Beam dump commissioning

Reporting on the work of many people who were involved, in particular:

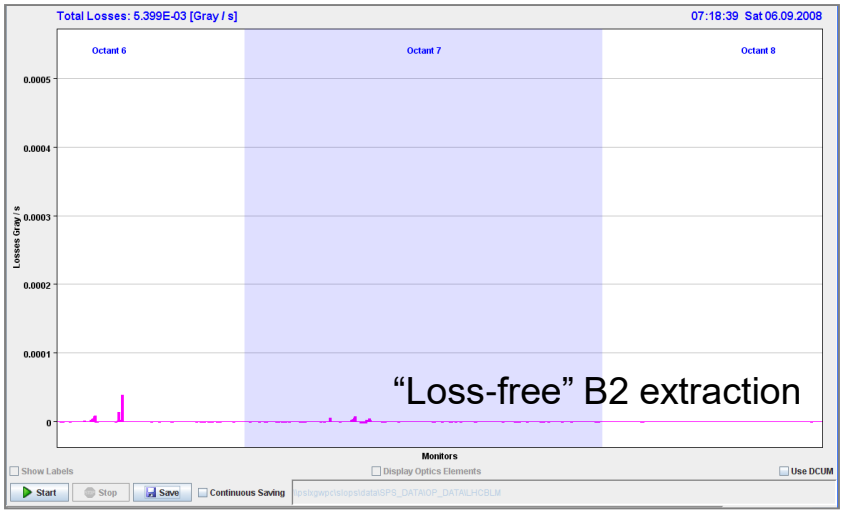
Etienne + team, Jan, Jörg , Ilya, Lars,
Laurent + team, Malika, Thomas, Verena

Dumps – what was done

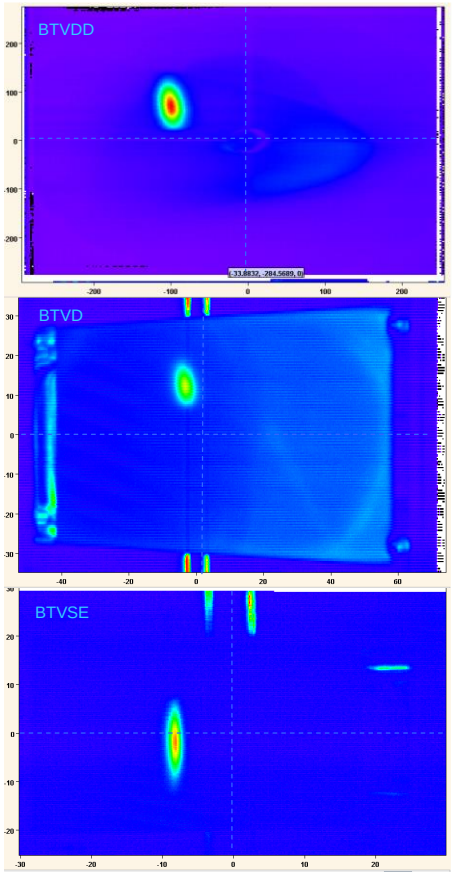
	Beam 1 (TD/UD68)	Beam 2 (TD/UD62)
Inject and dump setup	OK	OK
Circulate and dump setup	To do	OK
Dump region aperture	To do	Started (some phases)
Detailed kicker synchronisation	To do	To do
Extraction element strengths	Started (corrected MSD)	Started (corrected MSD)
Beam instrumentation checks	Started	Started
Interlocks (BPMSA, TCDQ, …)	To do	To do
Sweep waveform measurement	To do	To do (parasitic looks OK)
Dump protection systems setup	To do	To do
PM and XPOC	Started	Started
Tracking tests	Started	Started
Abort gap keeper	Started	Started

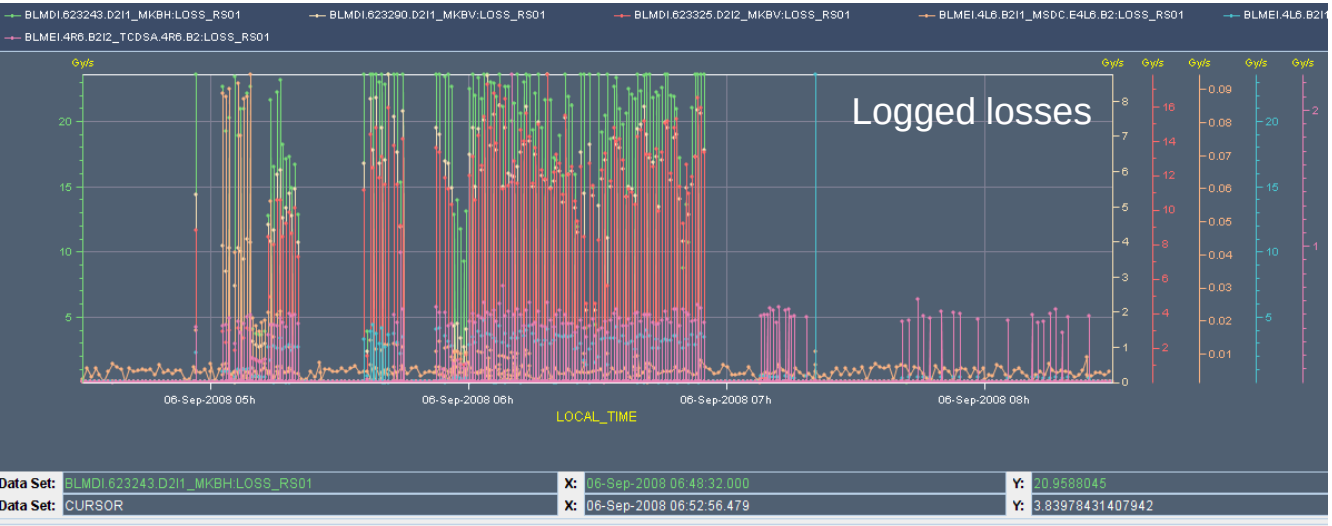
Extraction and dump BI

- No major problems seen – BLMs, BTVs working straight away
  - No time for systematic checks (some analysis from Rhod & lars)
  - BCT performance with kicker noise to be looked at



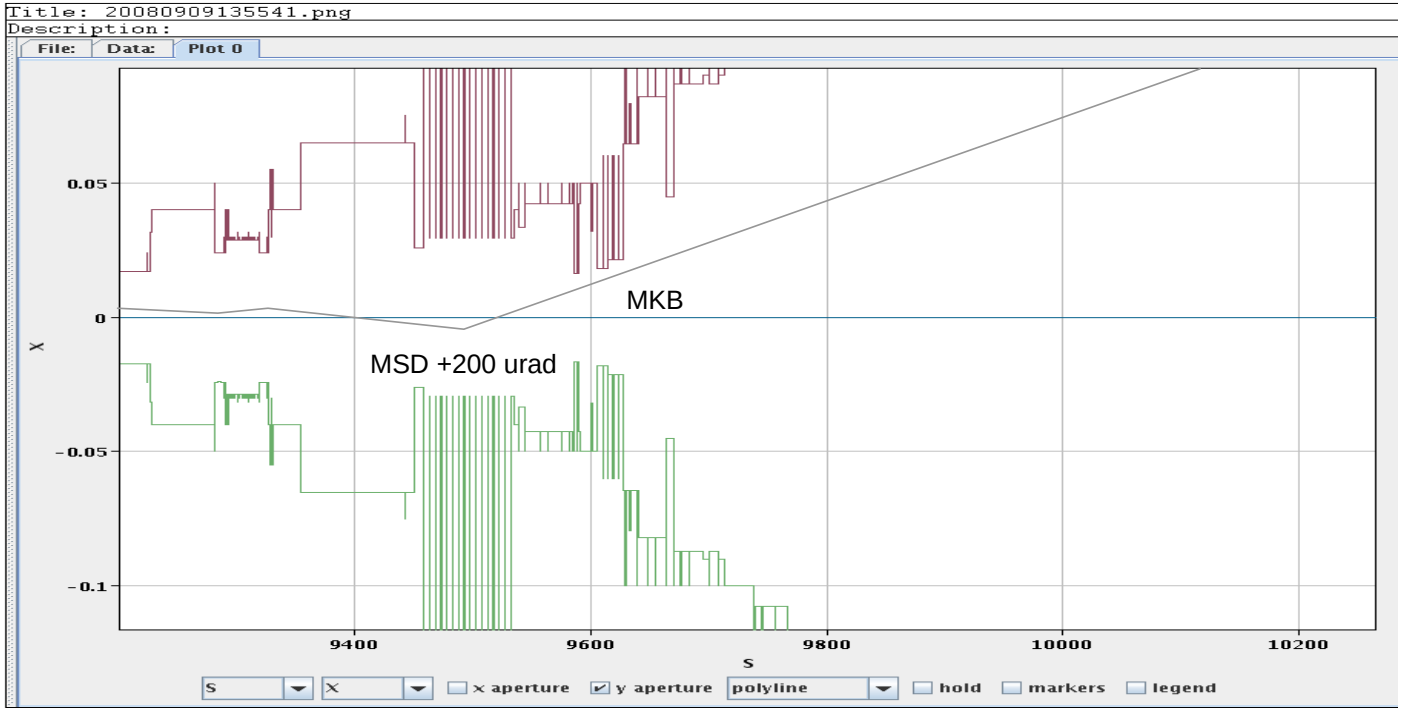
Dump BTVs





Strengths and setttings

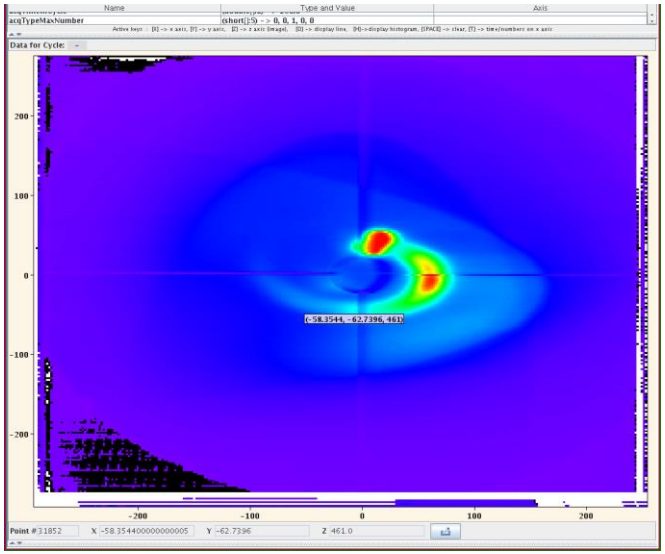
- In sector test #3 quickly found 200 urad error in MSD strength
  - V. trajectory from BTVs, losses at MKB
  - Corrected for 10/09 and then looked good (beam ~centred in MKB)
  - HW update of BETS tracking tables was made



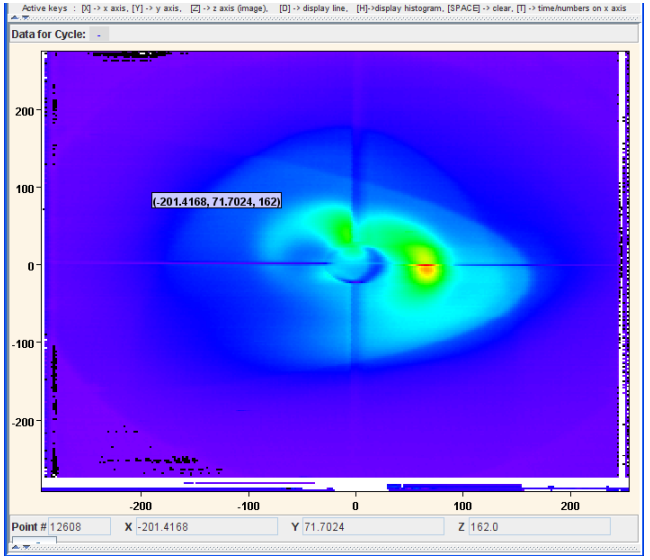
Kickers

- No problems seen so far
- MKD strength looks OK
  - Will need to sort out orbit before detailed checks
- MKB sweep has been seen on BTVDD already
  - Debunched beam extracted in a few cases
  - Sweep checked vs XPOC – agrees well

Inject, inject and dump mode

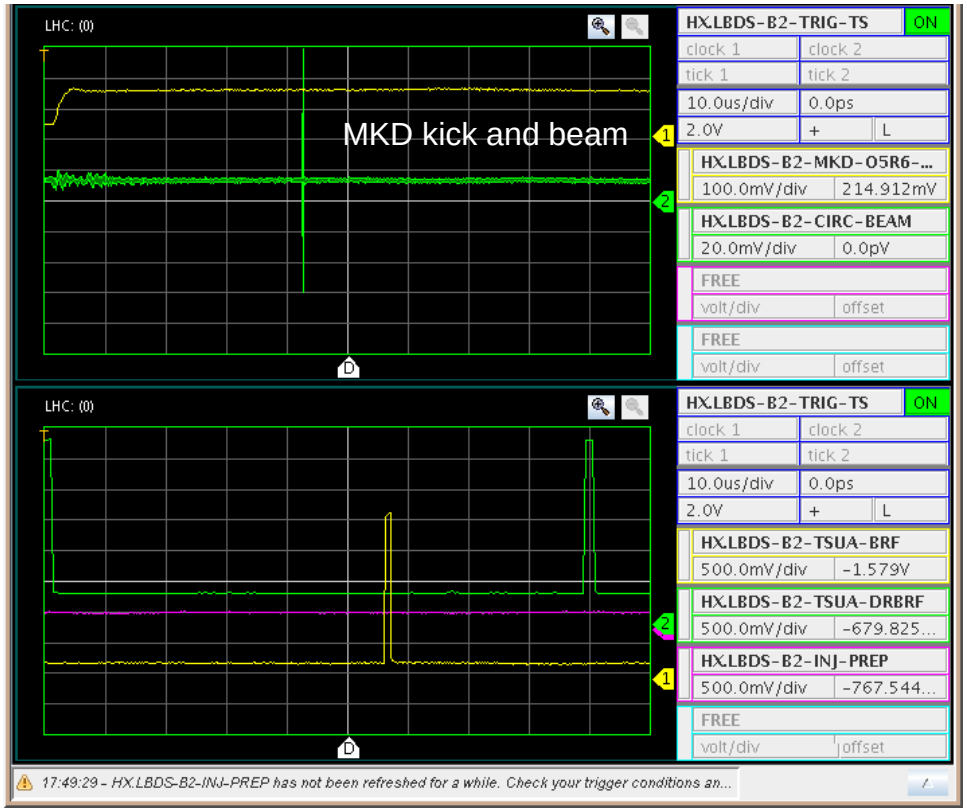


Dump with RF off



Sequencing and synchronisation

- Dump sequences well-sorted out
  - Arming, Inject and dump, circulate and dump
- “Inject and dump” and “circulate and dump” modes work OK
  - Did not check “C&D” for B1
  - Need to speed up to get every injection…Verena & Etienne updating
- Beam is kicked out OK
  - Detailed synchronisation between kick and bunch 1 not done



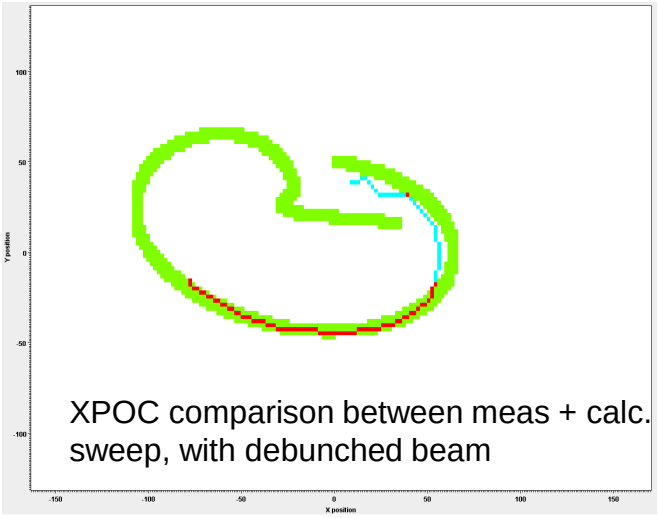
Aperture for extracted beam

- Still very preliminary
  - Trajectory through 6 not centered
  - Only a few phases could be scanned in short time available
  - Large steps of 2-3 sigma each time
- Vertically
  - so far looks fine through MSDs, and centred in MKBs
- Horizontally
  - limited by Q4 aperture
  - TCDS to MSDCA apertures offset but probably due to trajectory

	horizontal				vertical			
	positiv phase		negative phase		positive phase		negative phase	
phases	+ sigma	loss location	- sigma	loss location	+ sigma	loss location	- sigma	loss location
0	11	Q4	5	Q5&TCDS	11	Q4		
30	12	Q4	5	TCDSA				
60	12	TCDSA						
90	15	TCDSA	12	MSDC	15	MKBH	15	MKBH

XPOC system

- Looked good for kickers (operational now for ~10 months)
  - Confirmed several faults seen by IPOC
  - Found several problems missed by IPOC (history trending and different analysis)
- Other non-beam systems included like TDE pressure
- Beam based systems were being slowly commissioned
  - Still working on dynamic config with filling pattern
  - BTVDD trace analysis looks good
- Still weakness in sequencing and state machine
  - “solution” to call Bren/Jan for any XPOC failure not sustainable



XPOC comparison between meas + calc. sweep, with debunched beam

Interlocks status I

Test Group	Test Title	Action	Status
1. MKD & MKB Tests	Signal acquisition system	MKD Waveform	Done
	Signal acquisition system	MKB Waveform	Done
	Signal acquisition system	IPOCs	Done
	MKD generator temperature	NOT POSSIBLE AT PRESENT	To do
	MKD generator temperature interlock		Done
2. Links to injection system	Injection inhibit during arming		Done
	Abort gap keeper		Done
3. LBDS arming	Local/remote	Interlock when in LOCAL	Done
	Arming with BPL	Arming sequence OK	Done
		No arming if beam permit=false	Done
		No arming if IPOC/XPOC=false	Done
4. Timing system	Timing distribution for dump	Dump events and PM events	Done
5. Beam energy tracking	Calibration tables checks	MCS checks	Done
	BETS interlocks	RB out of tolerance	Partly done
		MSD out of tolerance	Done
		Q4 out of tolerance	Done
	Calibration tables update procedure		Partly done
	Orbit corrector interlock / SIS	Check tol <0.2% @ 450 GeV	Partly done
		Check tol <0.2% @ 7000 GeV	Partly done
6. Power converters	MSD FMCM		Done
	Current surveillance MSD/Q4		Partly done
7. Synchronization	Interlock on RF frequency absence		Done
	RF frequency interlock Df > 240 Hz		Done
	PLL locking of LBDS with frequency ramps		Done
	RF frequency trims & PLL lock		Done
	Power/UPS cut tests		Done

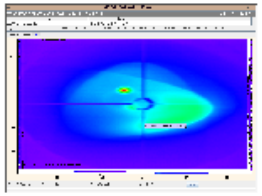
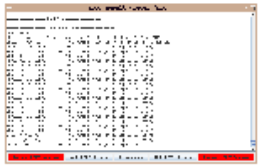
Interlock status II

8. BIS connection	Beam permit state change	Trigger and delays	Done
	BPL linking		Done
	BIS to test mode	Dump trigger	Done
	BIS failures	NOT POSSIBLE AT PRESENT	To do
9. TCDQ	Synchronized TCQD movement		Done
	TCDQ trim interlock	MCS check of trim	Partly done
	TCDQ energy interlock function	NOT POSSIBLE AT PRESENT	To do
	Power cut test	NOT POSSIBLE AT PRESENT	To do
10. Vacuum system	Vacuum interlock TPG		Done
	MKB vacuum interlock		Done
	Valve interlocks		Done
11. Beam instrumentation	BTV acquisitions		Done
	BTV BIS interlock		Done
	BTV SIS interlock		Done
	BTV movement inhibit	NOT POSSIBLE AT PRESENT	To do
	BTV calibrations		Done
	BPMD acquisition		Done
	BPM BIS interlock		To do
	BPM SIS interlock	To sort out with JW	To do
	BLM acqusition		Done
	BCT acquisition		Done
	BPMSA acq		To do
12. XPOC	XPOC server		Done
	XPOC results	Check at various energies	Done
	XPOC inject and dump		Done
13. Access system	LAS connection and "DSO" test		Done
	LAS/BIS/LBDS sequence		Done

Interlocks – for 2009

- Organisation of interlock testing
  - Done piecemeal by Etienne, Jorg, Verena, Brennan
  - Coordinate this better next time – or same again?
- Documentation
  - Was not fantastic
  - 2009 - make a specific page in the logbook (MP, BT, OP?) to record the LBDS interlock test results
  - Everyone use it for recording pre-beam and beam-interlock tests
- Test organisation
  - Will be even more difficult that 2008
  - Coordination with checkout crucial
  - Still no real method of how to enforce checks before beam conditions change – how will OP drive this?

Emergency dump “chain”

40	22:45	We kept the same BEAM for more then 10 minutes. Then, first emergency dump. Caused by the loss of RD circuits 81. Dump correctly executed.  20080911224733.png  20080911225142.png Created by lhcop from CWO-CCC-D3LS

First “Emergency Dump” on Thurs 11th at 22:45:08

- Timestamping had to be improved slightly in logging
- Otherwise looked fine in terms of diagnostics
- Work needed from beam PM to make easy interface and analysis (together with XPOC)

Fault statistics

- Over past 12 months have accumulated several faults:
  - Switch wafers failed in short-circuit (safe – would give synchro dump)
    - Temperature stabilisation will help
    - Long-term upgrade being studied
  - Power triggers failed (safe – would lose redundancy)
    - Under-dimensioned PT component found – being replaced
  - Power-trigger to switch connections (contacts)
    - Initial failures repaired, but seen again – investigating
  - Bad contacts of trigger cables between chassis
    - Discovered by XPOC
    - Improve testing procedure for 2009?
- No asynchronous dumps so far
- Checking cable-magnet power connection & magnets (sampling - preventive maintenance)
- Full statistics will be collated and published before 2009 run
  - Faults, number of operations, hours, comparison with expectations, …

Dumps: summary

- Basic functionality demonstrated for B1 and B2
  - Synchronisation, kickers, septum, BI, beam on TDE
- Systematic checks with beam only just started:
  - Aperture with extracted beam
  - Detailed synchronisation
  - Settings and strengths
  - MKB sweep measurement
  - Beam related interlocks (BPSA, TCDQ, BLMs, …)
  - Full BI checks
  - PM and XPOC systems
  - Setting-up and validation of dump protection systems
  - Commissioning of abort-gap keeper
- Some issues in organisation/bookkeeping
  - “Connected” phase between checkout and beam operation
  - Use dedicated logbook for interlock tests follow-up
  - Fault stats to publish while still interesting
  - Audit follow-up to organise…