CNRAD Update

- Results
- New installations
- RadMONs (2nd and 3rd Slots)
- Equipments to be tested in 2012

Results

- **RF MosFETs**
  - **Motivation**
    - Having a deeper understanding of their behavior and limits
      - ✓ **Used in the PS Booster over the last 20 years** → 10^5 – 10^6 Gy without major failures
  - In the PSB → **De-rated conditions**:
    - ✓ $V_{DS\ max}$ = 125 V → Vdrain swings between 0-80V (40 V_{DC})
  - **For the test:**
    - Test setup is placed inside the target area
      - ✓ Dose expected from Slot3 to the end of the year ≈ **11 kGy** *(will depend on the new schedule)*
    - Control/acquisition is located below station 2 with remote reset units
  - **Test are performed in the worst case condition (80 V_{DC})**
  - **Evaluation:**
    - Failure rate to single events
    - I_D vs V_G characteristic measurements vs dose

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Aborted due to a loss of communication with the PXI located below Station 2

Kept the MosFeTs (without any control and DAQ system connected) inside the target area for the last Slot

→ Possibility to measure Ids vs Vgs curve after irradiation

Actual levels:
Dose ≈ 6 kGy
HEH ≈ 3.8e13 cm^{-2}

Results

- **Cryo test**
  - **Motivation**
    - **Validate the design of a new power supply for the LHC beam screen heaters**
  - Required dose: **Up to 1 kGy** → To validate up to the DS level
  - **Decided test location : TSG45 – 451**
    - From Slot 3 to the end of the year ≈ **1 kGy** *(will depend on the new schedule)*
  - **For the application:**
    - Power supply will be “off” during beam
    - Will be “on” only when the beam is off to supply the beam screen heaters
  - **For the test:**
    - Off-line measurements at the end of each slot → 3 boards with MosFETs, 1 board will be removed at the end of each slot to measure I_{ds} vs V_{gs} curves.
    - On-line measurements

    → Operate constantly or in switching mode to check if they failed during irradiation. Specific application.

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Removal of 1 over 3 boards

Visual inspection of the 2 active MosFET boards

Installation of a new active board 4-channel analog Switchs

Installation of a new passive board containing 6 analog switches

On the active board, 3/12 analog switchs were not functionning at the end of Slot3

Results

- **TE/EPC – Puls AC/DC Power Supply**
  - **Motivation**
    - **Improvement of the Puls AC/DC power Supply used in the tunnel**
  - It has been found that 2 different versions of the PSU exist
    - One installed in the LHC (not rad. Tolerant).
    - The second one not installed (seems to be more rad. tolerant)
  - Those PSU are built by the same manufacturer
    - → Slight difference on the design for the same model → **COTS can show different behavior under radiation**
  - During slot 3, PSU failed at around **100 times higher HEH fluence** compare to the model installed in LHC.
  - During the last Slot, TE/EPC is testing **2 additional PSUs.**

New installations and results

- **LED Warning System**
  - **Motivation**
  - New prototype to be tested based on lessons learned from last year:
    - Safety lighting system powered by voltage transformer + Graetz bridge
    - Power LED technology
  - The system is tested on 2 different locations:
    - With monitoring : Position 453
    - Without monitoring to test if the prototype can survive up to higher doses : Position 451
  - Radiation levels since the beginning of the year:
    - Position 453: Dose: 337 Gy - ϕ_{eq}: 3.4×10^{12} neq/cm^2 – HEH : 2.4×10^{12} cm^{-2}
    - Position 451: Dose: 760 Gy - ϕ_{eq}: 7.5×10^{12} neq/cm^2 – HEH : 5.3×10^{12} cm^{-2}
- Up to know we are covering locations up to DS levels (close the quadrupole magnets (nom. operation):
  - ϕ_{eq} : 20 years
  - ϕ_{HEH} : 50 years
  - Dose: 4 years

New installations and results

- **LED Warning System**
  - **New installation**
  - Other lights
  - Type **400 W metal iodide**
  - Installed in **TCC2** → Several died
  - Radiation level is measured in TCC2 (end TS #4)
  - Which radiaton levels can they stand in **CNRAD** ?
  - Correlation with measurement in **TCC2**

New installations and results

- **BPM components**
  - **Motivation:**
    - 4 SFP bidirectional transceivers:
      - 2 × manufacturers (Huihong – Ligent)
    - 1 SFP Transceiver (2 fibers)
      - FFTX Technology
    - **Additional 12 SFP bidirectional transceivers have been installed**

- **QPS**
  - **Motivation**

- Up to June, only 1 µFIP failure with auto-reset has been detected and no failure on the PhotoMos relay has been observed so far.

- Radiation levels: Dose = 282 Gy, 2×10^{12} = HEH/cm^2 and $\phi_{eq} = 2.7\times10^{12}$ cm^{-2}
- *In terms of HEH fluence, we reached 20 years of LHC operation in the DS (close to quadrupole magnets)*
- During slot 3 **one failure** occurred:
- **Check and re-start of one DUT during TS** → Installation of a remote reset box.

New installations

- **RadMON Version 6**
  - **Motivation:**
    - Test of 2 prototypes of the **next version of the RadMON**.
    - Same used during the **H4 test** → They already get around **50 Gy** (No failure observed)
    - Tests have been performed at **PSI** up to ≈ 300 Gy → No failure observed
    - **Target dose: 200/300 Gy** → Installed in TSG45, position 451.

- **Acquisition crate for load sensors (BE/ABP)**
  - **Motivation**
  - They are installed in shielded area in P5 (2) and P2 (2). **After LS1, more will be installed**
    - **IP1** (US15) , **IP2** (UA23 & UA27), **IP5** (>LS1: IL55), and **IP8** (UA83 & UA87) → **Each IP : 2 crates**
  - Target dose: **100 Gy** → Position 453
  - Acquisition system composed by several semiconductor devices:
    - CMOS, MOSFET driver, FPGA (Xilink CPDL), 12 bit DAC …)

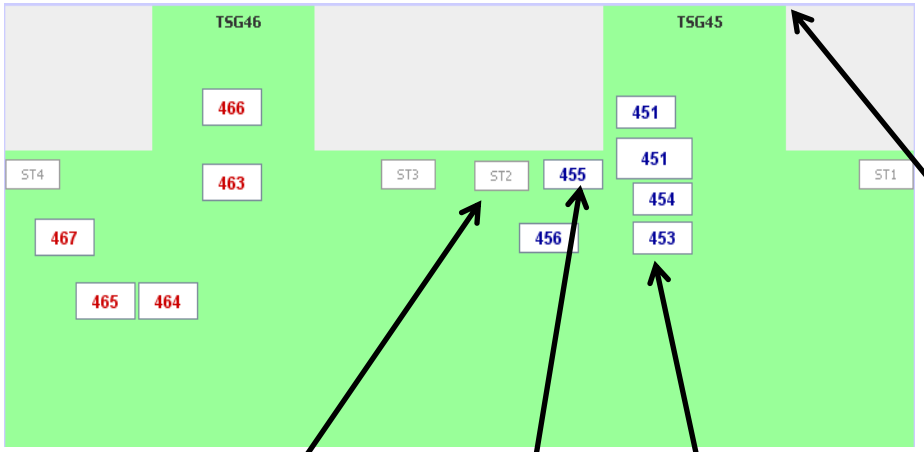
New installations

- **IT beacon**

  - **Motivation**
  - Will be installed everywhere in the **LHC tunnel**.
  - 15 beacons installed in TSG46 (data transmission monitored on-line)
    - Expected radiation levels:
      - Dose: : **≈ 30 Gy** (Nom. Operation → **15 years** in the Arcs (dose))
      - HEH fluence: **≈ 1.5e11 cm^{-2}** (Nom. Operation → **1,5 years** in the DS***** (HEH fluence))
  - 5 beacons installed in TSG45 – position 453 (off-line). **Check if still working** at the end of the slot
    - Expected radiation levels:
      - Dose: **≈ 120 Gy** (Nom. Operation → **7 months** in the DS***** (dose))
      - HEH fluence: **≈ 8e11 cm^{-2}** (Nom. Operation → **8 years** in the DS***** (dose))

*****In the DS, close to quadrupole magnets

RadMONs – 4th Slot



RM7 box (5V)
RM7 deported
RadFETs:
400 nm
1000 nm

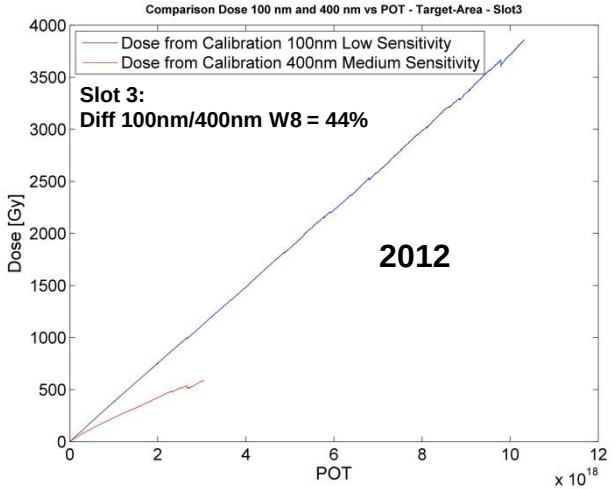
RM10 box (3V)

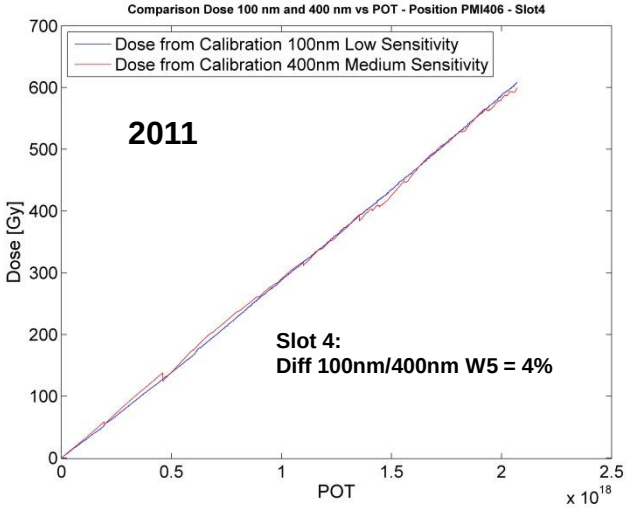
RM10 deported
(Target Area)
RadFETs:
400 nm W5
400 nm W8

RM8 deported
RadFETs:
100 nm
400 nm

RM8 box (3V)

Interesting results:





During last slot, comparison between

W5 and W8 wafers → Target Area

Equipments tested in 2012

- **BPM components**
- **LED warning system**
- **QPS**
- ~~**Ethernet Switches**~~
- ~~**Wifi access points**~~
- **Cryo power supply**
- **TE/EPC components**
- **Acquisition Crate load sensors (BE/ABP)**
- **IT beacons**
- **RadMON version V6**