

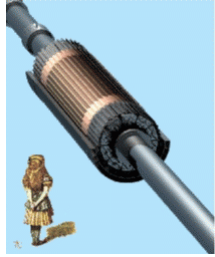


Radiation Test Alice1LHCb

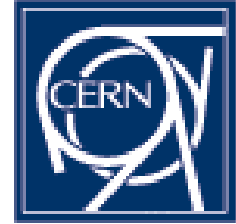


Jeroen J. van Hunen

- SEE (Ions and Protons)
- TID (X-ray)
- Tracking (MIPs at SPS)



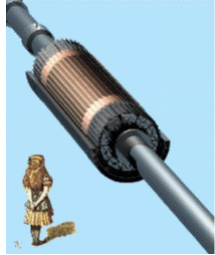
SEE (Single Event Effects)



- SEGR (Gate Rupture) \Rightarrow breakdown of transistor gate
- SEL (Latch-up) \Rightarrow high power supply current
- SEU (Upset) \Rightarrow switch logical level

Memory cells in Alice1LHCb (hardened) :

- Pixel cell : 8192×5 (threshold adjust, mask, test pulse)
- Periphery : 42×8 (DACs)



SEE (Single Event Effects)



A standard (not hardened) memory cell:

Particle	Flux $\text{cm}^{-2}\text{s}^{-1}$	σ_{SEU} cm^2	Upset rate s^{-1}
Hadrons $> 20 \text{ MeV}$	$2.0 \cdot 10^5$	$2.6 \cdot 10^{-13}$	$5.2 \cdot 10^{-8}$
Neutrons $< 20 \text{ MeV}$	$5.0 \cdot 10^4$	$2.6 \cdot 10^{-14}$	$1.3 \cdot 10^{-9}$

$1200 \text{ chips} \times 336 \text{ DAC bits} \Rightarrow 80 \text{ bits/hour}$

Alice1LHCb : All memory cells are hardened against SEE
 \Rightarrow measure SEU cross section using Protons and Ions



SEE (Single Event Effects)



Cyclotron, Louvain-la-Neuve :

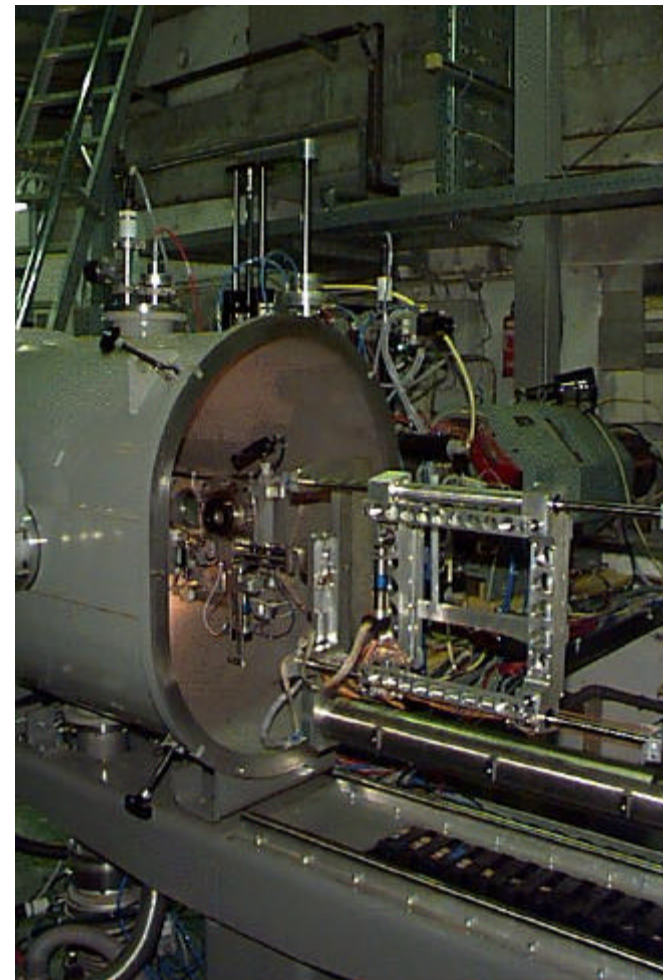
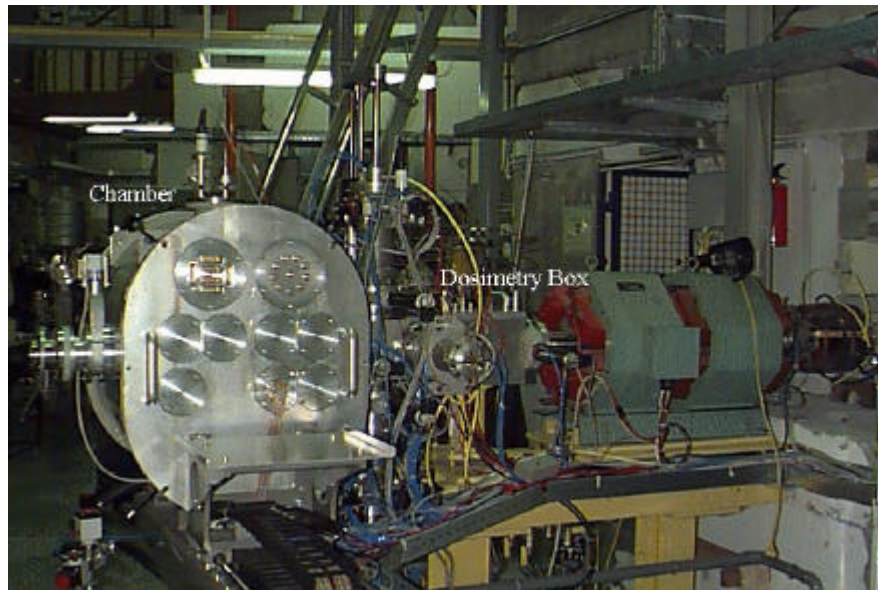
Irradiation with:	Flux $\text{cm}^{-2}\text{s}^{-1}$	σ_{SEU} (not hardened) cm^2	Upset rate s^{-1}
Ions ($<60 \text{ MeVcm}^2\text{mg}^{-1}$)	10^4	$2.7 \cdot 10^{-7}$	$2.7 \cdot 10^{-3}$
Protons $< 60 \text{ MeV}$	10^8	$\approx 10^{-13}$	$\approx 10^{-5}$

Ion irradiation :

A test of the DAC bits will need around 1 hour of irradiation



SEE , Louvain-la-Neuve



Measurements will take place in
March (June)



TID (Total Ionizing Dose)



TID effects \Rightarrow threshold voltage shifts, leakage current generation, noise enhancement, charge carrier mobility reduction, etc.

X-rays at CERN Micro Electronics:

- Tungsten, 10 keV X-rays
- Rate: 1.8 Mrad per hour, but large chip size (14*16 mm) \Rightarrow 0.4 Mrad/hour
- Measurements: March/April



SPS Beam Test



Alice1LHCb bump-bonded to a detector

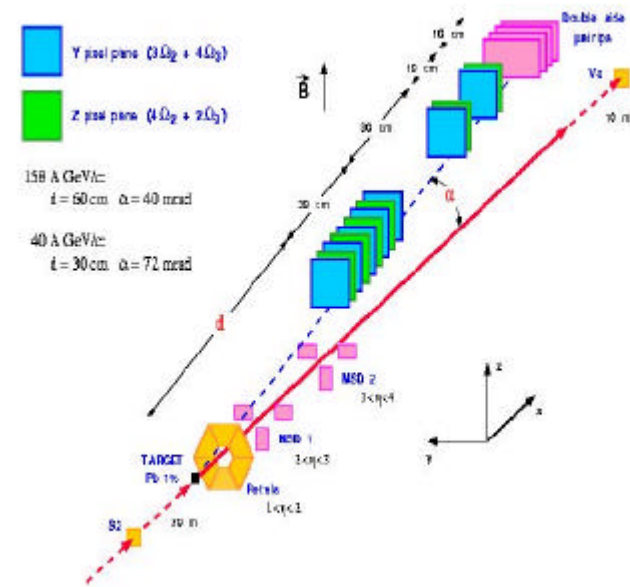
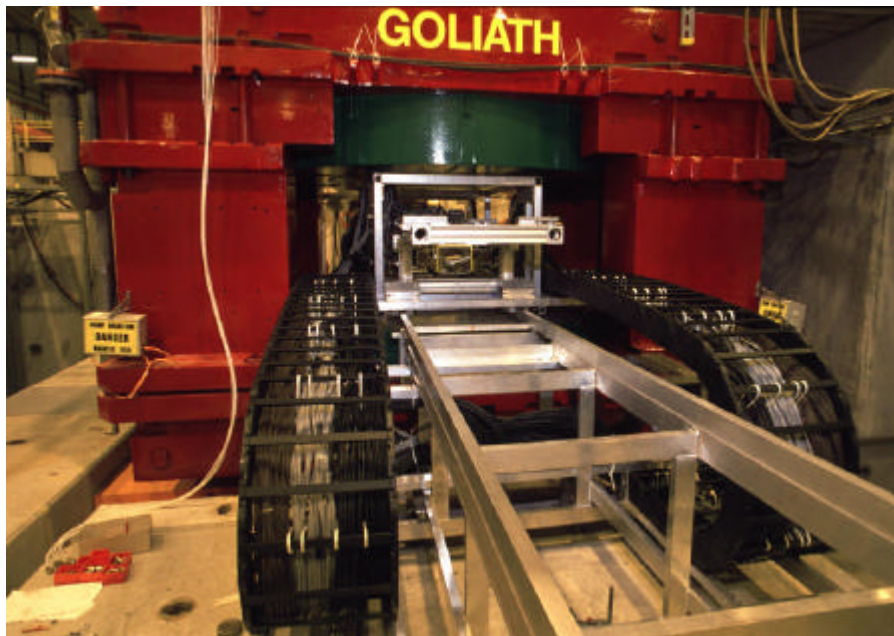
- Tracking (efficiency, resolution, cluster size) as function of detector bias, threshold, internal delay
- Time walk, etc.

System requirements:

- Tracking system with a good spatial resolution (the cell size is $50 \times 425 \mu\text{m} \Rightarrow 1/\sqrt{12} * 50 \times 425 = 14 \times 122 \mu\text{m}$)
- Scintillators, trigger, DAQ system



SPS Beam Test T2-H4 (NA57)



Measurements: July 12 - 25 and September 3 - 9