Generating Machine Collimation Settings from Beam Data

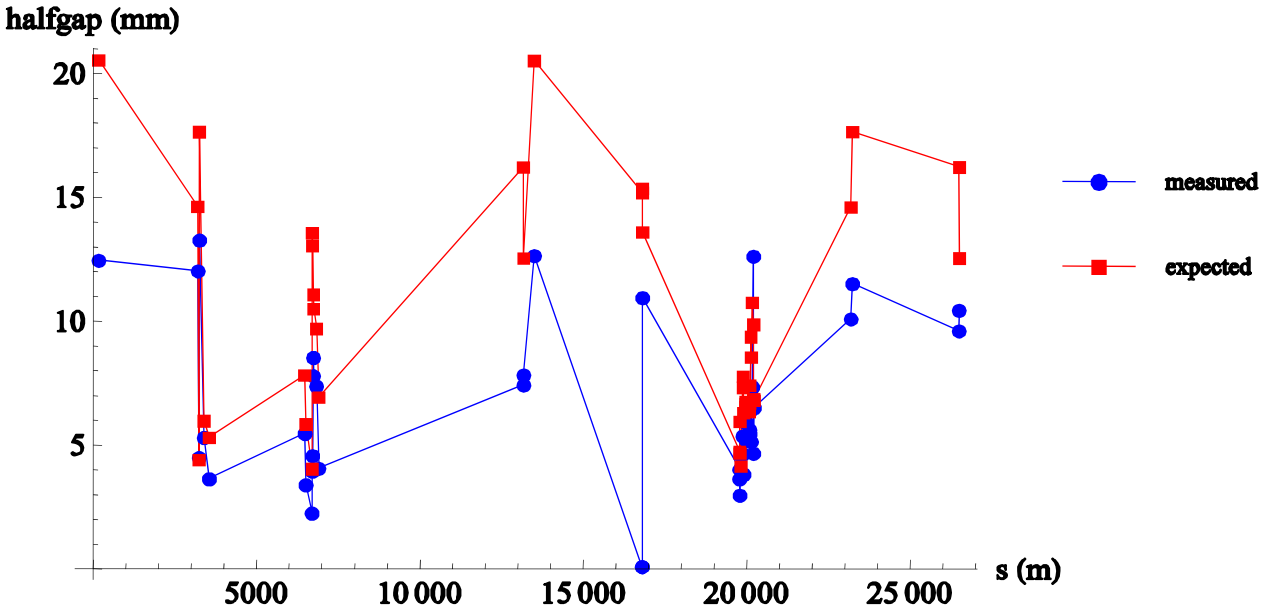
R. Bruce, R.W. Assmann, S. Redaelli, A. Rossi, D. Wollmann

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

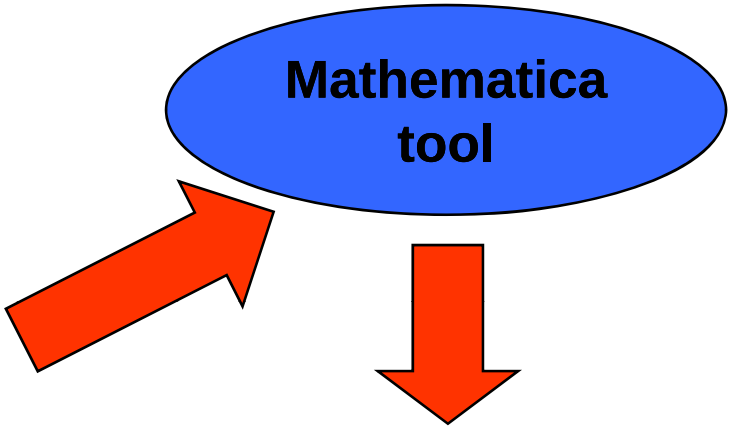
- Offsets between expected settings (using MAD-X) and values found through beam-based calibration are sometimes large
- Example: On 7/3/2010, beam based calibration of all collimators performed (see presentation by D. Wollmann).
- We want to quickly generate settings, warnings and thresholds for each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



Mathematica tool

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

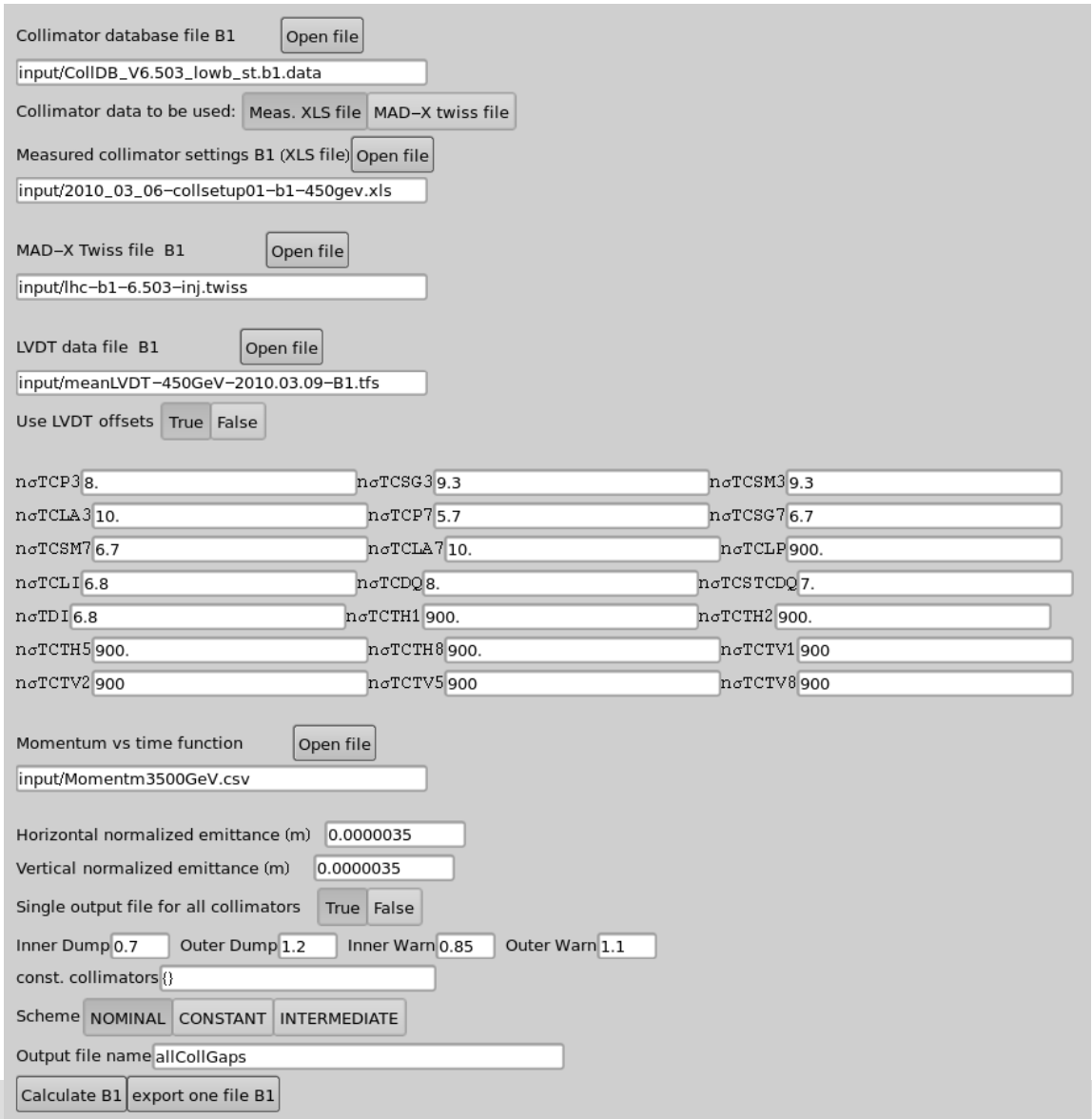
Input
- Collimator database file with names and tilt angles
- Collimator data, starting point of ramp:
  - Emittance + optics from MAD-X or beta beat measurements, or
  - Measured gap offsets and beam sigmas in Excel format
  - Nsigma for each collimator family
- Collimator data at end point (same options as for starting point, combinations possible)
- Measured LVDT readings (optional)
- Scheme: Nominal, Intermediate or Constant
- Subset of collimators kept constant
- Momentum time function
- Resolution (smallest step size)
- Maximum halfgap
- Warning and dump thresholds as fraction of gap



Output
- Gap settings
- Warning thresholds
- Dump thresholds

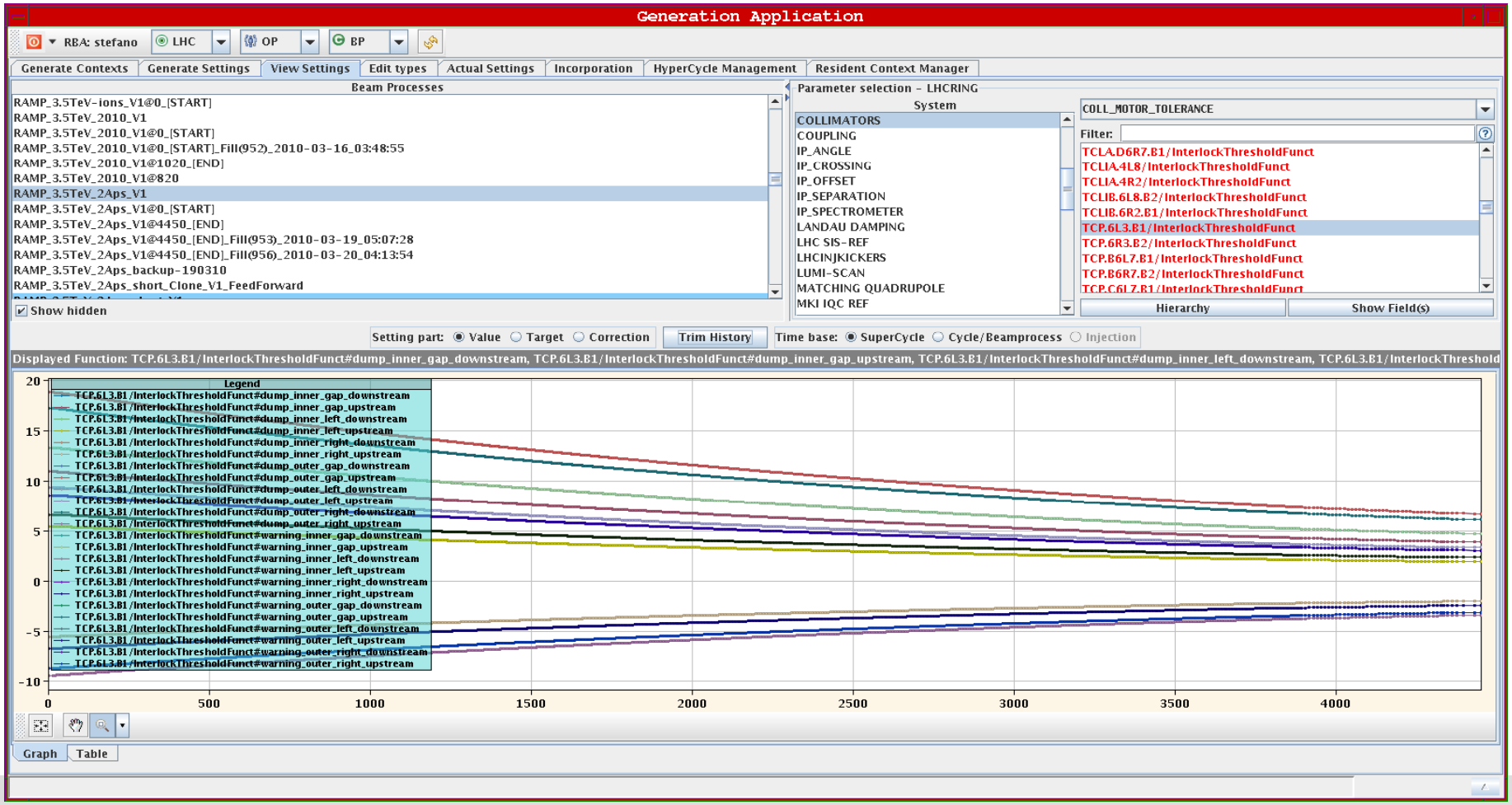
… as functions of time for all collimators, in a file format that can be directly imported in the control system
- Single file for all collimators or one file per collimator

Experimental: User interface



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



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