Post Mortem System

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Special thanks to J-C. Garnier, Z. Charifoulline,
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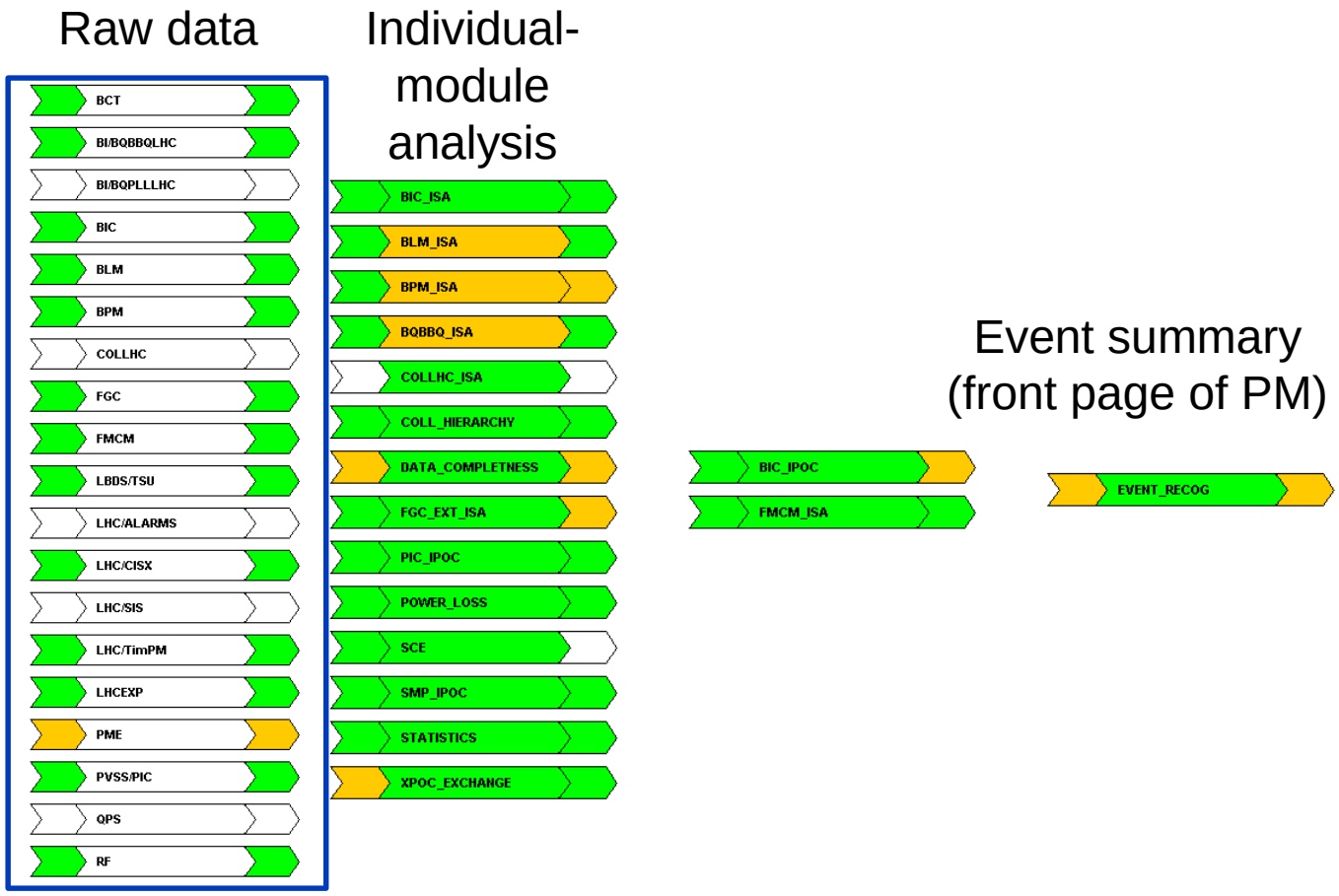
Motivation

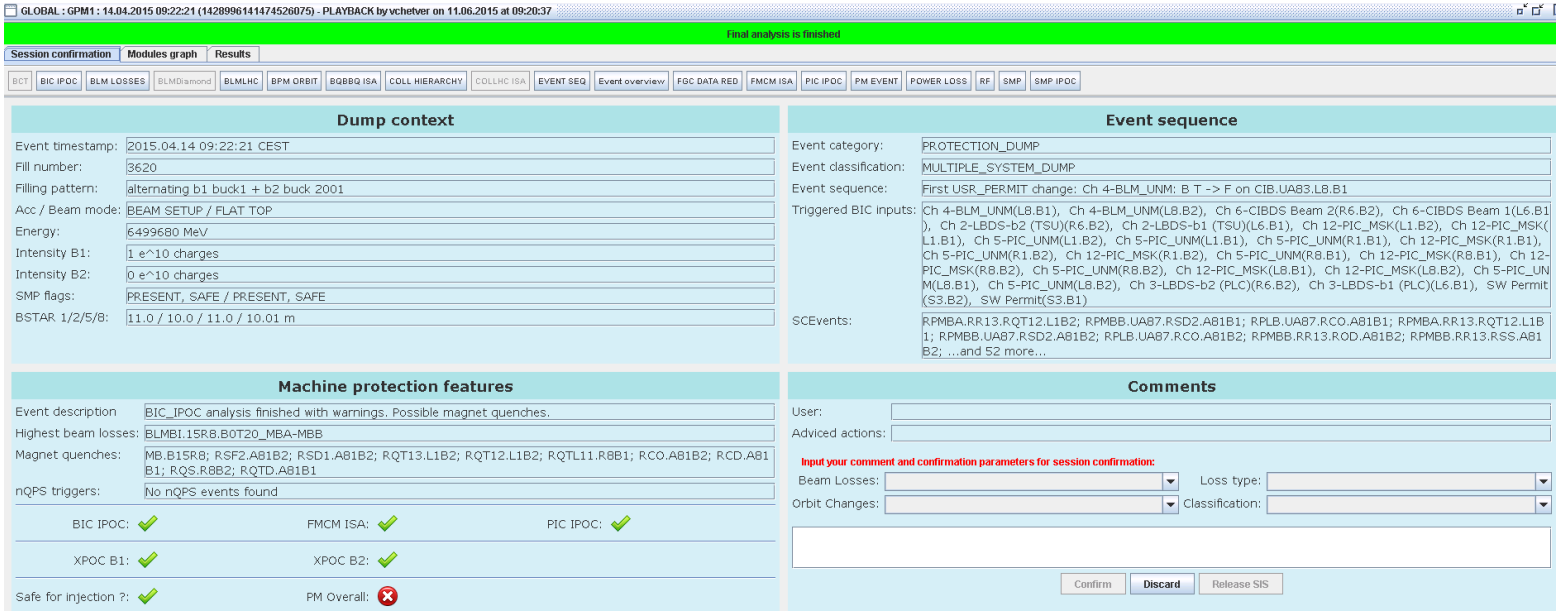
- PM system is needed to understand the reason and consequences of a beam dump
- PM stores information about
  - sequence of events
  - status of the MPS before/during/after dump
- Correct behavior of the MPS and other systems

Which systems are sending data to PM?

- BLM
- BCT
- BIC
- BPM
- FMCM
- LBDS
- BBQ
- RF
- Collimators
- Experiments
- PIC
- SIS
- etc..



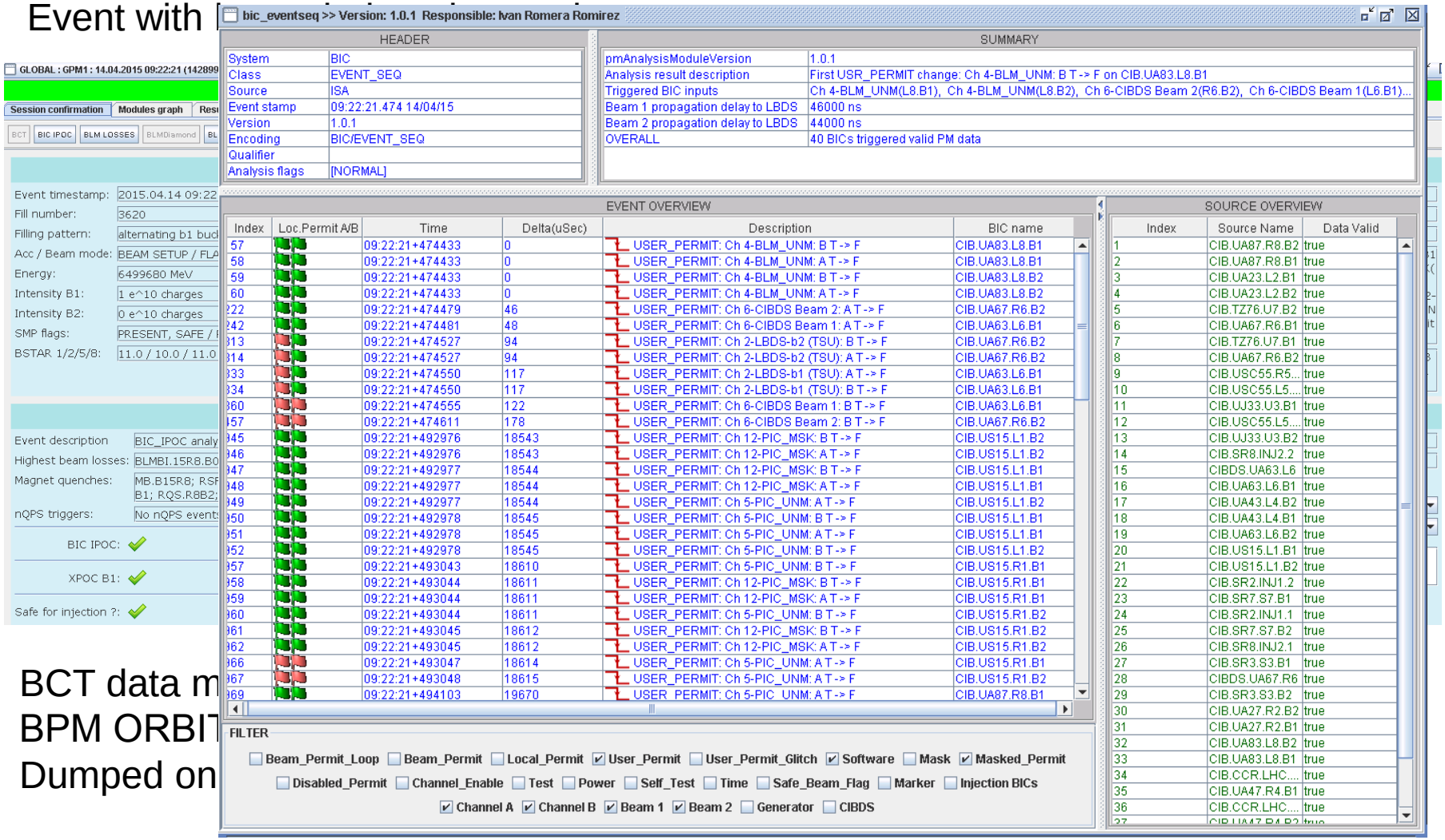
Front page of PM



- Most of the modules existed before LS1
- Due to changes of the names (collimators, BPMs etc), and FESA classes the modules were not fully operational after LS1
  - Problem solved during commissioning
- Some data structures changed

Automatic PM analysis – BLM, BPM ORBIT and EVENT_SEQ modules

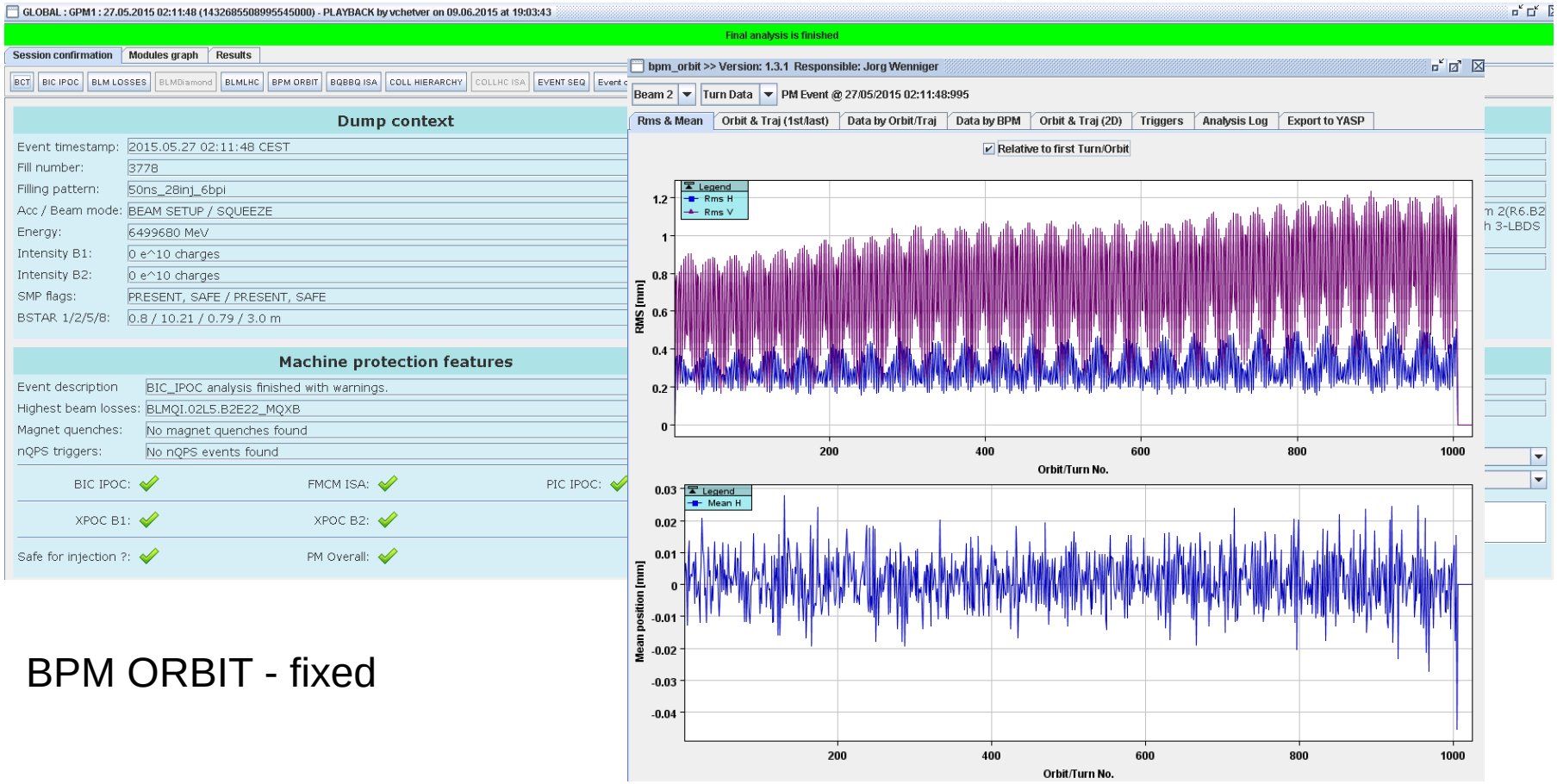
Event with



BCT data m
BPM ORBIT
Dumped on

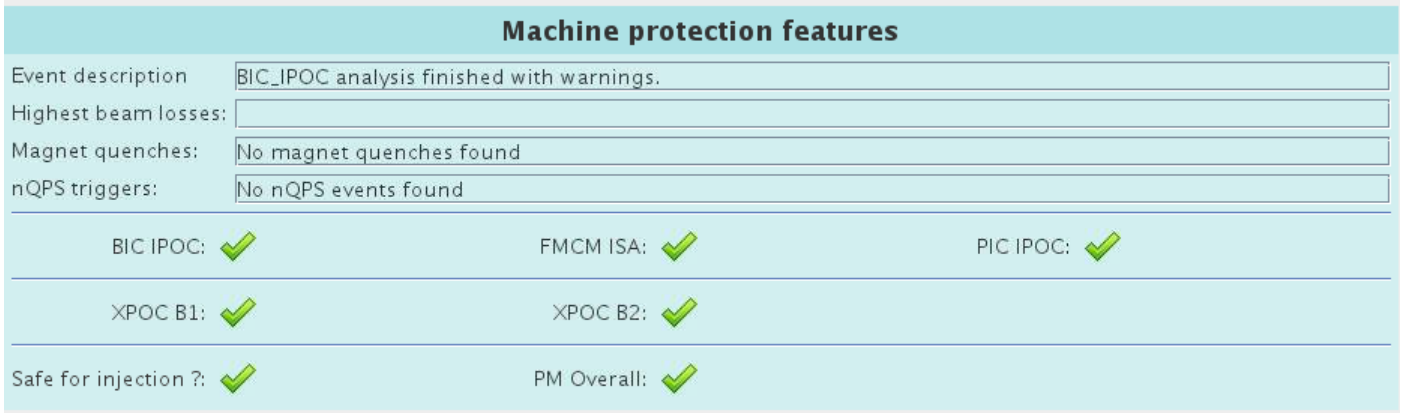
Automatic PM analysis – BPM ORBIT module

Event with Beam dump triggered by losses at IP5 due to AC dipole excitation



BPM ORBIT - fixed

Post Mortem Analysis Results



Machine protection features

Event description	BIC_IPOC analysis finished with warnings.
Highest beam losses:	
Magnet quenches:	No magnet quenches found
nQPS triggers:	No nQPS events found

BIC IPOC: ✓	FMCM ISA: ✓	PIC IPOC: ✓
XPOC B1: ✓	XPOC B2: ✓	
Safe for injection ?: ✓	PM Overall: ✓	

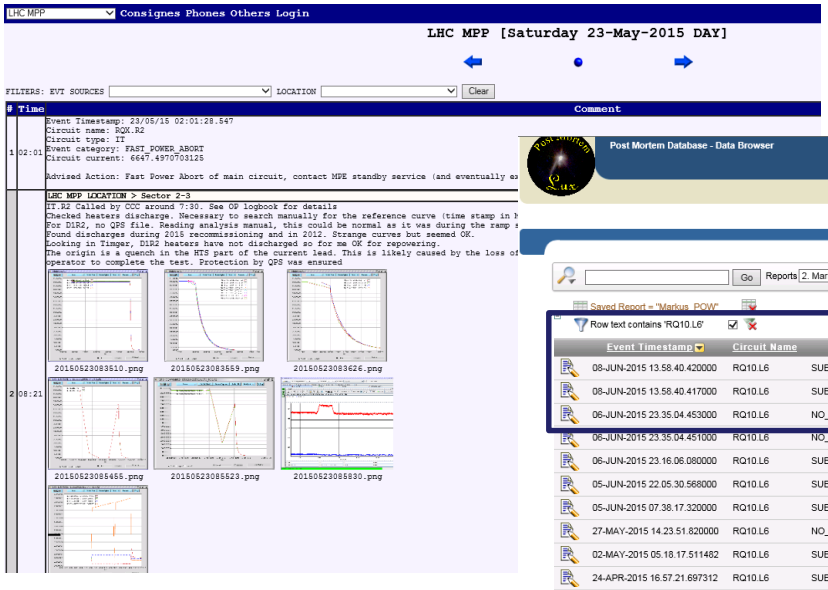
- System experts defined the specifications or implemented the modules BIC IPOC, FMCM ISA,PIC IPOC and XPOC B1/B2
- “Safe for injection ?” is a logical AND of BIC IPOC, FMCM ISA and PIC IPOC overall results
- PM Overall is false if nQPS or magnet quenches are present, or BIC, PIC and FMCM analysis results contains “INTERESTING_EQP”
- All details : https://wikis.cern.ch/x/ZQNgAQ

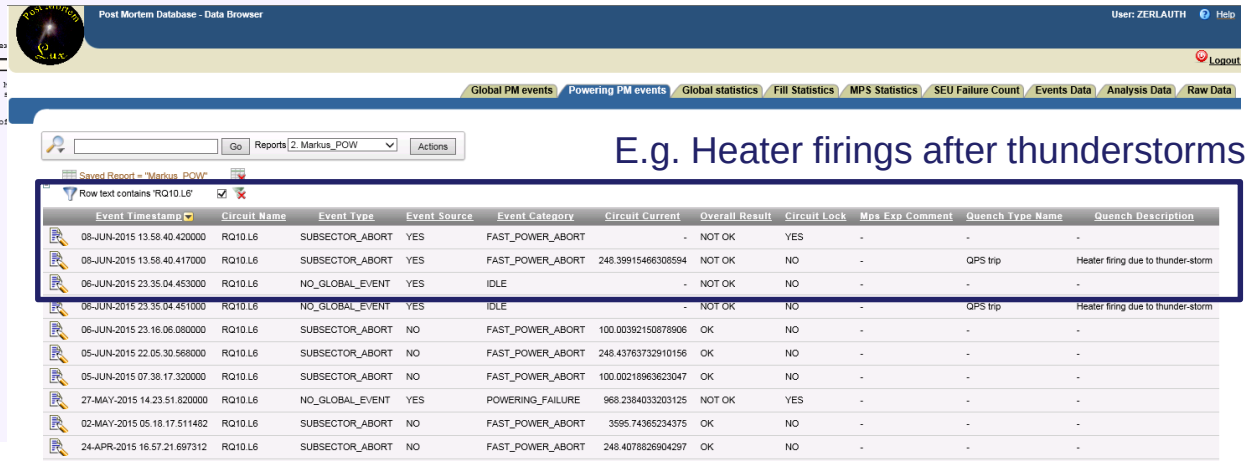
Changes during LS1

- BLM: data available for 1024 ms (vs 82 ms before LS1)
- Data acquisition
  - new library to support CMW-RDA3. Only internal changes and backward compatible API so far. Bigger upgrades to come end of the year.
- Storage:
  - no updates except following technology changes, e.g. from 32b to 64b architecture, and some bug fixes in the storage and its API.
- Analysis modules:
  - new Quench Heater Discharge Analysis module by Zinur, the rest of the modules were mostly kept the same, with some internal technology changes and/or optimization. Adaptation of energy extraction analysis modules by Arek for the 600A and 13kA circuits.

Automated Analysis of POWERING events

- Similar to Global (beam) Post Mortem, a PM_POWERING analysis server is continuously analysing events in the LHC magnet system
  - Automated event and source identification (global events)
  - 600A Energy Extraction + 13kA Energy extraction
  - 600A Quench Detection (trip identification,…)
  - Quench Heater Discharge Analysis
  - (MP3) logbook entries, automatic e-mails and PM Database (APEX)

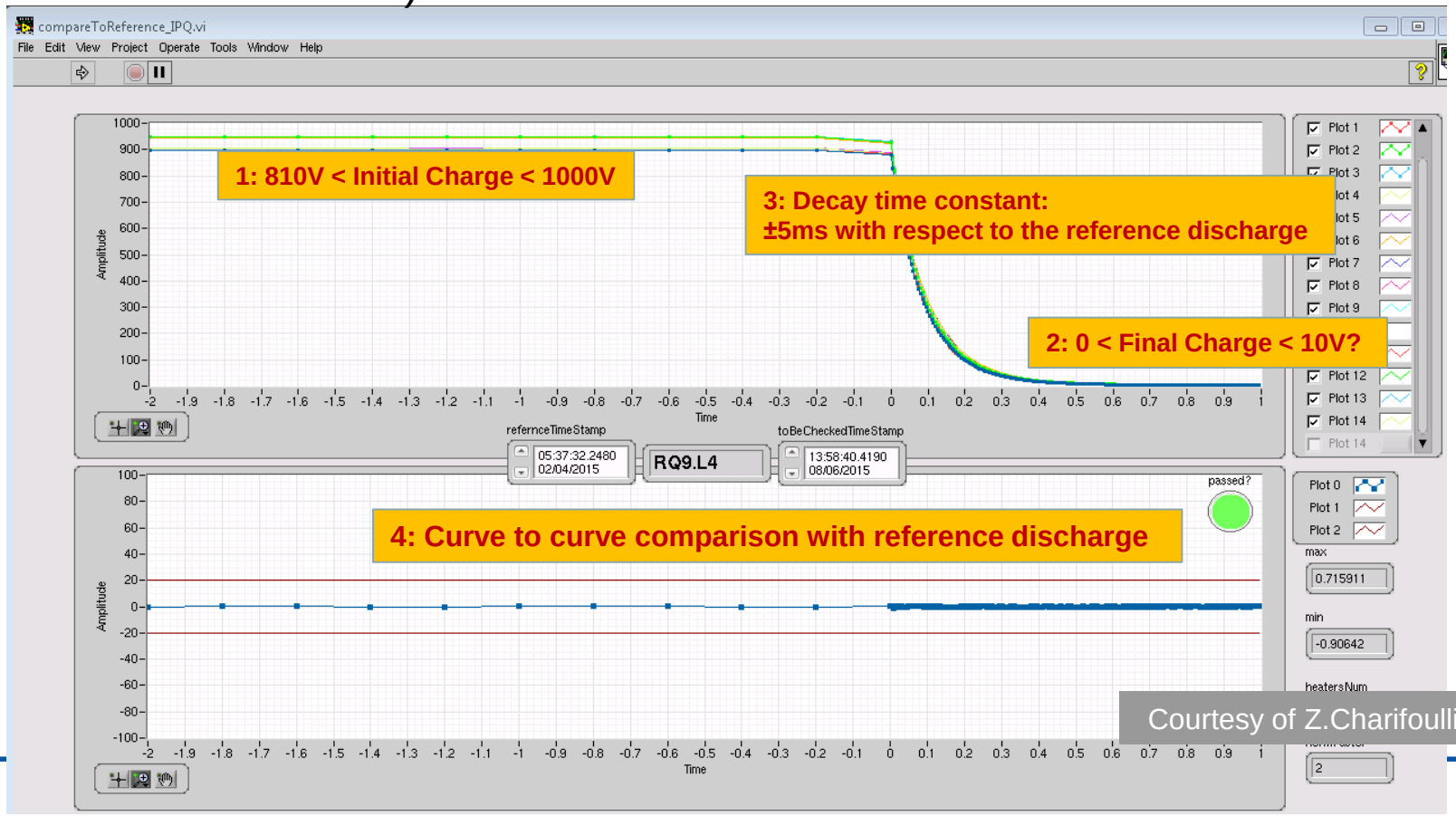




E.g. Heater firings after thunderstorms

IPD, IPQ and IT circuits: quench heater analysis automation

- Quench heater discharge analysis (MB, MQ, IPQ, IPD, IT) will be fully automated after TS1
- Must increase efforts to systematically screen more powering equipment during operation (refactoring/generalisation and inclusion of HWC modules)



Courtesy of Z.Charifoulline

Conclusions

- What is missing/nice to have?
  - dBLMs (Why? the only system for bunch-by-bunch loss detection – injection losses, dump losses, losses during scrubbing etc)
  - BPMS-IR6
  - Some data structures changed => time vector of the BCT_DC
  - Collimator time stamps (currently ~4 sec delay)
  - Review ***Event Classification:*** SINGLE_SYSTEM_DUMP vs MULTIPLE_SYSTEM_DUMP
  - Review protection dump classification in case of operator button use.
- Are we ready?
  - Essential systems are fully back in operation
  - Some modules still need to be revised