TTC2 area radiation tests 2001

Radiation qualification of the Beam Position Monitors front end electronics

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SL / Beam Instrumentation

Objectives for this year:

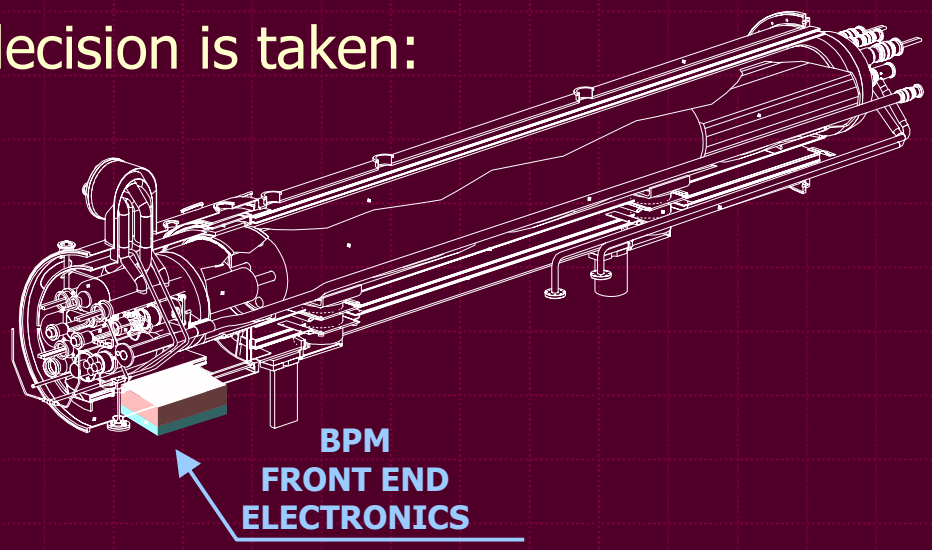
- Qualify the **W**ide **B**and **T**ime **N**ormalizer card (v.3) : Front end electronics card of the **B**eam **P**osition **M**onitors.
- Study the optical transmission in a radioactive environment
  - Efficiency loss ? threshold current increase ?
- Test the preliminary version of the power supplies
  - Linear : +5V (LM7805), -5.2V (LM333T), -2V (LM333T)
  - LHC4913, LHC7913 samples were not available 
- Test the preliminary version of the Calibration card for the WBTN

Placement & Expected Dose

- At the arcs the placement decision is taken:

The dose Radiation Environment information presented for the LHC main rings that appears in :

[1] C. Fynbo, G. Stevenson "Radiation Environment in the Main Ring of the LHC", 22 November 2001



shows radiation doses in this area is below 10Gy/y (ε<10%) ⇒ Rad Tolerant > 110 Gy

Objective :

Tolerate 300 Gy!

- Near the dispersion suppressors (DS1 & DS5) no decision is taken already:

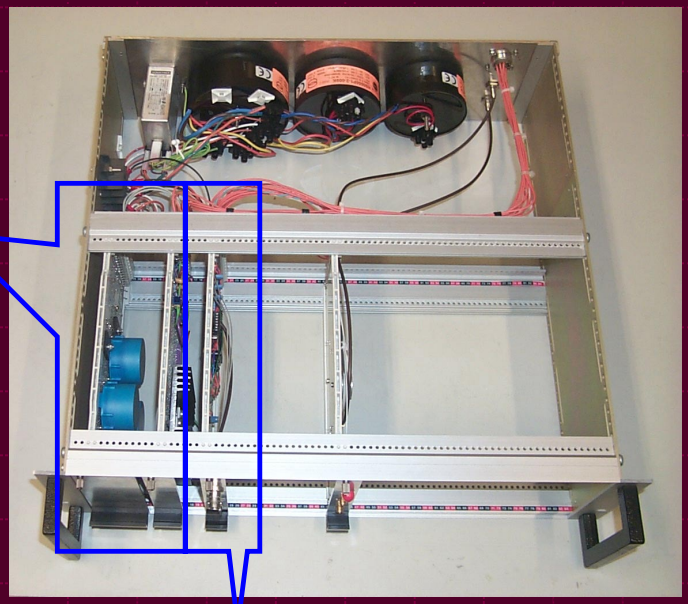
But, the dose level we expect is ~20Gy/y (ε<10%) ⇒ Rad Tolerant > 220 Gy

COTS used (I)

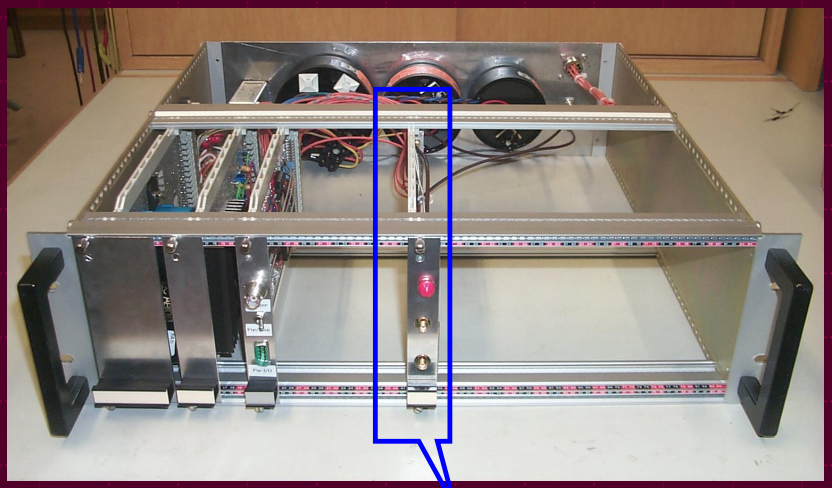
- ***WBTN card***: (mainly devices designed for high-speed applications)
  - **MC10EL** family CI's (coax. drivers, TTL to Diff ECL translators, counters, MUX, flip-flops, logic gates, etc)
  - Ultrafast ECL comparator: **AD96687BR**
  - Very wideband transistors: **BFQ19** (NPN), **BFQ149** (PNP)
  - High-speed diodes: **BA592**, **HSMS2814**
  - LVDS receivers: **DS90C402M**
  - Laser diode: **Italtel**
  - Some conventional devices: **PMLL4448**, **BSR17A**, **BSR18A**
  - (Others: filters, transmision lines, SMD resistances, switches, capacitors, transformers, etc.)

COTS used (II)

- ***Linear power supplies:***
  - Transformers
  - Rectifiers: **GBU8K**
  - Voltage regulators: **LM7805** (+5V), **LM333T** (-5.2V, -2V)
  - Electrolytic Capacitances and inductances

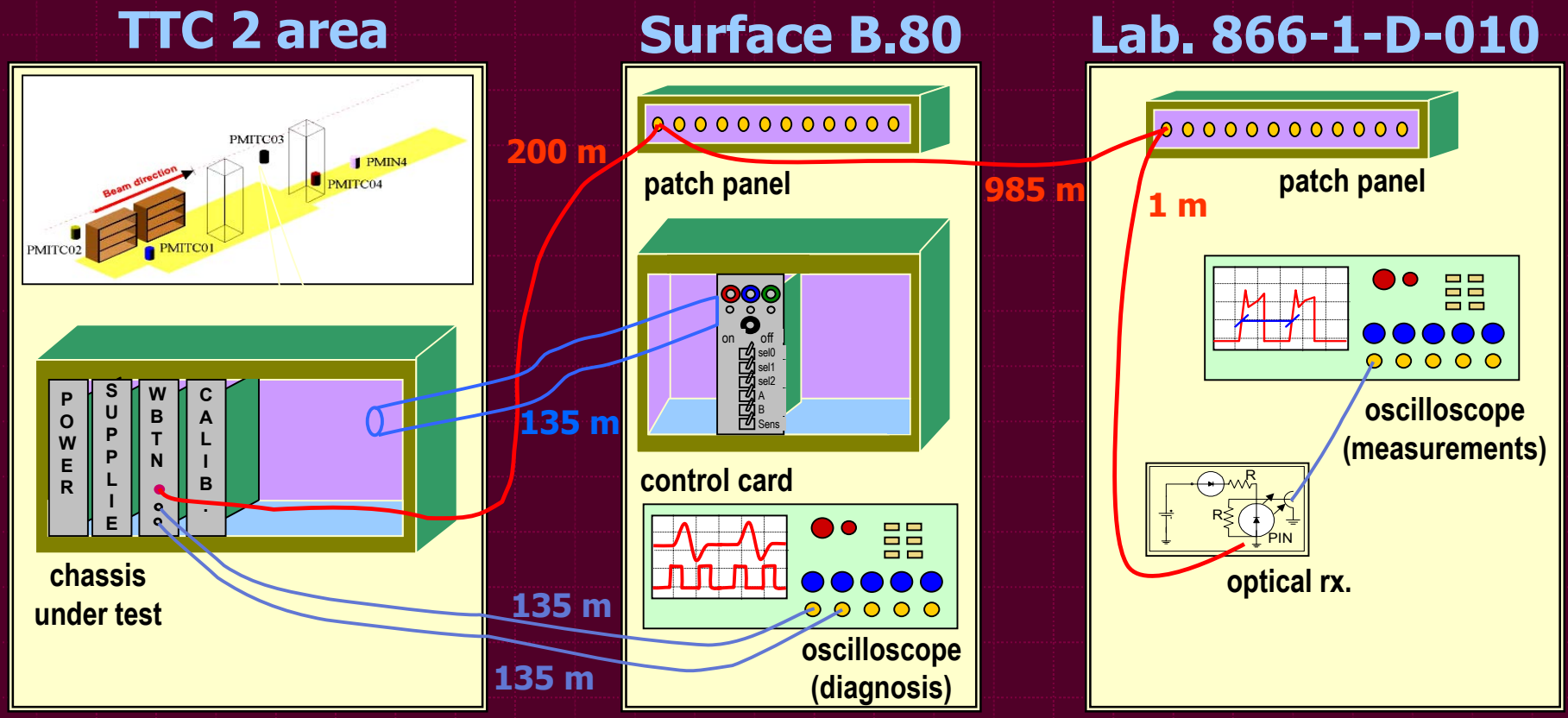


- ***Calibration card:***
  - CPLD Xilinx : **XC9536**
  - LVDS drivers: **DS90C401M**
  - 40 MHz quartz



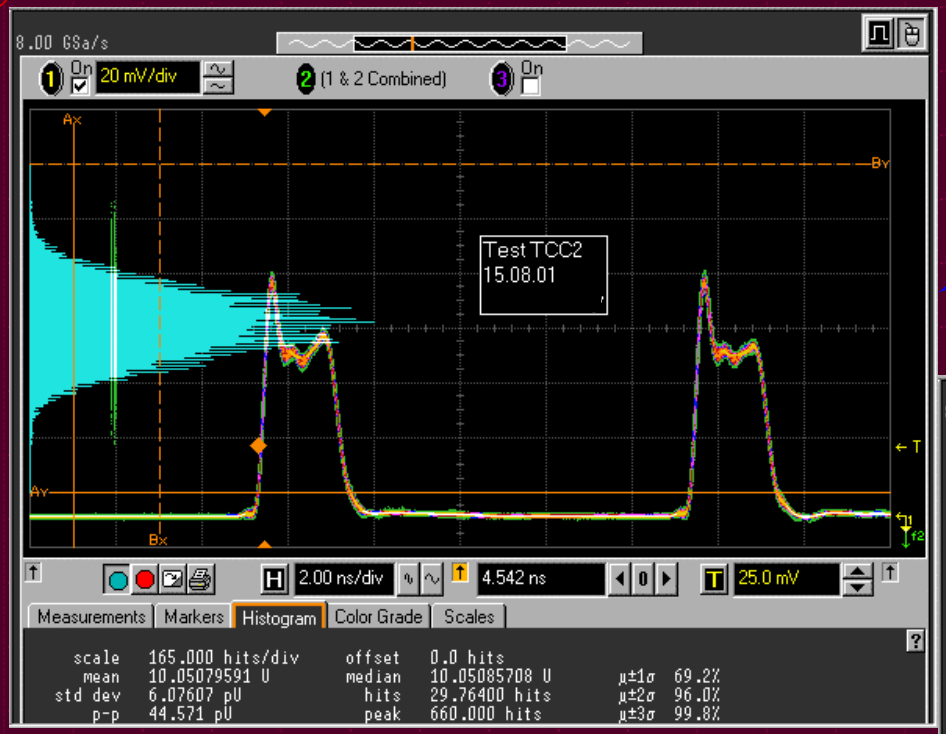
- ***WBTN card (v3)***

Experimental Set-up:



SM 9/125μm optical fiber
CC50 coaxial
NE 10 (5 twisted pairs + screen)

Measurement Examples:



15/8/01 – 36 Gy

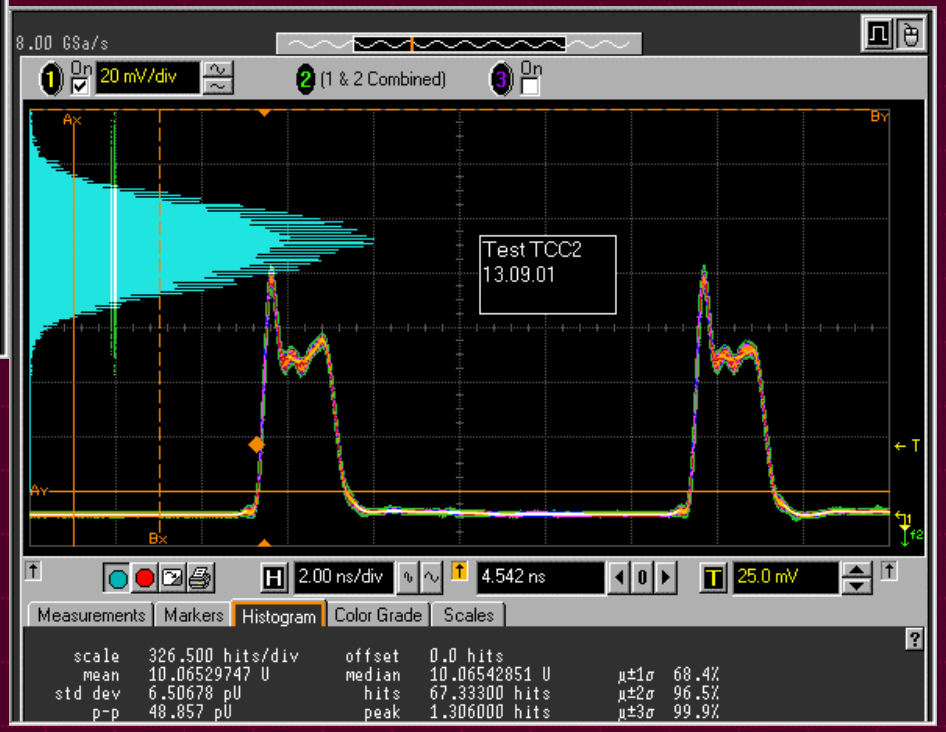
Mean: 10.051 ns

Std. Dev.:* 5.3 ps

13/9/01- 480Gy

Mean: 10.065 ns

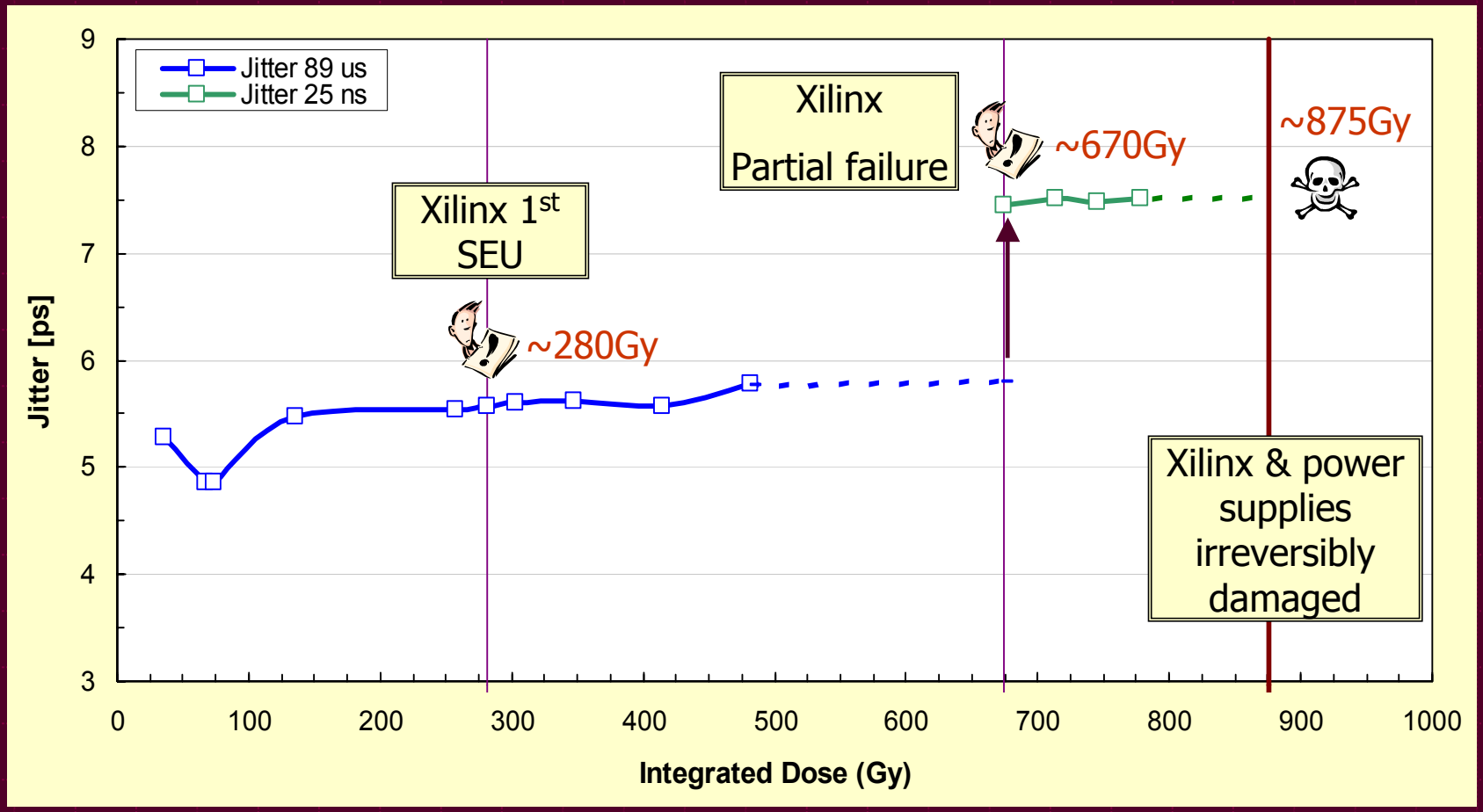
Std. Dev.: * 5.8 ps



- **Up to ~875 Gy, no significant deterioration in the performance is visible**

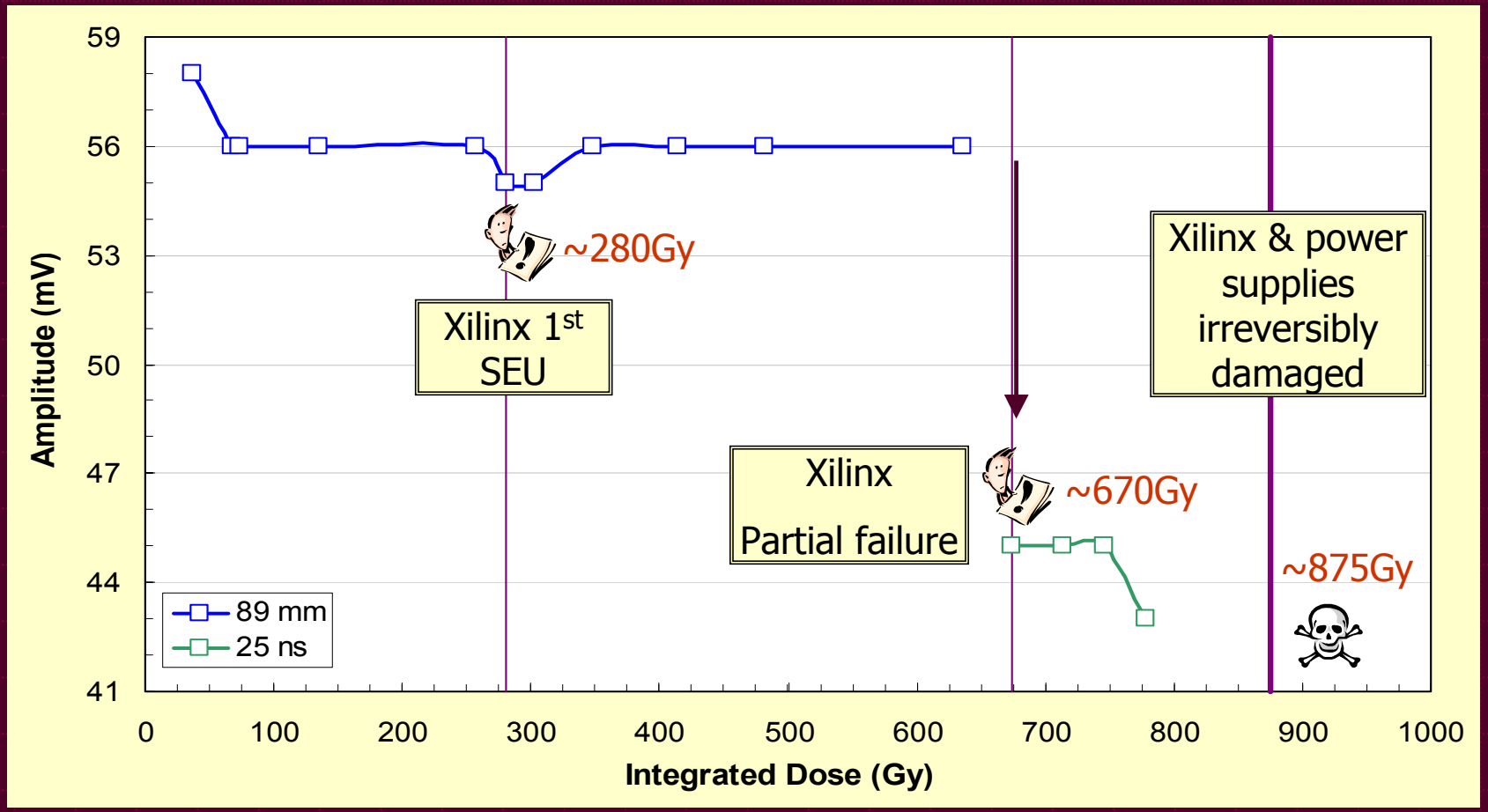
(*Corrected value)

Results (I) : WBTN - Jitter study



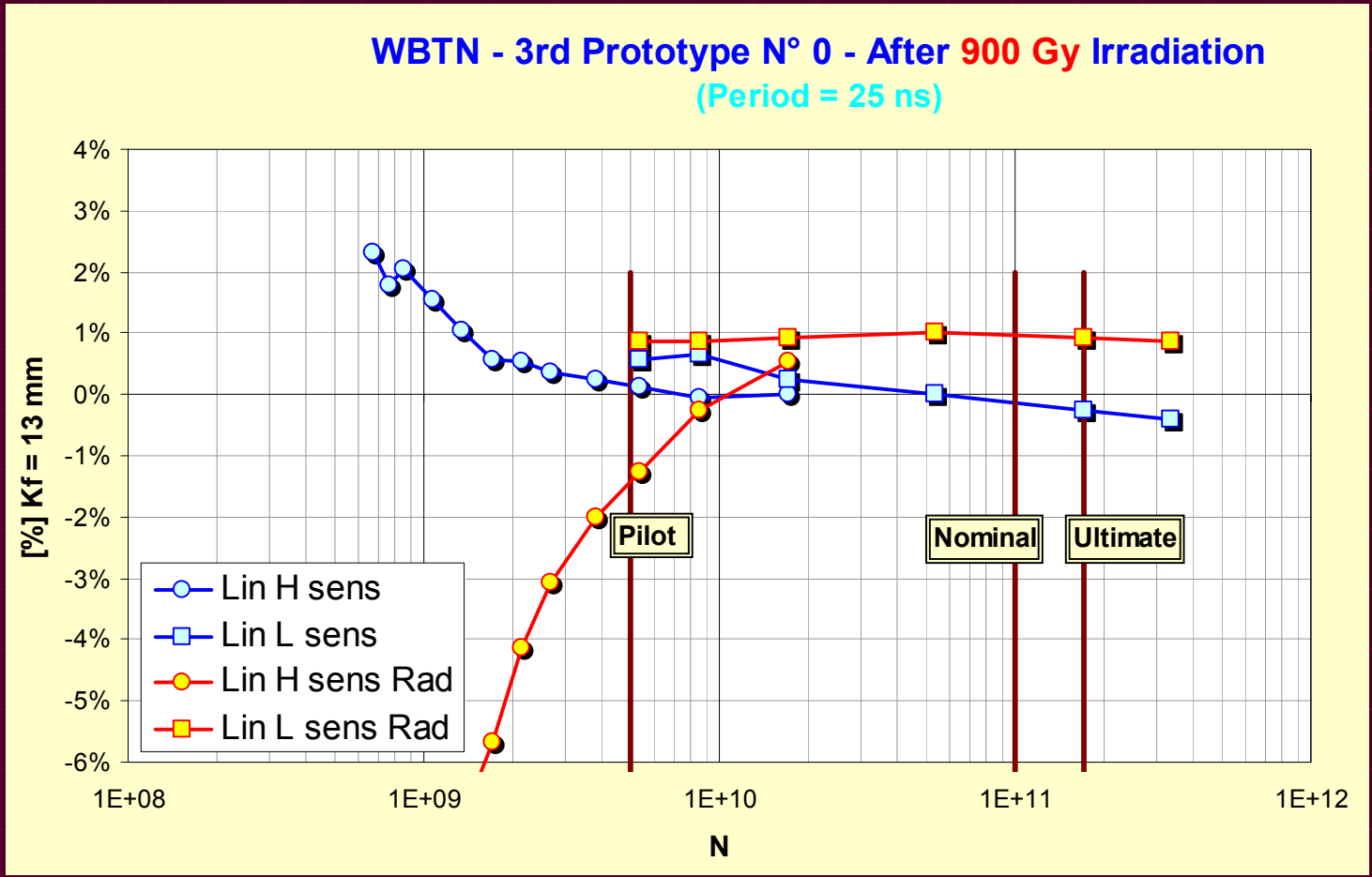
Note: After 2 weeks of annealing, new measures at lab. were done:
89μs → 5.4ps, 25ns → 5.4ps

Results (III) - Laser



Note: Measures at lab. show no amplitude or offset change appreciable so no efficiency loss or threshold current increase is appreciable up to ~875Gy.

Results (IV) – Linearity after 900Gy



Note: 3rd prototype N° 0. (40MHz)

What we have learned…

- **WBTN card :**
  - It has worked **nominally at least till ~875 Gy (Hard rad qualified).**

    Note: At the lab, after 2 weeks in storage (annealing), the WBTN card works into the nominal specifications (linearity, consumption, etc).
  - **Laser** : No significant deterioration in the performance up to ~**875Gy**.
- **Calibration card :** Xilinx **XC9536**
  - **1st SEU** at **~280 Gy**
  - **Partial failure** at **~670 Gy**.(Most of the functionalities were lost.)
  - **Irreversibly damaged** at **~870 Gy**.
- **Power supplies :**
  - Negative voltage regulator (**LM333T**) **irreversibly damaged** at **~870 Gy**.
  - Positive voltage regulator (**LM7805**) **OK** after **~875Gy**

Next year…

- **WBTN card:**
  - **On-line monitoring of the power consumption** in order to design properly the power supplies.
  - We will **test other lasers**
- **Calibration card:**
  - We will **continue working** on the calibration card. (Is it 281Gy high enough or should we change technology?)
- **Power supplies:**
  - We will test the new versions when we have some samples of the hard rad voltage regulators: LHC4913 and LHC7913.