1911-IR-Changes.pdf

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1/11/2019

This document compares the parameters in

file 1811-IR-v3.pdf entitled "Parameters" dated 12/3/2018 and emailed 12/14/2018, with those in

file 1809-IR-update-v7.pdf entitled "IR Update (v7)" dated 9/21/2018 and emailed on that date.

Both represent designs made after the pCDR that greatly reduced the required gradients by keeping e and hadron magnets side by side instead of alternating them.

The changes mainly reflected an improved match of betas around 30 m from the IP with those in the pCDR matched solution.

This is merely an attempt to guess what they may be when an actual match is performed.

In the forward proton case it also included new magnet tilts to maximize the space between e and p beams.

Forward Protons

In the forward proton case the amin changes came from new magnet tilts to maximize the space between e and p beams.
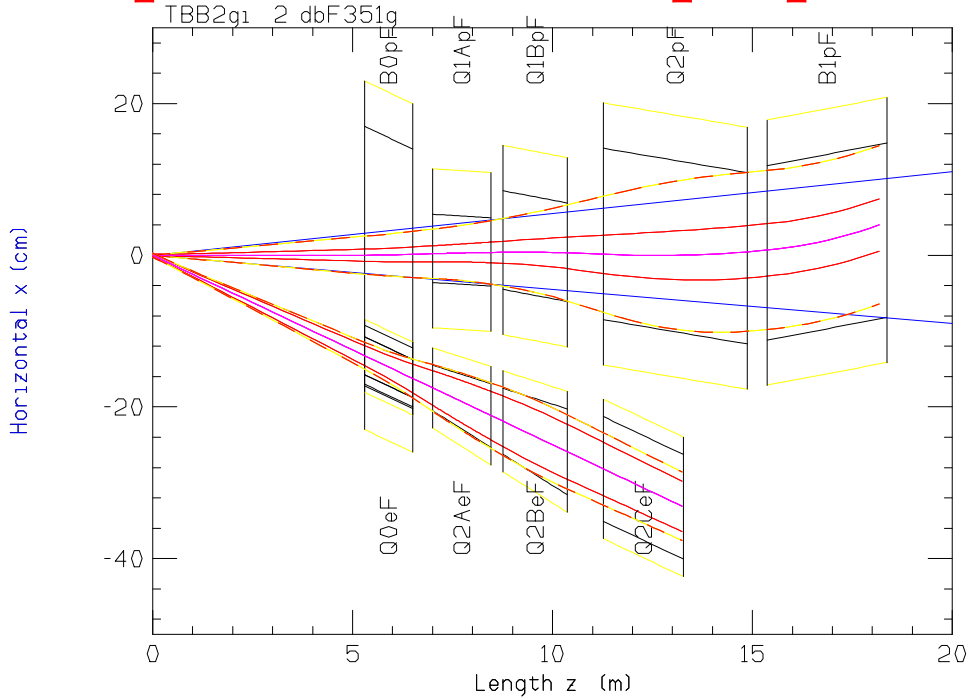
| | 9/21 | | | | | 12/14 | | | | | dap | dgrad |
| | Lc | L | ap | th | grad | Lc | L | ap | th | grad | | |
	m	m	m	mrad	T/m	m	m	m	mrad	T/m	%	%
B0pF	5.9	1.2	.17	-25*	0	=	=	=	=	-25	=	0	0
Q1ApF	7.73	1.46	0.045	-10	-77.903	=	=	=	=	-3.15	=	0	0
Q1BpF	9.65	1.61	0.065	-10	-63.028	=	=	=	=	-10	=	0	0
Q2pF1	13.07	3.6	0.108	-13	39.736	=	=	=	0.113	-8.89	=	+5	0
B1pF	16.87	3.0	0.125	0	0	=	=	=	0.115	10	=	-8	0

* incorrectly entered in document
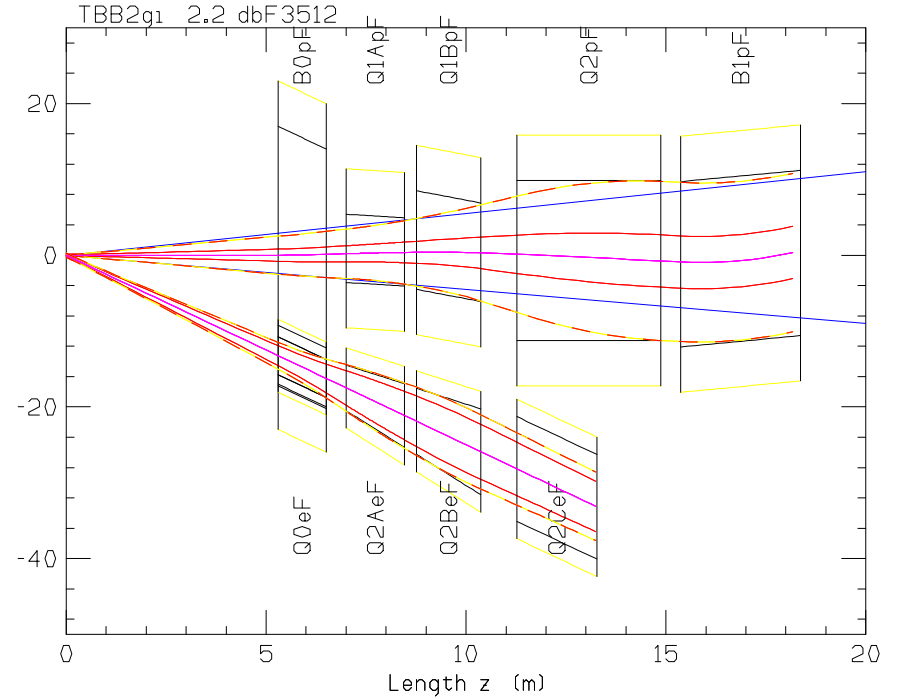
Betas compared with pCDR

matched pCDR   current
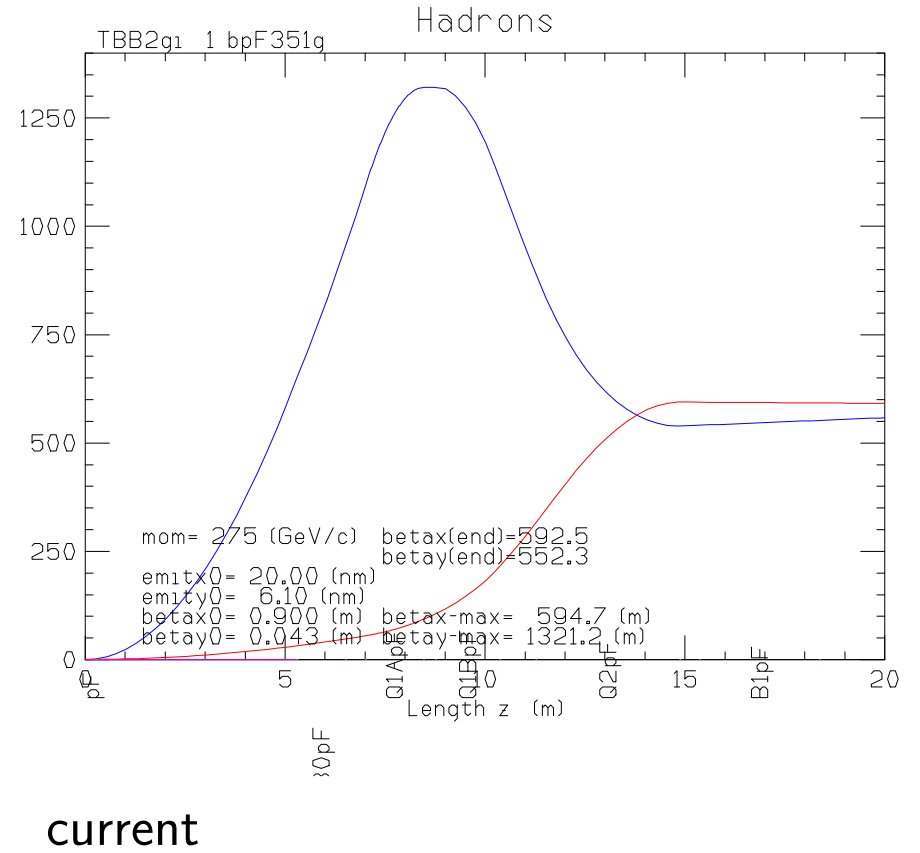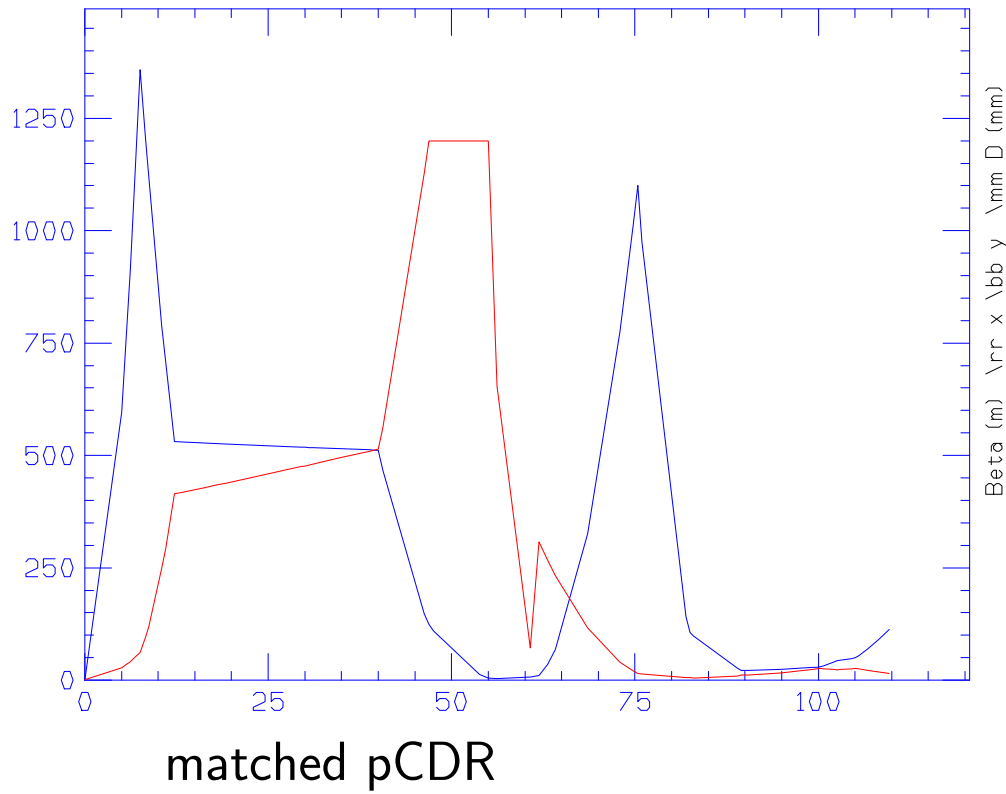
Apertures vs e-p space

maximize space   minimize apertures

#	name	center_z	center_x	center_y	rad	drad	length	angle	B	gradient
#		[m]	[m]	[m]	[m]	%	[m]	[mrad]	[T]	[T/m]
12/14	Q2pF	13.070	0.0120	0.00	0.1130	+5	3.600	−8.89	0.000	39.736
	B1pF	16.870	0.0180	0.00	0.1150	−8	3.000	10.00	−4.570	0.000
01/11/19	Q2pF	13.070	−0.0070	0.00	0.1055	−2	3.600	0.00	0.000	39.736
	B1pF	16.870	−0.0045	0.00	0.1090	−13	3.000	5.00	−4.570	0.000
9/21/18	Q2pF				0.108					
	B1pF				0.125					

Forward electrons for worst case

	9/21					12/14					dap	dgrad
	Lc m	L m	ap1 m	ap2 m	grad T/m	Lc m	L m	ap1 m	ap2 m	grad T/m	%	%
Q0eF	5.9	1.2	.026	.026	-12.713	Q0eF 5.9	1.2	.025	.025	-12.705	≈0	≈0
Q1eF	9.565	1.61	.0464	.058	1.675	Q1BeF 9.565	1.61	.0436	.0566	1.155	≈0	≈0
Q2eF	12.27	2.0	.065	.065	3.846	Q1CeF 12.27	2.0	.069	.069	3.85	+6	≈0
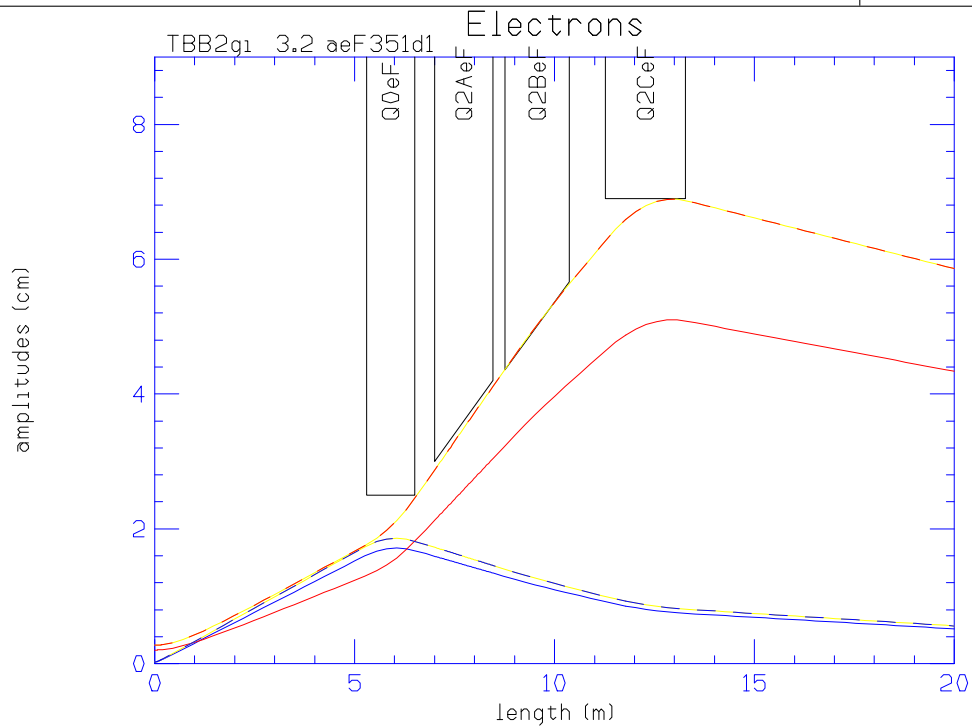
Aperture of Q1CeF in 9/21 appears to be an error

But it could be lowered at the price of a higher betamax
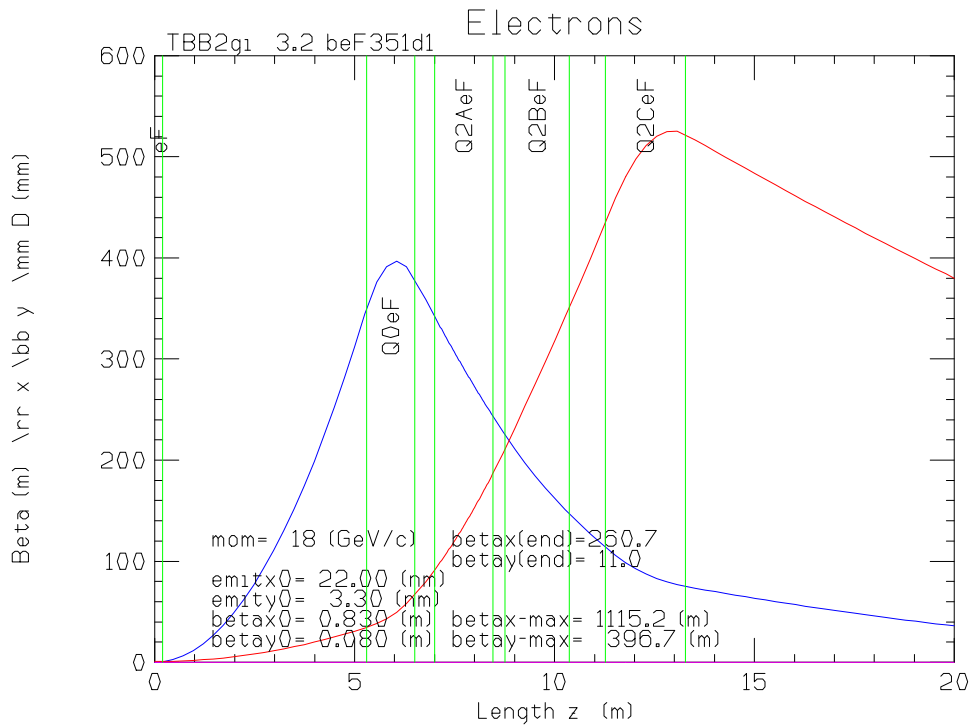
Forward electrons for baseline case

A stronger Q0eF allows a closer Q1eF and reduced betamax, but this, for a given worst case divergence, increases the synchrotron fan.

But for the baseline, the initial divergence is less allowing a stronger Q0eF, effectively closer Q1eF, and lower betamax.
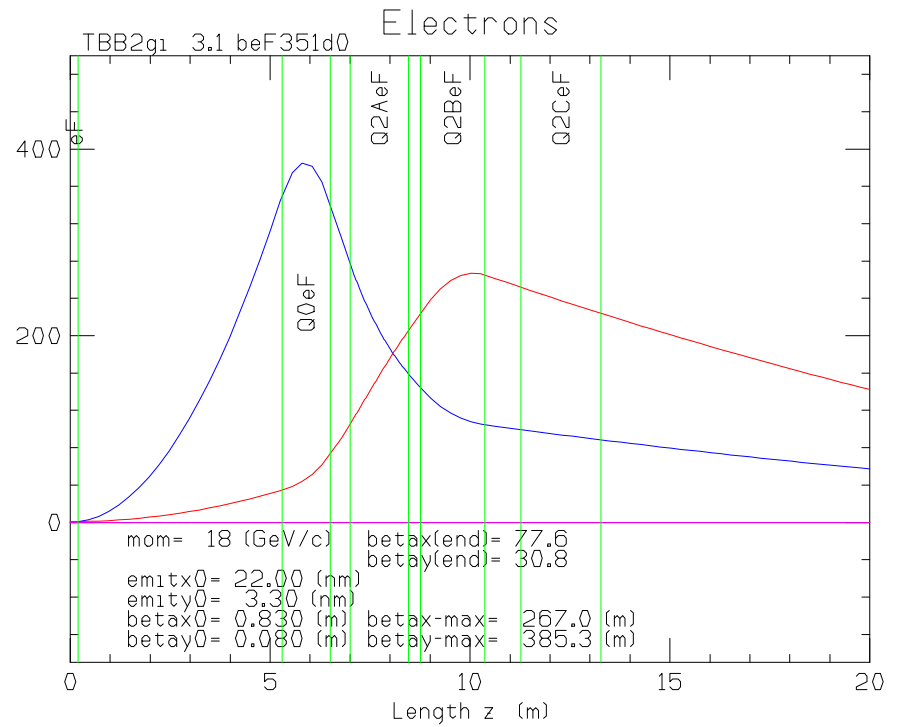
To get the effectively closer Q1eF, we introduce a new quad Q1AeF and increase the gradient in Q0eF by 36 %

If this is not possible one would have to back off, allowing the higher betamax.

	9/21						12/14					dap	dgrad
	Lc	L	ap1	ap2	grad		Lc	L	ap1	ap2	grad	dap	dgrad
	m	m	m	m	T/m		m	m	m	m	T/m	%	%
Q0eF	5.9	1.2	.026	.026	-12.713	Q0eF	5.9	1.2	.025	.025	-17.325	≈0	36
						Q2AeF	7.73	1.46	0.03	0.042	5.582	-	-
Q1eF	9.565	1.61	.0464	.058	1.675	Q1BeF	9.565	1.61	.0436	.0566	6.814	≈0	407
Q2eF	12.27	2.0	.065	.065	3.846	Q1CeF	12.27	2.0	.069	.069	0	+6	-100

Electrons

Left plot (worst case):

TBB2g1 3.2 beF351d1

Q0eF

Q2AeF   Q2BeF   Q2CeF

Q0eF

mom= 18 (GeV/c)   betax(end)=260.7
                   betay(end)= 11.0
emitx0= 22.00 (nm)
emity0= 3.30 (nm)
betax0= 0.830 (m) betax-max= 1115.2 (m)
betay0= 0.080 (m) betay-max= 396.7 (m)

Beta (m) \rr x \bb y \mm D (mm)

Length z (m)

Right plot (baseline with lower betamax):

Electrons

TBB2g1 3.1 beF351d0

Q0eF

Q2AeF   Q2BeF   Q2CeF

Q0eF

mom= 18 (GeV/c)   betax(end)= 77.6
                   betay(end)= 30.8
emitx0= 22.00 (nm)
emity0= 3.30 (nm)
betax0= 0.830 (m) betax-max= 267.0 (m)
betay0= 0.080 (m) betay-max= 385.3 (m)

Beta (m) \rr x \bb y \mm D (mm)

Length z (m)

worst case

baseline with lower betamax

Rear hadron

	9/21					12/14						
	Lc	L	ap1	ap2	grad	Lc	L	ap1	ap2	grad	dap	dgrad
	m	m	m	m	T/m	m	m	m	m	T/m	%	%
Q1A	-6.2	1.8	.0201	.027	-75.9	=	=	=	.0201	.0256	-83.417	0/-25	+10
Q1B	-9.3	1.4	.0289	.0342	-75.9	=	=	=	.028	.028	-83.417	≈0/-18	+10
Q2	-12	2.0	.0418	.0494	+63.25	=	=	=	.05	.05	+77	≈0	+22

Betas compared with pCDR

matched pCDR

current
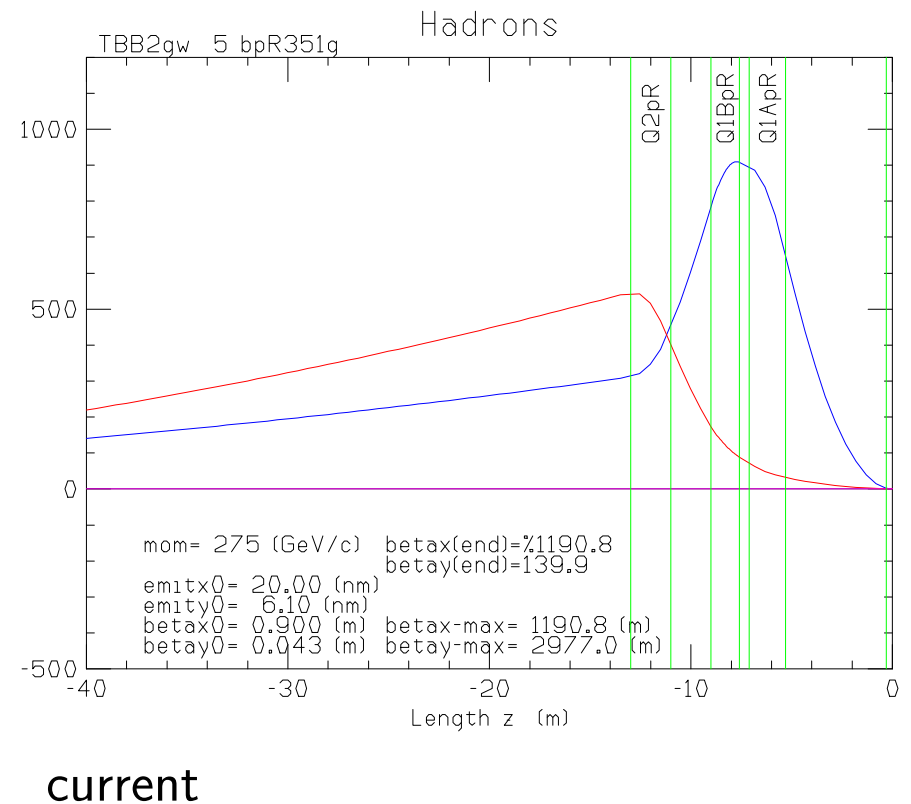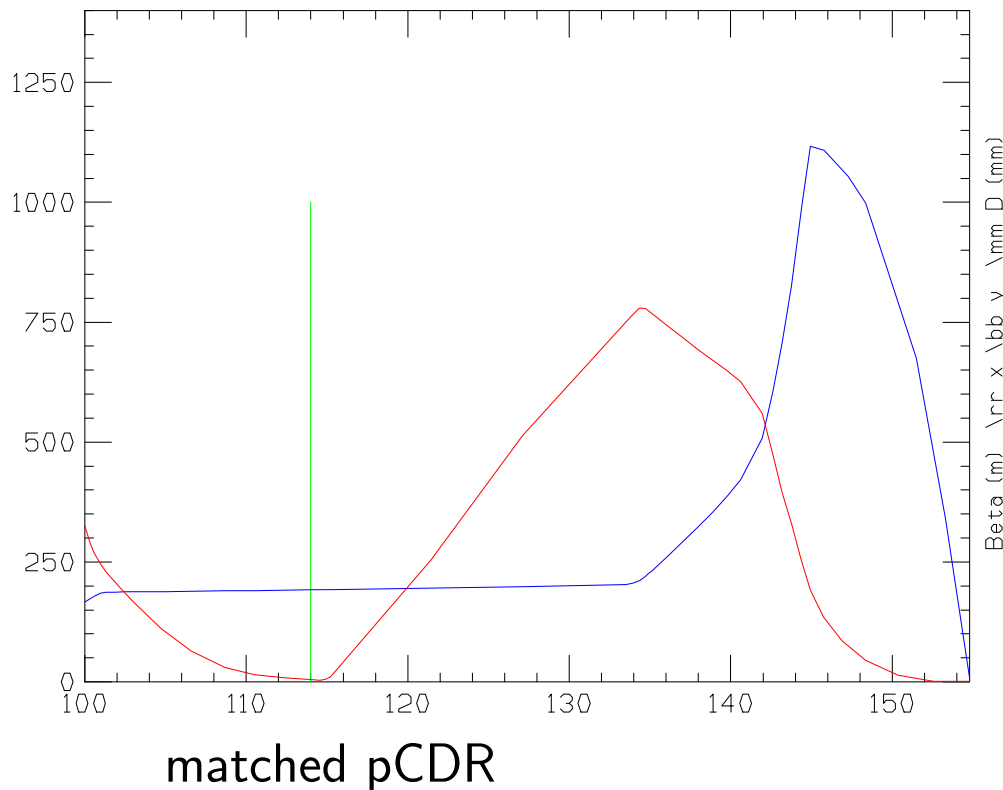
Adjusted Betas compared with pCDR

# name	center_z	center_x	center_y	radius	length	angle	B	gradient	
#	[m]	[m]	[m]	[m]	[m]	[mrad]	[T]	[T/m]	
Q1ApR	-6.200	0.0000	0.00	0.0201	1.800	0.00	0.000	-85.250	+12%
Q1BpR	-8.300	0.0000	0.00	0.0280	1.400	0.00	0.000	-85.250	+12%
Q2pR	-12.000	0.0000	0.00	0.0500	2.000	0.00	0.000	82.500	+30%
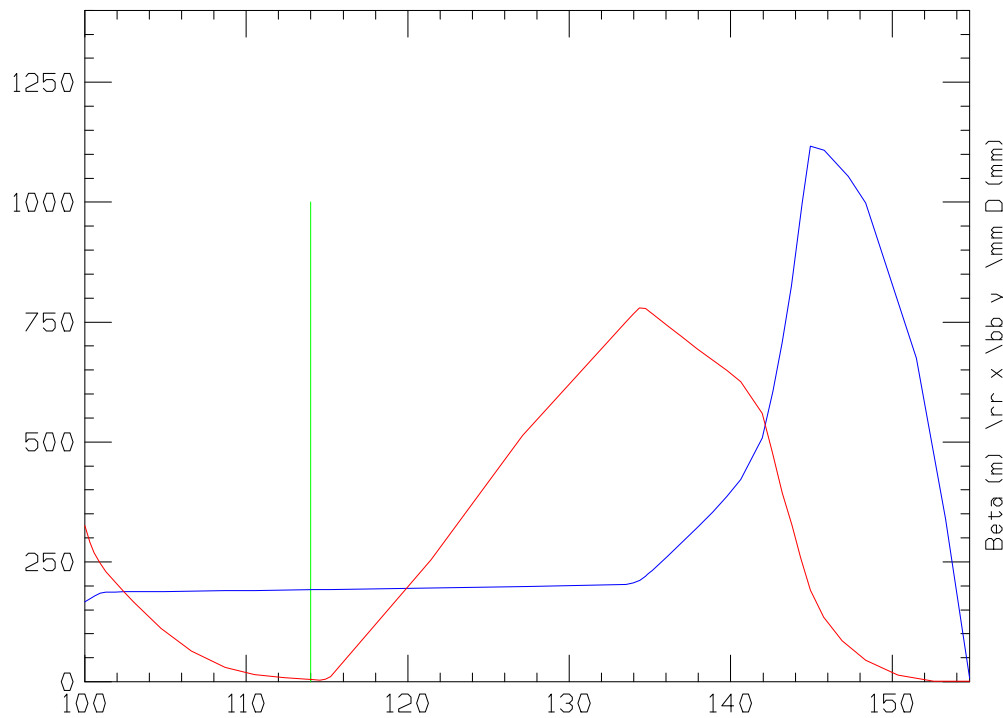
matched pCDR
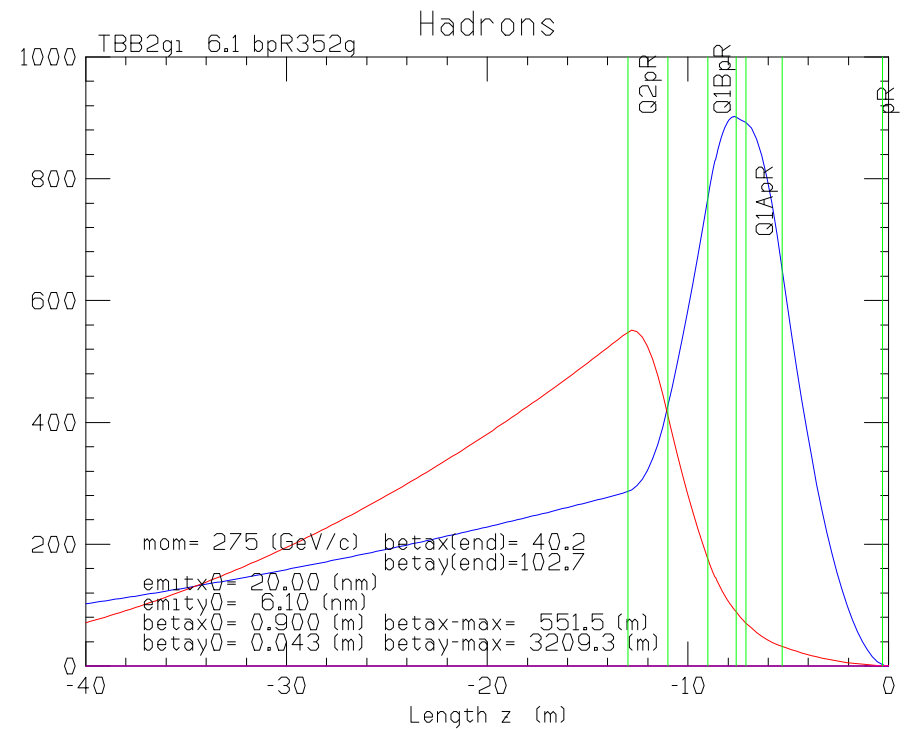
current

Clearly Q1pR needs to be longer

Rear electron

	9/21					12/14						
	Lc	L	ap1	ap2	grad	Lc	L	ap1	ap2	grad	dap	dgrad
	m	m	m	m	T/m	m	m	m	m	T/m	%	%
Q1	-6.2	1.8	.066	.0795	-12.9	=	=	=	=	-14.46	0	+12
Q2	-8.3	1.4	.0832	.0938	12.6	=	=	=	=	13.74	0	+9
B2	-12.25	5.5	.0975	.1388	0	=	=	=	=	0	0	0

pCDR e betas
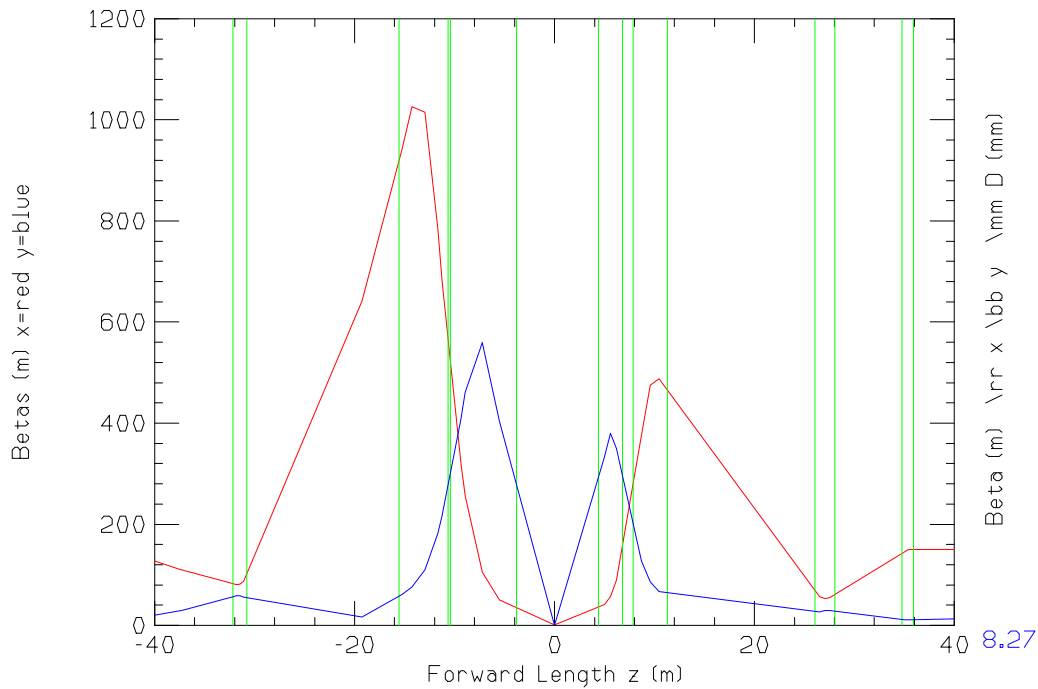
ppCDR dash=old line=new

Note lower beta max in ppCDR
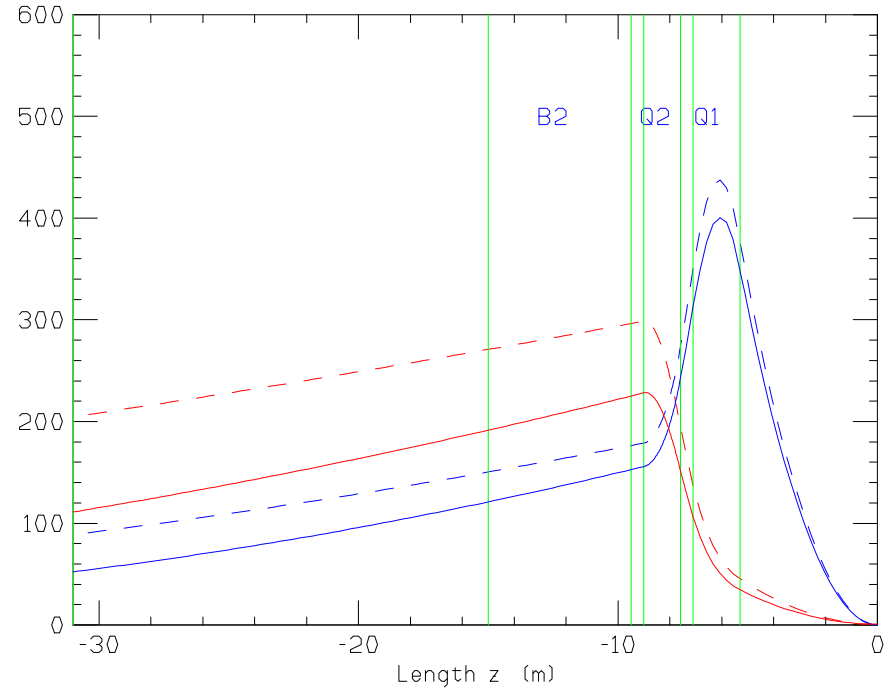
and lower beta at -31 m in new vs. old