Update on the new optics for off-momentum beating

16/Dec/2008

LCU section meeting

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Thanks to Massimo, Stephane and Thys

Introduction

- Study was initiated to have $\pi/2$ phase advance between two main collision points and arrives $\pi/2$ for the right side (IP5-IP1) in H and the left side (IP1-IP5) in V

  LCU 26th Aug., 6th Oct. and 4th Nov.
- For the off momentum beta-beating, $\pi/2$ for the left side in both planes is preferable
- Flexibility of horizontal phase advance in IRs is not enough to have $\pi/2$ for the left side $\rightarrow$ Use the arcs
- Additional improvements
  - Eliminating beam1-2 phase advance split
  - Zero dispersion in IR7 LSS
  - Aperture as much as possible
  - Cleaning up IR phase advances not to have fractional later than 4th digit, for example 2.272000, except for IR4 and IR7

Strategy

V6.503s2 colision

Beam1

	IR1	IR2	IR3	IR4	IR5	IR6	IR7	IR8
MUX	2.633	2.986	2.260	2.12940	2.633	2.015	2.49060	3.059
MUY	2.649	2.809	1.990	1.95787	2.649	1.780	2.01413	2.782

	MUX	MUY		
IP1	0.00	0.00		0.75
IP5	32.06	29.75	0.25	
IP1L	64.31	59.32		0.57

Beam2

	IR1	IR2	IR3	IR4	IR5	IR6	IR7	IR8
MUX	2.633	2.986	2.260	2.12860	2.633	2.015	2.49140	3.059
MUY	2.649	2.809	1.990	1.95713	2.649	1.780	2.01487	2.782

	MUX	MUY		
IP1	0.00	0.00		0.75
IP5	32.06	29.75	0.25	
IP1L	64.31	59.32		0.57

- Never touch IR1 and IR5
- Minimize the changes in IR2 and IR8
- Increase hor. phase advance 0.19 in the left side (32.06+0.19=32.25)
  - -0.02 in IR7, +0.02 in the left side with IR3 and/or 4
  - +0.085 in Arc23,34 and -0.85 in Arc67,78

Updated optics

V6.503 collision

Beam1

	IR1	IR2	ARC23	IR3	ARC34	IR4	IR5	IR6	ARC67	IR7	ARC78	IR8
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
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

	MUX	MUY		
IP1	0.00	0.00		
IP5	31.98	29.65	0.98	0.65
IP1L	64.31	59.32		

Beam2

	IR1	IR2		IR3		IR4	IR5	IR6	ARC67	IR7	ARC78	IR8
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
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

	MUX	MUY		
IP1	0.00	0.00		
IP5	32.06	29.76	0.06	0.76
IP1L	64.31	59.32		

V6.503s3 collision

Beam1

	IR1	IR2	ARC23	IR3	ARC34	IR4	IR5	IR6	ARC67	IR7	ARC78	IR8
MUX	2.633	2.986	5.583	2.272	5.612	2.13830	2.633	2.015	5.415	2.46974	5.442	3.059
MUY	2.649	2.809	5.098	1.990	5.073	1.95797	2.649	1.780	5.099	2.01403	5.074	2.782

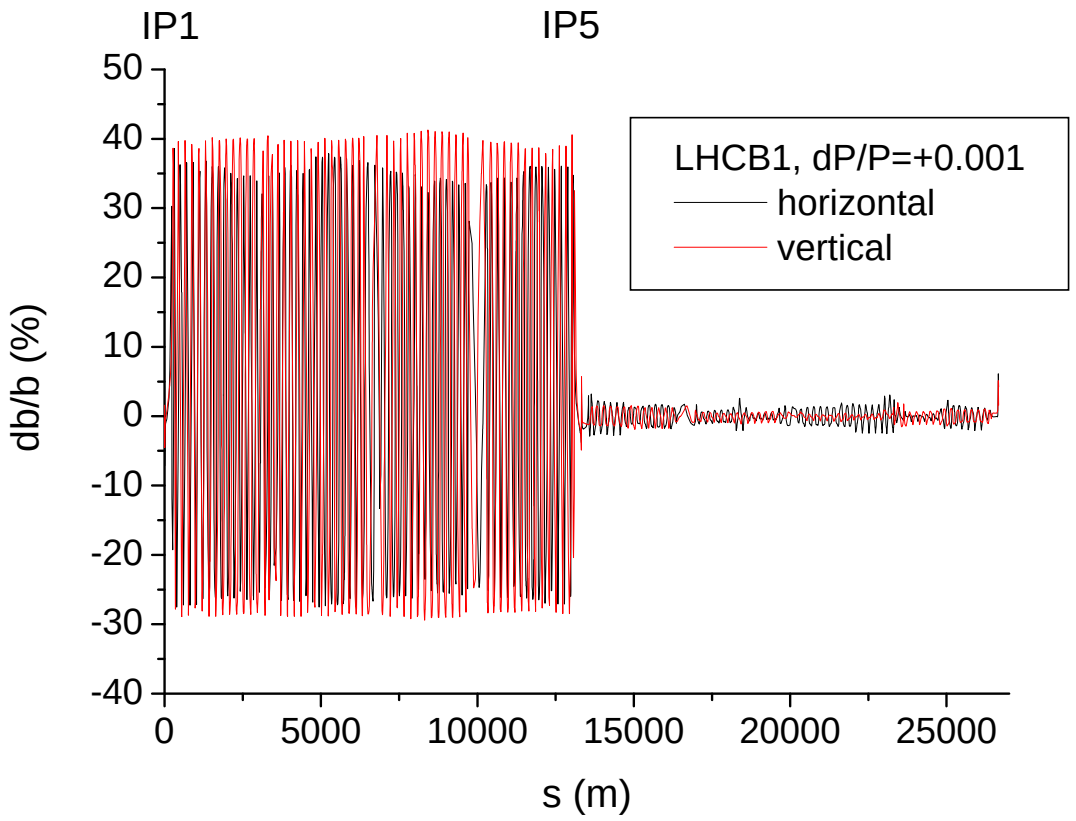
	MUX	MUY		
IP1	0.00	0.00		
IP5	32.25	29.75	0.25	0.75
IP1L	64.31	59.32		

Beam2

	IR1	IR2	ARC23	IR3	ARC34	IR4	IR5	IR6	ARC67	IR7	ARC78	IR8
MUX	2.633	2.986	5.612	2.272	5.583	2.13749	2.633	2.015	5.442	2.47052	5.414	3.059
MUY	2.649	2.809	5.074	1.990	5.099	1.95722	2.649	1.780	5.074	2.01477	5.098	2.782

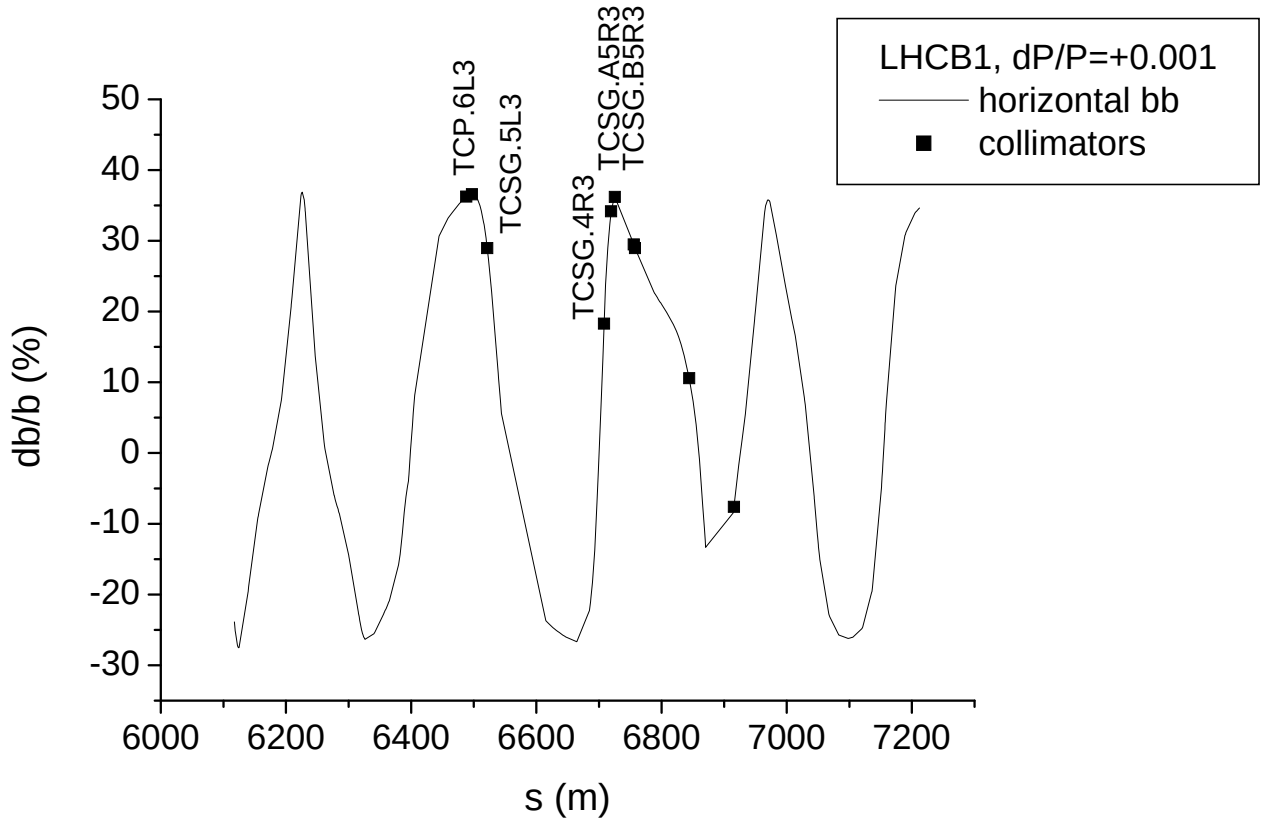
	MUX	MUY		
IP1	0.00	0.00		
IP5	32.25	29.75	0.25	0.75
IP1L	64.31	59.32		

Off momentum beta-beating



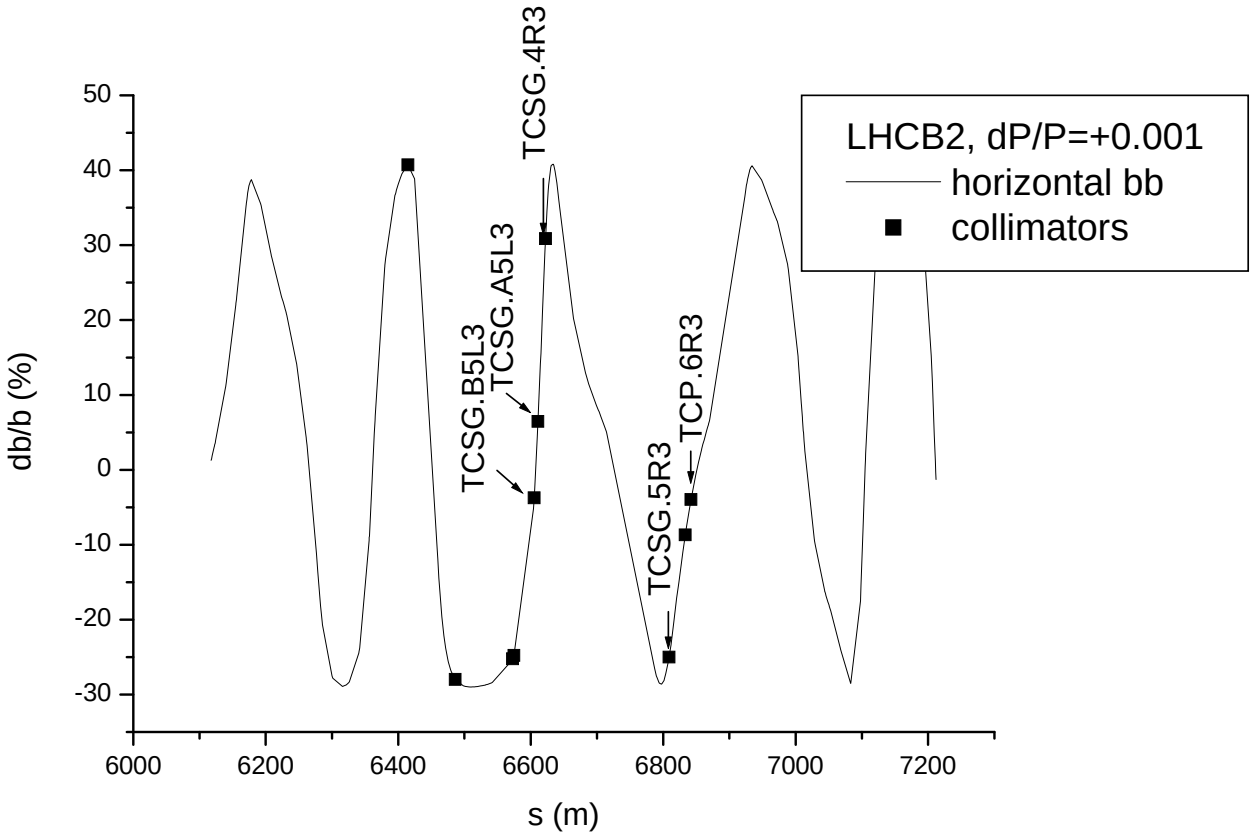
Off momentum beta-beating is confined in the left side

Off momentum beta beating in IR3B1

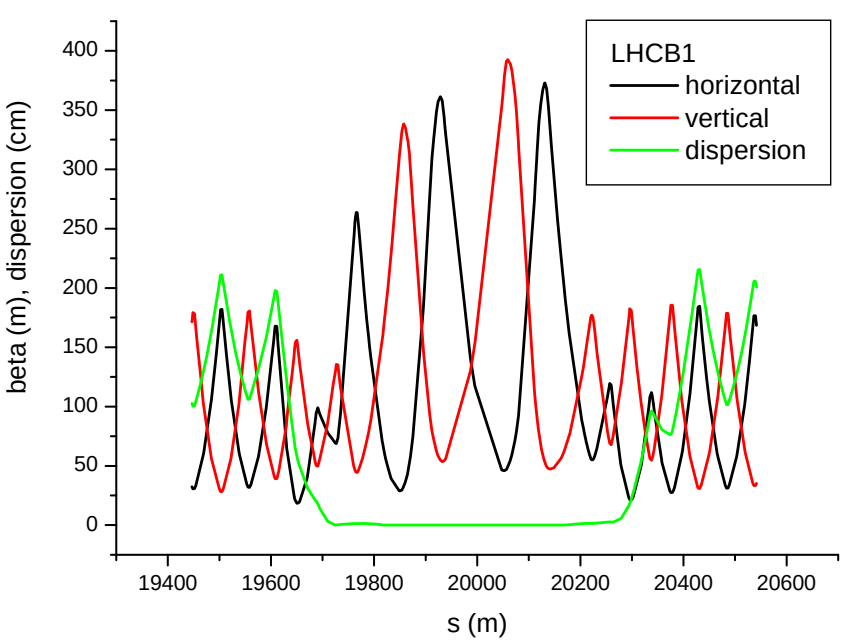


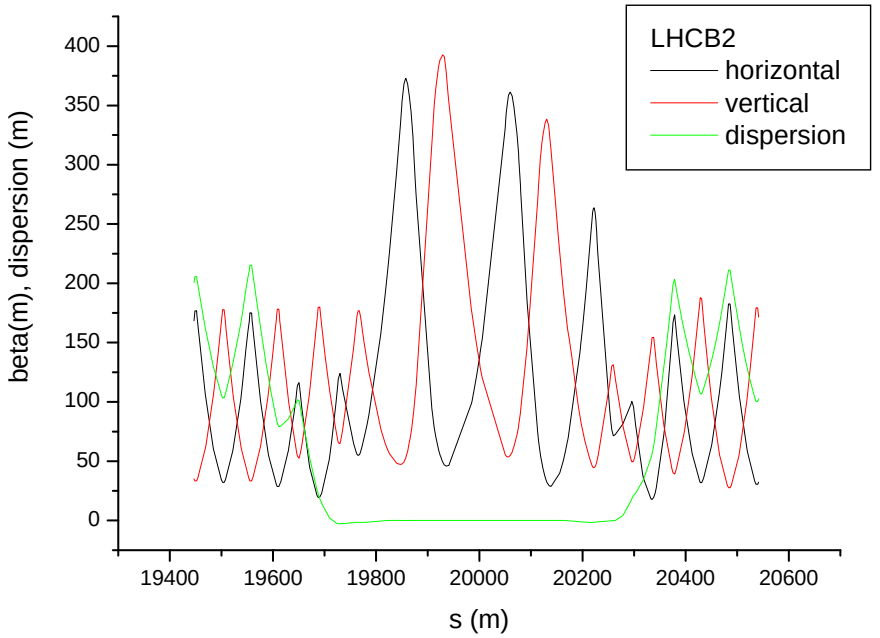
Phase advance between the primary and secondary collimator ~0.5
Same phase for the beta-beating ~1.0

Off momentum beta beating in IR3B2



IR7 optics





Zero dispersion in LSS for both B1 and B2, thanks to the new phase advance and the new boundary condition

Summary

- IP1-IP5 phasing – $\pi/2$ for the left side (IP1 to IP5) in both planes
  - Off momentum beta-beating is confined to the left side
    - Quite good for IR7 (betatron collimation)
    - Acceptable for IR3 (momentum collimation) ??
- Additional improvements
  - Eliminating beam1-2 phase advance split
  - Zero dispersion in IR7 LSS
  - Cleaning up IR phase advances not to have fractional later than 4^{th} digit, for example 2.272000, except for IR4 and IR7
- Detailed check and finalizing will be done
    - Aperture check (OK with quick look), optimization as much as possible
    - Q strength check (OK with quick look)
    - Avoid very weak excitation (less than ~5 A) in trim quads and warm quads in IR3 and 7
    - Pre-squeezing and Squeezing for IR2 and 8
    - etc…