Procedure of production, verification and transfer of threshold values to LSA
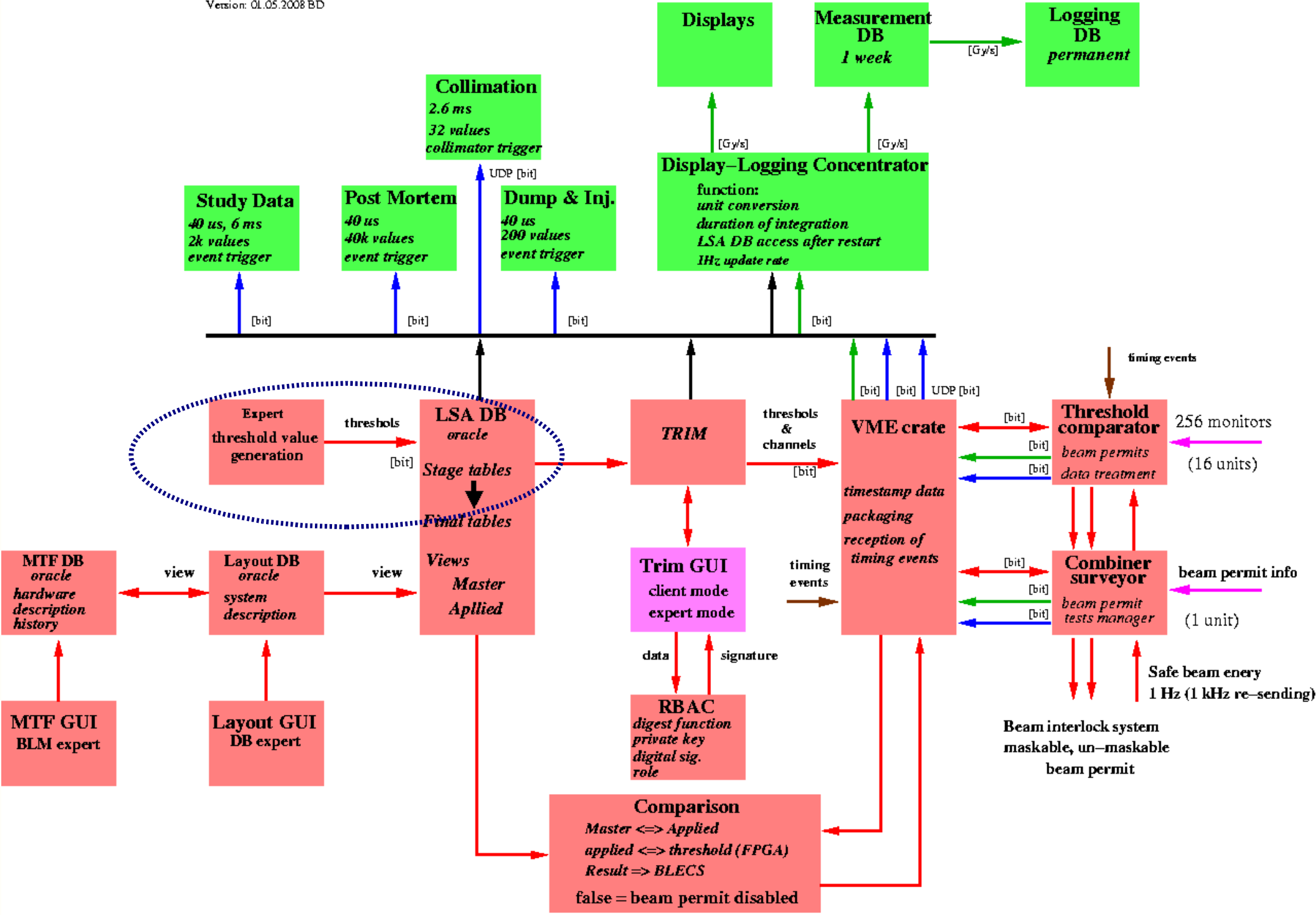
BLM System Audit
CERN
June 10th 2008
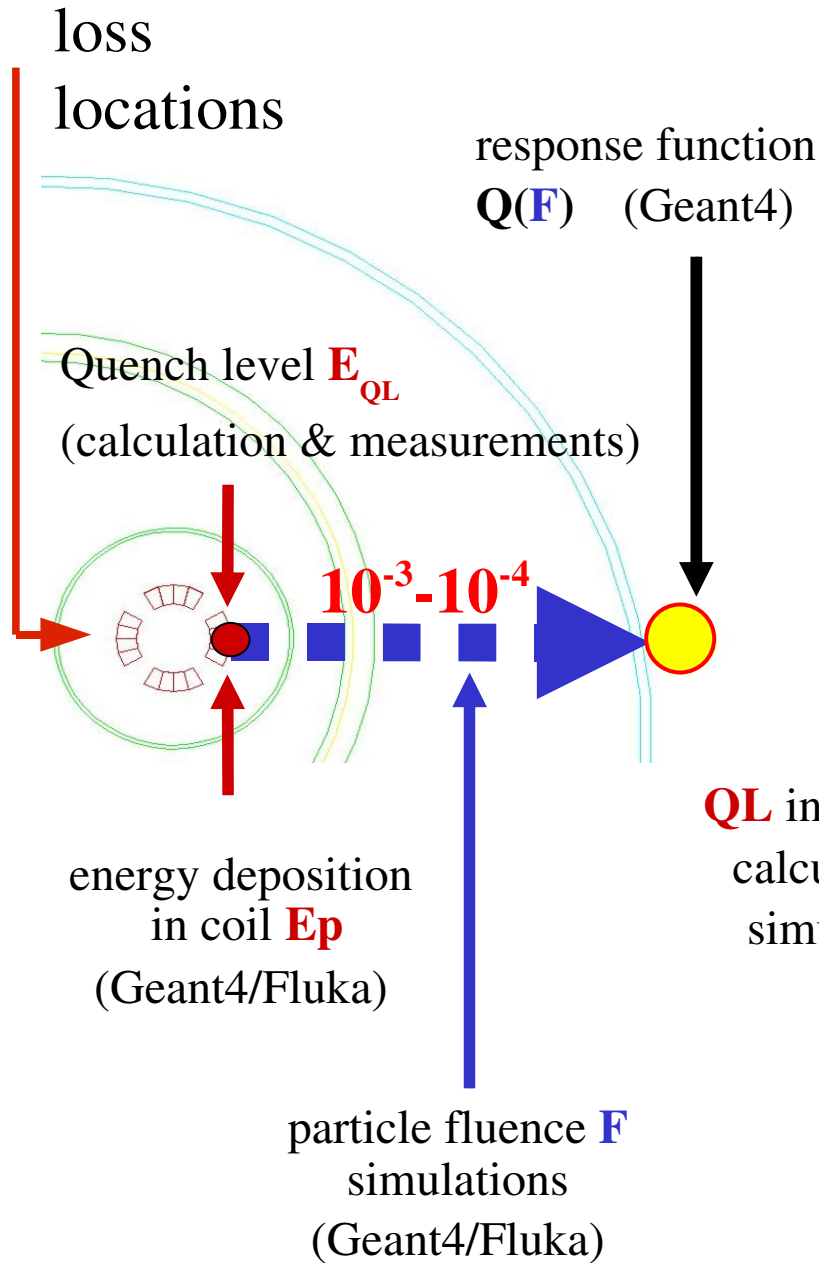
Version: 01.05.2008 BD

Displays

Measurement DB *1 week* → [Gy/s] → **Logging DB** *permanent*

Collimation
2.6 ms
32 values
collimator trigger

UDP [bit]

Display–Logging Concentrator
function:
unit conversion
duration of integration
LSA DB access after restart
1Hz update rate

[Gy/s]   [Gy/s]

Study Data
40 us, 6 ms
2k values
event trigger

Post Mortem
40 us
40k values
event trigger

Dump & Inj.
40 us
200 values
event trigger

[bit]   [bit]   [bit]   [bit]

[bit] [bit] UDP [bit]

Expert threshold value generation — threshols → [bit] → **LSA DB** *oracle* *Stage tables* *Final tables* *Views* *Master* *Applied*

TRIM — thresholds & channels → [bit]

VME crate *timestamp data packaging reception of timing events*

timing events

Threshold comparator *beam permits data treatment* — 256 monitors (16 units)

[bit]

Trim GUI client mode expert mode

timing events

Combiner surveyor *beam permit tests manager* — beam permit info (1 unit)

MTF DB *oracle hardware description history*

Layout DB *oracle system description* — view

view

RBAC *digest function private key digital sig. role*

data   signature

MTF GUI BLM expert

Layout GUI DB expert

Comparison
Master <=> Applied
applied <=> threshold (FPGA)
Result => BLECS
false = beam permit disabled

Safe beam enery 1 Hz (1 kHz re-sending)

Beam interlock system maskable, un-maskable beam permit

Legend:
- ■ Safety relevant
- — Safety relevant: thresholds, channels
- — Availability relevant, scaling applied table
- — 1 second data: loss, thresholds, configuration, status
- — configuration data: integration times, conversion factors
- — triggered data: post mortem, XPOC, Study data, Collimation

Outline

- Strategy to generate initial thresholds
- Setting the families
- Scrips to fill LSA
- LSA structure
- Scrips to verify the values

The functional specification of the databases and software to operate on them is available on http://cern.ch/blm webpage (edms document soon)
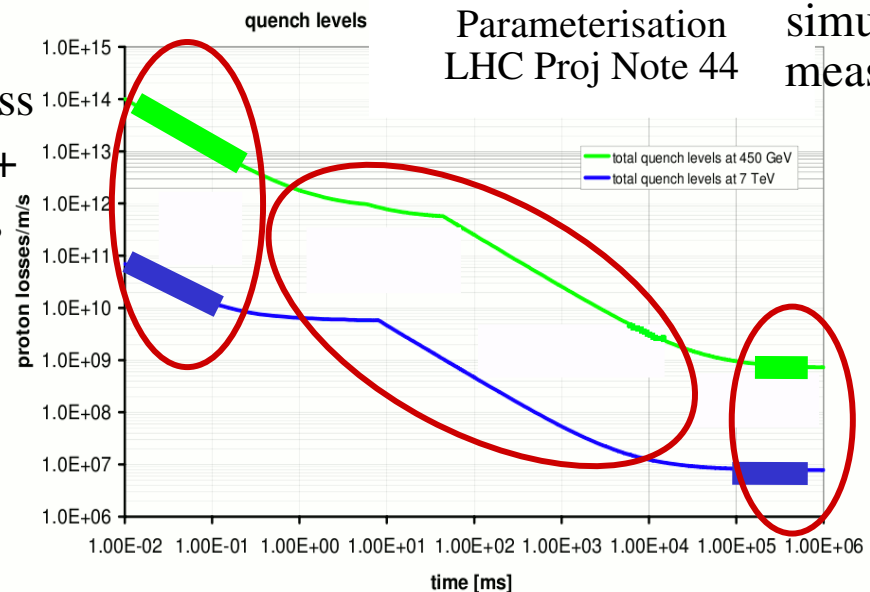
Strategy to generate thresholds

loss
locations

response function
$Q(F)$ (Geant4)

N protons quench = E_{QL}/Ep

Quench level E_{QL}
(calculation & measurements)

Threshold = $Q(F) \cdot N$protons quench $\cdot$ factor
(7 TeV, 40 μs)

10^{-3}-10^{-4}

QL
steady state loss
simulations +
measurements

QL instant loss
calculation +
simulations

Parameterisation
LHC Proj Note 44

energy deposition
in coil Ep
(Geant4/Fluka)

particle fluence F
simulations
(Geant4/Fluka)

quench levels

proton losses/m/s

total quench levels at 450 GeV
total quench levels at 7 TeV

time [ms]

Example values

- MQXA Fluka simulation: **1.6 •10^{-5} Gy**
- LHC lattice MQ Geant4 simulation: **7.7•10^{-5} Gy**
  (preliminary, loss in BPM, Agnieszka's presentation)
- TCP collimator steady state damage level: **98 Gy/s**
  (7 TeV, 90 kW, preliminary, Till's presentation)
- Tevatron settings: 3.5 rad/sec, for integration time
  2 ms (fast losses): **7·10^{-5} Gy**
  (Dean Still presentation at Collimation WG, 2005/04/14)

Families

	Magnet	Temp	dry mJ/cm^3
3	entalphy of different coils		
5			
6			
7			
8	MB Type-1	1.9K	0,93
9	MB Type-2	1.9K	0,90
10	MQ Type-3	1.9K	1,41
11	MQM Type-7	1.9K	1,06
12	MQM Type-7	4.5K	1,63
13	MQY Type-5	4.5K	2,46
14	MQY Type-6	4.5K	4,95
15			
16	MCB corr-1	1.9K	4,77
17	MCBC corr-2	1.9K	4,20
18	MCBC corr-2	4.5K	5,69
19	MCBY corr-2	1.9K	5,22
20	MCBY corr-2	4.5K	5,28
21	MCBXH corr-4	1.9K	10,91
22	MCBXV corr-4	1.9K	11,66
23			
24	MCD corr-3	1.9K	10,65
25	MCO corr-2	1.9K	7,64
26	MCOSX corr-2	1.9K	9,46
27	MCOX corr2	1.9K	9,37
28	MCS corr-3	1.9K	12,28
29	MCSSX corr-2	1.9K	9,50
30	MCSX corr-2	1.9K	7,02
31	MCTX corr-2	1.9K	4,89
32			
33	MO corr-3	1.9K	10,55
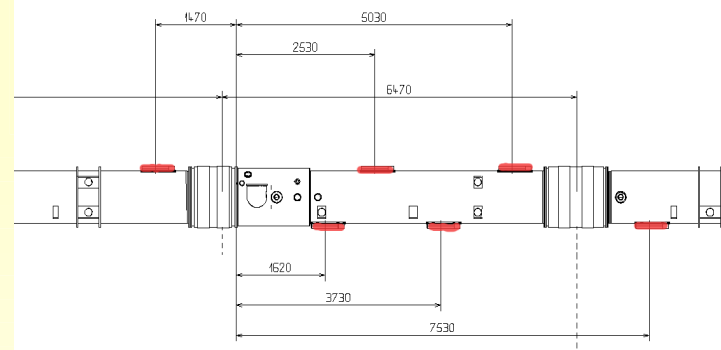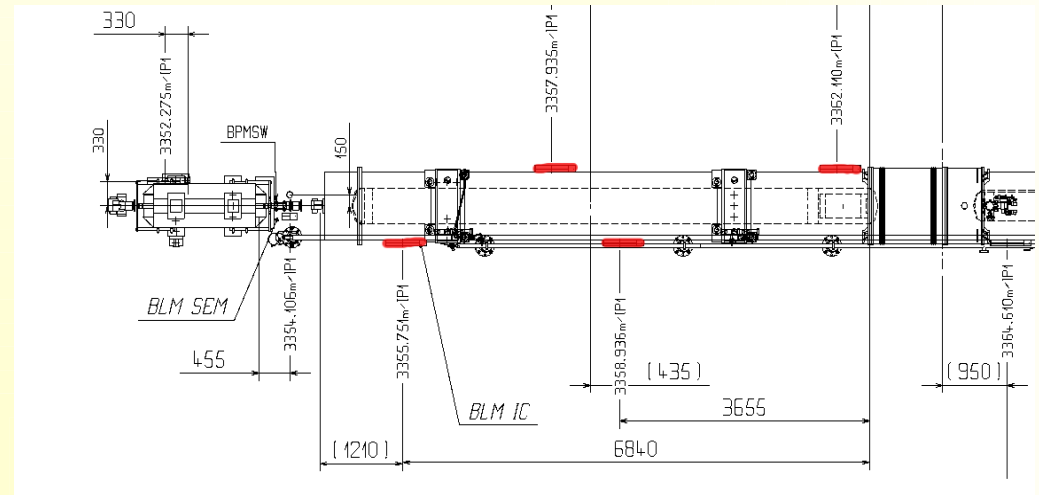
... and more

... and more

Family is a group of monitors with the same threshold

· about **300** families identified

· **2160** monitors in 6 arc families

Families – example of configuration file
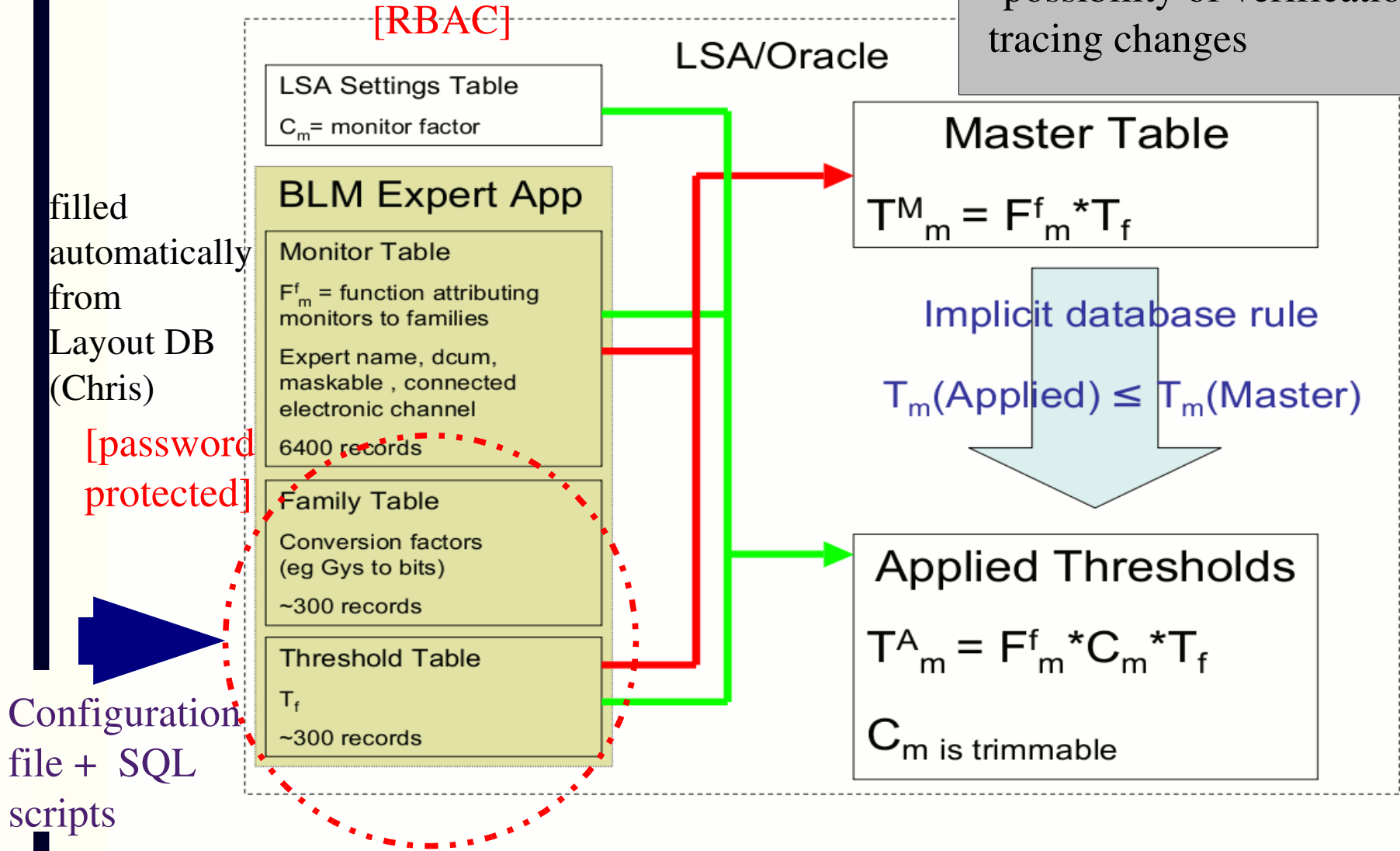
THRC.Name_0:   THRI.AR_7.B1.1_MQ   family name

THRC.Nquery_0:   23

THRC.Query0_0:   BLMQI.12%7.B1%1_MQ   SQL-like query on

(...)   expert names

THRC.Query22_0:   BLMQI.34%7.B1%1_MQ   in DB

THRC.Seed_0:   7.e-4 ◄—— seed threshold (7 TeV, fast loss)

THRC.GFac_0:   3.6200E-09 conversion factor BLMBIT->Gy

THRC.AFac_0:   0.000054   (thresholds are send in BLMBITS)

conv. factor Gy->Coulomb

To be added: choice of the time-energy evolution scheme
(different for triplets, warm elements, collimators...)

Structure in LSA

[RBAC]

LSA/Oracle
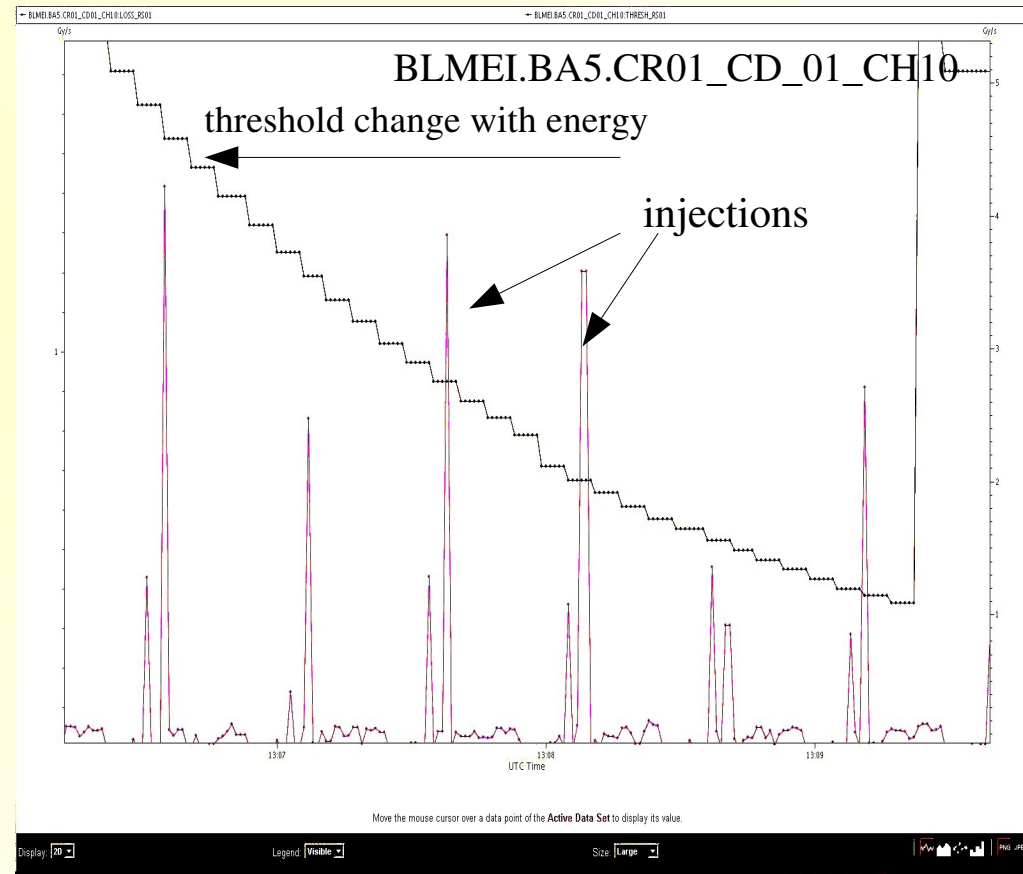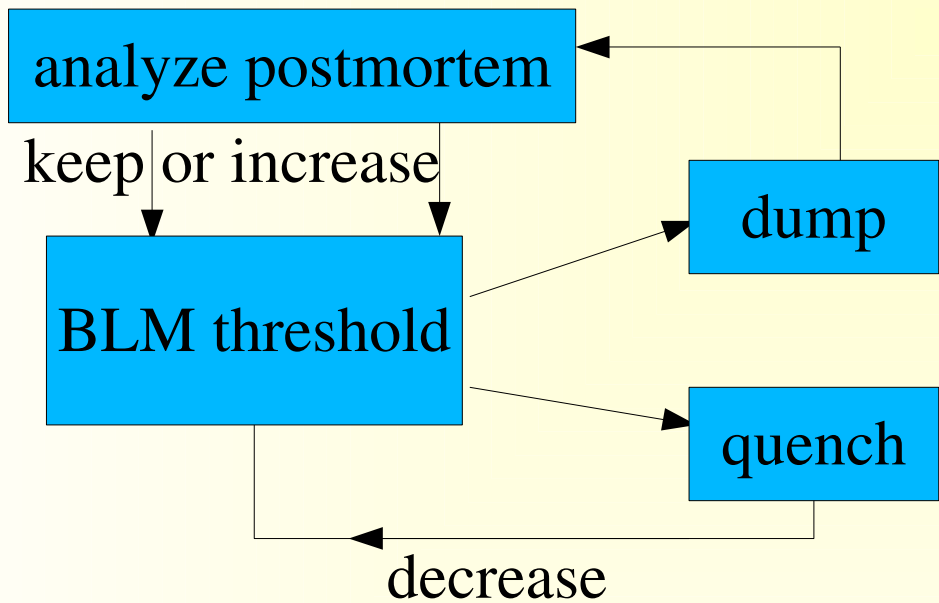
STAGE/FINAL tables
- filling FINAL - beam permit off
- possibility of verification and tracing changes

filled automatically from Layout DB (Chris)

[password protected]

LSA Settings Table

C_m = monitor factor

BLM Expert App

Monitor Table

F^f_m = function attributing monitors to families

Expert name, dcum, maskable , connected electronic channel

6400 records

Family Table

Conversion factors (eg Gys to bits)

~300 records

Threshold Table

T_f

~300 records

Master Table

$$T^M_m = F^f_m * T_f$$

Implicit database rule

$$T_m(\text{Applied}) \leq T_m(\text{Master})$$

Applied Thresholds

$$T^A_m = F^f_m * C_m * T_f$$

C_m is trimmable

Configuration file + SQL scripts

remarks

- The test of thresholds with LHC beam requested in Machine Protection System Commissioning Procedure
- Triggering from thresholds has been demonstrated during MD last fall:
- Threshold tuning is foreseen:

analyze postmortem

keep or increase

BLM threshold

dump

quench

decrease

BLMEI.BA5.CR01_CD_01_CH10

threshold change with energy

injections

Procedures for threshold plausibility checks

- **thresholds have to be input manually (expert knowledge) what increases probability of human error,**
- **history of threshold changes will be kept in LSA as a snapshot or via trim mechanism (monitor factors only),**
- **threshold plausibility checks will be developed for threshold values stored in LSA:**
- there will be simple checks like maximum/minimum values typical for various elements,
- as well as more complex ones like comparison with historical values (for instance at the level of APPLIED and MASTER tables).

Summary

- database structure to keep and maintain BLM system settings is ready,
- tools to set and modify BLM thresholds in LSA exist, more than 50% of values are filled

    (preliminary arc families),

- simulations performed (or in final stage) for a few families (MQ on arc, triplets, collimators),
- most of the families are defined,
- procedures to tune thresholds during operation are being developed,
- procedures of thresholds plausibility checks are being developed.