

# OPERATION AND FAILURES

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# OUTLINE

- ❖ LHC operational parameters
- ❖ Failure observed during 2012
- ❖ List per equipment
- ❖ Comparison with 2011
- ❖ Conclusions

# LHC operational parameters

- ❖ Settings changed for the collimators → **higher load at point 7**
- ❖ TCL collimators closed → **lower load in the RRs in P1/5**
- ❖ Increase of the beam gas effects at point 4
- ❖ Increase of the beam intensity ( $\sim 1.7e11$  p/bunch)
- ❖ 25 ns operation: Effect to be analysed after the runs at the end of the year
- ❖ Ion operation

# LHC operational parameters

- ❖ 25 ns operation: Effect to be analysed after the runs at the end of the year
- ❖ Ion operation: Ch

# SEE update

- ❖ **R2E weekly shift** to collect information
- ❖ **First information source: e-logbook, 8h30 LHC meeting**
- ❖ **TE/MPE, TE/CRG, TE/EPC, EN/STI** have assured a continuous follow-up
- ❖ **What we store:**
  - ❖ **Location**
  - ❖ **Date-Time failure**
  - ❖ **Equipment/Component**
  - ❖ **Consequence of the failure**
  - ❖ **Beam fill BC means To Be Confirmed**

# RADWG and PM web page

Rad WG web site-Detail

RadWG NEWS - QPS fault on RQTL11.R7B2

View

Version History Alert Me

Edit Item Manage Permissions Delete Item

Manage Actions

Title: QPS fault on RQTL11.R7B2

Body: two earlier cases due to SEE -> signature will be compared (recovered by power cycling)  
comment QPS team:  
RR77 DQGPU.E=RR77 RQTL11.R7B2 DQQDG #2A 20-09-2011 04:18:59.197  
Soft error likely but no PM data, lack of PM data meanwhile understood

LHC point: Point 7

Area: DS

Caused by SEE: YES

Event Type: soft SEE

Beam Dump: Yes

Equipment Type: QPS

Equipment Failure Mode: Other

Mitigation Measures: Not Known

Effective Date: 20/09/2011

LHC Fill #: 2,127

Expires:

Link with the fill number

Post Mortem Database

Post Mortem Database - Data Browser

Global PM events

Event Timestamp	Event Category	Accelerator Mode	Beam Mode	Beam Energy [MeV]	Fill Number	Stable Beams [hours]	Fill Luminosity [nb <sup>-1</sup> ]	Intensity B1 [t10]	Intensity B2 [t10]
21-SEP-11 07:14:00.976115 AM	PROTECTION_DUMP	PROTON PHYSICS	INJECTION PHYSICS BEAM	450120	2134	0	0	9597	9630
21-SEP-11 04:55:03.781585 AM	PROTECTION_DUMP	PROTON PHYSICS	RAMP	450120	2133	0	0	18742	18633
21-SEP-11 03:33:30.048091 AM	PROGRAMMED_DUMP	PROTON PHYSICS	INJECTION PHYSICS BEAM	450120	2132	0	0	18696	18851
21-SEP-11 12:27:57.219479 AM	PROTECTION_DUMP	PROTON PHYSICS	INJECTION PHYSICS BEAM	450120	2131	0	0	9151	9934
20-SEP-11 11:22:36.457883 PM	PROTECTION_DUMP	PROTON PHYSICS	INJECTION PHYSICS BEAM	450120	2130	0	0	17693	19723
20-SEP-11 08:25:16.053558 PM	PROTECTION_DUMP	PROTON PHYSICS	STABLE BEAMS	3500040	2129	10.3	76404.15	15217	15570
20-SEP-11 07:44:34.318800 AM	PROTECTION_DUMP	PROTON PHYSICS	SQUEEZE	3500040	2128	0	0	19260	19152
20-SEP-11 04:18:59.197561 AM	PROTECTION_DUMP	PROTON PHYSICS	STABLE BEAMS	3500040	2127	64	5903.773	18754	18856

Details on radiation failure

Mps Expert Comment

Mps Dump Cause

Mps First detection

Seu Dump

Seu Appeared Other Than Dump

Radwg Entry

Suspected SEU on QPS. Dump clean.

QPS

PIC

Possible

YES

[RadWG link1](#)  
[RadWG link2](#)

# SEE Failures

TBC: To be confirmed

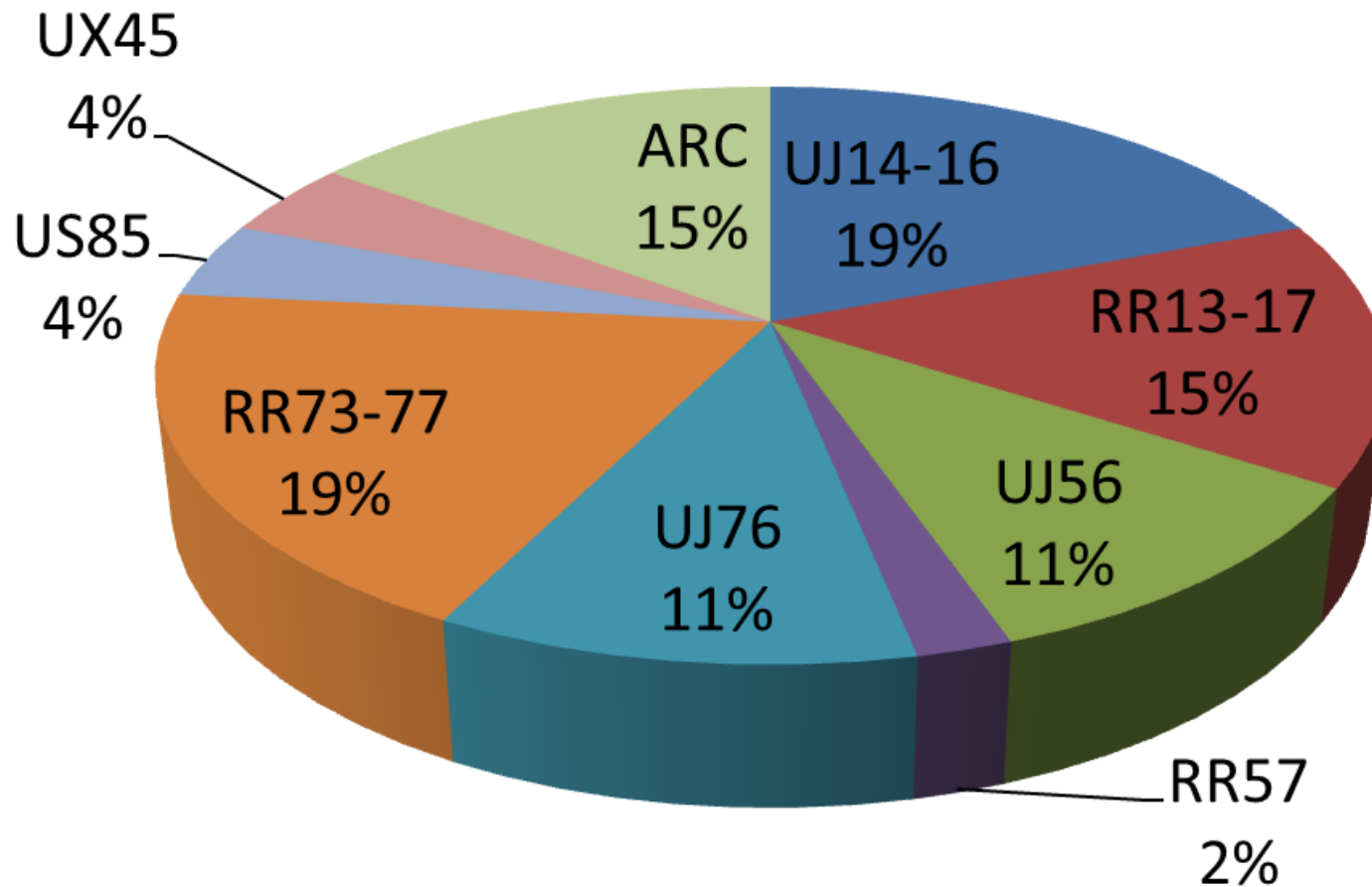
- ❖ Data from March 2012 to 10 October
- ❖ TBC means events To Be Confirmed, not sure if the failure cause is due to radiations

Dump	Dump TBC	No Dump	No Dump TBC
47	15	29	5

Destructive failures			
Dump	Dump TBC	No Dump	No Dump TBC
14	1	3	0

# Failures per area

Confirmed Dump per Area





# List of Failures

QPS			
Dump	Dump TBC	No Dump	No Dump/ TBC
26	2	19	0

- ❖ **Location:** UJ14/16, UJ56, RRs P1/P7, DS
- ❖ **Failure type:** Digital DAQ systems for nQPS and 600A protection, uFIP comm
- ❖ **Mitigations:**
  - ❖ New DAQ system under design (FPGA)
  - ❖ BricoFip (mid-term)/NanoFip (long-term)

# List of Failures

EPC			
Dump	Dump TBC	No Dump	No Dump/ TBC
10	7	7	1

- ❖ **Location:** UJ56, UJ16, RRs P1/P7, Arc
- ❖ **Failure type:** Aux Power Supply, FGC-COD (CPLD)
- ❖ **Mitigations:**
  - ❖ New design of the FGC Lite and of the power converters
  - ❖ AC/DC power supply problem understood

# List of Failures

CRYO			
Dump	Dump TBC	No Dump	No Dump/ TBC
3	1	1	0

- ❖ **Location:** UJ56, UJ76, UX45, US85
- ❖ **Failure type:** Mecos driver, Profibus communications
- ❖ **Mitigations:**
  - ❖ Mecos case (UX45, US85) is under study (deport electronics)
  - ❖ Relocation from UJs

# List of Failures

VACUUM			
Dump	Dump TBC	No Dump	No Dump/ TBC
4	3	0	0

- ❖ **Location:** UJ76 (all confirmed), IR7 (TBC), Point 4 (TBC), Point6 (TBC)
- ❖ **Failure type:** Loss of the PLC control (soft), power supply (destructive failures)
- ❖ **Mitigations:**
  - ❖ Relocation from UJ76

# List of Failures

EN/EL			
Dump	Dump TBC	No Dump	No Dump/ TBC
1	0	0	0

- ❖ **Location:** US85
- ❖ **Failure type:** IGBT failure  
(destructive)
- ❖ **Mitigations:**
  - ❖ Relocation to UA83
  - ❖ Use of the *Borri* version

# List of Failures

COLLIMATION CONTROL			
Dump	Dump TBC	No Dump	No Dump/ TBC
1	0	2	0

- ❖ **Location:** UJ16, UJ56
- ❖ **Failure type:** loss of communication
- ❖ **Mitigations:**
  - ❖ Relocation

# List of Failures

RF Equipment			
Dump	Dump TBC	No Dump	No Dump/ TBC
1	1	0	0

- ❖ **Location:** UX45
- ❖ **Failure type:** Not clear
- ❖ **Mitigations:**
  - ❖ Not known

# Comparison with 2011

	2011	2012 Expectation		2012 Data
	Dump	Without mitigation actions	With mitigation actions	Dump
Collimation	4	45	1	1
Cryo	30	82	1	3
EN/EL	2	6	1	1
EPC	11	25	15	10
QPS	22	45	20	26
Other			5	6
<b>TOTAL</b>	<b>69</b>	<b>150</b>	<b>45</b>	<b>47</b>



# Mitigation measurements 2011

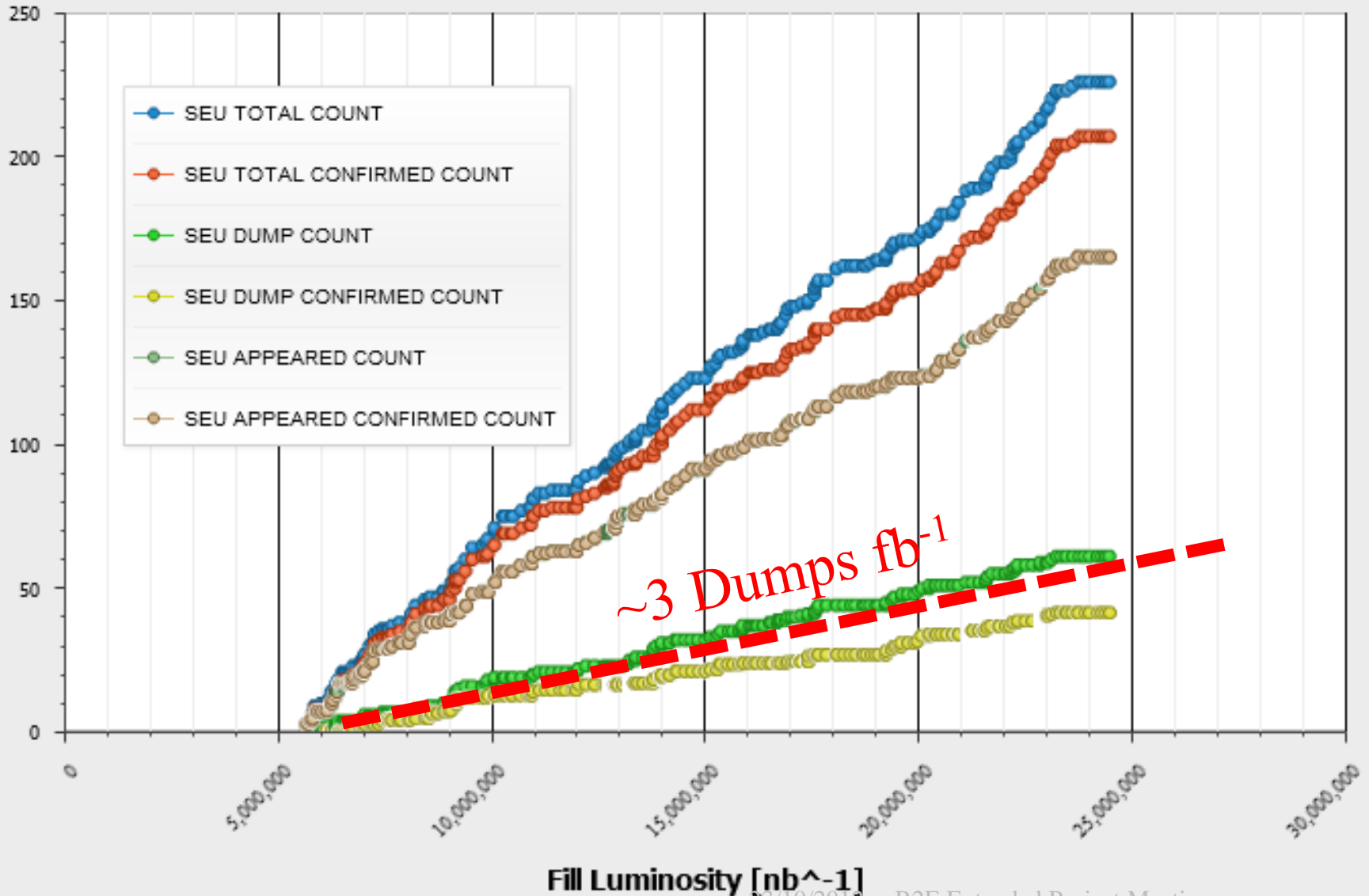
- ❖ **QPS – firmware upgrade (ISO150) almost 100 events avoided since then**
- ❖ **Cryo – PLC removed from US85**
- ❖ **Cryo (via EN/EL) – Replacement of power supply with old models**
- ❖ **Cryo – Automatic Reset of PLC (TE/CRG)**
- ❖ **P/W/BIC – Relocation of the equipment from UJ14/16**

# Mitigation measurements –Xmas 2011

- ❖ **QPS – various hardware updates**
- ❖ **Cryo – Hardware modifications to fix the false temperature readings (5 events in 2011)**
- ❖ **Cryo (EN/ICE) – PLC relocation at point 4, 6, 8 (8 events in 2011)**
- ❖ **Collimation – Survey of stuck bits (3-5 events in 2011)**
- ❖ **B/P/WIC – Relocation of the equipment from UJ56 and US85 (5 events happened in 2011)**
- ❖ **Other relocation of Fire Detectors Equipment**
- ❖ **Shielding of the area UJ14/16 →radiation reduced by a factor 2 in 2012. The factor 2 takes into account Shielding efficiency and radiation level increase**

# Summary

## SEU Failures vs Luminosity



# Conclusions

- ❖ **2011:** ~70 dumps events
- ❖ **2012:** ~50 dump events
  - ❖ In Agreement with predictions
  - ❖ Effectiveness of the mitigation actions
  - ❖ Failure estimation for the next has uncertainty factors
    - ❖ Beam gas effect
    - ❖ Collimation losses
    - ❖ Equipment failure types not yet appeared
- ❖ **>LS1:** relocation and shielding
  - + new developments

# LHC operational parameters

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