esa

RADECS

Radtest Ltd

A comparison of heavy ion and laser SEE test data for analogue and digital parts

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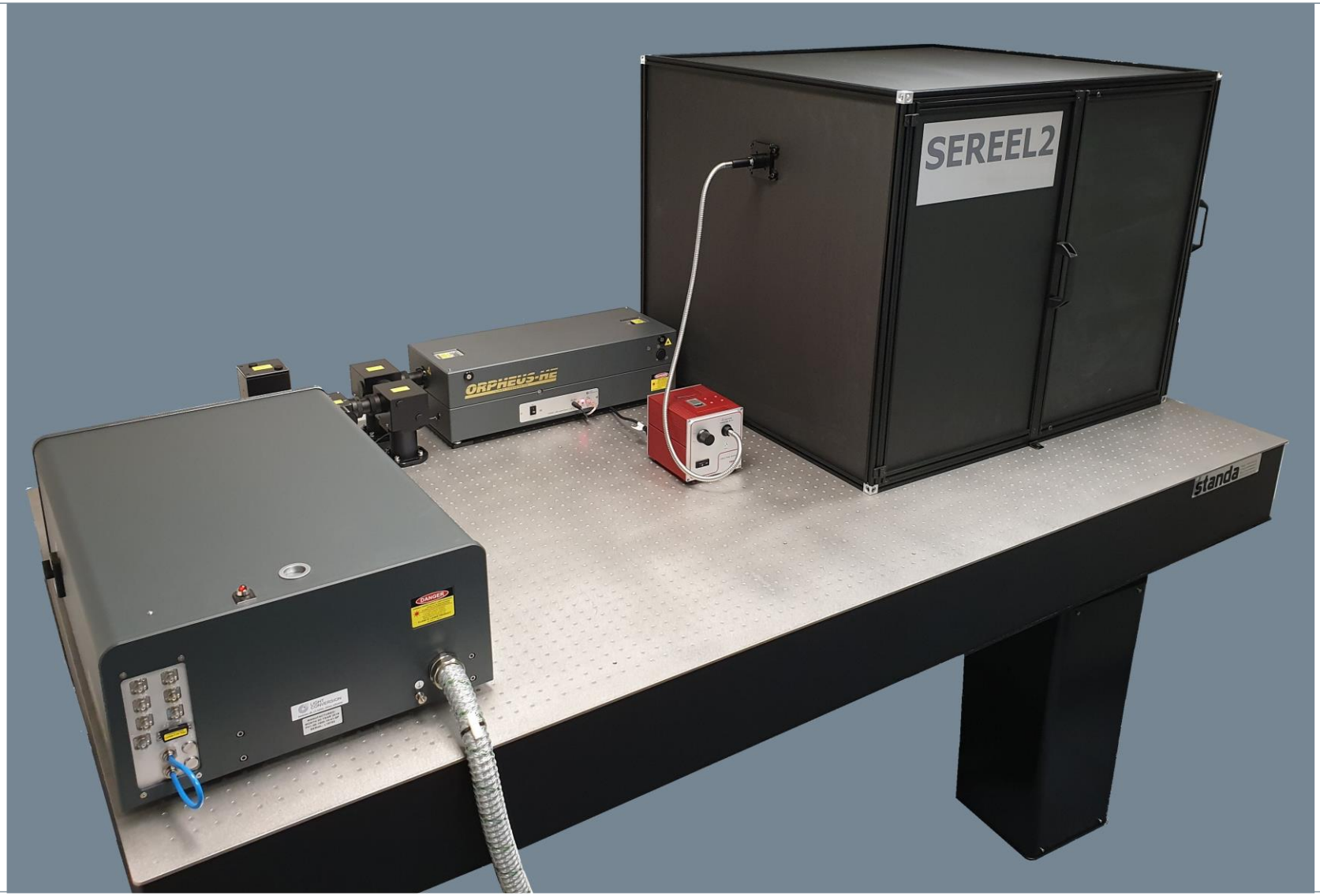
Radtest Ltd

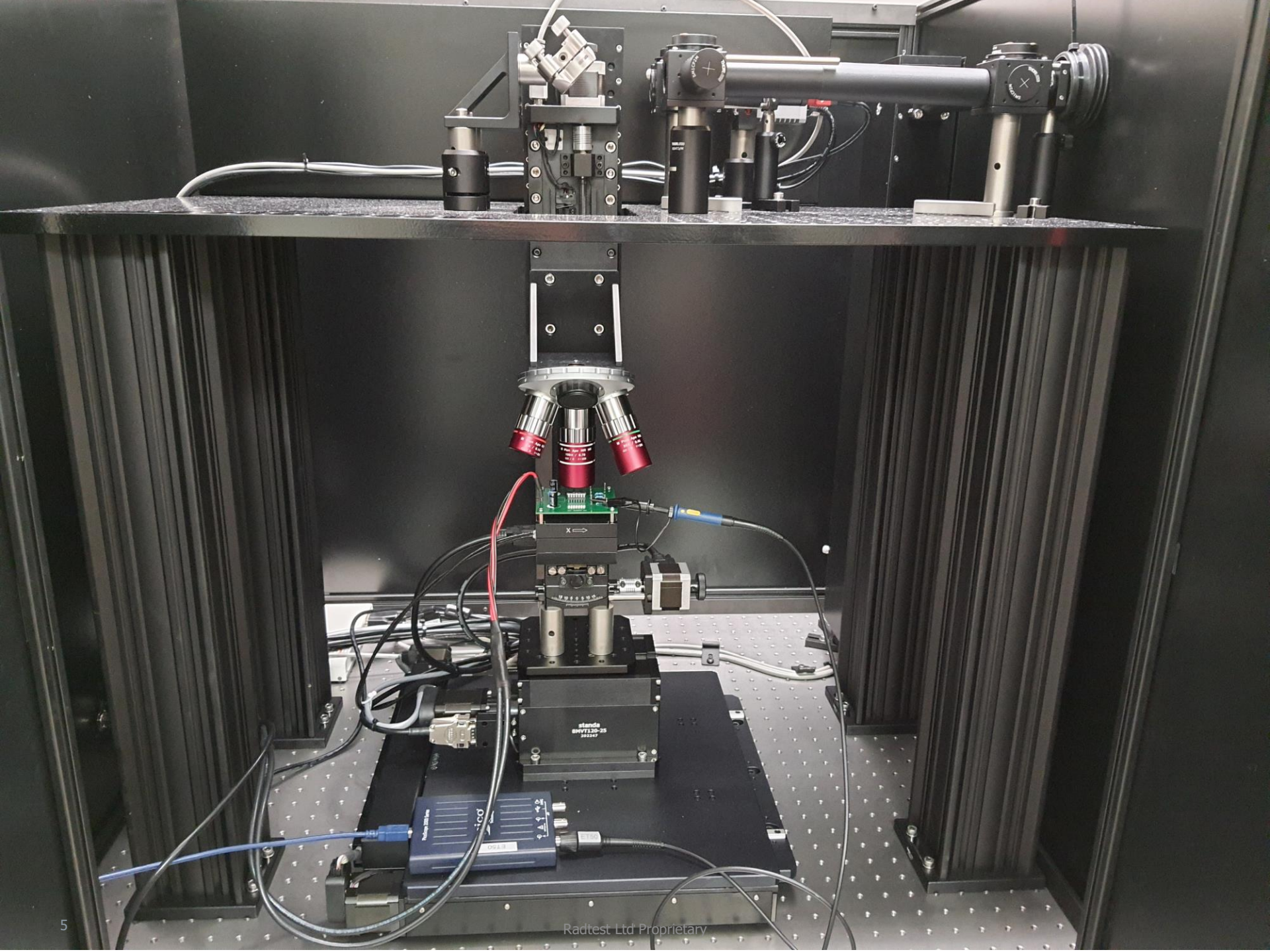
- The Radtest story began in December 2013, originally as part of Aeroflex, then Cobham and since 2020 an independent company
  - Located at Harwell, Oxfordshire in the heart of the UK space hub
  - Core service offering of radiation testing
  - Key product: SEREEL2 laser SEE test systems
  - Sectors covered:
    - Space
    - Nuclear
    - High-energy physics
    - Medical
    - Industrial

SEREEL2 and SCIF

- In October 2023, the UK Space Agency awarded a grant to Radtest, one of fourteen under the Space Clusters Infrastructure Fund (SCIF)
- The grant covered the manufacture, installation and commissioning of a SPA+TPA SEREEL2 system at Harwell
- The aim of the grant is to provide a system for rental for commercial testing purposes and to act as a development test-bed for improvements to the capabilities of SEREEL2, including to the SEESIM operating software
- Included was funding for comparative testing of digital and analogue test vehicles, using SEREEL2 and a heavy ion facility

SEREEL2 example configuration





Analogue test vehicle

- LM124 quad op amp, TI
- Widely used as a benchmark device for pulsed laser testing, enabling easy comparison with results from elsewhere
- Familiar to us from previous testing on SEREEL2
- One quarter shown here from IR camera image, with key transistors identified

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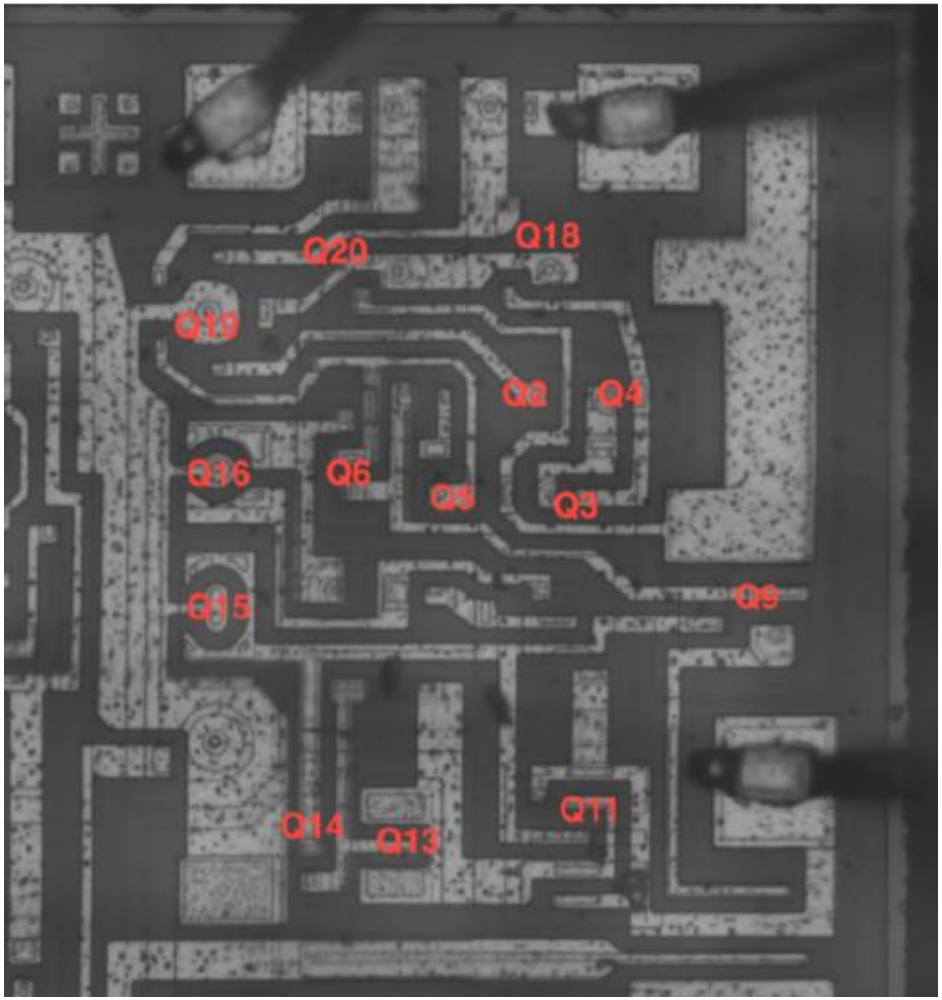
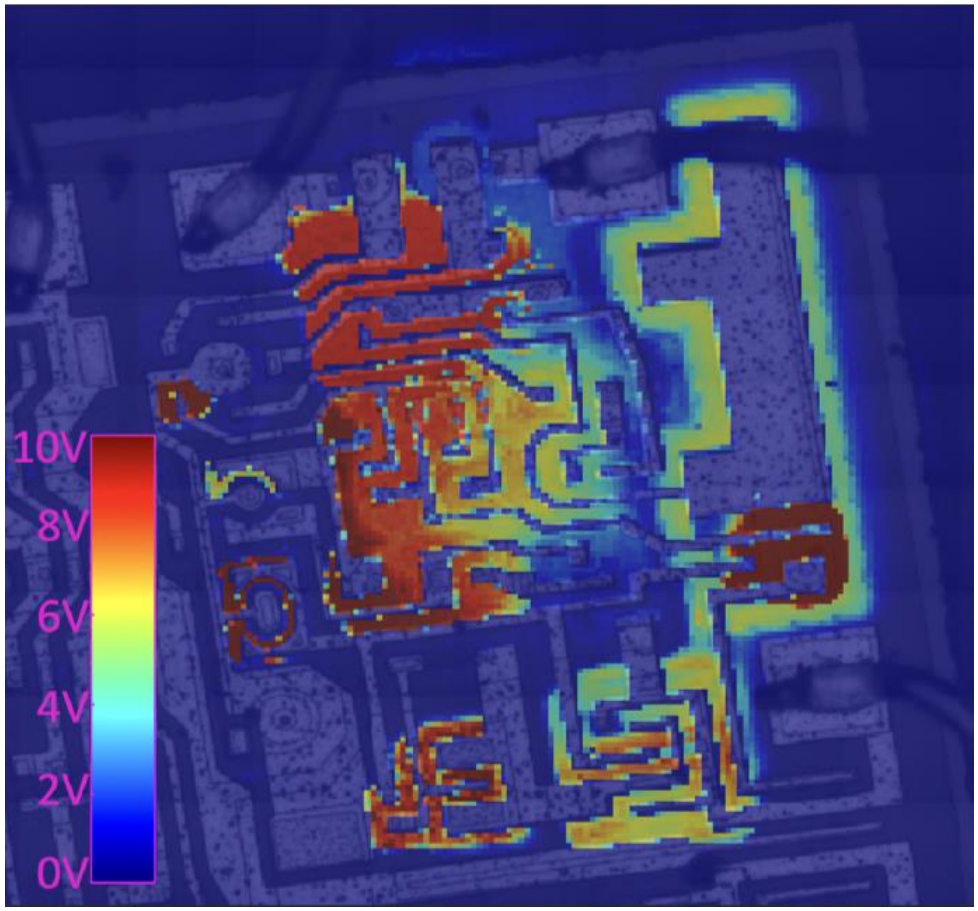


Analogue test vehicle – laser results

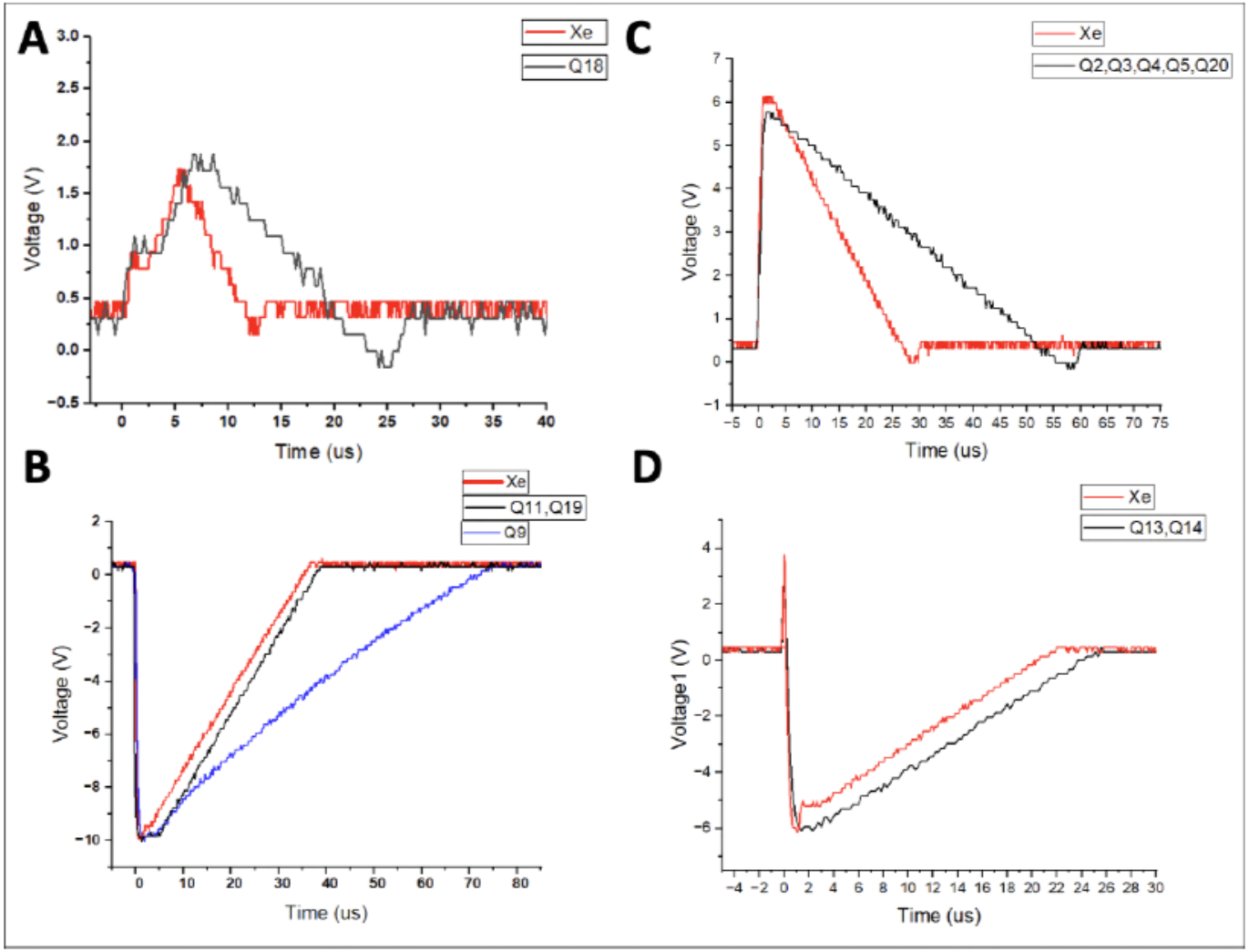
- Pulse energy values of 1 - 6 nJ, 1064nm, 200fs, 50x lens (NA 0.65), 2μm step size
- Many SETs observed
- Four categories of pulse shape have been associated with distinct transistor locations
- Cross-section curves derived



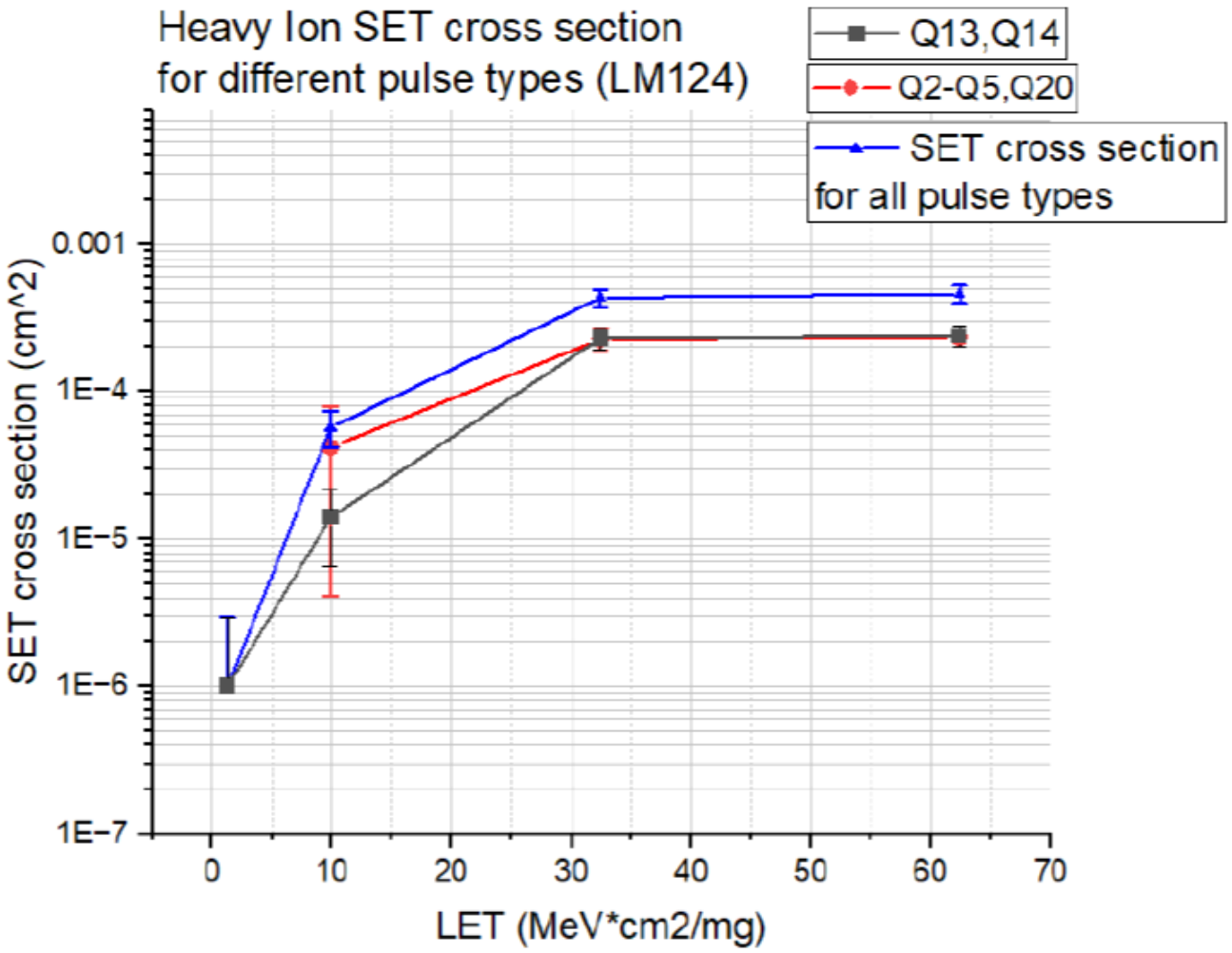
Analogue test vehicle – heavy ion results

- Test data obtained from HIF at UCL using the 9.3 MeV/nucleon cocktail
- LET values of 1.3, 3.3, 9.9, 32.4 and 62.5 MeV/mg/cm^2
- Four categories of pulse shape observed
- Cross-section curves derived

Analogue test vehicle - conclusions



Analogue test vehicle - conclusions



Analogue test vehicle - conclusions

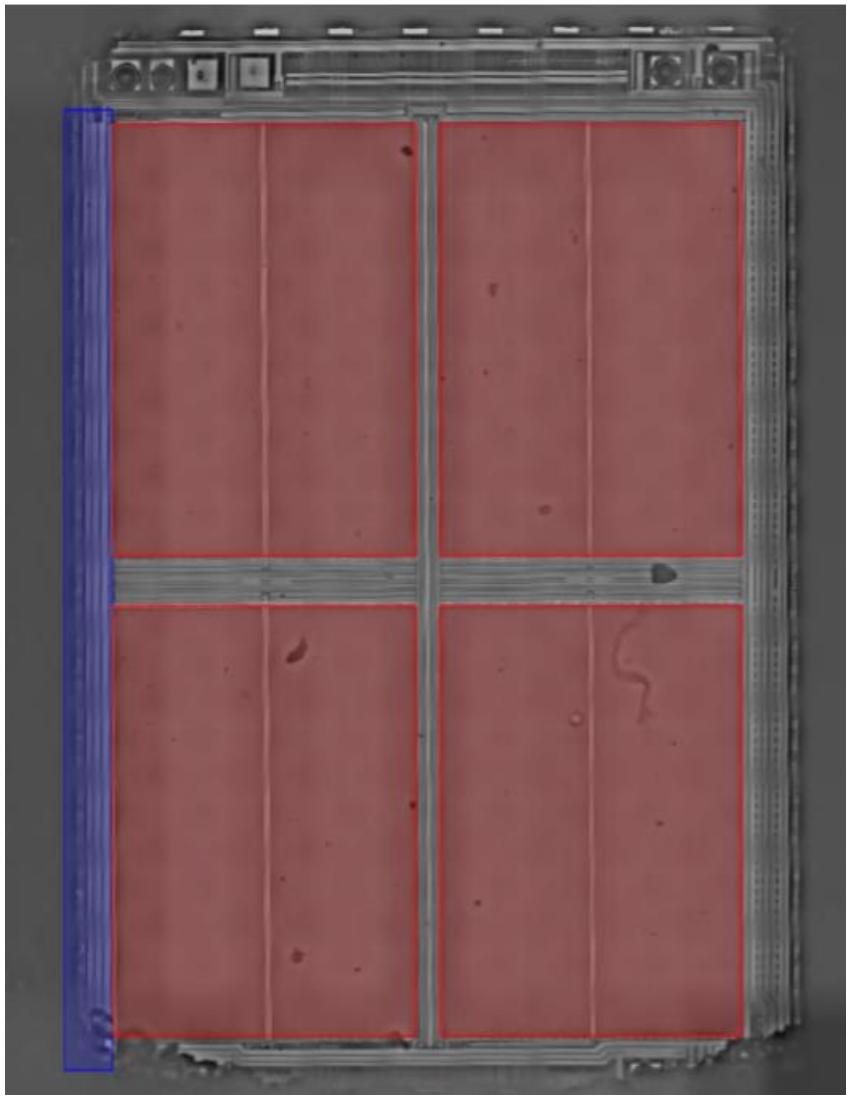
- Excellent agreement between laser and heavy ion results
- Similar effects observed, in terms of pulse shapes, magnitude and relative abundance
- Similar cross-section curves
- Saturation and threshold values very similar

Digital test vehicle

- 23LCV512 serial SPI SRAM, Microchip
- Familiar as previously used for development of a separate test system (student project)
- Front side exposure used for both laser and heavy ion testing

Digital test vehicle – laser results

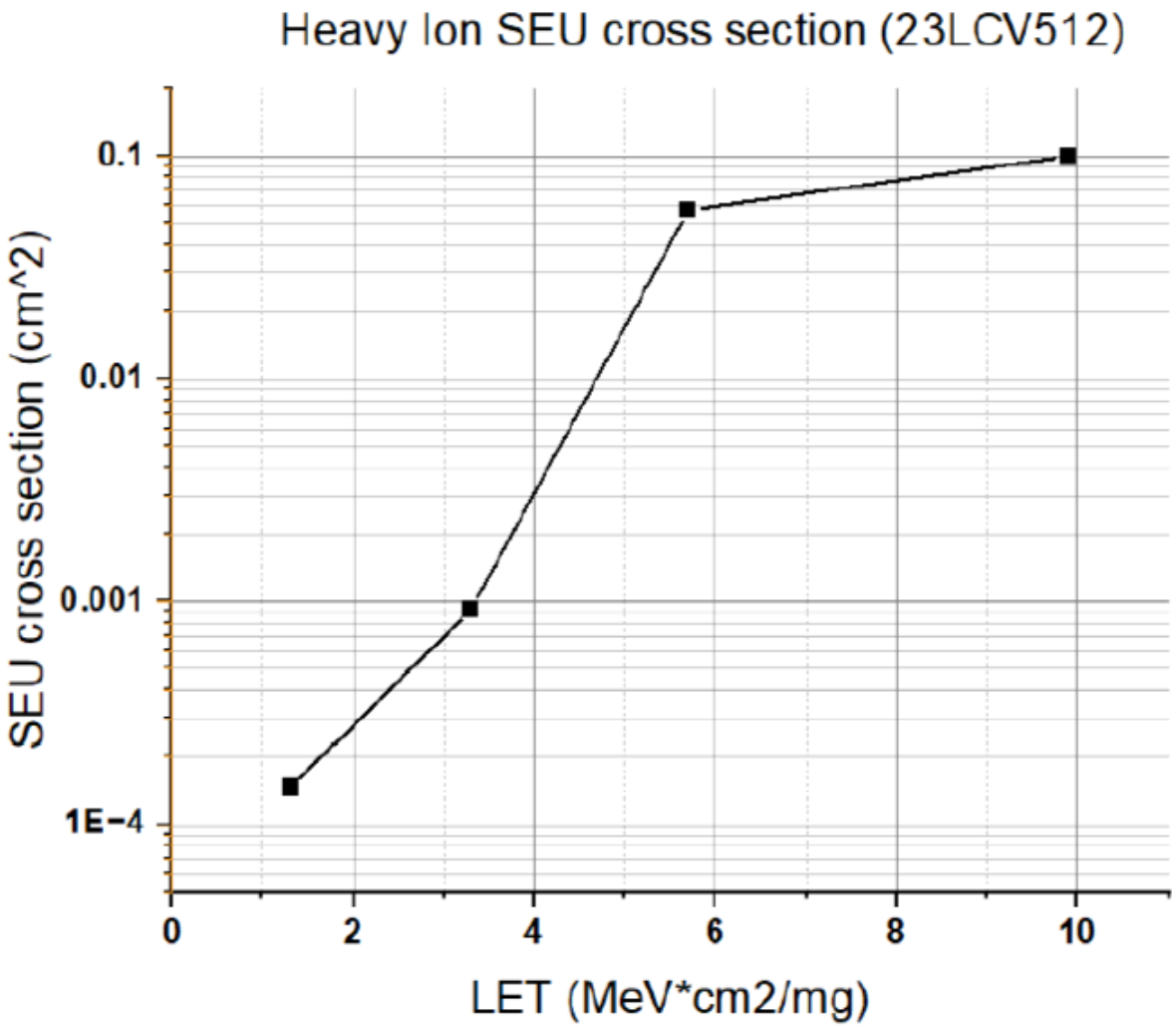
- Pulse energy values of 1 - 6 nJ, 1064nm, 200fs, 50x lens (NA 0.65), 2μm step size
- Front side lasing showed sensitivity only on one edge (blue), probably due to metallisation
- No SEU but many 4-bit MBU observed
- No latch-up observed
- Cross-section curves derived



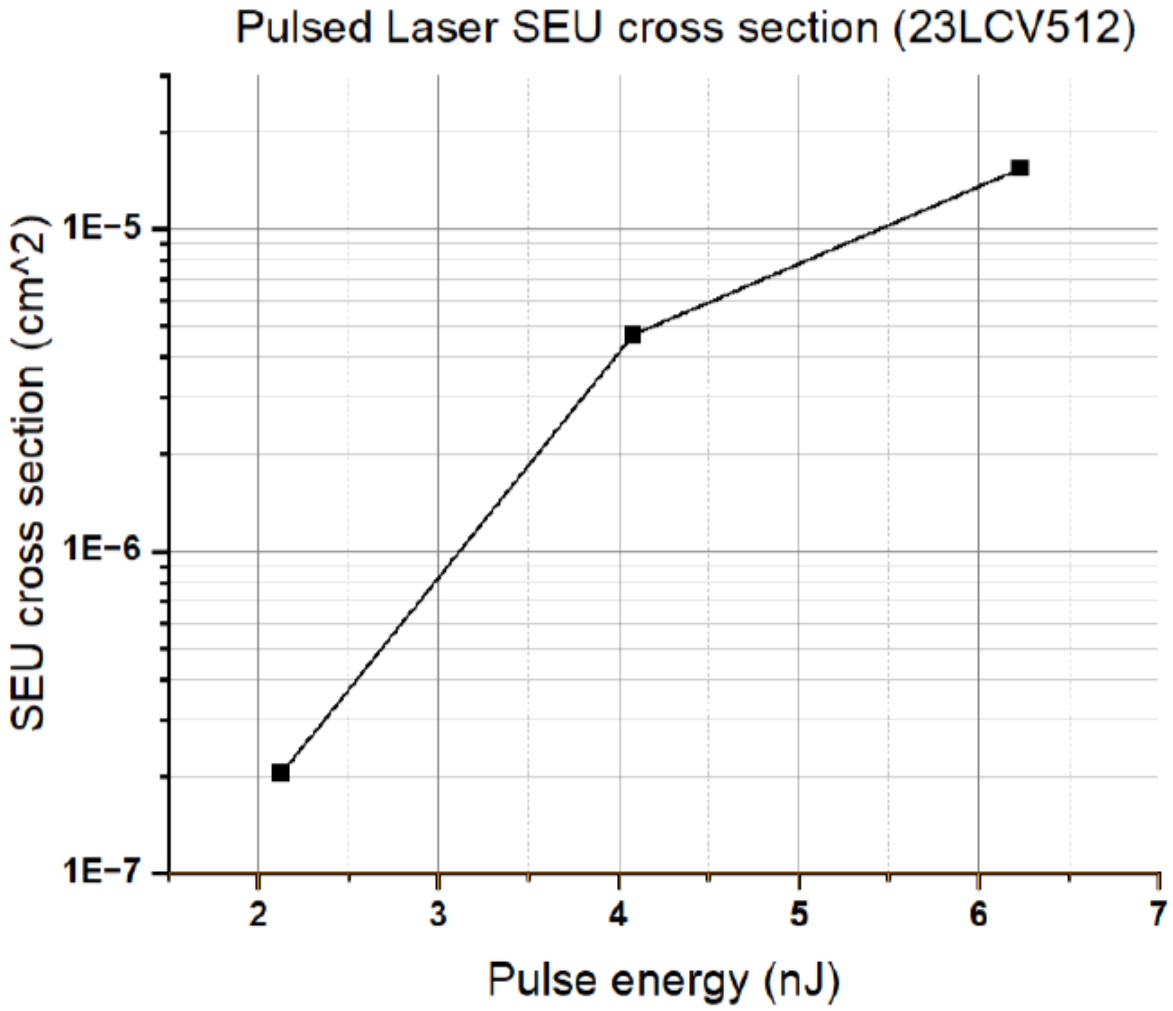
Digital test vehicle – heavy ion results

- Test data obtained from HIF at UCL using the 9.3 MeV/nucleon cocktail
- LET values of 1.3, 3.3 and 9.9 MeV/mg/cm^2
- High sensitivity to latch-up
- Many SEU but only a few 2- and 3-bit MBU observed
- Cross-section curves derived

Digital test vehicle - conclusions



Digital test vehicle - conclusions



Digital test vehicle - conclusions

- Qualitatively similar effects observed, although predominantly SEU with heavy ions and MBU with laser
- No laser effects observed in memory cell area, believed to be due to extent of metallisation above sensitive regions
- Many MBU observed in the output region
- Cross-section curves of similar shape but significantly different scale
- Laser testing from the back would enable data from the memory cells also to be gathered

Summary

- Facility: the SCIF grant has enabled a SPA+TPA SEREEL2 system to be set up at Radtest's Harwell site and is now available for use
- Benchmarking: comparative testing of analogue and digital samples has been carried out, using both SEREEL2 and heavy ions
- Analogue: close agreement
- Digital: agreement in one area of the DUT, lasing from the back required for assessment in the memory cell areas

- Open day: planned for Q4 2024, date TBC – watch for an announcement

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