Comparison of Single Event Transients Induced in an Operational Amplifier (LM124) by Pulsed Laser Light and a Broad Beam of Heavy Ions

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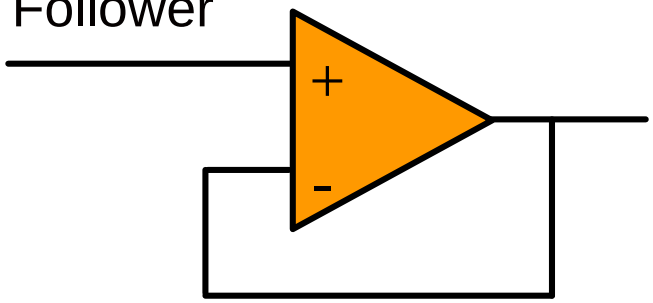
Presented by S. Buchner at RADECS03 in Noordwijk Holland September 16 2003

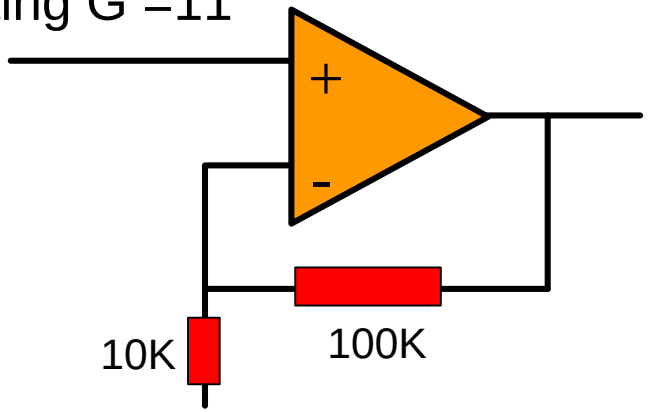
LM124

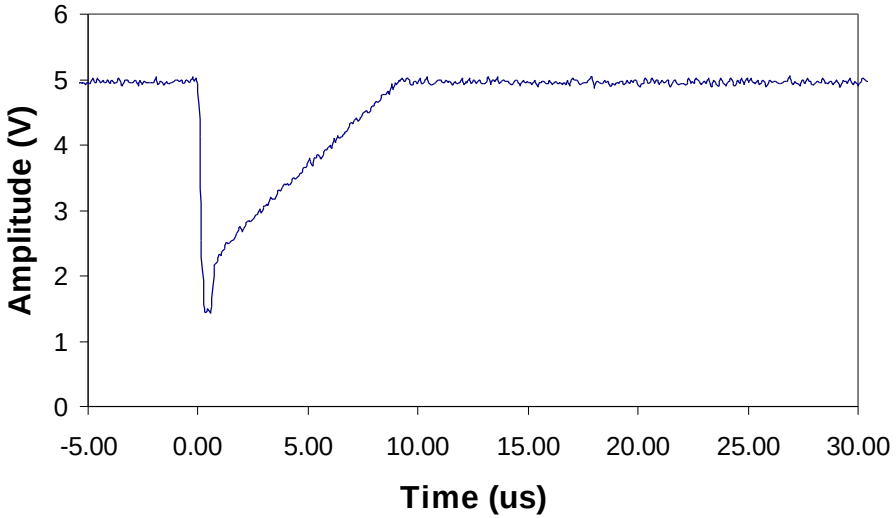
Single Event Transients in LM124

Voltage Follower



Non-Inverting G =11





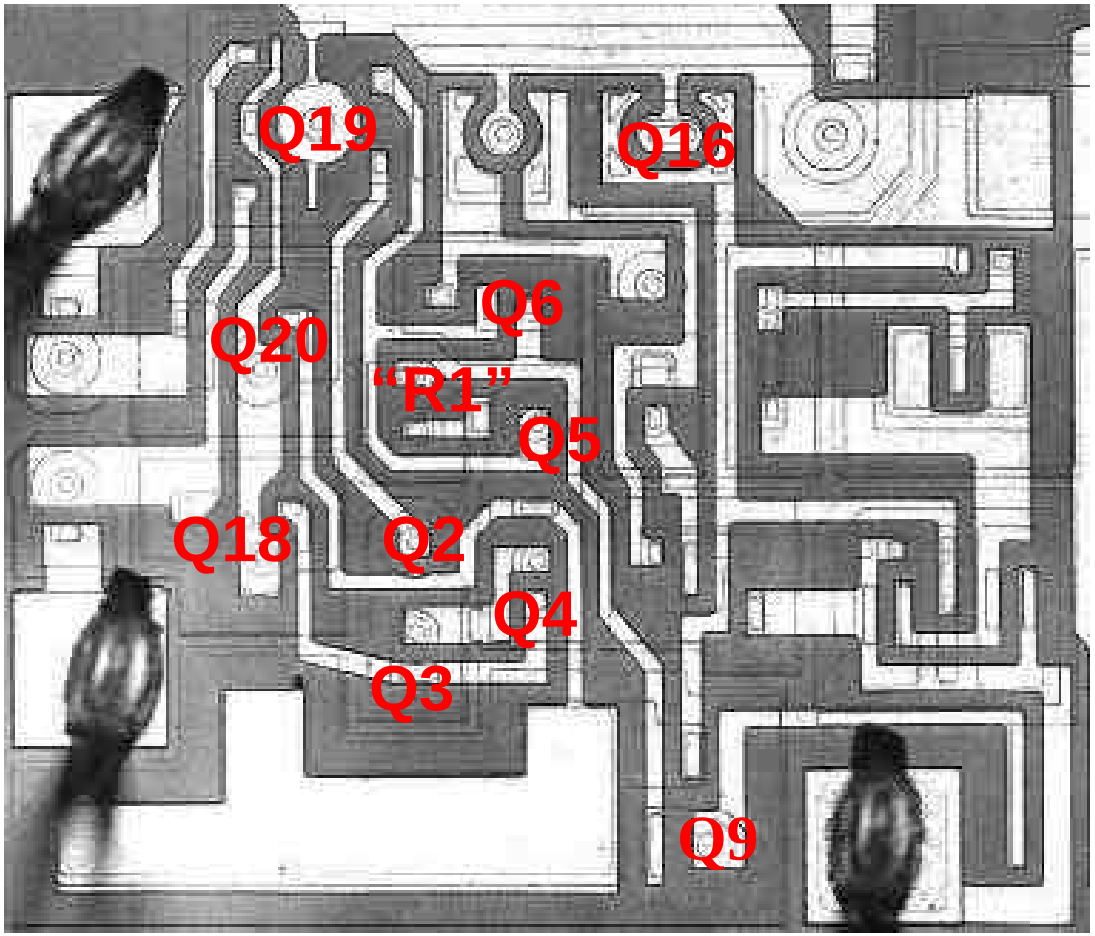
New Approach to SET Testing of Linear Devices

- It is expensive and time-consuming to do SET testing for every configuration of:
  - supply voltage,
  - input voltage,
  - gain
  - output loading
- Approach – Use a combination of pulsed laser and modeling to reduce (not replace) the amount of accelerator testing.

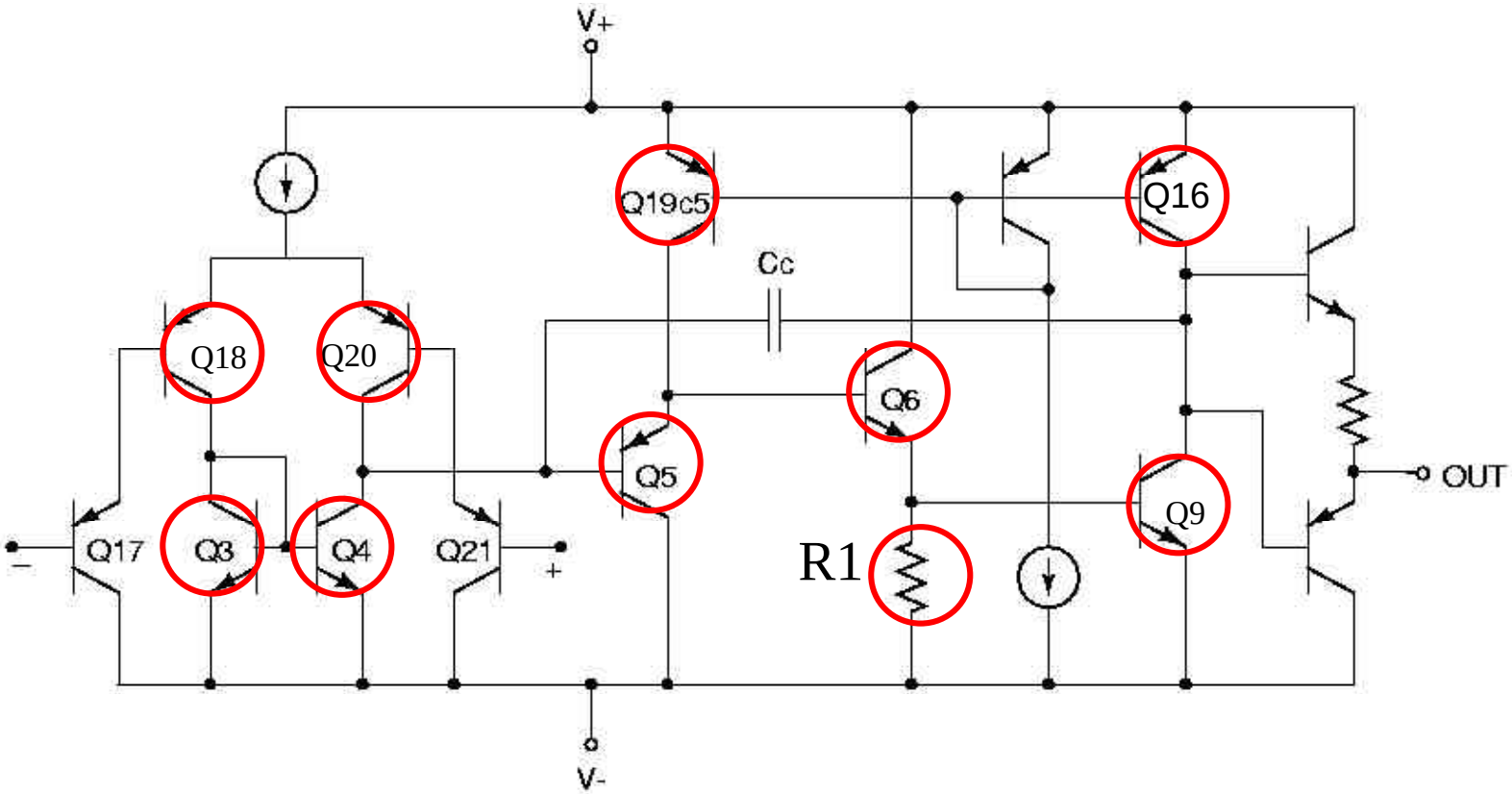
Previous Work

- Previous work showed excellent comparisons between ion and pulsed laser-light induced SETs. The results were incomplete because:
  - Ions had low LETs and small ranges, so not all transistors were SET sensitive,
  - metal coverage may have obscured some SET sensitive regions,
  - Laser light had a small penetration depth.

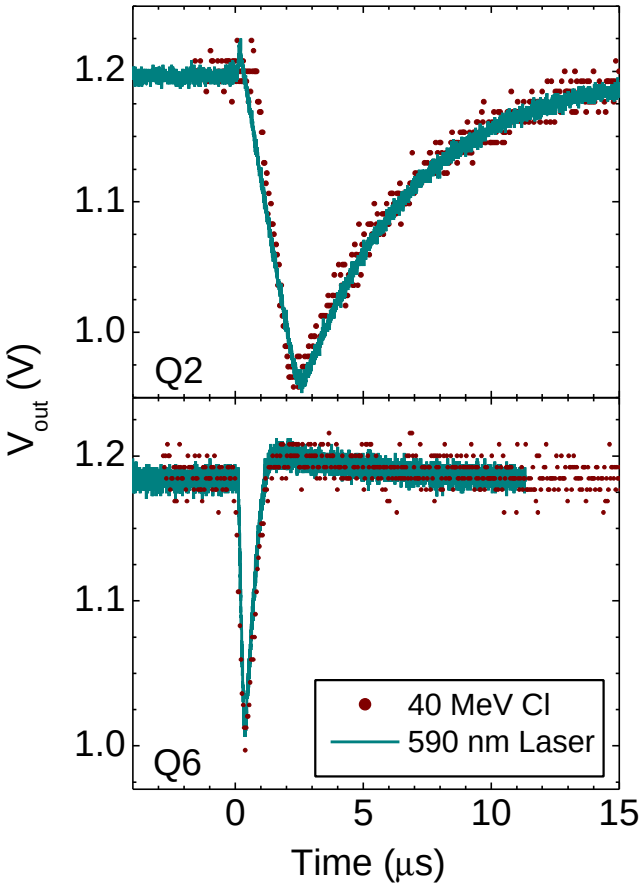
Photomicrograph of LM124



Circuit Diagram

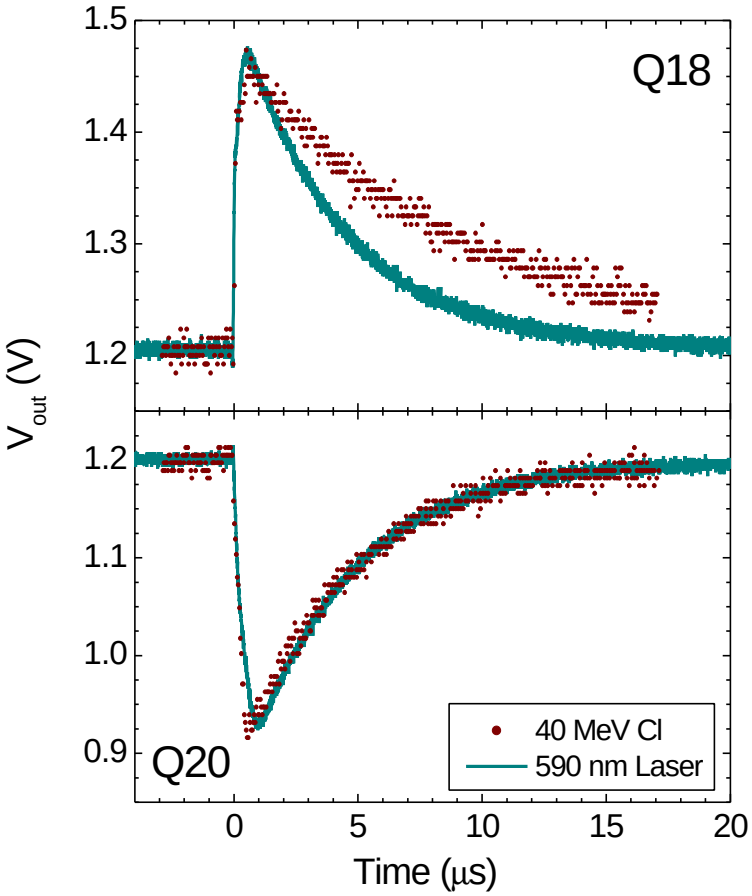


Comparison of Transients: Pulsed Laser Light and Low LET Heavy Ions

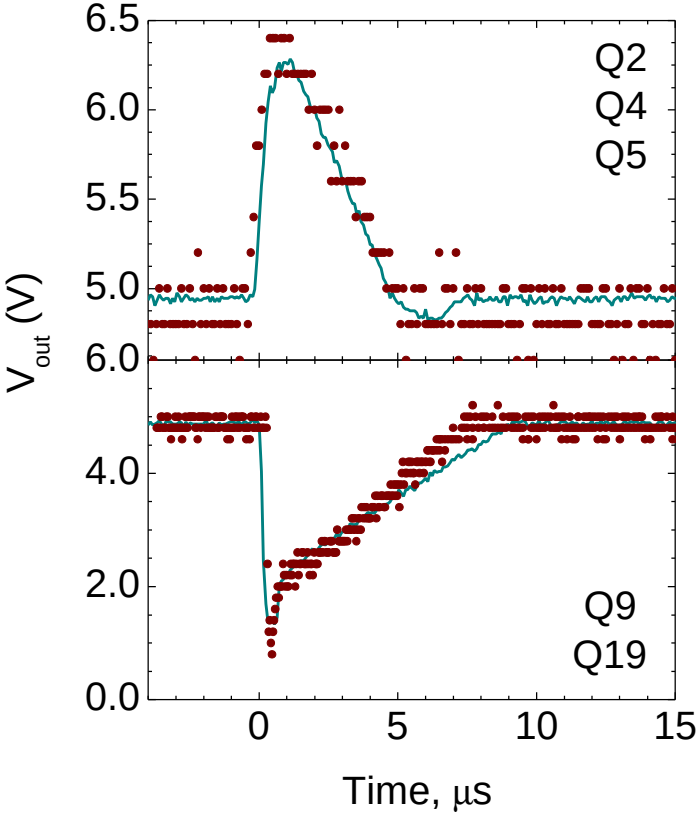


Inverting Configuration:

V_{dd} = +/-6 V
V_{in} = 60 mV



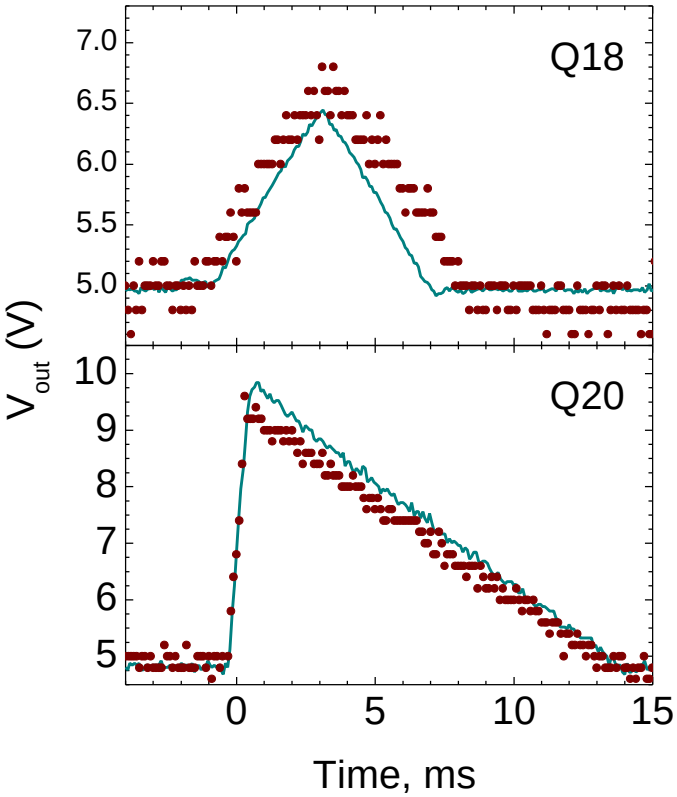
Comparison of Transients: Pulsed Laser Light and High LET Heavy Ions



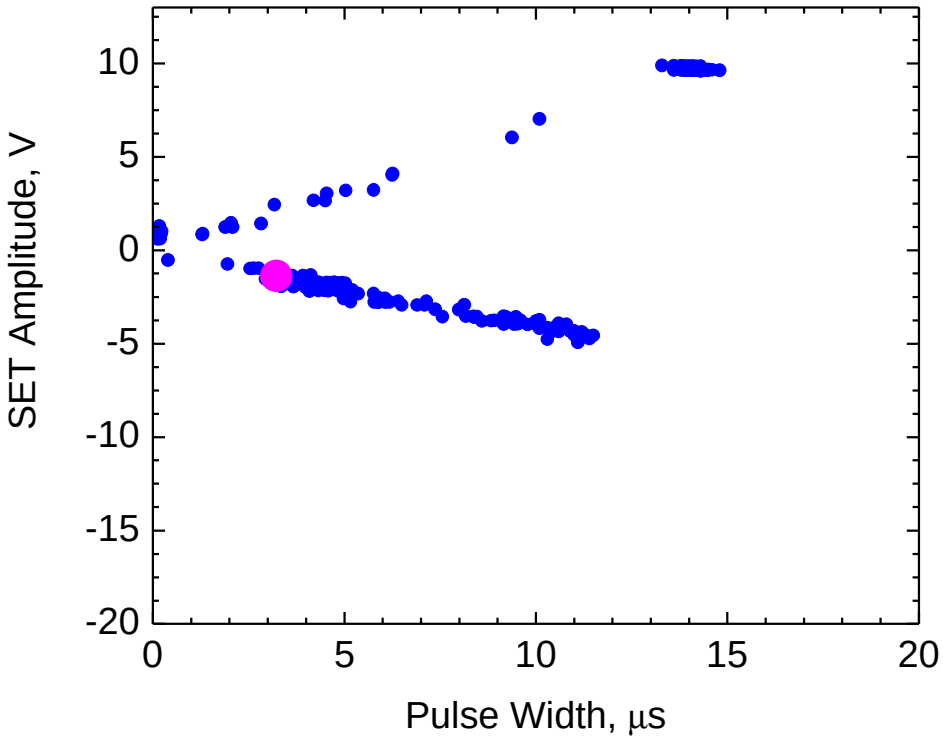
Voltage follower:

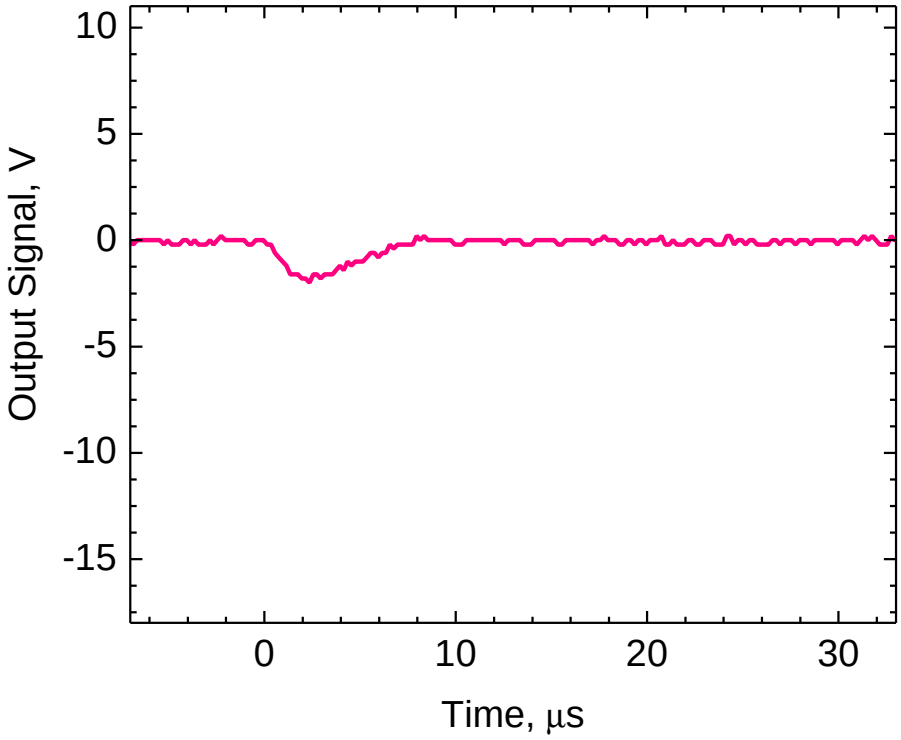
V_{dd} = +/-15 V

V_{in} = 5 V

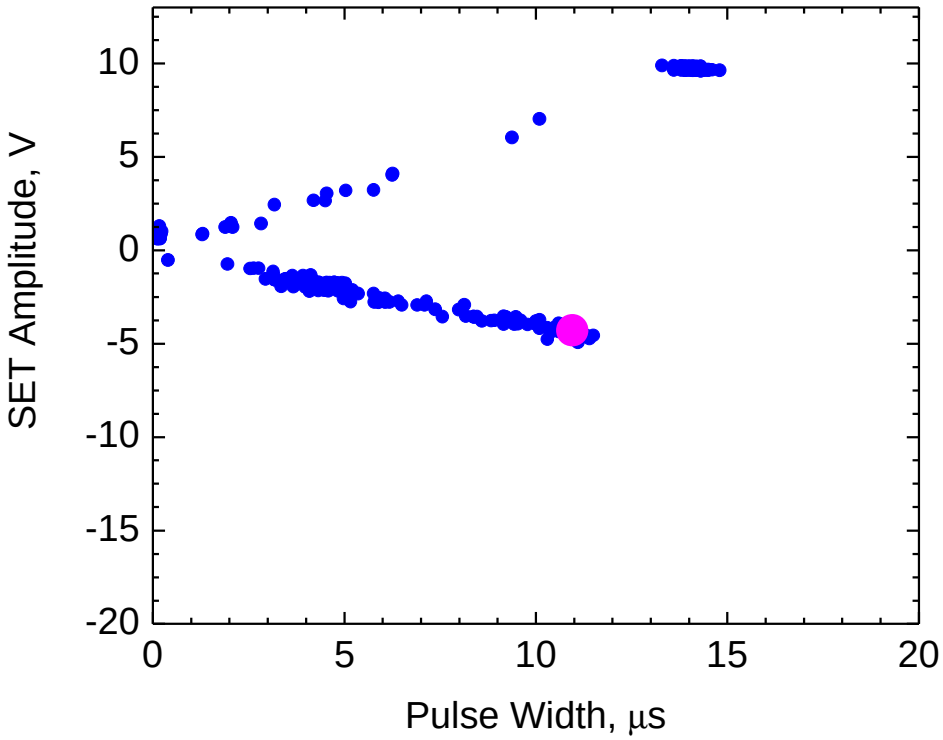


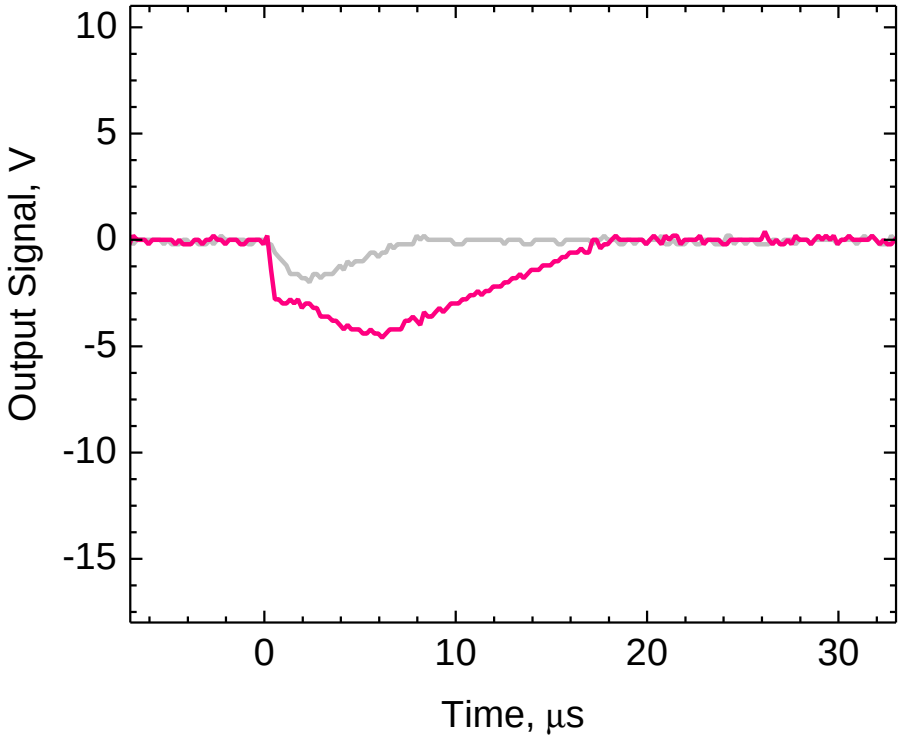
Pulsed Laser Data: Q20





Pulsed Laser Data: Q20





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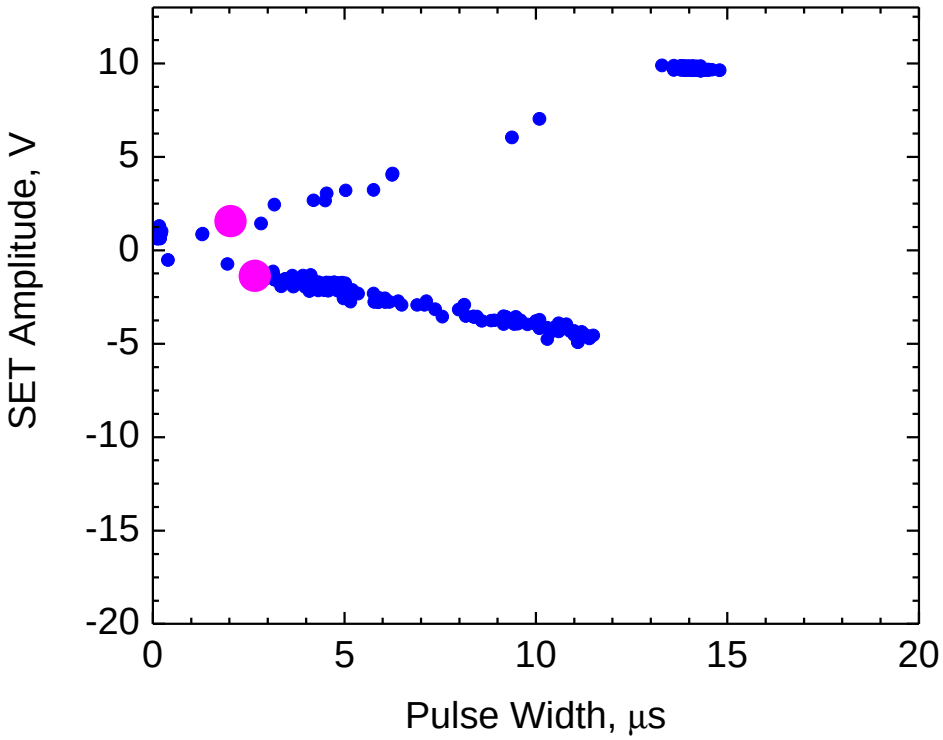

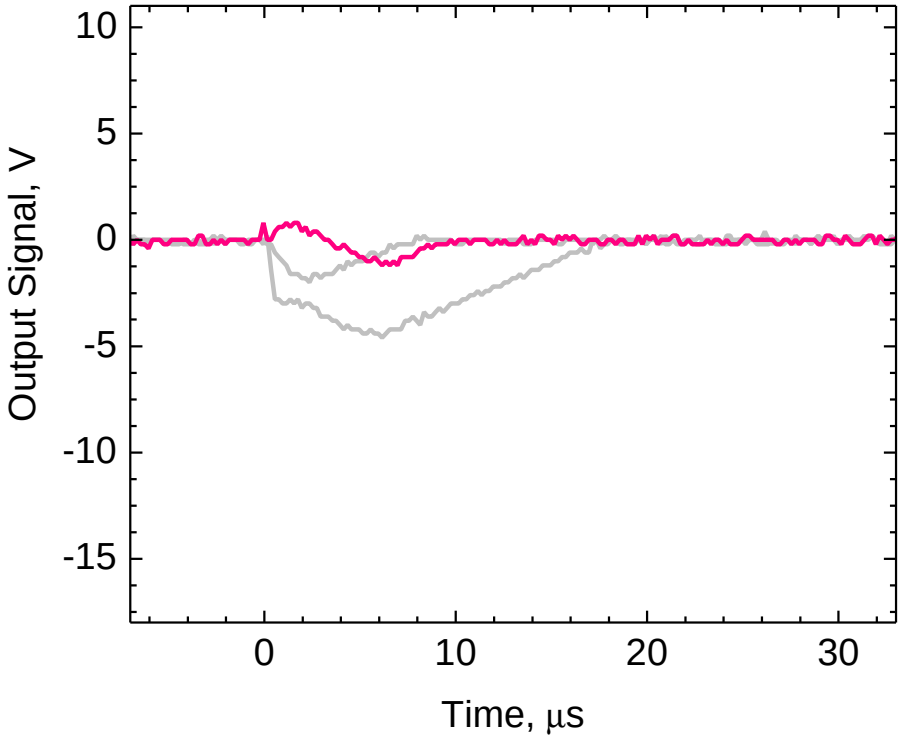

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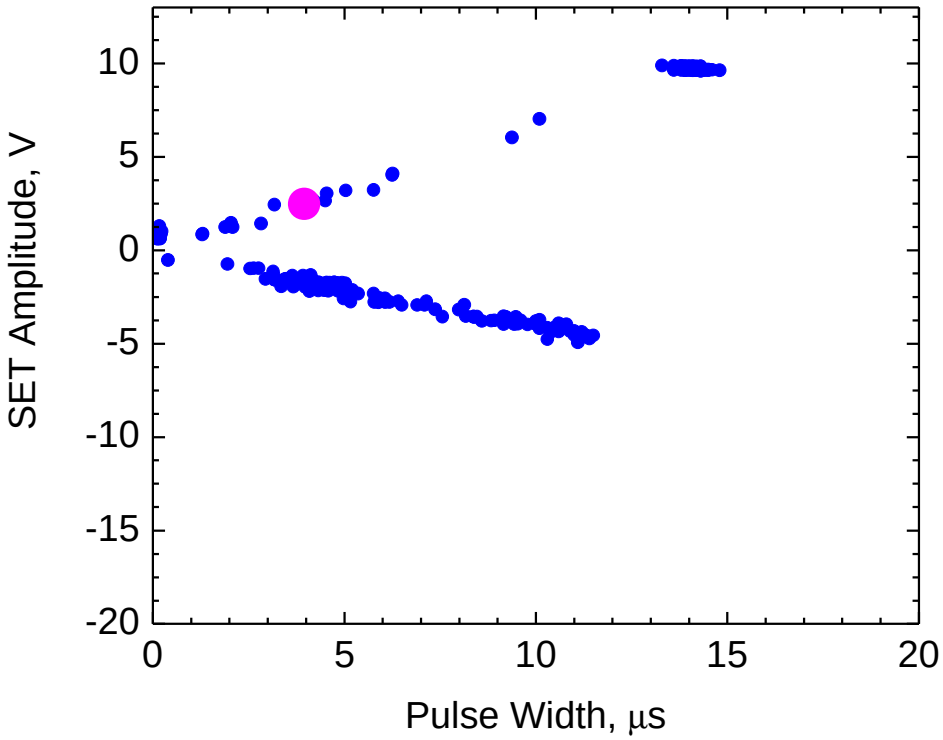

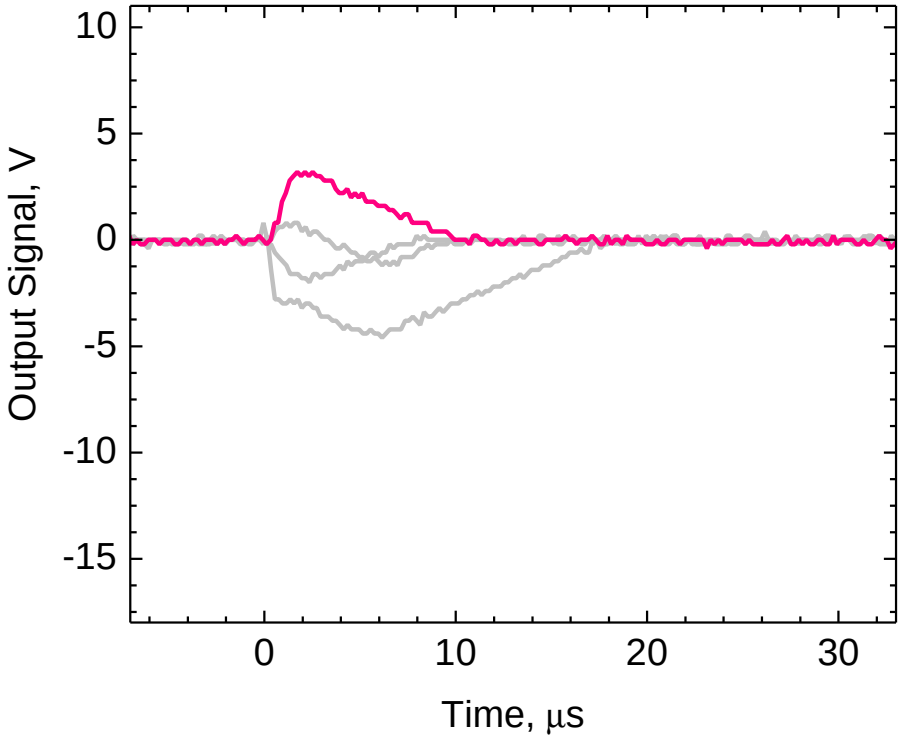

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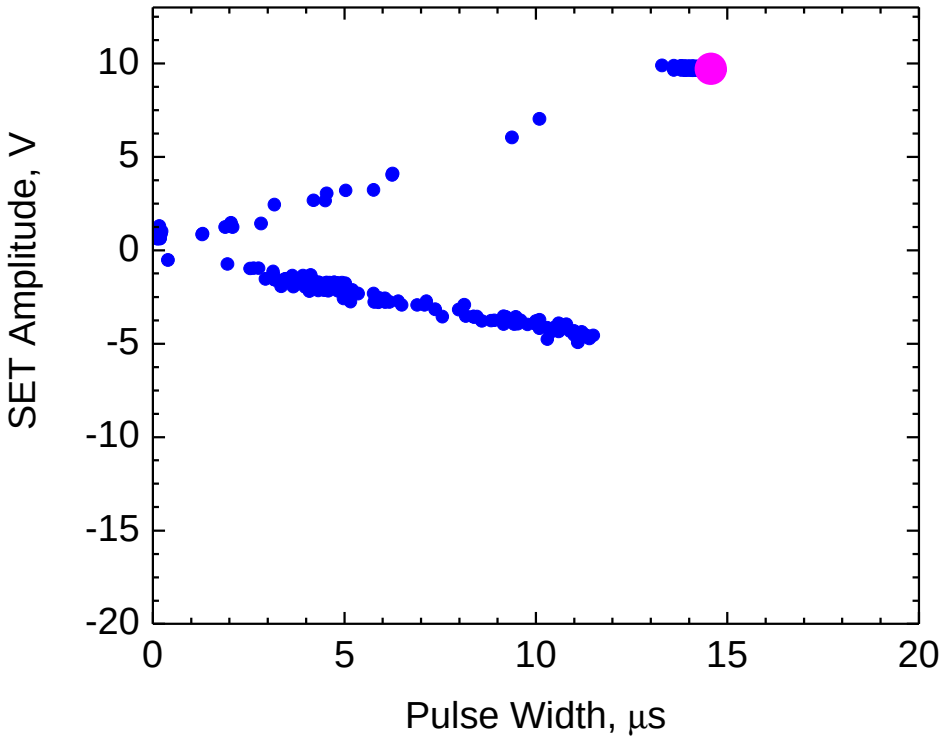

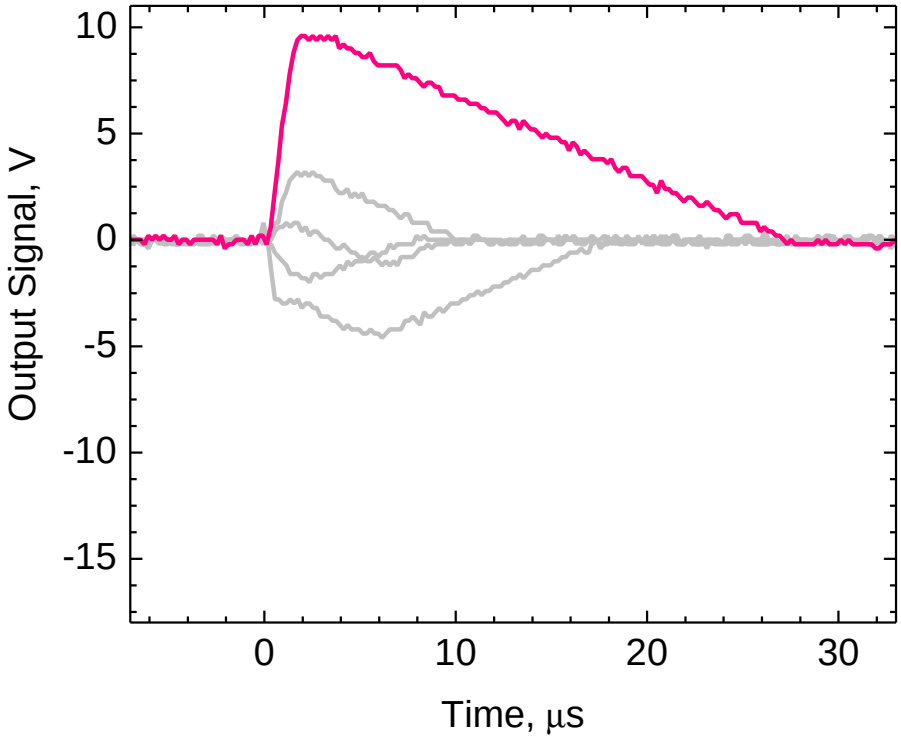

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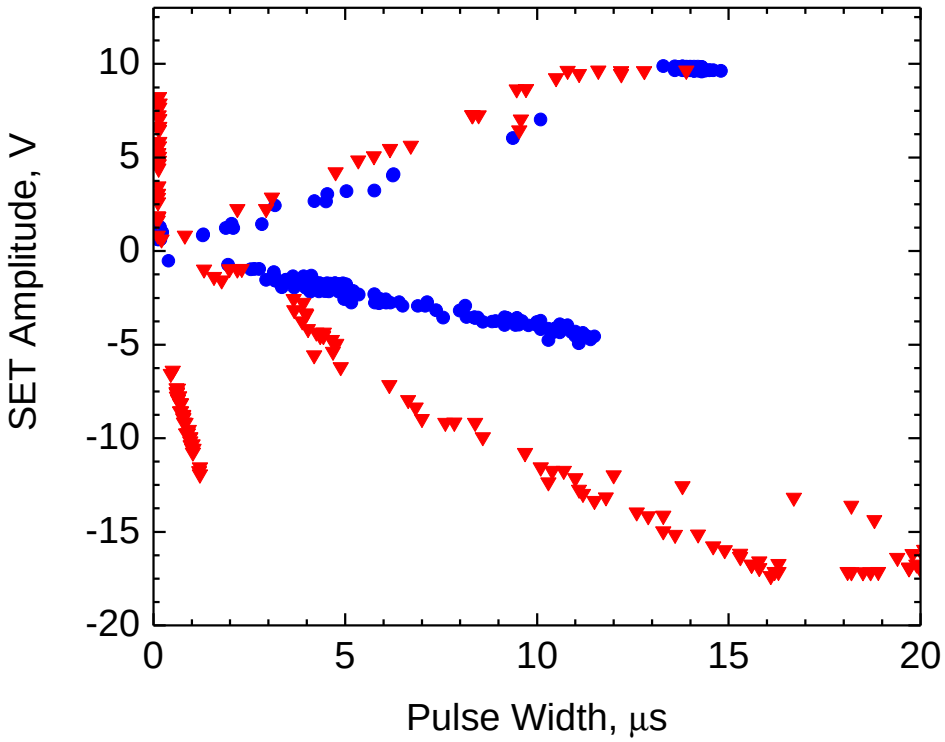
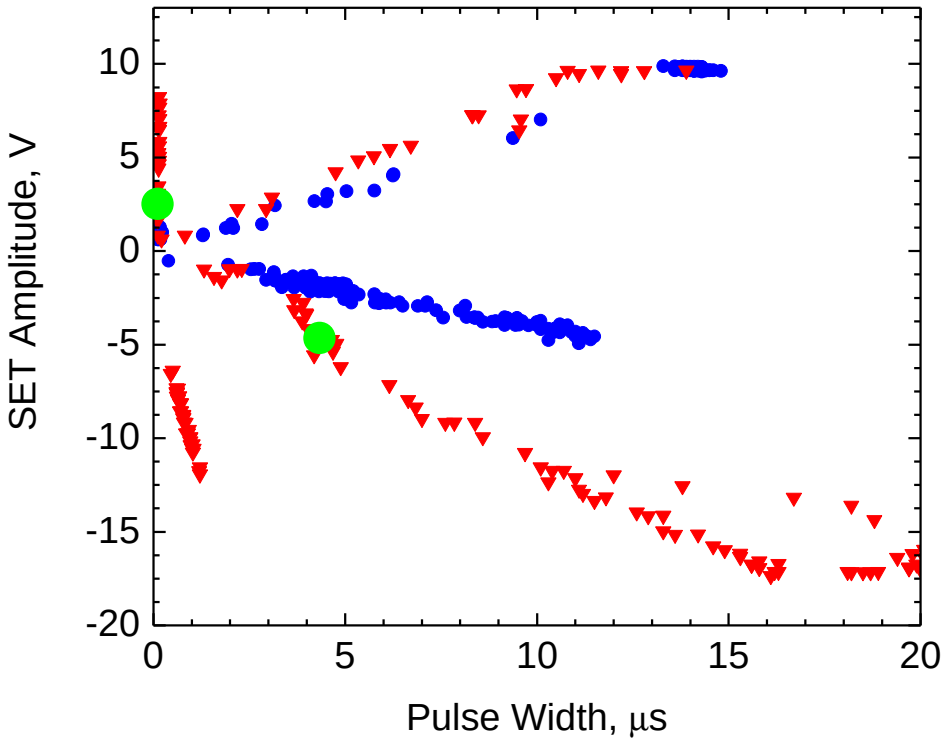
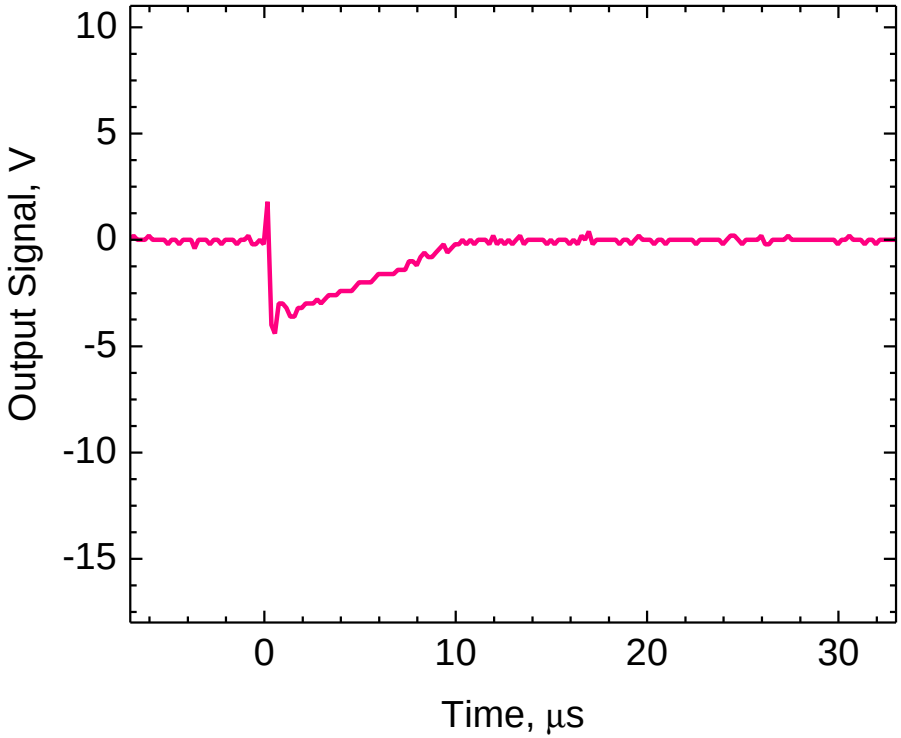


Pulsed Laser Data: Q20





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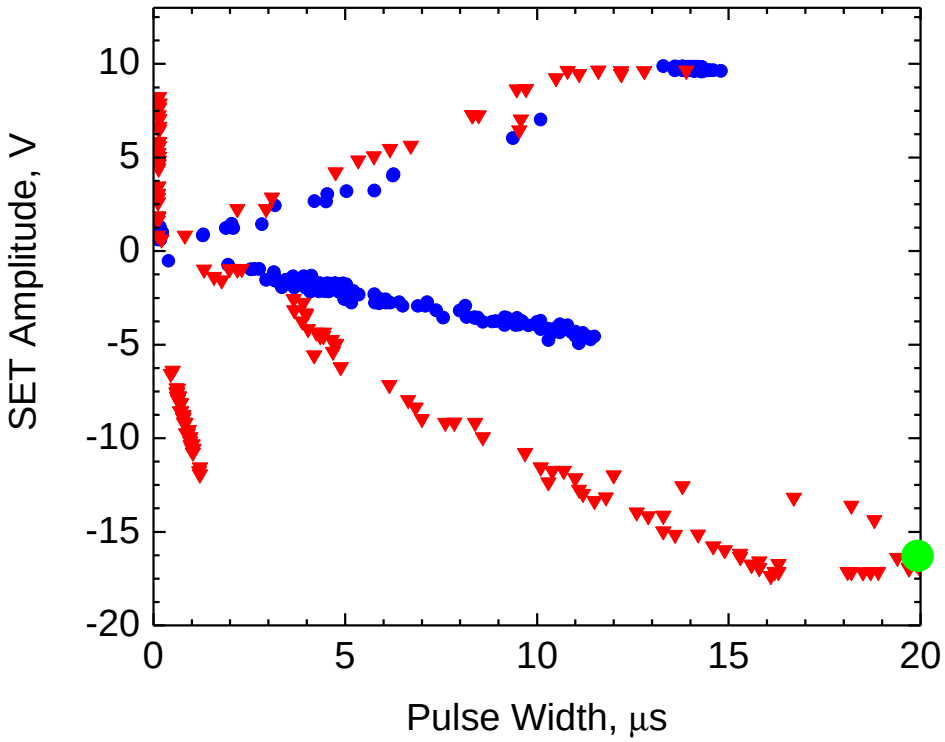

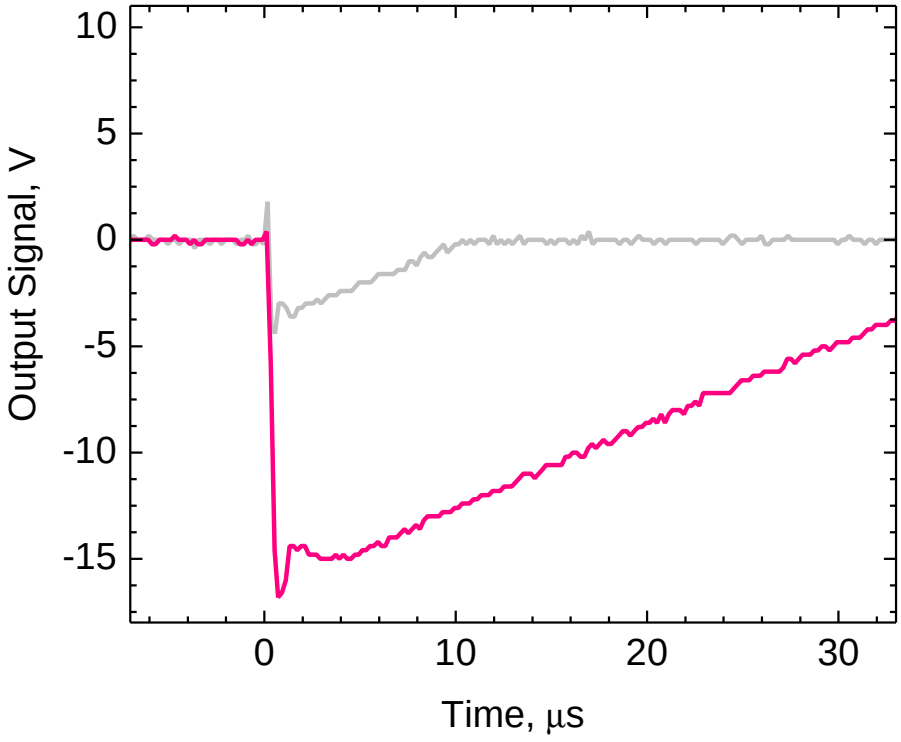

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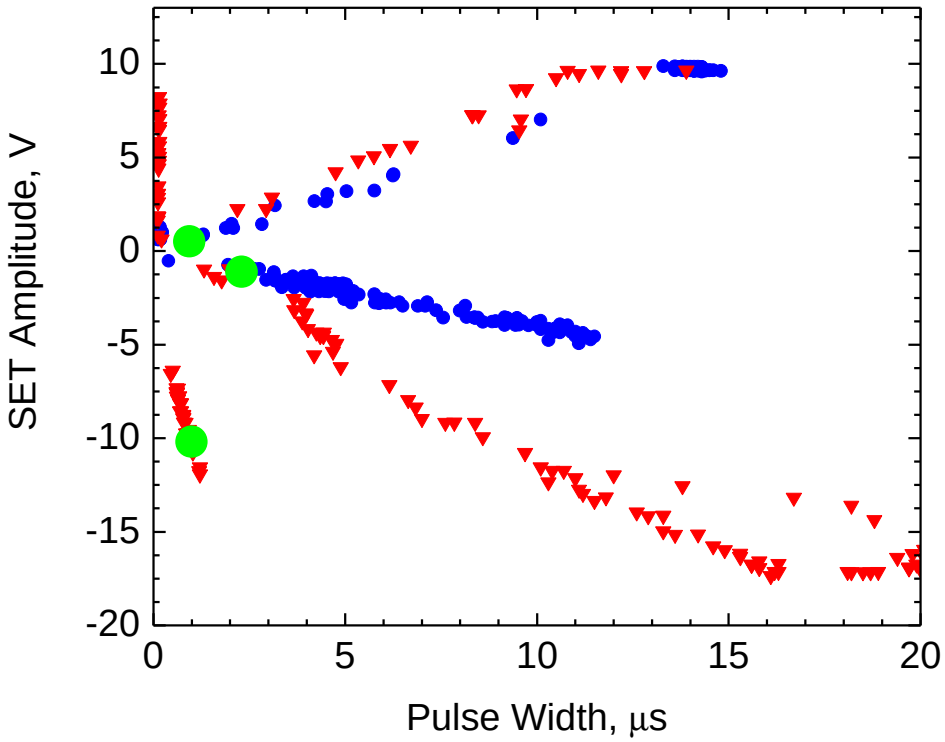

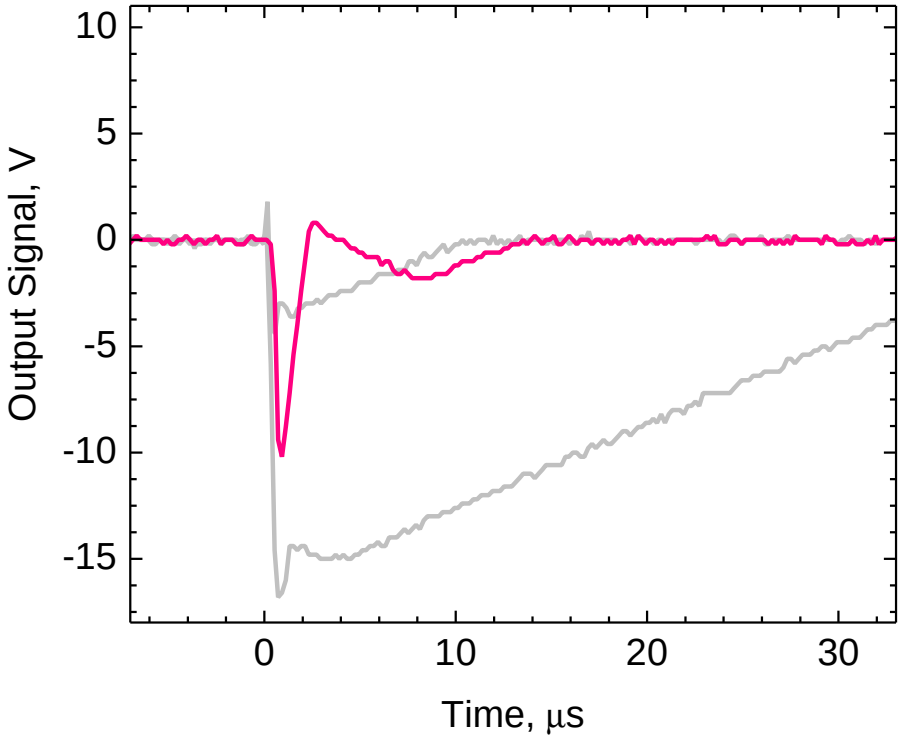

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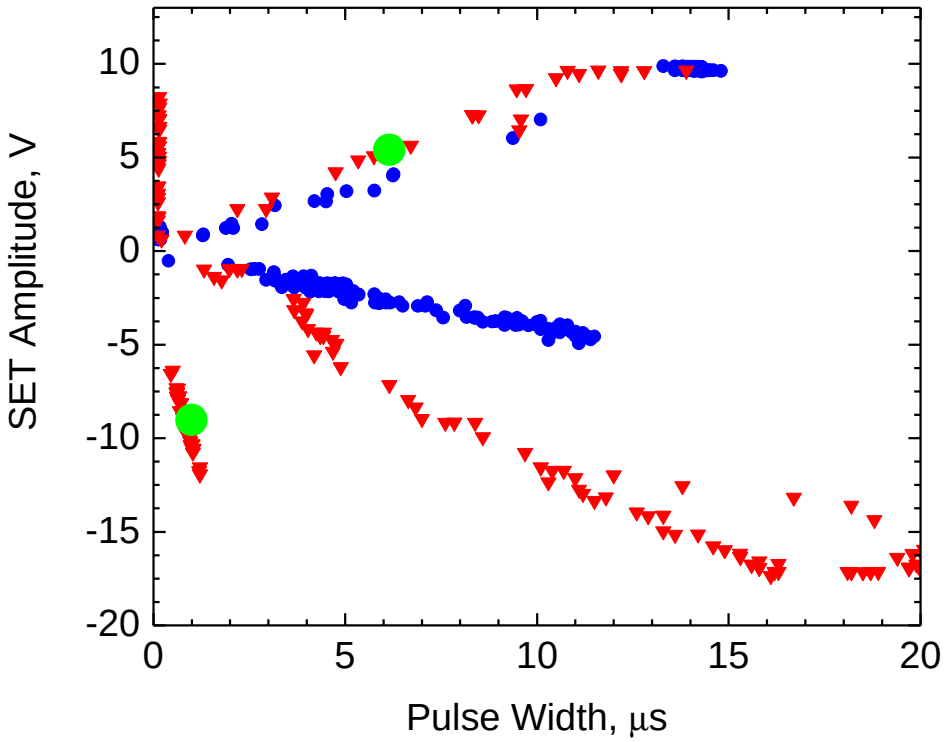
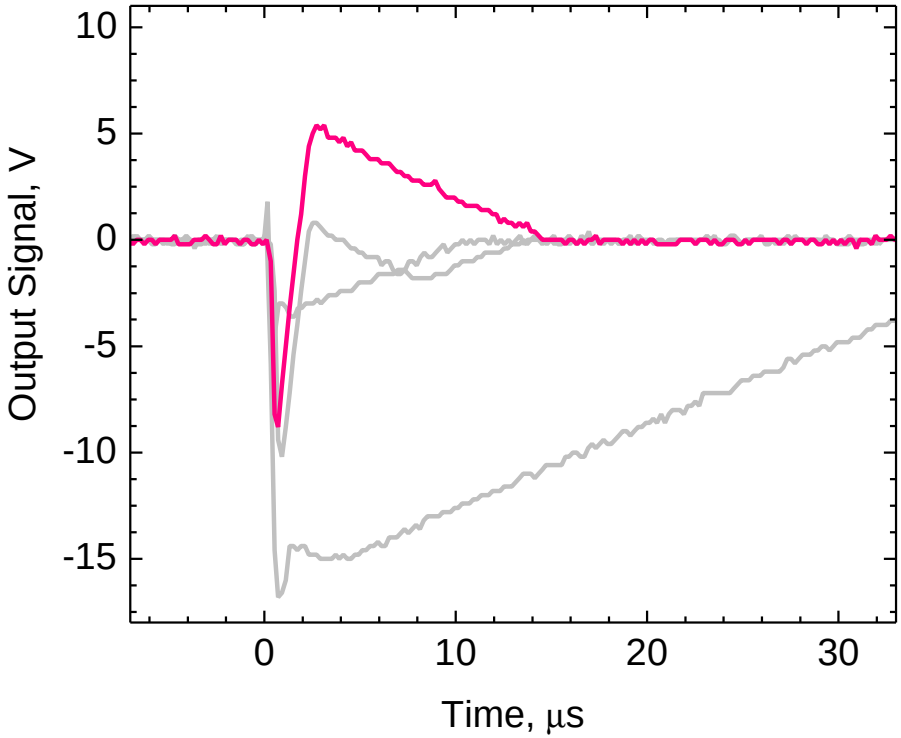
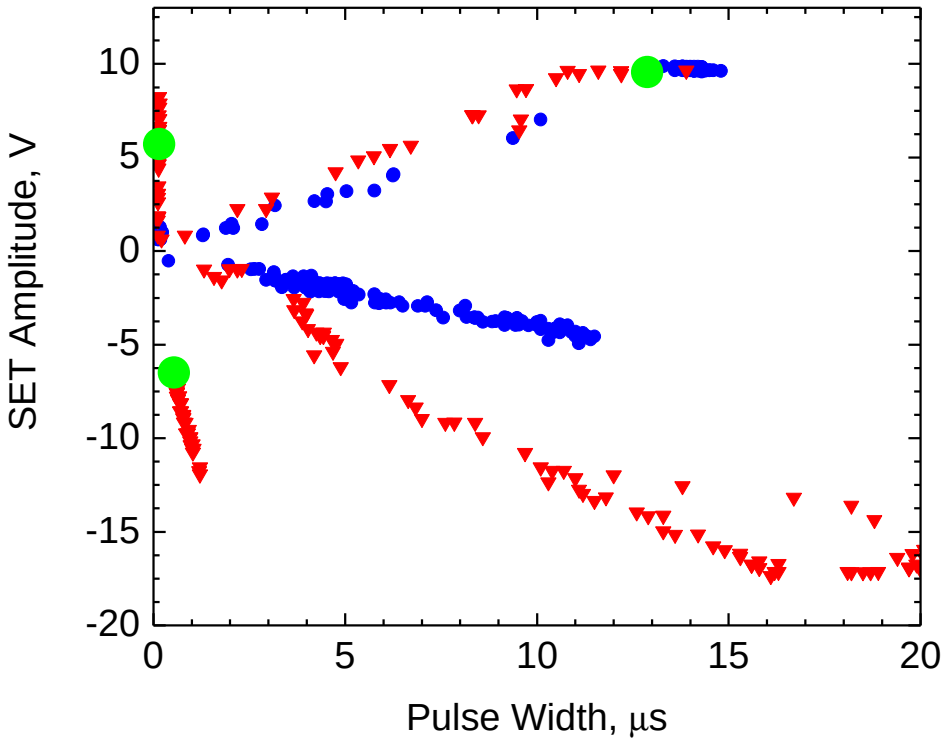
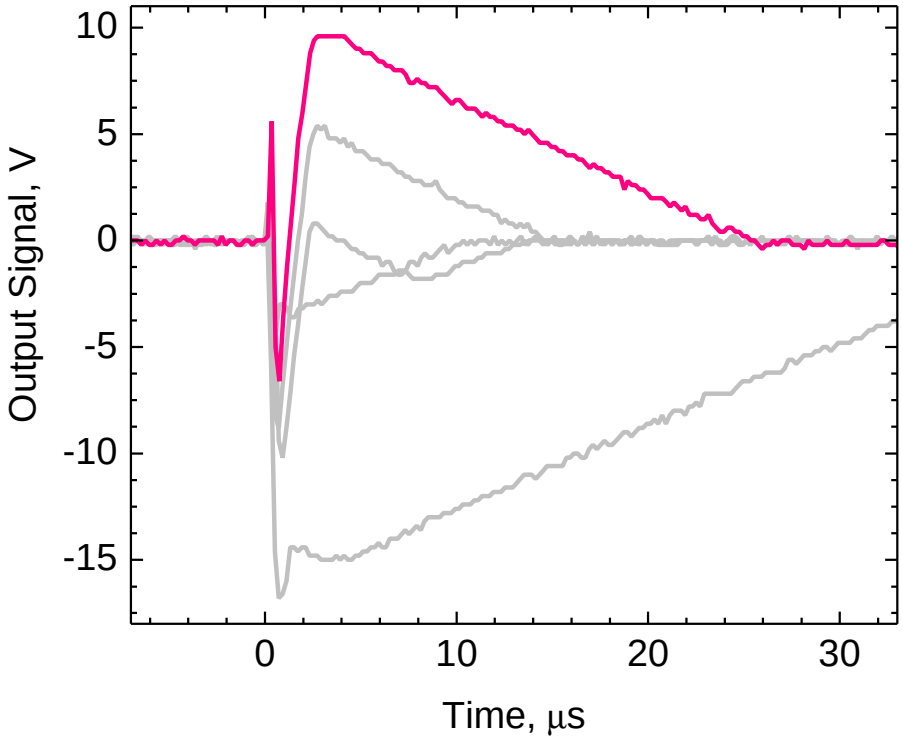


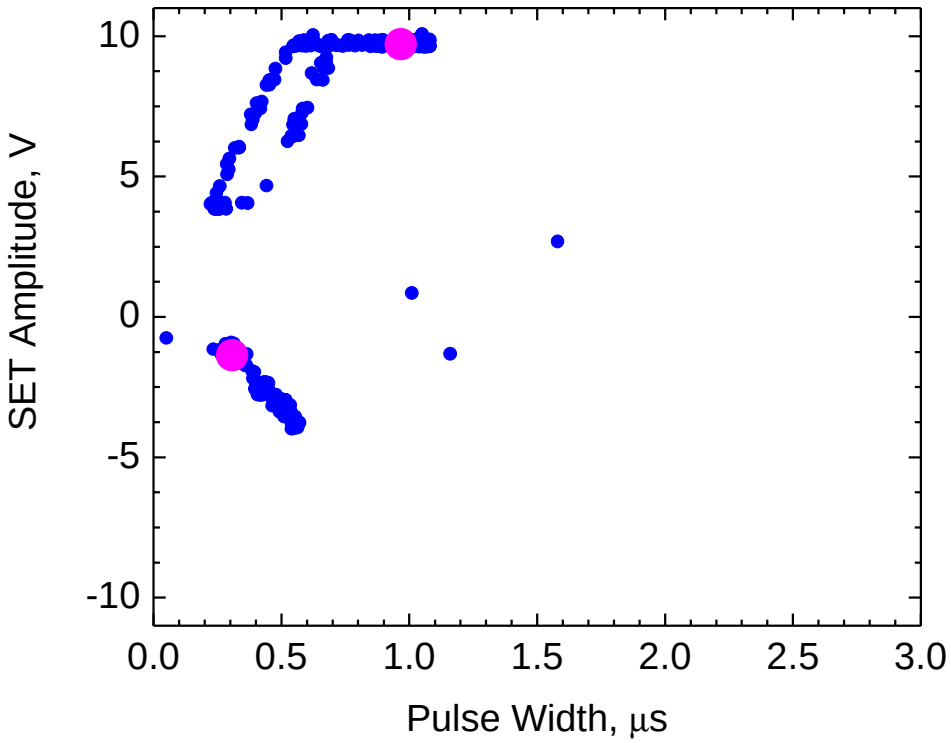


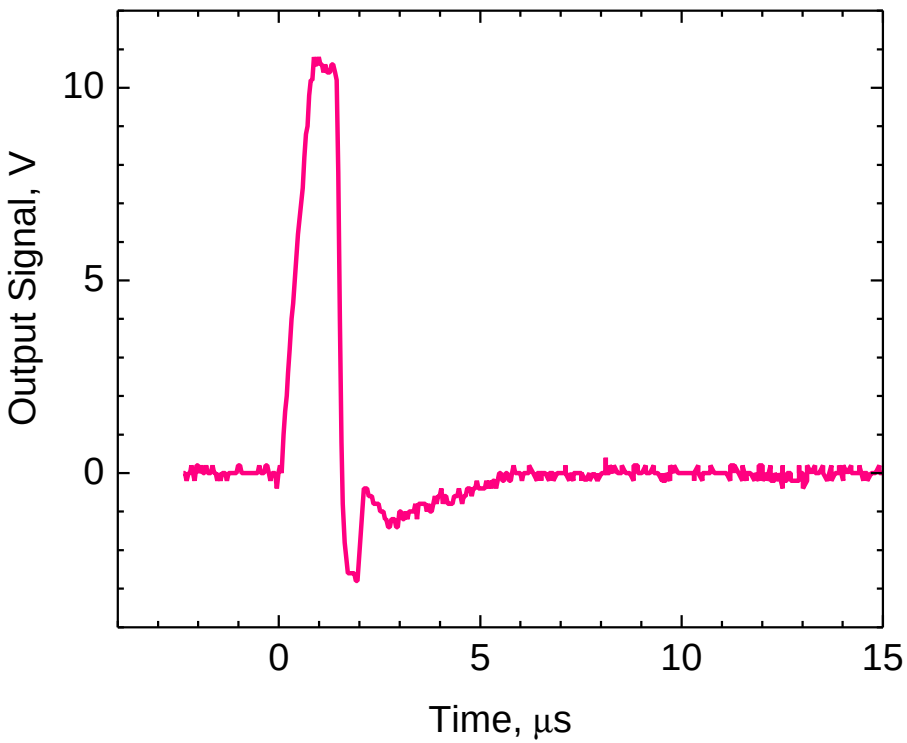
Pulsed Laser Data: Q20



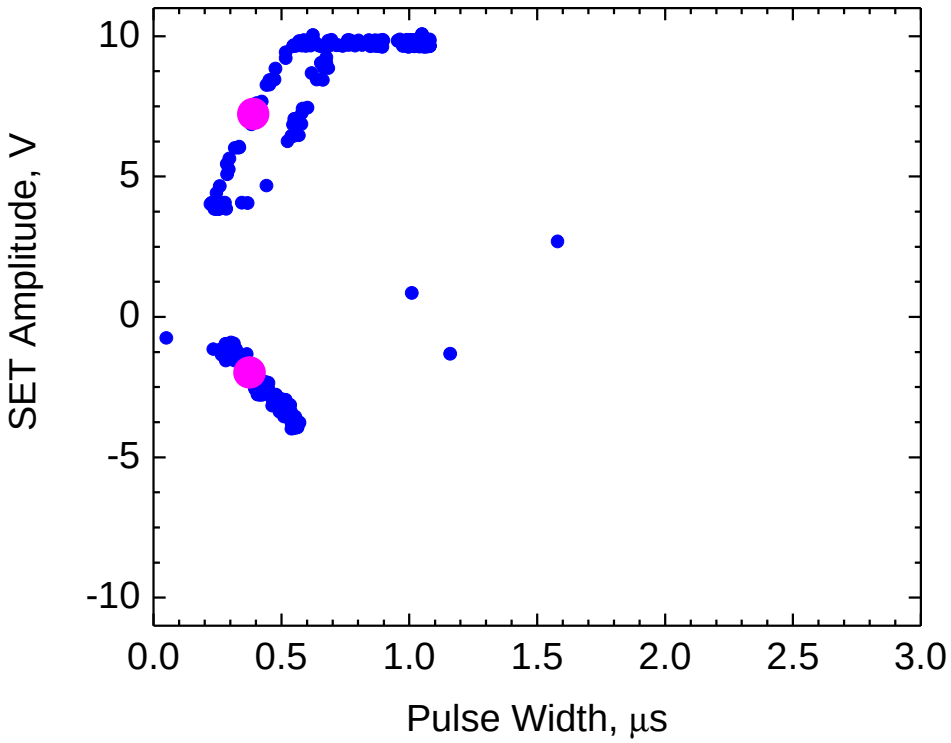


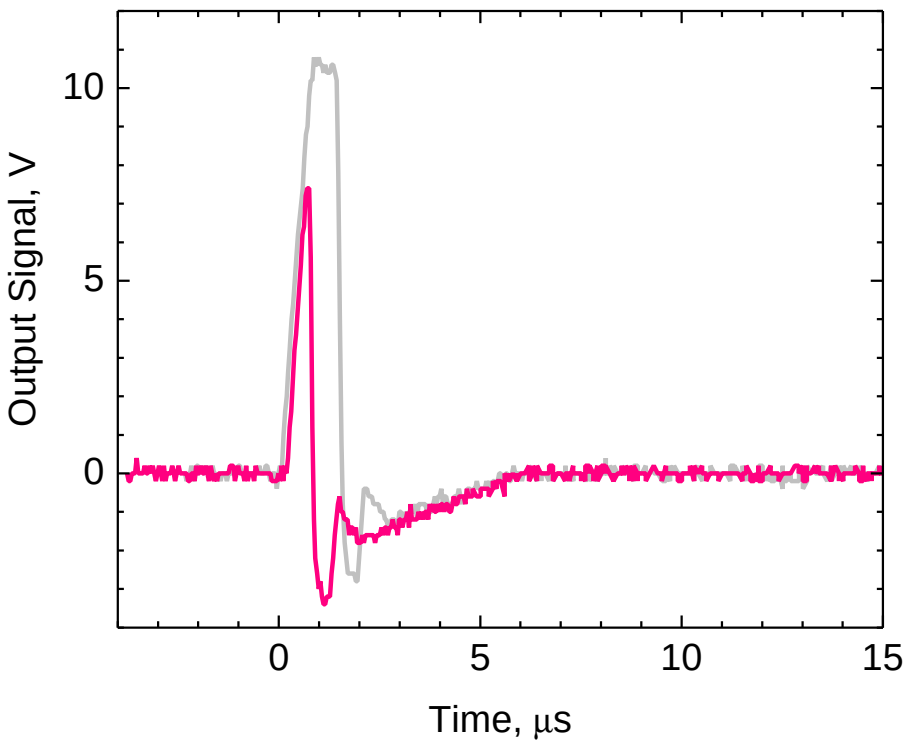
Pulsed Laser Data: R1



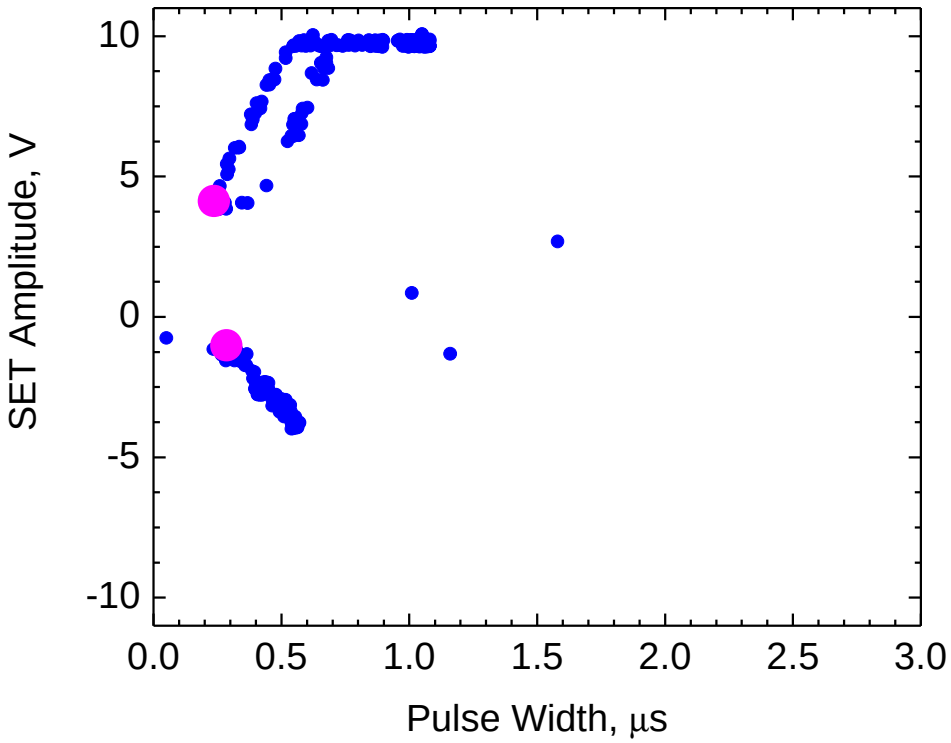


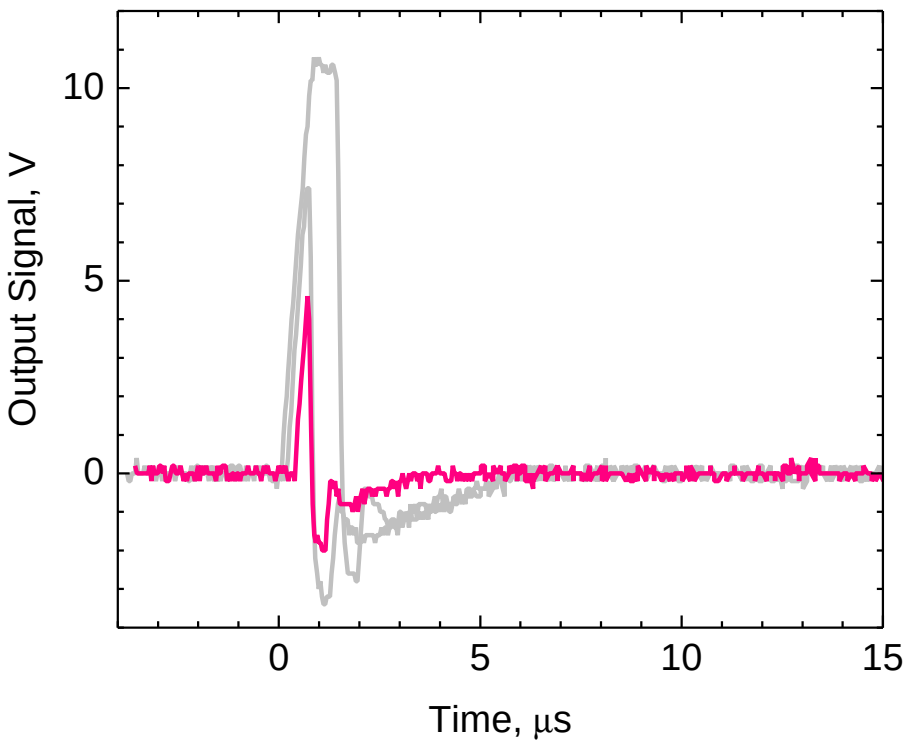
Pulsed Laser Data: R1



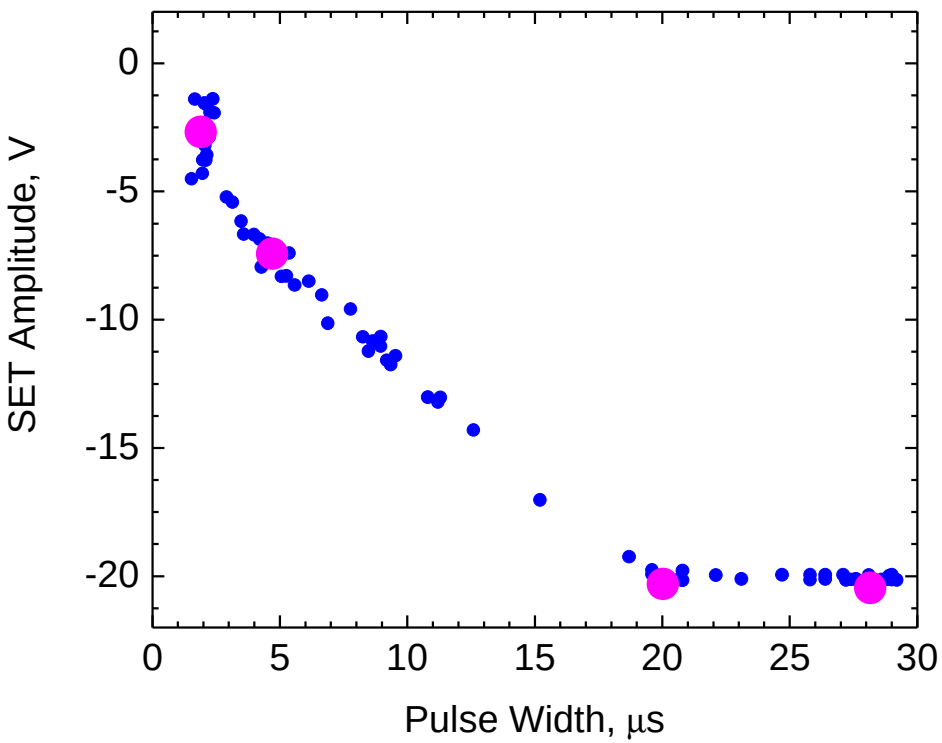


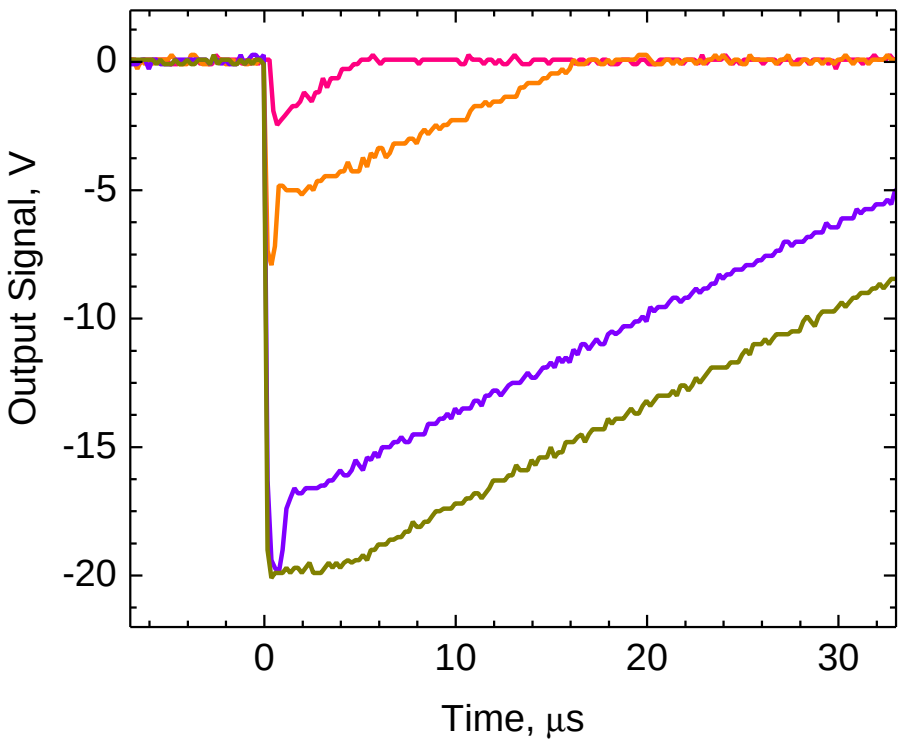
Pulsed Laser Data: R1



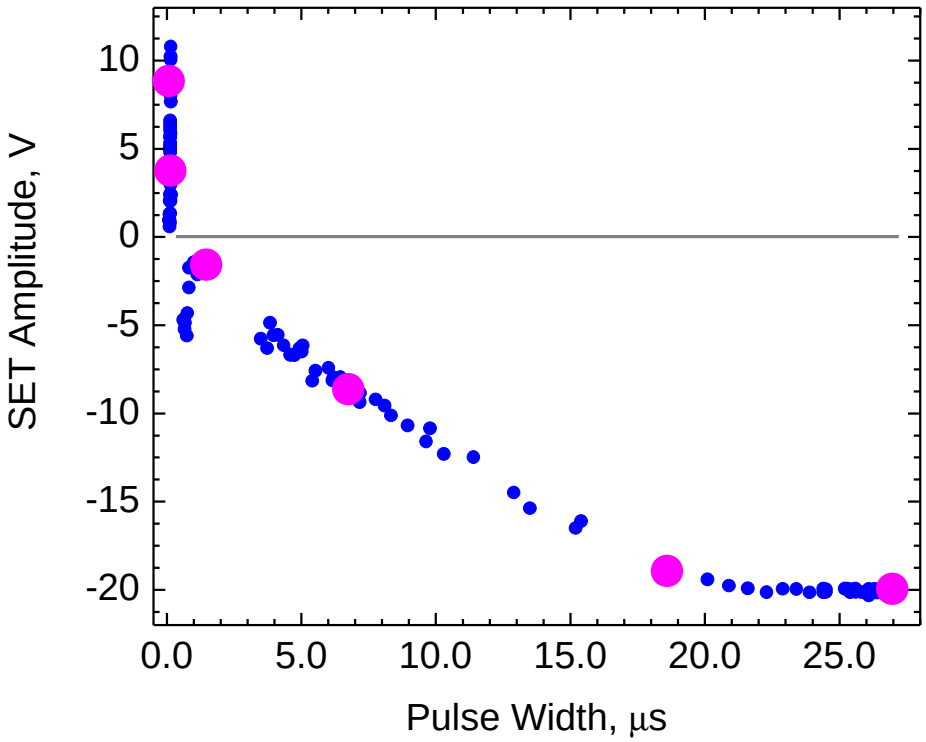


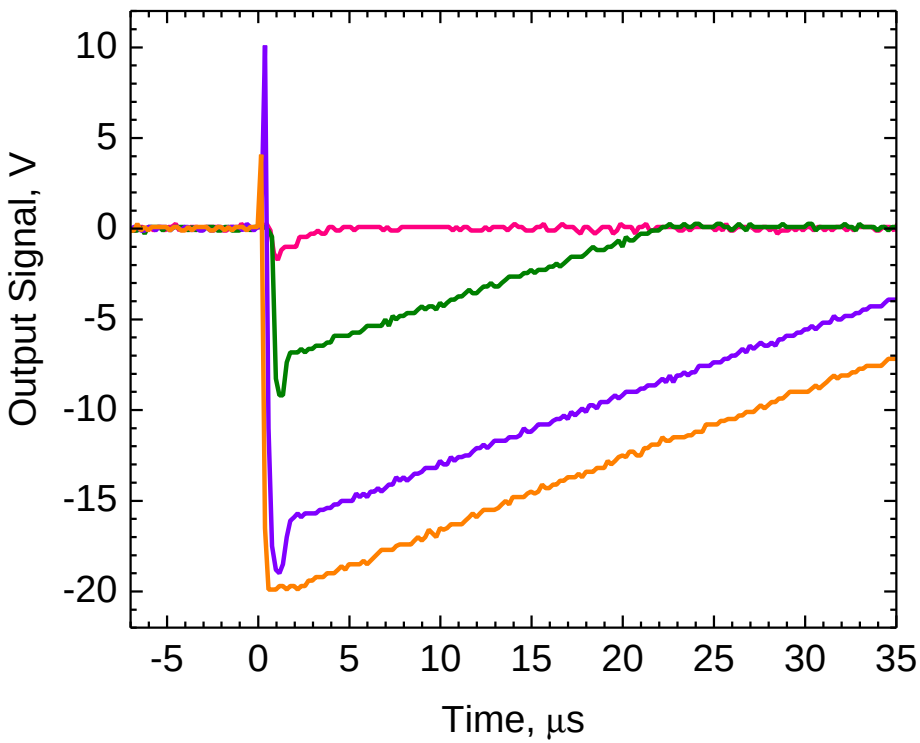
Pulsed Laser Data: Q19



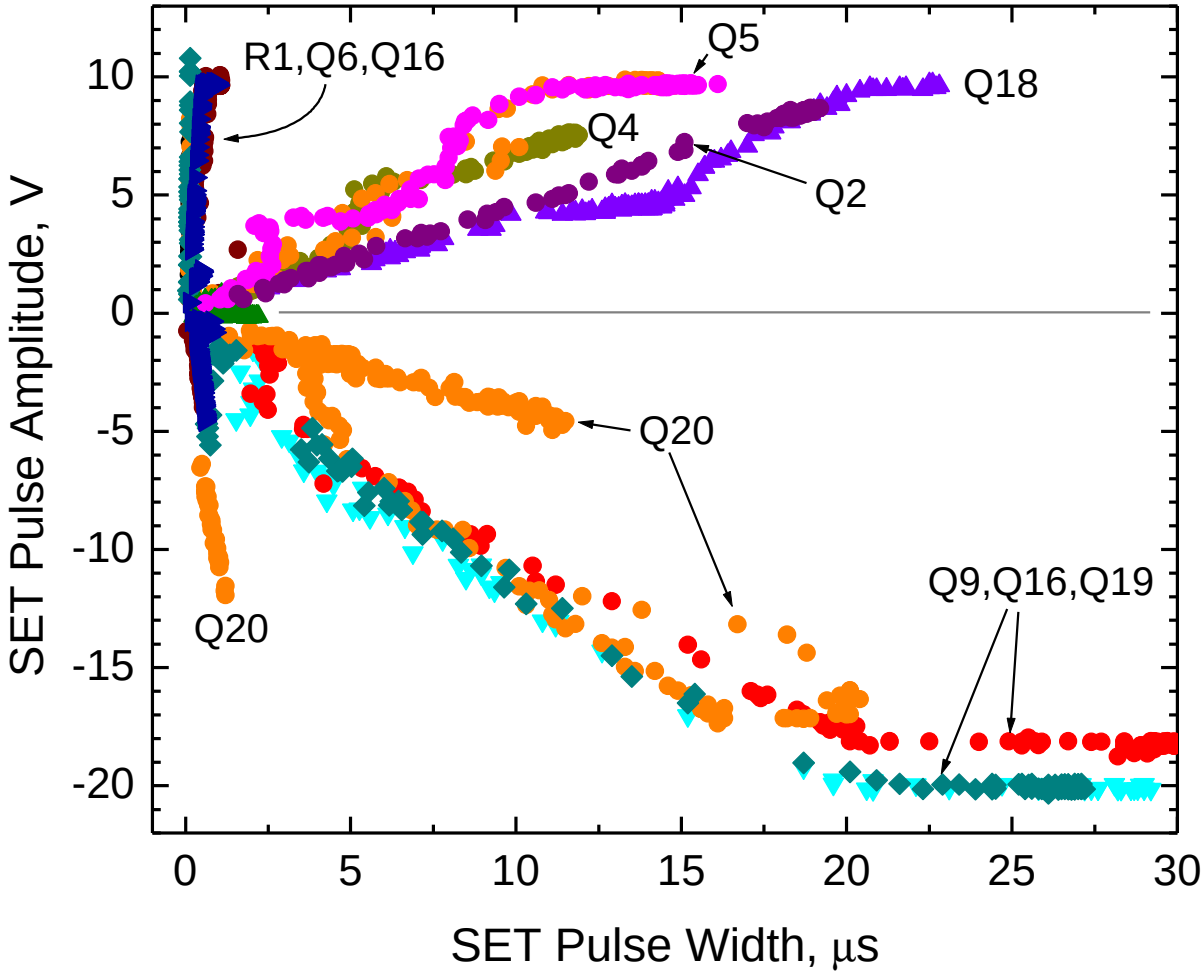


Pulsed Laser Data: Q16





Pulsed Laser Data: All Nodes

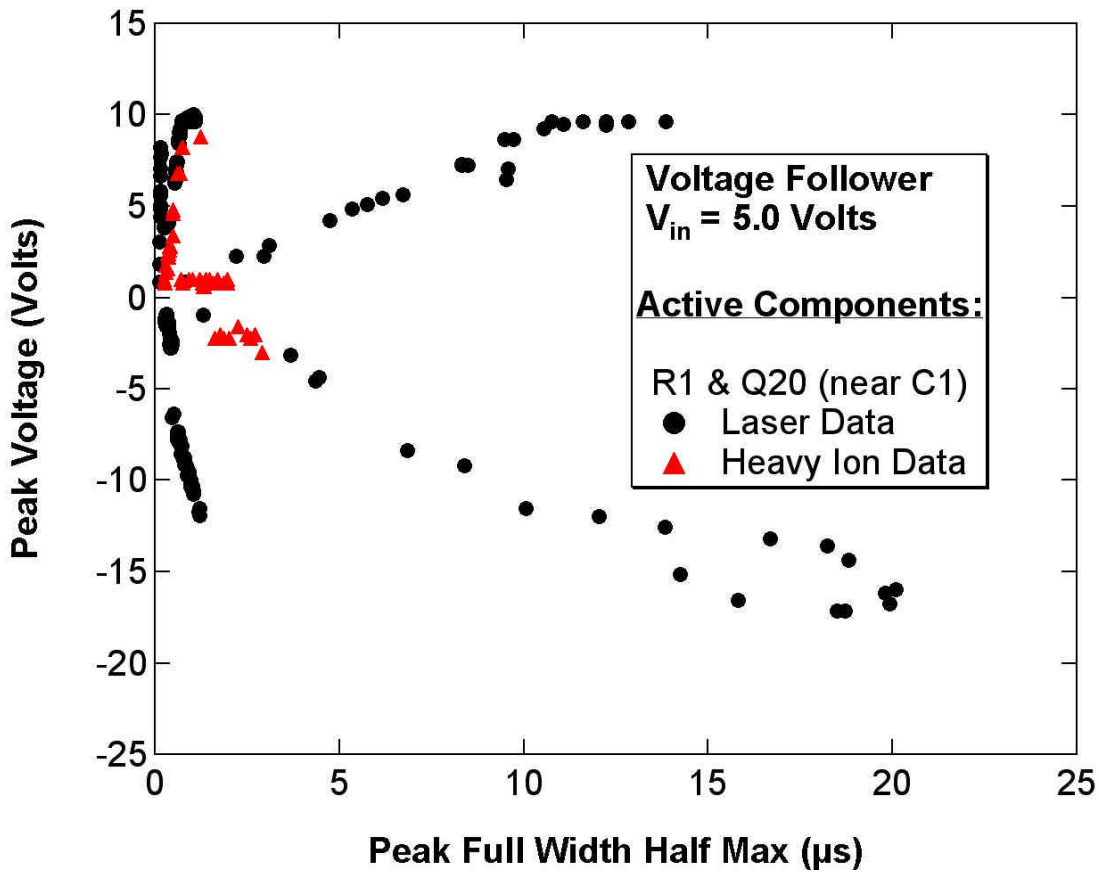


Comparison of Pulsed Laser and Ion Data

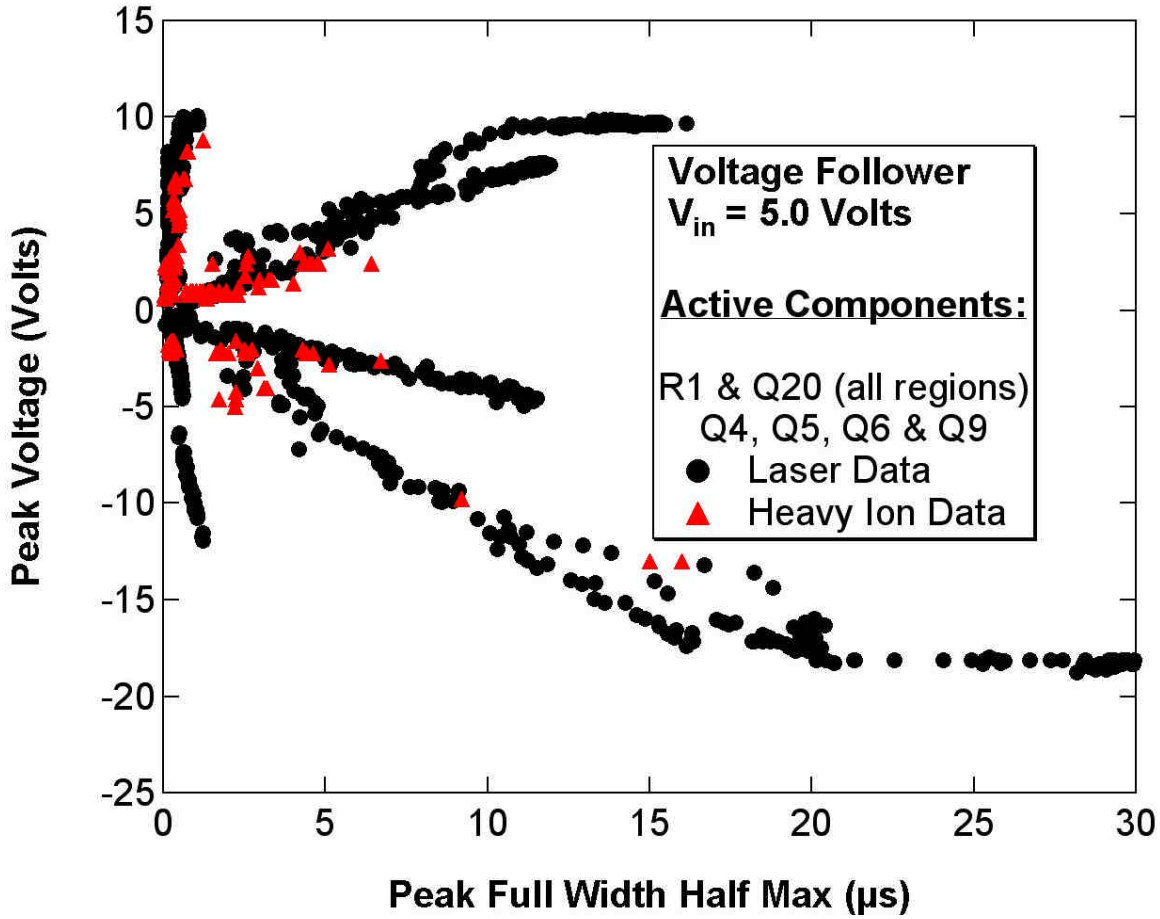
- Laser data obtained by focusing light on a transistor and varying deposited energy.

- Ion data obtained by keeping deposited energy constant and vary location.

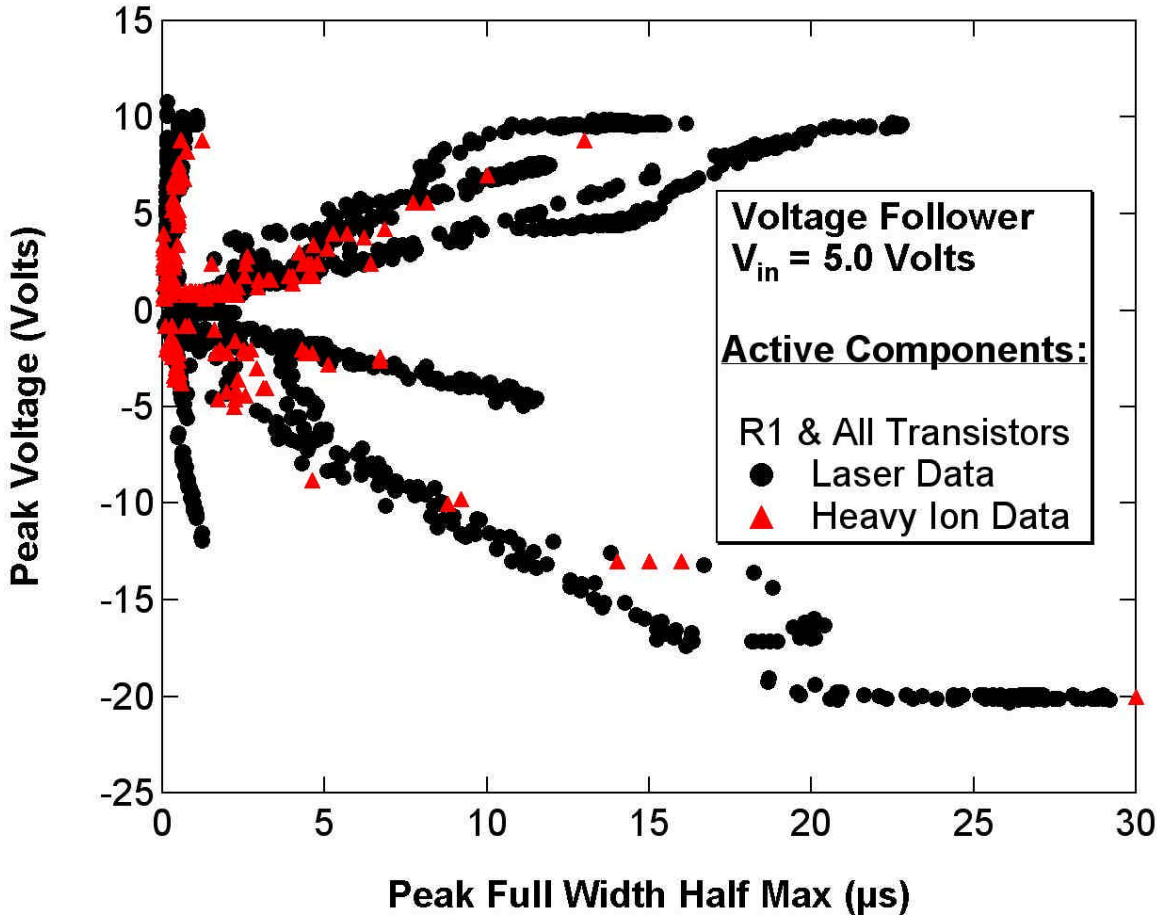
Low LET Ions and Laser Data



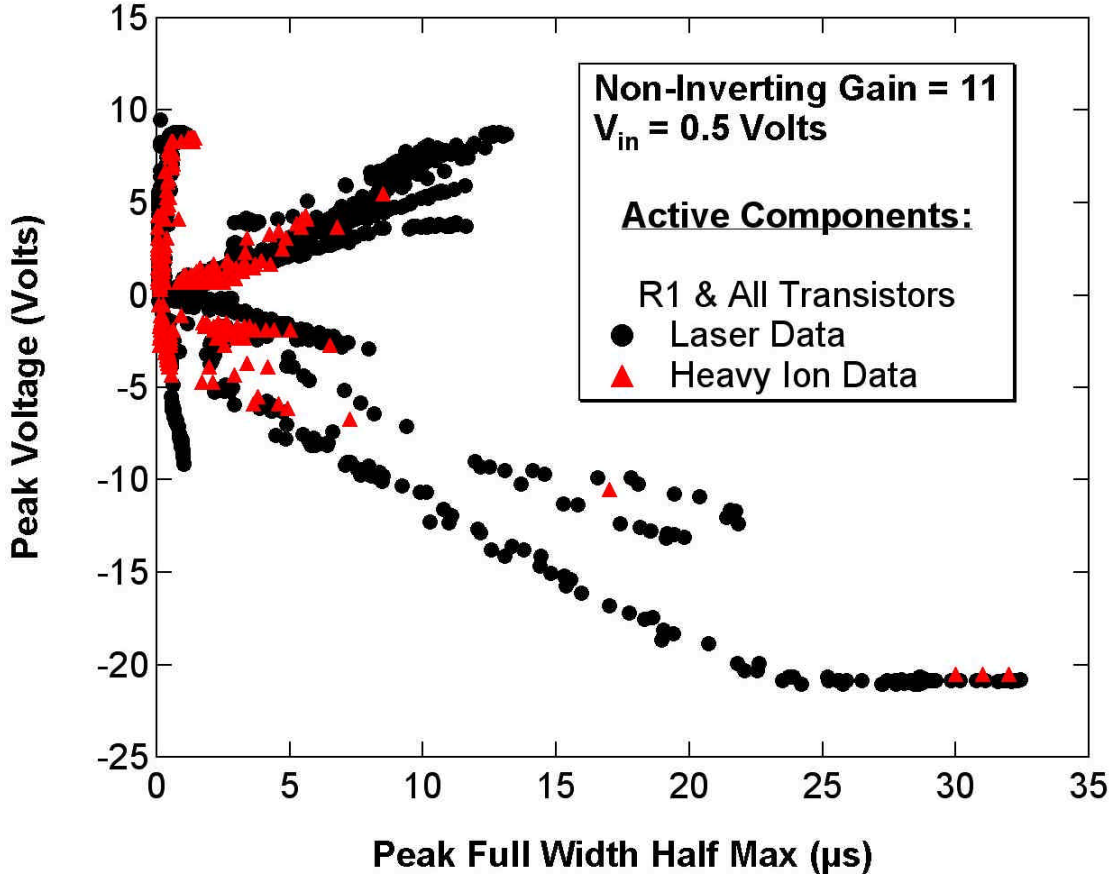
Moderate LET Ions and Laser



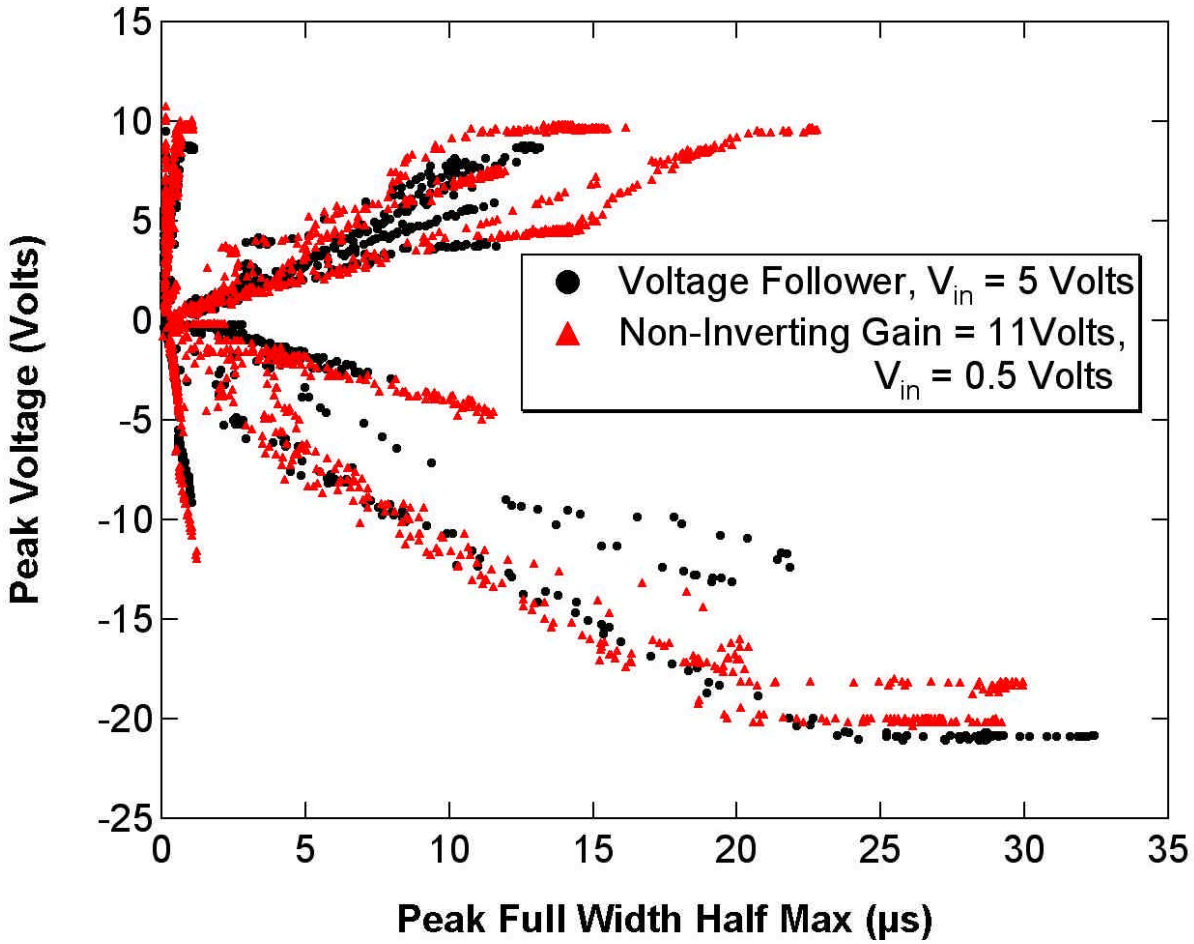
High LET Ions and Laser Data



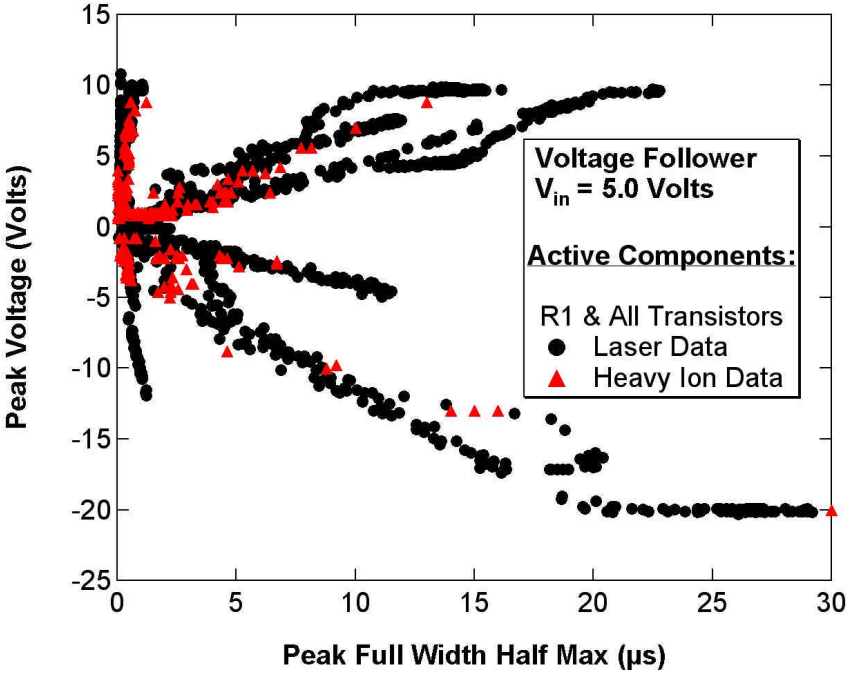
High LET Ions and Laser Data

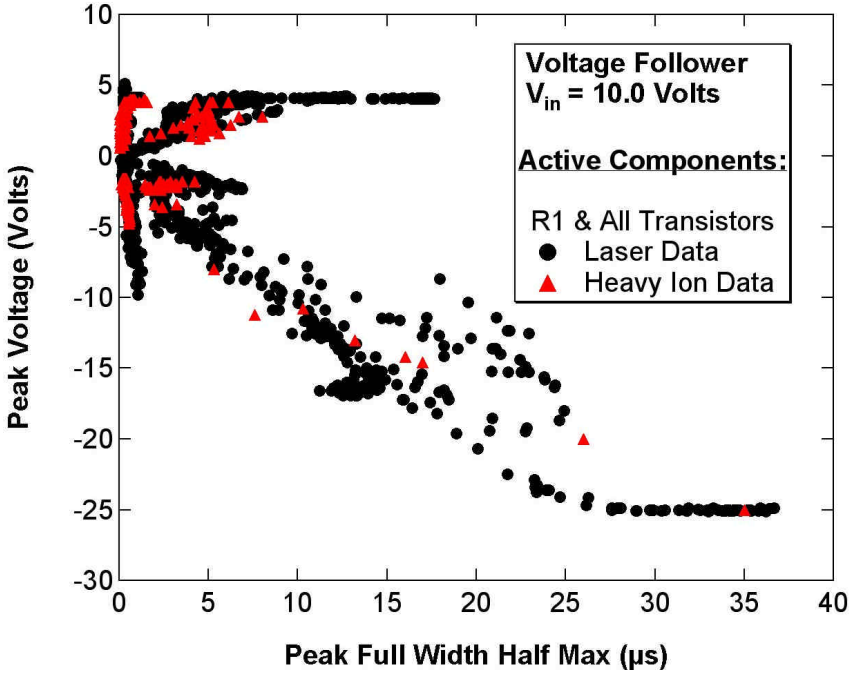


Configuration Comparison

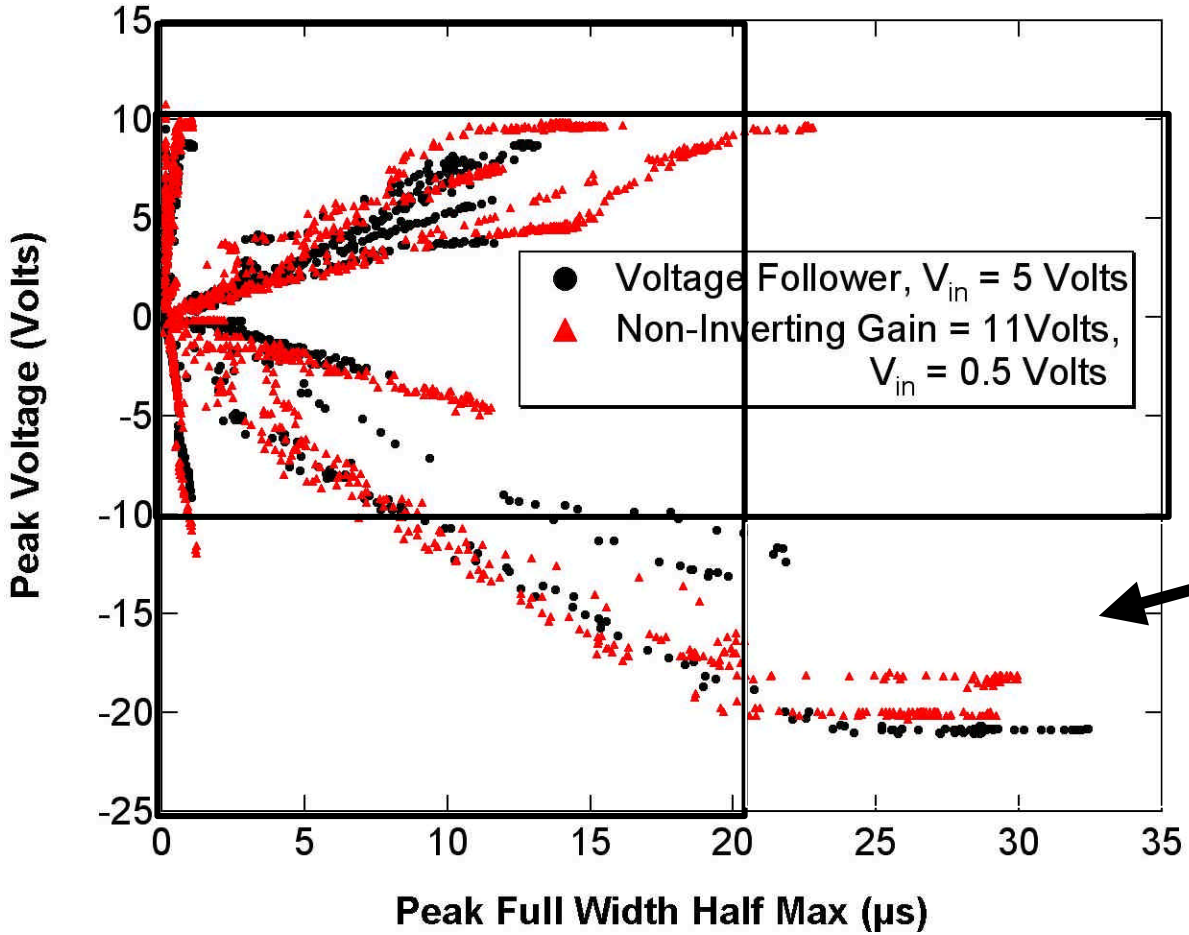


High LET Ions 5V and 10V Inputs Voltage Follower





Phase Space of Concern



Concern if:
$|V| > 10$ V,
$\Delta t > 20$ µs

Summary and Conclusions

- Laser light produces same SETs as high LET ions.
- The good agreement between laser and heavy ion SET shapes suggests that the laser measurements are not limited by the short penetration depth of light or metal coverage.
- Plots of V vs Δt are powerful way of visualizing SETs
- The pulsed laser is a powerful tool for understanding SETs in bipolar linear devices and for helping in reducing the amount of heavy-ion testing by bounding the problem.