Collimator Top-Level Controls: Integration into LSA

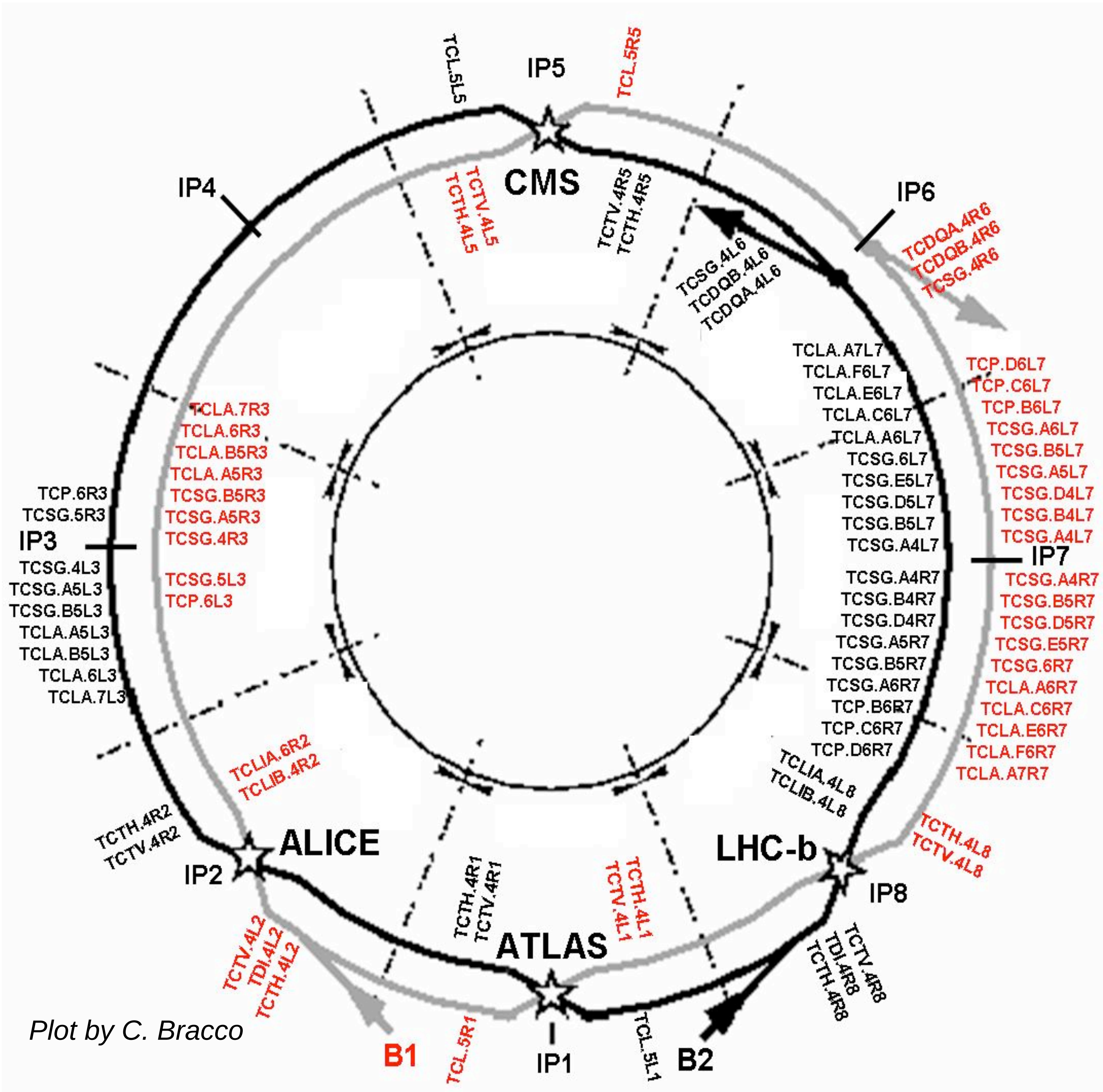
S. Redaelli, R. Assmann, M. Jonker,

M. Lamont, M. Sobczak, J. Wenninger

Overview of my talk

1. Introduction
2. Overall controls architecture
3. Requirements for collimator controls
5. Conclusions

Introduction



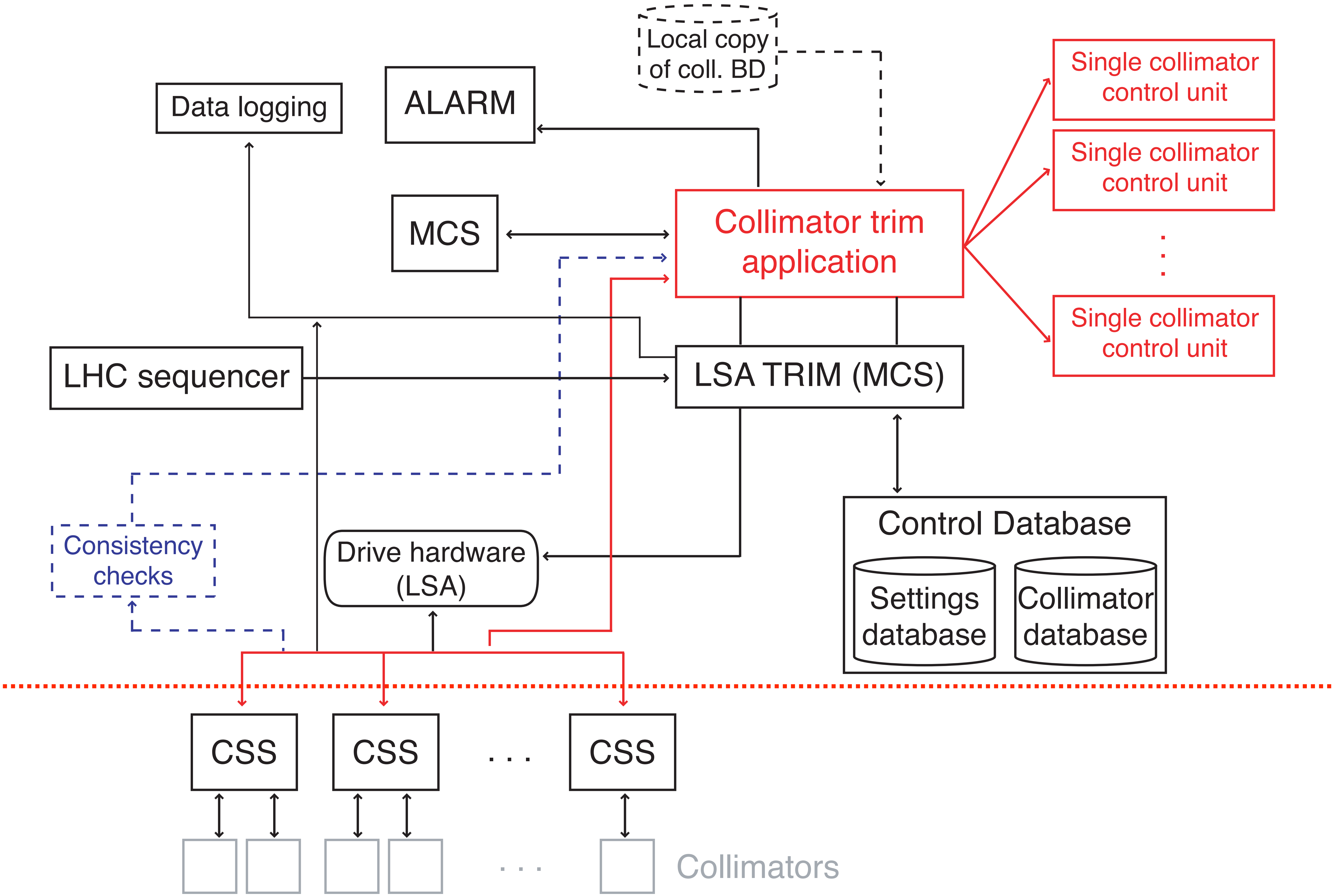
Plot by C. Bracco

- LHC: control of **~ 100 collimators**
- 500 degrees of freedom to control, all CRITICAL for safety
- Handle thresholds for dump levels
- Control the relative retraction of elements far from each other
- 600 jaw position/gap measurements
- Redundancy: 400 motors, 400 resolvers
- Control of 100 tank positions

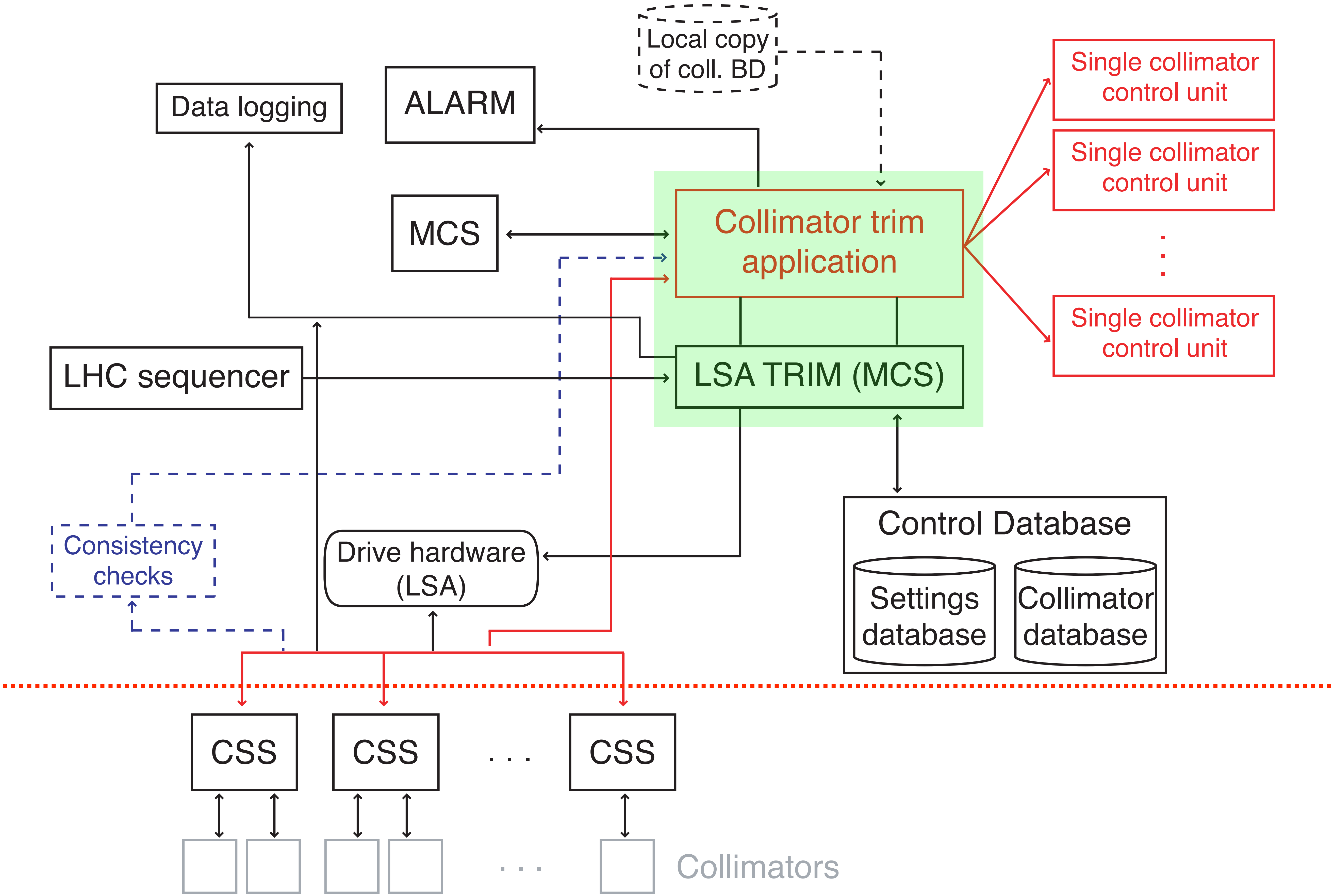
Key for success:
Rely on LSA functionalities,
adapt the to our needs

Work started on Feb. 2006 (AB-OP + COCOST)
Draft Engineering Specification available since May 2006
To be finalized based on SPS beam tests

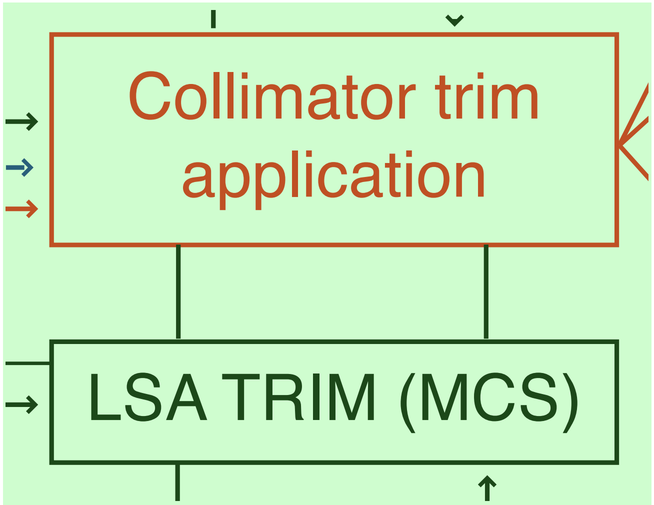
Top-level controls architecture



Top-level controls architecture



TRIM functionalities

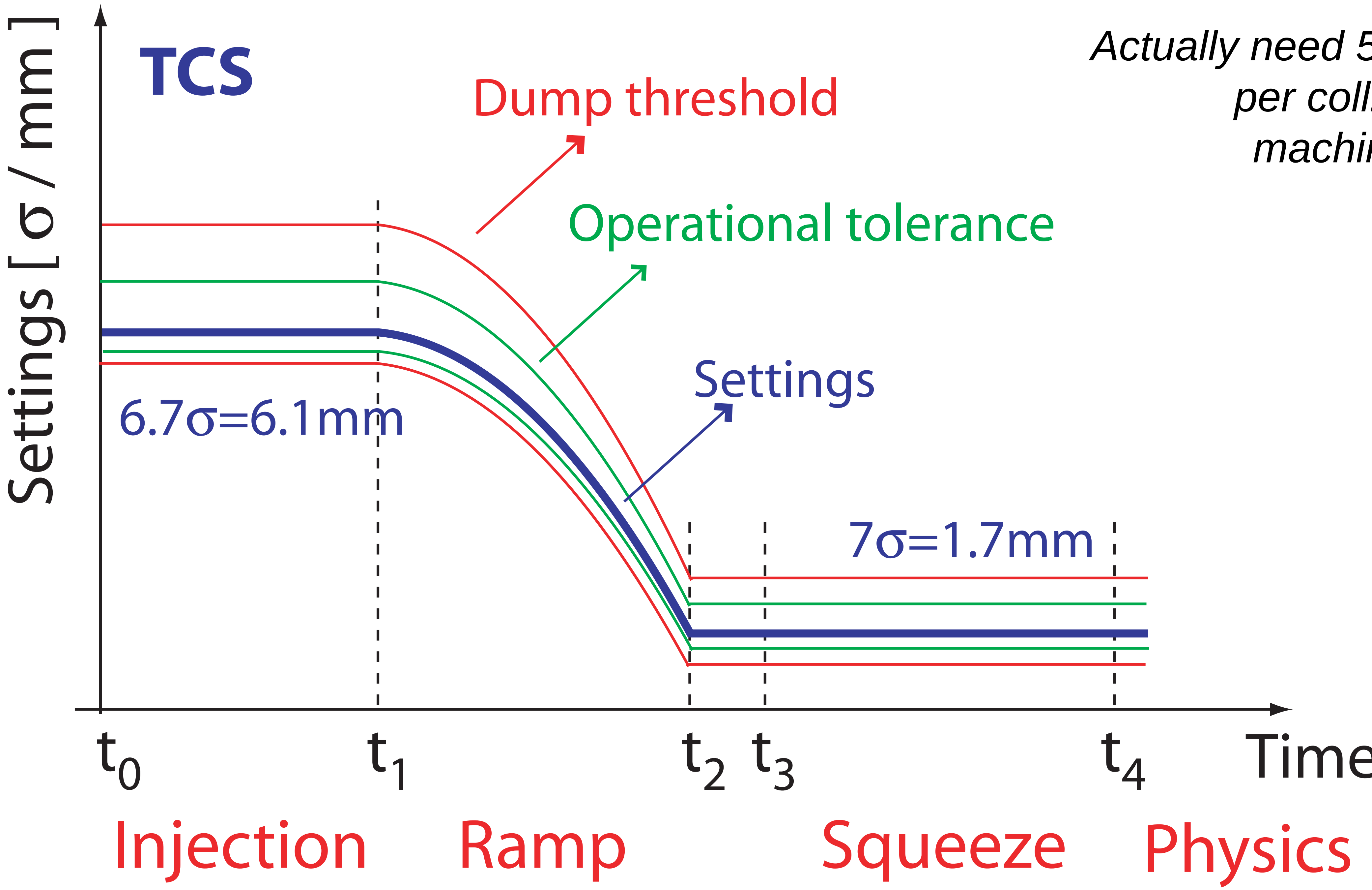


- ✦LSA-TRIM offers: Traceability, function generation, links to machine context, ...
- ✦It will also provide the MCS functionality

We will need:

- ✦Convenient environment for settings generation, function trimming and editing *(500 settings functions to handle...)*
- ✦Function generation and copying in **beam sigma units**
- ✦Simultaneous function editing and trim of various parameters
- ✦Definition of dump thresholds and operational limits around setting functions versus machine context (injection, ramp, ...)

Example of TRIM requirements

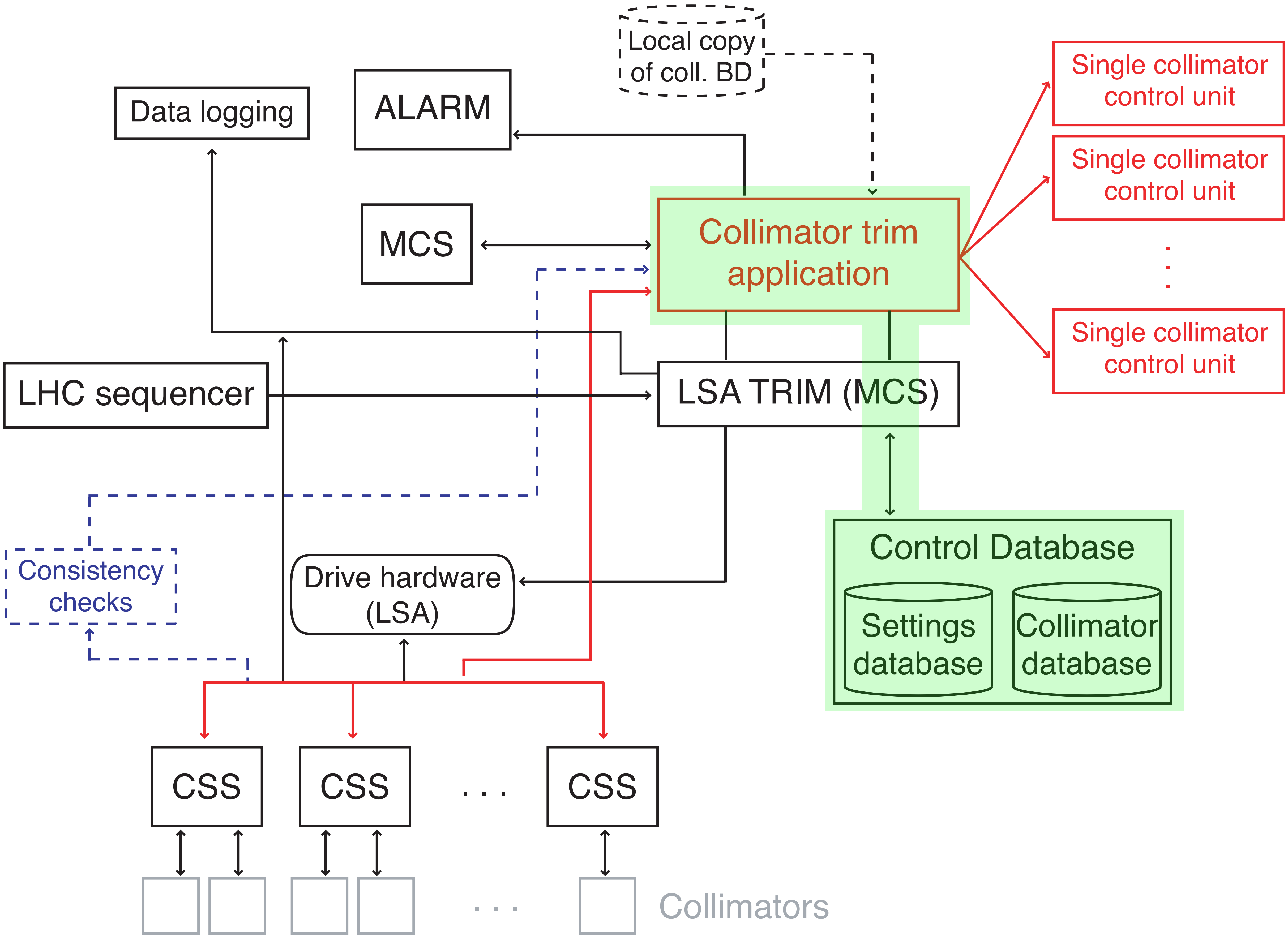


Actually need 5 functions per collimator per machine context

Example of operational scenarios:

"*Change all secondary collimators by 0.2σ*": is equivalent to (more convenient than) setting 11 gaps in mm (40 to 80 microns at 7 TeV)

Database issues



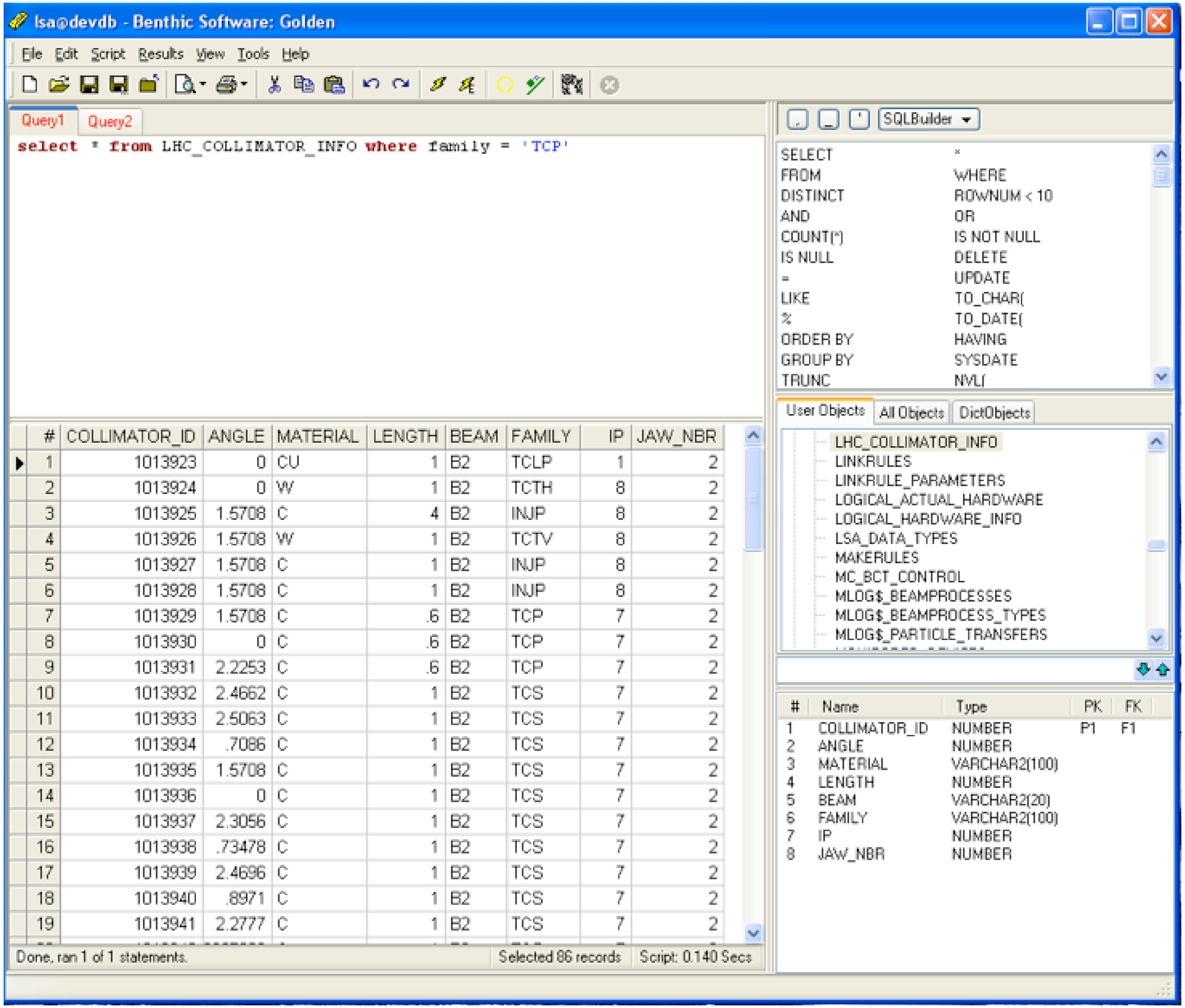
Database requirements

- Use the available databases with dedicated collimator tables
- Collect together operational data and static information

  Ex.: information from hardware commissioning, metrology, flatness, ...
- Changes of critical parameters managed by MCS
- Splitting among various DB's (LSA, config.) to be defined
- Beam-based parameters: dynamic BD (frequent changes)

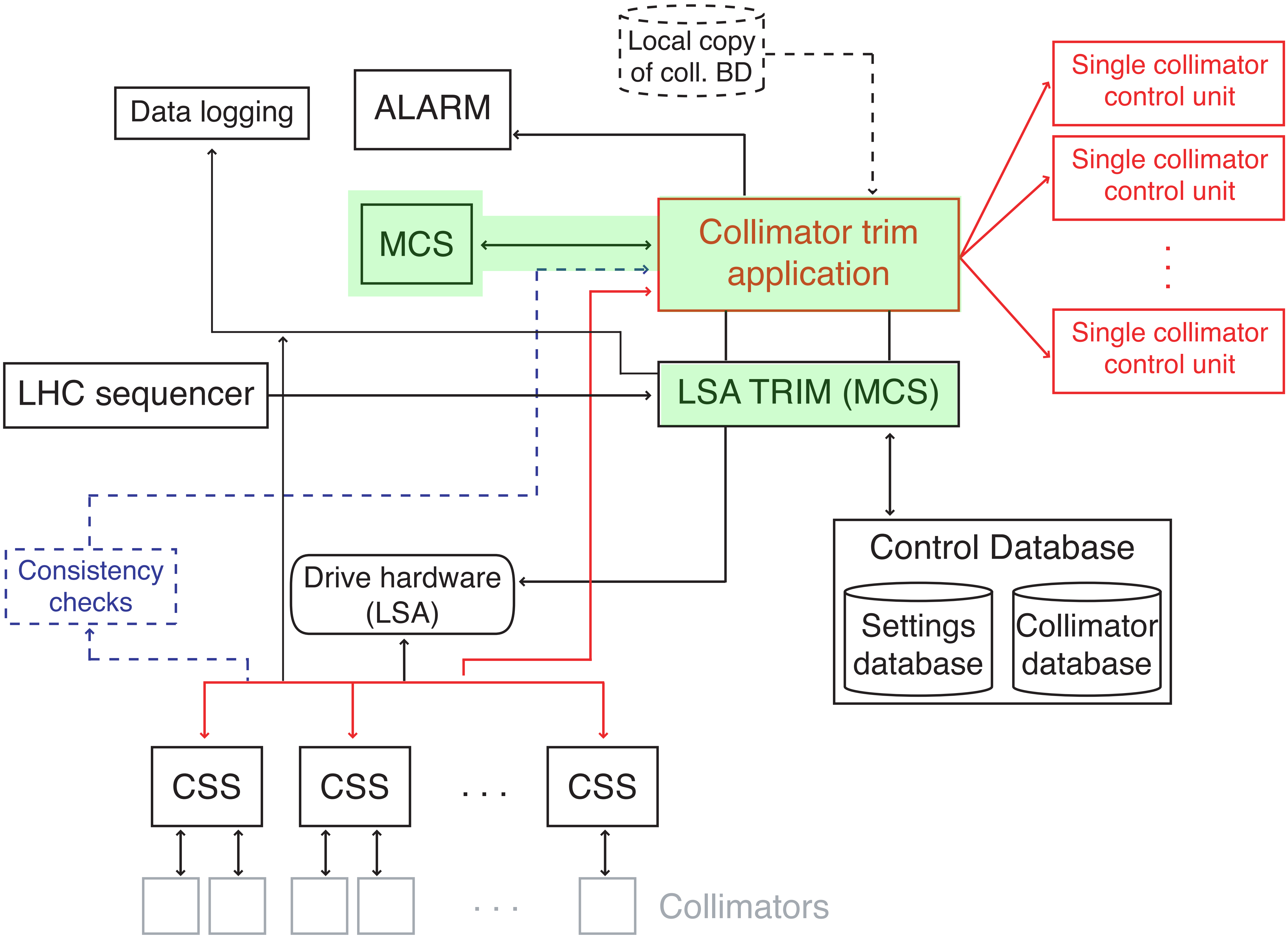
Parameter	Type	Source
Name, angle, material, length, **beam**, **family**, **IP** (TL)	static	Hardware owner
Spos, nominal optics ($\beta_{x,y}$, $\alpha_{x,y}$, $D_{x,y}$, ...)	static	MAD model
Mechanical plays, switch/stop positions, sensor calibrations, BLM-ID	static	HW owner (metr.)
Jaw positions, jaw angles, jaw speed, tank position [BOTH mm $\leftrightarrow$ σ]	**parameter**	**OP settings**
Beam-based parameter ($\sigma_{x,y} \leftrightarrow \beta_{x,y}$, centre, reference BLM threshold)	B-based	HW commissioner
Reference settings + tolerance + critical settings (vs. machine context)	B-based	HW commissioner
Statistics of faulty motor/sensors		HW owner

Status of collimator DB



- Work has started!
- Only static information is now there
- Used for the collimator control through the TRIM at the SPS
- ominal optics from MADX Twiss tables

Management of critical settings

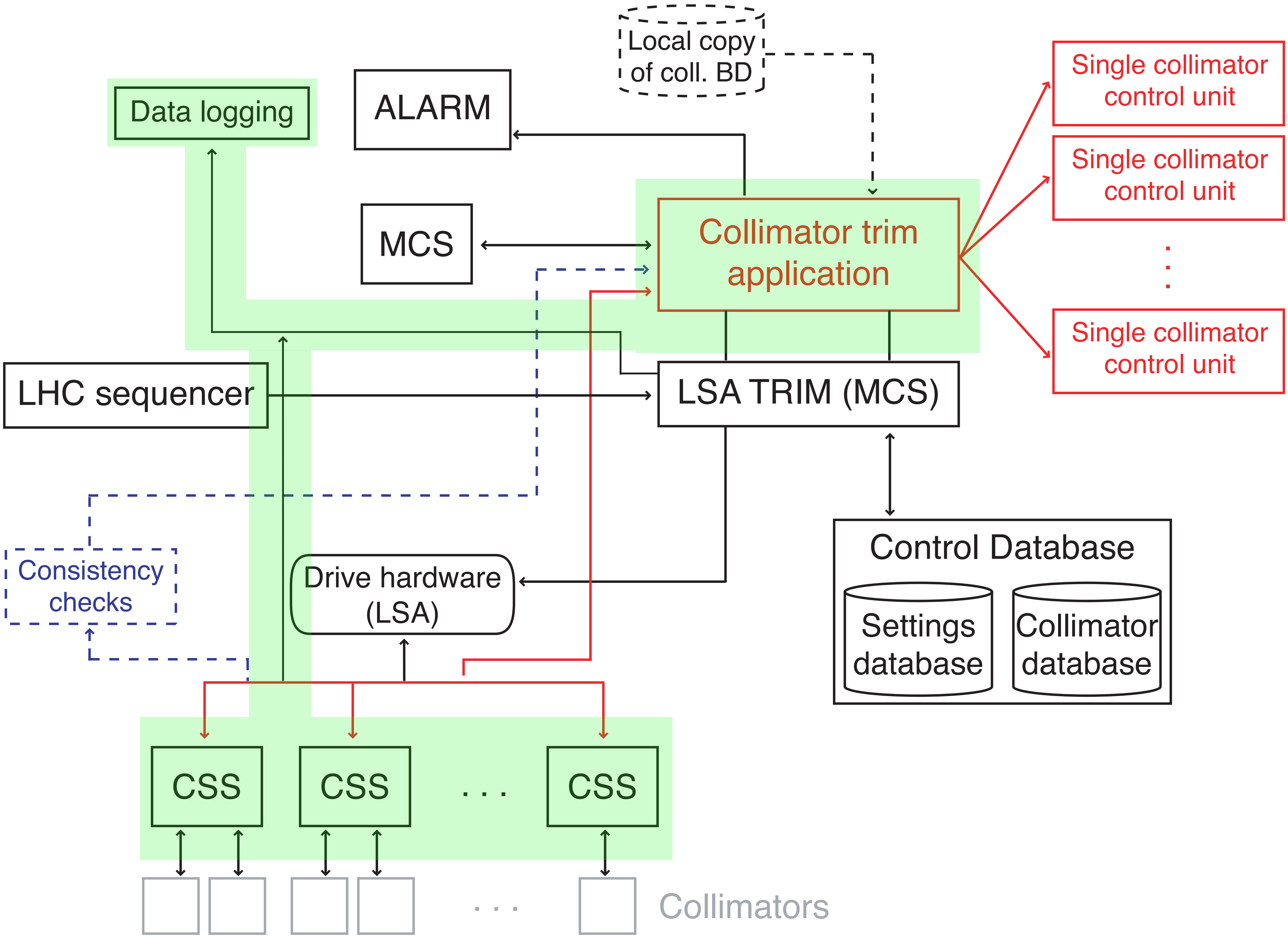


Management of critical settings

- Collimator control software is not responsible of providing the MCS functionality
- However, we will be one of the main “users” of the MCS tools that will be in place
- We will need MCS for:

  Dump levels, operational tolerances, settings
  Temperature thresholds
  Calibration of position and temperature sensors
  Information of beam-based alignment results
- More details on machine protection issues in Ralph’s talk

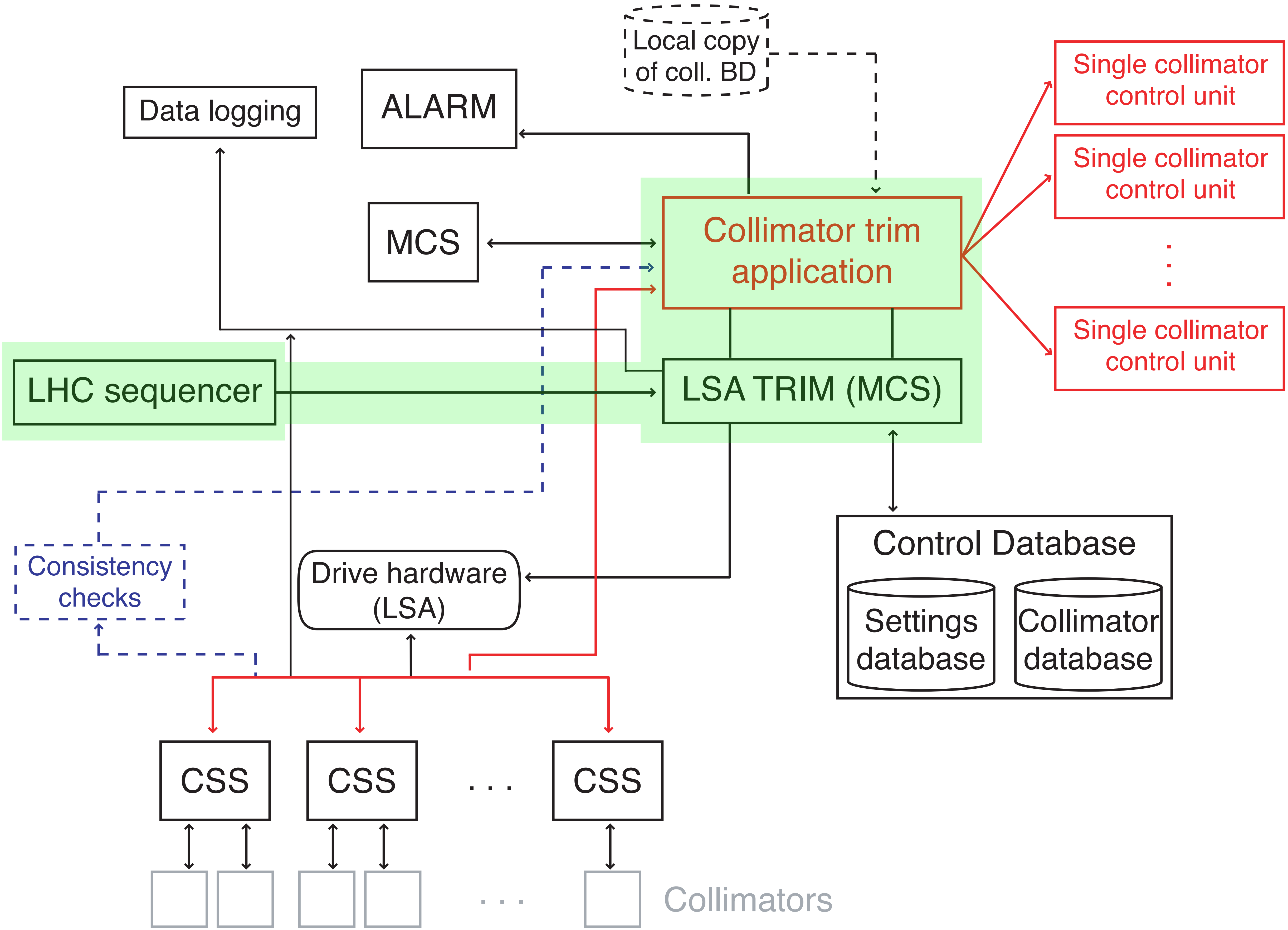
Data logging



Data logging requirements

- Data logging at ≥ 1 Hz for [per collimator]
  - *Demanded positions (4)*
  - *Position/gap measurements (14 + 2)*
  - *Switch status (10)*
  - *Temperatures (4)*
  - *Beam loss monitors (2)*
  - *Status of all the above*
  - *Relevant beam measurements (ex.: H and V orbit)*
- Dedicated on-line diagnostic at middle-level
  - *SDDS ready for time-series of data*
- Dedicated data acquisition at faster f_{acq}
  - *Ex.: fast BLM and jaw position measurements during MD studies*

Sequencer

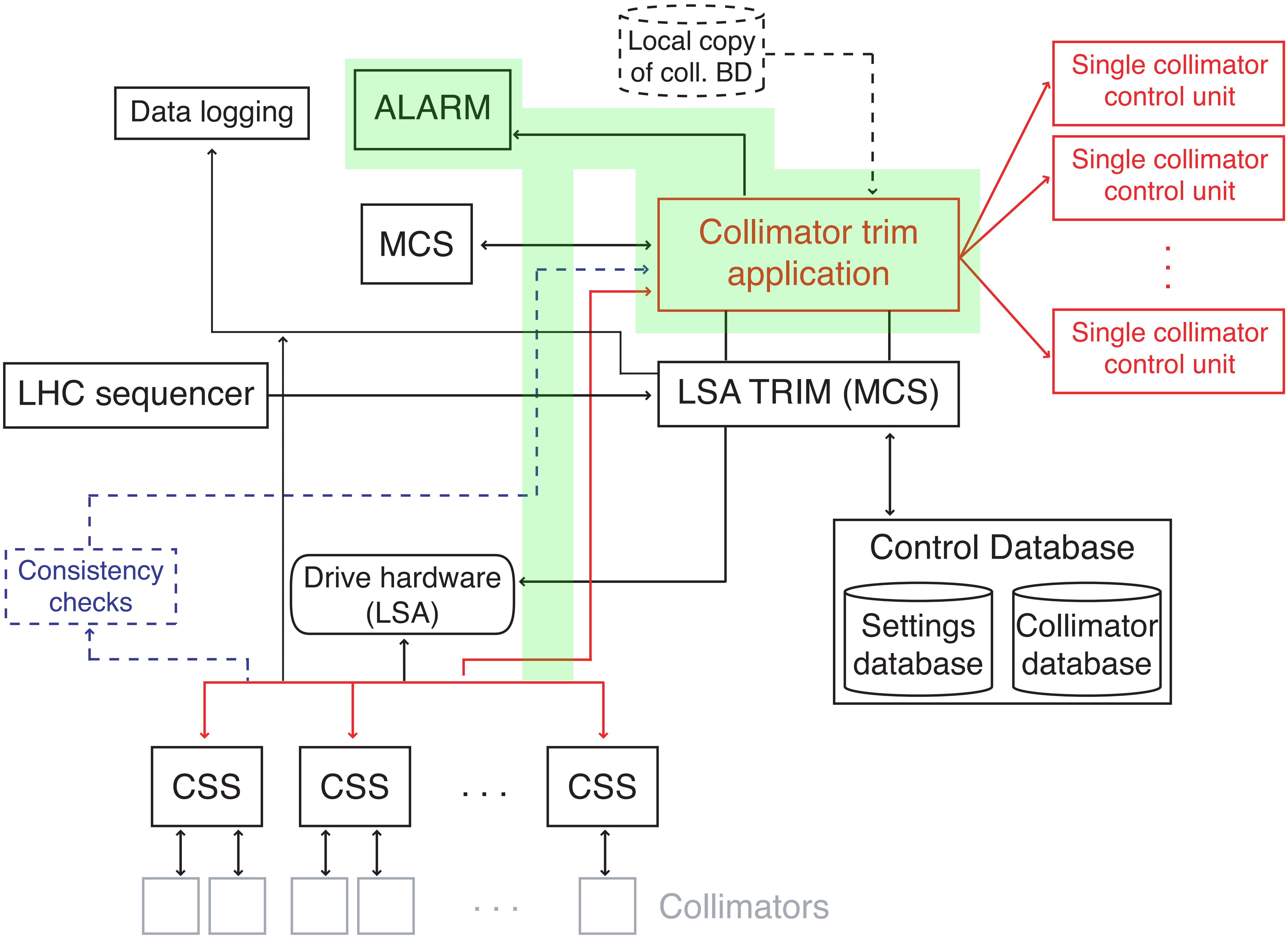


Local copy of coll. BD
Data logging
ALARM
Single collimator control unit
Single collimator control unit
MCS
Collimator trim application
Single collimator control unit
LHC sequencer
LSA TRIM (MCS)
Control Database
Consistency checks
Drive hardware (LSA)
Settings database
Collimator database
CSS
CSS
. . .
CSS
. . .
Collimators

Sequencer

- Standard requirements as for other systems driven by the sequencer:
- The sequencer will load and trigger the functions for the settings defined by the collimator experts
- Trigger through distribution of time events (“end injection”, “start ramp”, “start betatron squeeze”, ...)
- Collimator software will report the status (“Moving”, “Done”, “Warning”, ...)

ALARM



Local copy of coll. BD
Data logging
ALARM
MCS
Collimator trim application
Single collimator control unit
Single collimator control unit
Single collimator control unit
LHC sequencer
LSA TRIM (MCS)
Control Database
Settings database
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Collimators

Conclusions

- Requirements for the top-level collimator controls have been specified in detail
- We want to rely as much as possible on what LSA provides
  - *Fully rely on MCS functionalities (to be implemented)*
  - *Use the LSA TRIM functionalities*
- Nevertheless, dedicated implementations will be needed
  - *Trim definitions in terms of beam sigma unit*
  - *Database for beam-based parameters*
- We will rely on the good support from the LSA experts