ARC1

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13 December 2010

1 Requirements

- The TWISS values for the ARC1 section must be independent of how they are generated. That is, stand alone ARC1 must return the same TWISS values as LINAC1+ARC1 combined.

  – This means that the input TWISS values must be exactly identical to the output of LINAC1.

  – This also assumes that the input TWISS values to LINAC1 are correct.

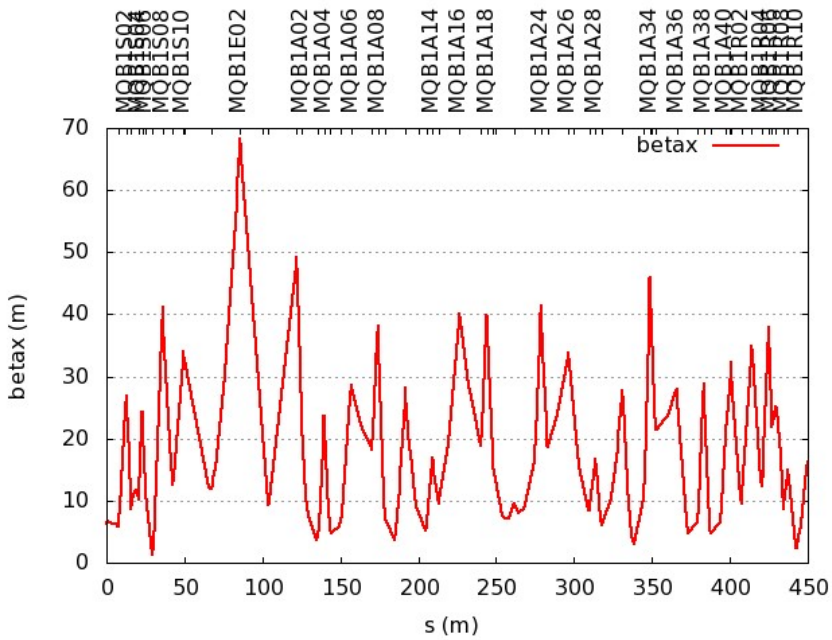
- The TWISS values in ARC1 are symmetric about MQA1A21
- Between the Arc bending magnets the Quadrupoles K1 and distances are symmetric about MQA1A21
- The ARC proper entrance/exit β values are equal
- The ARC proper entrance/exit α values are equal and opposite
- The TWISS values at the end of the Recombiner are matched exactly to the LINAC2 entrance TWISS.

  – Note, this can be achieved by also modifying the LINAC2 entrance TWISS values to be exactly those of the ARC1 exit values.

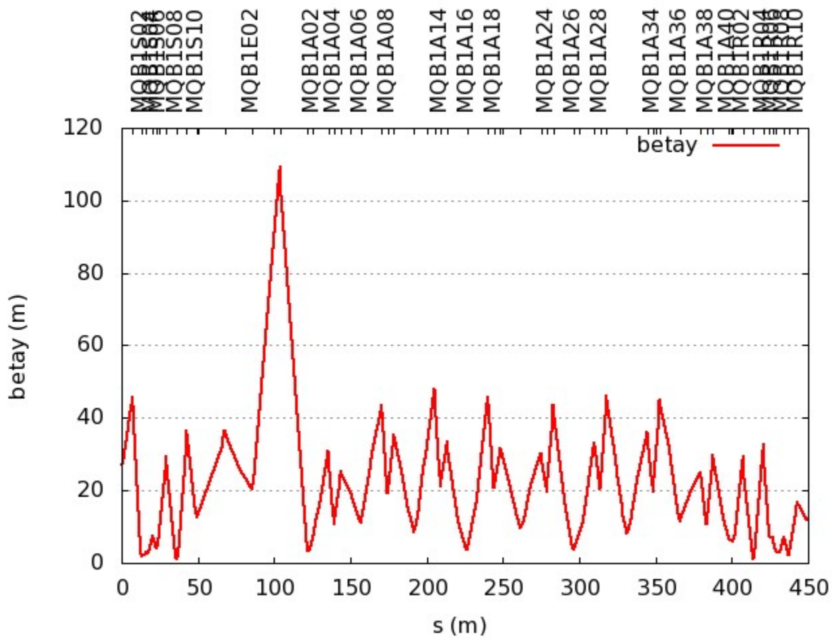
  – Or some combination of the two, fit to match, but transfer the exact final ARC1 values as the LINAC2 entrance values.

2 TWISS parameters in original Optim/Elegant files for Arc1

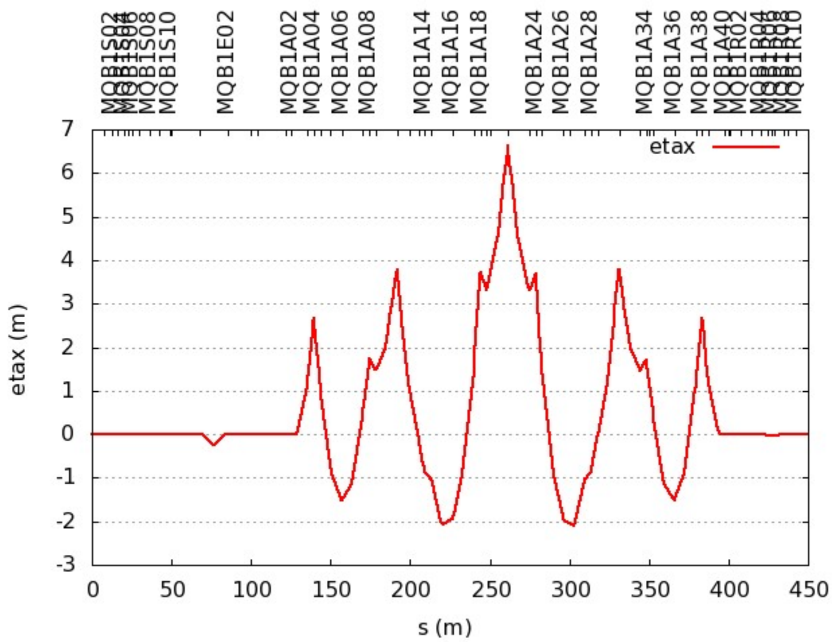
2.1 β_x



2.2 β_y

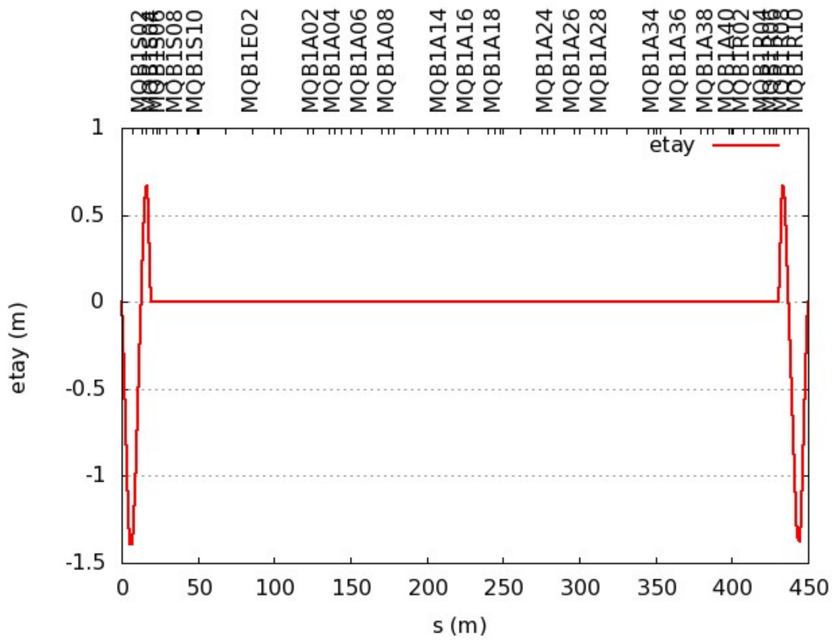

MQB1S02
MQB1S08
MQB1S10
MQB1E02
MQB1A02
MQB1A04
MQB1A06
MQB1A08
MQB1A14
MQB1A16
MQB1A18
MQB1A24
MQB1A26
MQB1A28
MQB1A34
MQB1A36
MQB1A38
MQB1R10
betay
betay (m)
s (m)
0
20
40
60
80
100
120
0
50
100
150
200
250
300
350
400
450

2.3 η_x



MQB1S02
MQB1S08
MQB1S10
MQB1E02
MQB1A02
MQB1A04
MQB1A06
MQB1A08
MQB1A14
MQB1A16
MQB1A18
MQB1A24
MQB1A26
MQB1A28
MQB1A34
MQB1A36
MQB1A38
MQB1A40
MQB1R02
MQB1R10
etax
etax (m)
s (m)
7
6
5
4
3
2
1
0
-1
-2
-3
0
50
100
150
200
250
300
350
400
450

2.4 η_y



3 TODO [11/15] Steps towards self-consistency

3.1 DONE Retrieve NL input parameters from Optim deck

2010-03-02 Tue 12:09

- Art++ Inj and North linac Optim deck at start of D39

  - β_x = 28.9072 m
  - α_x = -2.45782
  - β_y = 6.18386 m
  - α_y = 1.30688
  - η_x = 0.00189354 This should be zero
  - η_y = 0
  - $\eta_x\prime$ = 0.000149481 This should be zero
  - $\eta_y\prime$ = 0

- Present values in LINAC1.ele
  - β_x=2.863532e+01
  - α_x=-2.4307
  - β_y=6.178298e+00
  - α_y=1.3037
  - Z = -154.68952
- AB North linac Optim deck starts at beginning (D1000)
  - β_x = 37.5812 m
  - α_x = -2.80987
  - β_y = 3.15303 m
  - α_y = 0.6171
  - $\eta_x = \eta_y = \eta_x\prime = \eta_y\prime = 0$
  - s = -0.90004 m
  - Z = -153.11452
- Notes

  The difference in Z is 1.575 m between AB Optim and the elegant/Art++ decks, which is the exact length of an added drift in LINAC1.lte (D1000A). This D1000A (elegant) corresponds to D39 (optim). So one must pick TWISS parameters at front of D39, cannot use AB's deck.

  The difference between the Art++ and the elegant decks is small, but enough to cause grief.

3.2 DONE Modify LINAC1.ele to include the correct input parameters

Use the Art++ D39 values:

```
beta_x=2.89072e+01, alpha_x=-2.45782,
beta_y=6.18386e+00, alpha_y=1.30688,
```

3.3 DONE Run LINAC1.ele and extract final TWISS values

2010-03-02 Tue

- β_x = 6.062352e+00
- α_x = -2.087257e-02
- β_y = 2.723758e+01
- α_y = -1.853349e+00
- $\eta_{\mathrm{xy}} = \eta_{\mathrm{xy}}\prime = 0$
- Notes

  These are slightly different than the values in ARC1.ele (revision1.7). TWISS values found for ARC1 entrance.

  ```
  beta_x=6.35476, alpha_x=-0.0575519,
  beta_y=27.1339, alpha_y=-1.86361
  ```

3.4 DONE Modify ARC1.ele to use the LINAC1.ele exit TWISS as input

Modified ARC1.ele to reflect the output of LINAC1, $\mathrm{twiss}_{\mathrm{output}}$ parameters:

```
beta_x=6.06352, alpha_x=-2.087257e-2,
beta_y=27.23758, alpha_y=-1.853349
```

3.5 DONE Verify quadrupole symmetry in ARC1.lte

2010-03-09 Tue 13:03 The quadrupole magnets between the first and last dipole bends should be symmetric (in focal length and location) about the center (MQA1A21) of the Arc. The tables below show that the locations are symmetric at the tens of micron level and the focal lengths (K1s) are spot on.

- Arc1 Quad magnet S coordinate symmetry check

First Half	Second Half	Distance from center(first half)	Distance from center(2nd half)	
MQB1A03	MQB1A39	114.52362	114.52363	-
MQB1A04	MQB1A38	110.86681	110.86681	
MQB1A05	MQB1A37	107.21	107.20999	
MQB1A06	MQB1A36	95.0286899999999	95.0286899999997	
MQB1A07	MQB1A35	82.8473899999999	82.8473799999997	
MQB1A08	MQB1A34	79.1905699999999	79.1905699999997	
MQB1A09	MQB1A33	75.53375	75.5337599999998	-
MQB1A11	MQB1A31	63.3524599999999	63.3524599999999	
MQB1A13	MQB1A29	51.1711599999999	51.1711699999999	-
MQB1A14	MQB1A28	47.5143499999999	47.51435	
MQB1A15	MQB1A27	43.85754	43.85753	
MQB1A16	MQB1A26	31.6762299999999	31.67623	
MQB1A17	MQB1A25	19.4949299999999	19.49492	
MQB1A18	MQB1A24	15.83811	15.83811	
MQB1A19	MQB1A23	12.18129	12.1813000000001	-
			Total	

- Arc1 Quad focal length check

First Half	Second Half	K1 (first half)	K1 (2nd half)	Δ
MQB1A03	MQB1A39	-1.16578	-1.16578	0
MQB1A04	MQB1A38	2.13112	2.13112	0
MQB1A05	MQB1A37	-0.84544	-0.84544	0
MQB1A06	MQB1A36	0.79145	0.79145	0
MQB1A07	MQB1A35	-0.849229	-0.849229	0
MQB1A08	MQB1A34	1.56739	1.56739	0
MQB1A09	MQB1A33	-0.757331	-0.757331	0
MQB1A11	MQB1A31	1.235450559220401	1.235450559220401	0
MQB1A13	MQB1A29	-0.897281	-0.897281	0
MQB1A14	MQB1A28	1.39555	1.39555	0
MQB1A15	MQB1A27	-0.854162	-0.854162	0
MQB1A16	MQB1A26	0.539361	0.539361	0
MQB1A17	MQB1A25	-1.00616	-1.00616	0
MQB1A18	MQB1A24	1.29706	1.29706	0
MQB1A19	MQB1A23	-0.5900030000000001	-0.5900030000000001	0

- Verify dipole focusing symmetry

  2010-12-13 Mon 12:59 Michele points out that the dipole focusing terms should be checked for symmetry.

First Half	Second Half	K1 (first half of arc)	K1 (second half of arc)	Δ
MBE1A01	MBE1A16	-0.00512946613642266	0.00229840648881061	-7.4278726e-3
MBE1A02	MBE1A15	0.00229840648881061	0.00229840648881061	0.
MBE1A03	MBE1A14	0.00229840648881061	0.00229840648881061	0.
...		0.00229840648881061	0.00229840648881061	0.
MBE1A08	MBE1A09	0.00229840648881061	0.00229840648881061	0.

  Is the whole Arc1 symmetry problem due to MBE1A01 $\neq$ MBE1A16!!!!!

  Arc1 lattice definition of MBE1A01 and MBE1A16 note the value of K1:

```
MBE1A01: CSBEND, L=1.00161, ANGLE=0.196349540849362, K1=-0.00512946613642266 &
        , TILT=0 &
        , E1=0.09817477042468099, HGAP=0.0127, FINT=0.5 &
        , E2=0.09817477042468099, EDGE_ORDER=1 &
        , INTEGRATION_ORDER=4 &
        , N_KICKS=20

MBE1A16: CSBEND, L=1.00161, ANGLE=0.196349540849362, K1=0.00229840648881061 &
        , TILT=0 &
        , E1=0.09817477042468099, HGAP=0.0127, FINT=0.5 &
        , E2=0.09817477042468099, EDGE_ORDER=1 &
        , INTEGRATION_ORDER=4 &
        , N_KICKS=20
```

  Setting MBE1A01 K1 equal to that of the rest of the MBE's in the ARC makes the lattice symmetric and the fits converge to a gnats eyelash.

3.6 DONE Match to η_y=$\eta_y\prime$=0 at the 1SD and 1RD match points

2010-03-02 Tue 19:50

- 1S η location (MKMATCH1SD)

  - MQB1S02.K1 = 1.97364878
  - MQB1S03.K1 = -2.6228056
  - η_y = -2.5e-11 m
  - η_{yp} = 1.2e-12

- 1R η location (end of recombiner)

  - magnet:K1 Δ
  - MQB1R09.K1: 1.794174816572240e+00 2.784816572239723e-03
  - MQB1R10.K1: -1.224998094708481e+00 1.905291519221919e-06
  - η_y = 9.931705e-11
  - η_{yp} = -3.497203e-15

3.7 DONE Modify Lattice: set matched quad values

3.8 CANCELED Measure M_{56} across the Spreader, Arc, and Recombiner

2010-03-03 Wed 11:18 Is this really a necessary step? Why not simply require M_{56}(End of 1R) = 0, by adjusting quads in the Arc? No need to measure anything, just null it out.

3.9 DONE Optimize 1A16 1A11 and 1A31 to achieve M_{56} = 0

M_{56}(Arc) = -(M_{56}(Spreader) + M_{56}(Recombiner)) *2010-03-03 Wed 07:30* Are these the right quads? Adjusting these quads will break the symmetry of quad settings across the arc. Would MQB1A11 and MQB1A31 be a better match?

2010-03-03 Wed 11:24 1A11 and 1A31 is the correct pair, where did 1A16 come from?

- Results

```
Optimization results:
  optimization function has value 1.09266626400112e-23
Terms of equation:
MKMATCH1R#1.R56 0 - sqr:   1.092666264001120e-23
  A total of 88 function evaluations were made.
Optimum values of variables and changes from initial values:
MQB1A11.K1:   1.237074954941993e+00    1.624395721592231e-03
MQB1A31.K1:   1.237074954941993e+00
```

M_{56} for the entire spreader-arc-recombiner lattice after this fit is:

```
M_{56}(end of 1R) = -3.305550e-12 m
```

3.10 DONE Modify Lattice with matched quad values

3.11 DONE Optimize Spread matching quads for symmetry

Use the spreader matching quads to achieve the desired symmetry: $\beta_{\text{entrance}} = \beta_{\text{exit}}$ and α_{entrance} = -α_{exit}

2010-03-03 Wed 11:16 In discussion with Alex, it might be useful to split 1A21 quad in half and require that: $\alpha_{\text{xy}} = \eta_{\text{xy}}\prime = 0$ at the midplane of the ARC. This adds four more constraints and might make convergence faster.

2010-03-04 Thu 14:30 These extra constraints did really provide any benefit

- Need to restrict β_{xy}

  2010-03-05 Fri 14:30 The fit is converging to solution with very large β_x. In order to get control the twiss$_{\text{analysis}}$ command is used and a constraint on the maximum β_x and β_y across Arc proper is invoked.

  twiss$_{\text{analysis}}$:

```
&twiss_analysis
 start_name = "MKMATCH1S"
 end_name="MKMATCH1A"
 tag="ARC1"
&end
```

  constraint:

```
&optimization_term
  term="ARC1.max.betax  100  0.1 segt"
&end
&optimization_term
  term="ARC1.max.betay  100  0.1 segt"
&end
```

- Robust approach

  2010-12-08 Wed Worked out a three step process within elegant that appears to converge every time with the desired accuracy. The approach is to:

  1. use the positive 1S quads in 2^{nd} and 3^{rd} step to match the horizontal β and α values
  2. use the negative 1S quads in 2^{nd} and 3^{rd} step to match the vertical β and α values
  3. Perform a third fit that matches in both planes simultaneously.

  2010-12-08 Wed 09:21

  In order to retain the β_x minimum at the symmetry point another constraint is added to the horizontal penalty function requiring that ${\beta_x}^2$ be minimized at that location.

  - The elegant commands for the horizontal match are:

```
! recommended values for restarts=5, passes=3, evaluations=1500
&optimization_setup
  balance_terms = 0,
  tolerance = -1e-8,
  mode = "minimize",
  method = "simplex",
  n_restarts = 10,
  n_evaluations = 10000,
  n_passes = 3
&end

! -----------------------------------------------------
```

```
! horizonal betatron matching
! ------------------------------------------------------
&optimization_variable
  item = "K1",
  name = "MQB1S05",
  step_size = 0.1,
  upper_limit = 4,
  lower_limit = 0
&end

&optimization_variable
  item = "K1",
  name = "MQB1S06",
  step_size = 0.1,
  upper_limit = 4,
  lower_limit = 0
&end

! -------------------------------------------------------------------------
! There is another triplet (1S08, 1S09 and 1S10) that can be used as well
! -------------------------------------------------------------------------
&optimization_variable
  item = "K1",
  name = "MQB1S08",
  step_size = 0.1,
  upper_limit = 4,
  lower_limit = 0
&end
&optimization_variable
  item = "K1",
  name = "MQB1S10",
  step_size = 0.1,
  upper_limit = 4,
  lower_limit = 0
&end

! Require the entrance and exit \beta to be within 1cm of each other
! require the alphas to be equal but opposite to within 5%

! ---------------------------------------------------------------
```

```
! Horizontal plane constraints
! -----------------------------------------------------------------
&optimization_term
  weight=1,
  term="MKMATCH1S#1.betax MKMATCH1A#1.betax  0.01 sene"
&end
&optimization_term
  weight=1,
  term="MKMATCH1S#1.alphax MKMATCH1A#1.alphax + MKMATCH1S#1.alphax MKMATCH1A#
&end
!------------------------------------------------------------------
! try to keep betax minimized at the symmetry point
!------------------------------------------------------------------
&optimization_term
  weight=1,
  term="MKMATCH1A21#1.betax sqr"
&end

! ----------------------------------------------
! keep the beta's capped
! ----------------------------------------------
&optimization_term
  term="SPREADER.max.betax  250  0.1 segt"
&end
&optimization_term
  term="ARC1.max.betax  125  0.1 segt"
&end
&optimization_term
  term="RECOMBINER.max.betax  250  0.1 segt"
&end

&bunched_beam
  n_particles_per_bunch=1,
  emit_nx=5e-7, emit_ny=5e-7,
  use_twiss_command_values=1,
  sigma_dp=0,sigma_s=0,
  distribution_type[0] = 3*"gaussian",
  distribution_cutoff[0] = 3*3,
  enforce_rms_values[0]=1,1,1
&end
```

```
&optimize
   summarize_setup=1
&end
```

– The elegant commands for the vertical match are:

```
&optimization_variable
   item = "K1",
   name = "MQB1S04",
   step_size = 0.1,
   upper_limit = 0,
   lower_limit = -4
&end
&optimization_variable
   item = "K1",
   name = "MQB1S07",
   step_size = 0.1,
   upper_limit = 0,
   lower_limit = -4
&end
&optimization_variable
   item = "K1",
   name = "MQB1S09",
   step_size = 0.1,
   upper_limit = 0,
   lower_limit = -4
&end

! ---------------------------------------------------------------
! Vertical plane constraints
! ---------------------------------------------------------------
&optimization_term
   weight=1,
   term="MKMATCH1S#1.betay MKMATCH1A#1.betay  0.01 sene"
&end
&optimization_term
   weight=1,
   term="MKMATCH1S#1.alphay MKMATCH1A#1.alphay + MKMATCH1S#1.alphay MKMATCH1A
&end
```

```
!-----------------------------------------------------------------
! try to keep betay minimized at the symmetry point
!-----------------------------------------------------------------
&optimization_term
   weight=1,
   term="MKMATCH1A21#1.betay sqr"
&end

! ---------------------------------------------
! keep the beta's capped
! ---------------------------------------------
&optimization_term
   term="SPREADER.max.betay  250  0.1 segt"
&end
&optimization_term
   term="ARC1.max.betay  125  0.1 segt"
&end
&optimization_term
   term="RECOMBINER.max.betay  250  0.1 segt"
&end

&bunched_beam
        n_particles_per_bunch=1,
        emit_nx=5e-7, emit_ny=5e-7,
        use_twiss_command_values=1,
        sigma_dp=0,sigma_s=0,
        distribution_type[0] = 3*"gaussian",
        distribution_cutoff[0] = 3*3,
        enforce_rms_values[0]=1,1,1
&end

&optimize
   summarize_setup=1
&end
```

– Both planes simultaneously

Uses all the quads with the following optimization function

```
! ---------------------------------------------------------------
! Horizontal plane constraints
! ---------------------------------------------------------------
&optimization_term
   weight=1,
   term="MKMATCH1S#1.betax MKMATCH1A#1.betax  0.01 sene"
&end
&optimization_term
   weight=1,
   term="MKMATCH1S#1.alphax MKMATCH1A#1.alphax + MKMATCH1S#1.alphax MKMATCH1A
&end
!----------------------------------------------------------------
! try to keep betax minimized at the symmetry point
!----------------------------------------------------------------
&optimization_term
   weight=1,
   term="MKMATCH1A21#1.betax sqr"
&end

! ---------------------------------------------------------------
! Vertical plane constraints
! ---------------------------------------------------------------
&optimization_term
   weight=1,
   term="MKMATCH1S#1.betay MKMATCH1A#1.betay  0.01 sene"
&end
&optimization_term
   weight=1,
   term="MKMATCH1S#1.alphay MKMATCH1A#1.alphay + MKMATCH1S#1.alphay MKMATCH1A
&end
!----------------------------------------------------------------
! try to keep betay minimized at the symmetry point
!----------------------------------------------------------------
&optimization_term
   weight=1,
   term="MKMATCH1A21#1.betay sqr"
&end

! ---------------------------------------------
! keep the beta's capped
```

```
! ---------------------------------------------

&optimization_term
   term="SPREADER.max.betax  125  0.1 segt"
&end
&optimization_term
   term="SPREADER.max.betay  125  0.1 segt"
&end
&optimization_term
   term="ARC1.max.betax  62.5  0.1 segt"
&end
&optimization_term
   term="ARC1.max.betay  62.5  0.1 segt"
&end
&optimization_term
   term="RECOMBINER.max.betax  125  0.1 segt"
&end
&optimization_term
   term="RECOMBINER.max.betay  125  0.1 segt"
&end

! ---------------------------------------------------------
! make the slopes (alpha and etaprime) zero at the midplane
! ---------------------------------------------------------
&optimization_term
   weight=1,
   term="MKMATCH1A21#1.alphax  0.0 0.1 sene"
&end
&optimization_term
   weight=1,
   term="MKMATCH1A21#1.alphay  0.0 0.1 sene"
&end
&optimization_term
   weight=1,
   term="MKMATCH1A21#1.etaxp  0.0 0.1 sene"
&end
&optimization_term
   weight=1,
   term="MKMATCH1A21#1.etayp  0.0 0.1 sene"
&end
```

– Symmetry tests

* MBE1A01 K1 MBE1A16 K1 = 0.00229840648881061

  With a symmetric lattice the entrance and exit twiss parameters are converge to exact symmetry; note the comparison column!

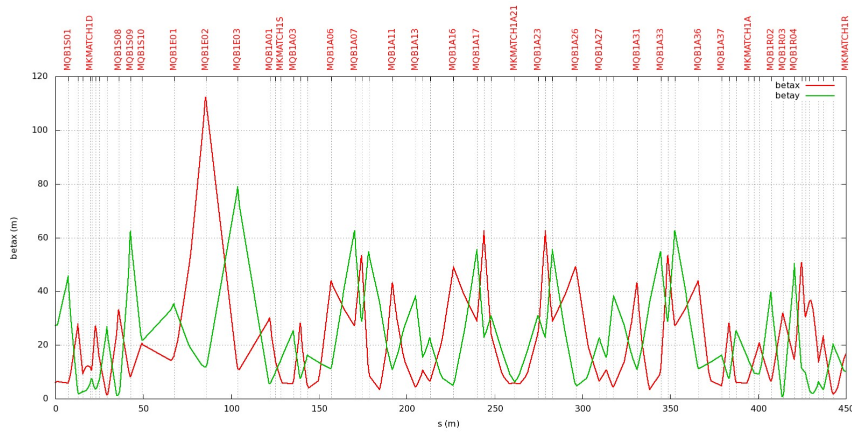
	Entrance	Exit	Comparison
β_x (m)	7.347613484574009	7.347681141696428	-6.765713e-5
α_x	9.129916217057950e-01	-9.129925569965449e-01	-1.0244240e-6
β_y (m)	1.420098183395828e+01	1.420091966002913e+01	6.2174e-5
α_y	-1.028547538430845	1.028546622961513e+00	8.9006135e-7

Mid-plane values (center of MQB1A21)

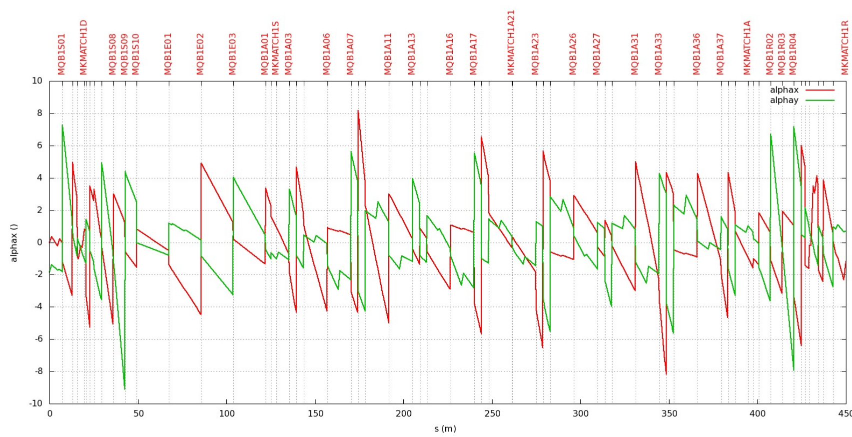
	Original Values	New Matched Values
β_x	5.065182	6.074257654736312
η_x	6.657828	6.658696287513183
$\eta^{'}_x$	7.5637e-5	-1.233393e-04
α_x	-1.02e-3	-2.995643959579468e-06
β_y	10.19728	6.261456179974243
η_y	-4.1932e-11	-3.338581402725067e-11
$\eta^{'}_y$	7.76e-13	-3.380323e-13
α_y	2.2715e-3	-4.624084827426058e-07

  · TWISS parameters after self-consistent effort: Elegant files for Arc1

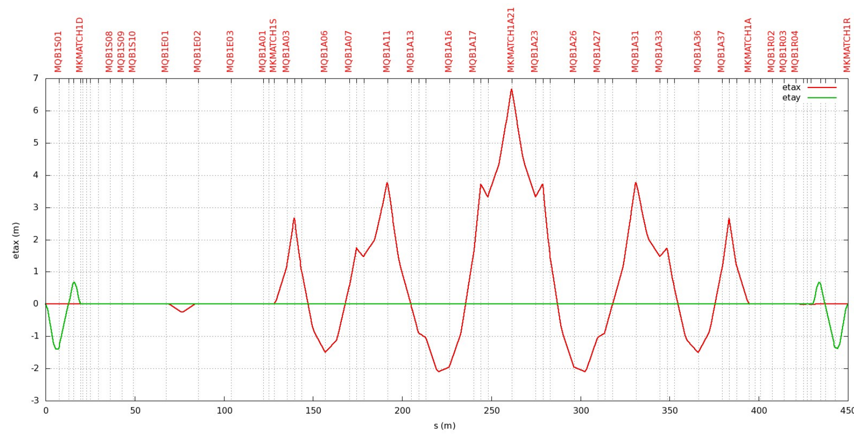
  · β


MQB1S01
MKMATCH1D
MQB1S08
MQB1S09
MQB1S10
MQB1E01
MQB1E02
MQB1E03
MQB1A01
MKMATCH1S
MQB1A03
MQB1A06
MQB1A07
MQB1A11
MQB1A13
MQB1A16
MQB1A17
MKMATCH1A21
MQB1A23
MQB1A26
MQB1A27
MQB1A31
MQB1A33
MQB1A36
MQB1A37
MKMATCH1A
MQB1R02
MQB1R03
MQB1R04
MKMATCH1R
betax
betay
betax (m)
s (m)

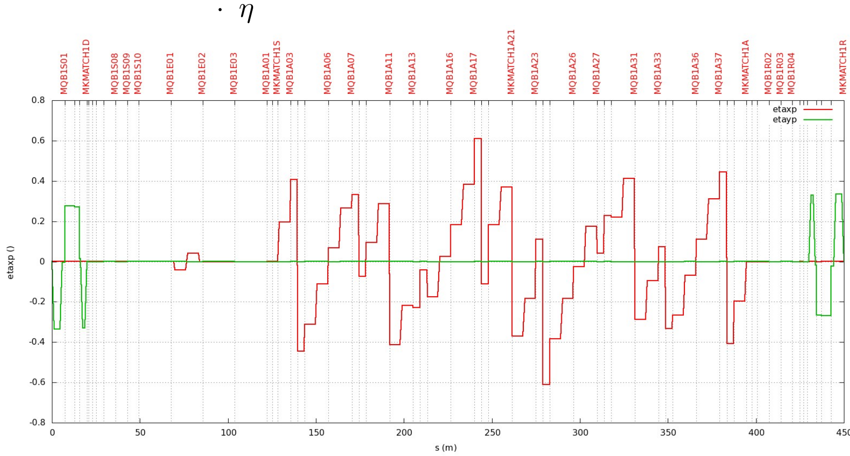
· α


MQB1S01
MKMATCH1D
MQB1S08
MQB1S09
MQB1S10
MQB1E01
MQB1E02
MQB1E03
MQB1A01
MKMATCH1S
MQB1A03
MQB1A06
MQB1A07
MQB1A11
MQB1A13
MQB1A16
MQB1A17
MKMATCH1A21
MQB1A23
MQB1A26
MQB1A27
MQB1A31
MQB1A33
MQB1A36
MQB1A37
MKMATCH1A
MQB1R02
MQB1R03
MQB1R04
MKMATCH1R
alphax
alphay
alphax ()
s (m)

· η



· η'



∗ MBE1A01 K1 ≠ MBE1A16

The entrance and exit values of β are equal to within 2cm, α equal to within 10%, this is with the MBE1A01 K1 set to a different value than the rest of the MBEs in ARC1.

	Entrance	Exit	Comparison
β_x (m)	8.163191652061844	8.179627172972415	-0.016435521
α_x	1.222492549349046e+00	-1.165207604761924e+00	0.047983365
β_y (m)	1.412595360953601e+01	1.413627273711798e+01	-0.010319128
α_y	-1.138031479032896e+00	1.024210542422408e+00	0.10528048

The agreement between MQB1A16 and MQB1A26 is even more striking. 14cm after the fit, 41cm before the fit.
Mid-plane values (center of MQB1A21)

	Original Values	New Matched Values
β_x	5.065182	7.249987858136383
η_x	6.657828	6.657828336727889
$\eta^{'}_x$	7.5637e-5	7.564383e-05
α_x	-1.02e-3	5.669592980057070e-03
β_y	10.19728	6.276331208837808
η_y	-4.1932e-11	-3.182633250108980e-11
$\eta^{'}_y$	7.76e-13	-1.642324e-12
α_y	2.2715e-3	3.916764081473525e-03

∗ Starting values

The entrance and exit values of β are equal to within 6cm, α equal to within 7%

	Entrance	Exit	Comparison
β_x (m)	6.823352196029701e+00	6.763475150966384e+00	0.059877045
α_x	7.359391717275321e-01	-6.850216765202025e-01	0.071666289
β_y (m)	1.260603245566939e+01	1.264853751186799e+01	-0.042505056
α_y	-1.465910707719168e+00	1.367932329777118e+00	0.069148768

3.12 TODO Modify Lattice with matched quad values

Optimum values of variables and changes from initial values:

Mostly modest changes except for the first three quads. MQB1S06 more than triples in strength, but it started with a relatively weak field.

Note that these quad changes are with the change to the MBE1A01 body gradient.

Quad	Original K1	New K1 value	Δ from initial	% change
MQB1S04.K1:	-2.30542	-2.449764722613911e+00	0.14434472	-6.2611030
MQB1S05.K1:	2.31853	2.156812108078475e+00	0.16171789	6.9750182
MQB1S06.K1:	0.0746592	3.489506004288736e-01	-0.27429140	-367.39129
MQB1S07.K1:	-1.87678	-2.097498686088701e+00	0.22071869	-11.760499
MQB1S08.K1:	1.52092	1.632437086350178e+00	-0.11151709	-7.3322127
MQB1S09.K1:	-1.50962	-1.448568041977770e+00	-0.061051958	4.0441938
MQB1S10.K1:	0.74106	7.613020410567002e-01	-0.020242041	-2.7314983
MQB1E01.K1	-0.373191	-0.373191	0.	0.
MQB1E02.K1:	0.556494	0.556494	0.	0.
MQB1E03.K1:	-0.613057	-0.613057	0.	0.
MQB1A01.K1:	1.05041	1.05041	0.	0.
MBE1A01	-0.00512946613642266	0.00229840648881061	-7.4278726e-3	144.80791

2010-12-13 Mon Table above represents the latest quad values for the step-by-step matching approach.

3.13 WAITING Re-run ARC1 elegant deck for verification

- Verify that $\eta = \eta\prime = 0$ at the 1SD and 1RD match points
- Verify that the TWISS parameters are symmetric

2010-03-09 Tue 13:15 The ARC1.lte deck as saved still has a visible asymmetry. Trying improve the fit.

3.14 TODO Add LINAC1+ARC1 together

3.15 TODO Run LINAC1$_{\mathrm{ARC1}}$ and compare TWISS with stand alone ARC1

4 Notes on the MBE1A01 body gradient

Deck	units	MBE1A01	MBE1A
Elegant ARC1.lte via edecks		-0.00512946613642266	0.00229840648881
Art++(optim)	kG/cm	-7.614e-4	3.4
12GeV/elegantdecks/baseline/Arc1.lte		-0.00512945462150605	-0.00512945462150
12GeV/dimad$_{\mathrm{decks}}$/trunk/baseline/Arc1.d		0.133478	0.1334
12GeV/dimad$_{\mathrm{decks}}$/trunk/4GeV$_{\mathrm{design}}$/arc1.opt	kG/cm	-0.0006012343	-0.000601

4.1 Optim

via Art++, MBE1A01 body gradient is set to $GMBE, and the rest set to $GMBE1.

- GMBE (MBE1A01)

  #Focusing parameters of Main Arc 1 dipoles GMBE= -0.00085*$scale; $scale = 0.895761 GMBE = -7.614e-4

- GMBE1 (MBE1A[2-16])

  #Main Arc dipoles - body gradients from July 2004 beam based measurements GMBE1 = 0.115/100*445/1500; => 3.4e-4

- Comments

  Art++ optim decks reflect the problem found in the working 6GeV elegant decks. 12GeV decks appear to have made a decision to use the MBE1A01 body gradient for all the dipoles in the Arc. This is

  Is the unique value for MBE1A01 found in the optim decks simply a mistake? The comment associated with GMBE1 suggests that it was, to me. My interpretation of the comment is that a new body gradient, GMBE1, was determined in 2004. But GMBE1 was not correctly applied to all the MBE instances, the first instance, MBE1A01 was missed by accident.

  It is clear that the values have changed several times. It is unclear what the correct value should be at this point in time.