



Generating Machine Collimation Settings from Beam Data

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Automatic generation of settings



- During LHC operation, collimator jaw positions and also warning and dump thresholds need to be defined in the control system
- Collimator settings depend on the machine optics, emittance and running conditions (injection/collision)
- During ramp, settings and thresholds change as a function of beam energy
- Settings and functions (time dependence of the settings) need to be changed after every modification of the optics
- Manual generation takes time and patience. Therefore, an automatic procedure is needed to generate collimator settings and functions

Measured and expected gap sizes



- Offsets between expected settings (using MAD-X) and values found through beam-based calibration are sometimes large
- Example: On 7/3/2010, beam based calibration of all collimators performed (see presentation by D. Wollmann).
- We want to quickly generate settings, warnings and thresholds for each optics (measured, ideal from MAD-X etc).



Mathematica tool



• To fill this need, a tool running in Mathematica is under construction

Mathematica Input tool Collimator database file with names and tilt angles •Collimator data, starting point of ramp: •Emittance + optics from MAD-X or beta beat measurements, or Measured gap offsets and beam sigmas in Excel format Nsigma for each collimator family Output Collimator data at end point (same options as for •Gap settings starting point, combinations possible) •Warning thresholds Measured LVDT readings (optional) •Dump thresholds Scheme: Nominal, Intermediate or Constant ... as functions of time Subset of collimators kept constant for all collimators, in a Momentum time function file format that can be •Resolution (smallest step size) directly imported in the Maximum halfgap control system Warning and dump thresholds as fraction of gap •Single file for all collimators or one file per collimator



Experimental: User interface

ollimator database file B1	Open file		
nput/CollDB_V6.503_lowb_st.b1	.data		
ollimator data to be used: Mea	s. XLS file MAD–X twiss file		
leasured collimator settings B1	(XLS file) Open file		
nput/2010_03_06-collsetup01-l	o1–450gev.xls		
AD-X Twiss file B1	pen file		
nput/lhc-b1-6.503-inj.twiss			
/DT data file B1 Ope	n file		
iput/meanLVDT-450GeV-2010.	03.09-B1.tfs		
se LVDT offsets True False			
σTCP3 8.	noTCSG39.3	noTCSM39.3	
oTCLA3 10.	noTCP7 5.7	noTCSG7 6.7	
oTCSM7 6.7	noTCLA7 10.	noTCLP 900.	
oTCLI 6.8	noTCDQ 8.	noTCSTCDQ7.	
oTDI 6.8	noTCTH1 900.	noTCTH2 900.	
отстн5 900.	noTCTH8 900.	noTCTV1 900	
oTCTV2 900	noTCTV5 900	noTCTV8 900	
omentum vs time function nput/Momentm3500GeV.csv	Open file		
orizontal normalized emittance	(m) 0.0000035		
artical normalized emittance (m) 0.0000035			
ingle output file for all collimate	ors True False		
ner Dump 0.7 Outer Dump	1.2 Inner Warn 0.85 Outer	Warn 1.1	
onst. collimators {}			
cheme NOMINAL CONSTANT	INTERMEDIATE		
utput file name allCollGaps			
Calculate B1 export one file B1			

LHC Collimation



Example of result



 Halfgap and thresholds as a function of time for TCP.6L3.B1 during the ramp, with starting point based on beam based alignment at injection

▼ (?) ▲ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■			
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(7) (1) (1) (1) (1) (1) (1) (1) (1			
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T(d(s)			
• Id(s)			
• 1d <i>(</i> 5)			
v Id(s)			
• Id(s)			
ld(s)			
Setting part: Value Target Correction Trim History Time base: SuperCycle Cycle/Beamprocess Injection			
erlockThreshold			



Status and future work



- Files are generated in a format readable by the control system
- Import tested (takes time, but works)
- Future work
 - Graphical user interface under development
 - Further cross-checks of output needed before tool is fully operational
 - Generation of functions internally from LSA (S. Redaelli, alternative to Mathematica tool)
 - Tilt jaws as a function of the angle of the beam envelope