

Post pCDR IR DRAFT v4

6/15/18

R.B.Palmer

ALL

- All are for the High Divergence with no cooling case, except at the end
- Crossing at 25 mrad (was 22)
- Start e quads at $4.5+0.8=5.3$ m (was 5.5) 80 cm warm to cold
- Start p quads at 5.3 m (was 5.5) 80 cm warm to cold

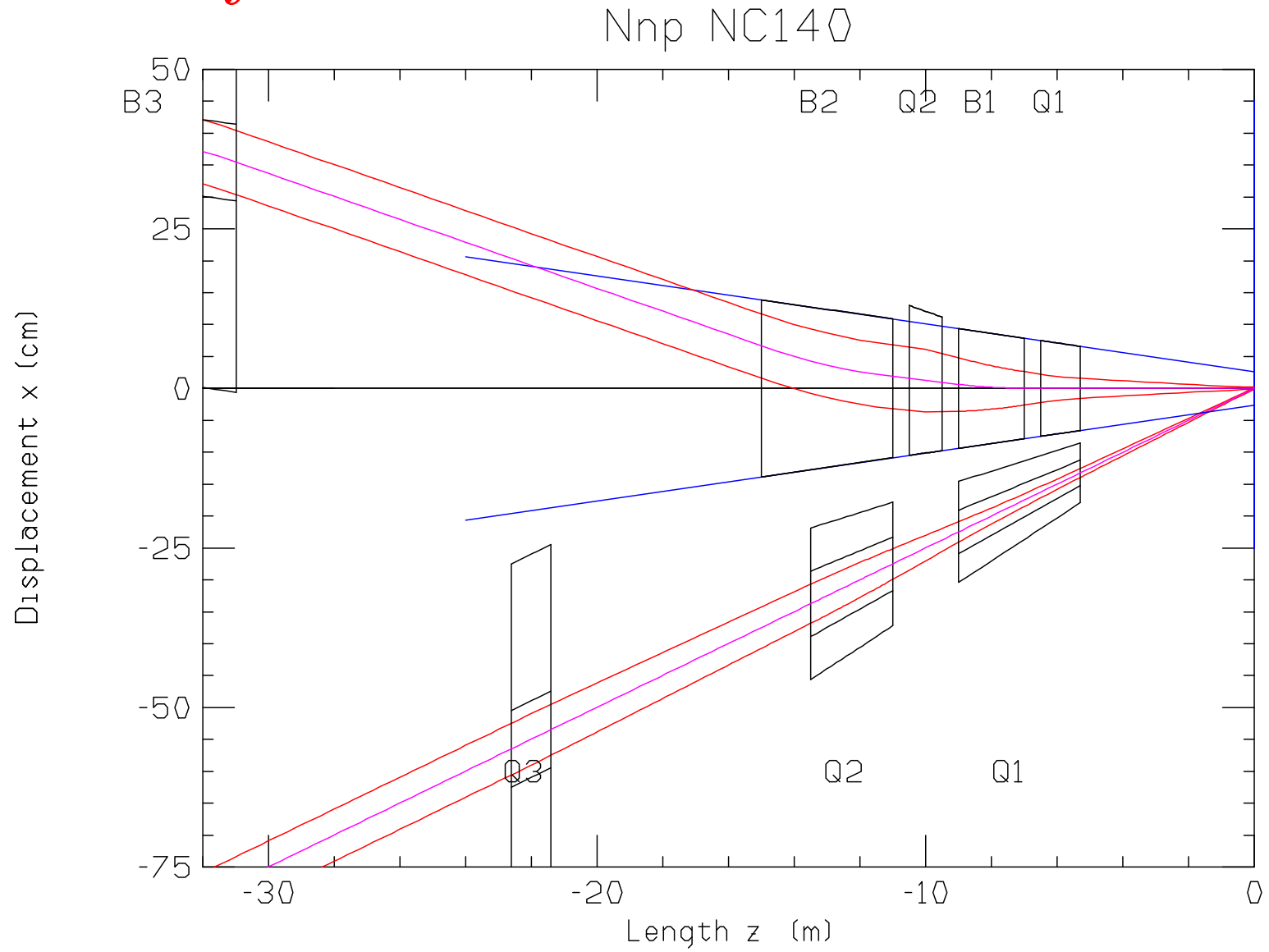
ALTERNATIVES

- A shorter Q1Re and Q2Re for reduced beta maxes
- B Q1Re and Q2Re closer together further reduced betax max
- C Gap in Q1Rp to match gap between Q1Re & Q2Re
- D Same as C but for High Acceptance

Alternative A

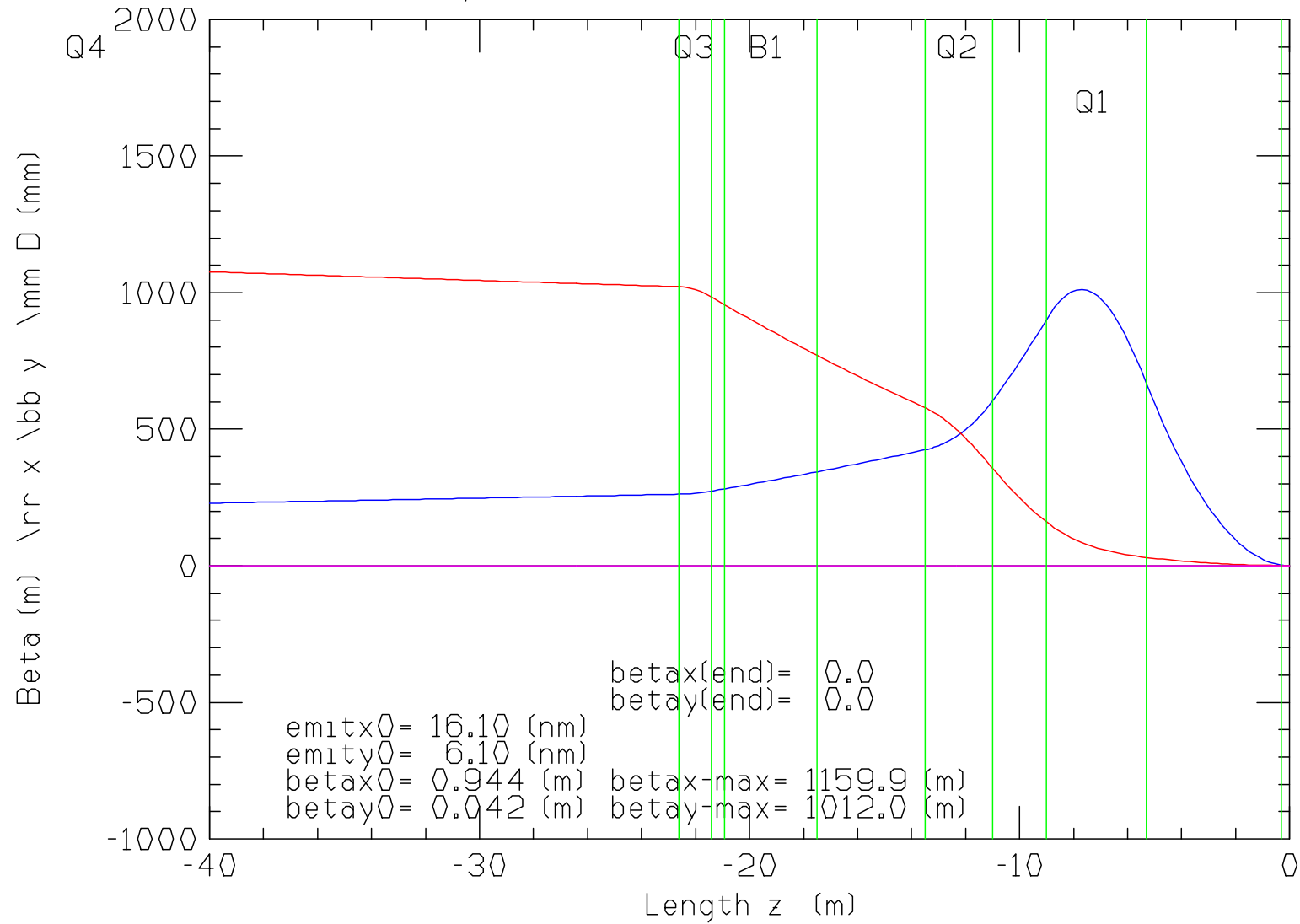
- Q1Rp length 3.7 m (3.42) \approx same
- Q2Rp length 2.5 m (2.57) \approx same
- Q1Re length 1.2 m (3.42) Shorter to reduce chromaticity
- Q2Re length 2 m (2.57) Shorter to reduce chromaticity
- e Chrom= x/y 4.3/7.1 (6.3/7.7) Reduced
- e Beta max= x/y 465/434 (900/589) Reduced

Rear Layout A



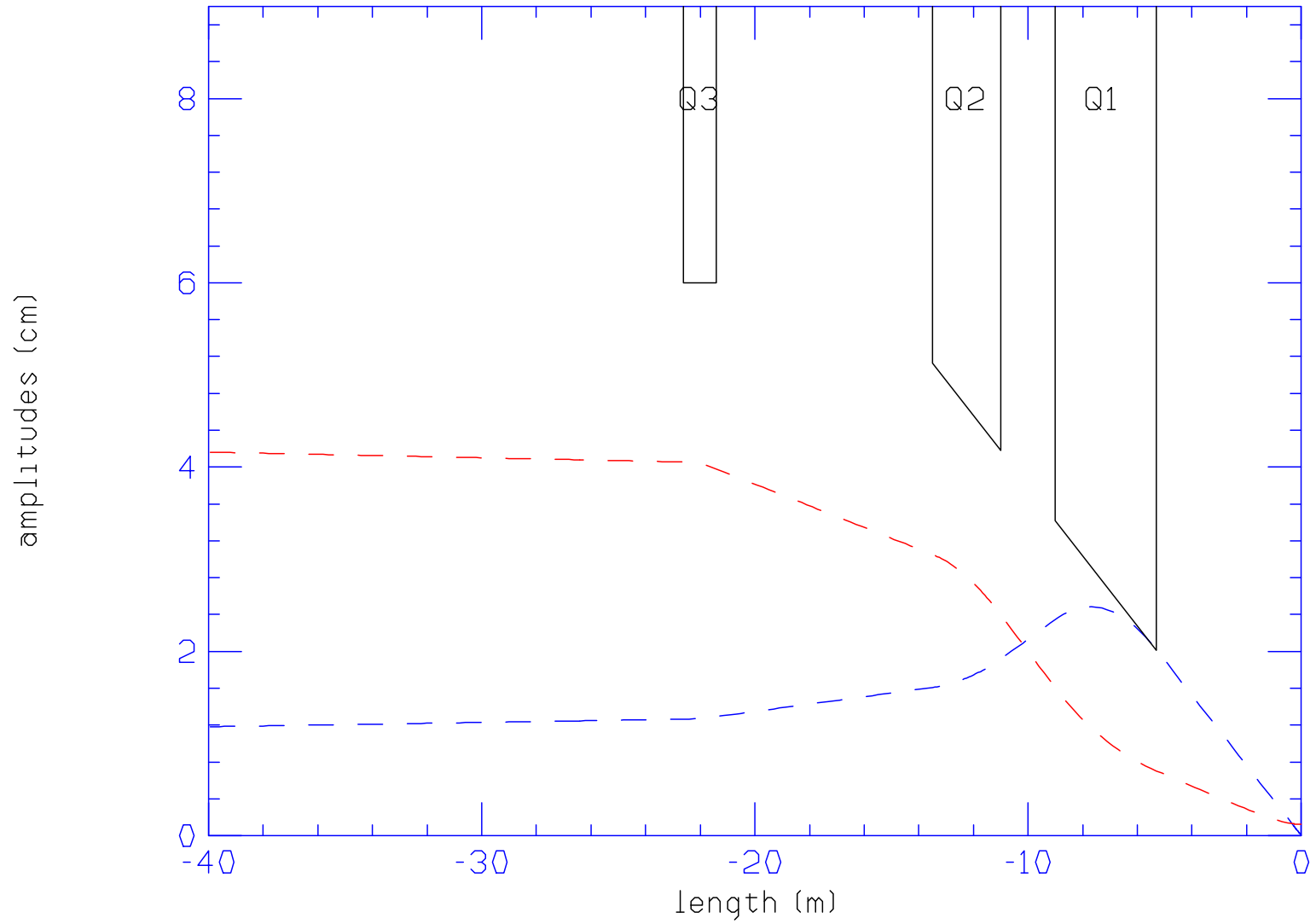
Rear p betas

Nnp NC140 Div = 3 Hadrons



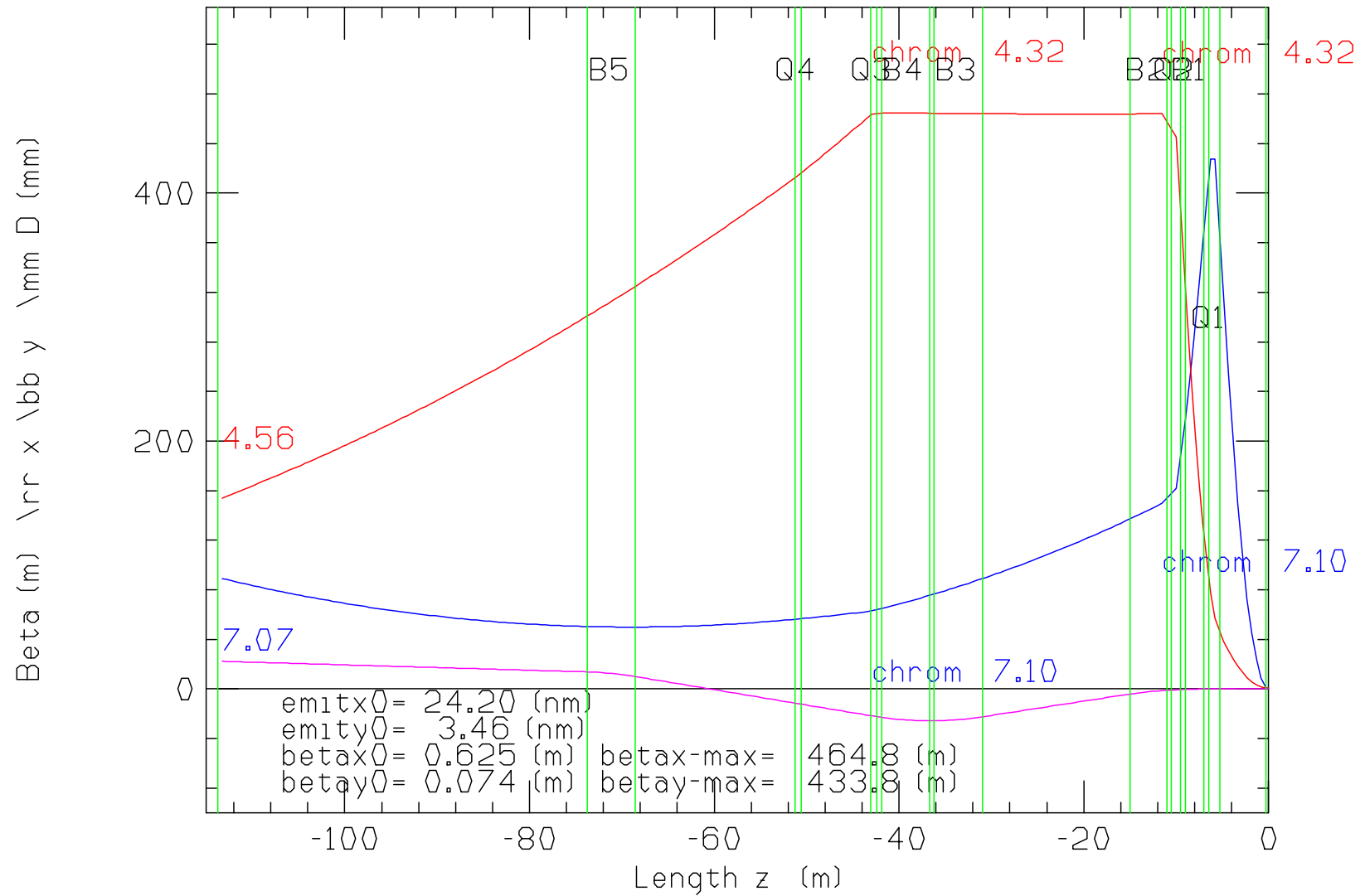
Rear p amps

Nnp NC140 Div = 3 Hadrons

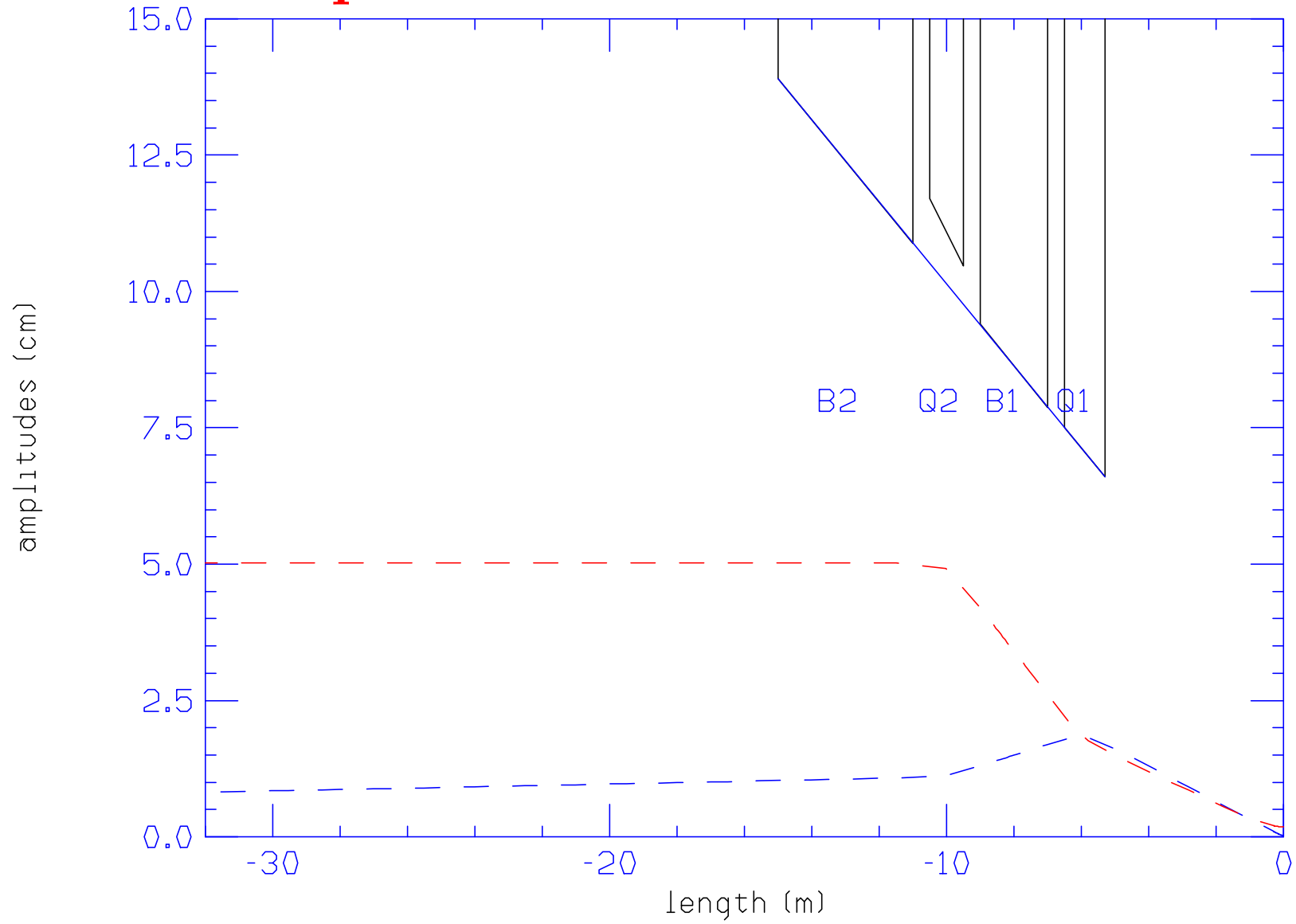


Rear e betas A

Nne NC140 Div = 3 Electrons



Rear e amps A



Old Rear Proton magnets

Chrom y 2.87 Chrom x 6.13 mom = 275

		L1	DL	gap	x	θ	IR ₁	IR ₂	B	Bpt	Grad)
		m	m	m	cm	mrاد	cm	cm	T	T	T/m
Q1	3	5.50	3.42	2.75	-12.1	-22.00	2.09	3.39	0.000	2.645	-78.000
Q2	5	11.67	2.57	2.69	-25.8	-22.00	4.44	5.41	0.000	3.246	60.000
Q3	9	20.84	1.20	21.40	-46.2	-23.00	6.00	6.00	0.000	1.125	-18.750

New A & B Rear Proton Magnets

Chrom y 13.26 Chrom x 6.57 mom = 275

		L1	DL	gap	x	θ	IR ₁	IR ₂	B	Bpt	Grad)
		m	m	m	cm	mrاد	cm	cm	T	T	T/m
Q1	3	5.30	3.70	2.00	-13.2	-25.00	2.01	3.42	0.000	2.100	-61.417
Q2	5	11.00	2.50	4.00	-27.5	-25.00	4.18	5.13	0.000	1.881	36.667
Q3	9	21.41	1.20	21.40	-53.5	-25.00	6.00	6.00	0.000	1.265	21.083

Old Electron Magnets

Chrom y 7.91 Chrom x 5.58 mom = 18

		L1	DL	gap	x	θ	IR ₁	IR ₂	B	Bpt	Grad)
		m	m	m	cm	mrاد	cm	cm	T	T	T/m
Q1	3	5.50	3.42	0.43	0.0	0.00	6.75	9.32	0.000	0.389	-4.180
B1	5	9.35	1.89	0.43	0.0	0.00	9.64	11.06	0.164	0.000	0.000
Q2	7	11.67	2.57	0.98	0.7	5.30	12.09	15.34	0.000	0.470	3.060
B2	9	15.22	4.00	20.28	0.0	0.00	14.04	17.04	0.164	0.000	0.000

Rear Electron Magnets A

Chrom y 7.07 Chrom x 4.56 mom = 18

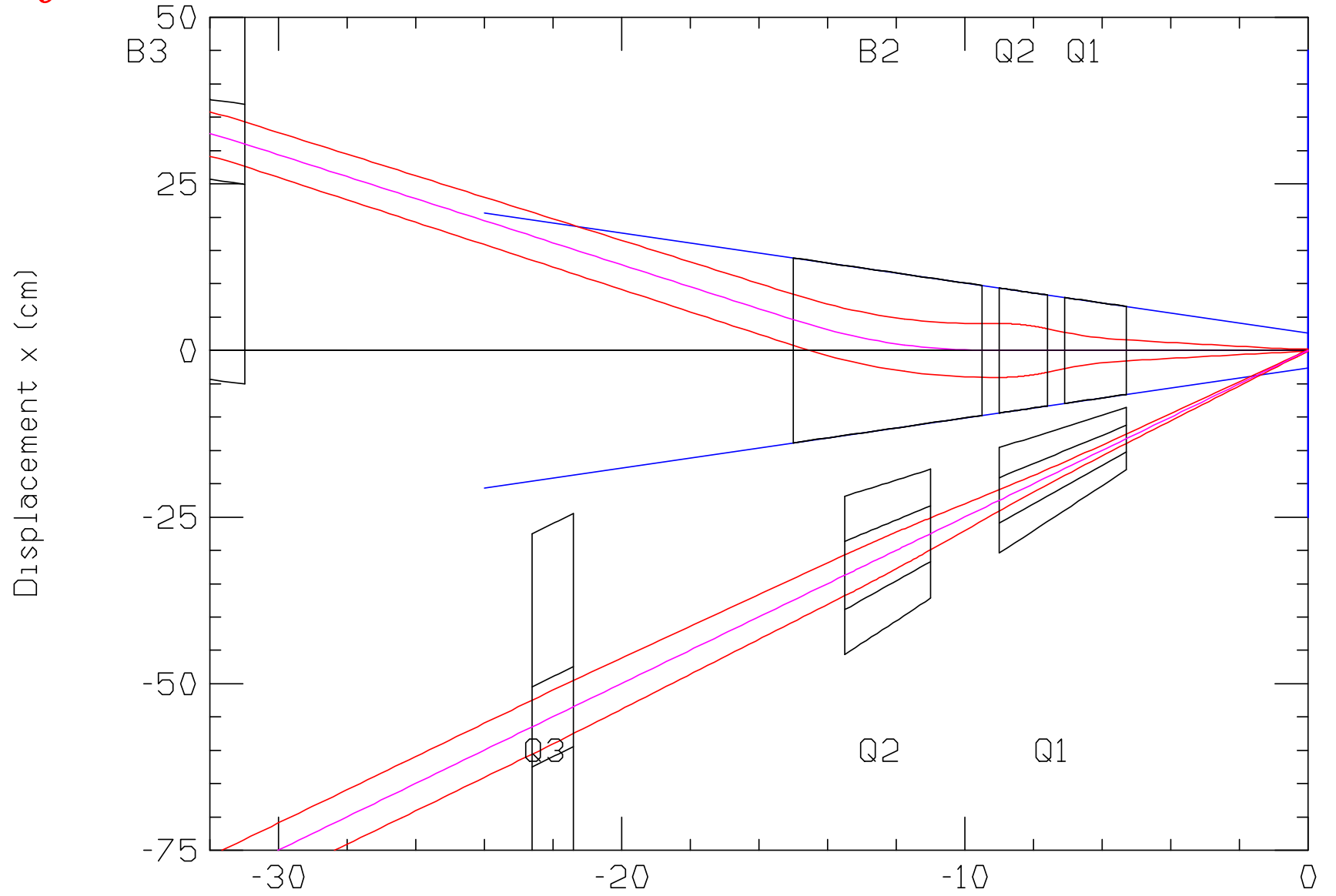
		L1	DL	gap	x	θ	IR ₁	IR ₂	B	Bpt	Grad)
		m	m	m	cm	mrاد	cm	cm	T	T	T/m
Q1	3	5.300	1.200	0.50	0.0	0.00	6.60	7.50	0.000	1.035	-13.800
B1	5	7.000	2.000	0.50	0.0	0.00	7.88	9.38	0.180	0.000	0.000
Q2	7	9.500	1.000	0.50	0.7	5.30	10.46	11.73	0.000	1.150	9.804
B2	9	11.000	4.000	15.98	0.0	0.00	10.88	13.88	0.180	0.000	0.000
B3	11	30.984	5.200	0.50	35.4	6.97	6.00	6.00	-0.180	0.000	0.000

Alternative B

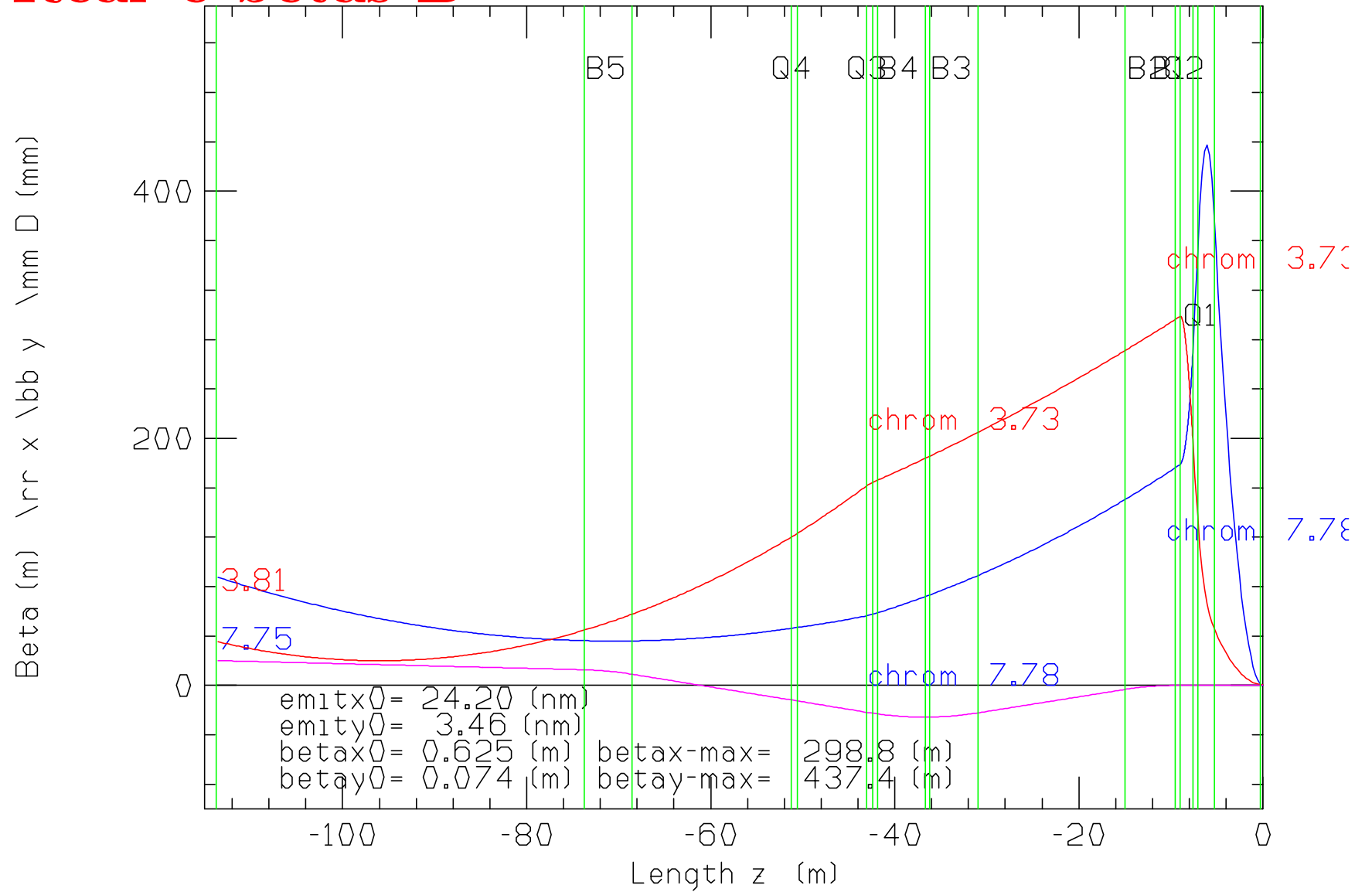
Bring Q1Re and Q2Re closer together further reduced betax max

- Q1Re length 1.8 m (1.2)(3.42)
- Gap 0.5 m no short bend here, stronger B2 ?
- Q2Re length 1.4 m (2.0)(2.57)
- e Chrom= x/y 3.7/7.8 (4.3/7.1) (6.3/7.7)
- e Beta max= x/y 300/437 (465/434) (900/589)

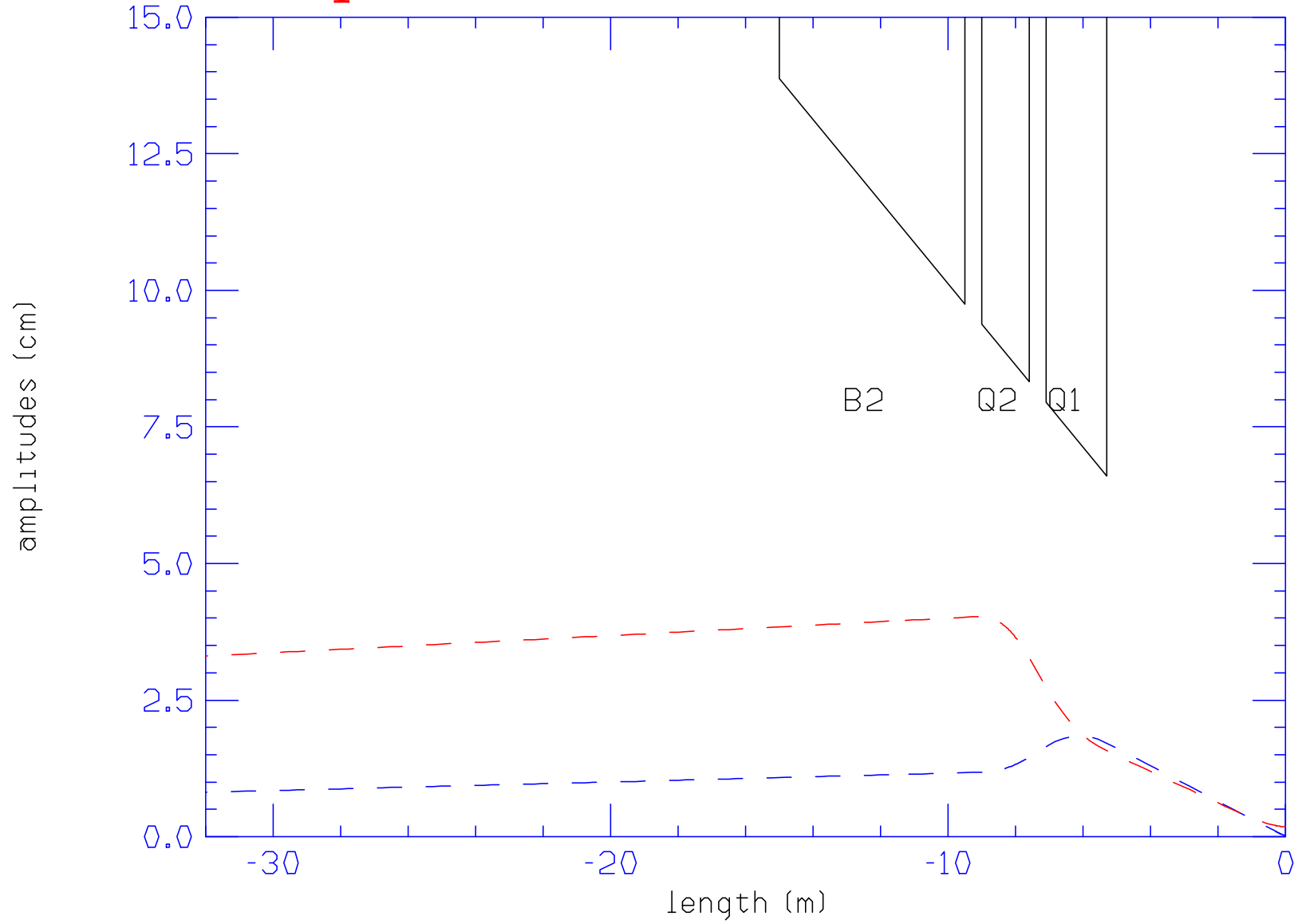
Layout B



Rear e betas B



Rear e amps B



Electron Magnets B

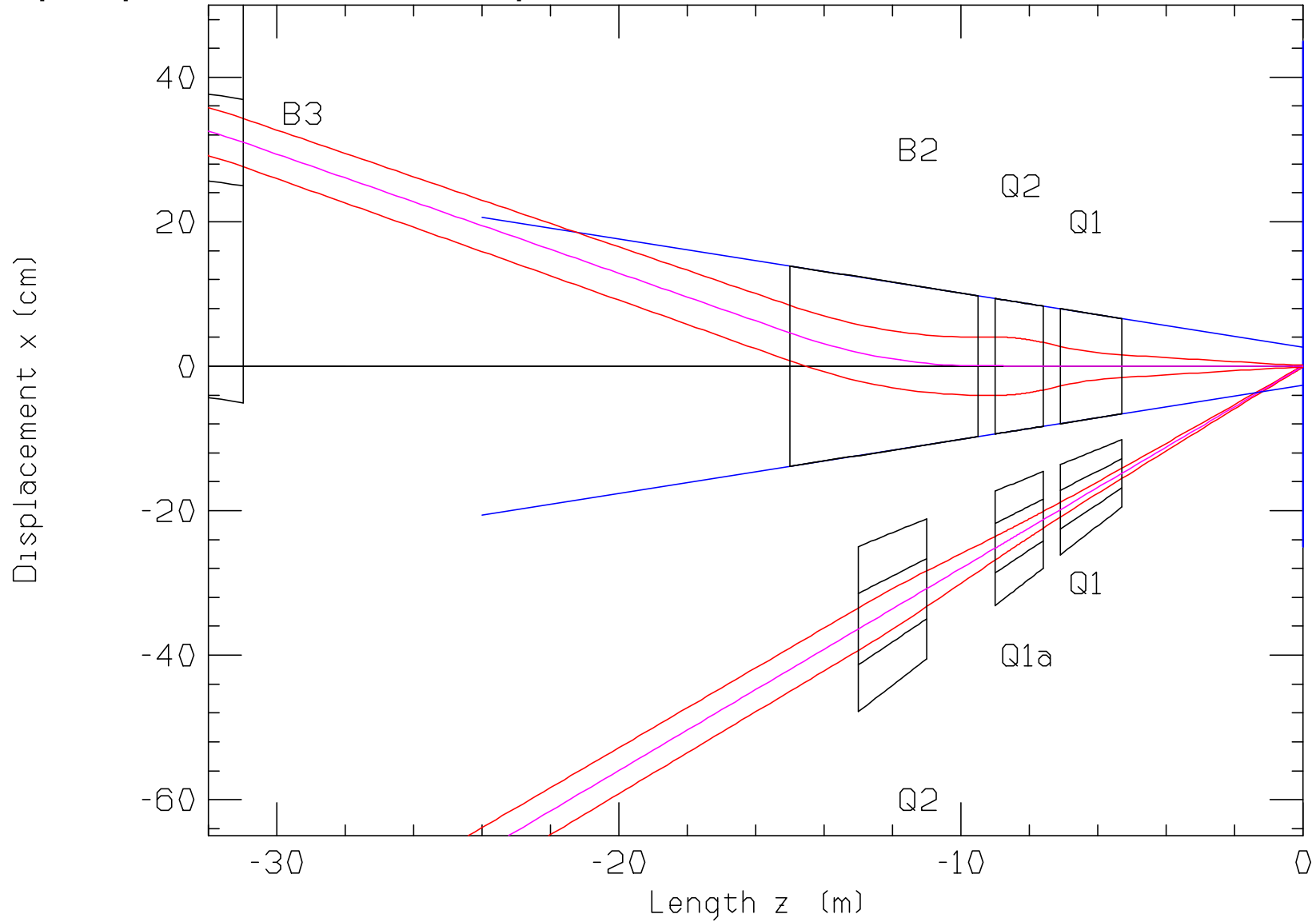
Chrom y 7.75 Chrom x 3.81 mom = 18

	L1	DL	gap	x	θ	IR ₁	IR ₂	B	Bpt	Grad)	
	m	m	m	cm	mrاد	cm	cm	T	T	T/m	
Q1	3	5.300	1.800	0.50	0.0	0.00	6.60	7.95	0.000	1.026	-12.900
Q2	5	7.600	1.400	0.50	0.0	0.00	8.32	9.38	0.000	1.181	12.600
B2	9	9.500	5.500	15.98	0.0	0.00	9.75	13.88	0.180	0.000	0.000

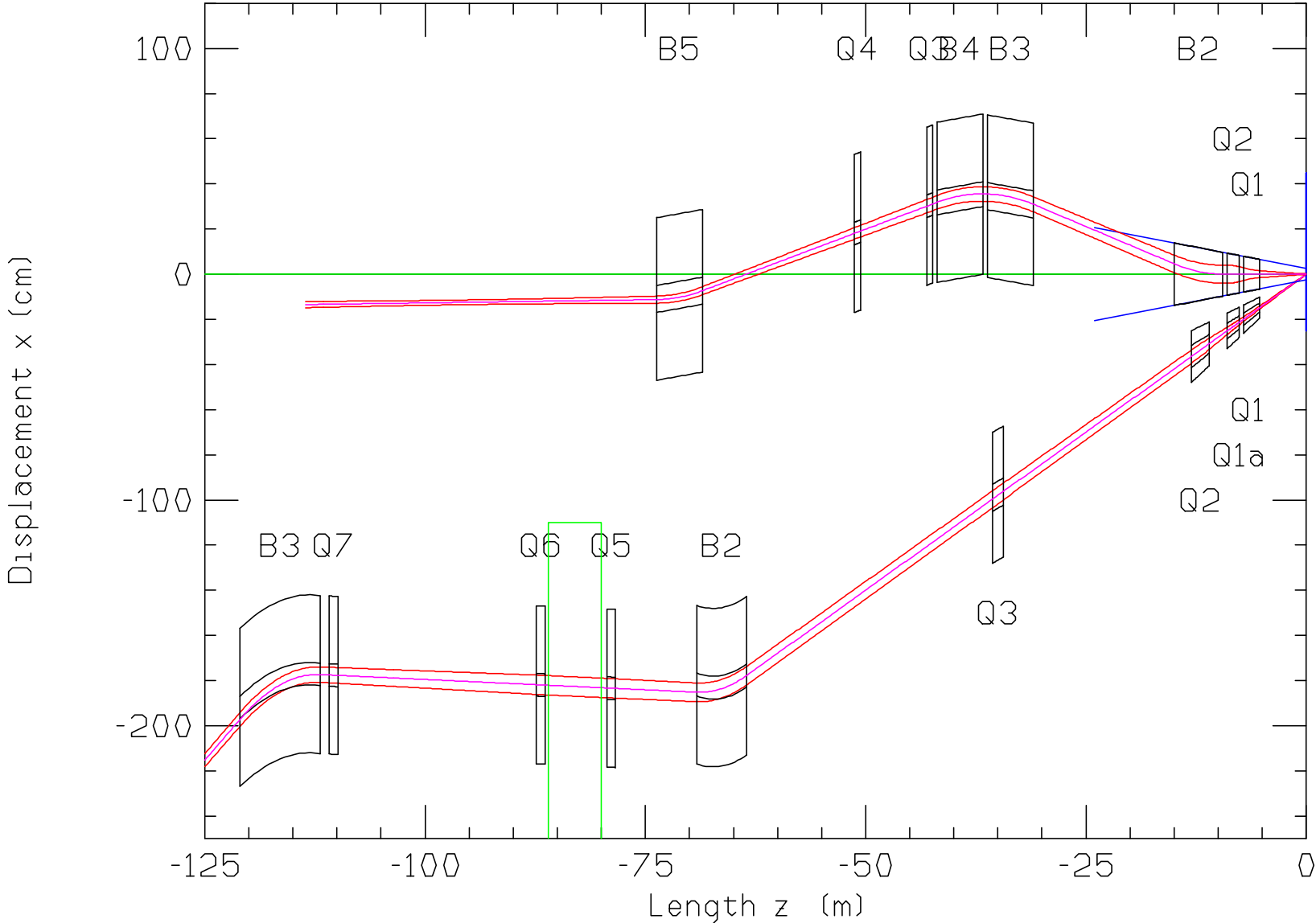
- "Pole tip" fields no worse than v1: 1.02 1.18 (1.03 1.15)
- x chromaticity less but y chromaticity more 3.7/7.8 (4.3/7.1)

Layout C split proton

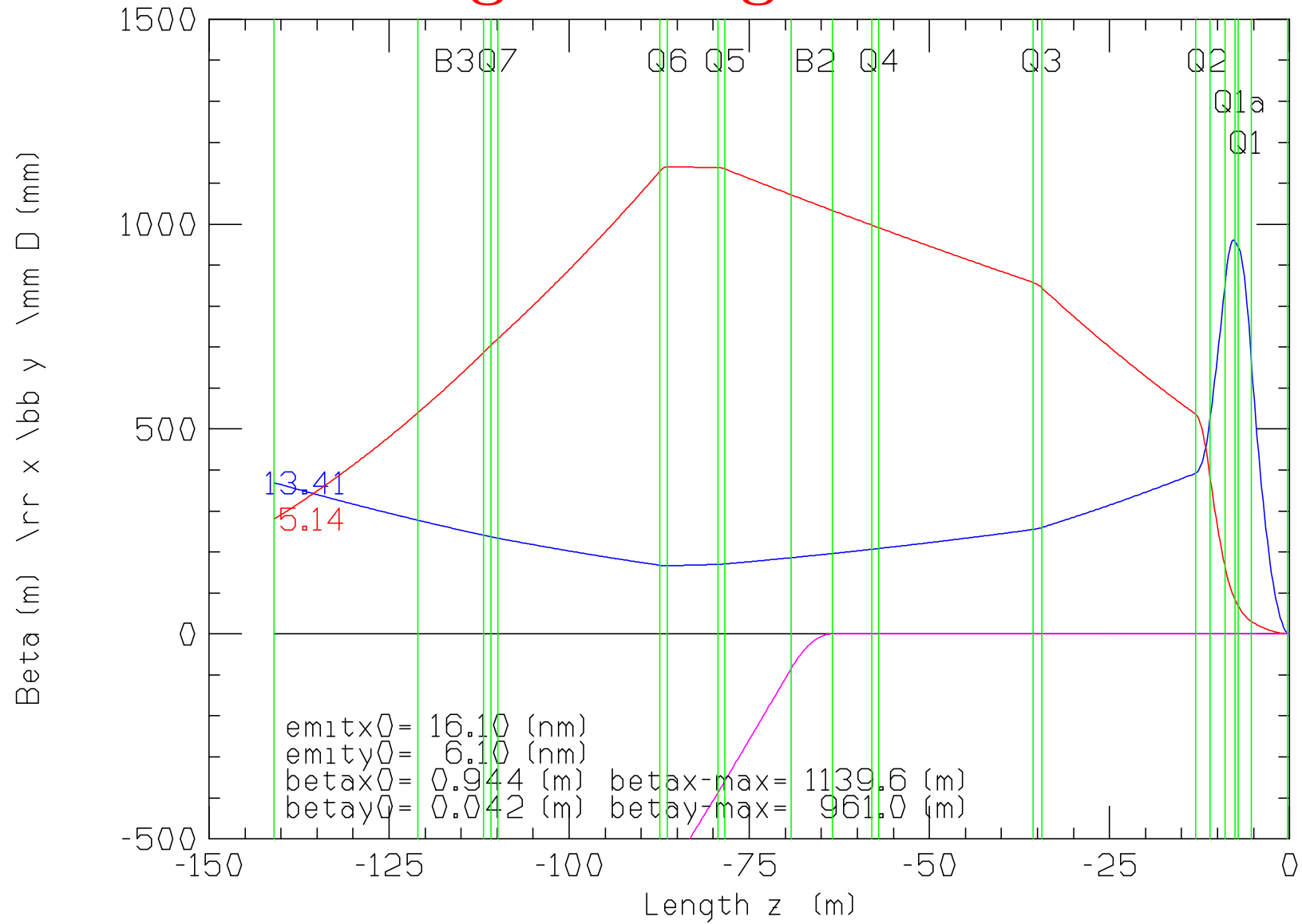
Split protons to match split in electrons $Q1 \rightarrow Q1 + Q1a$



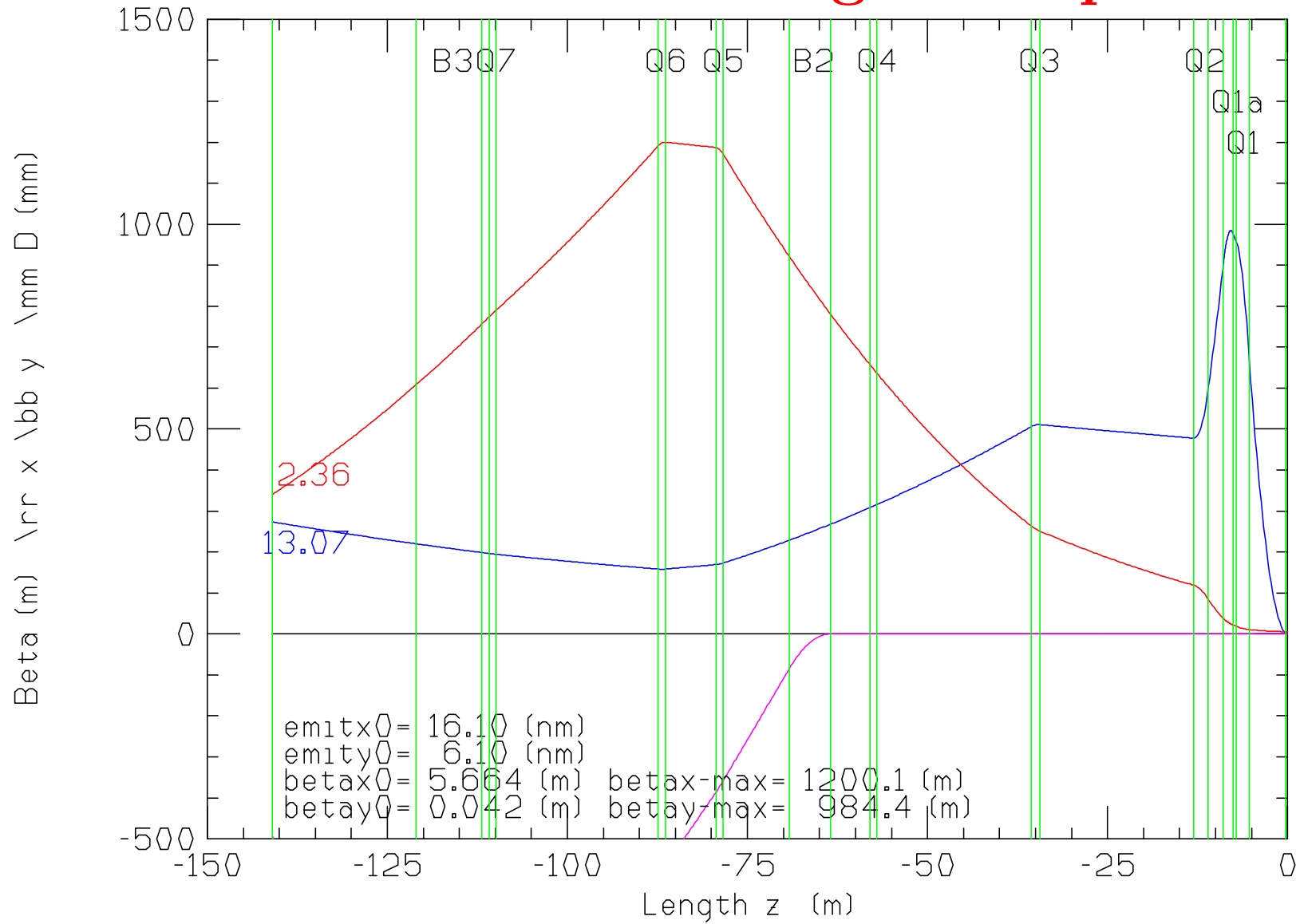
Layout C all the way back



Betas C for High Diverge



Betas D: same as C for High Acceptance



Magnets for C (High Divergence)

(mnnp3Rp7) Chrom y 13.41 Chrom x 5.14 mom = 275

		L1	DL	gap	x	θ	IR ₁	IR ₂	B	Bpt	Grad)
		m	m	m	cm	mrad	cm	cm	T	T	T/m
Q1	3	5.30	1.80	0.50	-14.8	-28.00	2.01	2.70	0.000	2.048	-75.900
Q1a	5	7.60	1.40	2.00	-21.3	-28.00	2.89	3.42	0.000	2.596	-75.900
Q2	7	11.00	2.00	21.40	-30.8	-28.00	4.18	4.94	0.000	3.125	63.250
Q3	9	34.40	1.20	21.40	-96.3	-23.00	6.00	6.00	0.000	0.275	4.583
B2	13	63.50	5.69	9.20	-177.8	-7.00	5.10	5.10	4.807	0.000	0.000
Q5	15	78.39	1.00	7.00	-183.5	1.84	5.00	5.00	0.000	0.138	2.750
Q6	17	86.39	1.00	22.50	-182.0	1.84	5.00	5.00	0.000	0.412	8.250
Q7	19	109.89	1.00	1.00	-177.7	1.84	5.00	5.00	0.000	0.046	0.917
B3	21	111.89	9.10	20.00	-177.4	-16.00	5.00	5.00	-4.730	0.000	0.000

Magnets D: as C, but for High Accept

(mnnp2R17) Chrom y 13.07 Chrom x 2.36 mom = 275

		L1	DL	gap	x	θ	IR ₁	IR ₂	B	Bpt	Grad)
		m	m	m	cm	mrاد	cm	cm	T	T	T/m
Q1	3	5.30	1.80	0.50	-14.8	-28.00	2.01	2.70	0.000	1.934	-71.683
Q1a	5	7.60	1.40	2.00	-18.3	-28.00	2.89	3.42	0.000	2.452	-71.683
Q2	7	11.00	2.00	21.40	-30.8	-28.00	4.18	4.94	0.000	2.717	55.000
Q3	9	34.40	1.20	21.40	-96.3	-23.00	6.00	6.00	0.000	0.522	-8.708
B2	13	63.50	5.69	9.20	-177.8	-7.00	5.10	5.10	4.807	0.000	0.000
Q5	15	78.39	1.00	7.00	-183.5	1.84	5.00	5.00	0.000	0.527	10.542
Q6	17	86.39	1.00	22.50	-182.0	1.84	5.00	5.00	0.000	0.412	8.250
Q7	19	109.89	1.00	1.00	-177.7	1.84	5.00	5.00	0.000	0.046	0.917
B3	21	111.89	9.10	20.00	-177.4	-16.00	5.00	5.00	-4.730	0.000	0.000

Summary

	L_{Q1Re} m	gap m	L_{Q1Re} m	L_{Q1Rp} m	$\hat{\beta}_x$ m	$\hat{\beta}_y$ m	G_{Q1Re} T/m	G_{Q2Re} T/m	G_{Q1Rp} T/m
old	3.42	2.75	2.57	3.42	900	589	4.2	3.1	78
A	1.2	2.0	2.0	3.7	464	433	13	10	61
B	1.8	0.5	1.4	3.7	299	437	13	13	61
C	1.8	0.5	1.4	1.8+1.4=3.2	"	"	"	"	76

- A) Shorter e quads reduces chromaticity and beta maxes but increases gradients
- B) Bringing them closer further lowers the betax with only minor increase in grad
- C) Matching Q1Re-Q2Re gap with gap in Q1Rp may help engineering but raised gradient
- D) As C for High Acceptance Q1Rp Q2RP gradients not higher

Comments

- For D with High Acceptance: By use of Q3Rp we can keep gradients for Q1Rp and Q2Rp below those for High Acceptance
- I still have tapered magnets with constant gradients that have higher "pole tip" fields at the far end. I could taper the gradients keeping the "pole tip" fields constant. That moves the center of gravity closer to the IP which is also in the right direction, but I do not know what Steve would think of that.
- I still need to do some checking of the apertures. They seem larger than they need be for case A, but I have not checked other cases yet.
- So this is still a DRAFT