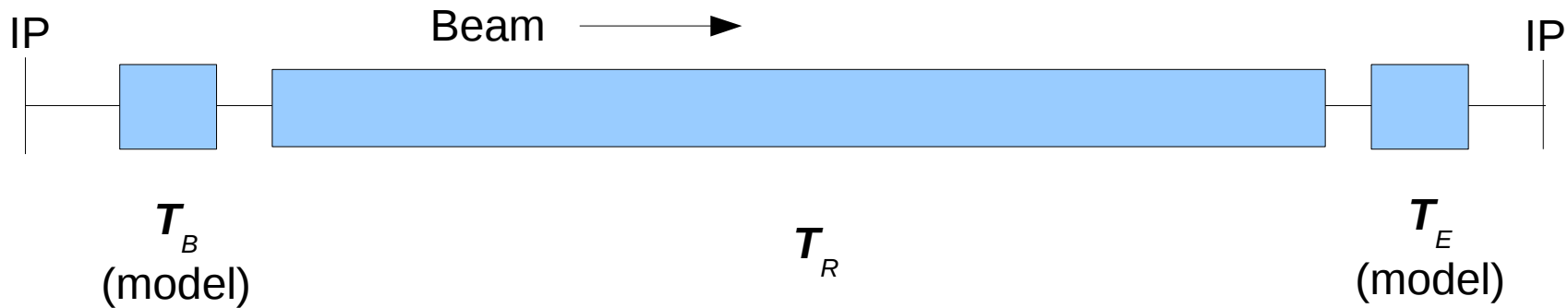


Description of Method

Extending the method of measuring β^* by varying the two quadrupoles about the IP.



The ring transfer matrix:

$$T = T_E T_R T_B = \begin{bmatrix} A & B \\ C & D \end{bmatrix}$$

T can be described with 10 parameters: $[\mu_x, \alpha_x, \beta_x, \mu_y, \alpha_y, \beta_y, a, b, c, d]$

[A] Vary a quadrupole in T_B : $T_{\Delta} = T_E T_R T_{B+\Delta} = T_E T_R T_B (T_B^{-1} T_{B+\Delta}) = T (T_B^{-1} T_{B+\Delta})$

[B] Vary a quadrupole in T_E : $T_{\Delta} = T_{E+\Delta} T_R T_B = (T_{E+\Delta} T_E^{-1}) T_E T_R T_B = (T_{E+\Delta} T_E^{-1}) T$

Tune Measurements

$$G = - \left[\frac{1}{2} (Tr(A) - Tr(D)) + \text{sign}(Tr(A) - Tr(D)) \sqrt{\frac{1}{4} (Tr(A) - Tr(D))^2 + |\bar{B} + C|} \right]^{-1} (\bar{B} + C)$$

$$M_x = A - \bar{G} C$$

$$M_y = D + G B$$

$$M_{x|y} = \begin{bmatrix} \cos(\mu_{x|y}) + \alpha_{x|y} \sin(\mu_{x|y}) & \beta_{x|y} \sin(\mu_{x|y}) \\ -\frac{1 + \alpha_{x|y}^2}{\beta_{x|y}} \sin(\mu_{x|y}) & \cos(\mu_{x|y}) - \alpha_{x|y} \sin(\mu_{x|y}) \end{bmatrix}$$

Quadrant II

$$0 > \cos(\mu_{x|y})$$

$$0 < \sin(\mu_{x|y})$$

Quadrant I

$$0 < \cos(\mu_{x|y})$$

$$0 < \sin(\mu_{x|y})$$

Quadrant III

$$0 > \cos(\mu_{x|y})$$

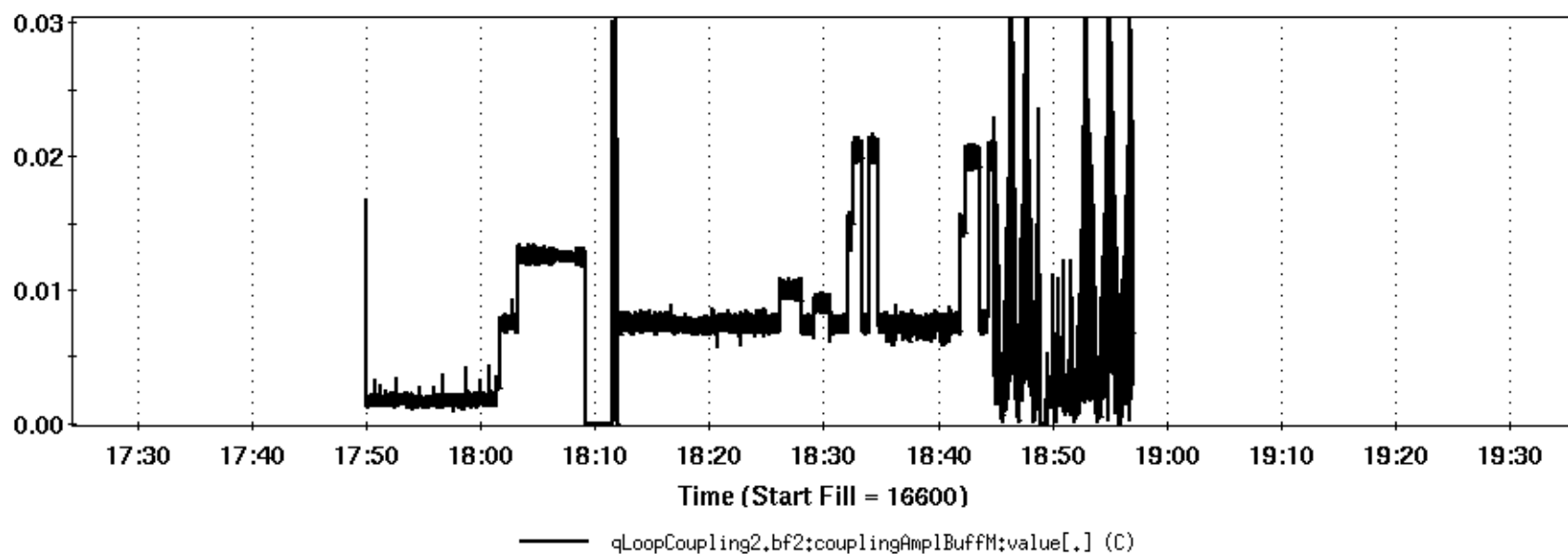
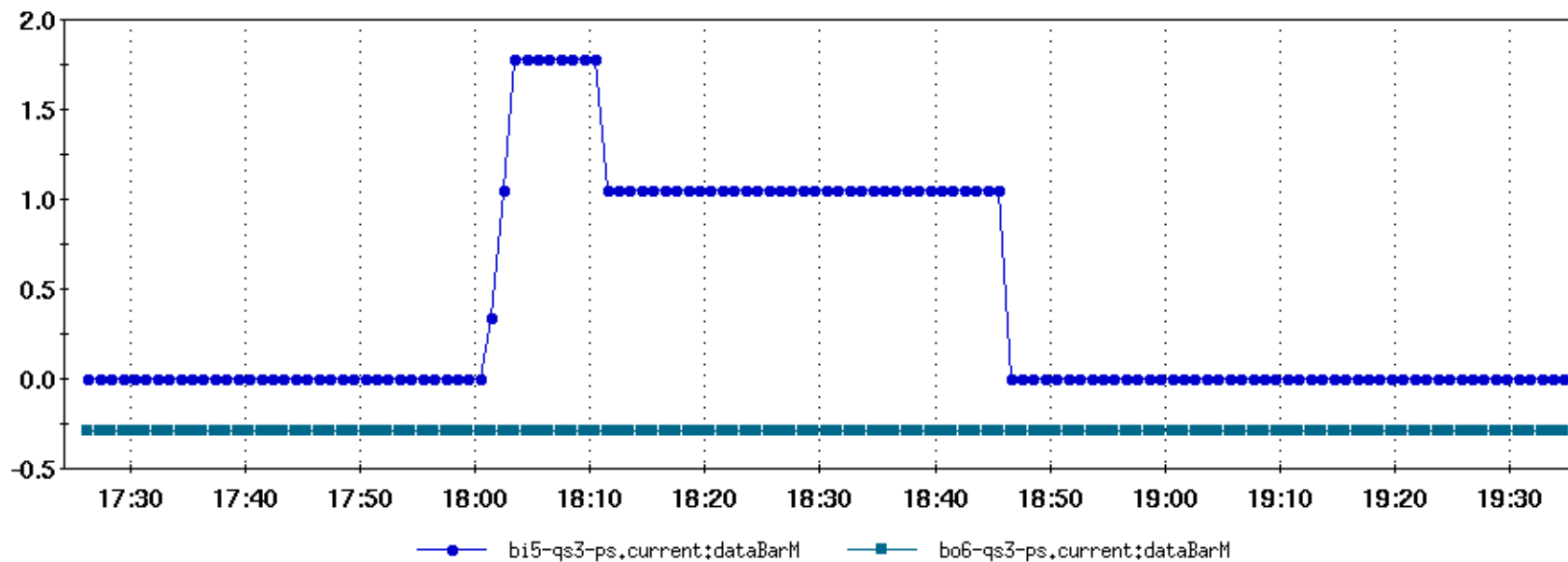
$$0 > \sin(\mu_{x|y})$$

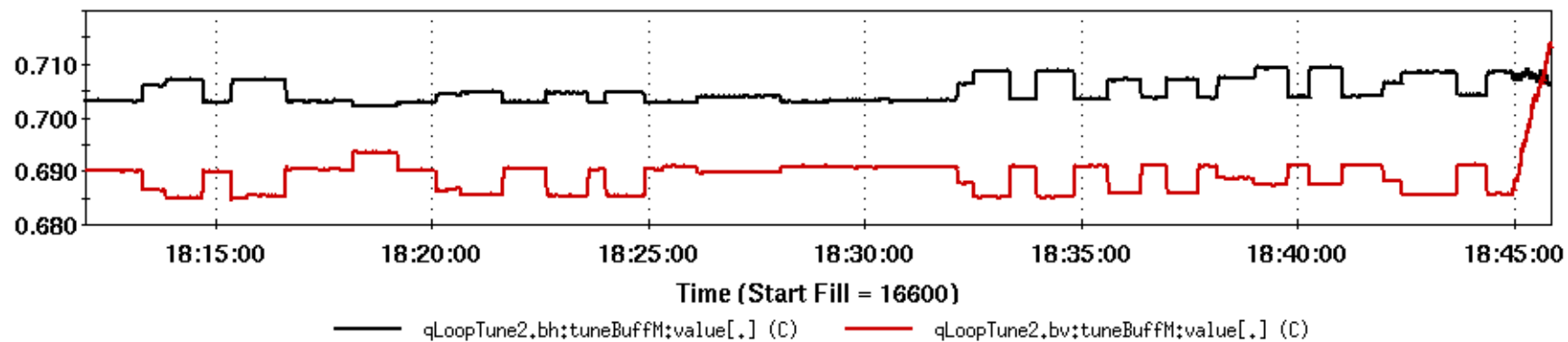
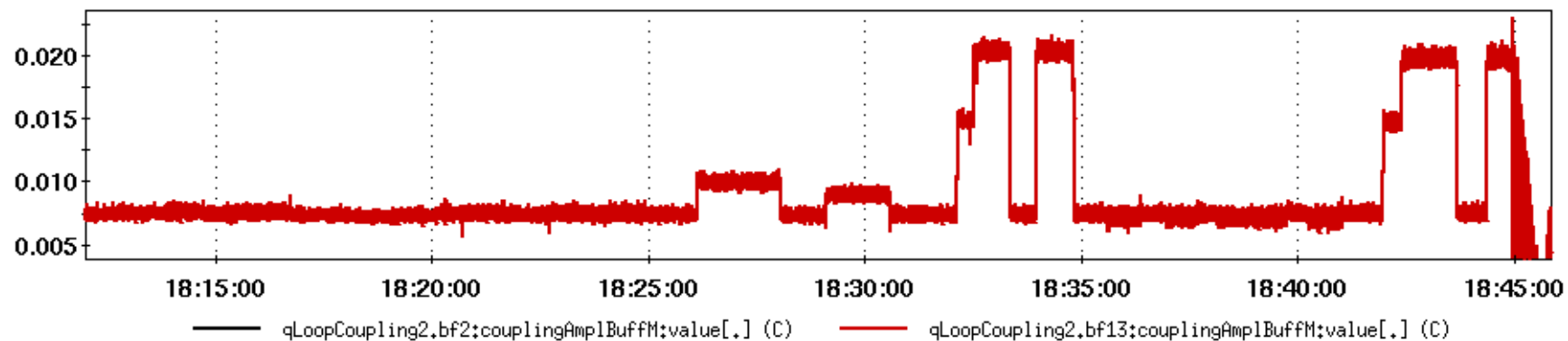
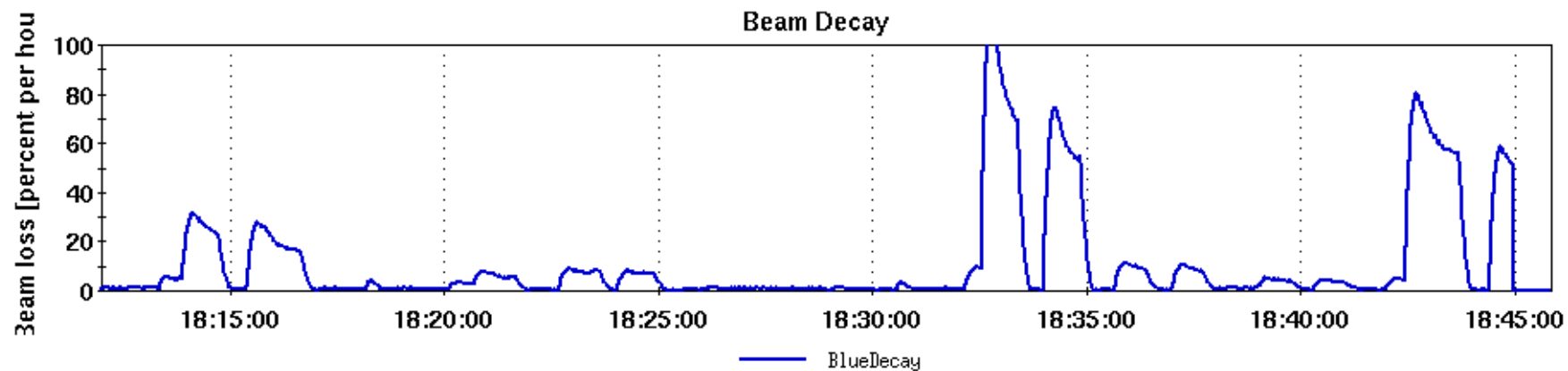
Quadrant IV

$$0 < \cos(\mu_{x|y})$$

$$0 > \sin(\mu_{x|y})$$

File Window Markers Analysis





	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1					Qx	Qy	ΔQ_{min}							
2			Averaged Base Tunes		0.703497	0.690757	0.00732802							
3														
4			Qx				Qy				ΔQ_{min}			
5	Quadrupole	Base	Diff	Tweaked	Corrected	Base	Diff	Tweaked	Corrected	Base	Diff	Tweaked	Corrected	
6		0.703169	-0.000328	0.707125	0.707453	0.690137	-0.000620	0.684985	0.685605	0.00732439	-0.00000363	0.00754715	0.00755078	
7	q1b	0.702949	-0.000548	0.707068	0.707616	0.690341	-0.000416	0.685414	0.685830	0.00726681	-0.00006121	0.00753351	0.00759472	
8		0.702978	-0.000519	0.704607	0.705126	0.690493	-0.000264	0.685353	0.685617	0.00725437	-0.00007365	0.00746283	0.00753648	
9	q2b	0.702933	-0.000564	0.704732	0.705296	0.690304	-0.000453	0.685354	0.685807	0.00726894	-0.00005908	0.00746741	0.00752649	
10		0.703261	-0.000236	0.708009	0.708245	0.690786	0.000029	0.685117	0.685088	0.00728937	-0.00003865	0.02035400	0.02039265	
11	q3b	0.703436	-0.000061	0.708089	0.708150	0.690881	0.000124	0.685101	0.684977	0.00733047	0.00000245	0.02033800	0.02033555	
12		0.704032	0.000050	0.708502	0.708452	0.691017	0.000177	0.685609	0.685432	0.00738943	0.00006141	0.01979730	0.01973589	
13	q3e	0.704283	0.000182	0.708598	0.708416	0.691136	0.000302	0.685686	0.685384	0.00738041	0.00005239	0.01979490	0.01974251	
14		0.703728	0.000231	0.709265	0.709034	0.690960	0.000203	0.687464	0.687261	0.00736692	0.00003890	0.00710575	0.00706685	
15	q2e	0.703969	0.000472	0.709350	0.708878	0.691039	0.000282	0.687463	0.687181	0.00737317	0.00004515	0.00711276	0.00706761	
16		0.703547	0.000050	0.707040	0.706990	0.690934	0.000177	0.685943	0.685766	0.00734730	0.00001928	0.00716839	0.00714911	
17	q1e	0.703679	0.000182	0.707152	0.706970	0.691059	0.000302	0.685936	0.685634	0.00734465	0.00001663	0.00717683	0.00716020	
18														
19														
20	Quadrupole	Final Qx	Final Qy	Final ΔQ_{min}										
21	q1b	0.707535	0.685718	0.00757275										
22	q2b	0.705211	0.685712	0.00753148										
23	q3b	0.708198	0.685033	0.02036410										
24	q3e	0.708434	0.685408	0.01973920										
25	q2e	0.708956	0.687221	0.00706723										
26	q1e	0.706980	0.685700	0.00715465										
27														
28														

Beam lines Measurements/Solver

Measured Base Tunes

Qx	Qy	ΔQ_{min}
0.703497	0.690757	0.00732802

Measured Tweak Tunes

Quadrupole	ΔKL	Qx	Qy	ΔQ_{min}
q1b	0.0007	0.707535	0.685718	0.00757275
q2b	0.0004	0.705211	0.685712	0.00753148
q3b	-0.0008	0.708198	0.685033	0.02036410
q3e	-0.0008	0.708434	0.685408	0.01973920
q2e	0.0006	0.708956	0.687221	0.00706723
q1e	0.0007	0.706980	0.685700	0.00715465

Initial Guess

Simplex

Lmdif

TNC

Evaluate

Method: Q1 - Q2 - Q3

Model Base Tunes

Qx	Qy	ΔQ_{min}
0.703497	0.690757	0.00733483393772

Model Twiss Parameters and Coupling

α_x	β_x	Couple ₁₁	Couple ₁₂
-0.217608465375	10.4785574679	-0.20563897446	-1.57780891609
α_y	β_y	Couple ₂₁	Couple ₂₂
0.0138198614988	7.4548456681	0.0278102908106	-0.273872148758

Waist

$\beta_x(\text{waist})$	Sx(waist)	$\beta_y(\text{waist})$	Sy(waist)
10.0047959224	-2.17712828707	7.45342214965	0.1030052618

Model Beam Transfer Matrix

-0.0944584757486	-9.88690896357	-0.000502859299097	-0.535776195922
0.0965501591933	-0.495415366916	-0.00256311699673	0.0110522145767
0.0172277185666	-0.31879237378	-0.380718993993	-7.03705290521
-0.0063876505847	0.0381663716611	0.12429043499	-0.332897623039

Model and Measurement Differences

Device	ΔQ_x	ΔQ_y	$10 \cdot \Delta(\Delta Q_{min})$
Base	0.0	0.0	6.81393772293e-05
q1b	0.000265368557346	0.000106579474296	9.96256279649e-05
q2b	0.000165632718198	0.000112555778874	0.000192447799957
q3b	6.31578725444e-05	0.000107159182593	1.37172205595e-05
q3e	0.000483060605039	0.000339780424124	6.22127233072e-05
q2e	0.000184512751722	0.000138241634845	0.000112574039851
q1e	8.11956177692e-05	0.000234381778367	0.000115068127241
Penalty (sum of the squares)			6.82412769452e-07

Open

Save

Quit

File

Help

Design+Trim

Ramp: pp12b-v2

Config: dbconfig/1325793289

Blue Species: PP

Yellow Species: PP

Options

BetaStarSlopes

DR8toDRG

DipoleHarmonics

FamilyTF

WarmTF

polyField

specificTF

State

On

On

Off

On

On

On

On

Blue

Yellow

DxAngles

StoneEditor

DipoleRamp

BetaStar

TuneChrom

Lattice

Optics

Magnets

Power Supplies

Stone: pp12b-v2::injection

Twiss

Orbit

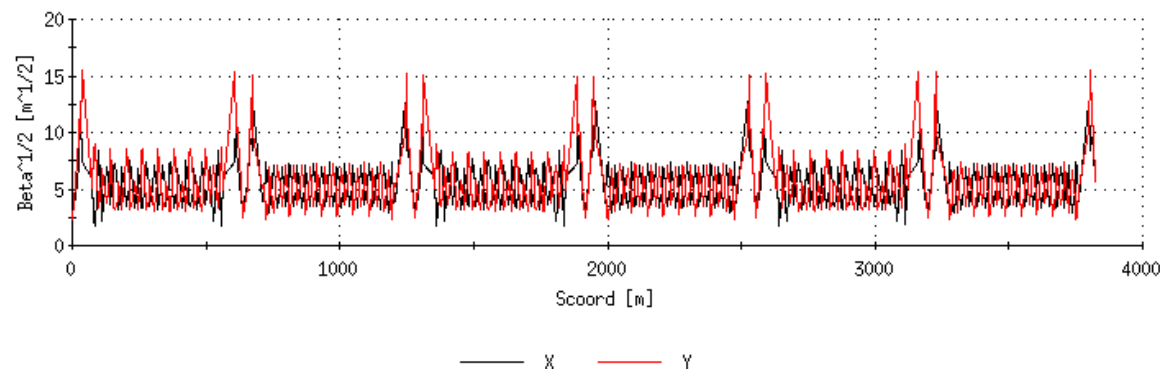
Correctors

Tunes/Chroms

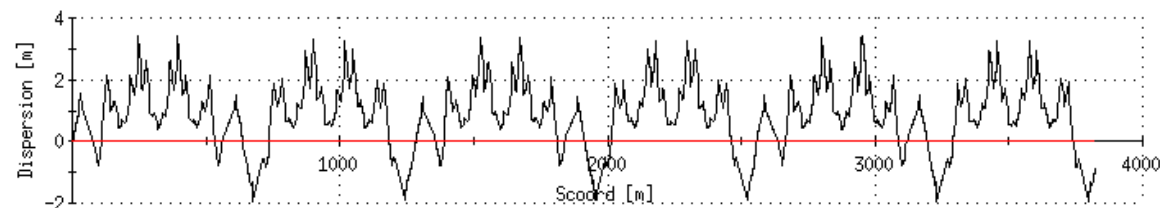
Stone #	1
Time [sec]	0
Gamma	25.3786244712
BetaGamma	25.3589151986
Brho [T-m]	79.3667745
Qx	28.7364402802
Qy	29.6157495625
ChromX	3.00806284771
ChromY	7.51048617701
ChromX2	141.195670586
ChromY2	195.259975814
ChromX3	1735.25408199
ChromY3	-235.218574902
GammaT	22.1681722576

Save to SXF File...

Beta Function



Dispersion Function



IP Parameters

Value/IP	IP6	IP8	IP10	IP12	IP2	IP4
BetaX [m]	10.1480512	10.2668127	10.4246226	10.4212426	10.2003389	10.4248634
BetaY [m]	5.62199908	5.81120808	5.90827985	6.06384601	5.87565401	5.75579345
AlphaX	0.246214371	-0.23749281	0.246846069	-0.258699714	0.254257195	-0.238302657
AlphaY	-0.00847445588	0.0654905384	0.0232068346	0.0129588799	-0.0391348908	0.00505734415
EtaX [m]	-0.164891881	-0.160504749	-0.177186983	-0.16600165	-0.166602285	-0.164324276
EtaY [m]	0	0	0	0	0	0
EtaX'	0.0570253488	-0.0566657377	0.0547324922	-0.0547503715	0.0556937562	-0.0567111179
EtaY'	0	0	0	0	0	0

Inform -- Getting the data...

Inform -- Getting the data...

Summary

	Measured	OptiCalc
β_x	10.479	10.219
α_x	-0.218	-0.228
β_y	7.455	5.646
α_y	0.014	0.066

- Make another test both uncoupled and coupled and compare to Yun's and/or Mei's measurements
- Measure at store both rings and IPs.
- Perhaps automate this in the future.
- Thanks to M. Wilinski and K. Mernick for BBQ operations.