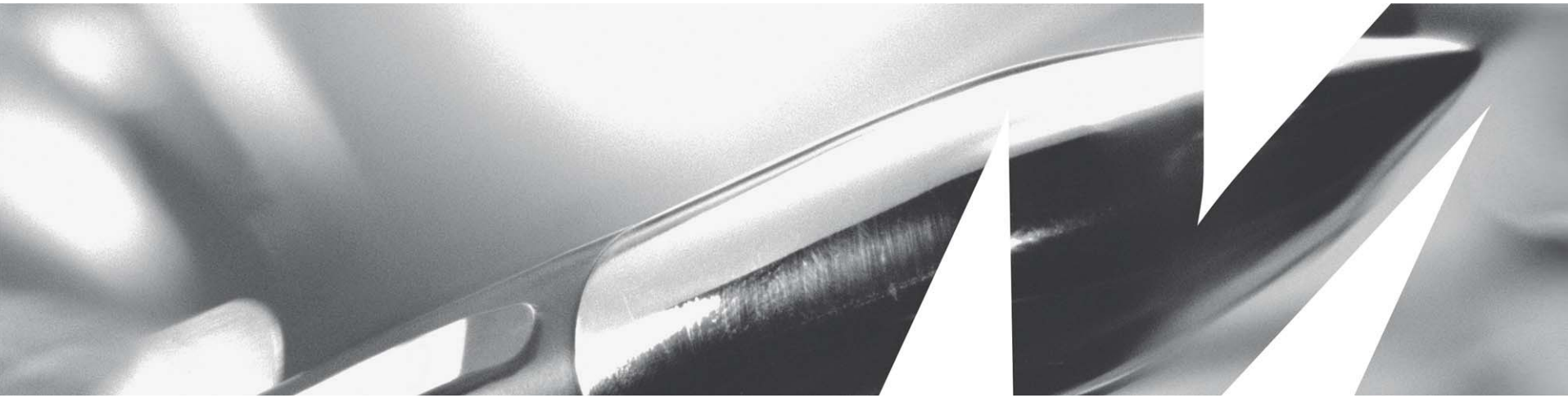

SET Sensitivity Testing with Lasers

By Andrew Chugg

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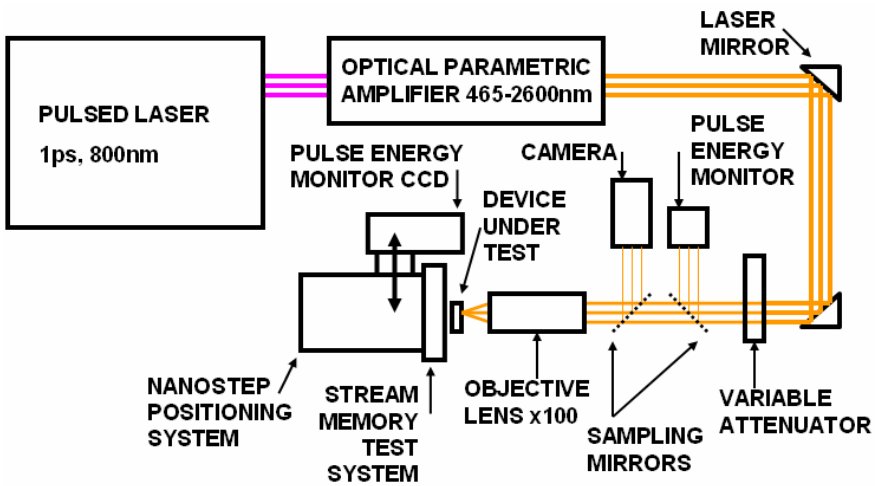
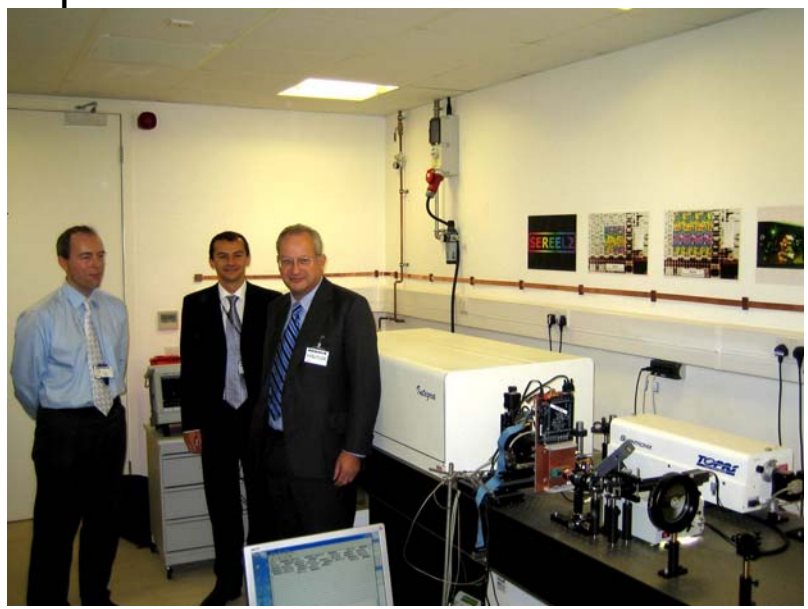
Why lasers are useful for SET sensitivity testing

- SET's propagate before they manifest an error/upset
  - Normal radiation beams do not reveal the location of SET sensitivity
  - Radiation microbeams have limited availability and are difficult to use
- Even sensitive region depths and thicknesses can be measured
  - Subject to some limitations on spatial resolution
- Lasers can potentially expose DSET sensitivity at lower operating frequencies than ions or nucleons
  - Because higher equivalent LET's are possible with lasers than are available with beams





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Conduct of SET testing with lasers

- The laser pulse should be comparable in duration with the SET event
  - Or at least short compared with the duration of the SET
- Laser pulse penetration needs to be sufficient
  - This depends on wavelength
  - IR pulses are needed to reach sensitive regions at 10's of μm
- Ideally there should be means of approximately calibrating laser pulse energy against LET
  - So that laser results can be related quantitatively to radiation particle SET's
- Metallisation may obscure SET sensitive regions
  - Therefore backside pulsing may be required
  - Two-photon technique is currently most spatially precise
    - But LET calibration is difficult, because absorption is non-linear
  - Single photon pulsing at ~1μm wavelength is also possible
    - But there is absorption through the entire substrate
    - LET calibration is difficult, because absorptivity is strongly dependent upon dopant concentration near the bandgap

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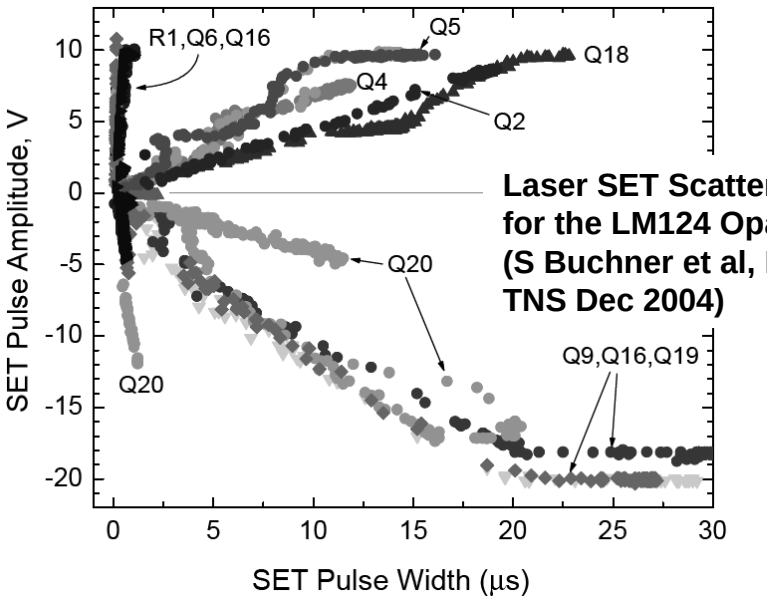
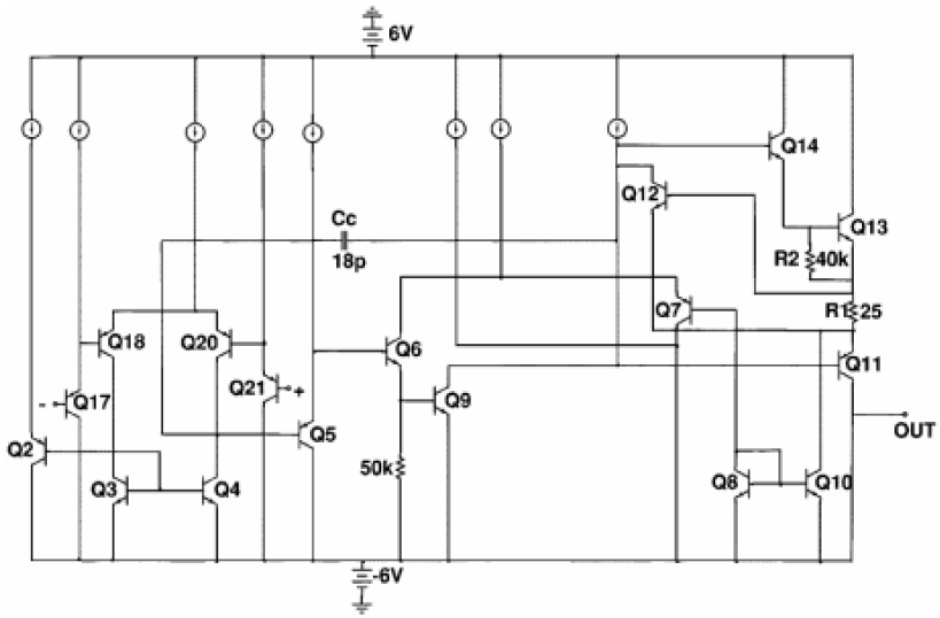
Conduct of Analogue SET testing with lasers

- Large feature sizes and large gaps between metallisation
  - Front side lasing is therefore possible
- Scatter plots of peak SET voltage versus duration
  - Exhibit various trends
  - A range of such trends may be seen in ion beam testing
  - Laser SET testing can be used to associate trends with transistors etc



Laser SET Scatter Plo for the LM124 Opamp (S Buchner et al, IEEE TNS Dec 2004)



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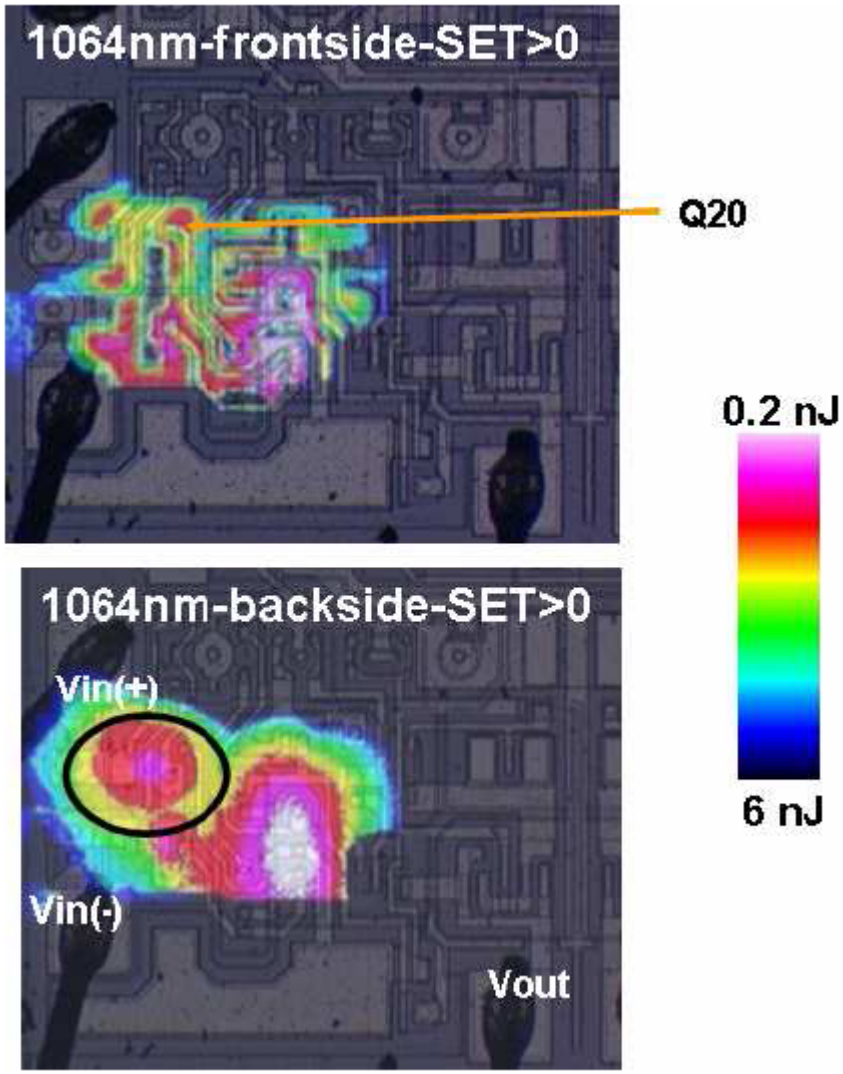
Example: ASET Sensitive Probing from either side



Probing SET Sensitive Volumes in Linear Devices Using Focused Laser Beam at different wavelengths

Cecile Weulersse, EADS, IW
Francoise Bezerra, CNES, DCT/AQ/EC
Florent Miller, EADS, IW
Thierry Carriere, EADS Astrium Transportation
Nadine Buard, EADS, IW
William Falo, TRAD

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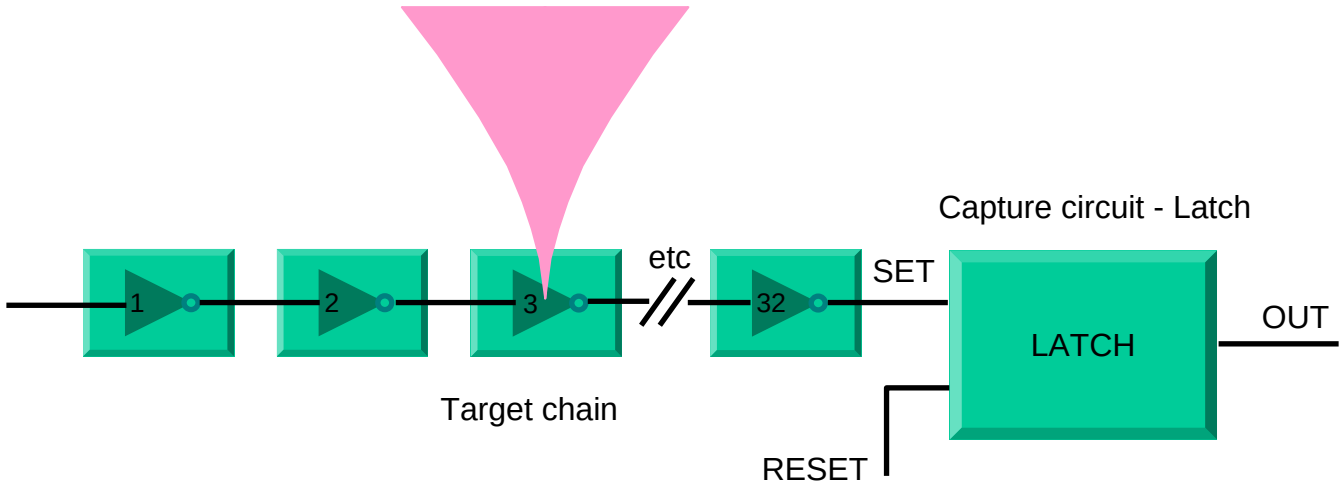
Conduct of DSET laser testing

- Short DSET durations require picosecond pulsed lasers
- Backside lasing preferable due to dense layers of metallisation
  - But direct calibration against ion sources probably necessary
- Lasers may be crucial in investigating DSET broadening in propagating through chains of device elements in FPGA's etc
  - By applying the same stimulus at different points in a chain



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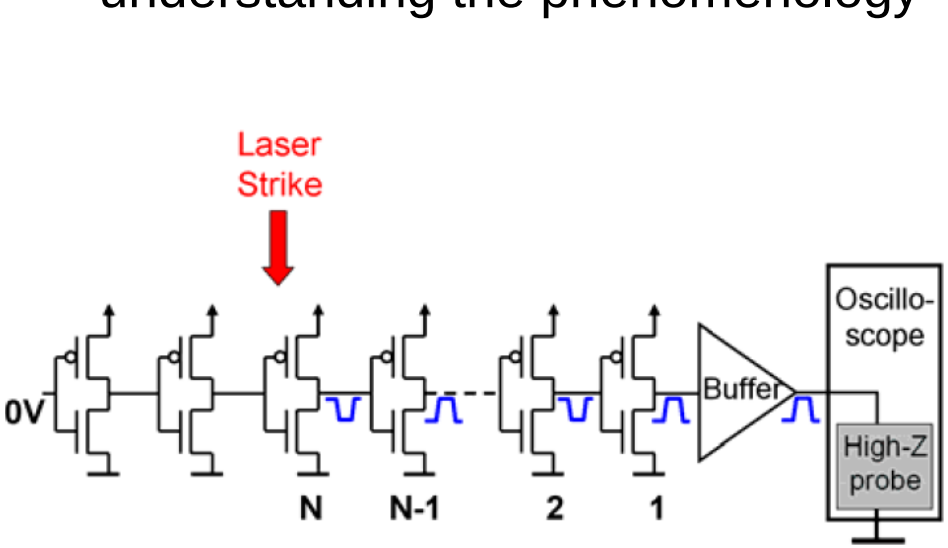
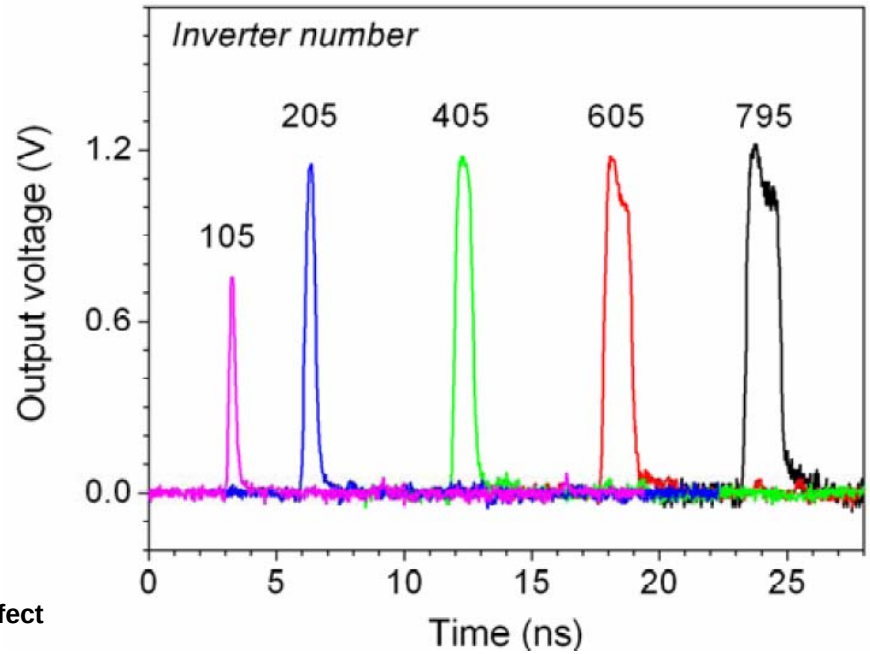
Examples of DSET laser testing

- Some initial studies show that broad agreement between laser pulse induced SET's and ion DSET's is observed
  - But there are some differences
    - Perhaps due to spatial distribution differences between ion & laser deposition
- Laser SET broadening studies have been very successful in understanding the phenomenology





Investigation of the Propagation Induced Pulse Broadening (PIPB) Effect on Single Event Transients in SOI and Bulk Inverter Chains
Veronique Ferlet-Cavrois et al, NSREC 2008

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