Injection of nominal bunch into empty LHC

MPP meeting of 22 April 2016

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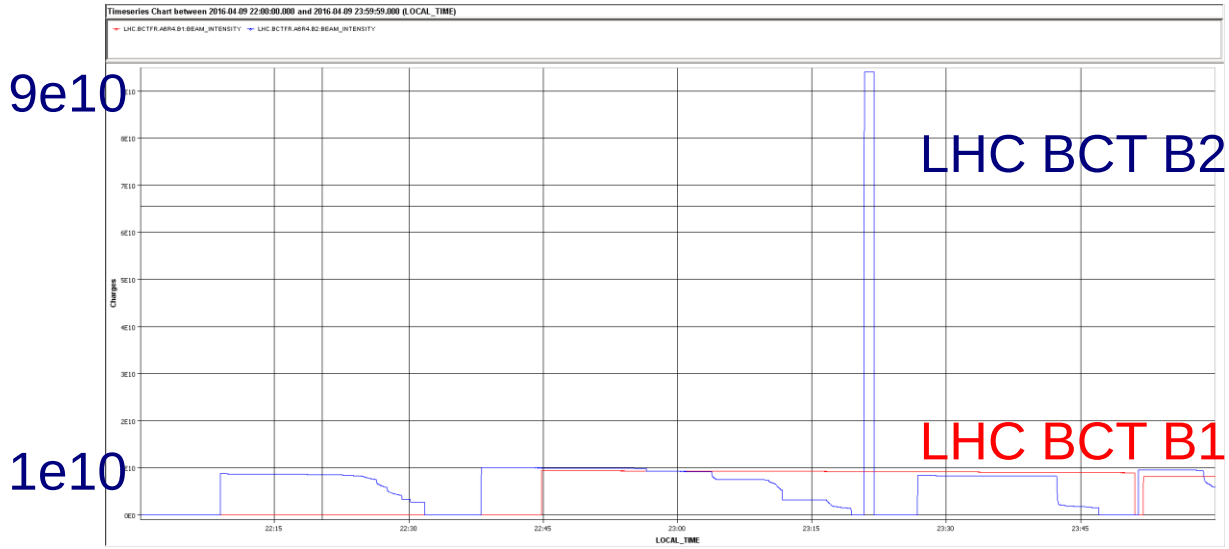
Saturday 9 April 2016 a 23:20:47 an indiv bunch is injected into an empty LHC

- Normally one should always first inject a probe beam, followed by an indiv bunch, followed by higher total intensity trains



- Nothing noted in the logbook, but the OP crew caught it
- Normally the SPS extraction BIC should protect us from this, taking into account the SPS Safe Machine Parameter system (SMP) Probe Beam Flag (PBM) and Setup Beam Flag (SBF) which are derived from the SPS BCT

SPS BCT Investigations

BA4·(high·gain·—·low·intensity)¶

Parameters

Name	Value
acqDesc	Not sure what to add in here ..
acqMsg	Data for device: SPS.BCTDC.41435
acqStamp	1460236847605238275
acqState	1
acqTime	2016/04/09 23:20:27.552056
beamID	0
cycleName	SPS.USER.LHCINDIV
cycleStamp	1460236826535000000
cycleTime	2016/04/09 23:20:27.552056
deviceName	SPS.BCTDC.41435
dumpCycleTime	20033
dumpInt	0.0
measStamp_unit	4
measStamp_unitExponent	-3.0
nbOfMeas	2005
observables	2
propType	2
samplingTime	10
sbfCycleTime	19536
sbfIntensity	0.0
slowExtInt	0.0
superCycleNb	53
totalIntensity_unit	7
totalIntensity_unitExponent	8.0

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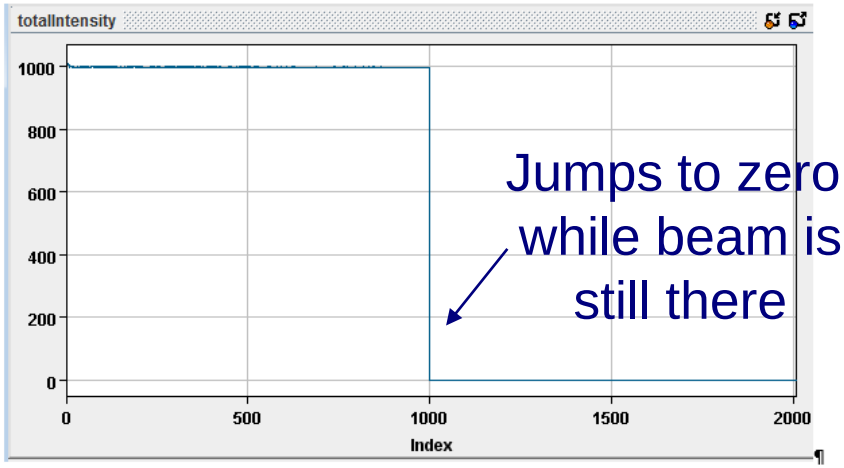

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10msec·between·samples¶

BA3·(low·gain·—·high·intensity)¶

Parameters

Name	Value
acqDesc	Not sure what to add in here ..
acqMsg	Data for device: SPS.BCTDC.31832
acqStamp	1460236847605238275
acqState	1
acqTime	2016/04/09 23:20:27.552118
beamID	0
cycleName	SPS.USER.LHCINDIV
cycleStamp	1460236826535000000
cycleTime	2016/04/09 23:20:27.552118
deviceName	SPS.BCTDC.31832
dumpCycleTime	20034
dumpInt	7.9500003
measStamp_unit	4
measStamp_unitExponent	-3.0
nbOfMeas	2005
observables	2
propType	2
samplingTime	10
sbfCycleTime	19536
sbfIntensity	7.9500003
slowExtInt	0.0
superCycleNb	53
totalIntensity_unit	7
totalIntensity_unitExponent	10.0

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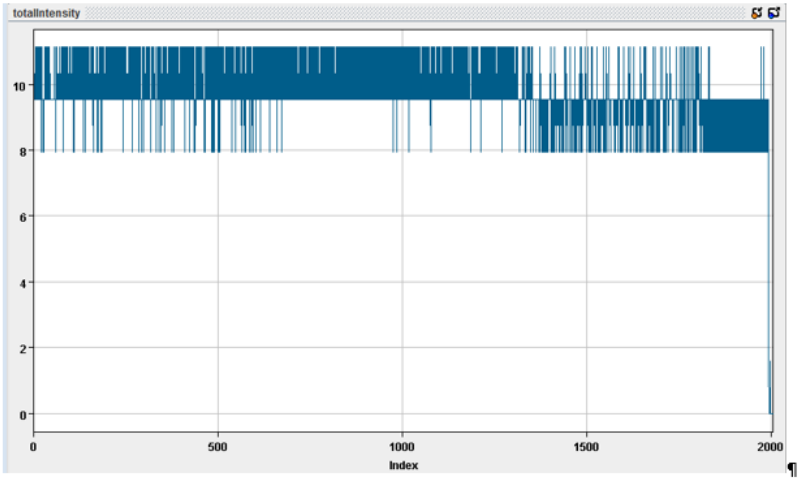

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10msec·between·samples¶

New development BCT in BA5

BA5·(all·intensity·ranges)¶

Name	Value
acqDesc	
acqMsg	Data for device: SPS.BCTDC.51895
acqStamp	1460236847706000000
acqState	1
acqTime	
cycleName	SPS.USER.LHCINDIV
cycleStamp	1460236826535000000
cycleTime	
measStamp_unit	4
measStamp_unitExponent	-3.0
nbOfAdcData	4192
nbOfMeas	4012
samplingTime	5
sbfCycleTime	19535
sbfIntensity	9.45258
selectedRange	3
superCycleNb	53
totalIntensity_unit	7
totalIntensity_unitExponent	10.0
vmodStatus	-1

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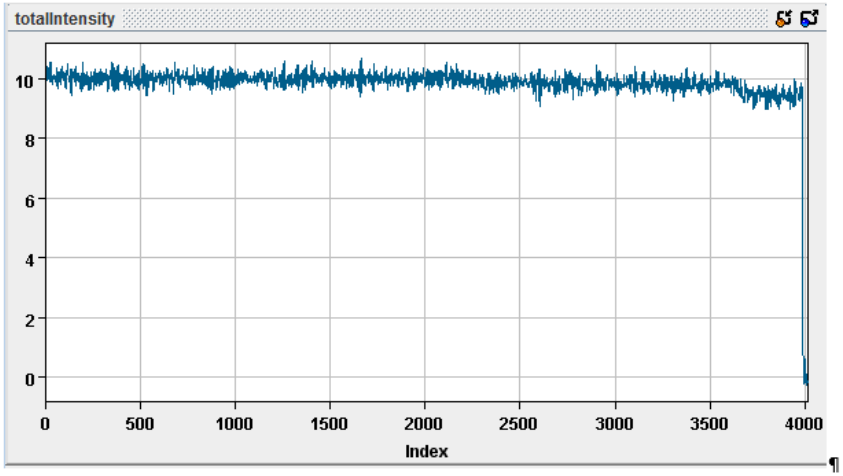

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5msec·between·samples¶

Action following ad-hoc meeting

1. On the BCT side, in BA3 and BA4:
   - All ADC hardware memory locations are reset to 0x0 before the 1st beam injection
   - During the SMP RT action, 10 ADC values are read from the hardware
   - If all 10 values are 0x0 then we consider that the acquisition has not started correctly -> unsafe
   - The value 0x7FFF is sent from BA4 (~= 3.278E12 charges) and BA3 (3.28e14 charges) on the SPS-SMP cable and stored to the sbfIntensity acquisition field → used to calculate the PBF and SBF of the SPS
2. Add check in IQC on the correctness of the SPS BCT4 buffer published. (Mirko as responsible contacted)
3. Check that the SPS SBF limit is set to 5e11 p+
   - Done 19th April evening by scraping the beam by scraping the beam, the limit was found to be 5.2e11 p+: OK

Longer Term Actions

- Evaluate the new IQC module to see how often the SPS BCT buffers jump to zero → FFF
- Consider using redundant BCT signals from the SPS (EYETS or LS2):
  - Start using the new BCT in BA5 (but keep old ones?);
  - Resolution for PBF 1e8 required)
  - What about the displacement of the SPS dump to LSS5?
- If we really want to be safe, we should go for a hardware solution?
- Change the extraction BIC logic?
- ??

CIB.BA4.EXT2							
0	SIS	1	1	1	1	1	1
1	E_AWAKE	x	1	0	0	0	0
2	E_LHC	x	0	1	1	1	1
3	TT40A	1	1	1	1	1	1
4	TT40B	1	1	1	1	1	1
5	TT40TED	1	0	0	0	0	0
6	TT41A	x	1	x	x	x	x
7	TT41B	x	1	x	x	x	x
8	TI8U	x	x	1	1	1	1
9	TI8D	x	x	1	1	1	1
10	TI8TED	x	x	1	0	0	0
11	INJ 2	x	x	x	1	1	1
12	SPS SMP PBF	x	x	x	1	0	0
13	LHC SMP BPF 2	x	x	x	x	1	1
14	LHC SMP SBF 2	x	x	x	x	x	0
15	SPS SMP SBF	x	x	x	1	1	0
OUT	Beam Permit	1	1	1	1	1	1
PPS	Mark						
		Beam to TED TT40	Beam to AWAKE	Beam to TED TI8	SPS Probe Beam to LHC	SPS Setup Beam to LHC	Nominal Beam to LHC