It should be pointed out that the 10F lattice is the result of an exercise to define the "horizontal" (in-plane) geometry of the Collider beam trajectory. The intent is that the bending regions, and hence the ideal beam trajectory defined by the 10F lattice, not be changed in any future lattice design iterations. Locations of quadrupole magnets, which do not affect the ideal beam trajectory, may in fact change in the future, especially in the interaction region. These modifications should not be confused with changes to the footprint.

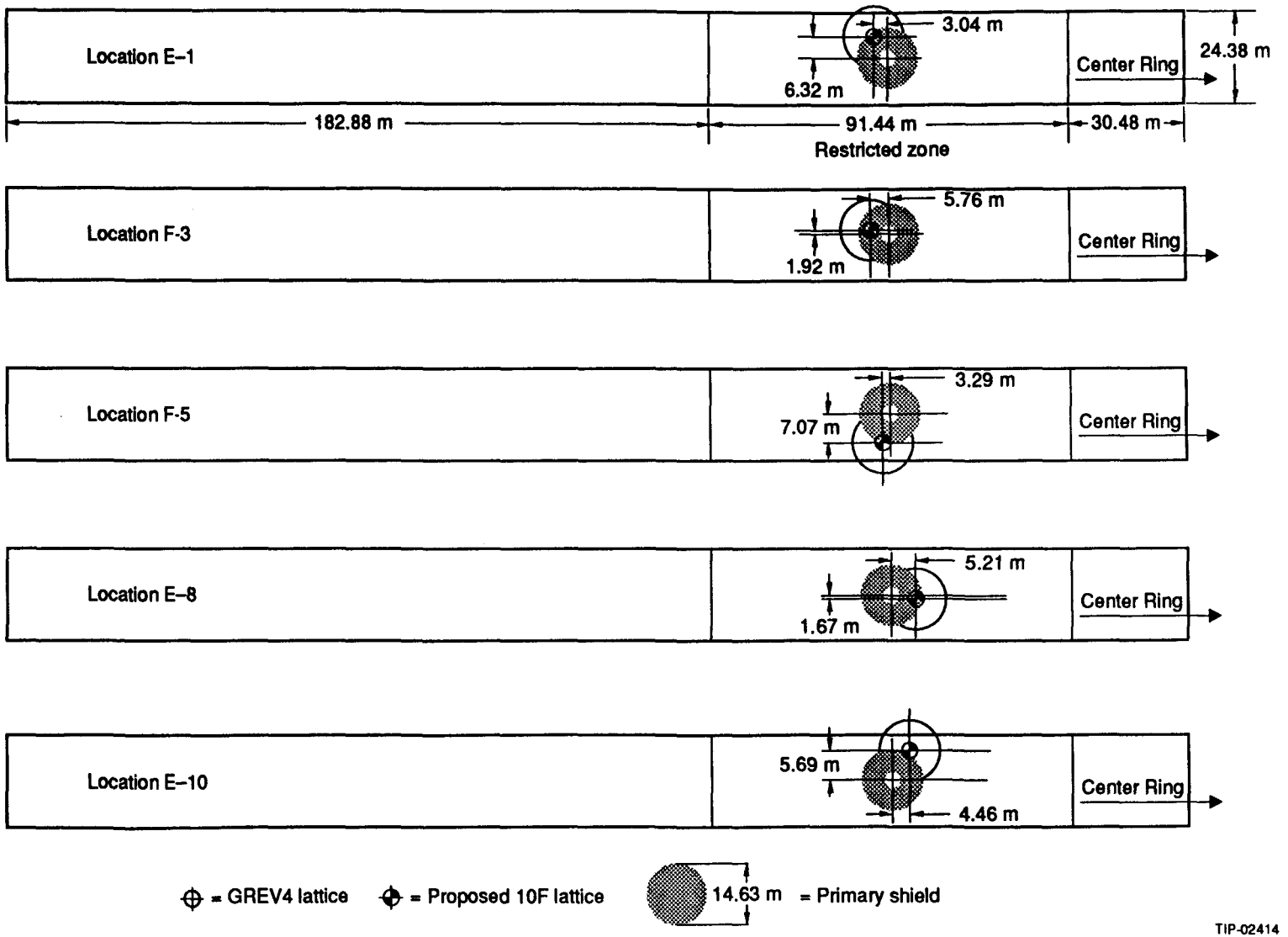
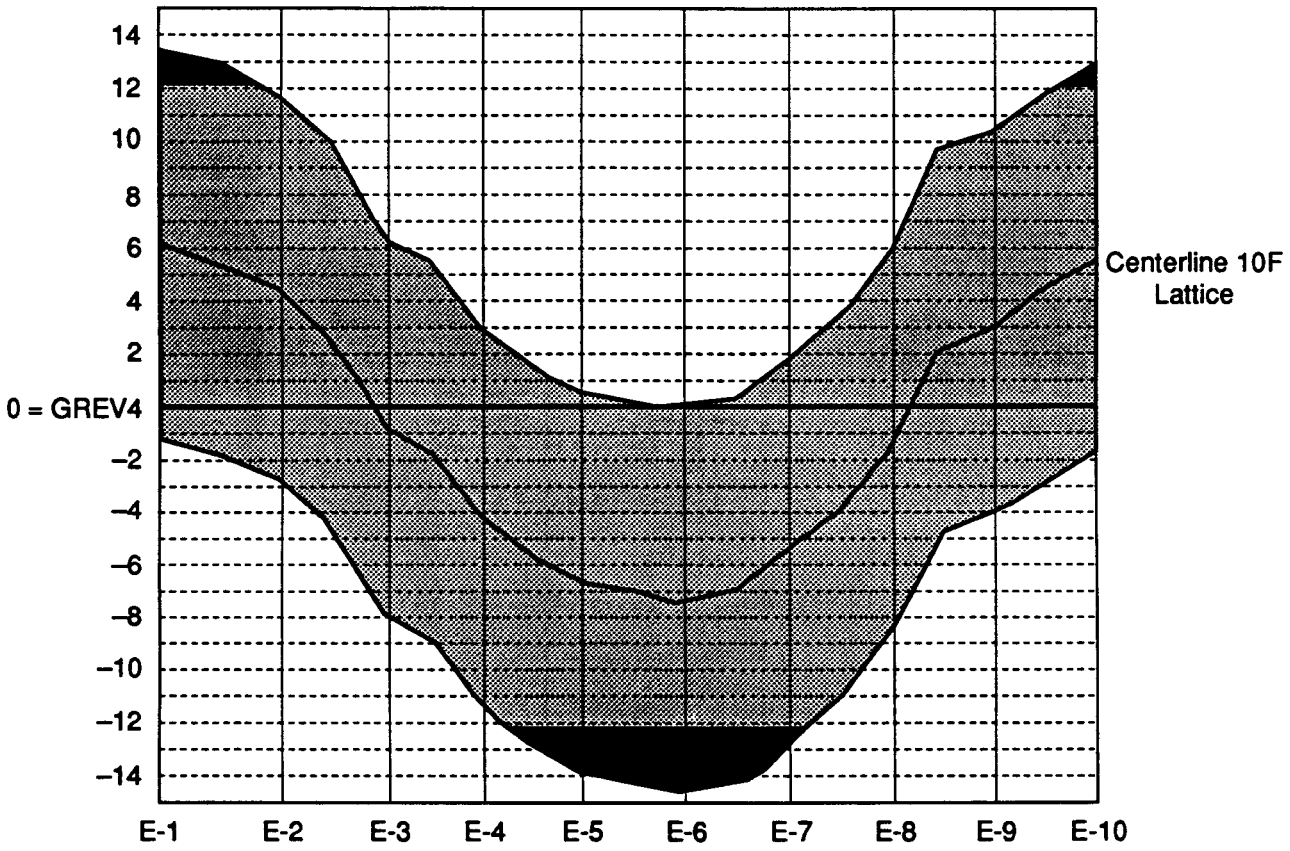


Figure 1. Comparison of Location of GREV4 to Proposed 10F Lattice.



Note: Darker shaded areas indicate those areas in which the proposed 10F lattice's primary shield leaves the confines of the GREV4 restricted zone. Lighter shaded areas indicate the vertical boundaries of the primary shield. The darker line in the center represents the proposed 10F lattice's centerline

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Figure 2. Vertical Comparisons of the GREV4 to Proposed 10F Lattice.