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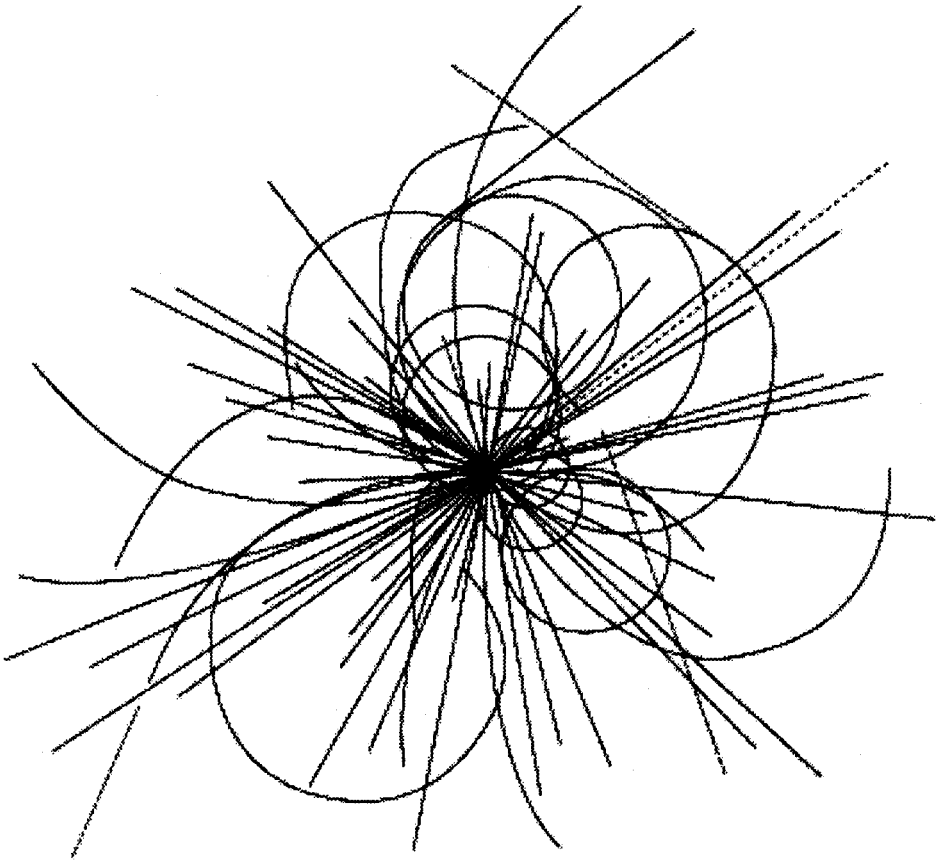

Superconducting Super Collider Laboratory

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Experimental Modification of SSC Interaction Region*

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June 1993

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EXPERIMENTAL MODIFICATION OF SSC INTERACTION REGION

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1. INTRODUCTION

The SSC Collider design has four interaction regions. Two of these regions are configured for high-luminosity collisions and have been previously described in detail. The other two regions are, as yet, uncommitted. Early Collider designs called for two medium-luminosity regions, and lattice designs very similar to those for the high-luminosity regions were developed.[1] An updated medium-beta design was recently developed.[2] Questions have been raised by experimental proponents as to the possibility of inserting analyzing magnets into the lattice design. This paper examines the interference of experimental magnets with the basic machine lattice.

2. LATTICE DESIGN

A layout of one-half of the Medium-beta IR design along with its lattice functions is shown in Figure 1.

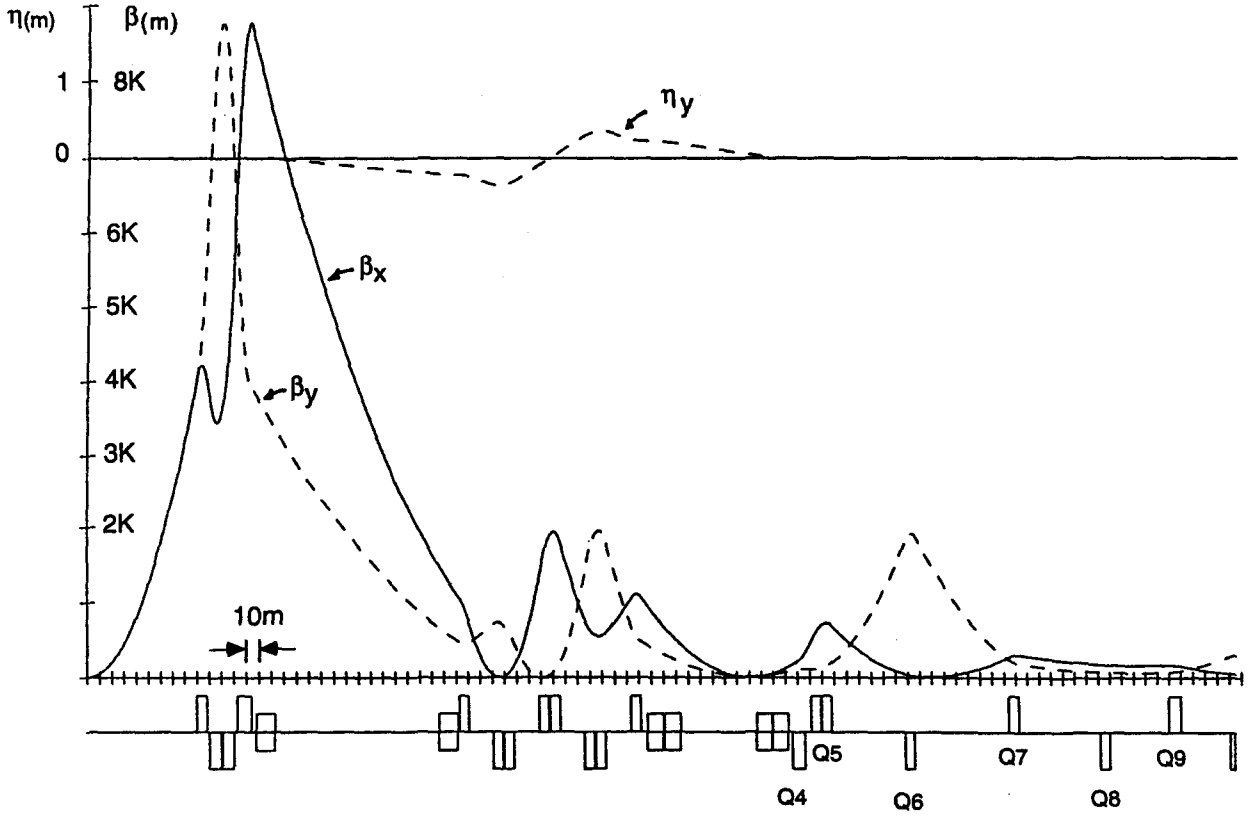

Figure 1. Layout of Medium-beta Interaction Region

The beta-squeeze is accomplished by adjusting the quadrupoles Q4 – Q9 on either side of the interaction point through a relatively small, continuous tuning range. This tuning is done after the beams have been accelerated to 20 TeV. As the beta function at the IP is reduced, the chromaticity produced by the IR quadrupoles increases dramatically. This increase must be continuously tracked by the correction sextupoles. Concurrent with the beta squeeze, the two beams are brought into collision with a set of trim dipoles on either side of the IP. The timing details of beta squeezing and crossing control will be determined experimentally in the future. Thus, the ability to control in detail the beam's behavior throughout the interaction region will exist as part of the basic lattice. This ability may be used to provide for analyzing magnets as well as for its primary purpose.

Many of the proposals for experiments in a medium-luminosity region desire to have a variety of magnets in or around the beamline. These magnets include dipoles, quadrupoles, sextupoles, toroids, and solenoids. All of the requests which have been examined can be accommodated with slight modifications to the basic IR design. These modifications consist mainly of a small retuning of the interaction quadrupoles, and, in some cases, the introduction of compensating magnets. The effect of the experimental magnets on the very stiff Collider beams is almost negligible, and can be easily controlled. An example of such compensation is presented below.

The Full Acceptance Detector proposal is currently considering analyzing magnets such as the ones listed in Table 1.[3]

Table 1. FAD Magnet Request.

Distance From IR (m)	Magnet Type	p_T Kick at Coil GeV/c	Aperture Radius (m)
3.0	Quad	0.8	1.5
6.5	Quad	0.8	0.75
16.5	Sextupole	0.8	0.75
38.0	Sextupole	0.8	0.75
70.0	Dipole	1.1	0.75

The FAD magnets can be accommodated into the SSC IR design in the following manner. The quadrupoles are inserted with opposite signs and their effects are removed with a vary slight retuning of the beta-squeezing quadrupoles. The dipole is compensated with the addition of two other trim dipoles, forming a simple orbit three bump. This could also be compensated by some complication on the crossing-angle system, if desired. The sextupoles are globally tuned out through the existing chromaticity sextupoles. Their effect on the beam adds nothing to the existing sextupole requirements.

Figure 2 shows the lattice functions for the fully compensated experimental region and Table 2 lists the tuning quadrupole gradients at 20 TeV for the original IR design and for the compensated design. The compensation adjustment is far smaller than that required to produce the beta squeeze and will not cause any increase in the system. Some increased complexity will be added due to the need to track the effects of the analyzing magnets along with all of the other IR systems, but the increase is small, and easily tolerable.

Table 2. IR Tuning Gradients for $\beta^* = 2$m

Quad	Standard (T/m)	Compensating (T/m)
Q4	-184.2866	-186.0234
Q5	177.9441	178.4417
Q6	-158.9960	-158.3286
Q7	161.3788	161.6200
Q8	-52.5808	-54.3169
Q9	115.8781	115.7887

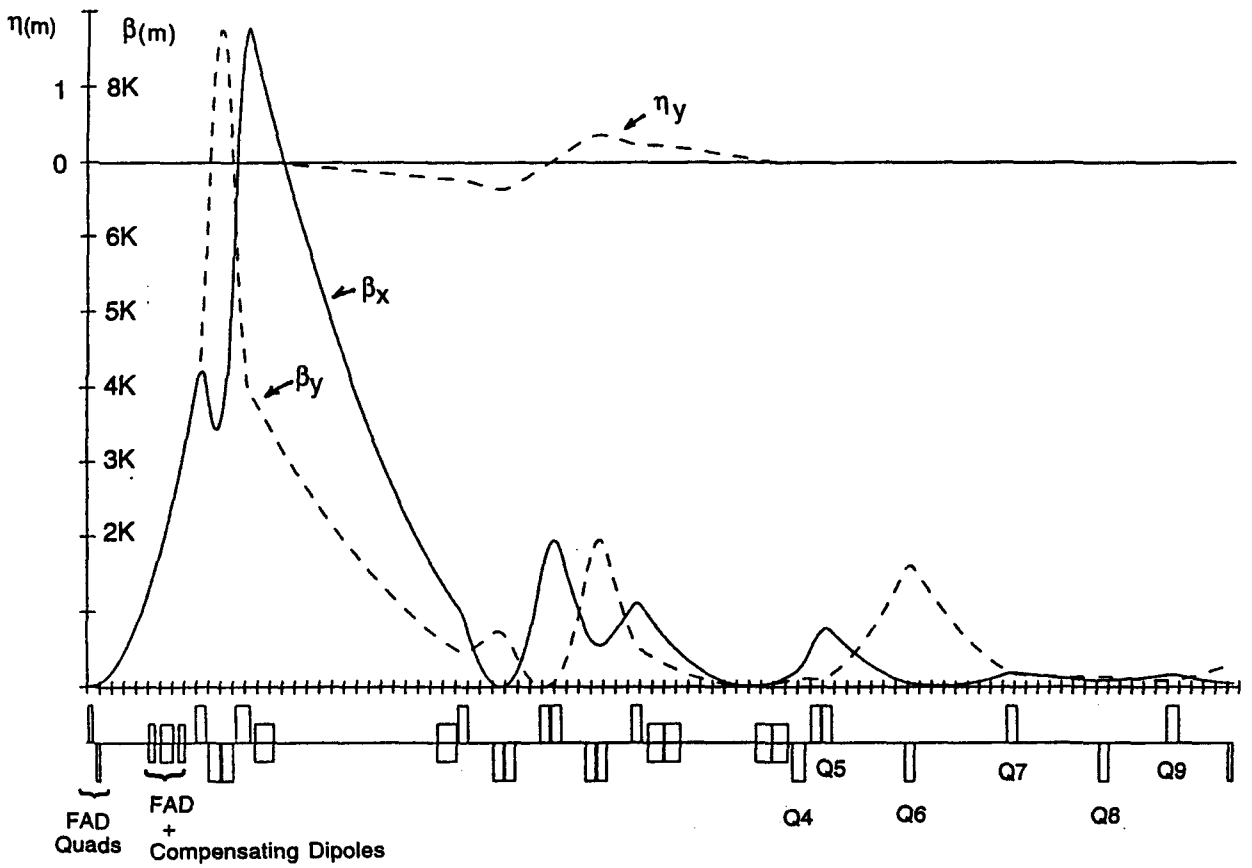

Figure 2. Medium-beta Interaction Region with compensated experimental magnets.

References

1. *Site-Specific Conceptual Design,* **SSCL–SR–1056** (1990), p. 55.
2. Y. Nosochov, report these proceedings.
3. B.J. Bjorken, private communication.

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