

Interactive β^* Knob Matching Tool for LHC on SAD/Tkinter

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Implementation

■ Implemented on SAD/Tkinter

- Code: Written by SADScript
- GUI: Based on Tk toolkit
- Lattice model: SAD
- Matching engine: SAD
- Supported ring: LHCB1, LHCB2
- Supported IP: IP1, IP5, IP8
- Matching constraint: Minimum set
- Parameter range: Not implemented

■ Lattice Model

- Based on `/afs/cern.ch/eng/lhc/optics/V6.501/`
 - ▶ Sequence: `V6.5.seq`
 - ▶ Parameter: `V6.5.coll.str`
 - ▶ Translated from MADX to SAD by SADScript

■ Code Location

- `/afs/cern.ch/user/a/amorita/public/mirror-ldata/LHC/SAD/BetaKnob.sad`

Matching Constraints & Variables

■ Matching Constraints[14+4]

- Total betatron tune($\nu_{x,y}$)[2]
- Beta*($\beta_{x,y}^*$) at IP[2] interactive parameter
- IP Waist($\alpha_{x,y \text{ at IP}} \cdot \beta_{x,y}^*$)[2] interactive parameter
- Horizontal dispersion(η_x, η'_x) at IP[2]
- Twiss parameter($\alpha_{x,y}, \beta_{x,y}, \eta_x, \eta'_x$) at Arc quadrupole[6]
- H or V bump orbit at IP(x,x' or y,y')[2]
- H or V bump is closed[2]

■ Matching Variables[16+4]

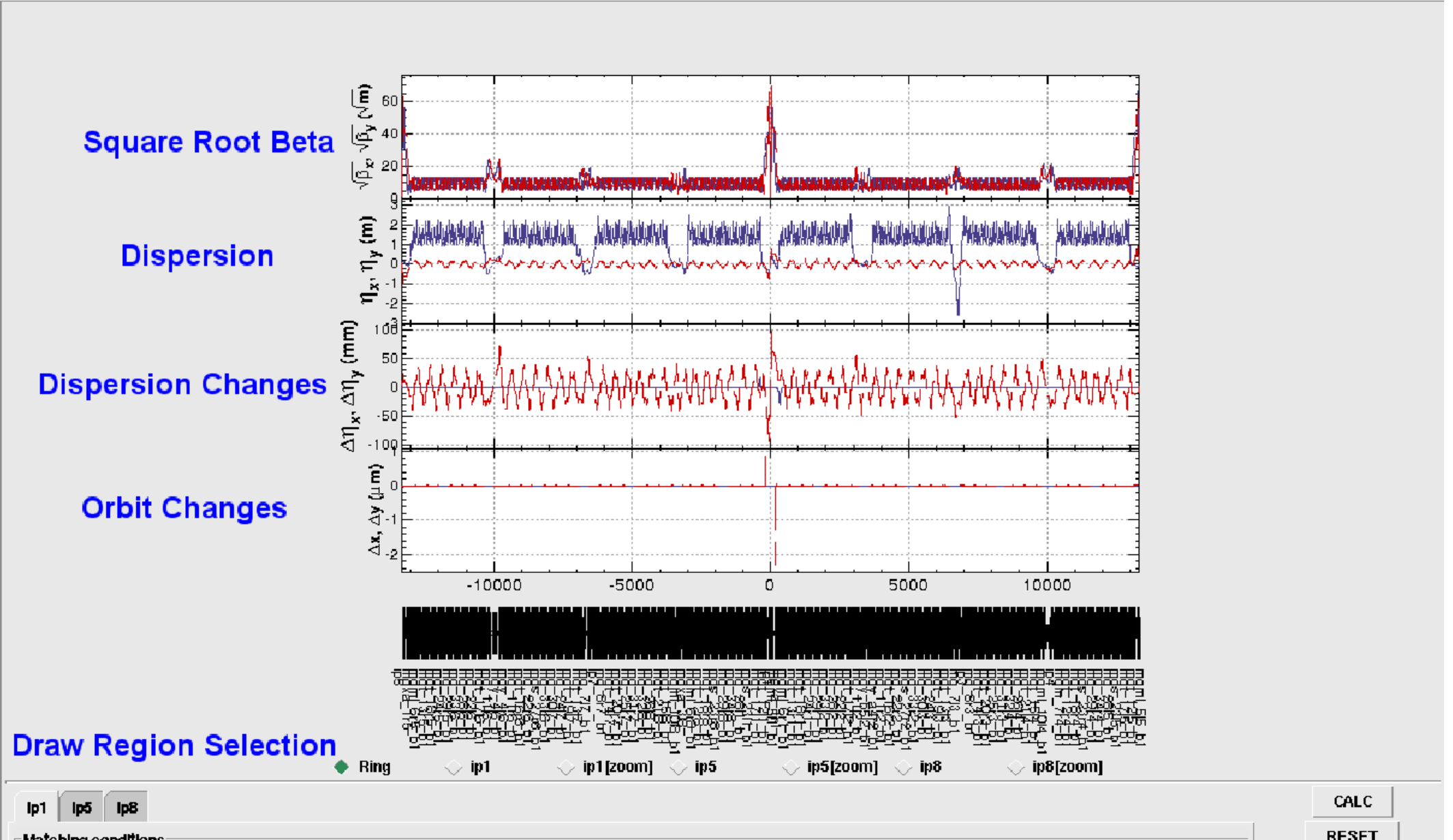
- 2x8-Quadrupoles: Q4~Q11(L/R) for Twiss parameter
- 4-Dipoles: MCB*H or MCB*V for closed bump

CAUTION: Vertical dispersion is out of control!

Matching Example(Optics Function)

File Edit Window

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Matching Condition: $\beta_x^* +10\%$, $\beta_y^* -10\%$

Matching Example(Parameter & Error)

◆ Ring ◇ ip1 ◇ ip1[zoom] ◇ ip5 ◇ ip5[zoom] ◇ ip8 ◇ ip8[zoom]

ip1 ip5 ip8

Matching conditions

IP Parameter Active Total Tune $\eta_x@ip$ $\eta_x@ip$ $\eta_x@arc$ $\eta_x@arc$

β_x^* [mm]:	60.0073	$\Delta\alpha_x^*$ [rad]:	3.751E-14	$\Delta\alpha_y^*$ [rad]:	-2.78E-14	$\Delta\beta_{x\ max}$ [m]:	366.5966	$\beta_{x\ max}$ [m]:	4035.0899
β_y^* [mm]:	50.0039	$\Delta\beta_x^*$ [m]:	9.297E-14	$\Delta\beta_y^*$ [m]:	-1.93E-14	$\Delta\beta_{y\ max}$ [m]:	439.9396	$\beta_{y\ max}$ [m]:	4841.6334
Δs_x [mm]:	0.0578	$\Delta\eta_x^*$ [m]:	3.853E-12	$\Delta\eta_y^*$ [m]:	1.6291E-4	$\Delta\eta_{x\ max}$ [m]:	.0328		
Δs_y [mm]:	0.0569	$\Delta\eta_x^*$ [rad]:	8.615E-12	$\Delta\eta_y^*$ [rad]:	.0020	$\Delta\eta_{y\ max}$ [m]:	.0877		
Residual:	7.273E-20	Δv_x :	1.137E-13	Δv_y :	-1.14E-13				

Residual Error at IP

Knob Quadrupoles

Q Selection Use: Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12 Q13

$\Delta K_1/K_1$:	Q13L	.0000	Q12L	.0000	Q11L	.0124	Q10L	.0023	Q9L	.0167	Q8L	.0070	Q7L	-8.068E-4
	Q6L	.0738	Q5L	-.0556	Q4L	-.0534	Q4R	-.0253	Q5R	-.0136	Q6R	.0362	Q7R	-.0119
	Q8R	-.0581	Q9R	-.0014	Q10R	-.0159	Q11R	.0021	Q12R	.0000	Q13R	.0000		

Q Parameter Changes

Calc Reset Clear

Tolerance: 1E-23

Main Application Area

Summary

- Preliminary beta* knob matching tool is reimplemented and looks like to work fine.

But

- Vertical dispersion is out of control
 - In order to control V-dispersion, either skew quadrupole or V-bump around sextupole is required
- Matching speed is very slow
 - Because of interference among Twiss matching, closed bump condition and uncontrollable vertical dispersion
- Parameter range and other constraint are not implemented
 - Need information about realistic parameter range and constraints