FAST MAGNET CURRENT CHANGE MONITOR ANALYSIS MODULE

Summer Student Sessions

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Contents

1. 2004 incident.
2. Fast Magnet Current change Monitor.
3. PostMortem framework.
4. Why is PM analysis software needed?
5. FMCM Analysis module.

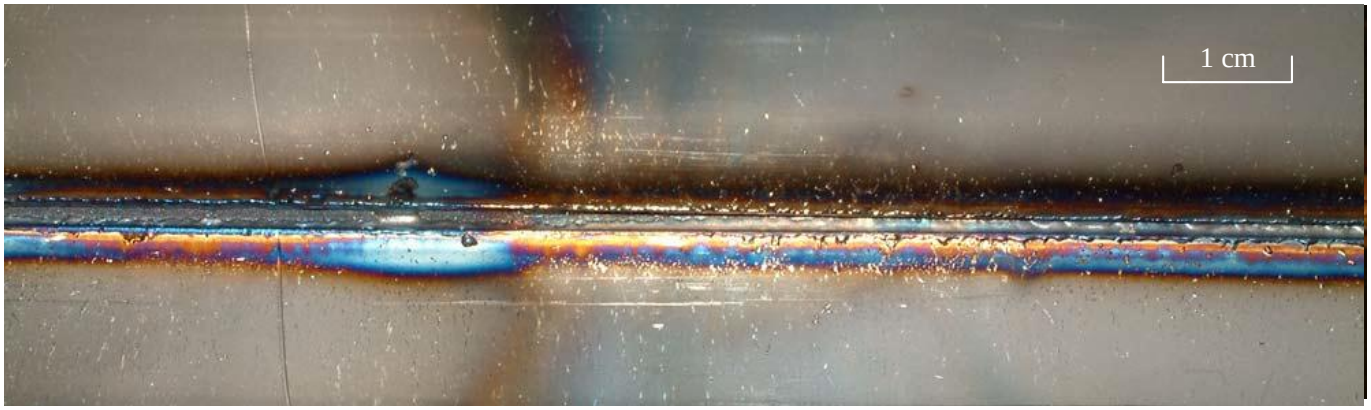
2004 incident

TT40 damage during high intensity SPS extraction

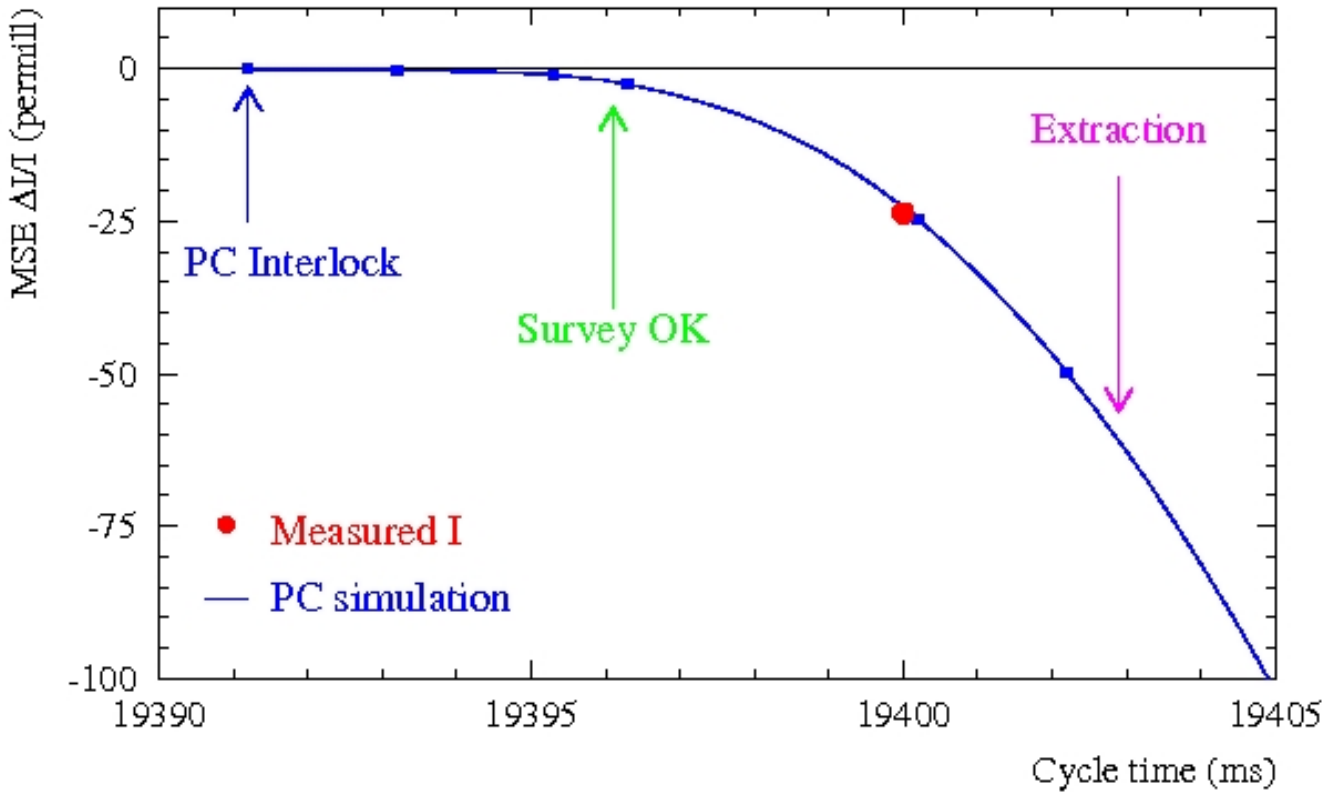
- Powering failure in a magnet.
  - Magnet with low time constant.

- Beam extraction with the wrong trajectory.
- Vacuum chamber badly damaged.

Inside of the vacuum chamber

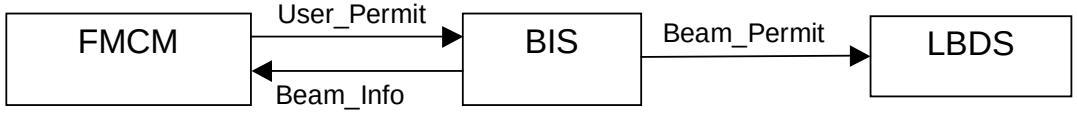


Outside of the vacuum chamber


MSE ΔI/I (permill)
0
-25
-50
-75
-100
19390
19395
19400
19405
Cycle time (ms)
PC Interlock
Survey OK
Extraction
Measured I
PC simulation

Fast Magnet Current change Monitor

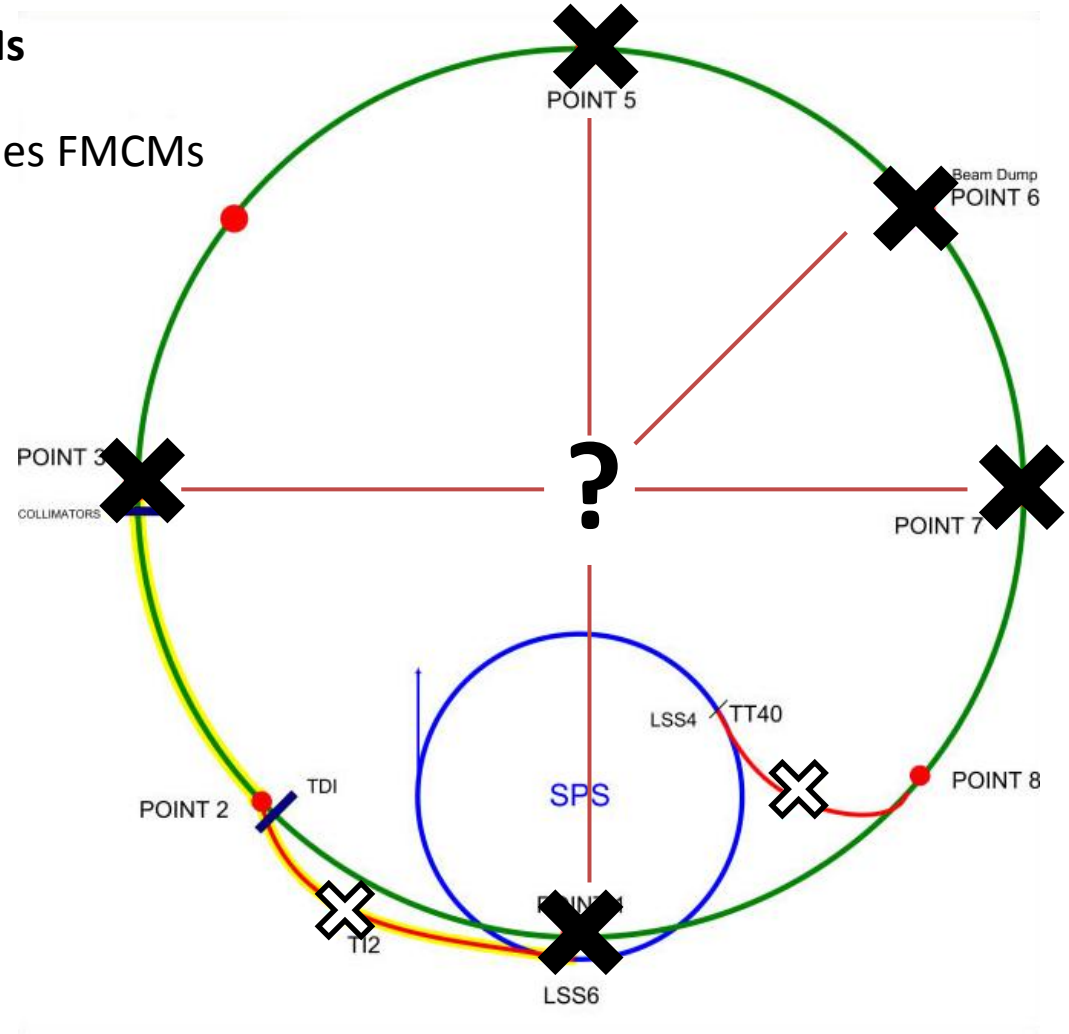
- FPGA based devices that monitor the state of a normal conducting magnets (“warm magnets”).
- Measures the voltage across magnets to detect fast current changes.
- Can trigger a beam dump.
  - When signals are above predefined thresholds.




Magnetstrom-Alarm
DESY MDI / MKK

LHC FMCMs

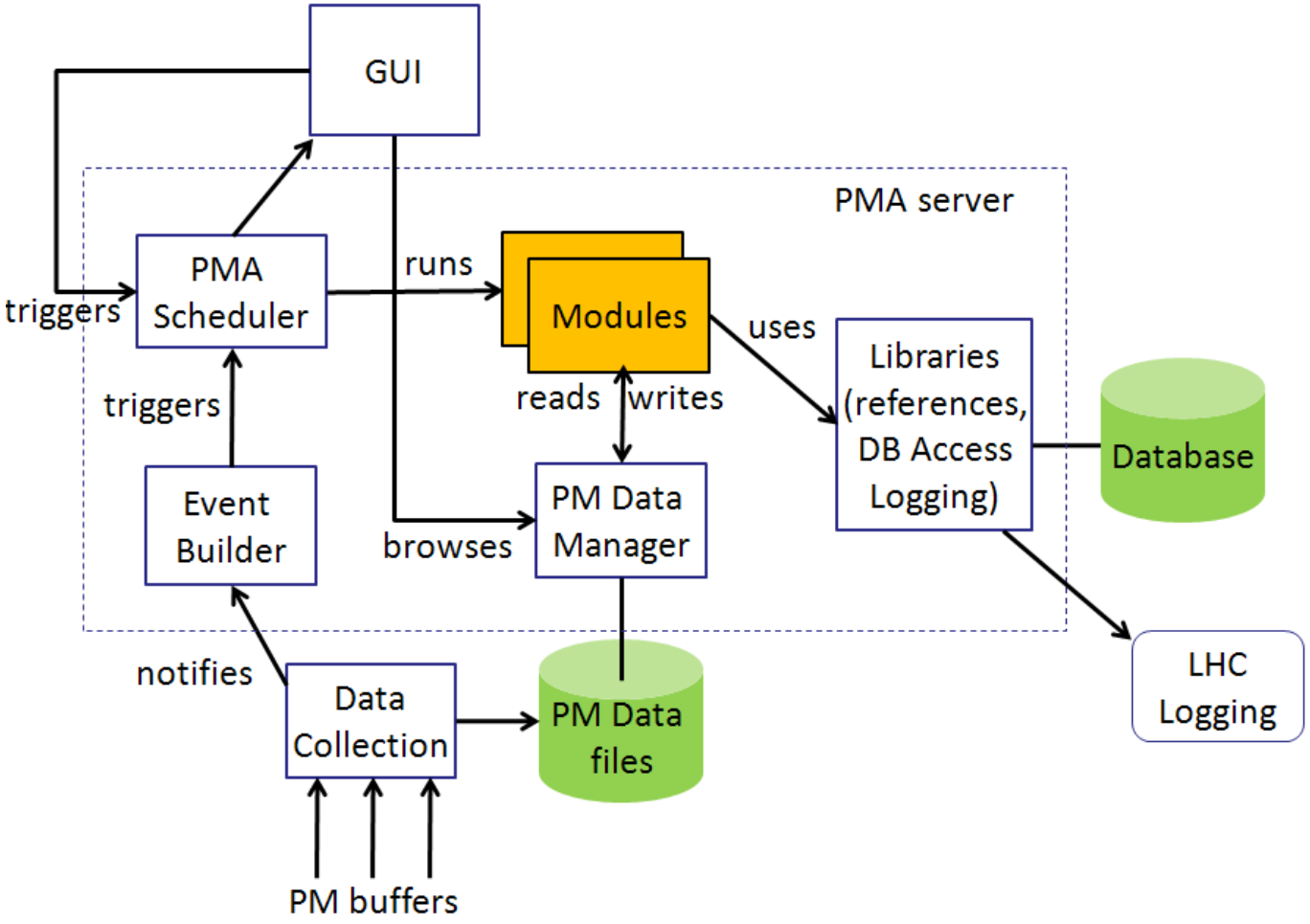
Transfer lines FMCMs



PostMortem framework

- Provides comprehensive monitoring of the functioning of machine protection system.
  - Improve efficiency of the LHC.
  - Explain damage.

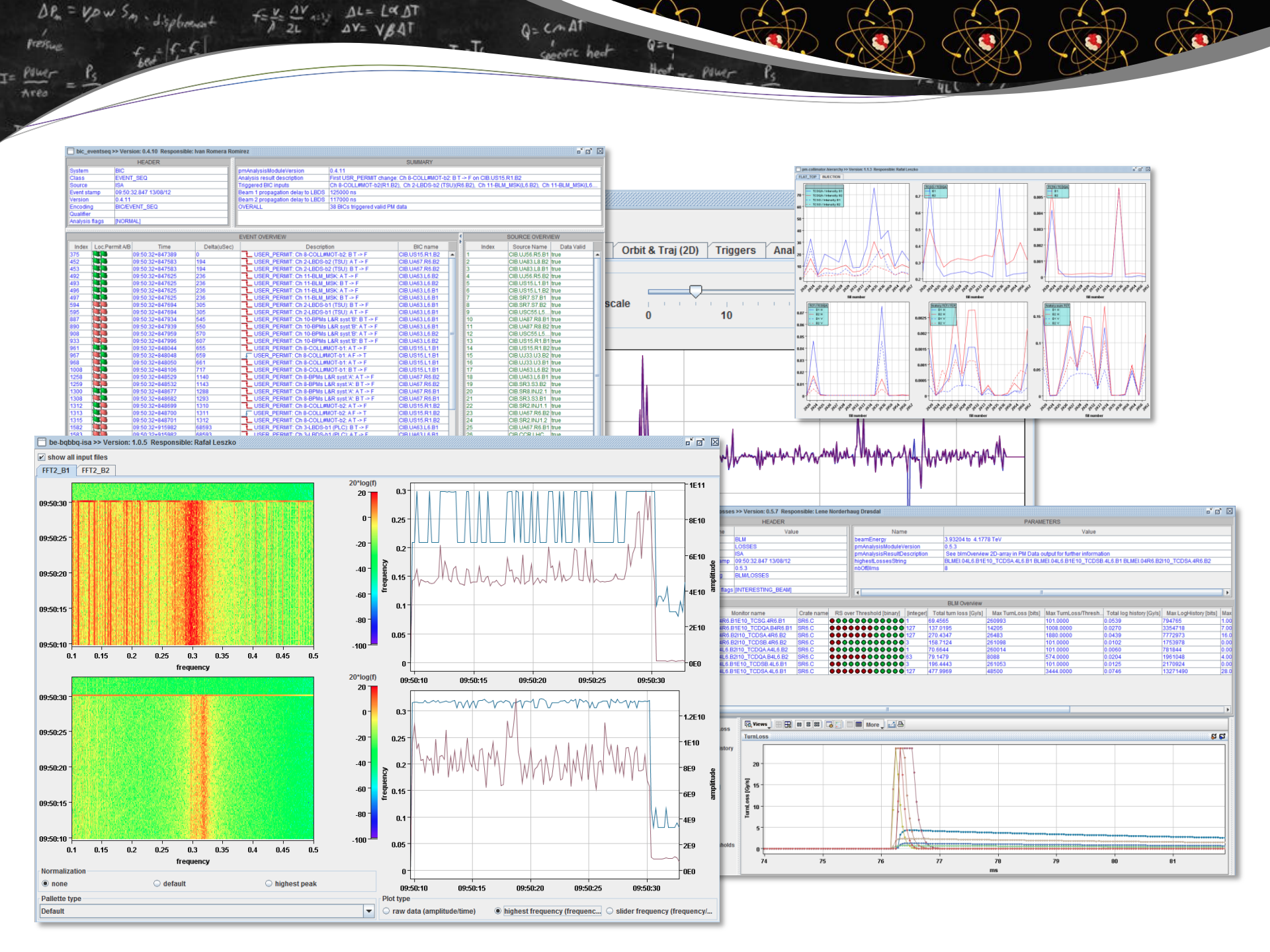
- The PM event must be automatically analyzed.
  - ‘Digested’ information must be generated for operators.

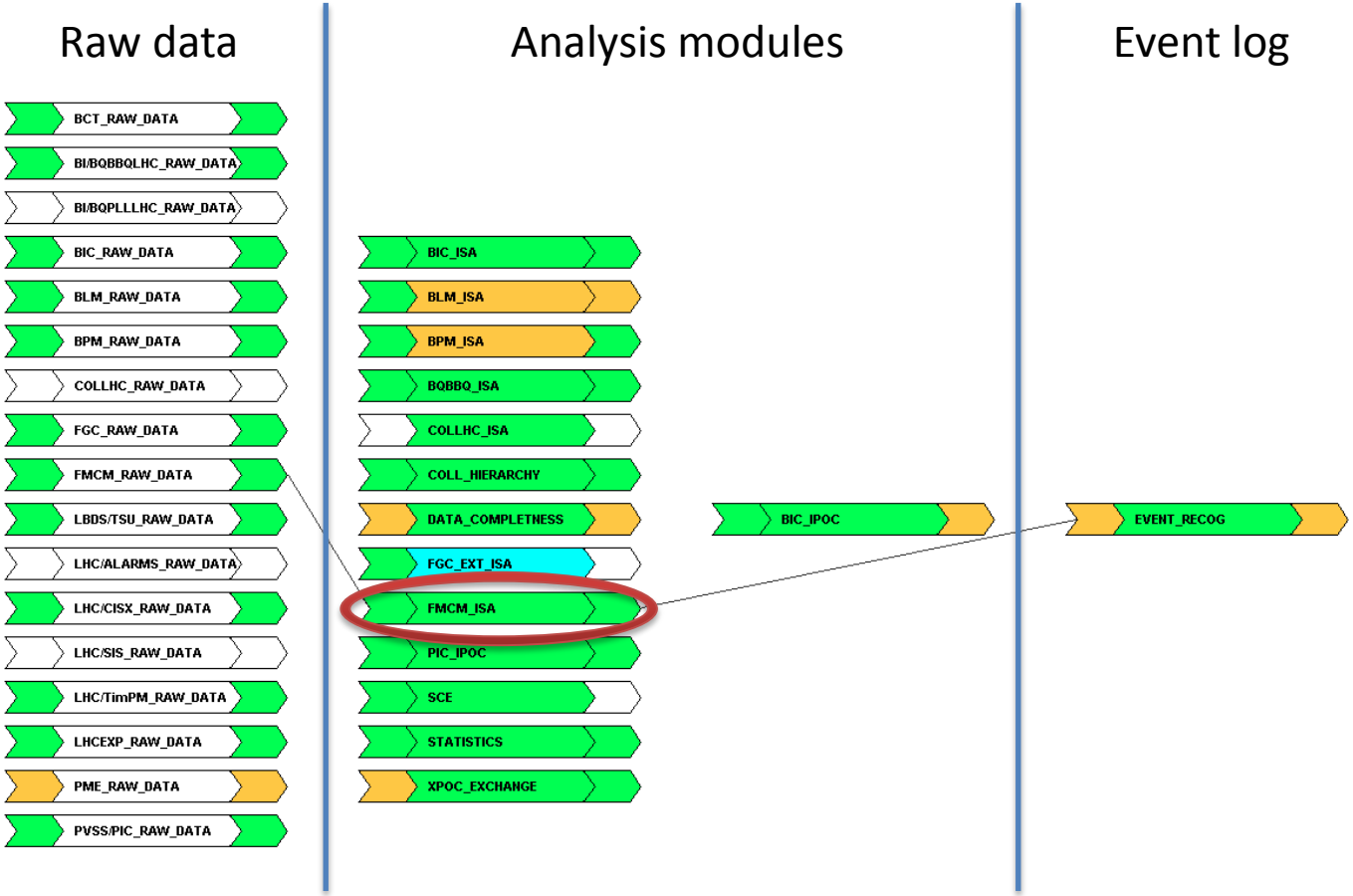

GUI
PMA server
PMA Scheduler
triggers
runs
Modules
uses
Libraries (references, DB Access Logging)
Database
triggers
reads
writes
Event Builder
PM Data Manager
browses
notifies
Data Collection
PM Data files
LHC Logging
PM buffers

PM analysis

- 4GBytes each PM event.
  - Too much to be browsed by the operator.
- Correct functioning of protection systems:
  - Must be verified before injecting a new beam.

- Software is used to:
  - Scan for faults.
  - Inspect evidence.
  - Develop understanding.


bic_eventseq >> Version: 0.4.10 Responsible: Ivan Romera Romirez
HEADER
SUMMARY
EVENT OVERVIEW
SOURCE OVERVIEW
Orbit & Traj (2D)
Triggers
scale
be-bqbbq-isa >> Version: 1.0.5 Responsible: Rafal Leszko
show all input files
FFT2_B1
FFT2_B2
frequency
amplitude
20*log(f)
Normalization
none
default
highest peak
Pallette type
Default
Plot type
raw data (amplitude/time)
highest frequency (frequenc...
slider frequency (frequency/...
losses >> Version: 0.5.7 Responsible: Lene Norderhaug Drøsdal
PARAMETERS
BLM Overview
TurnLoss
TurnLoss [Gy/s]
ms

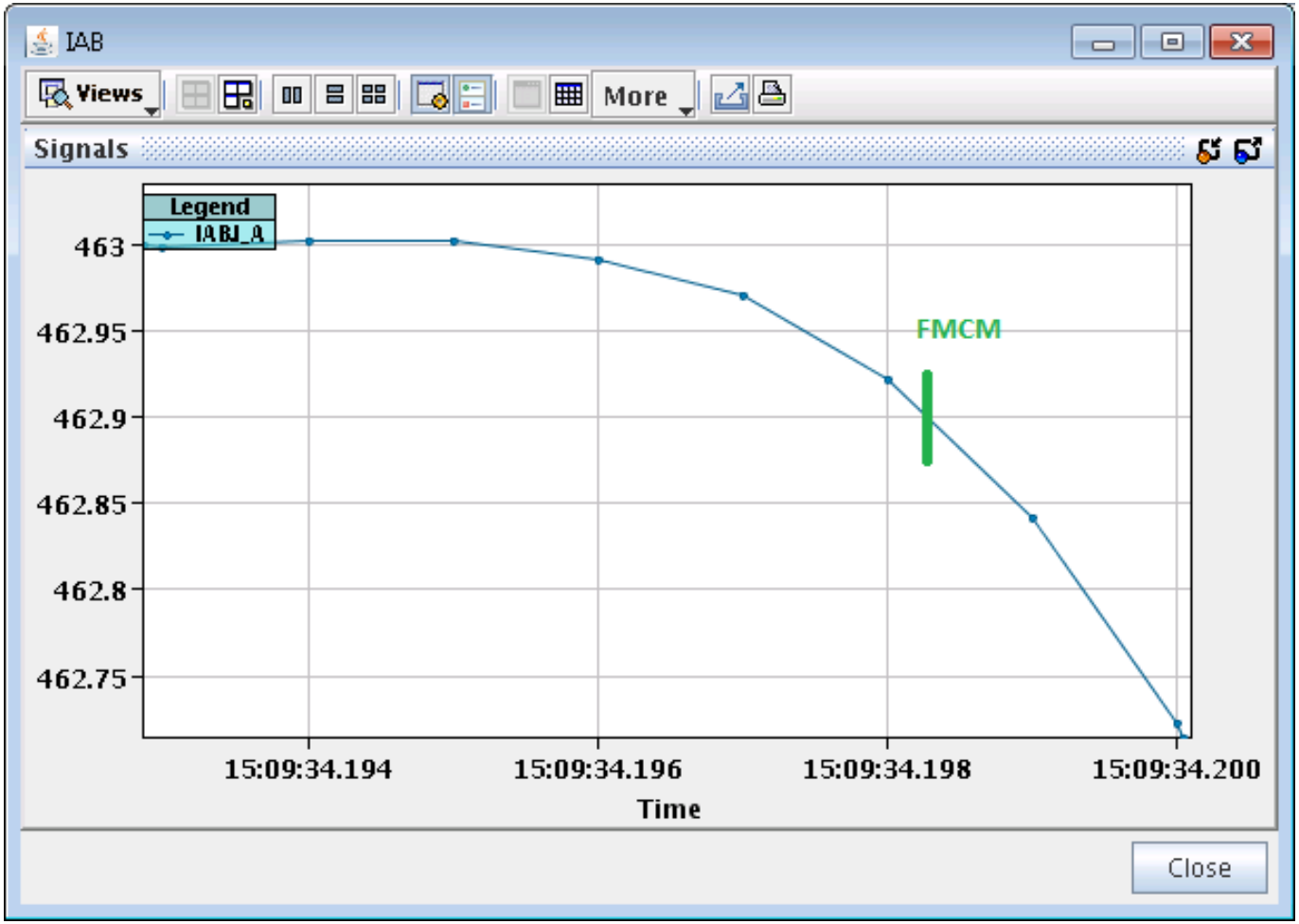

Raw data
Analysis modules
Event log
BCT_RAW_DATA
BI/BQBBQLHC_RAW_DATA
BI/BQPLLLHC_RAW_DATA
BIC_RAW_DATA
BLM_RAW_DATA
BPM_RAW_DATA
COLLHC_RAW_DATA
FGC_RAW_DATA
FMCM_RAW_DATA
LBDS/TSU_RAW_DATA
LHC/ALARMS_RAW_DATA
LHC/CISX_RAW_DATA
LHC/SIS_RAW_DATA
LHC/TimPM_RAW_DATA
LHCEXP_RAW_DATA
PME_RAW_DATA
PVSS/PIC_RAW_DATA
BIC_ISA
BLM_ISA
BPM_ISA
BQBBQ_ISA
COLLHC_ISA
COLL_HIERARCHY
DATA_COMPLETNESS
FGC_EXT_ISA
FMCM_ISA
PIC_IPOC
SCE
STATISTICS
XPOC_EXCHANGE
BIC_IPOC
EVENT_RECOG

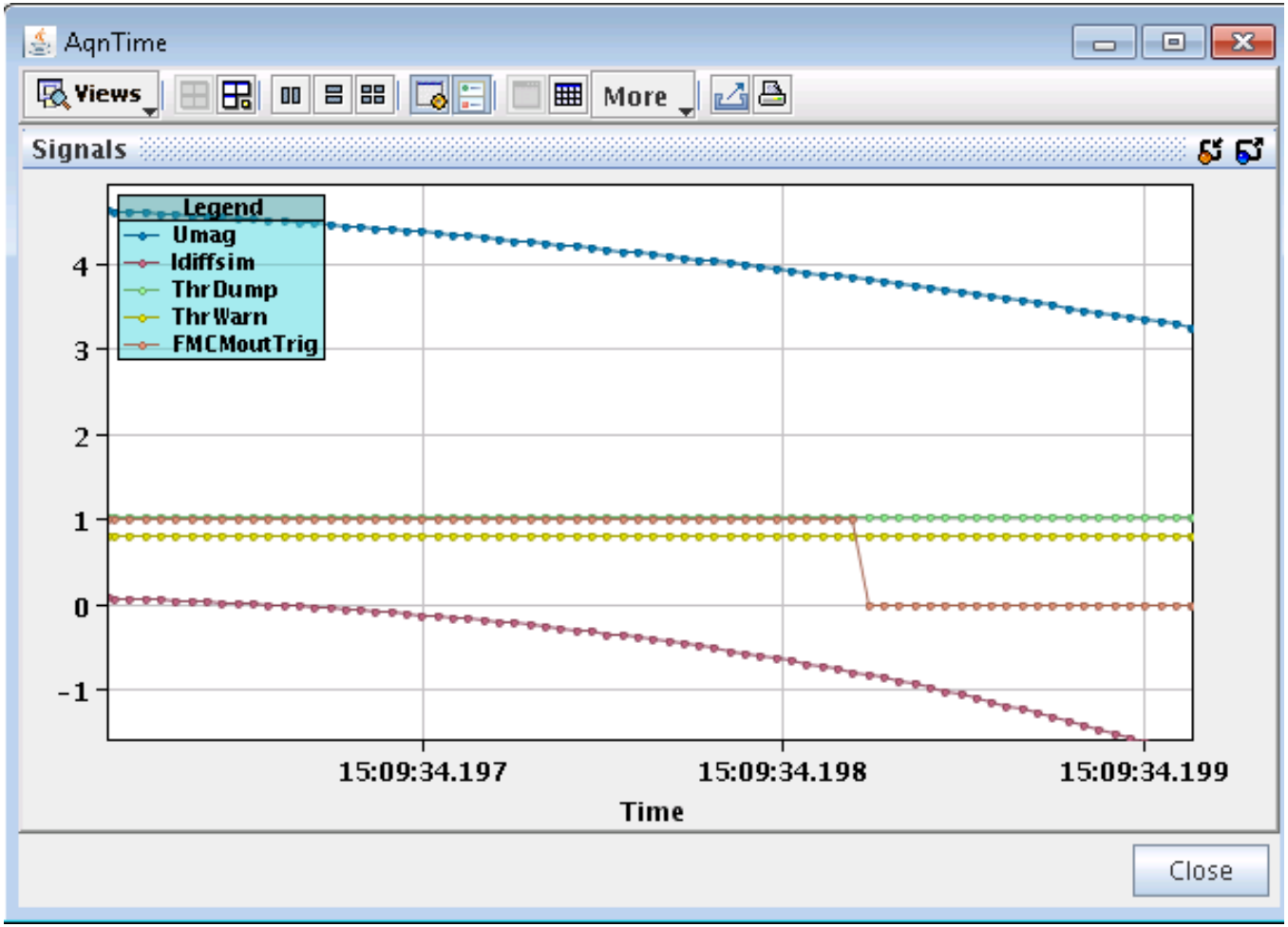
FMCM analysis module

- Were all FMCM logs correctly received?
- Are thresholds correctly set in the FMCMs?

- Was any of the FMCM responsible for a beam dump?
  - Correctly triggered?
  - Correct propagation to Beam Interlock System?
  - Reacted before than Warm magnet Interlock System?

  - Data:
    - Elapsed time from beam dump trigger and BIC reception.
    - Current at triggering time.
    - Relative current variation.
    - Longest excess observed.


IAB
Views
More
Signals
Legend
IABJ_A
463
462.95
462.9
462.85
462.8
462.75
FMCM
15:09:34.194
15:09:34.196
15:09:34.198
15:09:34.200
Time
Close


AqnTime
Views
More
Signals
Legend
Umag
Idiffsim
ThrDump
ThrWarn
FMCMoutTrig
4
3
2
1
0
-1
15:09:34.197
15:09:34.198
15:09:34.199
Time
Close

References

[1] B. Goddard, V. Kain, et al, “TT40 damage during 2004 high intensity SPS extraction”, AB-Note-2005-014 BT.

[2] M. Werner, M. Zerlauth, et al, “Requirements for the Fast Magnet Current change Monitors (FMCM) in the LHC and the SPS-LHC transfers lines”, LHC-CIW-ES-0002, 2005.

[3] M. Zerlauth, T. V. Jevard, “MPS aspects of the Fast Magnet Current change Monitors commissioning.”

[4] O. O. Andreassen, V. Baggiolini, et al, “The LHC Post Mortem analysis framework”, CERN, Geneva.

[5] R. J. Lauckner, “Post Mortem”, AB-LHC Review, 2003.

- Acknowledgement:
  - Iván Romera Ramírez, project supervisor.


displacement
pressure
power
area
Power
Heat
power