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Design Deck for 12 GeV Optics

Abstract

The optical lattice for CEBAF 12 GeV upgrade, including Hall D, is defined in this document. Also included are optimized configuration for orbit correction elements (BPM/corrector) and design field ranges for magnets (dipole/quadrupole/corrector). Rationale for the design is presented where necessary.

1 Overview

This document defines the baseline optical design for the CEBAF 12 GeV upgrade. It consists of the following components:

- Source file location of the complete[1] design deck
- Description of the optics and rationale
- Range requirements on magnets based on design optics and operational envelope
- Estimation on beam size vs aperture requirements.

2 Design Decks

The design decks for the 12 GeV baseline optics, from the exit of the Injector cryomodules (total energy 123 MeV) to the end of Hall D (total energy 12.113 GeV), can be accessed at this repository. The following areas are not part of this collection:

- Cathode to Injection cryo-module (at 123 MeV)
- Path of extracted beam from RF separator to the Lambertson septum for passes one through five.
- Halls A, B and C.

Appendix A details the organization of the above-mentioned repository.

[1] Parts of the design not included will be noted where necessary.

3 Description of Optics and Rationale

3.1 Overview of the Lattice

The optical lattice for the 12 GeV upgrade of CEBAF is a natural evolution from the original 6 GeV optical lattice, modified by the following new constraints.

Increased Bending and Focusing Strengths of Magnets

The increase in design energy from 6 GeV to 12 GeV demands stronger bending and focusing from the magnets. While in the arcs this can be achieved by modifying the dipoles to reduce saturation [1], in several locations in the spreaders, recombiners, and re-injection chicane longer dipoles must be installed to achieve desired bending. The need for quadrupole upgrades affects scattered areas throughout the machine, as detailed in [1].

Delivery of 5.5-Pass Beam to Experiment

A new beam separation scheme allowing a six-way separation out of the North Linac is a major feature of the 12 GeV upgrade. This is motivated by an additional line transporting the highest-energy (12.113 GeV) beam to Hall D, the new experimental facility to be located northeast of the accelerator. The sixth-pass beamline will branch out of the northeast spreader at an elevation 0.5 m below the linac axis. This implies staged separation of the last three passes using septum magnets—versus the last two now—while attending to tolerances on trajectory clearance inside septa and dispersion suppression within the existing longitudinal space.

Linac Energy Profile

The 12 GeV CEBAF linacs maintain the original design of a 120-degree FODO lattice with constant focal length for the first pass. The upgraded North and South Linacs each have five new 100 MeV cryomodules. These are placed in the five available zones at the end of both linacs.

Globally Optimized Beam Envelope

Due to a different linac energy profile, with energy gain developing more slowly along the linac for lower passes, the additional highest energy pass, and the significantly increased beam size due to synchrotron radiation, an optimization program was carried out to achieve optimal balance between lower and higher pass β functions [2-4]. The global optics thus obtained differs from that of the 6 GeV design in that the β function for the last two passes on the north side (recombiner-linac-spreader) is significantly reduced at the expense of the second pass. This results in reduced beam size and optical sensitivity at higher passes where emittance is large. As a reality check the same optimization program has been used to generate a commensurate lattice for the 6 GeV CEBAF, which demonstrated sustainable beam delivery to 5-pass experimental targets for several weeks [5].

3.2 Injector

The beam energy coming out of the Injector for the 12 GeV upgrade is 123 MeV. This is necessary to maintain the existing geometry in the spreaders and recombiners as energy gain is raised to 1090 MeV per linac. The two cryomodules currently installed in CEBAF are each capable of delivering in excess of 30 MV. The second of those cryomodules will be replaced with an existing upgraded cryomodule capable of producing ~100 MV of acceleration. The injection line at 123 MeV after the second cryomodule undergoes modification needed to accommodate the added final Arc and Recombiner in the northwest corner.

Realistic Parmela simulated beam entering this section was used to ensure that design lattice at the beginning part of the North Linac, critical to the global optimization program mentioned above, is not affected by the new Injection line design. The answer was in the affirmative [6].

3.3 Linac

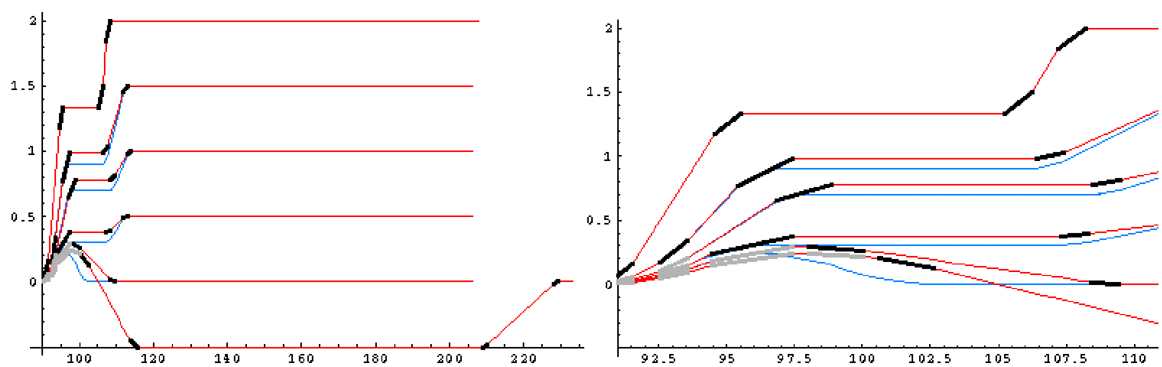
The number of cryomodules will be increased to 25 for each linac (five at 100 MeV and twenty at 29.5 MeV). Baseline configuration has the 5 higher-gradient cryomodules placed at the high-energy end of both North and South Linacs. Evaluation of the optics changes as a function of the placement of higher-gradient cryomodules in the North Linac can be found in [2-4].

3.4 Northeast Spreader and Southeast Recombiner

The northeast spreader (east spreader) and southeast recombiner (east recombiner) have undergone extensive modification from the existing 6 GeV CEBAF design to handle increased beam energy and an additional 5.5-pass beamline out of the North Linac [7]. Figure 1 shows two side views of this upgraded six-way separation by the east spreader, where bends bringing the sixth-pass beam back to the linac axis are also shown. The resulting magnet layouts are shown in Figure 2 and verify that there are no interferences between magnets.

The main deviation of the 12 GeV east spreader from the original can be summarized as follows.

Separation Scheme



Red: 12 GeV geometry, Blue: Existing 6 GeV geometry
Black: Main bending dipoles, Grey: Vertical extent of black dipole directly above
All lengths in meters. Linac axis at Y=0.

Figure 1. Two side views of the six-way separation by east spreader.

With the additional beam, extra septum magnets (YRs) are introduced to perform staged separation. A 3 m YR magnet bends passes four through six downward, away from the third pass. A second 2 m YR magnet bends the last two passes further downward. And finally a third 2 m YR magnet bends the sixth-pass beam still further downward. The sixth-pass beam is drifted to 0.5 m below the linac axis before being brought parallel to it by the next dipole.

Lengthened Dipoles

Several dipoles have increased in length for the 12 GeV design to handle higher-energy beam. The AM and AN dipoles of the second and third pass are replaced with 2 m AV and AU style curved dipoles. Other lengthened magnets include the YRs mentioned above, and a 2 m dipole to bring the sixth-pass beam parallel with the linac axis.

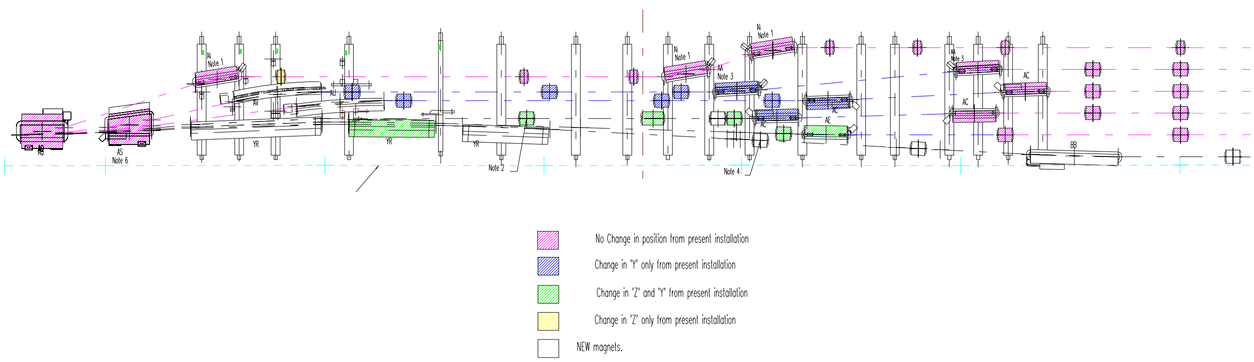


Figure 2. Layout of upgraded northeast spreader.

The east recombiner is a less-than-perfect mirror image of the east spreader, insofar as hardware-clearance driven modifications and the sixth pass are not considered.

3.5 Northwest Spreader and Southwest Recombiner

The west end spreader and recombiner geometry and lattice have been finalized in the most recent round of optics design, concluding the global definition of 5.5 pass 12 GeV lattice excluding lower-pass extraction. Apart from modifications dictated by hardware interferences, major deviations from the 6 GeV design in the west recombiner include the following:

- Additional 5th pass to transport beam from Arc 10 to the North Linac for a sixth time.
- Use of a 2-meter vertical dipole in place of the two 1-meter dipoles in the final chicane exiting Recombiner 10.

The west spreader is a less-than-perfect mirror image of the west recombiner, insofar as hardware-clearance driven modifications are not considered. As in the recombiner, it uses a 2-meter vertical dipole in place of the two 1-meter dipoles in contrast to the 6 GeV layout.

3.6 Existing Arcs

Optical design for the first to the ninth arc followed the design used at 6 GeV. Virtues of the current arcs such as second-order achromaticity[2] and linear isochronicity are kept intact, as well as the magnitudes of the matched beta functions.

3.7 Arc 10 and West Spreader/Recombiner

Arc 10 is composed of four super-periods analogous to the lower arcs, providing second-order achromaticity and linear isochronicity. One new 4 m dipole design is needed for Arc 10 and is also used in the Hall D transport. The design will be a C style magnet similar to the common arc dipoles and operate at 0.9 T [8].

3.8 Hall D Transport

A lattice has been designed to separate sixth-pass beam at the end of the North Linac and take it to hall D [9]. The beam angles upward at 10 degrees, changing the beam height by 5.2 m finally ending up 1.25 m below grade. Three quad triplets and one dispersion correction quad are used to compensate for the incoming dispersion in the ramp. All but the last are strongly excited. The large incoming horizontal emittance and the need to focus the virtual beam 75 m from the radiator to maximize photon polarization require the large increase in horizontal beta function in the final quadruplet. The lattice is shown in Figure 3. Beam envelopes are shown in Figure 3.

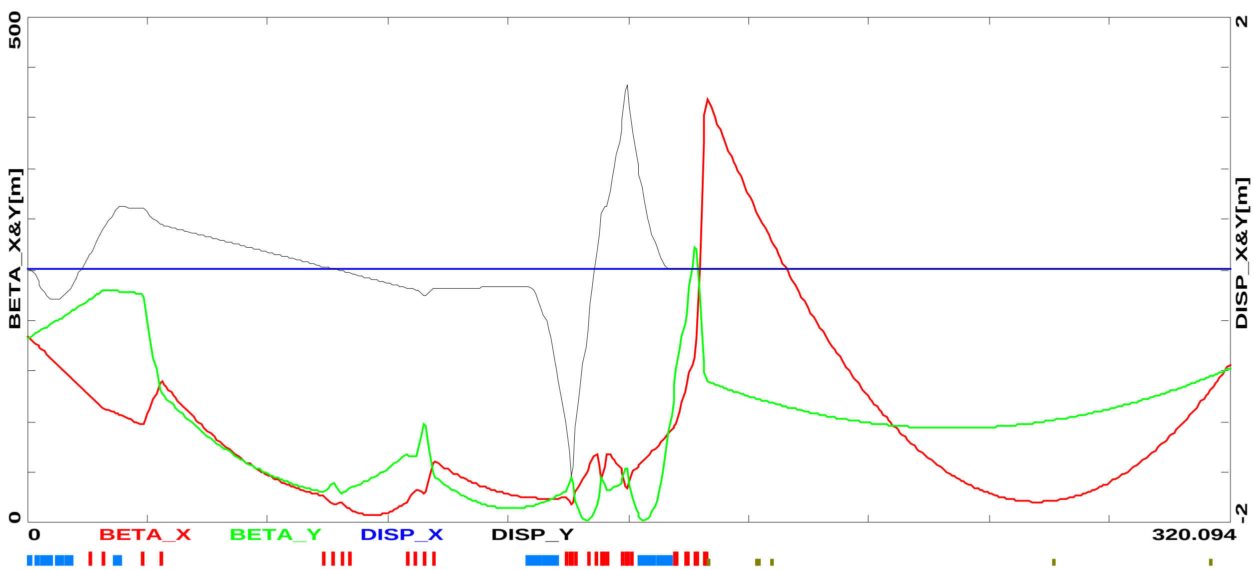


Figure 3. Hall D Transport Lattice

3.9 Coil Pack Compensation for Synchrotron Radiation Induced Energy Loss

In passing through each recirculation arc, the beam will lose energy from synchrotron radiation. The greatest loss is in arc 10 (11023 MeV/c), where the beam will lose approximately 16 MeV in energy (0.5 MeV in each of the 32 dipoles). This relative energy loss is 4.5e-5 per dipole, or 1.5e-3 across the complete arc. Various means of compensation, ranging from matching the dipole buss to the average beam energy to supplying shunting power supplies to compensate

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[2] Except in Arcs 1 and 2.

each dipole individually, have been considered, but one appeared clearly superior from both economic and operational vantage points. The total number of amp-turns in the Arc 10 dipole magnets will be approximately (40*460) 18400. To remain matched to the beam energy, each successive dipole requires 0.8 fewer amp-turns. This is very reasonably accomplished in the second magnet by a single small-gauge copper conductor. The first dipole of the 32 in Arc 10 will be matched to the average energy of the beam. The second dipole will be matched by adding a single turn of (e.g.) #16 wire to its coil pack, opposing the main coils. The third dipole will have two turns, the fourth three turns, and so forth. Powering them all in series with a single power supply compensates all of the dipoles for cumulative energy loss. The current required in the conductor is defined by the energy loss per dipole. This provides a single control parameter means of compensation of each arc, which is adjustable for any beam energy.

4 Magnet Range

4.1 Dipoles

Requirement for main dipole range demands that they can be operated at field strengths spanning the range from 50% to 100% of the design.

4.2 Quadrupoles

Quadrupole range was dictated by the 12 GeV design lattice and the need for a reasonable headroom to perform optical tuning. The latter was determined by a "shortest focal length" paradigm [10] based on typical optics in the tuning regions, and operational experience from 6 GeV CEBAF[3]. This was based on two observations:

- Matching quad changes needed to counteract a typical optical error are usually of the same order of magnitude, in terms of absolute BDL, for all quads used, which is roughly proportional to beam momentum.
- The strongest quads in all major CEBAF matching sections all correspond to a focal length of about 3 m, independent of momentum.

The basic matching quad tuning range, applied to all quads in any particular section, was thus set at 30% of the quad with a 3 m focal length at the momentum of interest. The 30% number is concluded from extensive experience of matching the beam at CEBAF.

A smaller percentage of the full quad strength was used for quads used for functions other than matching. These are usually smaller, again based on extensive experience of CEBAF operation.

A safety margin of 15% is imposed on all non-tuning quads.

[3] The original application of this paradigm was done in 2004-2005. Most recent iteration and finalization happened in 2007 between A. Freyberger, M. Wiseman and Y. Chao.

4.3 Correctors

The corrector magnet range for the 12 GeV design were arrived at by a study of the eight save sets of a 5.75 GeV setup of the existing CEBAF accelerator. The eight sets were taken between October 2004 and January 2005. The average and RMS of the eight data sets was determined. The required field for 12 GeV operations was taken to be the scaled absolute value of the mean plus 3 standard deviations. For the new lines, ArcA, HallD, existing lines were used as templates and scaled to the appropriate energy (Arc8 scaled to ArcA, Hall-B scaled to Hall-D). Improvements on corrector location and required strengths beyond the scaled 6 GeV data is taken from calculations contained in the next section; Optimized Orbit Correction Configuration.

Appendix B summarizes the range requirements on all quadrupoles and correctors.

5 Beam Sizes and Aperture Occupancy

5.1 Beam size from simulation

The horizontal RMS beam size in the spreaders-arc-recombiner sections of the 12 GeV optics design is shown in Figure 4. Evident in this plot is the large dispersive optics in the first two arcs, damping of the emittance due to energy gain in the lower passes, the emittance growth due to synchrotron radiation in the higher passes and the large beta values required to match the Linacs in the higher passes. The beam size grows to near 1mm RMS at the end of the ArcA recombiner.

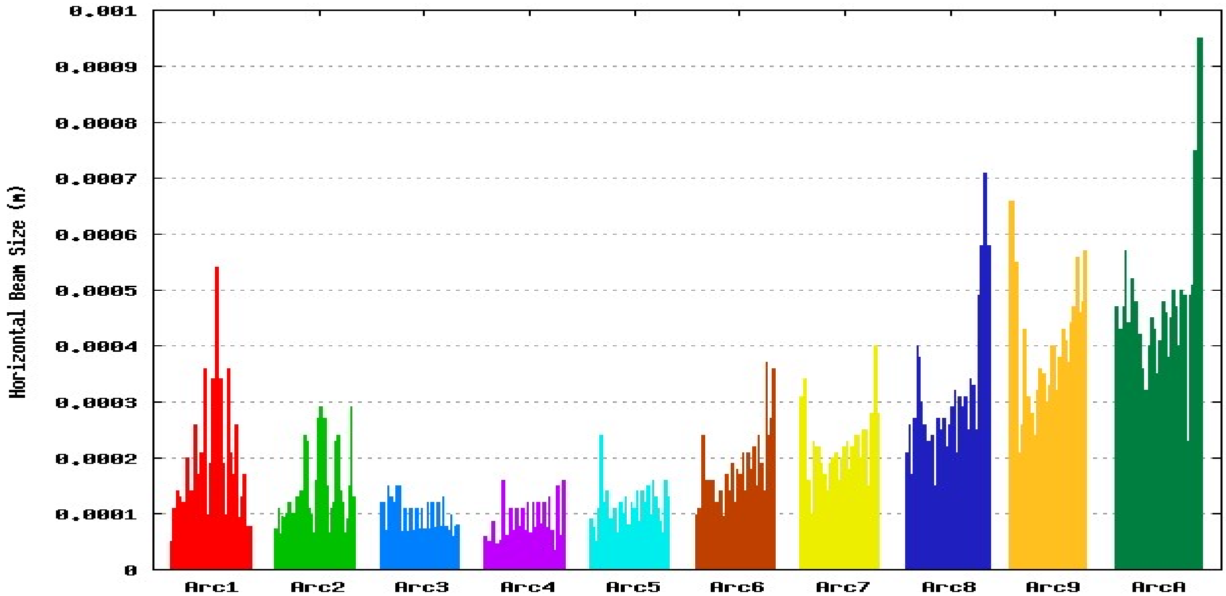

Figure 4. Horizontal Beam Size

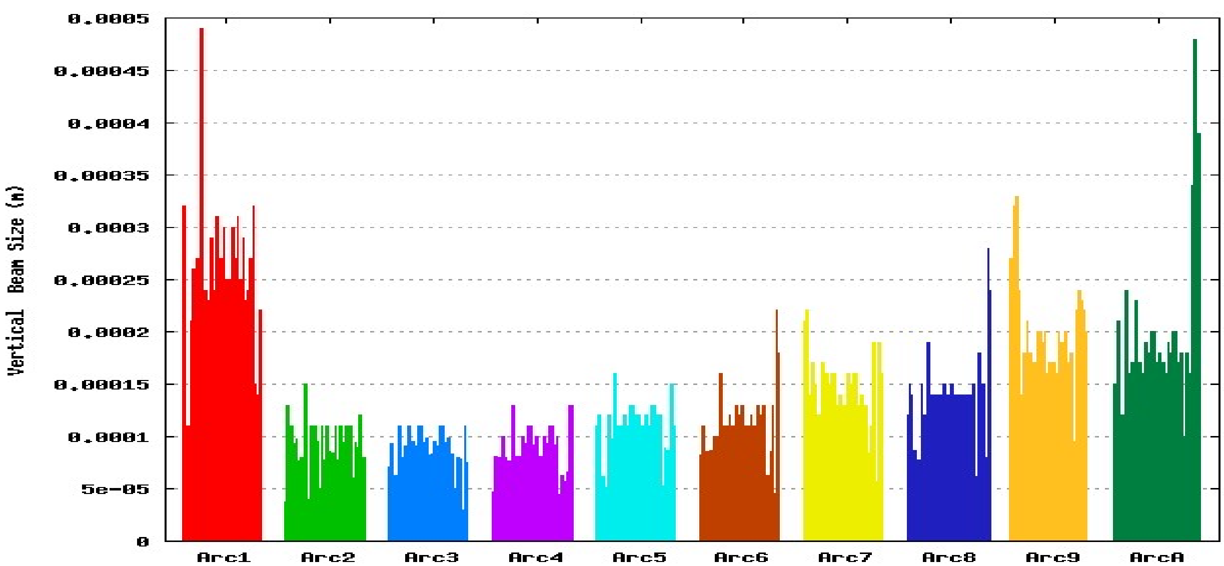

Figure 5. Vertical Beam Size

The RMS vertical beam size in each of the spreader-arc-recombiner sections is shown in Figure 5. The amount of emittance growth due to synchrotron radiation is not as great in the horizontal plane, however there is some vertical growth due to the synchrotron radiationin the spreaders and recombiners. As in the horizontal plane the largest vertical beam size (0.5mm) is at the end of the ArcA recombiner.

5.2 Beam Occupancy Requirements:

The beam occupancy for *runmode* operations is defined as: 4♦+*orbit*+*pathlength_adjustmen*t divided by the half-aperture. The *pathlength_adjustment* of 1.8mm is required in ArcA only, and allows for a orbital pathlength shift in the Arc. This pathlength adjustment is needed to adjust for seasonal variation in the length of the machine. The *orbit* is the allowed transverse orbit and the value of 1mm is used. Figure 6 shows the resulting beam occupancy in percent of half-aperture. The pattern closely follows that of the beam size with the notable exception of ArcA, where larger bore quadrupole magnets in the arc proper reduce the occupancy. This plot is for the design orbit, accounting for off design beam parameters, transverse misalignments of elements, non-linear fields or other effects is not included. For some safety margin the value of occupancy based on this calculation should not exceed 50%. The locations with maximum occupancy are in the Arc8 and ArcA recombiner sections and limited to a few quadrupole magnet locations.

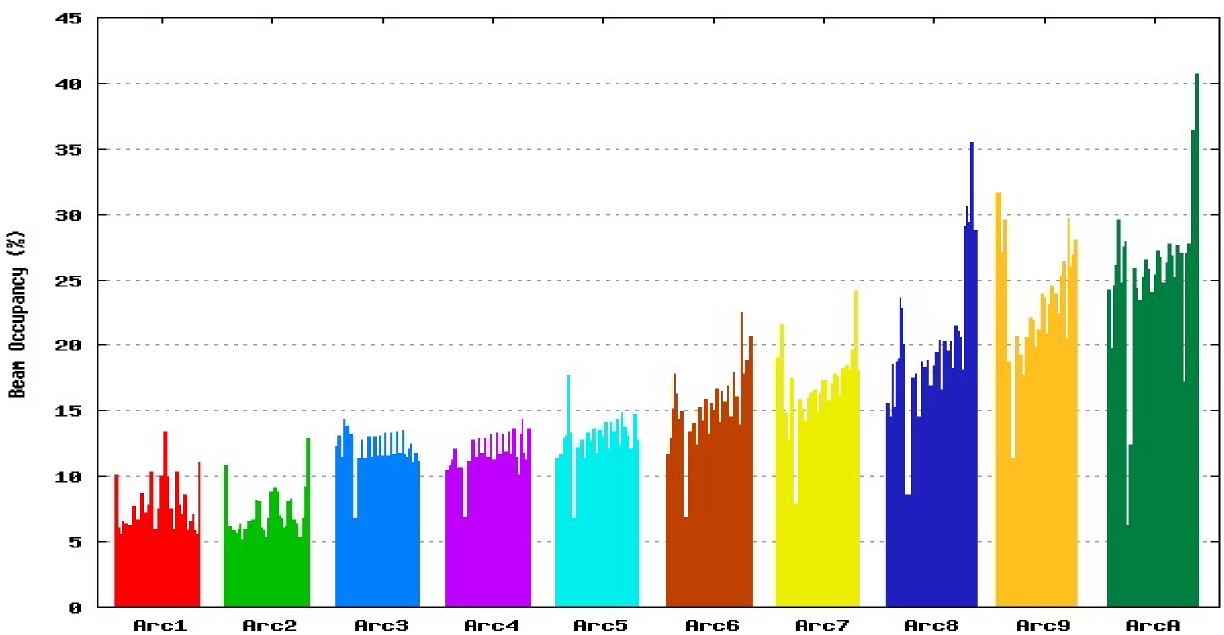

Figure 6. Occupancy with 1 mm orbit

References

[1]. Chapter 3, Interim Point Design for the CEBAF 12 GeV Upgrade, 25 May, 1999. .
[2]. Y. Chao, “Preliminary Design for the Recirculated Injector of CEBAF 12 GeV Upgrade”, Jlab-TN-05-003.
[3]. Y. Chao, “Study of Optimized Multiple Pass Linac Beam Profile and Matching to Spreaders and Recombiners”, Jlab-TN-99-036
[4]. Y. Chao, “Improved Optimization of North Linac Momentum Profile for CEBAF 12 GeV Upgrade”, Jlab-TN-05-004
[5]. Y. Chao, “Testing Rationale of 12 GeV Globally Optimized Optics in 6 GeV CEBAF”, JLAB-TN-06-014
[6]. Y. Chao, “123 MeV Injection Chicane and Compatibility with Global Optics for 12 GeV CEBAF”, JLAB-TN-07-027.
[7]. Y. Chao, “Design of Vertical Separation Schemes for the CEBAF 12 GeV Upgrade Extraction Lines”, Jlab-TN-05-005
[8]. R. Wines, “4 m Dipole Specification for the 12 GeV Upgrade”, JLAB-TN-05-034
[9] J. Benesch, “Hall D Optics Design” JLAB-TN-03-027.
[10]. Y. Chao, “Rationale for Quadrupole Range Requirements for 12 GeV CEBAF”, JLAB-TN-07-028.
[11]. Y. Chao, “Evaluation and Optimization of Orbit Correction System Configuration of 12 GeV CEBAF”**,** JLAB-TN-06-015
[12]. Y. Chao, “Optimized Orbit Correction System Configuration for 12 GeV CEBAF”, JLAB-TN-07-026

Appendix A. Organization of the Design Optics Repository

All files, documents and computer programs used in the 12 GeV upgrade beam physics design are managed with the "subversion" revision control system (http://subversion.tigris.org). The subversion system allows tracking of all changes to files as well as temporal tagging so that one can always revert to a previous well defined state. The subversion system installation and repository are maintained by the JLAB Computer Center staff. It is backed up every night.

The "tag" associated with the accelerator layout as of this review is: LEHMAN2007_decks. The dimad decks can be found in https://svncasa.jlab.org/repos/12GeV/dimad_decks/tags/LEHMAN2007_decks. The corresponding Optim decks can be found in https://svncasa.jlab.org/repos/12GeV/optim_deck/tags/LEHMAN2007_decks.

Appendix B. Range Requirements on Quadrupoles and Correctors

Quadrupoles

Arc1:

Name	Type	K (m^ -2)	L (m)	Gradient kgauss/cm	BL kgauss-cm/cm	F (m)	Integrated Gradient needed (kg/cm)cm
MQB1S01	QB	-1.24	0.15	-0.49	-7.42	5.4	9.84
MQB1S02	QB	1.76	0.15	0.71	10.6	3.78	13.02
MQB1S03	QB	-2.49	0.15	-1	-14.97	2.67	17.40
MQB1S04	QB	-2.94	0.15	-1.18	-17.63	2.27	21.67
MQB1S05	QB	2.7	0.15	1.08	16.21	2.47	20.26
MQB1S06	QB	-0.34	0.15	-0.14	-2.06	19.47	6.10
MQB1S07	QB	-1.89	0.15	-0.76	-11.36	3.52	15.41
MQB1S08	QB	1.58	0.15	0.63	9.48	4.22	13.52
MQB1S09	QB	-1.41	0.15	-0.57	-8.49	4.72	12.53
MQB1S10	QB	0.61	0.15	0.25	3.69	10.86	7.73
MQB1E01	QB	-0.37	0.15	-0.15	-2.24	17.86	2.46
MQB1E02	QB	0.56	0.15	0.22	3.34	11.98	3.68
MQB1E03	QB	-0.61	0.15	-0.25	-3.68	10.87	4.05
MQB1A01	QB	1.19	0.15	0.48	7.17	5.58	7.89
MQB1A02	QB	-0.39	0.15	-0.16	-2.35	17.06	2.58
MQB1A03	QB	-1.12	0.15	-0.45	-6.74	5.94	7.41
MQB1A04	QB	2.12	0.15	0.85	12.71	3.15	13.98
MQB1A05	QB	-0.85	0.15	-0.34	-5.08	7.89	5.58
MQB1A06	QB	0.83	0.15	0.33	5	8.01	5.50
MQB1A07	QB	-0.85	0.15	-0.34	-5.1	7.85	5.61
MQB1A08	QB	1.56	0.15	0.62	9.36	4.28	10.30
MQB1A09	QB	-0.76	0.15	-0.3	-4.55	8.8	5.00
MQB1A11	QB	1.22	0.15	0.49	7.32	5.47	8.05
MQB1A13	QB	-0.9	0.15	-0.36	-5.39	7.43	5.93
MQB1A14	QB	1.4	0.15	0.56	8.38	4.78	9.22
MQB1A15	QB	-0.85	0.15	-0.34	-5.13	7.8	5.64
MQB1A16	QB	0.57	0.15	0.23	3.43	11.68	3.77
MQB1A17	QB	-1.01	0.15	-0.4	-6.04	6.63	6.65
MQB1A18	QB	1.34	0.15	0.54	8.05	4.97	8.85
MQB1A19	QB	-0.59	0.15	-0.24	-3.54	11.3	3.90
MQB1A21	QB	0.79	0.15	0.32	4.75	8.43	5.23
MQB1A23	QB	-0.59	0.15	-0.24	-3.54	11.3	3.90
MQB1A24	QB	1.34	0.15	0.54	8.05	4.97	8.85
MQB1A25	QB	-1.01	0.15	-0.4	-6.04	6.63	6.65
MQB1A26	QB	0.57	0.15	0.23	3.43	11.68	3.77
MQB1A27	QB	-0.85	0.15	-0.34	-5.13	7.8	5.64
MQB1A28	QB	1.4	0.15	0.56	8.38	4.78	9.22
MQB1A29	QB	-0.9	0.15	-0.36	-5.39	7.43	5.93
MQB1A31	QB	1.22	0.15	0.49	7.32	5.47	8.05
MQB1A33	QB	-0.76	0.15	-0.3	-4.55	8.8	5.00
MQB1A34	QB	1.56	0.15	0.62	9.36	4.28	10.30
MQB1A35	QB	-0.85	0.15	-0.34	-5.1	7.85	5.61
MQB1A36	QB	0.83	0.15	0.33	5	8.01	5.50
MQB1A37	QB	-0.85	0.15	-0.34	-5.08	7.89	5.58
MQB1A38	QB	2.12	0.15	0.85	12.71	3.15	13.98
MQB1A39	QB	-1.12	0.15	-0.45	-6.74	5.94	7.41
MQB1A40	QB	0.9	0.15	0.36	5.43	7.37	5.97
MQB1R01	QB	0.46	0.15	0.18	2.76	14.48	8.04
MQB1R02	QB	-1.7	0.15	-0.68	-10.19	3.93	15.46
MQB1R03	QB	1.8	0.15	0.72	10.82	3.7	16.09
MQB1R04	QB	-1.97	0.15	-0.79	-11.81	3.39	17.08
MQB1R05	QB	-0.35	0.15	-0.14	-2.08	19.23	7.36
MQB1R06	QB	2.8	0.15	1.12	16.82	2.38	22.09
MQB1R07	QB	-2.87	0.15	-1.15	-17.24	2.32	22.52
MQB1R08	QB	-2.43	0.15	-0.97	-14.61	2.74	17.04
MQB1R09	QB	1.77	0.15	0.71	10.6	3.78	13.02
MQB1R10	QB	-1.12	0.15	-0.45	-6.73	5.95	9.16

Arc2:

Name	Type	K	L	Gradient	BL	Fadient needed	
		(m^ -2)	(m)	kgauss/cm	kgauss-cm/cm	(m)	(kg/cm)cm
MQB2S01	QB	-1.35	0.15	-1.04	-15.57	4.93	20.18
MQC2S02	QC	1.25	0.3	0.96	28.82	2.66	33.43
MQC2S03	QC	-1.46	0.3	-1.12	-33.7	2.28	38.31
MQC2S04	QC	-1.14	0.3	-0.87	-26.19	2.93	33.87
MQC2S05	QC	0.83	0.3	0.63	19.04	4.03	26.72
MQC2S06	QC	0	0.3	0	-0.07	1058.02	7.75
MQC2S07	QC	0	0.3	0	0.05	1479.71	7.73
MQC2S08	QC	-0.31	0.3	-0.24	-7.1	10.8	14.78
MQC2S09	QC	0	0.3	0	0.01	6703.76	7.69
MQC2S10	QC	0.31	0.3	0.24	7.13	10.76	14.81
MQB2E01	QB	-0.53	0.15	-0.41	-6.08	12.62	6.69
MQB2E02	QB	0.57	0.15	0.44	6.53	11.74	7.19
MQB2E03	QB	-0.67	0.15	-0.51	-7.72	9.94	8.49
MQC2A01	QC	0.4	0.3	0.3	9.15	8.39	10.06
MQC2A02	QC	0.05	0.3	0.04	1.14	67.11	1.26
MQC2A03	QC	-0.62	0.3	-0.48	-14.26	5.38	15.68
MQC2A04	QC	1.22	0.3	0.93	28.02	2.74	30.82
MQC2A05	QC	-0.5	0.3	-0.38	-11.55	6.64	12.70
MQC2A06	QC	0.53	0.3	0.41	12.29	6.24	13.52
MQC2A07	QC	-0.51	0.3	-0.39	-11.74	6.53	12.92
MQC2A08	QC	1.05	0.3	0.8	24.13	3.18	26.54
MQC2A09	QC	-0.44	0.3	-0.34	-10.19	7.53	11.21
MQC2A11	QC	0.51	0.3	0.39	11.78	6.51	12.95
MQC2A13	QC	-0.57	0.3	-0.44	-13.14	5.84	14.46
MQC2A14	QC	1.08	0.3	0.83	24.86	3.09	27.35
MQC2A15	QC	-0.39	0.3	-0.3	-8.99	8.53	9.89
MQC2A16	QC	0.38	0.3	0.3	8.86	8.66	9.74
MQC2A17	QC	-0.44	0.3	-0.34	-10.16	7.55	11.17
MQC2A18	QC	0.55	0.3	0.42	12.69	6.04	13.96
MQC2A19	QC	-0.28	0.3	-0.21	-6.37	12.04	7.01
MQC2A21	QC	0.27	0.3	0.21	6.27	12.24	6.89
MQC2A23	QC	-0.28	0.3	-0.21	-6.37	12.04	7.01
MQC2A24	QC	0.55	0.3	0.42	12.69	6.04	13.96
MQC2A25	QC	-0.44	0.3	-0.34	-10.16	7.55	11.17
MQC2A26	QC	0.38	0.3	0.3	8.86	8.66	9.74
MQC2A27	QC	-0.39	0.3	-0.3	-8.99	8.53	9.89
MQC2A28	QC	1.08	0.3	0.83	24.86	3.09	27.35
MQC2A29	QC	-0.57	0.3	-0.44	-13.14	5.84	14.46
MQC2A31	QC	0.51	0.3	0.39	11.78	6.51	12.95
MQC2A33	QC	-0.44	0.3	-0.34	-10.19	7.53	11.21
MQC2A34	QC	1.05	0.3	0.8	24.13	3.18	26.54
MQC2A35	QC	-0.51	0.3	-0.39	-11.74	6.53	12.92
MQC2A36	QC	0.53	0.3	0.41	12.29	6.24	13.52
MQC2A37	QC	-0.5	0.3	-0.38	-11.55	6.64	12.70
MQC2A38	QC	1.22	0.3	0.93	28.02	2.74	30.82
MQC2A39	QC	-0.62	0.3	-0.48	-14.26	5.38	15.68
MQC2A40	QC	0.17	0.3	0.13	3.88	19.79	4.26
MQC2R01	QC	1.04	0.3	0.8	23.87	3.21	33.89
MQC2R02	QC	-1.8	0.3	-1.38	-41.53	1.85	51.55
MQC2R03	QC	2.11	0.3	1.62	48.55	1.58	58.57
MQC2R04	QC	-1.9	0.3	-1.46	-43.67	1.76	53.68
MQC2R05	QC	1.25	0.3	0.96	28.81	2.66	38.82
MQC2R06	QC	-2.49	0.3	-1.91	-57.27	1.34	67.29
MQC2R07	QC	0.63	0.3	0.49	14.59	5.26	24.60
MQC2R08	QC	-1.46	0.3	-1.12	-33.6	2.28	38.21
MQC2R09	QC	1.25	0.3	0.96	28.82	2.66	33.43
MQB2R10	QB	-1.36	0.15	-1.04	-15.6	4.92	20.20

Arc3:

Name	Type	K	L	Gradient	BL	Fadient needed	
		(m^ -2)	(m)	kgauss/cm	kgauss-cm/cm	(m)	(kg/cm)cm
MQA3S01	QA	-0.71	0.3	-0.81	-24.32	4.66	31.11
MQA3S02	QA	1.01	0.3	1.14	34.34	3.3	41.13
MQA3S03	QA	-1.26	0.3	-1.43	-42.82	2.65	49.61
MQA3S04	QA	-1.6	0.3	-1.81	-54.3	2.09	65.62
MQA3S05	QA	1.25	0.3	1.41	42.39	2.68	53.70
MQA3S06	QA	0.51	0.3	0.58	17.26	6.57	28.57
MQA3S07	QA	-1.45	0.3	-1.64	-49.24	2.3	60.56
MQA3S08	QA	1.65	0.3	1.87	55.98	2.03	67.29
MQA3S09	QA	-1.48	0.3	-1.68	-50.35	2.25	61.66
MQA3S10	QA	1.12	0.3	1.27	38.19	2.97	49.50
MQB3E01	QB	-0.69	0.15	-0.78	-11.67	9.71	12.84
MQB3E02	QB	0.68	0.15	0.77	11.6	9.78	12.76
MQB3E03	QB	-0.69	0.15	-0.78	-11.67	9.71	12.84
ıould be Qas							
MQU3A01	QU	0.52	0.3	0.59	17.73	6.4	19.51
MQU3A02	QU	-0.57	0.3	-0.64	-19.34	5.86	21.27
MQU3A03	QU	1.02	0.3	1.16	34.84	3.26	36.93
MQU3A04	QU	-0.57	0.3	-0.64	-19.34	5.86	21.27
MQU3A05	QU	0.45	0.3	0.52	15.46	7.34	17.01
MQU3A06	QU	-0.57	0.3	-0.64	-19.34	5.86	21.27
MQU3A07	QU	1.02	0.3	1.16	34.84	3.26	36.93
MQU3A08	QU	-0.57	0.3	-0.64	-19.34	5.86	21.27
MQU3A09	QU	0.61	0.3	0.7	20.89	5.43	22.98
MQU3A10	QU	-0.57	0.3	-0.64	-19.34	5.86	21.27
MQU3A11	QU	1.02	0.3	1.16	34.84	3.26	36.93
MQU3A12	QU	-0.57	0.3	-0.64	-19.34	5.86	21.27
MQU3A13	QU	0.45	0.3	0.52	15.46	7.34	17.01
MQU3A14	QU	-0.57	0.3	-0.64	-19.34	5.86	21.27
MQU3A15	QU	1.02	0.3	1.16	34.84	3.26	36.93
MQU3A16	QU	-0.57	0.3	-0.64	-19.34	5.86	21.27
MQU3A17	QU	0.61	0.3	0.7	20.89	5.43	22.98
MQU3A18	QU	-0.57	0.3	-0.64	-19.34	5.86	21.27
MQU3A19	QU	1.02	0.3	1.16	34.84	3.26	36.93
MQU3A20	QU	-0.57	0.3	-0.64	-19.34	5.86	21.27
MQU3A21	QU	0.45	0.3	0.52	15.46	7.34	17.01
MQU3A22	QU	-0.57	0.3	-0.64	-19.34	5.86	21.27
MQU3A23	QU	1.02	0.3	1.16	34.84	3.26	36.93
MQU3A24	QU	-0.57	0.3	-0.64	-19.34	5.86	21.27
MQU3A25	QU	0.61	0.3	0.7	20.89	5.43	22.98
MQU3A26	QU	-0.57	0.3	-0.64	-19.34	5.86	21.27
MQU3A27	QU	1.02	0.3	1.16	34.84	3.26	36.93
MQU3A28	QU	-0.57	0.3	-0.64	-19.34	5.86	21.27
MQU3A29	QU	0.45	0.3	0.52	15.46	7.34	17.01
MQU3A30	QU	-0.57	0.3	-0.64	-19.34	5.86	21.27
MQU3A31	QU	1.02	0.3	1.16	34.84	3.26	36.93
MQU3A32	QU	-0.57	0.3	-0.64	-19.34	5.86	21.27
MQA3R01	QA	0.76	0.3	0.87	26	4.36	40.76
MQA3R02	QA	-1.42	0.3	-1.61	-48.41	2.34	63.17
MQA3R03	QA	0.65	0.3	0.73	22	5.16	36.76
MQA3R04	QA	-0.92	0.3	-1.04	-31.23	3.63	45.99
MQA3R05	QA	0.01	0.3	0.01	0.42	271.98	15.17
MQA3R06	QA	1.01	0.3	1.15	34.52	3.28	49.28
MQA3R07	QA	-0.88	0.3	-0.99	-29.82	3.8	44.58
MQA3R08	QA	-1.26	0.3	-1.43	-42.93	2.64	49.71
MQA3R09	QA	1	0.3	1.13	34.02	3.33	40.81
MQA3R10	QA	-0.71	0.3	-0.81	-24.28	4.67	31.07

Arc4:

Name	Type	K (m^ -2)	L (m)	Gradient kgauss/cm	BL kgauss-cm/cm	Fated (m)	Gradient needed (kg/cm)cm
MQA4S01	QA	-0.72	0.3	-1.07	-32.2	4.66	41.17
MQA4S02	QA	1.21	0.3	1.81	54.42	2.76	63.39
MQA4S03	QA	-1.5	0.3	-2.25	-67.4	2.23	76.37
MQA4S04	QA	-0.72	0.3	-1.08	-32.32	4.64	47.27
MQA4S05	QA	1.26	0.3	1.89	56.69	2.65	71.64
MQA4S06	QA	-0.63	0.3	-0.95	-28.59	5.25	43.54
MQA4S07	QA	0	0.3	-0.01	-0.16	935.79	15.11
MQA4S08	QA	-0.18	0.3	-0.26	-7.92	18.94	22.87
MQA4S09	QA	-0.01	0.3	-0.01	-0.24	637.95	15.19
MQA4S10	QA	0.28	0.3	0.42	12.62	11.89	27.57
MQB4E01	QB	-0.46	0.15	-0.69	-10.38	14.47	11.41
MQB4E02	QB	0.59	0.15	0.88	13.27	11.31	14.60
MQB4E03	QB	-0.66	0.15	-1	-14.96	10.04	16.45
MQA4A01	QA	0.48	0.3	0.72	21.54	6.97	23.70
MQA4A02	QA	-0.57	0.3	-0.85	-25.64	5.85	28.20
MQA4A03	QA	1	0.3	1.49	44.82	3.35	47.50
MQA4A04	QA	-0.57	0.3	-0.85	-25.64	5.85	28.20
MQA4A05	QA	0.46	0.3	0.69	20.71	7.25	22.79
MQA4A06	QA	-0.57	0.3	-0.85	-25.64	5.85	28.20
MQA4A07	QA	1	0.3	1.49	44.82	3.35	47.50
MQA4A08	QA	-0.57	0.3	-0.85	-25.64	5.85	28.20
MQA4A09	QA	0.61	0.3	0.91	27.44	5.47	30.18
MQA4A10	QA	-0.57	0.3	-0.85	-25.64	5.85	28.20
MQA4A11	QA	1	0.3	1.49	44.82	3.35	47.50
MQA4A12	QA	-0.57	0.3	-0.85	-25.64	5.85	28.20
MQA4A13	QA	0.46	0.3	0.69	20.71	7.25	22.79
MQA4A14	QA	-0.57	0.3	-0.85	-25.64	5.85	28.20
MQA4A15	QA	1	0.3	1.49	44.82	3.35	47.50
MQA4A16	QA	-0.57	0.3	-0.85	-25.64	5.85	28.20
MQA4A17	QA	0.61	0.3	0.91	27.44	5.47	30.18
MQA4A18	QA	-0.57	0.3	-0.85	-25.64	5.85	28.20
MQA4A19	QA	1	0.3	1.49	44.82	3.35	47.50
MQA4A20	QA	-0.57	0.3	-0.85	-25.64	5.85	28.20
MQA4A21	QA	0.46	0.3	0.69	20.71	7.25	22.79
MQA4A22	QA	-0.57	0.3	-0.85	-25.64	5.85	28.20
MQA4A23	QA	1	0.3	1.49	44.82	3.35	47.50
MQA4A24	QA	-0.57	0.3	-0.85	-25.64	5.85	28.20
MQA4A25	QA	0.61	0.3	0.91	27.44	5.47	30.18
MQA4A26	QA	-0.57	0.3	-0.85	-25.64	5.85	28.20
MQA4A27	QA	1	0.3	1.49	44.82	3.35	47.50
MQA4A28	QA	-0.57	0.3	-0.85	-25.64	5.85	28.20
MQA4A29	QA	0.46	0.3	0.69	20.71	7.25	22.79
MQA4A30	QA	-0.57	0.3	-0.85	-25.64	5.85	28.20
MQA4A31	QA	1	0.3	1.49	44.82	3.35	47.50
MQA4A32	QA	-0.57	0.3	-0.85	-25.64	5.85	28.20
MQA4R01	QA	1.03	0.3	1.55	46.45	3.23	65.95
MQA4R02	QA	-1.56	0.3	-2.34	-70.34	2.13	89.84
MQA4R03	QA	1.92	0.3	2.89	86.65	1.73	106.15
MQA4R04	QA	-1.83	0.3	-2.75	-82.57	1.82	102.07
MQA4R05	QA	0.07	0.3	0.11	3.2	46.87	22.70
MQA4R06	QA	1.56	0.3	2.34	70.26	2.14	89.76
MQA4R07	QA	-1.39	0.3	-2.08	-62.47	2.4	81.97
MQA4R08	QA	-1.49	0.3	-2.24	-67.26	2.23	76.23
MQA4R09	QA	1.08	0.3	1.62	48.52	3.09	57.49
MQA4R10	QA	-0.72	0.3	-1.07	-32.23	4.66	41.20

Arc5:

Name	Type	K	L	Gradient	BL	Fıdient needed	
		(m^ -2)	(m)	kgauss/cm	kgauss-cm/cm	(m)	(kg/cm)cm
MQA5S01	QA	-0.54	0.3	-1	-30	6.23	41.15
MQA5S02	QA	1.09	0.3	2.04	61.17	3.05	72.32
MQA5S03	QA	-1.69	0.3	-3.16	-94.82	1.97	105.97
MQA5S04	QA	-1.8	0.3	-3.36	-100.91	1.85	119.50
MQA5S05	QA	1.82	0.3	3.4	102.15	1.83	120.73
MQA5S06	QA	-1.05	0.3	-1.96	-58.83	3.18	77.41
MQA5S07	QA	-1.35	0.3	-2.51	-75.42	2.48	94.01
MQA5S08	QA	1.51	0.3	2.82	84.62	2.21	103.20
MQA5S09	QA	-1.27	0.3	-2.37	-71.08	2.63	89.66
MQA5S10	QA	0.92	0.3	1.73	51.83	3.6	70.42
MQB5E01	QB	-0.66	0.15	-1.23	-18.5	10.1	20.35
MQB5E02	QB	0.71	0.15	1.32	19.81	9.43	21.79
MQB5E03	QB	-0.65	0.15	-1.22	-18.27	10.22	20.10
MQA5A01	QA	0.48	0.3	0.89	26.65	7.01	29.31
MQA5A02	QA	-0.59	0.3	-1.1	-32.9	5.68	36.19
MQA5A03	QA	1.06	0.3	1.98	59.37	3.15	62.93
MQA5A04	QA	-0.59	0.3	-1.1	-32.9	5.68	36.19
MQA5A05	QA	0.45	0.3	0.85	25.44	7.34	27.98
MQA5A06	QA	-0.59	0.3	-1.1	-32.9	5.68	36.19
MQA5A07	QA	1.06	0.3	1.98	59.37	3.15	62.93
MQA5A08	QA	-0.59	0.3	-1.1	-32.9	5.68	36.19
MQA5A09	QA	0.59	0.3	1.1	32.86	5.69	36.14
MQA5A10	QA	-0.59	0.3	-1.1	-32.9	5.68	36.19
MQA5A11	QA	1.06	0.3	1.98	59.37	3.15	62.93
MQA5A12	QA	-0.59	0.3	-1.1	-32.9	5.68	36.19
MQA5A13	QA	0.45	0.3	0.85	25.44	7.34	27.98
MQA5A14	QA	-0.59	0.3	-1.1	-32.9	5.68	36.19
MQA5A15	QA	1.06	0.3	1.98	59.37	3.15	62.93
MQA5A16	QA	-0.59	0.3	-1.1	-32.9	5.68	36.19
MQA5A17	QA	0.59	0.3	1.1	32.86	5.69	36.14
MQA5A18	QA	-0.59	0.3	-1.1	-32.9	5.68	36.19
MQA5A19	QA	1.06	0.3	1.98	59.37	3.15	62.93
MQA5A20	QA	-0.59	0.3	-1.1	-32.9	5.68	36.19
MQA5A21	QA	0.45	0.3	0.85	25.44	7.34	27.98
MQA5A22	QA	-0.59	0.3	-1.1	-32.9	5.68	36.19
MQA5A23	QA	1.06	0.3	1.98	59.37	3.15	62.93
MQA5A24	QA	-0.59	0.3	-1.1	-32.9	5.68	36.19
MQA5A25	QA	0.59	0.3	1.1	32.86	5.69	36.14
MQA5A26	QA	-0.59	0.3	-1.1	-32.9	5.68	36.19
MQA5A27	QA	1.06	0.3	1.98	59.37	3.15	62.93
MQA5A28	QA	-0.59	0.3	-1.1	-32.9	5.68	36.19
MQA5A29	QA	0.45	0.3	0.85	25.44	7.34	27.98
MQA5A30	QA	-0.59	0.3	-1.1	-32.9	5.68	36.19
MQA5A31	QA	1.06	0.3	1.98	59.37	3.15	62.93
MQA5A32	QA	-0.59	0.3	-1.1	-32.9	5.68	36.19
MQA5R01	QA	0.59	0.3	1.1	33.14	5.64	57.38
MQA5R02	QA	-0.5	0.3	-0.93	-27.77	6.73	52.01
MQA5R03	QA	0.47	0.3	0.87	26.2	7.13	50.44
MQA5R04	QA	-0.47	0.3	-0.87	-26.19	7.13	50.43
MQA5R05	QA	-0.43	0.3	-0.81	-24.16	7.73	48.41
MQA5R06	QA	1.32	0.3	2.46	73.77	2.53	98.02
MQA5R07	QA	-0.95	0.3	-1.78	-53.35	3.5	77.60
MQA5R08	QA	-1.7	0.3	-3.18	-95.35	1.96	106.50
MQA5R09	QA	1.09	0.3	2.04	61.29	3.05	72.44
MQA5R10	QA	-0.55	0.3	-1.02	-30.62	6.1	41.77

Arc6:

Name	Type	K (m^-2)	L (m)	Gradient kgauss/cm	BL kgauss-cm/cm	F (m)	Gradient needed (kg/cm)cm
MQA6S01	QA	-0.7	0.3	-1.62	-48.71	4.79	62.04
MQA6S02	QA	1.17	0.3	2.73	81.77	2.86	95.1
MQA6S03	QA	-1.64	0.3	-3.84	-115.18	2.03	128.51
MQA6S04	QA	-0.71	0.3	-1.66	-49.7	4.7	71.91
MQA6S05	QA	1.11	0.3	2.59	77.55	3.01	99.77
MQA6S06	QA	-0.5	0.3	-1.16	-34.9	6.69	57.11
MQA6S07	QA	-0.01	0.3	-0.03	-0.94	249.67	23.15
MQA6S08	QA	-0.3	0.3	-0.7	-21.12	11.06	43.33
MQA6S09	QA	-0.01	0.3	-0.02	-0.5	469.5	22.71
MQA6S10	QA	0.37	0.3	0.85	25.64	9.11	47.85
MQC6E01	QC	-0.29	0.3	-0.68	-20.27	11.52	22.3
MQC6E02	QC	0.32	0.3	0.74	22.26	10.49	24.49
MQC6E03	QC	-0.33	0.3	-0.77	-23.08	10.12	25.39
MQA6A01	QA	0.5	0.3	1.16	34.84	6.7	38.33
MQA6A02	QA	-0.57	0.3	-1.34	-40.16	5.81	44.18
MQA6A03	QA	1.02	0.3	2.38	71.43	3.27	75.72
MQA6A04	QA	-0.57	0.3	-1.34	-40.16	5.81	44.18
MQA6A05	QA	0.46	0.3	1.08	32.28	7.23	35.5
MQA6A06	QA	-0.57	0.3	-1.34	-40.16	5.81	44.18
MQA6A07	QA	1.02	0.3	2.38	71.43	3.27	75.72
MQA6A08	QA	-0.57	0.3	-1.34	-40.16	5.81	44.18
MQA6A09	QA	0.59	0.3	1.37	41.22	5.66	45.35
MQA6A10	QA	-0.57	0.3	-1.34	-40.16	5.81	44.18
MQA6A11	QA	1.02	0.3	2.38	71.43	3.27	75.72
MQA6A12	QA	-0.57	0.3	-1.34	-40.16	5.81	44.18
MQA6A13	QA	0.46	0.3	1.08	32.28	7.23	35.5
MQA6A14	QA	-0.57	0.3	-1.34	-40.16	5.81	44.18
MQA6A15	QA	1.02	0.3	2.38	71.43	3.27	75.72
MQA6A16	QA	-0.57	0.3	-1.34	-40.16	5.81	44.18
MQA6A17	QA	0.59	0.3	1.37	41.22	5.66	45.35
MQA6A18	QA	-0.57	0.3	-1.34	-40.16	5.81	44.18
MQA6A19	QA	1.02	0.3	2.38	71.43	3.27	75.72
MQA6A20	QA	-0.57	0.3	-1.34	-40.16	5.81	44.18
MQA6A21	QA	0.46	0.3	1.08	32.28	7.23	35.5
MQA6A22	QA	-0.57	0.3	-1.34	-40.16	5.81	44.18
MQA6A23	QA	1.02	0.3	2.38	71.43	3.27	75.72
MQA6A24	QA	-0.57	0.3	-1.34	-40.16	5.81	44.18
MQA6A25	QA	0.59	0.3	1.37	41.22	5.66	45.35
MQA6A26	QA	-0.57	0.3	-1.34	-40.16	5.81	44.18
MQA6A27	QA	1.02	0.3	2.38	71.43	3.27	75.72
MQA6A28	QA	-0.57	0.3	-1.34	-40.16	5.81	44.18
MQA6A29	QA	0.46	0.3	1.08	32.28	7.23	35.5
MQA6A30	QA	-0.57	0.3	-1.34	-40.16	5.81	44.18
MQA6A31	QA	1.02	0.3	2.38	71.43	3.27	75.72
MQA6A32	QA	-0.57	0.3	-1.34	-40.16	5.81	44.18
MQA6R01	QA	1.09	0.3	2.55	76.55	3.05	105.52
MQA6R02	QA	-1.18	0.3	-2.76	-82.69	2.82	111.67
MQA6R03	QA	1.28	0.3	2.99	89.66	2.6	118.63
MQA6R04	QA	-1.96	0.3	-4.58	-137.46	1.7	166.43
MQA6R05	QA	1.48	0.3	3.46	103.87	2.25	132.85
MQA6R06	QA	-0.09	0.3	-0.21	-6.42	36.39	35.39
MQA6R07	QA	-1.05	0.3	-2.45	-73.36	3.18	102.33
MQA6R08	QA	-1.63	0.3	-3.81	-114.42	2.04	127.75
MQA6R09	QA	1.24	0.3	2.9	86.96	2.69	100.29
MQA6R10	QA	-0.67	0.3	-1.55	-46.59	5.01	59.92

Arc7:

Name	Type	K	L	Gradient	BL	F	adient needed
		(m^ -2)	(m)	kgauss/cm	kgauss-cm/cm	(m)	(kg/cm)cm
MQA7S01	QA	-1.15	0.3	-3.06	-91.7	2.91	107.21
MQR7S02	QR	1.12	0.5	2.98	149.09	1.79	164.6
MQA7S03	QA	-1.48	0.3	-3.96	-118.79	2.25	134.3
MQA7S03A	QA	-1.48	0.3	-3.96	-118.79	2.25	134.3
MQA7S04	QA	-0.64	0.3	-1.71	-51.36	5.2	77.21
MQA7S05	QA	1.46	0.3	3.89	116.68	2.29	142.53
MQA7S06	QA	-1.11	0.3	-2.97	-89.19	2.99	115.04
MQA7S07	QA	0.13	0.3	0.36	10.69	24.95	36.55
MQR7S08	QR	1.07	0.5	2.84	142.18	1.88	168.03
MQA7S09	QA	-1.13	0.3	-3.02	-90.57	2.95	116.43
MQA7S10	QA	0.84	0.3	2.25	67.43	3.96	93.28
MQC7E01	QC	-0.27	0.3	-0.98	-29.39	12.48	32.33
MQC7E02	QC	0.22	0.3	0.8	23.86	15.38	26.24
MQC7E03	QC	-0.35	0.3	-1.28	-38.33	9.57	42.16
MQA7A01	QA	0.41	0.3	1.11	33.19	8.04	36.51
MQA7A02	QA	-0.59	0.3	-1.57	-47.1	5.67	51.81
MQA7A03	QA	1.08	0.3	2.89	86.79	3.07	92
MQA7A04	QA	-0.59	0.3	-1.57	-47.1	5.67	51.81
MQA7A05	QA	0.47	0.3	1.25	37.58	7.1	41.34
MQA7A06	QA	-0.59	0.3	-1.57	-47.1	5.67	51.81
MQA7A07	QA	1.08	0.3	2.89	86.79	3.07	92
MQA7A08	QA	-0.59	0.3	-1.57	-47.1	5.67	51.81
MQA7A09	QA	0.58	0.3	1.55	46.62	5.72	51.28
MQA7A10	QA	-0.59	0.3	-1.57	-47.1	5.67	51.81
MQA7A11	QA	1.08	0.3	2.89	86.79	3.07	92
MQA7A12	QA	-0.59	0.3	-1.57	-47.1	5.67	51.81
MQA7A13	QA	0.47	0.3	1.25	37.58	7.1	41.34
MQA7A14	QA	-0.59	0.3	-1.57	-47.1	5.67	51.81
MQA7A15	QA	1.08	0.3	2.89	86.79	3.07	92
MQA7A16	QA	-0.59	0.3	-1.57	-47.1	5.67	51.81
MQA7A17	QA	0.58	0.3	1.55	46.62	5.72	51.28
MQA7A18	QA	-0.59	0.3	-1.57	-47.1	5.67	51.81
MQA7A19	QA	1.08	0.3	2.89	86.79	3.07	92
MQA7A20	QA	-0.59	0.3	-1.57	-47.1	5.67	51.81
MQA7A21	QA	0.47	0.3	1.25	37.58	7.1	41.34
MQA7A22	QA	-0.59	0.3	-1.57	-47.1	5.67	51.81
MQA7A23	QA	1.08	0.3	2.89	86.79	3.07	92
MQA7A24	QA	-0.59	0.3	-1.57	-47.1	5.67	51.81
MQA7A25	QA	0.58	0.3	1.55	46.62	5.72	51.28
MQA7A26	QA	-0.59	0.3	-1.57	-47.1	5.67	51.81
MQA7A27	QA	1.08	0.3	2.89	86.79	3.07	92
MQA7A28	QA	-0.59	0.3	-1.57	-47.1	5.67	51.81
MQA7A29	QA	0.47	0.3	1.25	37.58	7.1	41.34
MQA7A30	QA	-0.59	0.3	-1.57	-47.1	5.67	51.81
MQA7A31	QA	1.08	0.3	2.89	86.79	3.07	92
MQA7A32	QA	-0.59	0.3	-1.57	-47.1	5.67	51.81
MQA7R01	QA	0.78	0.3	2.07	62.17	4.29	95.89
MQA7R02	QA	-0.42	0.3	-1.11	-33.28	8.02	67
MQA7R03	QA	0.11	0.3	0.29	8.64	30.88	42.36
MQA7R04	QA	0.03	0.3	0.07	2.07	129.2	35.78
MQA7R05	QA	-0.73	0.3	-1.94	-58.09	4.59	91.81
MQA7R06	QA	1.25	0.3	3.33	100.01	2.67	133.73
MQA7R07	QA	-0.68	0.3	-1.82	-54.53	4.89	88.25
MQA7R08	QA	-1.24	0.3	-3.31	-99.35	2.69	114.86
MQA7R08A	QA	-1.24	0.3	-3.31	-99.35	2.69	114.86
MQR7R09	QR	0.93	0.5	2.48	124.07	2.15	139.58
MQA7R10	QA	-1.01	0.3	-2.69	-80.84	3.3	96.35

Arc8:

Name	Type	K (m^ -2)	L (m)	Gradient kgauss/cm	BL kgauss-cm/cm	F (m)	Integrated Gradient needed (kg/cm)cm
MQA8S01	QA	-0.79	0.3	-2.38	-71.32	4.21	89.01
MQA8S02	QA	1.11	0.3	3.34	100.15	3	117.84
MQR8S03	QR	-0.93	0.5	-2.79	-139.37	2.15	157.06
MQA8S04	QA	-1.1	0.3	-3.3	-99.09	3.03	128.58
MQA8S04A	QA	0	0.3	0	0	1000000	29.49
MQA8S05	QA	0.69	0.3	2.07	62.03	4.84	91.52
MQA8S05A	QA	0	0.3	0	0	1000000	29.49
MQA8S06	QA	0.51	0.3	1.52	45.67	6.57	75.16
MQA8S06A	QA	0.51	0.3	1.52	45.67	6.57	75.16
MQA8S07	QA	-0.89	0.3	-2.68	-80.28	3.74	109.77
MQA8S07A	QA	-0.89	0.3	-2.68	-80.28	3.74	109.77
MQA8S08	QA	1	0.3	2.99	89.81	3.34	119.29
MQA8S08A	QA	1	0.3	2.99	89.81	3.34	119.29
MQA8S09	QA	-0.85	0.3	-2.54	-76.3	3.93	105.79
MQA8S09A	QA	-0.85	0.3	-2.54	-76.3	3.93	105.79
MQA8S10	QA	0.7	0.3	2.11	63.2	4.75	92.69
MQA8S10A	QA	0.7	0.3	2.11	63.2	4.75	92.69
							0.00
MQC8E01	QC	-0.37	0.3	-1.36	-40.89	8.97	44.98
MQC8E02	QC	0.35	0.3	1.29	38.66	9.49	42.53
MQC8E03	QC	-0.33	0.3	-1.22	-36.63	10.02	40.29
							0.00
MQA8A01	QA	0.47	0.3	1.42	42.72	7.03	46.99
MQA8A02	QA	-0.58	0.3	-1.73	-51.91	5.78	57.10
MQA8A03	QA	1.02	0.3	3.06	91.94	3.27	97.46
MQA8A04	QA	-0.58	0.3	-1.73	-51.91	5.78	57.10
MQA8A05	QA	0.46	0.3	1.39	41.77	7.19	45.94
MQA8A06	QA	-0.58	0.3	-1.73	-51.91	5.78	57.10
MQA8A07	QA	1.02	0.3	3.06	91.94	3.27	97.46
MQA8A08	QA	-0.58	0.3	-1.73	-51.91	5.78	57.10
MQA8A09	QA	0.59	0.3	1.77	53.24	5.64	58.56
MQA8A10	QA	-0.58	0.3	-1.73	-51.91	5.78	57.10
MQA8A11	QA	1.02	0.3	3.06	91.94	3.27	97.46
MQA8A12	QA	-0.58	0.3	-1.73	-51.91	5.78	57.10
MQA8A13	QA	0.46	0.3	1.39	41.77	7.19	45.94
MQA8A14	QA	-0.58	0.3	-1.73	-51.91	5.78	57.10
MQA8A15	QA	1.02	0.3	3.06	91.94	3.27	97.46
MQA8A16	QA	-0.58	0.3	-1.73	-51.91	5.78	57.10
MQA8A17	QA	0.59	0.3	1.77	53.24	5.64	58.56
MQA8A18	QA	-0.58	0.3	-1.73	-51.91	5.78	57.10
MQA8A19	QA	1.02	0.3	3.06	91.94	3.27	97.46
MQA8A20	QA	-0.58	0.3	-1.73	-51.91	5.78	57.10
MQA8A21	QA	0.46	0.3	1.39	41.77	7.19	45.94
MQA8A22	QA	-0.58	0.3	-1.73	-51.91	5.78	57.10
MQA8A23	QA	1.02	0.3	3.06	91.94	3.27	97.46
MQA8A24	QA	-0.58	0.3	-1.73	-51.91	5.78	57.10
MQA8A25	QA	0.59	0.3	1.77	53.24	5.64	58.56
MQA8A26	QA	-0.58	0.3	-1.73	-51.91	5.78	57.10
MQA8A27	QA	1.02	0.3	3.06	91.94	3.27	97.46
MQA8A28	QA	-0.58	0.3	-1.73	-51.91	5.78	57.10
MQA8A29	QA	0.46	0.3	1.39	41.77	7.19	45.94
MQA8A30	QA	-0.58	0.3	-1.73	-51.91	5.78	57.10
MQA8A31	QA	1.02	0.3	3.06	91.94	3.27	97.46
MQA8A32	QA	-0.58	0.3	-1.73	-51.91	5.78	57.10
							0.00
							0.00
MQA8R01	QA	1.2	0.3	3.6	108.12	2.78	146.58
MQA8R01A	QA	0	0.3	0	0	1000000	38.46
MQA8R02	QA	-1.29	0.3	-3.87	-116.23	2.58	154.69
MQA8R02A	QA	0	0.3	0	0	1000000	38.46
MQA8R03	QA	0.68	0.3	2.03	61.04	4.92	99.50
MQA8R03A	QA	0.68	0.3	2.03	61.04	4.92	99.50
MQA8R04	QA	-1.13	0.3	-3.4	-102.04	2.94	140.50
MQA8R04A	QA	-1.13	0.3	-3.4	-102.04	2.94	140.50
MQA8R05	QA	0.5	0.3	1.51	45.3	6.63	83.76
MQA8R05A	QA	0.5	0.3	1.51	45.3	6.63	83.76
MQA8R06	QA	0.4	0.3	1.19	35.65	8.42	74.12
MQA8R06A	QA	0	0.3	0	0	1000000	38.46
MQA8R07	QA	-1.02	0.3	-3.07	-91.99	3.26	130.45
MQA8R07A	QA	0	0.3	0	0	1000000	38.46
MQR8R08	QR	-0.93	0.5	-2.8	-139.99	2.14	157.68
MQA8R09	QA	1.11	0.3	3.34	100.3	2.99	117.99
MQA8R10	QA	-0.79	0.3	-2.38	-71.28	4.21	88.97

Arc9:

Quad	Type?	Dimad K	Dimad L	Gradient	Bl	Focal length	Integrated Gradient needed
		M^ -2	M	kgauss/cm	kgauss-cm/cm	M	(kg/cm)cm
MQA9S01	QA	0	0.3	0	0.07	4919.39	6.51
MQA9S02	QA	-0.33	0.3	-1.1	-32.99	10.11	39.43
MQA9S03	QA	0.54	0.3	1.8	54.01	6.18	68.18
MQA9S04	QA	-0.3	0.3	-1.01	-30.22	11.04	44.39
MQA9S05	QA	0	0.3	0	0.12	2669.91	14.30
MQA9S06	QA	0.59	0.3	1.98	59.53	5.6	73.70
MQC9E01	QC	-0.3	0.3	-1.1	-33.06	11.1	36.37
MQC9E02	QC	0.3	0.3	1.1	33.06	11.1	36.37
MQC9E03	QC	-0.3	0.3	-1.1	-33.06	11.1	36.37
							0.00
							0.00
							0.00
MQA9A01	QA	0.49	0.3	1.62	48.74	6.84	53.62
MQA9A02	QA	-0.59	0.3	-1.98	-59.27	5.63	65.20
MQA9A03	QA	1.08	0.3	3.6	107.93	3.09	114.41
MQA9A04	QA	-0.59	0.3	-1.98	-59.27	5.63	65.20
MQA9A05	QA	0.46	0.3	1.53	45.93	7.26	50.52
MQA9A06	QA	-0.59	0.3	-1.98	-59.27	5.63	65.20
MQA9A07	QA	1.08	0.3	3.6	107.93	3.09	114.41
MQA9A08	QA	-0.59	0.3	-1.98	-59.27	5.63	65.20
MQA9A09	QA	0.58	0.3	1.93	57.8	5.77	63.58
MQA9A10	QA	-0.59	0.3	-1.98	-59.27	5.63	65.20
MQA9A11	QA	1.08	0.3	3.6	107.93	3.09	114.41
MQA9A12	QA	-0.59	0.3	-1.98	-59.27	5.63	65.20
MQA9A13	QA	0.46	0.3	1.53	45.93	7.26	50.52
MQA9A14	QA	-0.59	0.3	-1.98	-59.27	5.63	65.20
MQA9A15	QA	1.08	0.3	3.6	107.93	3.09	114.41
MQA9A16	QA	-0.59	0.3	-1.98	-59.27	5.63	65.20
MQA9A17	QA	0.58	0.3	1.93	57.8	5.77	63.58
MQA9A18	QA	-0.59	0.3	-1.98	-59.27	5.63	65.20
MQA9A19	QA	1.08	0.3	3.6	107.93	3.09	114.41
MQA9A20	QA	-0.59	0.3	-1.98	-59.27	5.63	65.20
MQA9A21	QA	0.46	0.3	1.53	45.93	7.26	50.52
MQA9A22	QA	-0.59	0.3	-1.98	-59.27	5.63	65.20
MQA9A23	QA	1.08	0.3	3.6	107.93	3.09	114.41
MQA9A24	QA	-0.59	0.3	-1.98	-59.27	5.63	65.20
MQA9A25	QA	0.58	0.3	1.93	57.8	5.77	63.58
MQA9A26	QA	-0.59	0.3	-1.98	-59.27	5.63	65.20
MQA9A27	QA	1.08	0.3	3.6	107.93	3.09	114.41
MQA9A28	QA	-0.59	0.3	-1.98	-59.27	5.63	65.20
MQA9A29	QA	0.46	0.3	1.53	45.93	7.26	50.52
MQA9A30	QA	-0.59	0.3	-1.98	-59.27	5.63	65.20
MQA9A31	QA	1.08	0.3	3.6	107.93	3.09	114.41
MQA9A32	QA	-0.59	0.3	-1.98	-59.27	5.63	65.20
							0.00
							0.00
MQA9R01	QA	0.48	0.3	1.61	48.18	6.92	62.35
MQA9R02	QA	0.44	0.3	1.46	43.73	7.63	57.90
MQA9R03	QA	-0.51	0.3	-1.7	-51.07	6.53	65.24
MQA9R04	QA	0.69	0.3	2.29	68.55	4.87	82.72
MQA9R05	QA	-0.33	0.3	-1.11	-33.44	9.97	47.61
MQA9R06	QA	0	0.3	0	-0.04	8	6.48
MQA9R07	QA	0	0.3	0	0.07	4985.65	6.51

Arc10:

Type?	DIMAD K	DIMAD L	Gradient kg/cm	Bl	Focal length (m)	Integrated Gradient needed (kg/cm)cm
QA	-0.77	0.3	-2.82	-84.55	4.34	98.38
QA	0.57	0.3	2.09	62.81	5.84	76.63
QA	-0.84	0.3	-3.07	-92.14	3.98	105.96
QA	0.04	0.3	0.16	4.72	77.69	37.08
QA	0.73	0.3	2.69	80.7	4.55	113.06
QA	-0.89	0.3	-3.26	-97.82	3.75	130.18
QA	0.7	0.3	2.57	77.23	4.75	109.59
QA	0.74	0.3	2.73	81.81	4.49	114.17
QA	-0.98	0.3	-3.59	-107.85	3.4	140.21
QA	0.66	0.3	2.41	72.3	5.07	104.66
QA	0.54	0.3	2	59.87	6.13	92.23
QC	-0.37	0.3	-1.36	-40.89	8.97	44.98
QC	0.35	0.3	1.29	38.66	9.49	42.53
QC	-0.33	0.3	-1.22	-36.63	10.02	40.29
QP	0.47	0.3	1.73	52.02	7.05	57.22
QP	-0.57	0.3	-2.11	-63.21	5.8	69.53
QP	1.03	0.3	3.76	112.83	3.25	119.60
QP	-0.57	0.3	-2.11	-63.21	5.8	69.53
QP	0.47	0.3	1.74	52.18	7.03	57.40
QP	-0.57	0.3	-2.11	-63.21	5.8	69.53
QP	1.03	0.3	3.76	112.83	3.25	119.60
QP	-0.57	0.3	-2.11	-63.21	5.8	69.53
QP	0.6	0.3	2.19	65.64	5.59	72.20
QP	-0.57	0.3	-2.11	-63.21	5.8	69.53
QP	1.03	0.3	3.76	112.83	3.25	119.60
QP	-0.57	0.3	-2.11	-63.21	5.8	69.53
QP	0.47	0.3	1.74	52.18	7.03	57.40
QP	-0.57	0.3	-2.11	-63.21	5.8	69.53
QP	1.03	0.3	3.76	112.83	3.25	119.60
QP	-0.57	0.3	-2.11	-63.21	5.8	69.53
QP	0.6	0.3	2.19	65.64	5.59	72.20
QP	-0.57	0.3	-2.11	-63.21	5.8	69.53
QP	1.03	0.3	3.76	112.83	3.25	119.60
QP	-0.57	0.3	-2.11	-63.21	5.8	69.53
QP	0.47	0.3	1.74	52.18	7.03	57.40
QP	-0.57	0.3	-2.11	-63.21	5.8	69.53
QP	1.03	0.3	3.76	112.83	3.25	119.60
QP	-0.57	0.3	-2.11	-63.21	5.8	69.53
QP	0.6	0.3	2.19	65.64	5.59	72.20
QP	-0.57	0.3	-2.11	-63.21	5.8	69.53
QP	1.03	0.3	3.76	112.83	3.25	119.60
QP	-0.57	0.3	-2.11	-63.21	5.8	69.53
QP	0.47	0.3	1.74	52.18	7.03	57.40
QP	-0.57	0.3	-2.11	-63.21	5.8	69.53
QP	1.03	0.3	3.76	112.83	3.25	119.60
QP	-0.57	0.3	-2.11	-63.21	5.8	69.53
QR	0.72	0.5	2.64	132.14	2.78	151.96
QA	-0.99	0.3	-3.64	-109.14	3.36	125.51
QA	-0.91	0.3	-3.35	-100.44	3.65	115.51
QA	0.88	0.3	3.25	97.37	3.77	147.56
QA	0.91	0.3	3.33	99.87	3.67	150.06
QR	-0.91	0.5	-3.35	-167.27	2.19	217.46
QA	-0.97	0.3	-3.57	-107.14	3.42	157.33
QA	0.63	0.3	2.3	68.85	5.33	119.04
QA	0.52	0.3	1.9	57.04	6.43	107.23
QA	-0.99	0.3	-3.63	-109.01	3.37	159.20
QA	0.49	0.3	1.8	53.93	6.8	104.12
QA	-0.35	0.3	-1.29	-38.63	9.5	88.82

Correctors

Cells with red background denote correctors where the 12 GeV required field exceeds the present capability of the install 6 GeV corrector.

Injector:

corrector	Required 12 GeV field
MAT0L06H	566.34
MAT0L06V	174.60
MAT0L07H	135.00
MAT0L07V	67.44
MAT0L08H	111.18
MAT0L08V	65.26
MAT0L09H	176.52
MAT0L09V	50.03
MAT0L10H	697.92
MAT0L10V	160.04
MAT0R01H	40.45
MAT0R01V	194.65
MAT0R02H	104.78
MAT0R02V	7.09
MAT0R03H	70.78
MAT0R03V	76.40
MAT0R03V	76.40
MAT0R04H	567.20
MAT0R04V	23.43
MAT0R04V	23.43
MAT0R05H	50.36
MAT0R05V	178.05
MAT0R06H	186.64
MAT0R06V	60.10
MAT0R07H	197.12
MAT0R07V	330.41

North Linac:

corrector	Required 12 GeV field (gauss-cm)
MAT1L02H	187.66
MAT1L02V	410.27
MAT1L03V	66.21
MAT1L04H	430.54
MAT1L05V	69.14
MAT1L06H	357.11
MAT1L07V	193.27
MAT1L08H	101.32
MAT1L09V	238.28
MAT1L10H	50.16
MAT1L11V	139.98
MAT1L12H	124.78
MAT1L13V	134.91
MAT1L14H	152.69
MAT1L15V	126.36
MAT1L16H	145.40
MAT1L17V	128.93
MAT1L18H	570.79
MAT1L19V	142.70
MAT1L20H	336.81
MAT1L21V	63.25
MAT1L22H	651.65
MAT1L23V	117.55
MAT1L24H	359.78
MAT1L25V	164.62
MAT1L26H	312.19
MAT1L27H	61.52
MAT1L27V	349.31

Arc1:

corrector	Required
	12 GeV field
	(gauss-cm)
MBT1S01H	1191.76
MBT1S01V	1300.81
MBT1S02H	1081.30
MBT1S02V	4626.47
MBT1S05H	695.99
MBT1S05V	1524.57
MBT1S07V	1581.27
MBT1S08V	6355.21
MBT1S09V	4505.84
MBT1S10H	1261.50
MBT1S10V	1594.40
	.00
	.00
	1745.82
	1557.06
MBT1E01H	3788.20
MBT1E01V	1528.87
MBT1E02H	2526.16
MBT1E02V	1401.69
MBT1E03H	1745.82
MBT1E03V	722.34
	.00
	.00
	2154.01
MBT1A01H	1299.92
MBT1A01V	1927.23
MBT1A03V	1032.20
MBT1A04H	534.75
MBT1A05V	1259.76
MBT1A06H	297.98
MBT1A07V	740.61
MBT1A08H	759.42
MBT1A09V	807.19
MBT1A11H	568.98
MBT1A13V	595.22
MBT1A14H	175.70
MBT1A15V	1377.90
MBT1A16H	737.72
MBT1A17V	750.94
MBT1A18H	585.55
MBT1A19V	864.31
MBT1A21H	835.80
MBT1A23V	1503.83
MBT1A24H	207.72
MBT1A25V	1248.20
MBT1A26H	566.30
MBT1A27V	428.65
MBT1A28H	356.67
MBT1A30V	2187.31
MBT1A31H	860.26
MBT1A33V	2495.85
MBT1A34H	1134.33
MBT1A35V	2665.15
MBT1A36H	1256.96
MBT1A37V	360.62
MBT1A38H	1161.90
MBT1A40V	717.32
MBT1R01H	963.91
MBT1R02V	379.32
MBT1R03H	144.44
MBT1R04V	284.73
MBT1R06H	1978.57
MBT1R07V	481.37
MBT1R09H	1014.54
MBT1R10V	362.81
MBT1R10H	5446.60

South Linac:

corrector	Required 12 GeV field (gauss-cm)
MAT2L02V	305.90
MAT2L03H	358.96
MAT2L04V	146.02
MAT2L05H	265.36
MAT2L06V	746.40
MAT2L07H	350.75
MAT2L08V	178.43
MAT2L09H	221.49
MAT2L10V	205.33
MAT2L11H	164.43
MAT2L12V	164.89
MAT2L13H	111.13
MAT2L14V	41.89
MAT2L15H	697.28
MAT2L16V	34.68
MAT2L17H	91.33
MAT2L18V	112.91
MAT2L19H	237.54
MAT2L20V	466.20
MAT2L21H	861.86
MDJ2L22V	328.44
MAT2L24V	284.87
MAT2L25H	475.51
MAT2L26V	703.26

Arc2:

corrector	Required 12 GeV field (gauss-cm)
MBT2S01H	2420.87
MBT2S01V	393.20
MBT2S02H	499.44
MBT2S02V	866.62
MBT2S03H	1071.77
MBT2S03V	.00
MBT2S05H	482.67
MBT2S05V	.00
MBT2S06V	2098.75
MBT2S07H	972.25
MBT2S07V	.00
MBT2S08H	425.37
MBT2S08V	857.76
MBT2S09H	384.86
MBT2S09V	736.13
MBT2S10H	1011.98
MBT2S10V	3295.84
MAT2S10H	.00
	.00
	.00
	1752.71
	611.62
MBT2E01H	3624.69
MBT2E01V	469.42
MBT2E02H	4928.26
MBT2E02V	415.82
MBT2E03H	1729.12
MBT2E03V	520.96
	.00
	.00
	2998.82
MBT2A01H	2731.69
MBT2A01V	927.20
MBT2A03V	2587.12
MBT2A04H	3330.49
MBT2A05V	1754.31
MBT2A06H	2665.49
MBT2A07V	359.59
MBT2A08H	422.02
MBT2A09V	951.22
MBT2A11H	436.44
MBT2A13V	668.89
MBT2A14H	2080.28
MBT2A15V	117.96
MBT2A16H	2447.46
MBT2A17V	290.89
MBT2A18H	732.49
MBT2A19V	428.82
MBT2A21H	1853.94
MBT2A23V	196.86
MBT2A24H	638.10
MBT2A25V	305.89
MBT2A26H	1582.14
MBT2A27V	566.95
MBT2A28H	527.52
MBT2A30V	1216.44
MBT2A31H	2411.60
MBT2A33V	516.45
MBT2A34H	601.01
MBT2A35V	612.24
MBT2A36H	3321.85
MBT2A37V	2492.86
MBT2A38H	1139.67
MBT2A40V	.00
	2051.02
	512.35
	1167.55
MBT2R01H	725.48
MBT2R02V	288.87
MBT2R03H	1842.30
MBT2R04V	1167.55
MBT2R06H	2836.37
MBT2R07V	.00
MBT2R09H	1512.20
MBT2R09V	.00
MBT2R10H	2197.89
MBT2R10V	1703.24

Arc3:

corrector	Required
	12 GeV field
	(gauss-cm)
MBC3S01H	4290.08
MBC3S01V	.00
MBC3S02H	374.17
MBC3S02V	956.78
MBC3S03H	1083.69
MBC3S05H	258.13
MBC3S05V	4456.24
MBC3S07H	582.22
MBC3S07V	1179.59
MBC3S08H	91.01
MBC3S08V	3082.91
MBC3S09H	.00
MBC3S09V	1577.31
MBC3S10H	987.90
MBC3S10V	1745.54
	.00
	.00
	1205.68
	4565.65
MBM3E01H	6441.57
MBM3E01V	2426.16
MBM3E02H	1801.40
MBM3E02V	2096.49
MBM3E03H	1321.21
MBM3E03V	4565.65
	.00
	.00
	4913.55
MBC3A01H	950.35
MBC3A01V	6174.21
MBC3A02V	4898.23
MBC3A03H	2233.76
MBC3A04V	3631.79
MBC3A05H	1407.98
MBC3A06V	1978.80
MBC3A07H	1540.18
MBC3A08V	4180.41
MBC3A09H	2073.54
MBC3A10V	2272.42
MBC3A11H	1763.47
MBC3A12V	4140.62
MBC3A13H	945.09
MBC3A14V	1706.99
MBC3A15H	735.10
MBC3A16V	3280.64
MBC3A17H	2318.18
MBC3A18V	2657.82
MBC3A19H	863.10
MBC3A20V	1510.22
MBC3A21H	1696.36
MBC3A22V	1099.72
MBC3A23H	925.25
MBC3A24V	1967.23
MBC3A25H	1346.77
MBC3A26V	1409.12
MBC3A27H	2371.69
MBC3A28V	912.95
MBC3A29H	1776.85
MBC3A30V	1460.72
MBC3A31H	1792.71
	.00
	.00
	5919.94
	3480.37
	2768.64
MBC3R01H	1405.54
MBC3R02H	2438.98
MBC3R02V	2018.51
MBC3R03H	286.85
MBC3R04H	1343.78
MBC3R04V	.00
MBC3R06H	742.57
MBC3R07V	694.71
MBC3R08H	2895.42
MBC3R09V	5464.80
MBC3R09H	4248.32
MBC3R10V	3920.03
MBC3R10H	5979.88

Arc4:

corrector	Required
	12 GeV field
	(gauss-cm)
MBC4S01H	13453.30
MBC4S01V	5606.49
MBC4S02H	1737.53
MBC4S02V	288.87
MBC4S03H	4032.88
MBC4S03V	1048.53
MBC4S05H	1445.86
MBC4S05V	10390.09
MBC4S07H	.00
MBC4S07V	4484.24
MBC4S08H	.00
MBC4S08V	9674.42
MBC4S09H	.00
MBC4S09V	.00
MBC4S10H	3316.44
MBC4S10V	5772.16
MAT4S10H	.00
	.00
	.00
	2379.81
	2379.68
MBM4E01H	5487.25
MBM4E01V	2379.68
MBM4E02H	11446.25
MBM4E02V	.00
MBM4E03H	2525.88
MBM4E03V	1756.01
	.00
	.00
	5277.78
MBC4A01H	4456.56
MBC4A01V	4345.36
MBC4A02V	2038.78
MBC4A03H	4787.44
MBC4A04V	1486.79
MBC4A05H	2236.30
MBC4A06V	2610.03
MBC4A07H	3104.77
MBC4A08V	253.06
MBC4A09H	2634.67
MBC4A10V	1936.17
MBC4A11H	4310.12
MBC4A12V	2293.85
MBC4A14V	2475.71
MBC4A15H	3224.90
MBC4A16V	563.26
MBC4A17H	4456.92
MBC4A18V	1292.16
MBC4A19H	1463.22
MBC4A20V	2308.72
MBC4A22V	714.83
MBC4A23H	2897.06
MBC4A24V	1474.95
MBC4A25H	4021.96
MBC4A26V	4111.11
MBC4A27H	782.02
MBC4A28V	3844.32
MBC4A29H	4641.35
MBC4A30V	986.95
MBC4A31H	2869.93
	.00
	.00
	2396.14
	6704.77
	3652.71
MBC4R01H	3554.63
MBC4R02H	.00
MBC4R02V	3325.28
MBC4R03H	2425.68
MBC4R04H	5321.47
MBC4R04V	9045.15
MBC4R06H	2536.77
MBC4R07V	1219.68
MBC4R08H	222.81
MBC4R08V	6742.50
MBC4R09H	1172.73
MBC4R10H	439.07
MBC4R10V	3648.19

Arc5:

corrector	Required
	12 GeV field
	(gauss-cm)
MBC5S01H	5746.26
MBC5S01V	4288.18
MBC5S02H	131.66
MBC5S03H	775.66
MBC5S05H	321.12
MBC5S05V	5371.89
MBC5S07H	225.78
MBC5S07V	5141.91
MBC5S08H	.00
MBC5S08V	.00
MBC5S09H	.00
MBC5S09V	.00
MBC5S10H	981.67
MBC5S10V	3187.83
	.00
	.00
	6545.54
	1678.72
MBM5E01H	12.39
MBM5E01V	1678.72
MBM5E02H	6545.54
MBM5E02V	.00
MBM5E03H	833.30
MBM5E03V	39.32
	.00
	.00
	11272.84
MBC5A01H	4590.10
MBC5A01V	11268.90
MBC5A02V	561.81
MBC5A03H	1729.48
MBC5A04V	2420.32
MBC5A05H	5913.87
MBC5A06V	1334.93
MBC5A07H	2502.72
MBC5A08V	2798.30
MBC5A09H	6168.50
MBC5A10V	1176.37
MBC5A11H	3667.86
MBC5A12V	2228.29
MBC5A13H	4549.05
MBC5A14V	1424.60
MBC5A15H	1833.52
MBC5A16V	926.18
MBC5A17H	6468.68
MBC5A18V	412.78
MBC5A19H	3730.20
MBC5A20V	1184.62
MBC5A21H	2516.82
MBC5A22V	1264.13
MBC5A23H	4326.92
MBC5A24V	1691.88
MBC5A25H	4130.79
MBC5A26V	3410.89
MBC5A27H	1155.81
MBC5A28V	3669.02
MBC5A29H	1501.22
MBC5A30V	636.49
MBC5A31H	1200.89
MBC5A32V	448.42
	.00
	.00
	8837.97
	3715.65
	3077.27
MBC5R01H	1500.50
MBC5R02H	461.26
MBC5R02V	1364.02
MBC5R03H	1720.96
MBC5R04H	3058.66
MBC5R04V	2393.59
MBC5R06H	1993.74
MBC5R07V	8113.43
MBC5R08H	4488.83
MBC5R09H	1828.86
MBC5R10V	3715.65
MBC5R10H	8837.97

Arc6:

corrector	Required
	12 GeV field
	(gauss-cm)
MBC6S01H	2502.57
MBC6S01V	4908.18
MBC6S02H	3266.36
MBC6S02V	.00
MBC6S03H	8.86
MBC6S05H	1757.51
MBC6S05V	6378.50
MBC6S07H	93.73
MBC6S07V	.00
MBC6S08H	.00
MBC6S08V	2910.74
MBC6S09H	374.44
MBC6S09V	1831.94
MBC6S10H	3820.02
MBC6S10V	2808.18
MAT6S10H	.00
	.00
	.00
	8564.42
	1178.30
MBM6E01H	925.15
MBM6E01V	581.00
MBM6E02H	10342.92
MBM6E02V	1547.54
MBM6E03H	8564.42
MBM6E03V	1504.76
	.00
	.00
	5359.62
MBC6A01H	9265.00
MBC6A01V	6624.00
MBC6A02V	2606.05
MBC6A03H	3302.20
MBC6A04V	2949.44
MBC6A05H	3711.90
MBC6A06V	1814.66
MBC6A07H	914.40
MBC6A08V	4346.92
MBC6A09H	1295.65
MBC6A10V	6519.84
MBC6A11H	2172.09
MBC6A12V	7435.25
MBC6A13H	7479.03
MBC6A14V	5275.41
MBC6A15H	1847.07
MBC6A16V	429.27
MBC6A17H	5097.87
MBC6A18V	1857.08
MBC6A19H	914.99
MBC6A20V	2531.53
MBC6A21H	7758.34
MBC6A22V	981.53
MBC6A23H	5021.55
MBC6A24V	3073.72
MBC6A25H	7608.35
MBC6A26V	6022.36
MBC6A27H	1582.03
MBC6A28V	5686.72
MBC6A29H	11777.53
MBC6A30V	1789.45
MBC6A31H	5261.93
MBC6A32V	508.26
	.00
	.00
	12663.78
	Err:511
	2912.37
MBC6R01H	3124.96
MBC6R02H	303.91
MBC6R02V	3745.29
MBC6R03H	1542.42
MBC6R04H	2666.54
MBC6R04V	18706.38
MBC6R06H	12663.78
MBC6R07V	648.18
MBC6R08H	.00
MBC6R08V	5596.77
MBC6R09H	1232.63
MBC6R10H	2788.06
MBC6R10V	1249.58

Arc7:

corrector	Required
	12 GeV field
	(gauss-cm)
MBC7S00H	1114.33
MBC7S01V	1965.99
MBC7S02V	2634.43
MBC7S02H	2944.15
MBC7S03V	1310.66
MBC7S05H	3712.72
MBC7S05V	3931.98
MBC7S07V	.00
MBC7S08H	2789.36
MBC7S08V	.00
MBC7S09V	2658.98
MBC7S10H	3601.10
MBC7S10V	2496.17
	.00
	.00
	3472.02
	2493.12
MBM7E01H	4680.73
MBM7E01V	.00
MBM7E02H	7193.45
MBM7E02V	2493.12
MBM7E03H	3694.42
	.00
	.00
	7947.58
MBC7A01H	1795.74
MBC7A01V	8280.88
MBC7A02V	2529.14
MBC7A03H	3171.64
MBC7A04V	2796.79
MBC7A05H	2070.21
MBC7A06V	2400.43
MBC7A07H	1642.95
MBC7A08V	382.07
MBC7A09H	3346.77
MBC7A10V	1909.68
MBC7A11H	2341.98
MBC7A12V	.00
MBC7A13H	1647.35
MBC7A14V	3221.21
MBC7A15H	665.69
MBC7A16V	1881.04
MBC7A17H	4271.04
MBC7A18V	.00
MBC7A19H	1243.11
MBC7A20V	2115.94
MBC7A21H	2088.86
MBC7A22V	4618.20
MBC7A23H	1857.05
MBC7A24V	5467.85
MBC7A25H	3728.51
MBC7A26V	.00
MBC7A27H	1681.45
MBC7A28V	415.04
MBC7A29H	2835.71
MBC7A30V	1964.37
MBC7A31H	828.78
MBC7A32V	359.54
	.00
	.00
	Err:502
	12641.01
	799.39
MBC7R01H	2684.04
MBC7R02V	423.42
MBC7R03H	3556.90
MBC7R06H	1650.85
MBC7R07V	4248.89
MBC7R08V	9194.66
MBC7R09H	5510.79
MBC7R10V	10845.30
MBC7R10H	4741.05
MBC7R10AH	4800.07

Arc8:

corrector	Required
	12 GeV field
	(gauss-cm)
MBC8S00H	15963.94
MBC8S01V	113.30
MBC8S02H	4901.84
MBC8S02V	1980.28
MBC8S03V	5894.78
MBC8S05H	6114.91
MBC8S05V	12155.47
MBC8S07V	.00
MBC8S08V	.00
MBC8S09V	5441.01
MBC8S10H	4739.40
MBC8S10V	891.25
MAT8S10H	1685.93
	.00
	.00
	1511.78
	16.86
MBM8E01H	.00
MBM8E01V	197.57
MBM8E02H	11650.07
MBM8E02V	16.86
MBM8E03H	1666.97
MBM8E03V	4169.79
	.00
	.00
	9786.06
MBC8A01H	8600.90
MBC8A01V	4835.92
MBC8A02V	3785.46
MBC8A03H	4466.31
MBC8A04V	1827.79
MBC8A05H	6063.56
MBC8A06V	1110.84
MBC8A07H	4535.27
MBC8A08V	4303.12
MBC8A09H	6155.28
MBC8A10V	3645.63
MBC8A11H	5358.42
MBC8A12V	3605.87
MBC8A13H	5465.73
MBC8A14V	8735.42
MBC8A15H	965.05
MBC8A16V	5027.84
MBC8A17H	3890.62
MBC8A18V	3675.52
MBC8A19H	1603.74
MBC8A20V	3707.73
MBC8A21H	6192.54
MBC8A22V	1837.82
MBC8A23H	2025.34
MBC8A24V	893.40
MBC8A25H	5627.86
MBC8A26V	1389.75
MBC8A27H	5031.03
MBC8A28V	1500.46
MBC8A29H	7331.44
MBC8A30V	3475.35
MBC8A31H	2570.47
MBC8A32V	.00
	.00
	.00
	.00
	5271.46
	2379.84
MBC8R01H	759.97
MBC8R02H	8396.78
MBC8R02V	577.75
MBC8R03H	1721.11
MBC8R04H	2076.84
MBC8R04V	5241.35
MBC8R06H	12233.81
MBC8R08H	.00
MBC8R08V	11516.10
MBC8R09H	3866.05
MBC8R10H	2783.89
MBC8R10V	5245.41
MAR8R10AH	2182.40

Arc9:

corrector	Required
	12 GeV field
	(gauss-cm)
MBM9S01H	.00
MBC9S02V	2841.00
MBC9S03H	.00
MBC9S03V	1588.77
MBC9S04H	.00
MBC9S04V	.00
MBC9S05H	.00
MBC9S05V	419.94
MBC9S06H	8822.11
MBC9S06V	7170.65
MBC9S07H	9119.12
MBC9S07V	393.20
MBC9S08H	4634.19
MBC9S08V	.00
	.00
	.00
	6566.42
	2183.27
MBM9E01H	6875.21
MBM9E01V	1686.40
MBM9E02H	5923.47
MBM9E02V	5170.29
MBM9E03H	6538.77
MBM9E03V	1530.20
	.00
	.00
	12973.31
MBC9A01H	5465.83
MBC9A01V	10041.81
MBC9A02V	2399.53
MBC9A03H	3971.92
MBC9A04V	9077.72
MBC9A05H	7218.31
MBC9A06V	1686.99
MBC9A07H	2190.69
MBC9A08V	1485.98
MBC9A09H	8891.88
MBC9A10V	2076.13
MBC9A11H	5597.27
MBC9A12V	2055.86
MBC9A13H	9759.13
MBC9A14V	3771.05
MBC9A15H	910.20
MBC9A16V	901.11
MBC9A17H	7856.14
MBC9A18V	6492.02
MBC9A19H	5283.73
MBC9A20V	9999.36
MBC9A21H	8499.00
MBC9A22V	5526.69
MBC9A23H	1916.89
MBC9A24V	8075.56
MBC9A25H	5277.13
MBC9A26V	4843.05
MBC9A27H	7770.10
MBC9A28V	3949.18
MBC9A29H	6818.71
MBC9A30V	3023.15
MBC9A31H	2226.37
MBC9A32V	.00
	.00
	.00
	11485.64
	14902.42
	3819.38
MBC9R01H	3562.46
MBC9R02H	2988.09
MBC9R02V	843.20
MBC9R03H	7152.78
MBC9R03V	21895.05
MBC9R04H	2961.17
MBC9R04V	.00
MBC9R05H	2248.53
MBC9R05V	2810.66
MBC9R06H	2231.31
MBC9R06V	.00
MBC9R07H	281.07
MBC9R07V	14761.18
MBM9R08H	11485.64

2T/4T/6T Transfer Lines:

corrector	Required 12 GeV field (gauss-cm)
MBC2T01H	1232.54
MBC2T01V	1228.85
MBC2T02H	.00
MBC2T03H	.00
MBC2T03V	.00
MBC2T04H	.00
MBC2T04V	.00
MBC2T05V	.00
MBC2T06H	754.41
MBC2T07H	272.43
MBC2T07V	.00
MBC2T08H	943.02
MBC2T08V	.00
MBC2T09H	427.46
MBC2T09V	11773.41
MBC4T01H	2888.14
MBC4T01V	633.07
MBC4T03H	8806.18
MBC4T03V	.00
MBC4T04H	338.22
MBC4T04V	.00
MBC4T05V	.00
MBC4T06H	2700.88
MBC4T07H	1537.81
MBC4T07V	13051.91
MBC4T08H	6369.44
MBC4T08V	.00
MBC4T09DV	32685.93
MBC6T01H	1691.34
MBC6T01V	4145.00
MBC6T03H	2207.86
MBC6T03V	.00
MBC6T04H	.00
MBC6T04V	2848.93
MBC6T05V	9932.25
MBC6T06H	.00
MBC6T07H	.00
MBC6T07V	18564.74
MBC6T08H	.00
MBC6T08V	9296.00
MBC6T09H	15869.39
MBD6T09V	49372.55

8T/AT Transfer Lines:

corrector	Required
	12 GeV field
	(gauss-cm)
MBC8T01H	5972.04
MBC8T01V	320.57
MBC8T03H	6689.82
MBC8T03V	1109.73
MBC8T04H	10898.65
MBC8T04V	3046.78
MBC8T05V	21406.63
MBC8T06H	.00
MBC8T07H	.00
MBD8T07V	26409.58
MBC8T08H	.00
MBC8T08V	3080.56
MBC8T09H	2154.33
MBD8T09V	39226.82
MBC8T09AH	3718.64
MBMAS00H	.00
MBCAT01H	.00
MBCAT01V	7754.63
MBCAT02H	12546.39
MBCAT02V	.00
MBCAT03H	.00
MBCAT03V	5910.34
MBCAT04H	5769.78
MBCAT04V	.00
MBCAT05H	11278.78
MBCAT05V	2436.15
MBMAT06H	16173.07
MBMAT06V	.00
MBMAT07H	7360.50
MBMAT07V	.00
MBMAT08H	52.83
MBMAT08V	7014.28

HallA (1C) Line:

corrector	Required
	12 GeV field
	(gauss-cm)
MBD1C00V	13391.74
MBD1C00AV	13391.74
MBC1C01H	3606.24
MBC1C02V	9233.34
MBC1C03H	3784.38
MBC1C04H	2258.90
MBC1C07V	384.05
MBC1C07H	1192.82
MBC1C09V	.00
MBC1C11V	.00
MBC1C13V	.00
MBC1C15V	.00
MBC1C18V	5190.78
MBC1C20H	2658.14
MBC1C20V	3600.00
MBT1P01H	.00
MAT1H01H	360.00
MBC1H01V	4540.00
MBD1H04H	7980.00

Hall B (2C) Line:

corrector	Required
	12 GeV field
	(gauss-cm)
MBD2C00V	4060.00
MBD2C00H	923.08
MBD2C01H	600.00
MBD2C01V	.00
MBC2C02H	2680.00
MBC2C03V	1340.00
MBC2C04H	.00
MBC2C05V	.00
MBC2C06H	.00
MBC2C07V	.00
MBC2C08H	3200.00
MBC2C09V	720.00
MBC2C10H	.00
MBC2C11V	.00
MBC2C12H	.00
MBC2C13V	.00
MBC2C14H	120.00
MBC2C15V	6040.00
MBC2C16H	.00
MBC2C17V	4200.00
MBC2C18H	900.00
MBC2C19V	3272.40
MBC2C20H	7225.80
MBC2C21H	4980.00
MBC2C21AH	5240.00
MBC2C21V	6067.22
MBC2C22H	15768.58
MBC2C23V	.00

Hall C (3C) Line:

corrector	Required
	12 GeV field
	(gauss-cm)
MBD3C00V	14400.00
MBD3C00AV	14400.00
MBC3C01H	.00
MBC3C02V	971.47
MBC3C03H	3600.00
MBC3C04H	2031.39
MBC3C05V	.00
MBC3C06H	.00
MBC3C07V	30.08
MBC3C07H	1497.86
MBC3C09V	86.63
MBC3C11V	.00
MBC3C13V	762.31
MBC3C15V	.00
MBC3C17V	715.46
MBC3C18H	13.10
MBC3C18V	909.58
MBC3C20H	1463.99
MBC3C20V	595.56
MBD3H01H	4574.00
MBD3H02V	11516.00
MBD3H02AV	11516.00
MBD3H04V	8780.00
MBD3H04AV	8780.00