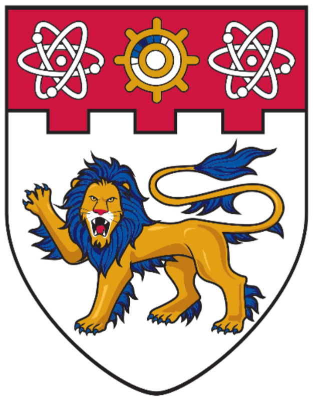

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Radiation Testing – NTU Pulsed Laser SEE Test Setup

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ABSTRACT

This paper describes the pulsed laser Single Event Effect (SEE) radiation test setup established at NTU. Pulsed laser SEE test provides a complementary (but do not yet replace) technique to conventional heavy ion accelerator test (which faces high cost, long waiting time, limited access, etc). Advantages of this technique include providing users with the ability to control both the spatial and timing aspect of the induced SEE, thereby revealing additional information which otherwise cannot be obtained from broad beam heavy ion test. We also present various case studies and advantages on a variety of tested devices, some results of which are compared with heavy ion test.

PRINCIPLES

Pulsed laser test technique is based on the photoelectric effect whereby silicon absorbs a photon in order to generate an electron-hole pair. Although different from heavy ion (via coulombic interaction), the resultant e-h pair effect is sufficiently similar to mimic the effects.

NTU SETUP

A pulsed laser source of 1064 nm, 10 ps was integrated with a Semicaps Optical Failure Analysis system. The laser can deliver up to 11 nJ (at source) of pulses from single shot to 50 MHz.

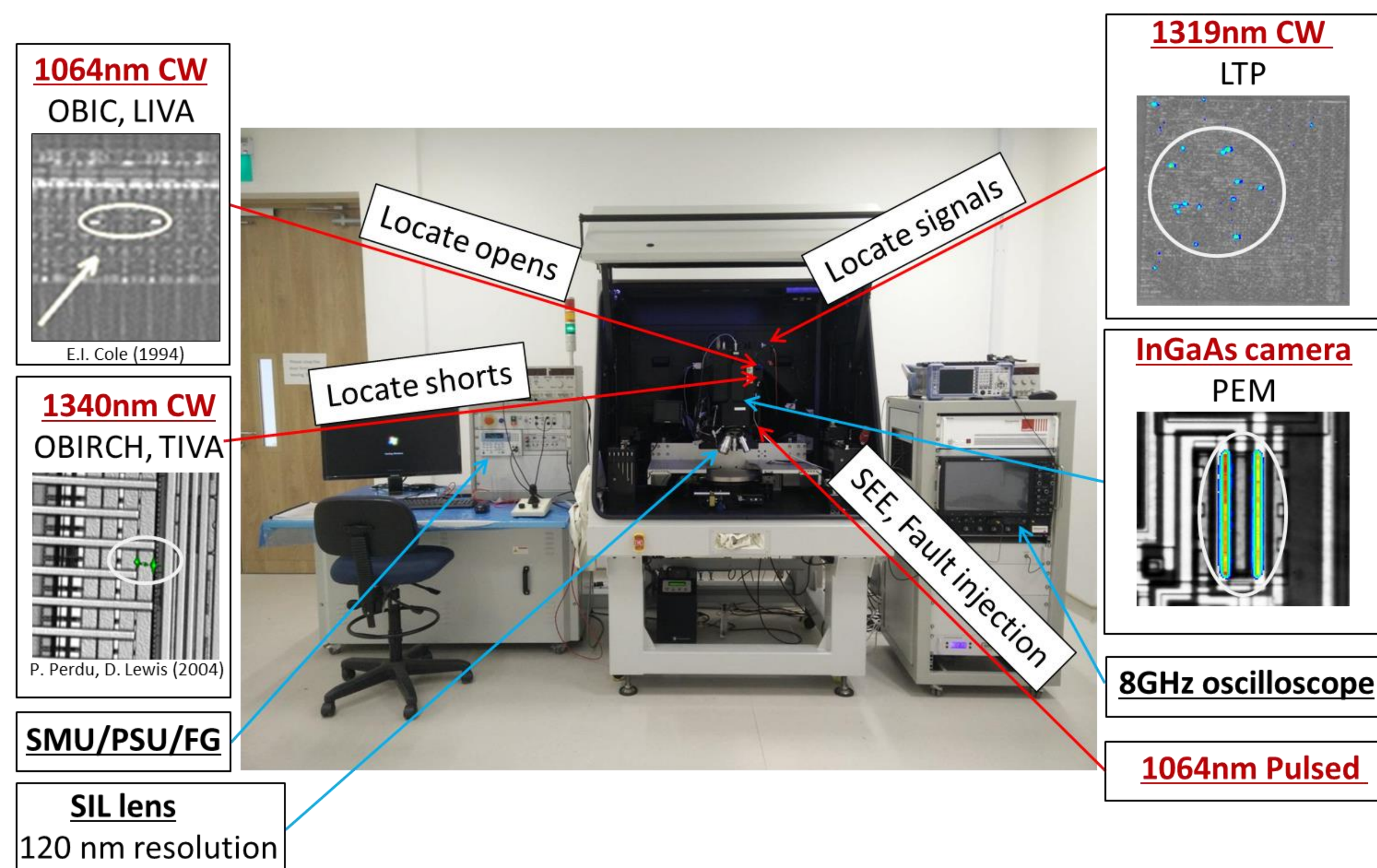

Fig 1. Integration of pulsed laser to Semicaps Optical Failure Analysis system. Several other optical techniques are also available in the system.

ADVANTAGE 1: SPATIAL CONTROL

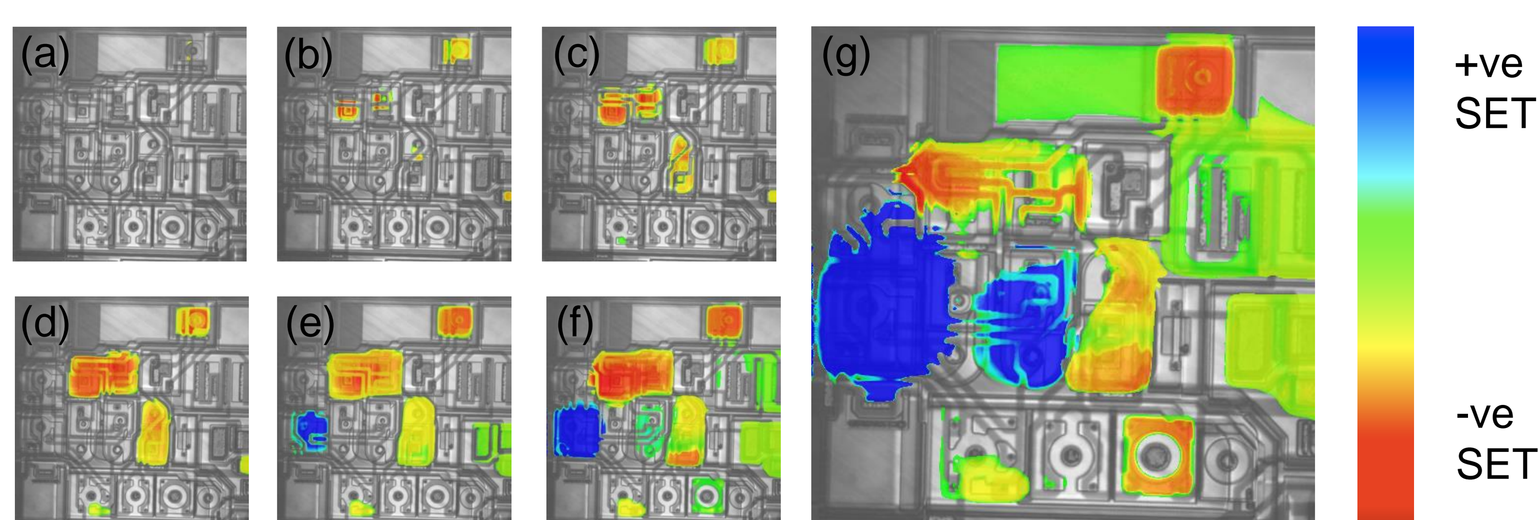

Fig 2. Localization of SET-sensitive area in LM124 operational amplifier. Increase in SET-sensitive area as laser energy increases from (a) to (g).

ADVANTAGE 2: TEMPORAL CONTROL

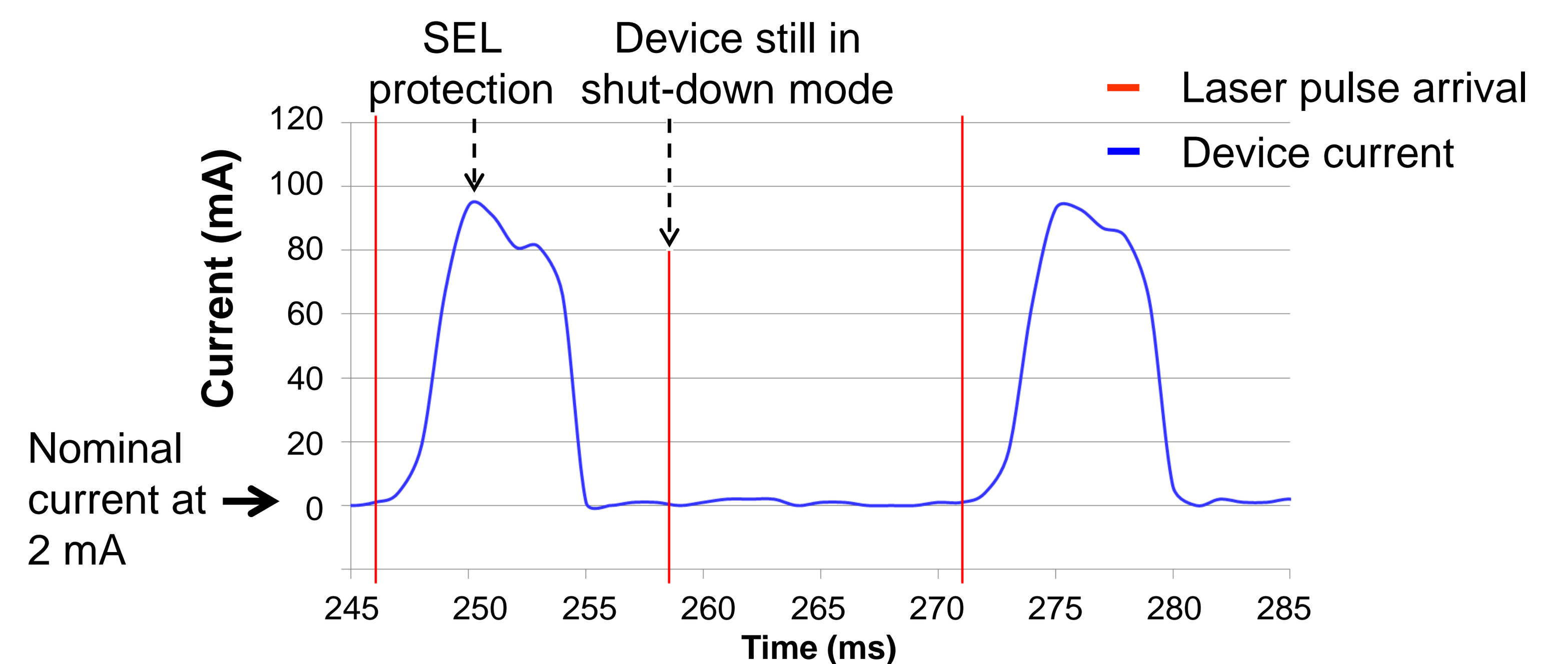

Fig 3. 80 Hz laser inducing "on-demand" SEL (i.e, high current state) in AD8629. Controlled laser timing and repetition to induce SEE at specific time in a test pattern.

CASE STUDY 1: SYNERGY OF TECHNIQUES

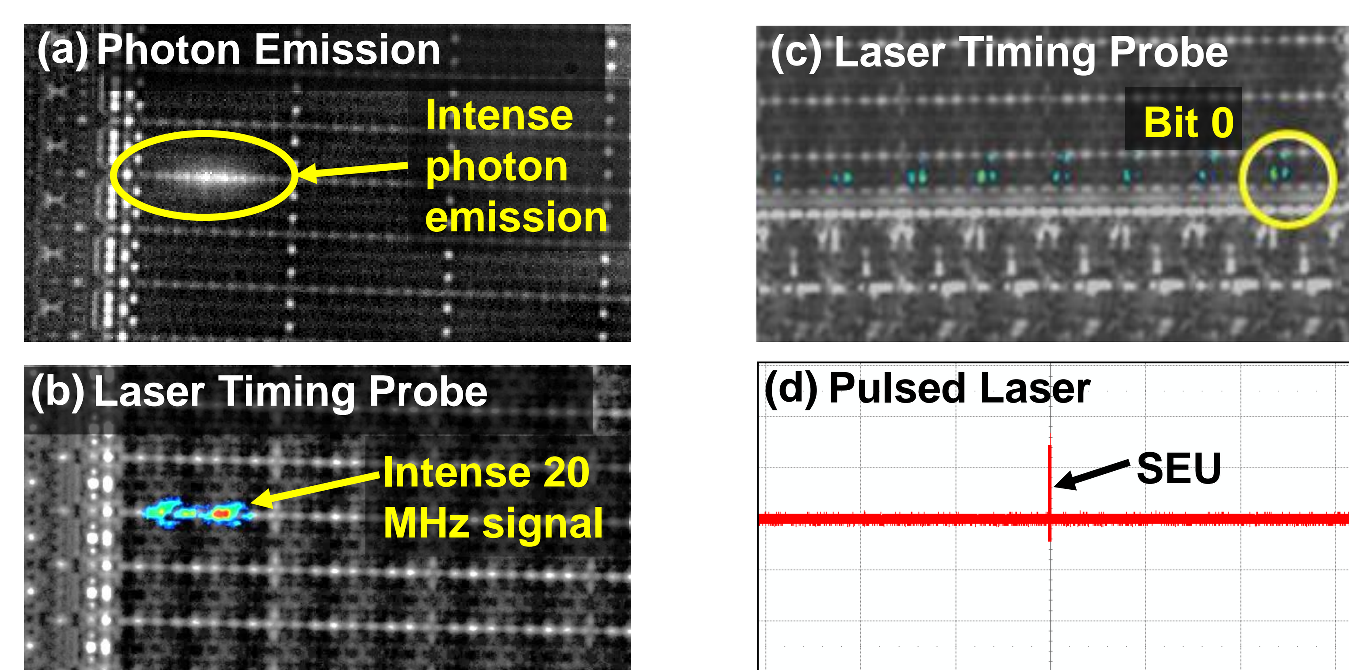

Fig 4. Demonstration of various techniques (in a single system) on a commercial microcontroller : (a) Localizing SEL site, (b) Locating 20 MHz signal, (c) Localizing memory bit physical location and (d) Inducing SEU.

CASE STUDY 2: EFFECTS OF AGEING

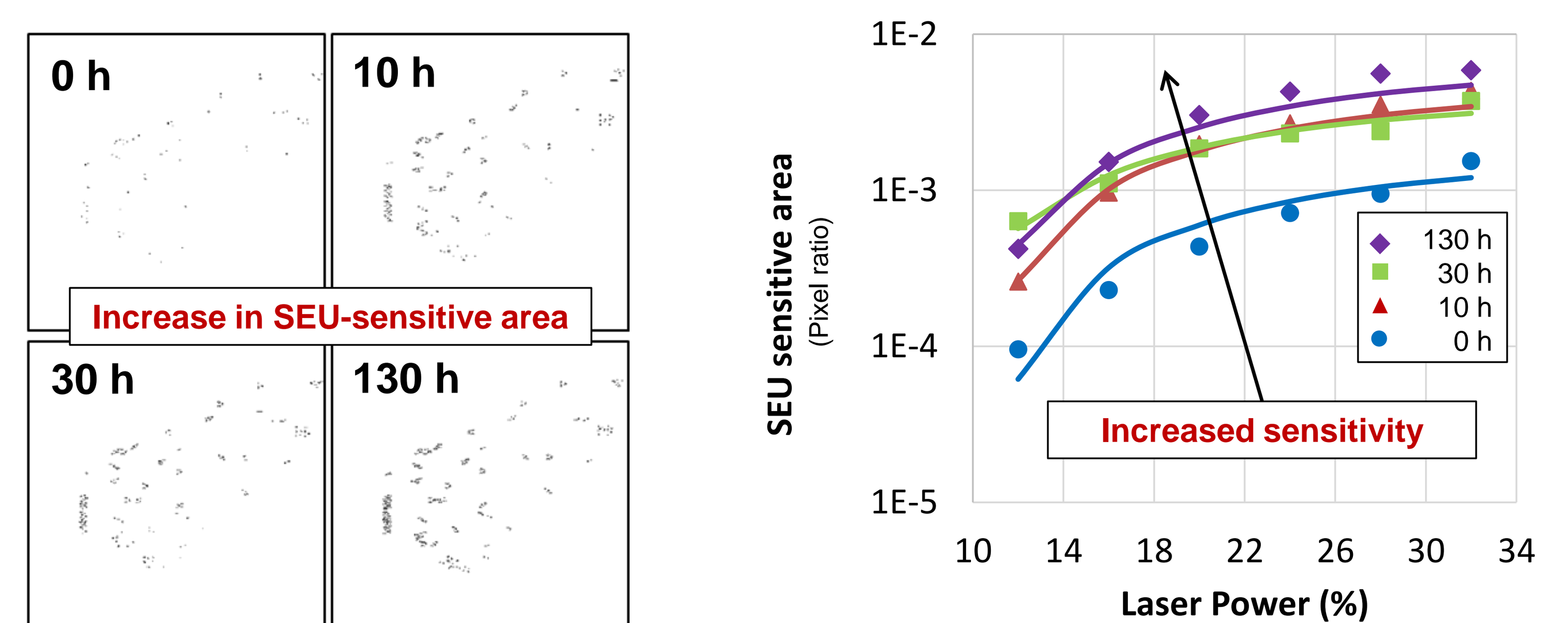

Fig 5. Increase in SEU-sensitive area in 65 nm chain of 100 flip-flops after voltage stress of 12.5% above nominal for various stress duration.

CONCLUSION

Pulsed laser test technique can offer quick radiation evaluation for design feedback and reduce turnaround time. Both traits may prove especially attractive for short development cycles of cubesats.

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