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## Session 3 - Beam diagnostics

- Bernd Dehning (session chair)
- Eva Barbara Holzer

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- Christos Zamantzas

*Hardware changes in BLM system during LS1*

- Eduardo Nebot Del Busto

*Beam losses and thresholds*

- Ralph Steinhagen

*Experiences with feedback systems and foreseen improvements for LS1*

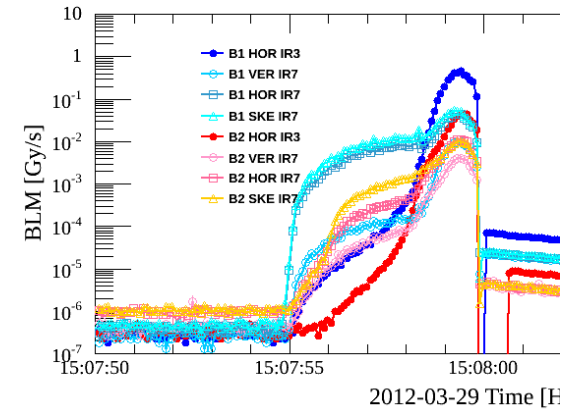
- Enrico Bravin

*Experiences with MPS related systems and foreseen improvements for LS1*

# BLM System

## ■ 2012:

- LIC detector: now fully qualified for operational use
- 12.5 Hz data for collimators; new capture data buffer (used by UFO Buster)
- Daily **automatic** analysis of the systems performance
  - Unavailability due to errors from optical link failures **increased**
  - Many **interventions** in the shadow before affecting LHC availability



## ■ Wish-list for Application improvements

- Internal Parameters application
- System Status application
- System Management application
- Monitor Factor application

# After LS1

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- All electronics will be modified mainly to reduce failures
  - Optical links
  - HV power supply
  - 'BLM Sanity checks'
- Most of the system **completely re-installed**
  - 2 out of 6 monitors relocated from MQ to MB interconnect to protect against quenches from UFO losses
    - ➔ FLUKA simulations for threshold determination
- **Quench tests 2013**
  - ➔ Potentially **change all cold magnet thresholds**
    - **Energy extrapolation** following the QP3/Note44 models
      - **How does an ad-hoc correction change with energy?**
    - New thresholds hopefully based on QP3 model
  - Threshold generation inside LSA database
    - Flexible, reliable, safe and **maintainable**
- **Complete re-commissioning (hardware, software and thresholds)!**

# Discussions

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- **‘sun glasses’**: injection-event triggered interlock-inhibit
  - 2 new crates: **identical system at start-up, possibility to change the firmware to inhibit the interlock at injection**
  - ➔ Identify monitors, use present redundancy to protect against different loss scenarios (→ presentation W. Bartmann)
    - Combinations: IC, LIC, filter, new inhibit functionality
  - ➔ Identify the necessary blind-out time
  - ➔ Determine reliability of the system after modification
  - ➔ Define trigger signal - rather quickly, might need additional work
- Proposal to continue the quench test working group: analysis of the quench tests and for definition of new thresholds
- Additional questions:
  - **Piquet**: Can the fault down-time be reduced by introducing a piquet service?
  - **Shift the dynamic range** of the BLMs upwards to higher loss rates? (Would imply loosing some resolution)
  - Eventually move HV interlock from SIS to hardware

# Experiences with Feedback Systems and foreseen Improvements for LS1

- no “direct” link to MPS but can create dangerous, combined failure modes
- Large system many devices & services involved
- Maximum drift rates of 40  $\mu\text{m/s}$   $\rightarrow$  (close to) limit of Orbit-FB at 4 TeV
- Pointed out that controller and service unit server failures increased as well as orbit and tune feedback related dumps in 2012
- Main issues of 2012 dumps with beam related to:
  - Beam measurement quality
  - Front-end/SW infrastructure problems: FESA, CMW, Timing & network
  - Insufficient loop stability margin due to data latencies

# Experiences with Feedback Systems and foreseen Improvements for LS1

- LS1 activities
  - Temperature controlled racks & new Diode-Orbit ACQ for the IR BPMs
  - Front-end/SW infrastructure nonconformities will be addressed in a review in June
  - Operate with actual and not approximate optics (particular during squeeze)
  - Better diagnostics and pre-warning, better GUI integration, particularly concerning the system overview
- Discussion concerning data transmission latencies:
  - Comments: upgrade to Gbit switch foreseen, prioritizing of single host possible, dedicated network not expensive

# Interlocked BPMs

- Note: the system always triggers when needed!
- 158 dumps in 2012/13 run
  - 1 setup, 120 injection, 3 flat top, 2 ramp, 3 adjust, 29 stable beams (of which 22 are in 2013, likely most during the ion run)

## LS1:

- Install filters near the BPMs to reduce the reflections (symmetric Gaussian filters)
  - => High Sensitivity mode: to be quantified, theoretically  $1E9$  to  $3E11$  possible
- Replace the two (fixed) threshold levels with a remotely programmable DAC
- Investigate improvements of the normalizer card
- Improve the diagnostic / post mortem analysis
- It is expected that the interlocked BPMs should not be a performance limit after LS1



# dl/dt

- Interlock system based on fast beam current transformers
- Two systems running in parallel in 2012 (same hardware different firmware)

## LS1:

- Production of 6 complete units, with reduced noise floor
- New fast beam current transformer: Out of 3 the best FBCT will be connected to the acquisition
- Control and acquisition software will be developed
- Questioned concerned the noise level and the implementation schedule (no measurements available for the second system, schedule to be defined)

# Abort Gap

- The AGM uses a photomultiplier and is integrated in the BSRT telescope
- For protons: sensitivity is better than 10% of quench level (for all Energies)
- The error on the measurement is of the order of 50%

## LS1:

- New mirror system to address the extraction mirror heating
- Consolidate the telescope hardware (new optical system)
- Consolidate the software
  - Automatic steering of the BSRT
  - Introduce internal checks, “self” calibration, robust saturation recovery and watch dogs in the AGM
  - A document describing the AGM software modifications is being finalized and will be circulated for approval
- System should become much more reliable and in particular self-diagnosing
- Questions concerned the connection to ADT and BIS (first YES, second NO)