



Beam Dumping System

MPP review 12/06/2015

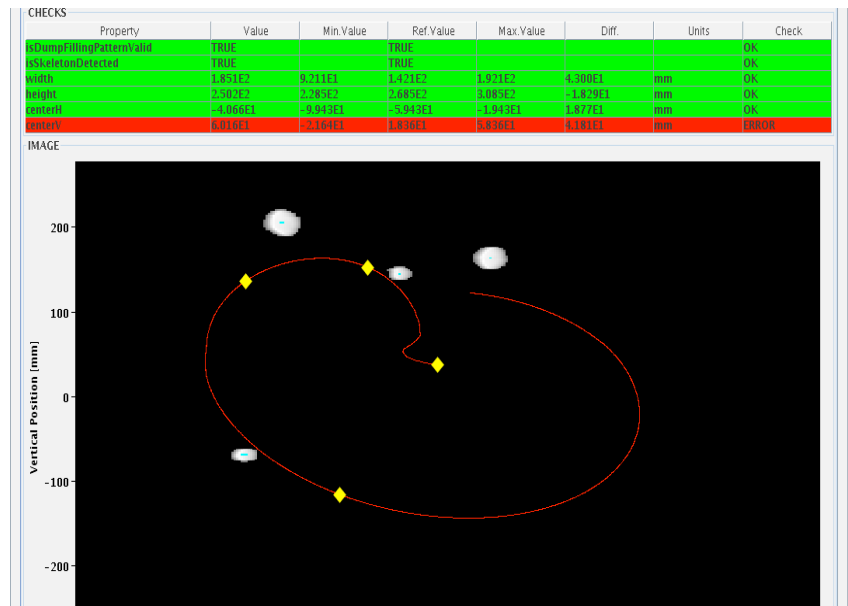
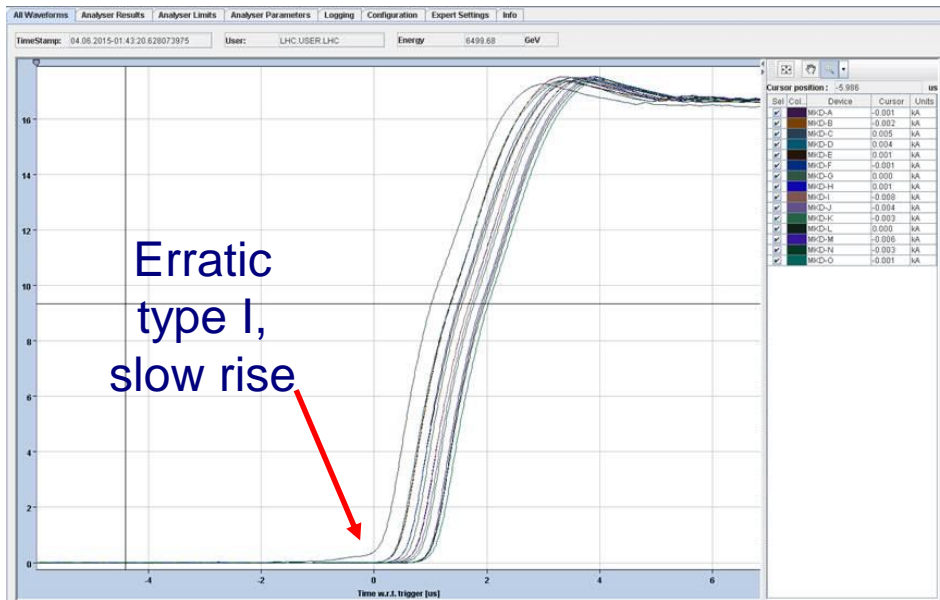
Jan Uythoven for the ABT team

Overview

- Erratics and other worries
 - MKD erratic
 - MKB erratics
- New after LS1
- Outstanding tests
 - What is left
 - When should they be done
- Are we ready?

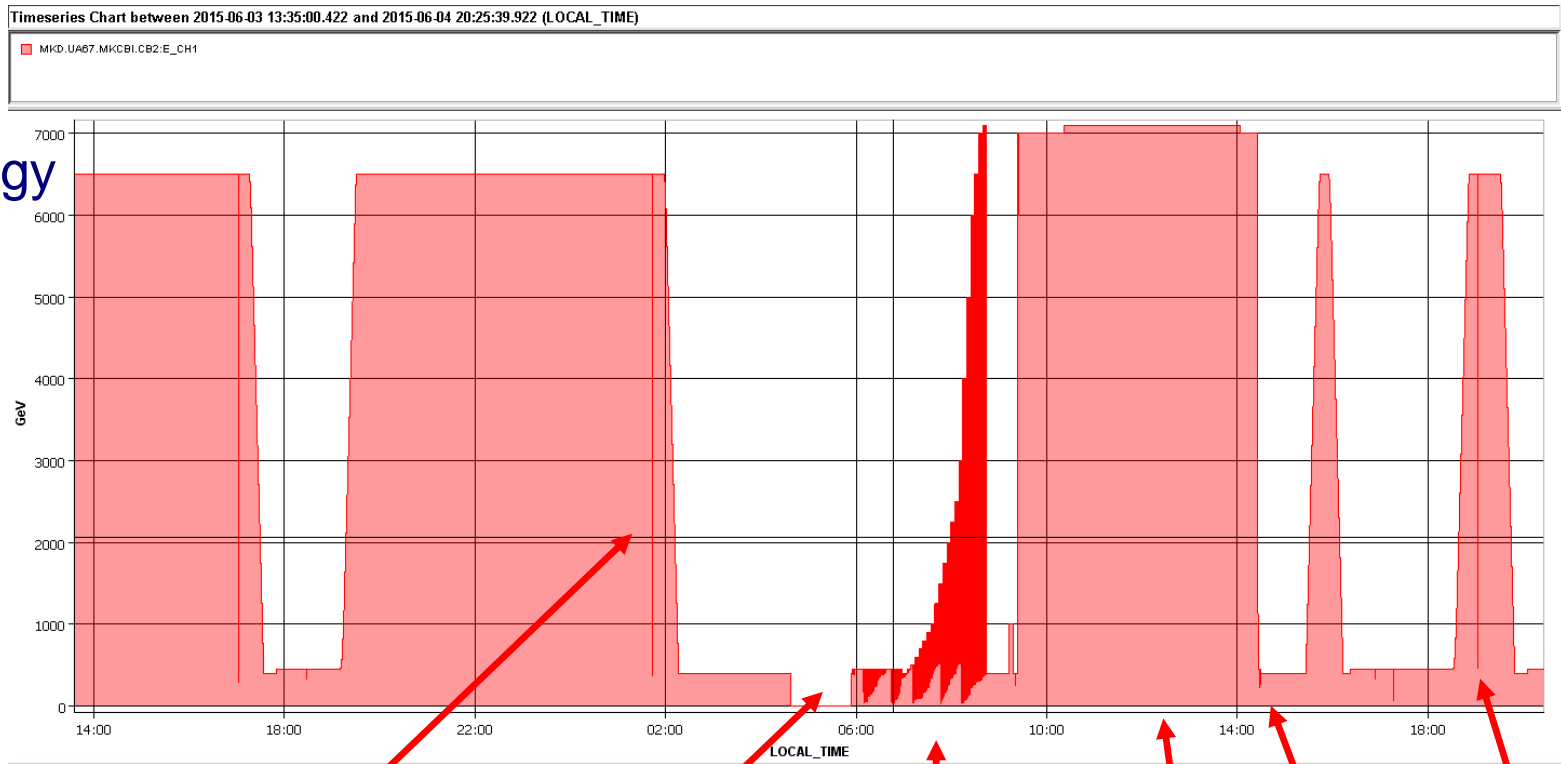
MKD Erratic

- One so far on 4/6/2015
 - The first asynchronous beam dump of the 3/year/beam announced
 - All detection and redundancy worked correctly
 - 400 ns needed to re-trigger the adjacent generators
- Replaced switch and tests following procedures
 - If tests would not have been successful → replacement of MKD generator
- No beam in the abort gap → no beam losses



No beam in the gap

MKD erratic: the Sequence



01:43
Erratic MKD

Switch Exchange

Energy Scan →
new XPOC limits

4 h @ 7.1 TeV

14:15
Back in remote

19:03 Test
dump with
1 bunch at
6.5 TeV

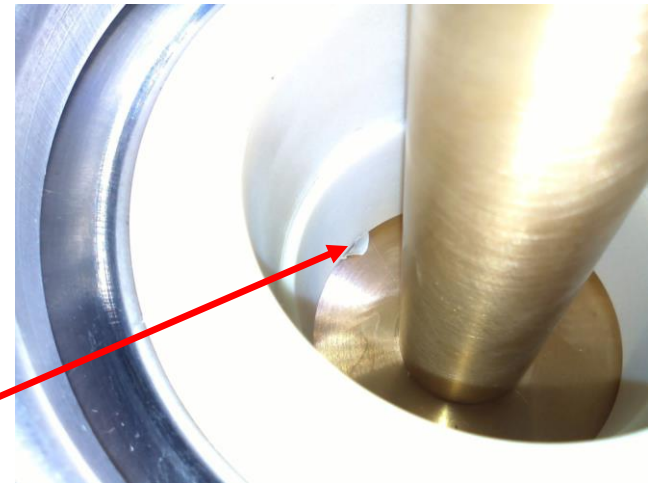
MKD Erratic: Remaining Issues

- MKD switch dismounted in the lab. Found space between insulators not completely filled with silicon grease – non conformity during mounting
- This time lucky as no beam in the abort gap (and little beam in the machine)
- Reference losses on the TCDS and TCDQ have been measured and to be repeated in case of serious losses during an asynchronous beam dump
 - Check on integrity of absorber blocks etc.
 - Results of reference measurements to be written down and made easily accessible so checks can also be made in case of absence of experts
- Simulations with FLUKA / ANSYS of absorbers for “new” Type 2 erratic, also for BCMS beams (collaboration collimation team)

MKB Erratics: 3x, 1 exchange

- Lead to a synchronous beam dump
 - No risk of quenching magnets etc...
- 26/04/15 08:23:04.594
 - LBDS dilution kicker MKBH erratic trigger at 6.5 TeV
 - Caused synchronous beam dump, as it should
- 27/04/15 09:00:31.239
 - Second erratic on the same MKBH kicker magnet at 6.5 TeV
 - Also synchronous dump
- 27/04/15 11:39
 - LHC stopped for MKBH switch replacement
 - 18:10 access finished
- 28/04/15 01:41
 - System operational again
- 31/05/15 00:56:36
 - Erratic on replaced MKB switch

inspection shows piece of glove from previous switch replacement



MKB in XPOC

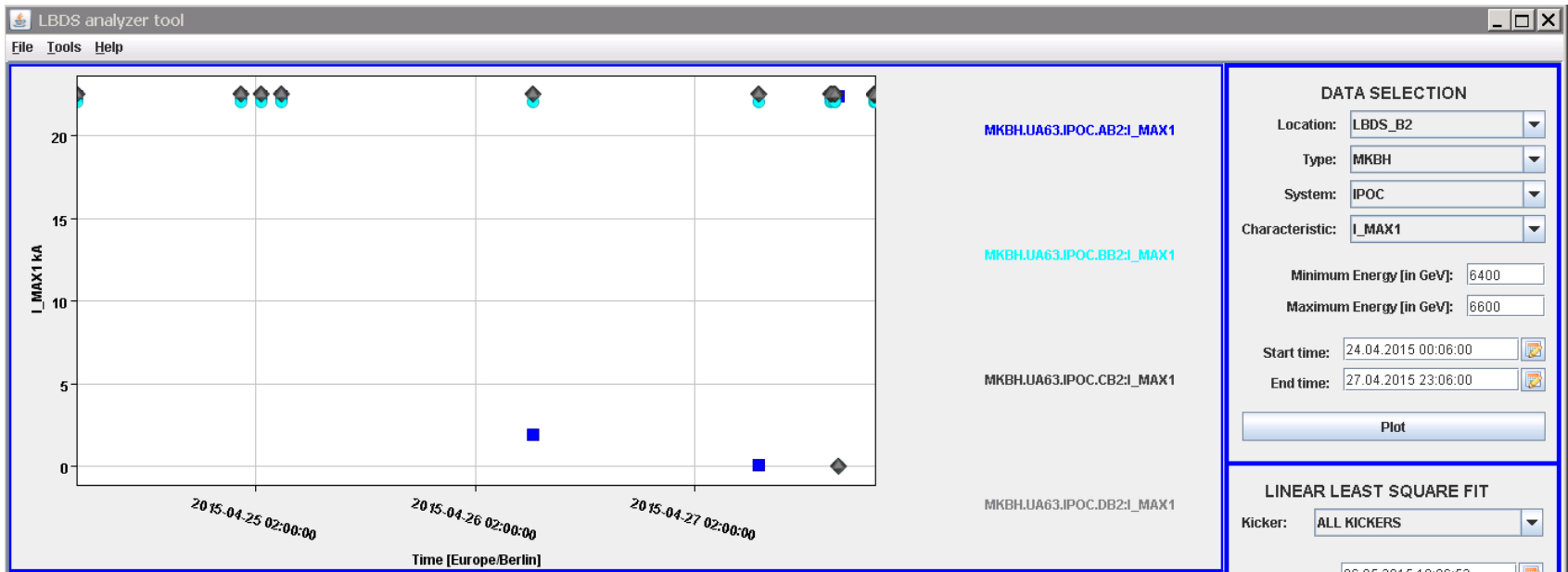


Nominal trigger time

The amplitudes of all other MKB magnets are within XPOC limits: dilution close to nominal

Small amplitude

- Dump actually triggered by BETS surveillance of MKB.
- Slow reaction time of order of 1 ms, resulting in small amplitude of MKB where erratic took place
 - So limited impact when in anti-phase with another MKB



Procedure switch replacement

■ Procedure

- If two MKB erratics < 4 weeks: exchange the switch
 - For extraction kicker MKD this is after one single erratic, as for the MKD this is an asynchronous dump
- Controls tests
- HV tests
- Energy scan (check XPOC, IPOC limits, energy tracking etc.)
- Run at 7.1 TeV for 4 hours in local
 - If this would not have been successful, then complete generator would have been changed.

■ Diagnostics of the switch

- Noticed in the tunnel that switch was rather dirty: dust etc. Like noticed for the MKD switches → will be cleaned during TS1
- Back in the laboratory switch HV tested, initially very high spark rate, conditioned away to normal rate
- Dismounted in the lab, nothing abnormal found

Conclusions on MKD & MKB switch erratics

- All protection / re-triggering worked as expected
- The number is still acceptable
- In 2 out of 3 cases the erratic was related to non conformities of the installed switches
 - Working on detailed procedures for installation but not completely finished
 - Should include checklist to be ticked off and signed
 - Upgrade of MKD switches foreseen for LS2 to make the installation less critical (reduce max electrical fields), to be presented in TE-TM in the coming weeks. Possibly tests of few of them in the machine before LS2.
- The procedures for switch replacement seems to be effective and was followed twice
 - Now this procedure to be put in edms, to make it official
- Reference losses TCDS and TCDQ also to be officially written down so can be done by non-specialists
- This TS1:
 - Clean the MKB switches (without demounting)
 - Endoscope inspection of the most critical MKD switches which had marks on the insulators. Third inspection of same switches to check on any changes

New Run 2

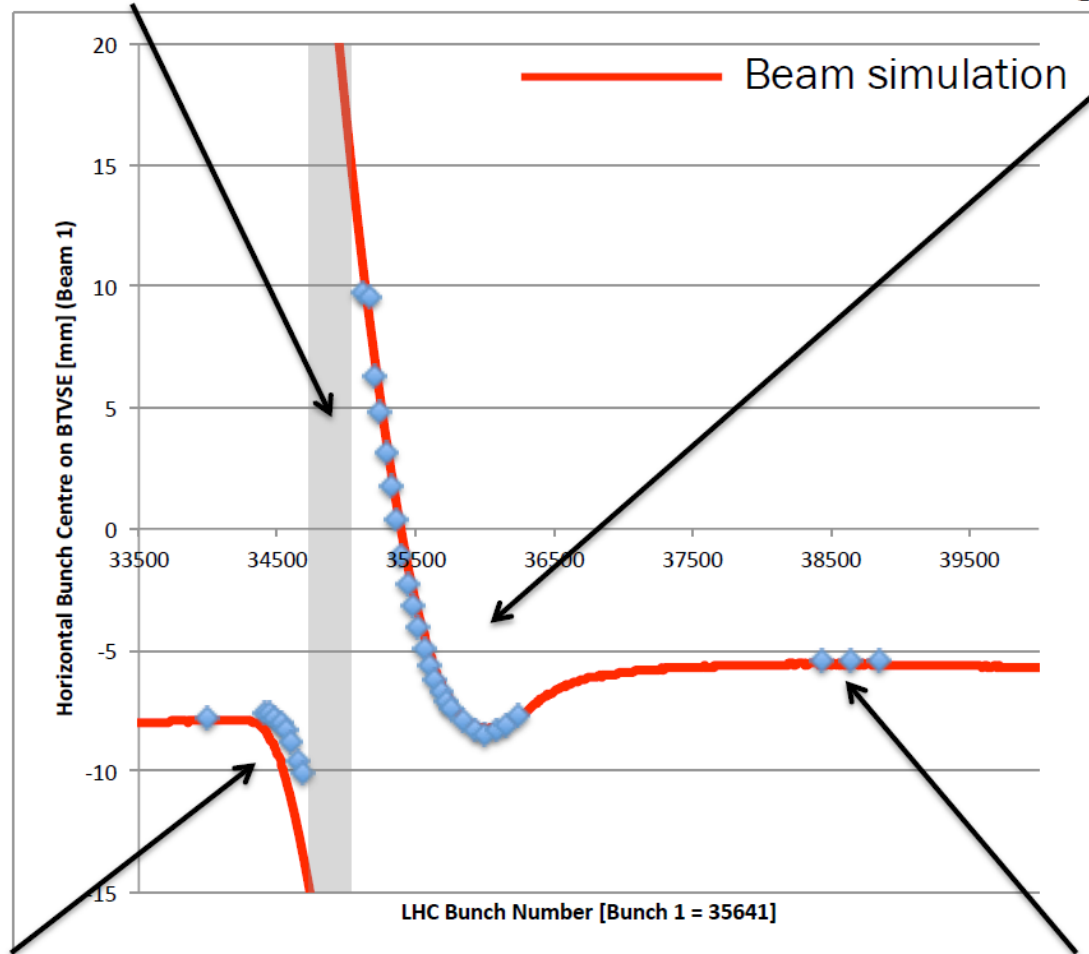
- (BETS) TCDQ
 - New and longer TCDQ well aligned and set-up
 - BETS on TCDQ new for Run 2
 - Problems with arming / interlocking during commissioning when TCDQ functions were not used / available
 - Arming sequence modified
 - Given reset rights to OP
 - Justified as the interlocking is on an actual position (compared to XPOC where the system has to work on command)
- CIBDS – see later
- MKD waveform measured for the first time, looks good !

MKD waveform measurement @ 450 GeV

Matthew Fraser

Either lost on TCDQ or misses BTV area:

Top of MKD rise: single kick to TD68.



Start of MKD rise: seen after one extra turn in the LHC.

MKD 100% level

MKD waveform measurement

For the rise-time:

a. Beam 1 we measure roughly:

$$0 \% \text{ to } 100 \% = (35592 - 34441)/10 \text{ bunches} = 115.1 * 25 \text{ ns} = 2.88 \mu\text{s}$$

(0% : nearest bunch where we detect a change in screen position. The rise-time can be defined as desired but here it's difficult to get an absolute magnitude of the kick, no voltage calibration possible)

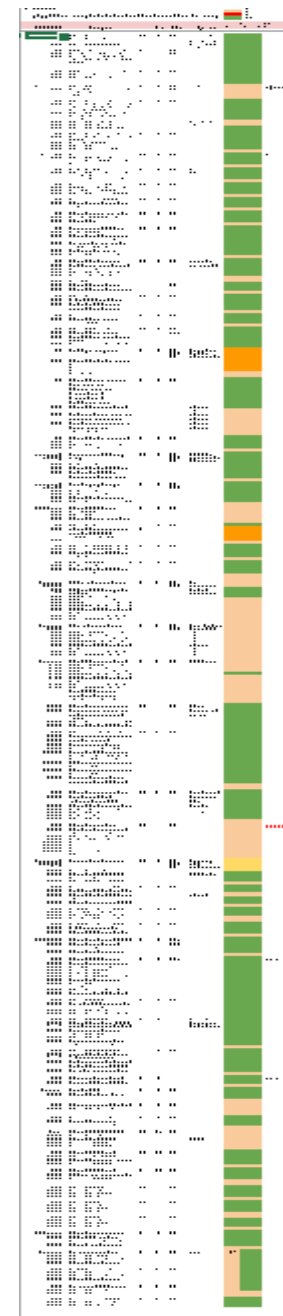
b. Beam 2 we measure roughly:

$$0 \% \text{ to } 100 \% = (35650 - 34441)/10 \text{ bunches} = 120.9 * 25 \text{ ns} = 3.02 \mu\text{s}$$

Abort gap is 3.0 μs , MKD waveform should be 2.8 μs rise time (definition) and 200 ns margin for timing and synchronisation. Seems rather good.

Outstanding Machine Protection Items

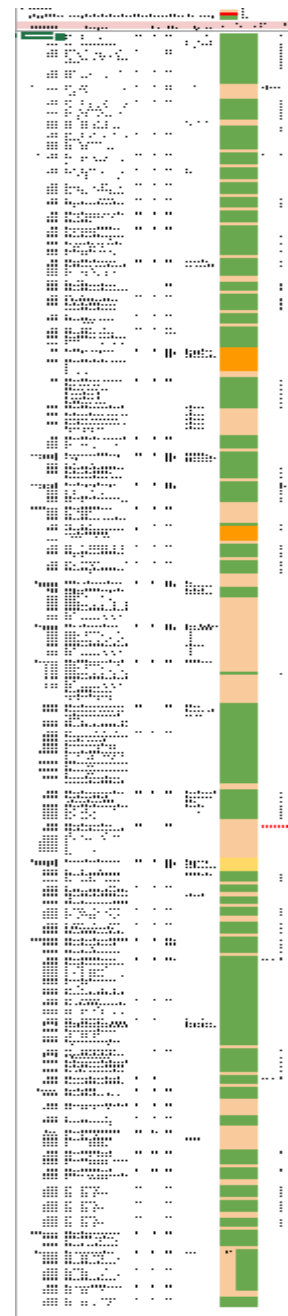
- UPS / powering failures checks B1 not done
 - Foreseen to be done in TS1 (modified test as cannot arm)
- Redundant PSU surveillance by SIS to be checked
- Direct BLM into LBDS to be tested with beam
 - Should be done soon after TS1
 - Check with BI group for step-by-step procedures
- Procedures in case of non-working beam dump (edms #1166480)
 - To be checked if they are still valid on paper
 - To be tried out with pilot beam
- Interlock on integrated corrector settings (energy) and Δf_{rf}
- Filling pattern still manually edited → problem XPOC
- Some XPOC modules can be reset by OP and shouldn't
- Abort gap cleaning at 6.5 TeV remains to be commissioned
- BSRA about working but not always ...
 - Automatic abort gap cleaning via SIS to be commissioned
- Interlocked BPMS non-conformities (see presentation Thibaut)



CIBDS

- New link between BIS and LBDS not using the TSU
- Seems to be working correctly
- However, automatic check at every XPOC remains to be deployed

MPS check filled in, basically OK.
Should adapt some of the tests to
actual situation



Conclusions – Are we Ready ?

- I think YES
- No system faults or unexpected malfunction detected
- Erratics are the main worry, but still within expectation and are not dangerous for the machine as such
 - High rate was expected from reliability run with new top energy: reliability run was EXTREMELY useful
 - Some checks on MKB and MKD generators foreseen in TS1
 - LS2 upgrade of MKD generators being worked on
- Some tests and developments are outstanding, minor none conformities to be fixed
 - Should have priority during the intensity ramp up in the coming weeks, so they can be closed before the summer holidays