SSC Central Design Group

Minutes of the Clustered IR Parameters Meeting

October 18, 1985

Morning Session:

The meeting began with a presentation by Alex Chao of the highlights of the Clustered IR Option Report (SSC-SR-1014). Al Garren and Steve Peggs then discussed a variety of clustered IR lattice examples with emphasis on the configurations having 4 IR's on one side of the ring and 2IR's, 2 utility straights on the others, (so called 2, 4 layouts).

Backgrounds in one IR due to interactions in a nearby crossing point, and energy deposition at intervening locations was the subject of a talk by Don Stork. He was followed by Albin Wrulich and Beat Leemann, who covered the comparison of tracking results on various lattices.

In the concluding segment of the morning session, the attendees reaffirmed the principal recommendation of the Clustered IR Option Report, i.e., that the Conceptual Design Report employ a clustered IR lattice. It was also agreed to adopt the 2, 4 configuration in view of its advantages for chromatic adjustment, and, when combined with utility sections, its advantages for site layout. It should be noted that these advantages had already made this configuration the most developed; a significant consideration in view of the short time remaining toward the conceptual design goal. Finally, it was agreed to concentrate near-term effort on the particular 2, 4 variant that places its utility sections next to one another, and diametically opposes the two undeveloped IR's. This layout preserves a vestige of overall symmetry (a potential superperiodicity of 2), had somewhat better chromatic properties than the other version and offers substantial flexibility for design of injection, abort and other accelerator functions and experimental application.

Afternoon Session

The relatively brief afternoon session was used to review the status of and make recommendations concerning 4 topics that appear on the following sheets. Though not the subjects of specific recommendation, an underlying theme is the cost-benefit justification of the overall circumference, which is influenced by the IR spacing and utility section length.

Participants: The Clustered IR Study Group
The SSC Parameters Committee

Notes takes by Don Edwards

1. <u>Main Features of 2 Lattices Presented</u>

	AG	SP (Courant, Garren, Johnson, Neuffer, Peggs)	
Field	6	6.4	T
Circumference	100	89.9	km
Length Exp't Straight	1.5	0.86	km
Length Utility Straight	1.5	0.86	
Separation Between IP's: Transverse	~ 225	~ 42	m
Longitudinal	3.6	1.93	km
Band Angle Between IP's	7.2	2.5	deg
Phase Advance Between IP's	3.75	3.25	
Phase Advance Between Utilities	2.25		
Magnetic Radius	11.688	10.395	km
Packing Fraction P/R	0.734	0.726	
Power Supplies	<u>Types</u>		
Exp't	7x6	6x6	
Utility	4x2	4x4	
Trombone	5x8	8x6 8x4	
Cell	<u>(2)</u>	<u>(2)</u>	
	90	132	
Verticle Dipoles	(2x6)	(1x6)	
Beam Splitter Field	1.8	6.4	T
IP - Beam Splitter Distance	72	220	m
IP - Beam Splitter Phase	.25/.25	.73/.33	
Peak ß	3924/3927	3988/3600	
Utility ß	1638	509/356	
Secondary Tune	86.23/86.24	84.26/84.28	
Chromaticity	-220	-219	

2. <u>Accelerator Functions</u>

Harrison
Peterson
Schachinger

It was felt that both the short (Peggs) utility straight section and the long (Garren) version presented as options in the 2, 4 lattice scenario , had more than sufficient suitable warm regions with appropriate lattice functions to accommodate the requirements of the R.F. systems and any specialized beam pick-ups and diagnostics associated with monitoring and feed back systems.

The free space available in the utility straight sections does however impact the beam transfer systems (or vice versa). In the long utility straight sufficient space is available to permit both beams to be injected with flexibility in lattice matching and sufficient physical separation between both machines to allow independent operation. The abort system, which uses a dog-leg, also fits comfortably into the long version of the utility straight.

The ~ 500 m of free space in the short utility straight version presents problems for both the injection and abort systems. It seems unlikely that bi-directional injection can be done in a straight forward way. The relatively close proximity of both utility straights in this scenario does however allow the possibility of injecting one beam in each section with injection lines of a similar length to those used in the "long" utility straight. It also becomes increasingly difficult to steer the aborted beam past the inner quads as the available length decreases.

The basic problem to be confronted is to define the appropriate length of the utility section possibly under several different basic designs.

3. <u>Backgrounds and Energy Deposition</u>

Groom
Stork

a. Backgrounds

i. Beam splash effects on the next IR. With the Garren lattice (126 mr of bend between IR's 3.6 km apart), the beam line projection from one IR is 226 m outboard at the next. For reasons of simplicity it is hoped that the IR staging area will be "outboard;" since its length will be nowhere near 226 meters the presence of a very weak muon beam at this distance is totally inconsequential. However, in the Peggs scenario (43 mr bend, 1.9 km separation), the beam projection is only 41 m outboard---probably within the IR staging area. It is much more intense because of the smaller distance; in the a absence of "fanning" in the insertion dipoles it would present a radiation hazard in the middle of the beam spot.

In addition, there will be some reflection of radiation down the tunnel from one IR to the next. While some shielding walls will probably be necessary in any case, the problem would be very much exacerbated in the small-distance-small-bend case.

ii. Muons. The muon flux should also be suppressed for general environmental reasons. Nothing can be done about prompt muons, but the dominant contribution at low x (< 0.1 or so) comes from pion decay. The problem is to get off-momentum mesons into matter as soon as possible, since essentially all of the decays occur in low-density drift spaces.

In essence, this means a strong dipole as close to the IR as practical. At least as presently conceived, the Garren IR optics is much to be preferred.

A great deal more modeling of the muon flux is necessary, and is in progress. It will be comparatively easy to obtain momentum distributions, while spatial distributions will (a) have to come from Monte Carlo calculations, e.g. using CASIM, and (b) will probably not be too accurate, due to the complicated behavior of muons as they pass through the solid part of various magnets.

Optimal design of the insertion magnets can also help--e.g. the use of "C" (rather than "H") shaped dipoles, opening downward, will essentially eliminate negative muons. Positive muons will spread rather unpredictably in a vertical fan.

iii. In-aperture particles. The forward high energy protons from inelastic collisions have been tracked from their point of production in one IR to the following clustered IR's in Steve Peggs' design. These quasi-elastic protons are generated with the ISAJET Monte Carlo program with the "MINBIAS" option. The acceptance is determined by the aperture in the vertical bends and for a diameter of 3 centimeters, 0.06 % of the IR collisions lead to a proton that survives to the next IR. This background accumulates to form a benign beam halo with standard deviations of about 20 microns in the transverse dimension and 20 microradians in angular spread in a momentum band dp/p < 0.003. Loss of the surviving protons is very small in subsequent neighboring inter-IR segments. In this lattice scheme, the largest energy dump is 5% of the IR collision energy in protons stopped in the vertical bend element "v6a" which is 47 meters long. Further studies will be made to incorporate diffractive and elastic scatters in the Monte Carlo approach and to optimally place beam scrapers.

b. Energy deposition. As expected from the RDS study, a substantial fraction of the total 768 W (nominal) carried out of each IR by scattered particles will end up in the final focus quadrupoles and the insertion dipoles. More detailed studies are under way, and so far have produced dP/dz (d(power)/d(length)) along the quadrupoles. They will be extended to the dipoles shortly; main goals are to (a) find the optimal collimator placement and (b) examine the difference between the Garren and Peggs IR optics. Superficially, the long drift after a close-in first dipole in the Garren scenario presents welcome opportunities for collimation, shielding, etc., as well as the possibility of obtaining a "free" high-x test beam of sorts.

4. A Comment on Accelerator Physics Issues

Leemann
Talman
Wrulich

We feel that the Clustered Interaction region Study Group has concluded its work and can now be discharged. The viability of the clustered IR configuration as a design choice is no longer an issue insofar as accelerator physics questions are concerned. On the other hand, we recommend that consideration be given to the appointment of a study group on Errors and Corrections. Although pieces of the topics covered by this heading have been studied before, this study group can assure that they are attacked in a systematic fashion.

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