

Group Meeting

2026-07-24

Taiichi Egami

Schedule (What I Did)

Sun	Mon	Tue	Wed	Thu	Fri	Sat
7/5	6	7	8	9	10	11
<u>MOSAIX testbeam analysis</u>			<u>Group Meeting</u> 🔥			
<u>Preparation for MOSAIX SEL test</u>						
12	13	14	15	16	17	18
	<u>MOSAIX SEL test @ HIF-UCL in Belgium</u>			<u>MOSAIX testbeam</u>		
				<u>MOSAIX SEL test analysis</u>		
19	20	21	22	23	24	25
<u>MOSAIX testbeam</u>		<u>MOSAIX testbeam analysis</u>			<u>Group Meeting</u> 🔥	
<u>MOSAIX SEL test analysis</u>						

SEL Measurement



ALICE UCLouvain

SEL measurement: babyMOSAIX

Luca Aglietta, **Taiichi Egami***, Hartmut Hillemanns,
Yoonha Hong, Tucker Hwang, Jiyoung Kim, Bong-Hwi
Lim, Nicola Minafra, Zhenyu Ye

ITS3 WP3 meeting
21/07/2026

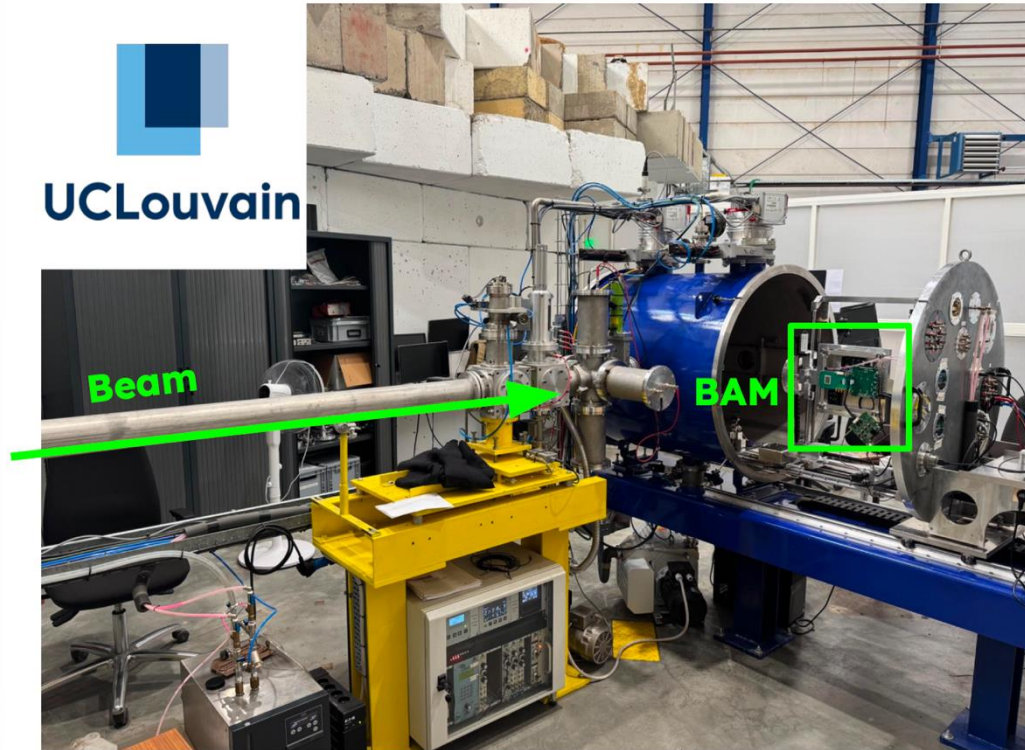


UTokyo



Setup

Setup @ HIF-UCL



Place: Heavy Ion Facility (HIF),
Cyclotron Resource Centre (CRC),
UCLouvain — Louvain-la-Neuve
(Belgium)

Date: 2026 July 14-15

Participants: Taiichi Egami,
Hartmut Hillemanns,
Yoonha Hong.

Chip temperature: 15°C (chiller).

In the Chamber (Vacuum)



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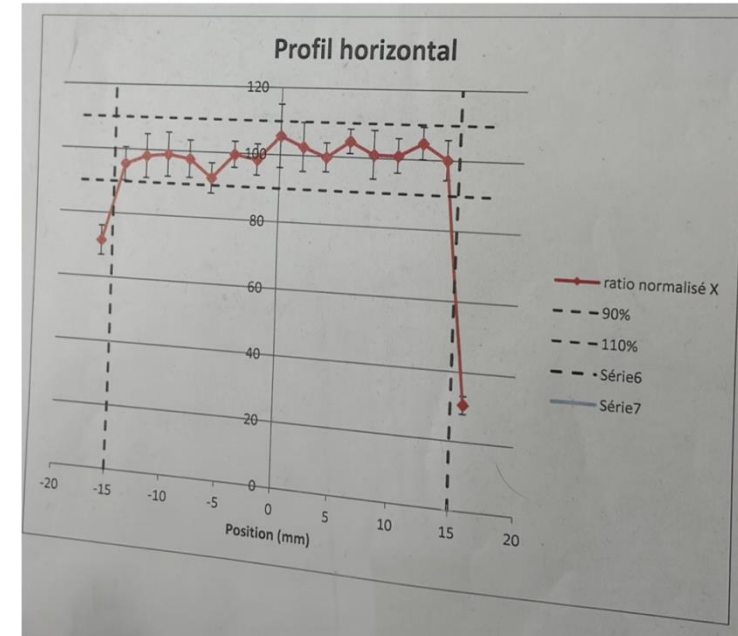
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Beam Info

Beam info about HIF-UCL

Ion	Energy [MeV]	LET [MeV/(mg/cm ²)]
$^{13}\text{C}^{4+}$	133	1.2
$^{22}\text{Ne}^{7+}$	242	3.2
$^{27}\text{Al}^{8+}$	257	5.6
$^{36}\text{Ar}^{11+}$	365	9.7
$^{53}\text{Cr}^{16+}$	525	15.8
$^{58}\text{Ni}^{18+}$	607	19.9
$^{84}\text{Kr}^{25+}$	808	31.7
$^{103}\text{Rh}^{31+}$	1013	45.0
$^{124}\text{Xe}^{35+}$	1073	61.3

[Ligne d'ions lourds \(HIF\) | Université catholique de Louvain](#)



Beam profile: 30 x 30 mm

Max. flux = 15,000 particles/cm²/s

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Measurement Schedule

Measurement strategy

Original plan:

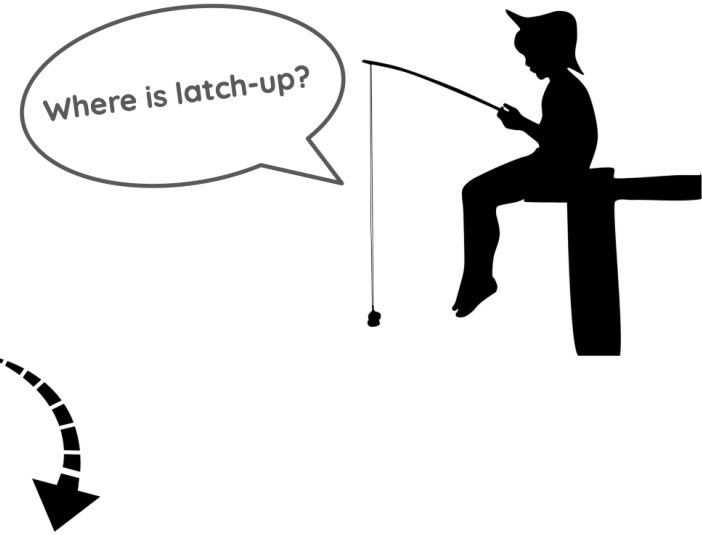
1. Commission the setup and verify operation
2. Identify the SEL signal — start at the highest LET (Xe-124)
3. Measure the SEL cross-section vs LET

What happened:

- At step 2, **no latch-up ever appeared** (the clear signal seen on MLR1 SEU1 / MOSS was absent).

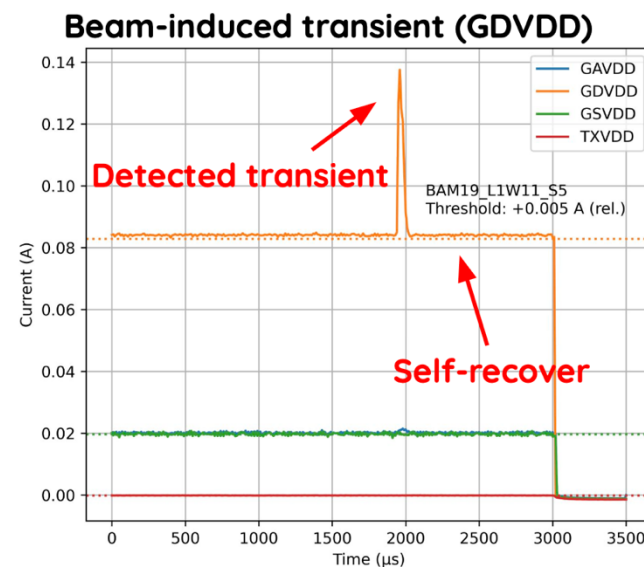
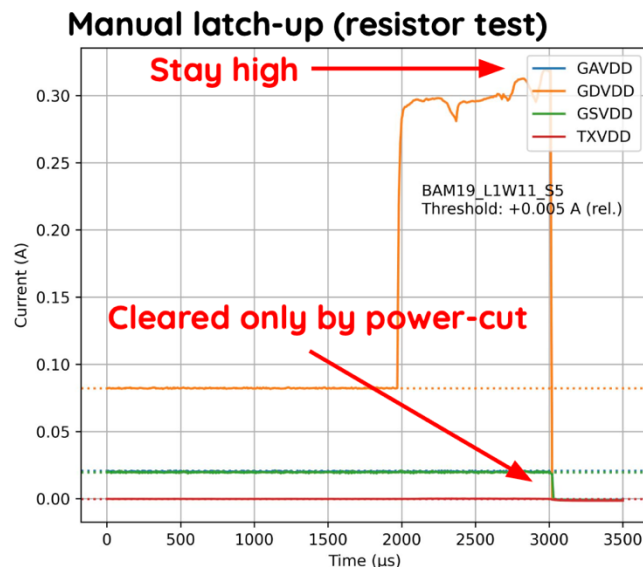
→ Shift of focus:

- from “measure the SEL cross-section” → “confirm we are not missing a latch-up.”



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Results: observed current signals



- Under beam: **no (rectangular) latch-up** — only rare transient excursions.
- Transients appeared exclusively on the digital supply (GDVDD); they self-recover to nominal without intervention (~1 per 20–30 min at max Xe flux).
- The manual resistor test produces a **persistent** pulse that the chain holds and power-cuts.

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Cross check: did we miss a latch-up?

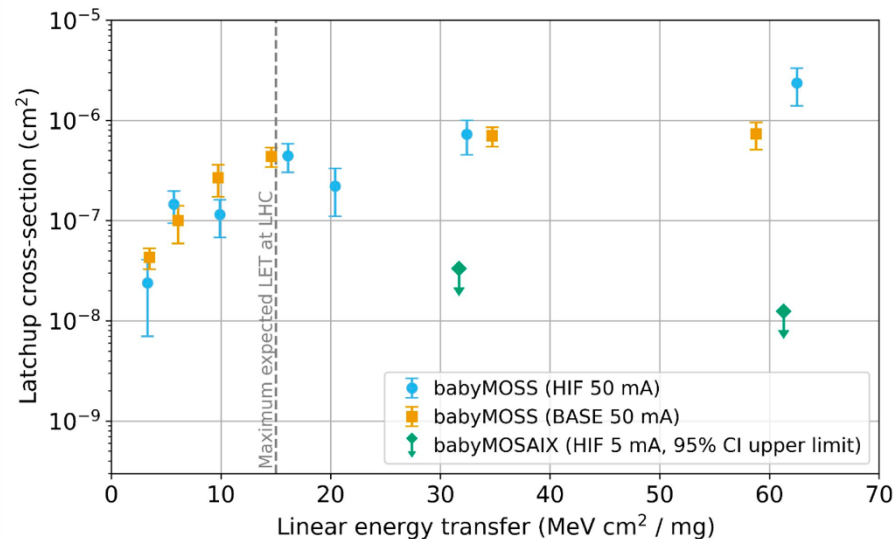
Zero persistent latch-up → multiple independent checks

Check	Results	What it means
High-LET Xe-124 first, flux then increased	No latch-up	Not observed even with the highest-LET
2 ion species (Xe, Kr)	No latch-up	Not ion-specific
2 chips (BAM10, BAM19)	No latch-up	No chip dependency
Multiple fluxes ($\leq \sim 2 \times 10^4 \text{ cm}^{-2}\text{s}^{-1}$)	No latch-up	
Low 5 mA threshold	No latch-up	Sensitive well below a real SEL ($\sim 30 \text{ mA}$)
Manual resistor test	Detection + power-cut worked	Detection chain proven to fire
Extended post-trigger recording (FW change)	No latch-up	Detected trips identified as transients, not latch-up
Hitmaps during beam	Chips stayed operational	Chip alive and being hit

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Comparison with babyMOSS



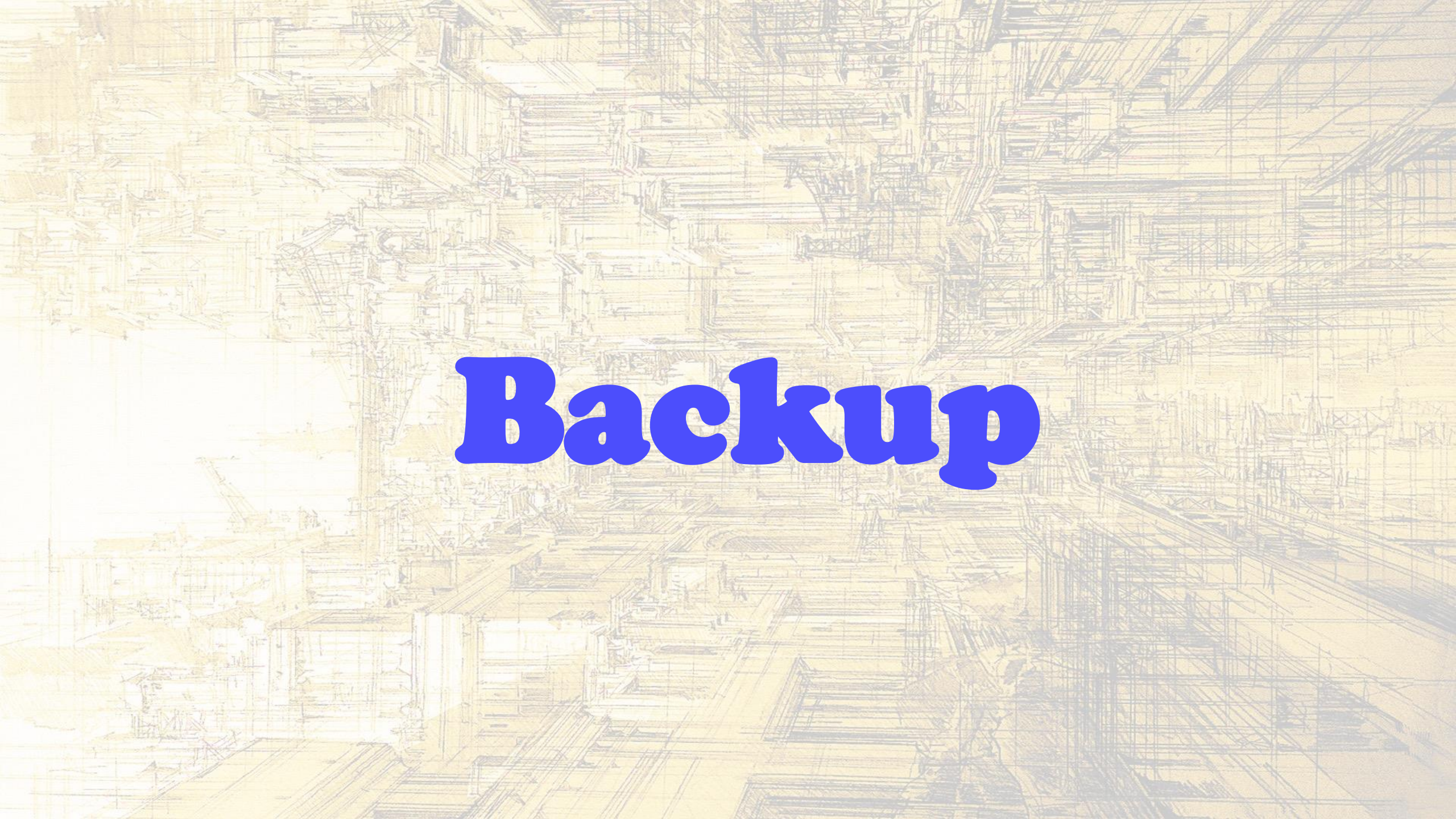
- **babyMOSS** (previous results):
a clear latch-up cross-section, increasing with LET.
- **babyMOSAIX**:
zero latch-up events → only upper limits (95% CL),
around two orders of magnitude below the babyMOSS
cross-section.
- The Xe and Kr upper-limit difference reflects **different accumulated live time** (Xe ~4.5 h, Kr ~1.5 h) — **not a difference in SEL sensitivity**.
- Upper limits are **not measured cross-sections**;
our threshold (**5 mA**) is even lower than babyMOSS
(10/50 mA).

2026-07 Test Beam



Schedule (What's Next)

Sun	Mon	Tue	Wed	Thu	Fri	Sat
7/19	20	21	22	23	24	25
					<u>Group Meeting</u> 🔥	
26	27	28	29	30	31	8/1
2	3	4	5	6	7	8



Backup

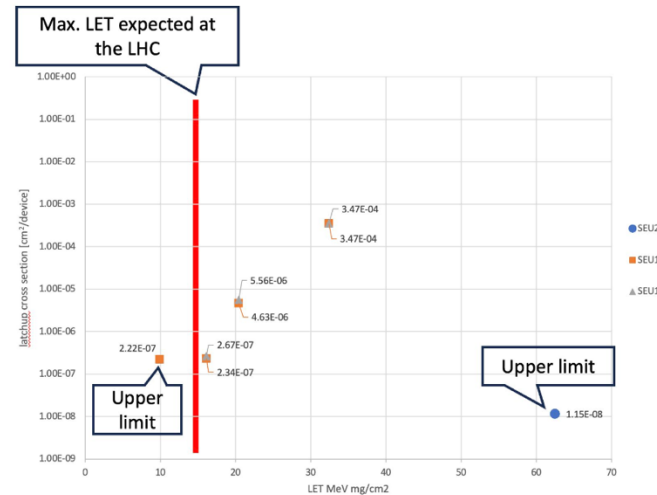
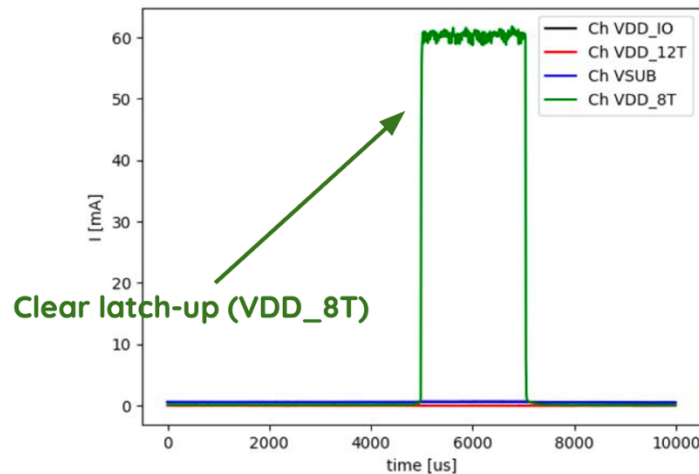
Latch-up Test @ MLR1

History of SEL in ITS3 1/2

LET = Linear Energy Transfer

SEL was tested for every generation of ITS3 sensor prototypes:

- MLR1:
 - SEU1 memory chip showed SEL on 8T FIFO, but **not** below 15 MeV·cm²/mg.
 - SEU2 memory chip did **not** show any SEL.
→ so only upper limit for the SEL sensitivity given based on the fluence.



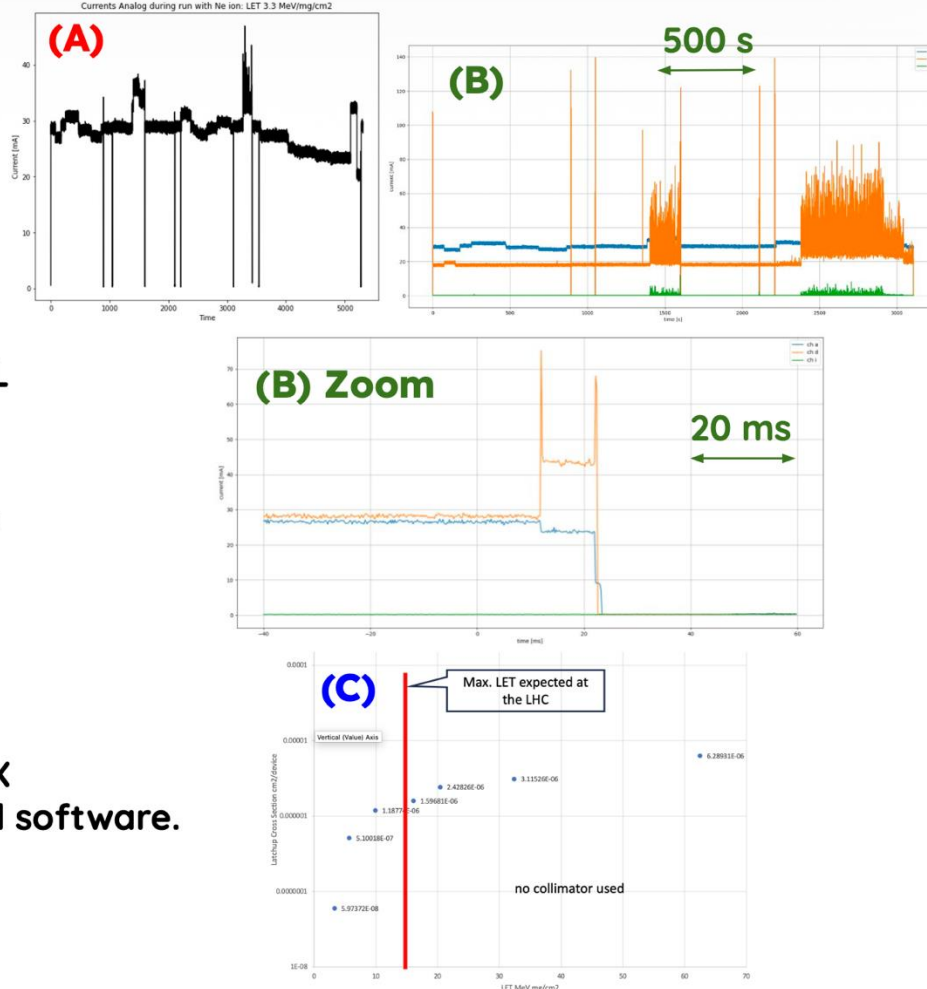
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Latch-up Test @ ER1 (MOSS)

History of SEL in ITS3 2/2

- ER1 (MOSS):
 - **spikes** of several tens of mA and a few ns duration were observed — (A).
 - They occurred **much more often than real SEL** → SEL trigger was modified to take **pulse duration** into account — (B).
 - **Chip settings kept changing**, due to SEU in the non-protected sensor DACs.
 - SEL was observed even below $15 \text{ MeV}\cdot\text{cm}^2/\text{mg}$, in the chip periphery — (C).

This has led to a sensor design optimisation in MOSAIX and had thus to be re-tested, requiring new hard- and software.



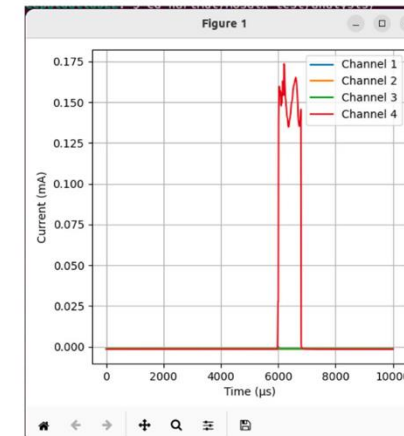
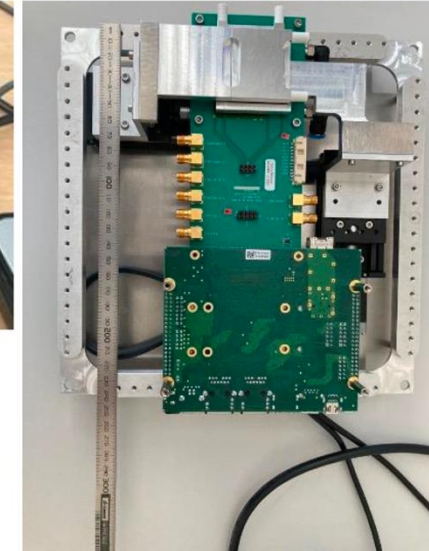
Latch-up Test @ ER2 (This Time)

MOSAIX SEL Test System Preparation

Development of a MOSAIX SEL test system based on BAM and Enclustra board:

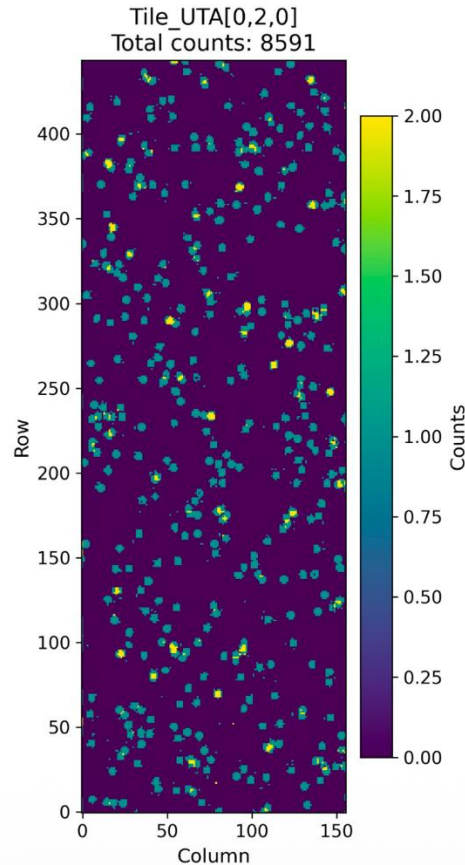
- Electronics:
 - Development of a new small SEL-dedicated powerboard (N. Minafra).
 - Operation and SEL detection using Teensy MC.
 - Fw development and optimisation (Tucker, HHI).
- Mechanics:
 - Development of a mechanical support structure accommodating the HIF frame, Zaber stages for collimators, and cooling blocks (Jaap).
- Software:
 - Development of power board specific mosaix_util classes → hardware agnostic power operation identical to R&S PSU.
 - Integration of SEL tests in the MOSAIX test software as debug script and Test.
 - Development of SEL specific test output and analysis scripts.

Extensive system tests prior to HIF including manually generated SEL (short cutting supply currents using various resistors)



Beam Flux in HIF-UCL

Beam flux



Data-taking scan for verification of complete beam incidence

- Xe-124 with BAM10_L1W11_S5
- Flux measurement at UTA[0, 2, 0]
66 clusters / 0.33 cm^2 / 0.25 seconds
= 804 particles/cm²/s
- Target flux specification
= 1,000 particles/cm²/s

Increased to 15,000 parts/cm²/s for SEL test