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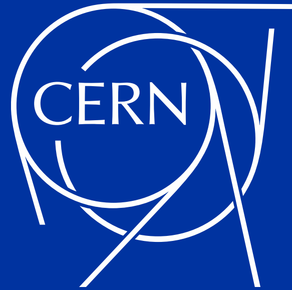

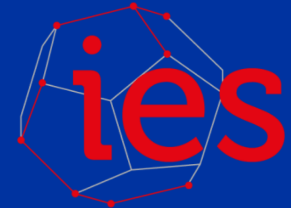

Laser SEE Testing of Commercial SRAMs and Correlation with Heavy Ion Data

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RADLAS 2024 – ESA-ESTEC – 11th September 2024

Motivation

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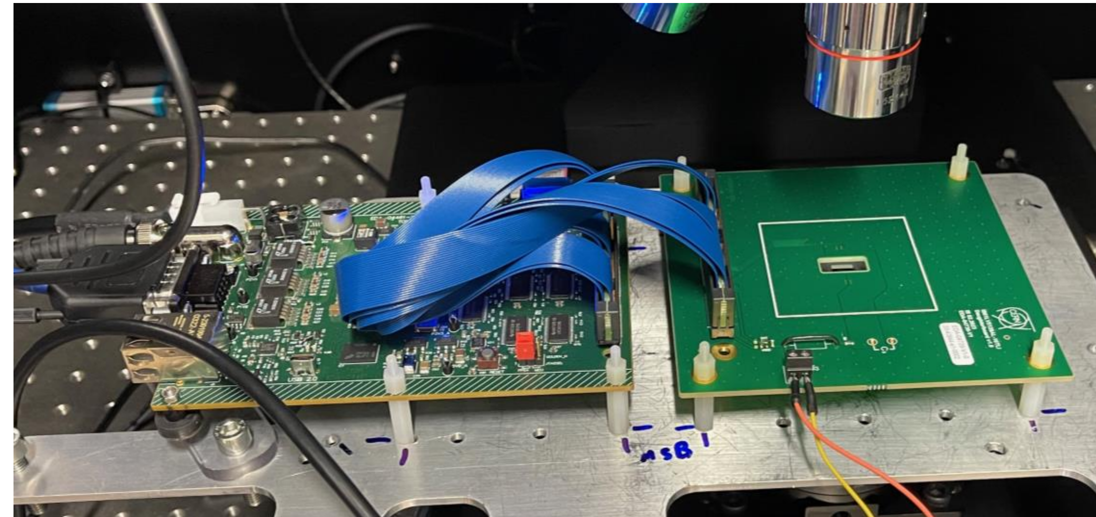
- **Pulsed laser SEE testing has numerous advantages.**
- **SRAM memories are interesting devices:**
  - Present in numerous electronic systems,
  - Both discrete and integrated on microcontrollers,
  - Existent for many technology nodes,
  - Used also as radiation monitors, such as RadMon at CERN.
- **Large devices (die tens of mm^2 die), allowing extrapolation from some representative areas.**
- **Well characterised set of devices across facilities,**
- **Useful to cross to hadron SEE studies.**
- **Poster presentation at RADECS 2024.**



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Memories under test

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Reference	Manufacturer	Size [Mbit]	Technology [nm]	SEE study	Threshold [MeV·cm^2/mg]
CY7C1069AV33-10ZXC	Cypress	16	150	SEL	3.0
IS61LV5128AL-10TLI	ISSI	4	180	SEL	1.6
K6R4016V1D-TC10	Samsung	4	180	SEL	8.6
AS7C34098A-10TCN	Alliance	4	200	SEL	9.2
IS61WV204816BLL-10TLI	ISSI	32	40	SEU	0.2
CY62167GE30-45ZXI	Cypress	16	65	SEU	0.3
RMLV0816BGSA-4S2	Renesas	8	110	SEU	12.0

Test conditions

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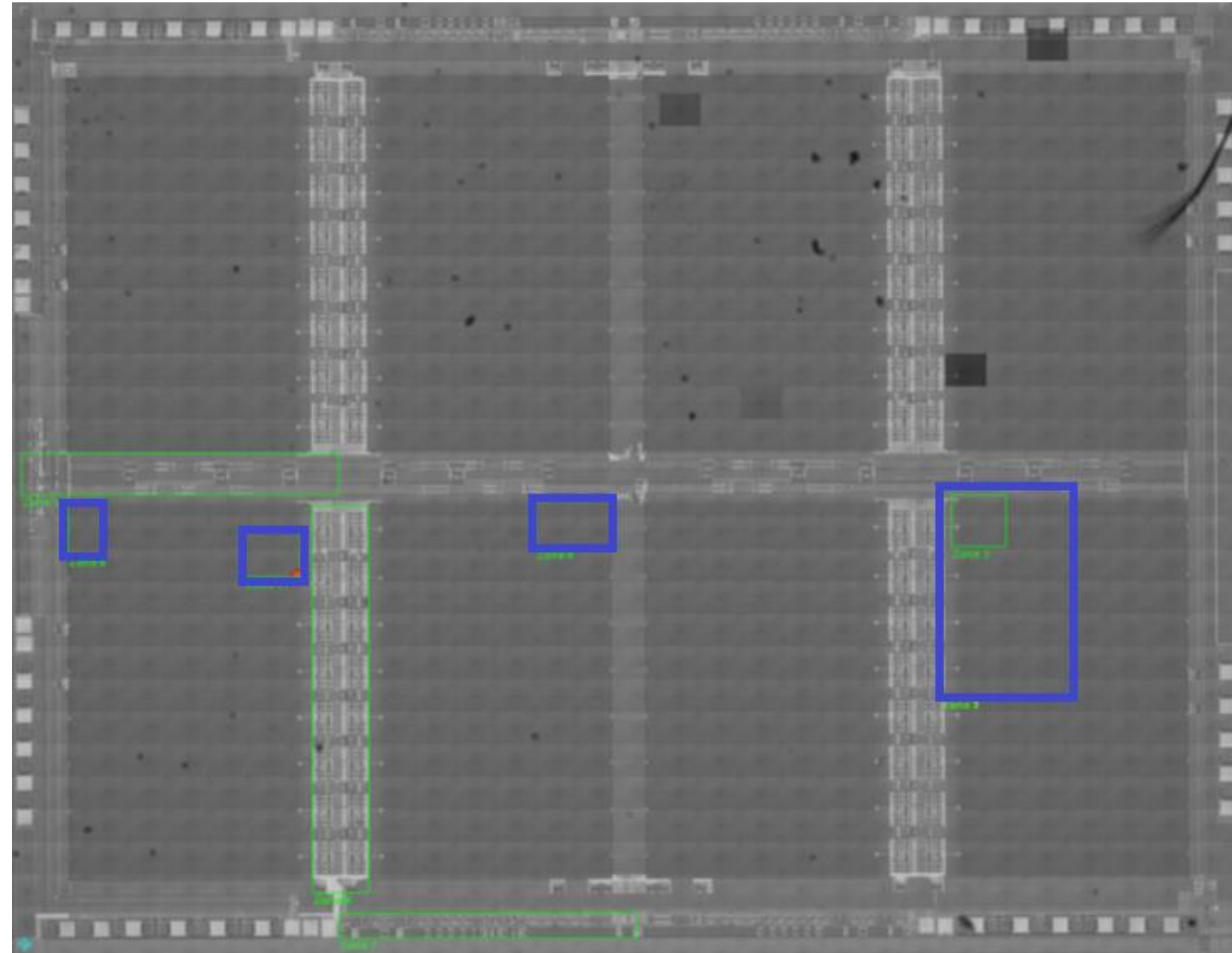
Setup	IES Preserve - Montpellier
SEE mechanism	SPA
Wavelength	1064 nm
Pulse energy	20 – 600 pJ
Pulse duration	30 ps
Pulse size	~ 1.2 um (100X)
XY step size	2-20 um
Injection mode	Backside, no thinning



Mapping IS61LV5128AL

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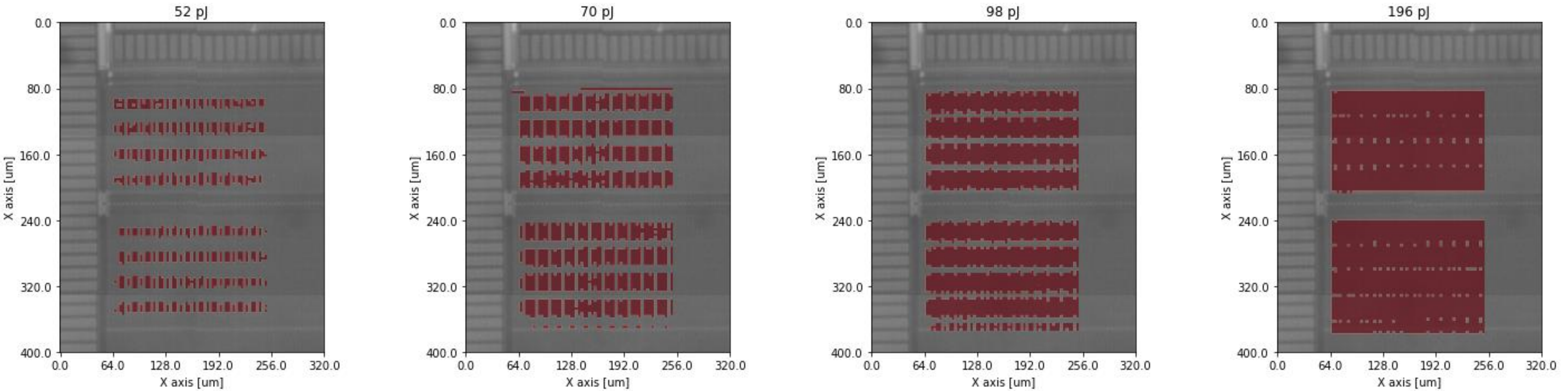

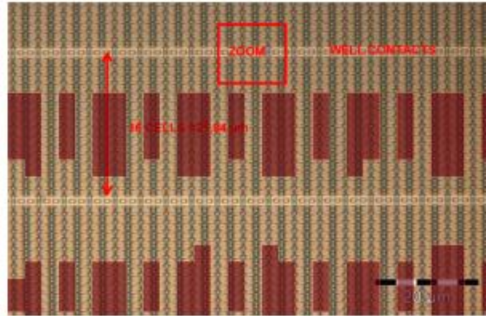
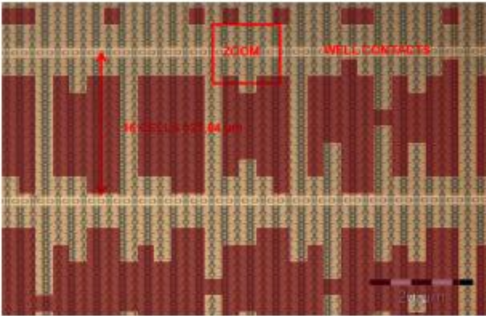
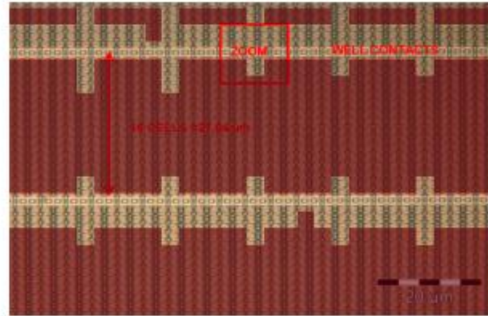
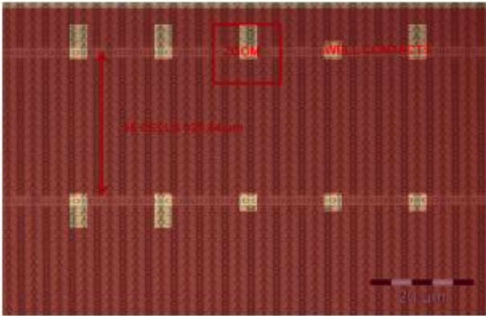

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Mapping K6R4016V1D

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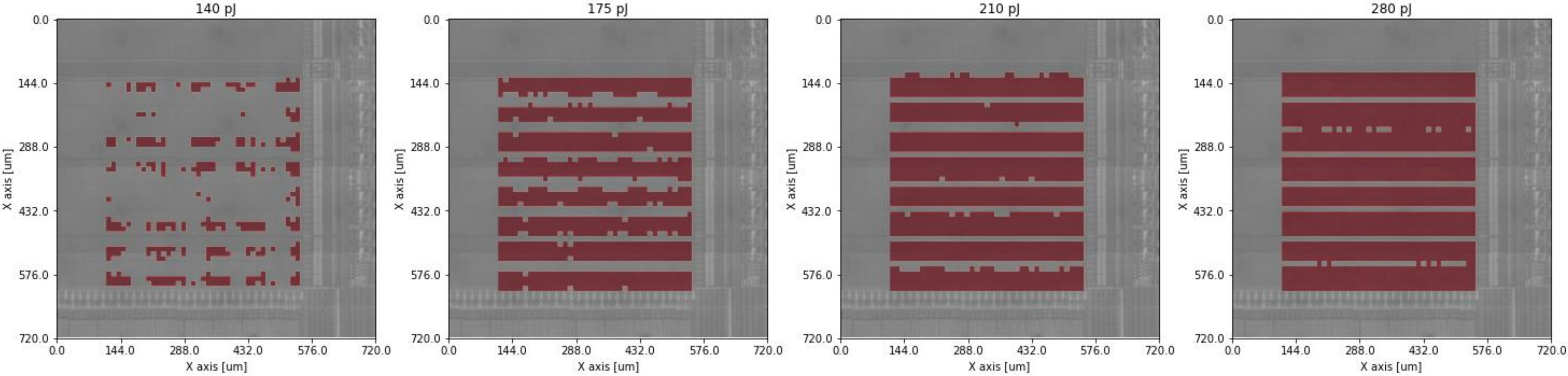

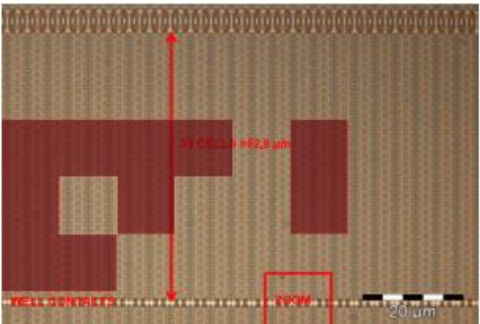
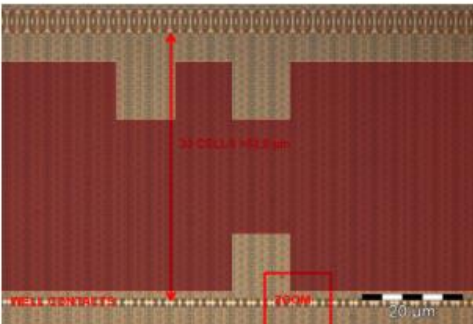
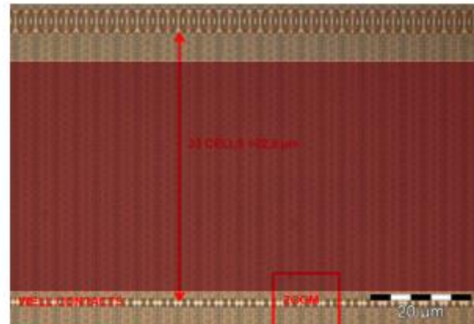
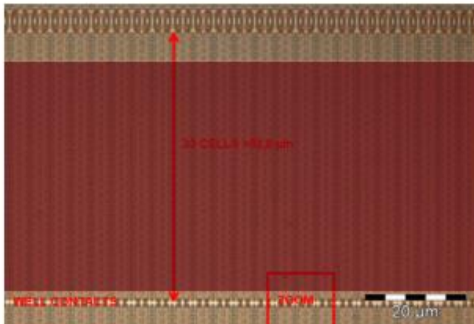

Deep sub-micron SEU SRAMs

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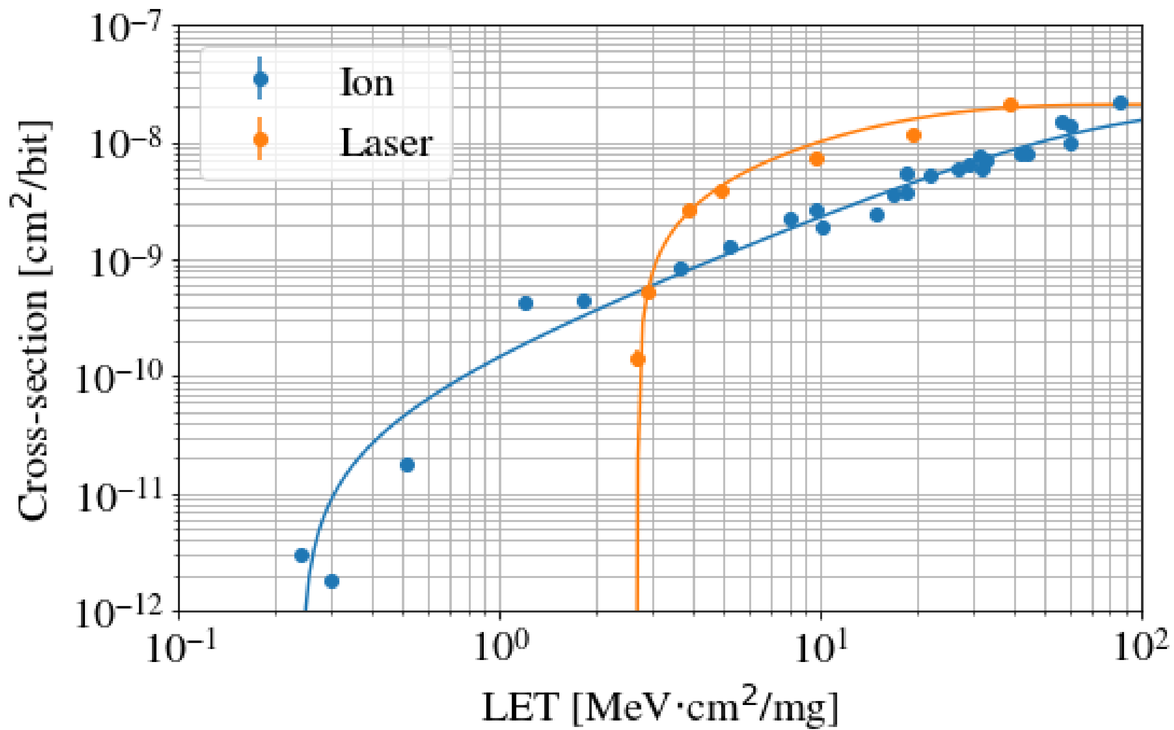
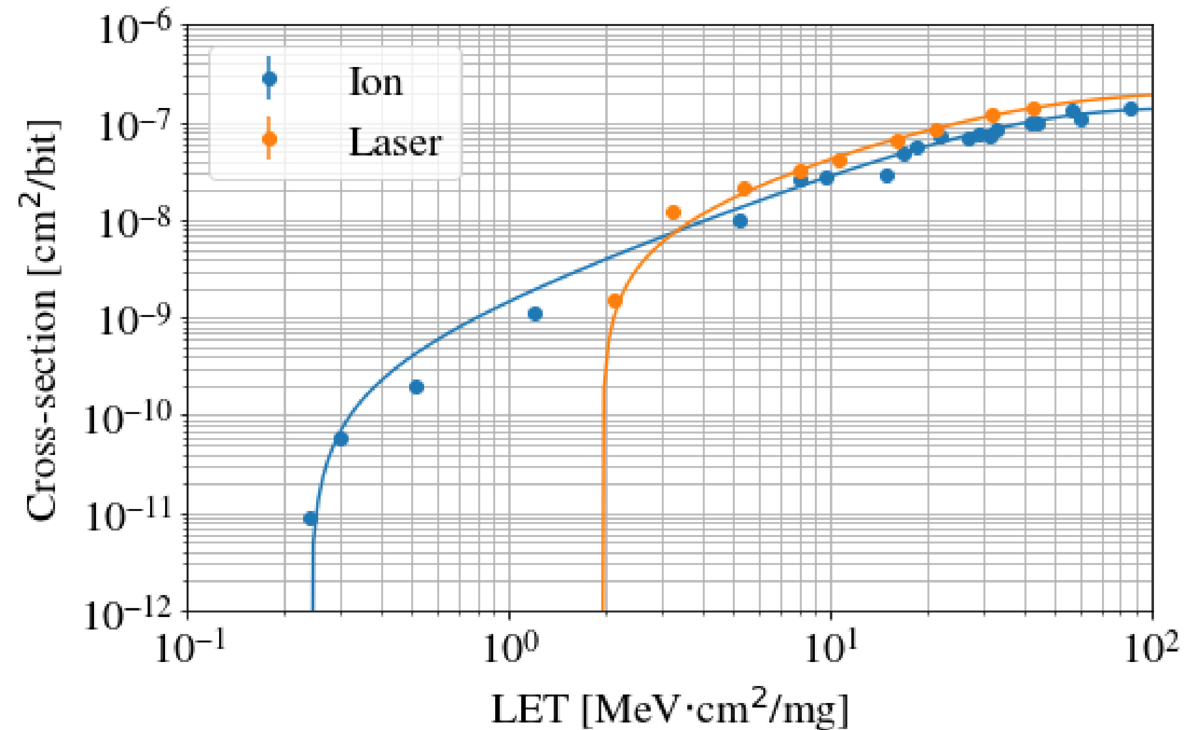
ISSI IS61WV204816BLL



Cypress CY62167GE30



110nm SEU SRAM

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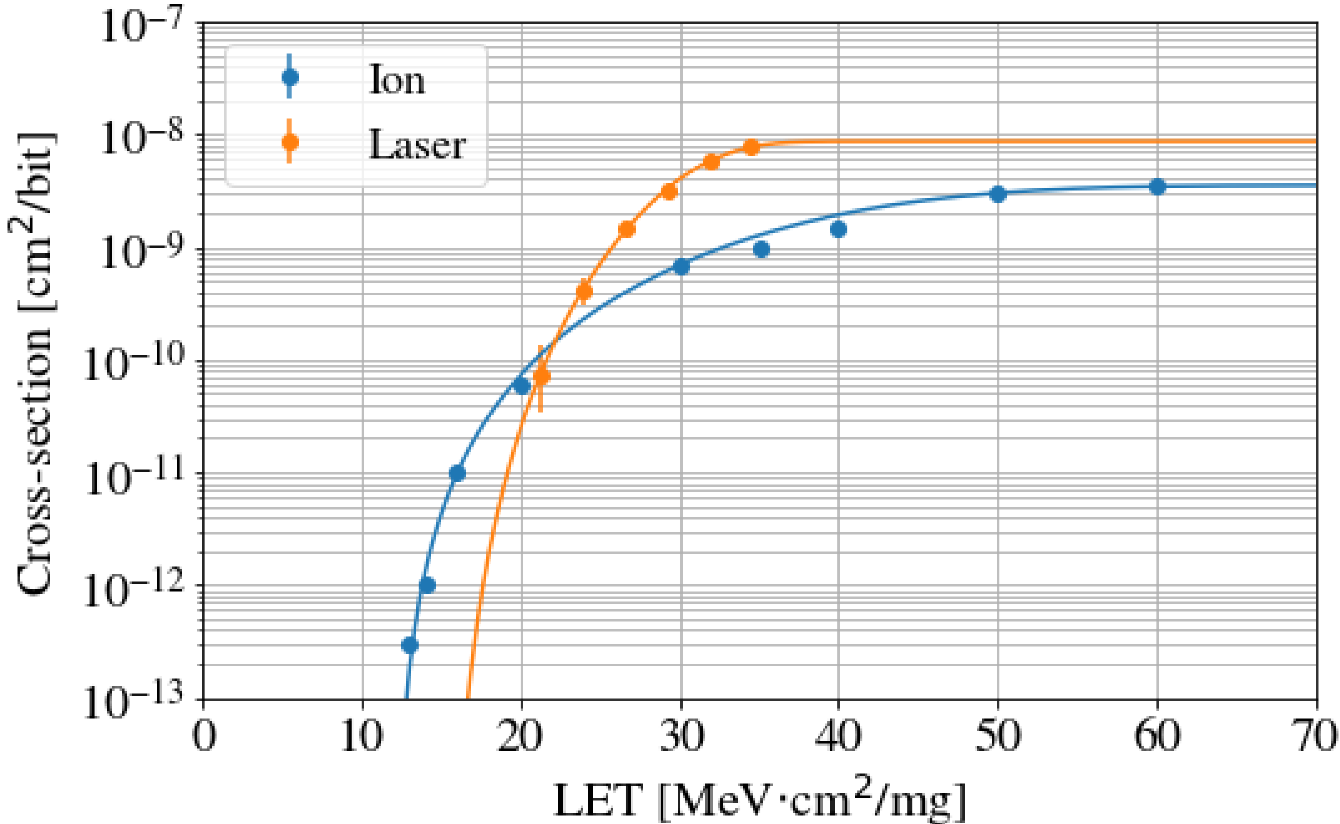
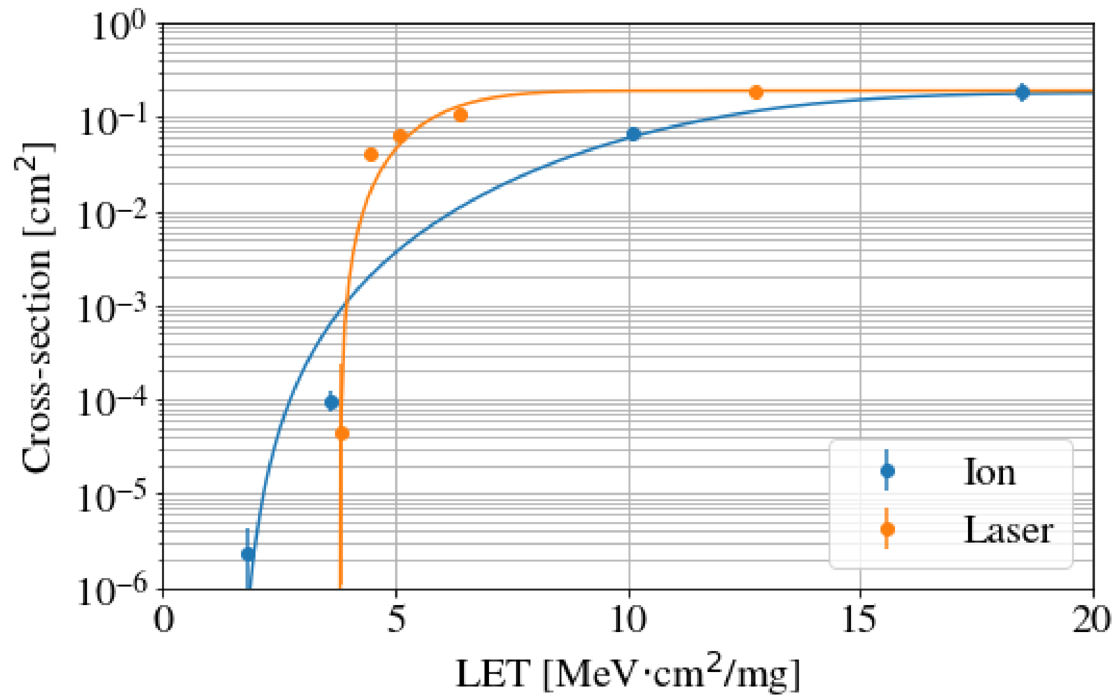
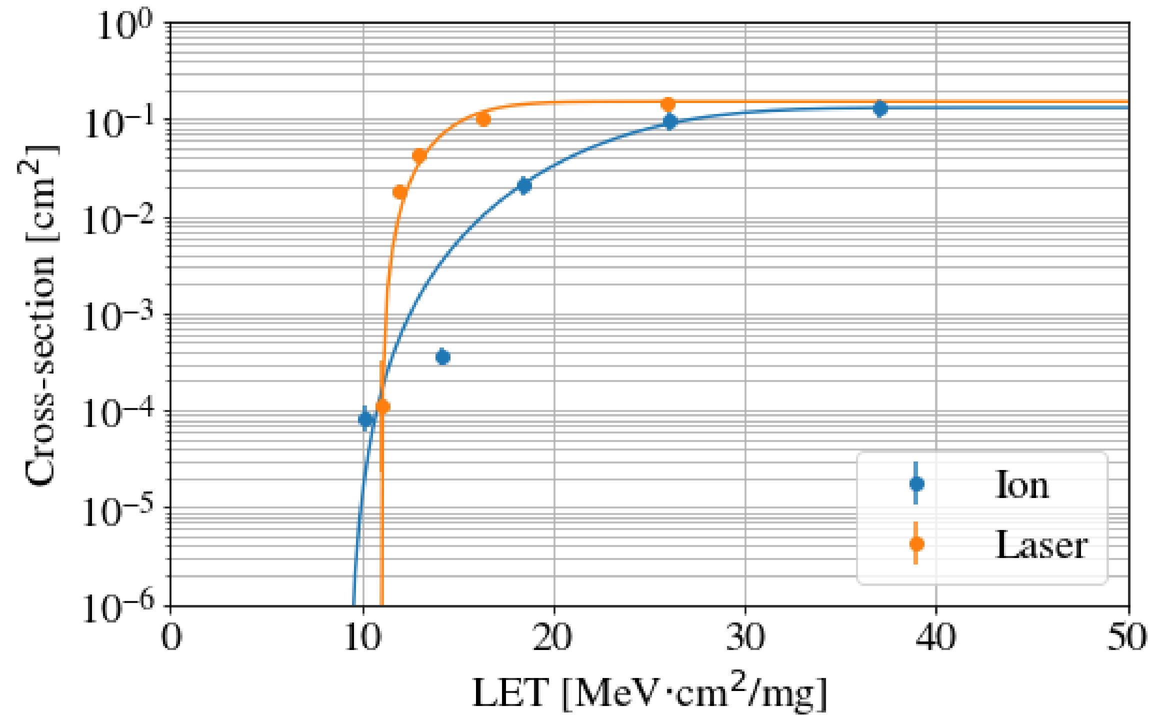
Renesas RMLV0816BGSA



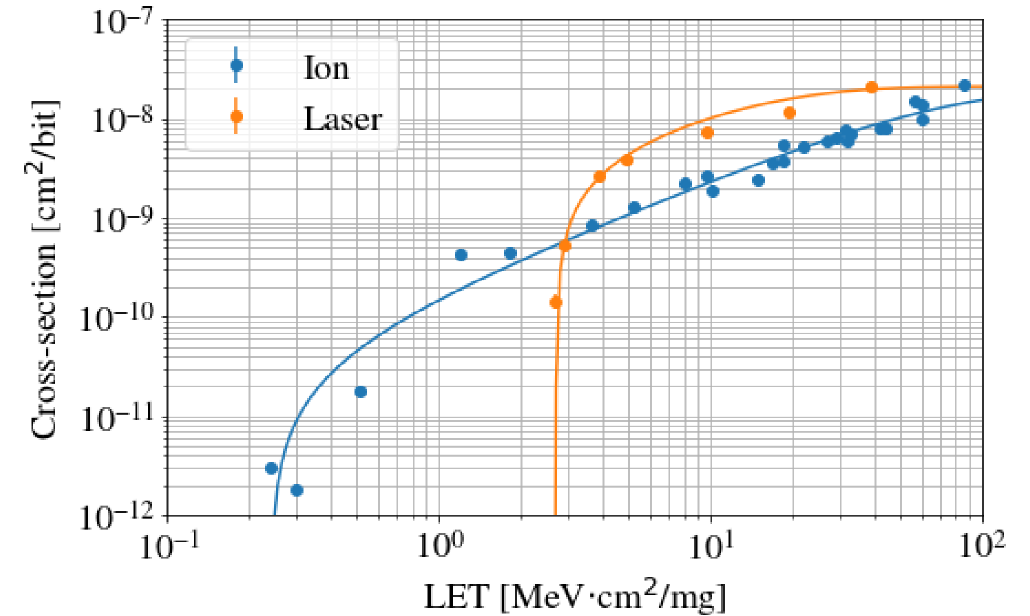
SEL-sensitive SRAM





Weibull parameters head-to-head

- **Higher laser-equivalent LET threshold:** dependant on LET definition**.**
- **Similar saturation cross-section** (within 10%): Device feature.
- **Lower shape and width parameters:** Fast increase in the cross-section with energy, possibly related to laser pulse shape with energy.



Parameter	Laser compared to ions
LET_{Th}	↑
σ_{Sat}	=
$s,\ w$	↓

Experimental threshold fit

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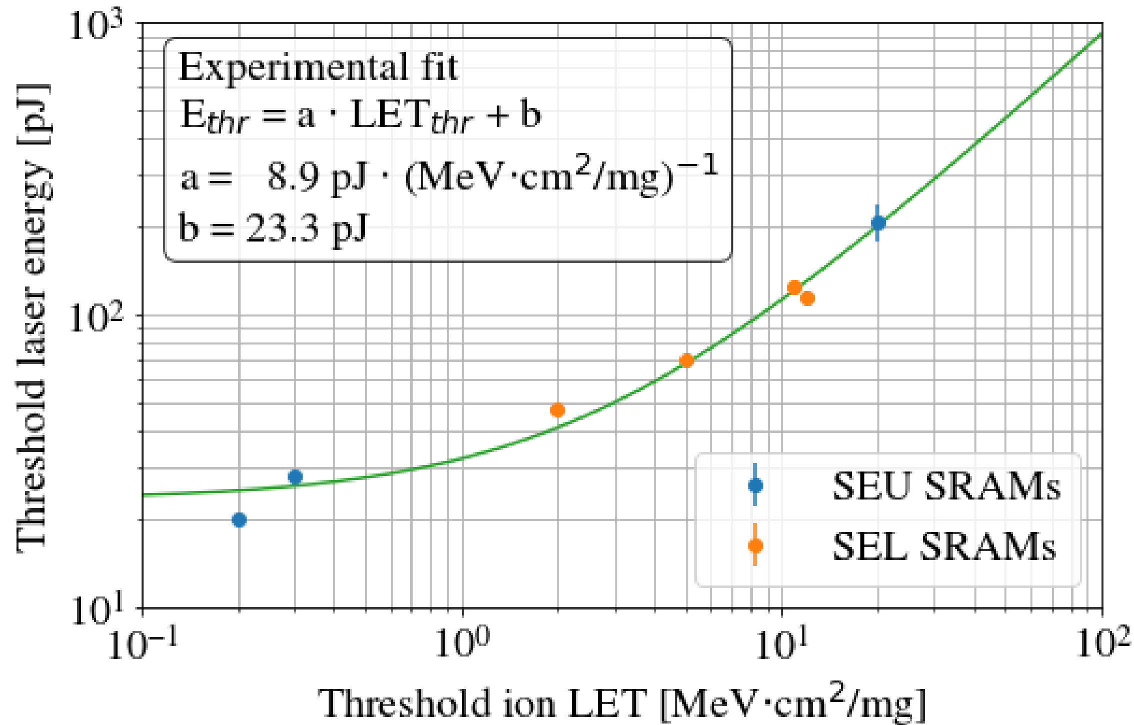

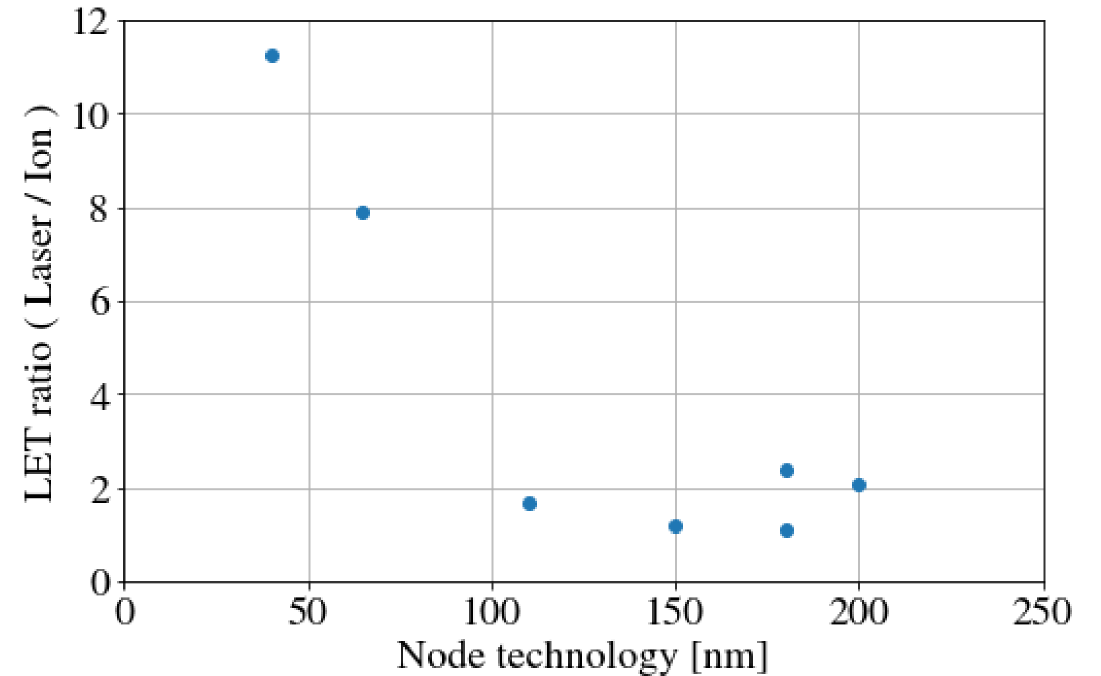

Linear correlation between threshold pulse energy and ion LET (mind the log axes)

Infinite integration laser LET / Ion LET

Summary

- A set of **seven SRAM memories** (SEL and SEU-sensitive) were tested.
- **Laser** results **compared to standard heavy-ion** SEE tests.
- Confirmed role of contact wells to determine SEL sensitive areas.
- **Weibull fit parameters** were confronted.
- **Linear trend** of laser **threshold energy** with respect to **ion LET** threshold.
- Infinite volume laser-equivalent LET vs ion LET **thresholds deviate for deep submicron SRAMs**, and match for > 100 nm technologies, particularly for threshold > 10 MeV·cm^2/mg.
- Continuation of the work at RADECS 2024 with SEE rate in-orbit simulations.

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Extra: SEL-sensitive SRAM