

Status report on studies for new optics version

Masamitsu Aiba

Thanks to Massimo, Simon, Stephane and Thys

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Introduction

- Updating V6.503
 - $\pi/2$ phase advances IP1 to IP5
 - No off-momentum beta-beat in IR7, ~40% in IR3
 - Modify IR2, IR3, IR4, IR6, IR7 and IR8, but not IR1 and 5
 - Modify Arc23, Arc34, Arc67, Arc78 slightly
 - No B1-B2 phase split except for IR4 and IR7
 - Compatible with the constructed machine (MQTL, measured profile etc.)

V6.503 collision																		
Beam1														MUX	MUY			
	IR1	IR2	ARC23	IR3	ARC34	IR4	IR5	IR6	ARC67	IR7	ARC78	IR8		IP1	0.00	0.00		
MUX	2.633	2.986	5.499	2.261	5.527	2.045	2.633	2.015	5.499	2.450	5.527	3.183		IP5	31.98	29.65	0.98	0.65
MUY	2.649	2.809	5.098	1.905	5.073	1.941	2.649	1.780	5.099	1.924	5.074	2.974		IP1L	64.31	59.32		
Beam2																		
	IR1	IR2	IR3		IR4	IR5	IR6	ARC67	IR7	ARC70	IR8			IP1	0.00	0.00		
MUX	2.633	2.991	5.527	2.260	5.499	2.125	2.633	2.015	5.527	2.489	5.499	3.059		IP5	32.06	29.76	0.06	0.76
MUY	2.649	2.844	5.074	1.990	5.099	1.934	2.649	1.780	5.073	2.003	5.098	2.782		IP1L	64.31	59.32		
V6.503s3 collision																		
Beam1														MUX	MUY			
	IR1	IR2	ARC23	IR3	ARC34	IR4	IR5	IR6	ARC67	IR7	ARC78	IR8		IP1	0.00	0.00		
MUX	2.633	2.986	5.583	2.272	5.612	2.13830	2.633	2.011	5.415	2.48474	5.442	3.048		IP5	32.25	29.75	0.25	0.75
MUY	2.649	2.809	5.098	1.990	5.073	1.95797	2.649	1.780	5.099	2.04603	5.074	2.750		IP1L	64.31	59.32		
Beam2																		
	IR1	IR2	ARC23	IR3	ARC34	IR4	IR5	IR6	ARC67	IR7	ARC78	IR8		IP1	0.00	0.00		
MUX	2.633	2.986	5.612	2.272	5.583	2.13749	2.633	2.011	5.442	2.48552	5.414	3.048		IP5	32.25	29.75	0.25	0.75
MUY	2.649	2.809	5.074	1.990	5.099	1.95722	2.649	1.780	5.074	2.04677	5.098	2.750		IP1L	64.31	59.32		

Towards finalizing (1)

- Collision optics of IR2 and IR8
 - IR8: $\beta^*=10$ m and 2 m
 - done with triplet~201 T/m @ 7 TeV
 - IR2: $\beta^*=10$ m and 2 m
 - done with triplet~201 T/m @ 7 TeV
 - IR2: $\beta^*=0.5$ m (Ion beam)
 - done but with triplet~**207** T/m @ 7 TeV (as in V6.503) ← Should be revisited
- Pre-squeezing and Squeezing
 - Not yet...

Towards finalizing (2)

- Crossing and separation for IR2 and IR8

(thanks to Simon for collision optics)

- Decouple injection and crossing/sep.

- IR2B1: Bump closed at Q5L-Q5R
- IR2B2: Bump closed at Q6L-Q5R
- IR8B1/B2: Bump closed at Q5L-Q5R with MCBX1

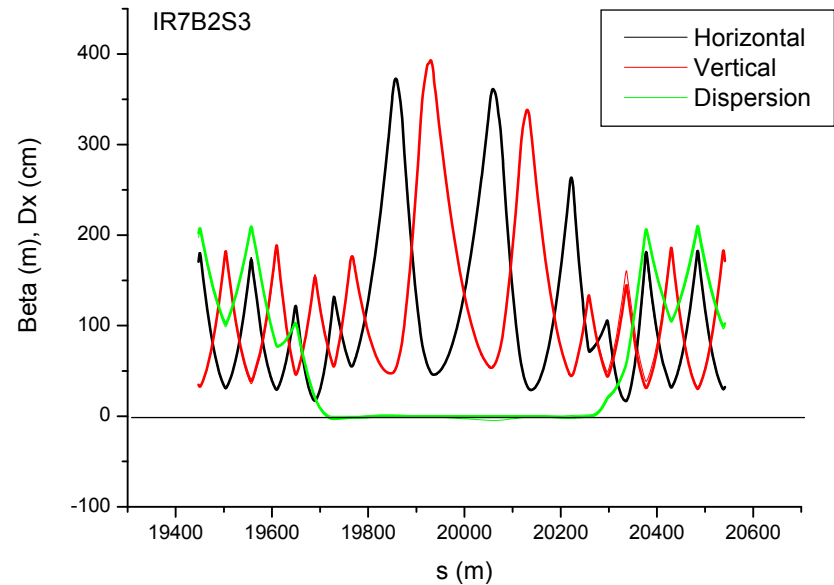
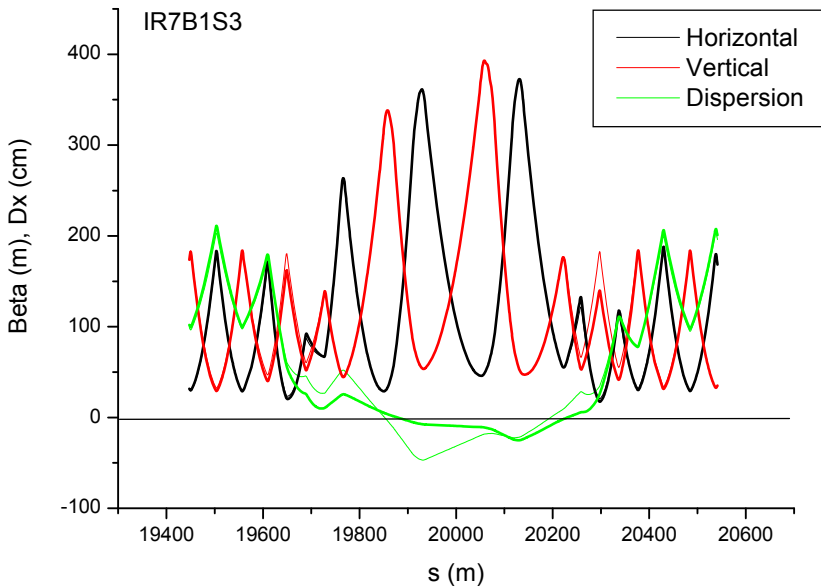
- Aperture at MCBX1 with crossing and sep.

- Tight N1~6.4
- Need to reduce the orbit tolerance, 4 mm to ~3.0 mm
- Increasing beta* at injection up to ~11 m would help MCBX1 aperture← Should be revisited

Known issues in new optics

- Aperture
 - $N1 < 6.9(F)/6.6(D)$ (dN1 w.r.t. V6.503)
 - At several vacuum markers and BPMs
 - MQ.11R3.B1(F) $N1=6.59$ (dN1=+0.067) / MQ.11L3.B2(F) $N1=6.44$ (dN1=+0.015)
 - MQTLH.6L3.B1(F) $N1=5.96$ (dN1=-0.0013) / MQTLH.6R3.B2(F) $N1=5.71$ (dN1=-0.0051)
 - MQML.6R8.B1(F) $N1=6.896$ (dN1=+0.0053)
- Matching of IR3 to the new arcs is “hard”
 - (Negligible) B2 LSS optics change to match the new arc optics
 - Visible aperture deterioration in IR3B1 to match the new arc optics
 - MQ.11L3.B1(D) $N1=6.60$ (dN1=-0.10)
 - MQ.8R3.B1(D) $N1=6.62$ (dN1=-0.19)
 - As bad as (V6.503) IR3B2... orbit tolerance, 4 mm to ~3.5 mm
 - Different vertical phase advance helps? ← Would be revisited
- Q strength
 - 3% constraint (at injection)
 - KQ8.L2B1 ~2.8%
 - KQ8.L6B1 ~2.5%
 - KQ8.R6B1 ~2.5%
- IR7B1 (next slide)
 - DX and DPX in LSS are not zero (but better than that of V6.503) because of the aperture at MCBV.10R7.B1 (tolerance=1 mm)

IR7 optics

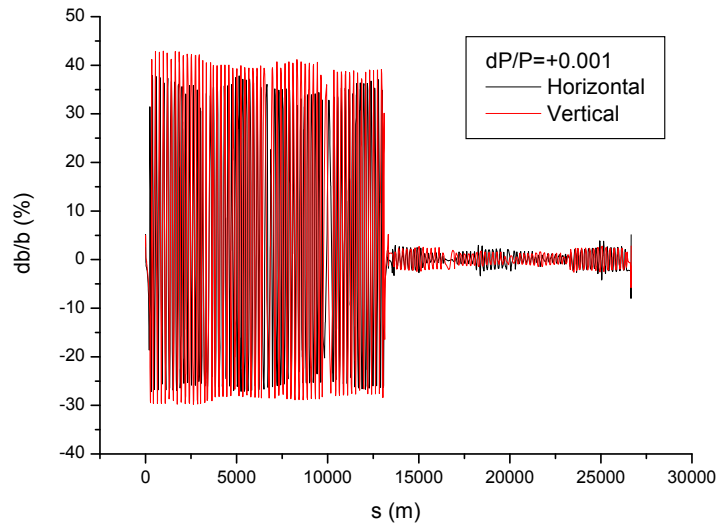


Thin line → Thick line
V6.503 → New optics

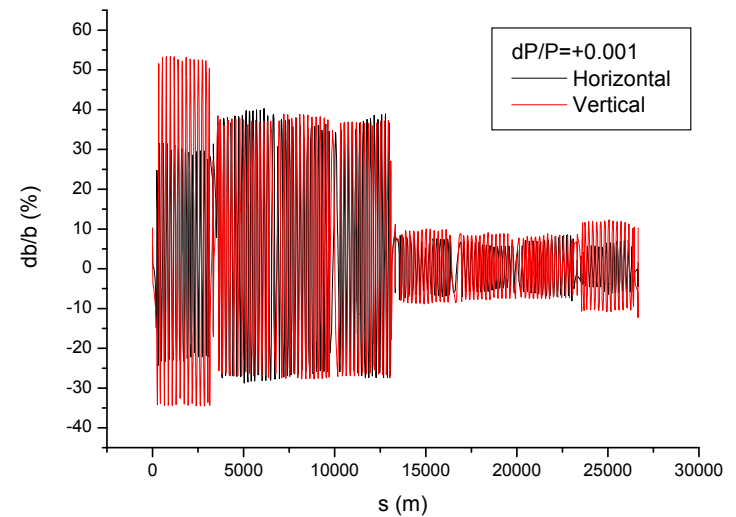
IR7B1: compromise between MCBV.10R7.B1 aperture and DX/DPX in LSS
 $N1=6.57 \sim \underline{6.64} \leftrightarrow DX=0 \text{ cm} \sim \underline{-9 \text{ cm}}$

IR7B2: $DX=DPX=0$

Off momentum beta-beat



$\text{Beta}^*s=(0.55, 10.0, 0.55, 10.0)$ m



$\text{Beta}^*s=(0.55, 2.0, 0.55, 2.0)$ m

Summary

- New optics is getting ready
 - Need to finalize collision optics
 - To be revisited
 - $\beta^*=0.5$ m in IR2
 - Aperture at MCBX1 in IR2 and IR8, try $\beta^*=11$ m
 - QD aperture in IR3B1, try different V phase advance

IR3 optics

