Comparison of Segment-by-Segment and Action-Phase-Jump techniques in the calculation of IR local corrections in LHC (MOPAB186)

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Segment-by-Segment

- From the measured TbT data we are able to obtain the difference between the actual phase advance and the measured one.
- Deviations are used to correct the optics with quadrupoles in the segment.

Action-Phase Jump

- Based in the principle of preservation of Action and Phase variables in the absence of magnetic errors.
- Use the action and phase jumps to find corrections that suppress those jumps.

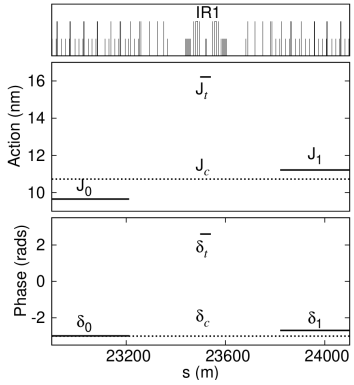

Figure: Sketch of the Action and Phase jump technique principle.

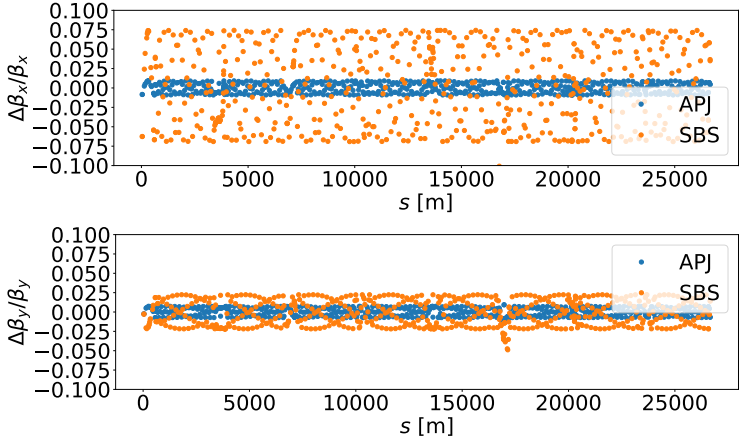

Figure: Computed β-beating along the ring for B1 in the horizontal plane (top) and vertical plane (bottom) after adding the magnetic errors.

Table: Computed RMS and Maximum β-beating Along the Ring Before Correction and After Applying APJ and SbS Correction Techniques in B1 and B2

	B1		B2	
$\Delta\beta/\beta$ [%]	H	V	H	V
Uncorrected RMS	8.14	12.8	11.8	6.16
APJ RMS	0.63	0.55	0.73	1.57
SbS RMS	2.56	0.85	1.19	3.57
Uncorrected Max	117	98.6	53.6	79.19
APJ Max	0.92	1.08	1.06	2.21
SbS Max	14.5	6.31	4.62	7.08

Table: β^* Values Obtained in IP1 Before Correction and After Applying APJ and SbS Correction Techniques in B1 and B2

	B1		B2	
	β_x^* [cm]	β_y^* [cm]	β_x^* [cm]	β_y^* [cm]
Design	40	40	40	40
Uncorrected	87.0	79.4	61	72
APJ	40.3	40.4	39.96	40.5
SbS	45.8	42.5	38.98	38.7

Conclusions

- APJ technique shows a better performance than SbS and hence it looks as a promising technique for optics correction in the LHC.
- This methodology will be applied to different optics with different sets of errors in the IR magnets.
- Test this technique during the commissioning of the LHC at the beginning of Run 3.

Table: Magnetic Errors Assigned to the Inner Triplet and Matching Section Quadrupoles

Magnet	Error $[10^{-5}\mathrm{m}^{-2}]$
Q1L/R	-0.6/0.70
Q2L/R	-1.17/0.74
Q3L/R	-1.31/2.60
Q4L/R.B1	-7.00/5.70
Q4L/R.B2	7.00/-5.70
Q5L/R.B1	-6.86/2.98
Q5L/R.B2	7.01/-3.45
Q6L/R.B1	41.34/-23.71
Q6L/R.B2	-31.51/20.44