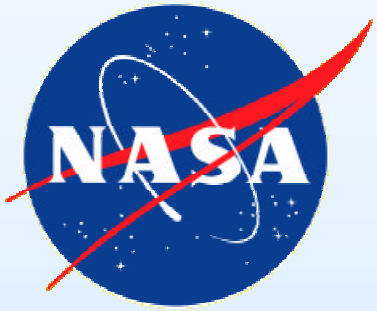

Single Event Transient (SET) in Linear Devices, Testing Guidelines

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Outline

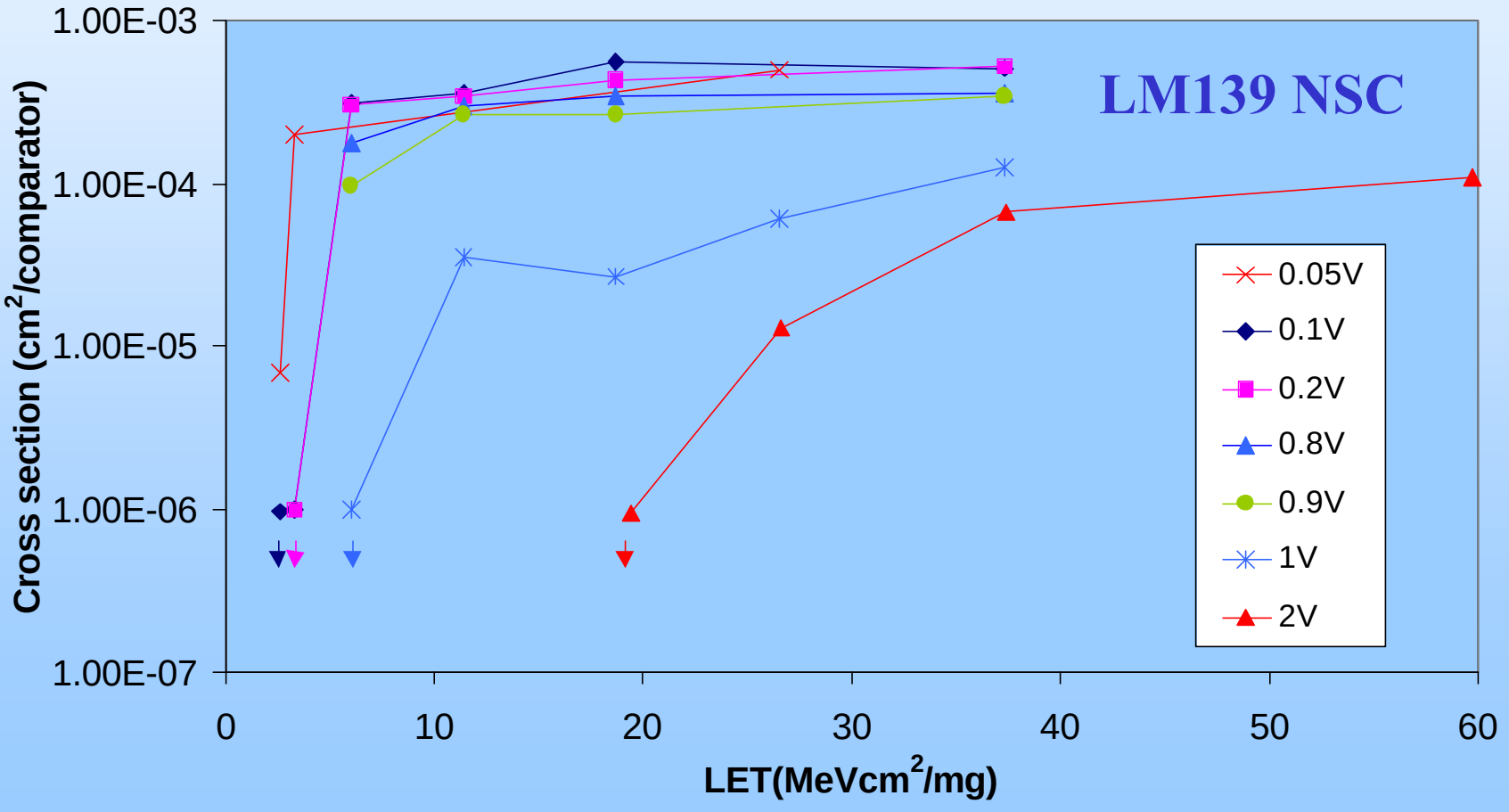
- Introduction
- Lessons learned
  - Irradiation conditions
  - Bias conditions
  - Test set-up
  - Data analysis and reporting
- Testing guidelines

Introduction

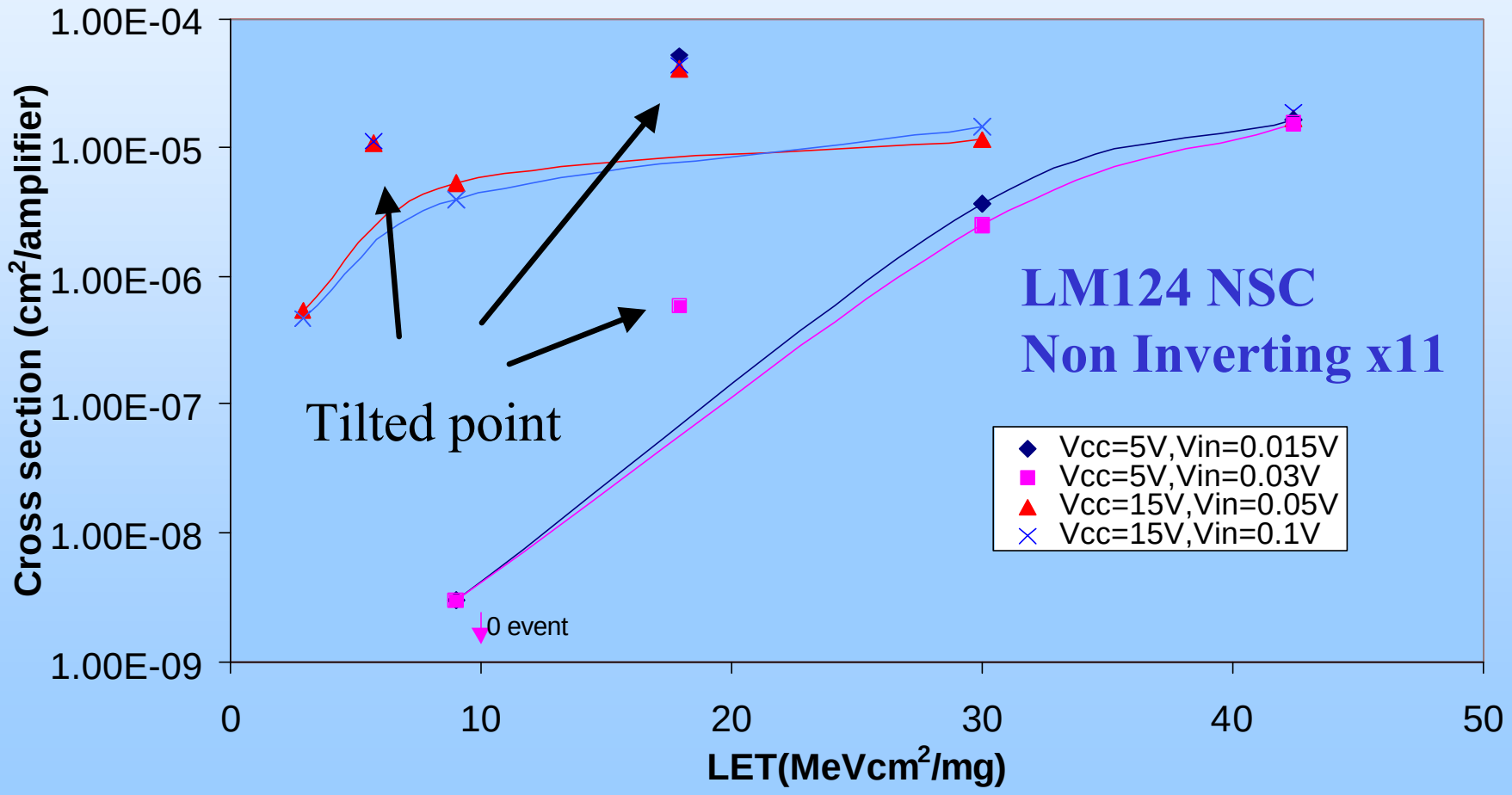
A significant amount of SET tests have been performed the last two years at NASA-GSFC, first as an attempt to define a low cost conservative test methodology.

This talk presents the lessons learned during these tests, and propose testing guidelines.

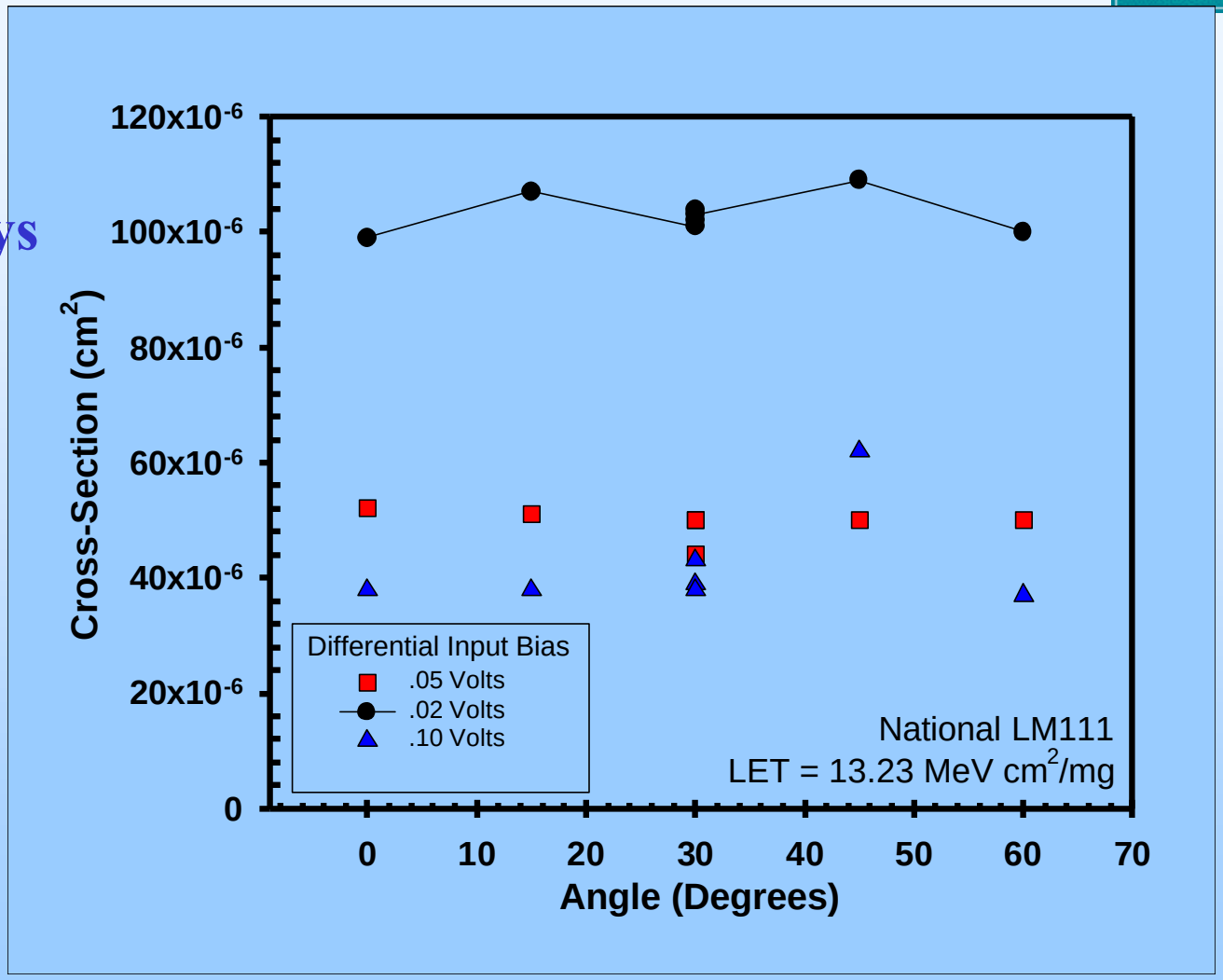
Bias conditions have a significant effect on device sensitivity
Input Voltage



Bias conditions have a significant effect on device sensitivity
Power Supply Voltage



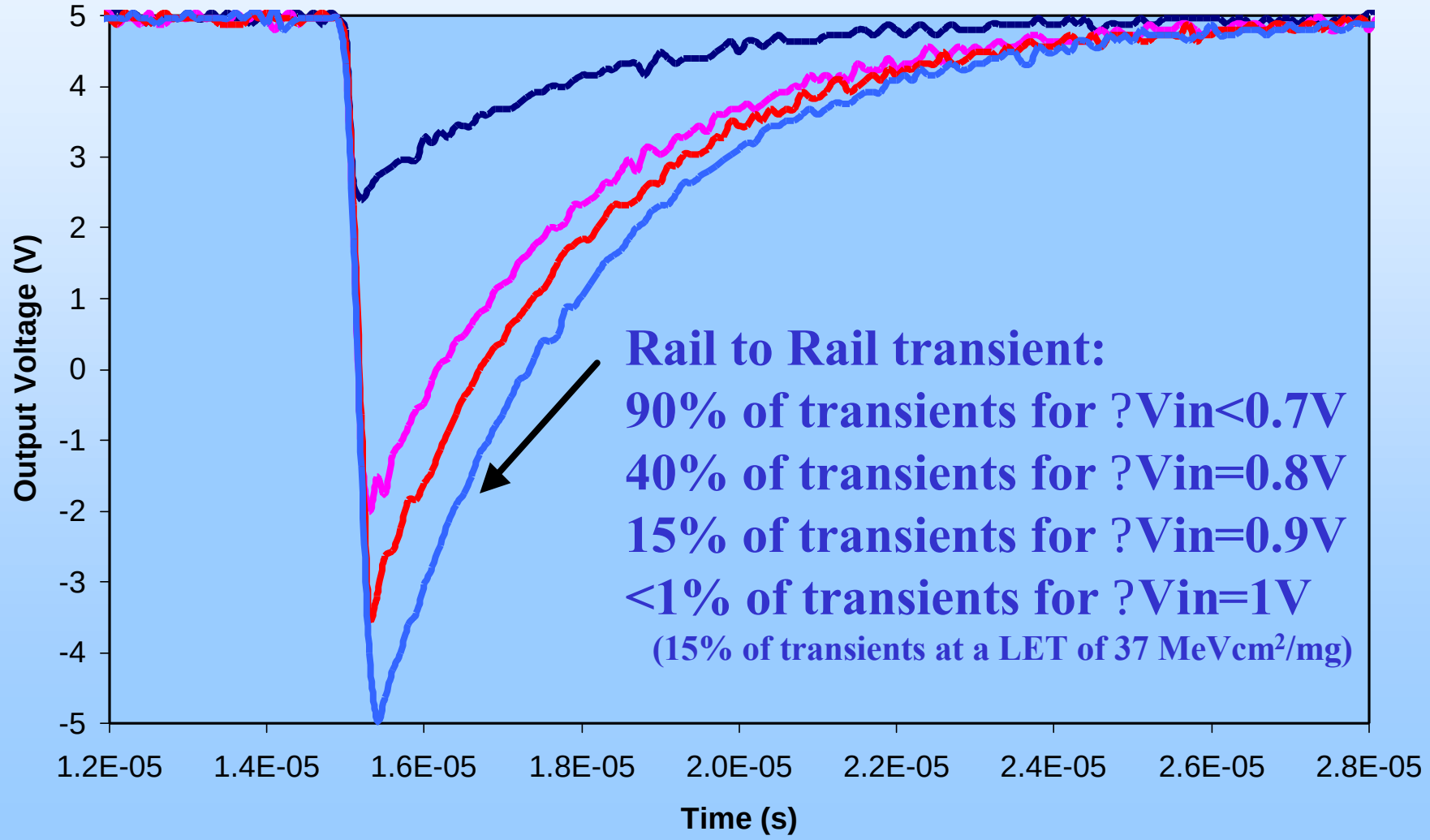
There is not always a dependence on tilt angle



Data provided by M. Savage, NAVSEA CRANE

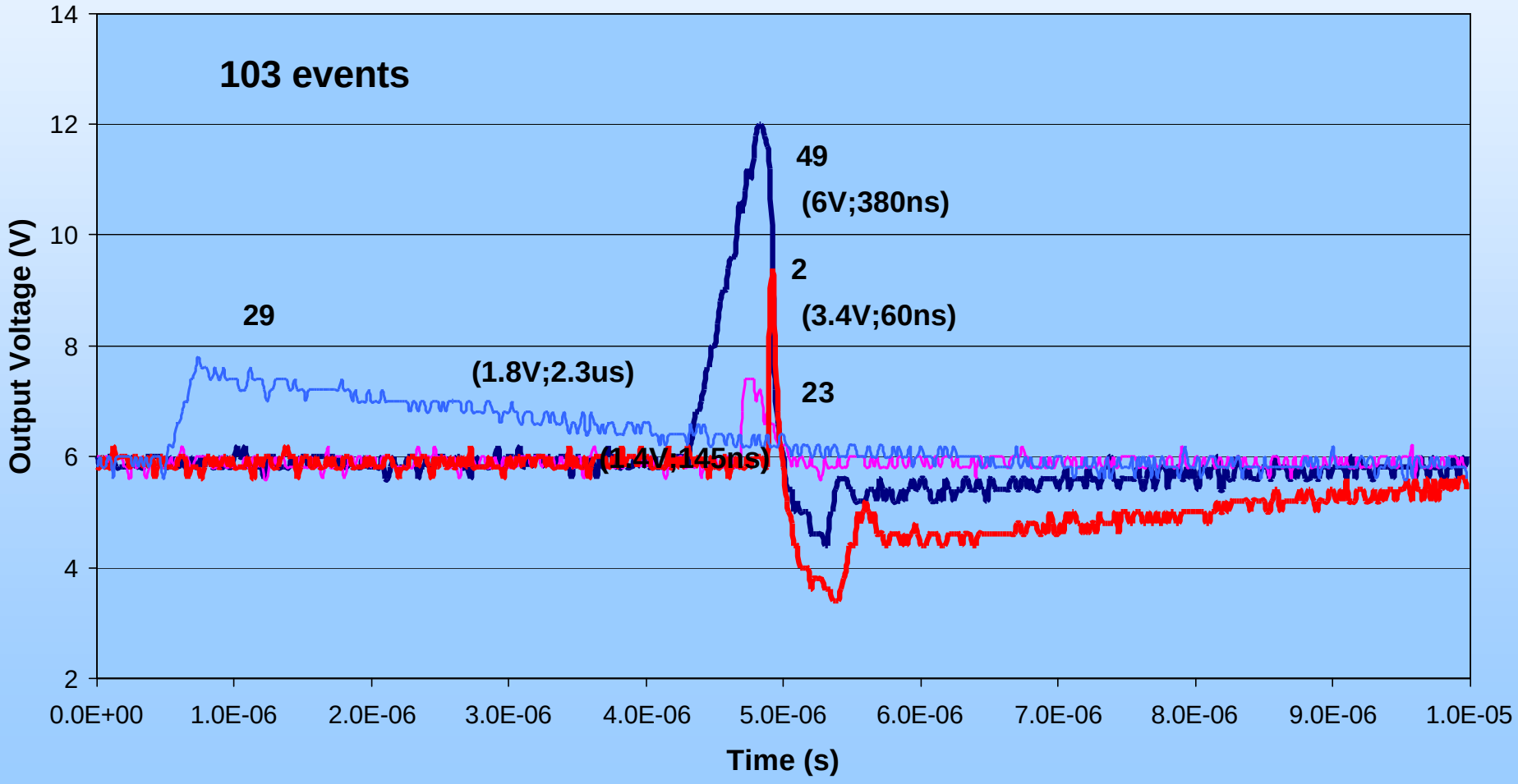
Bias conditions have a significant effects on transient waveform

LM139 Vcc=+/-5V TAMU LET=18.7 MeVcm^2/mg

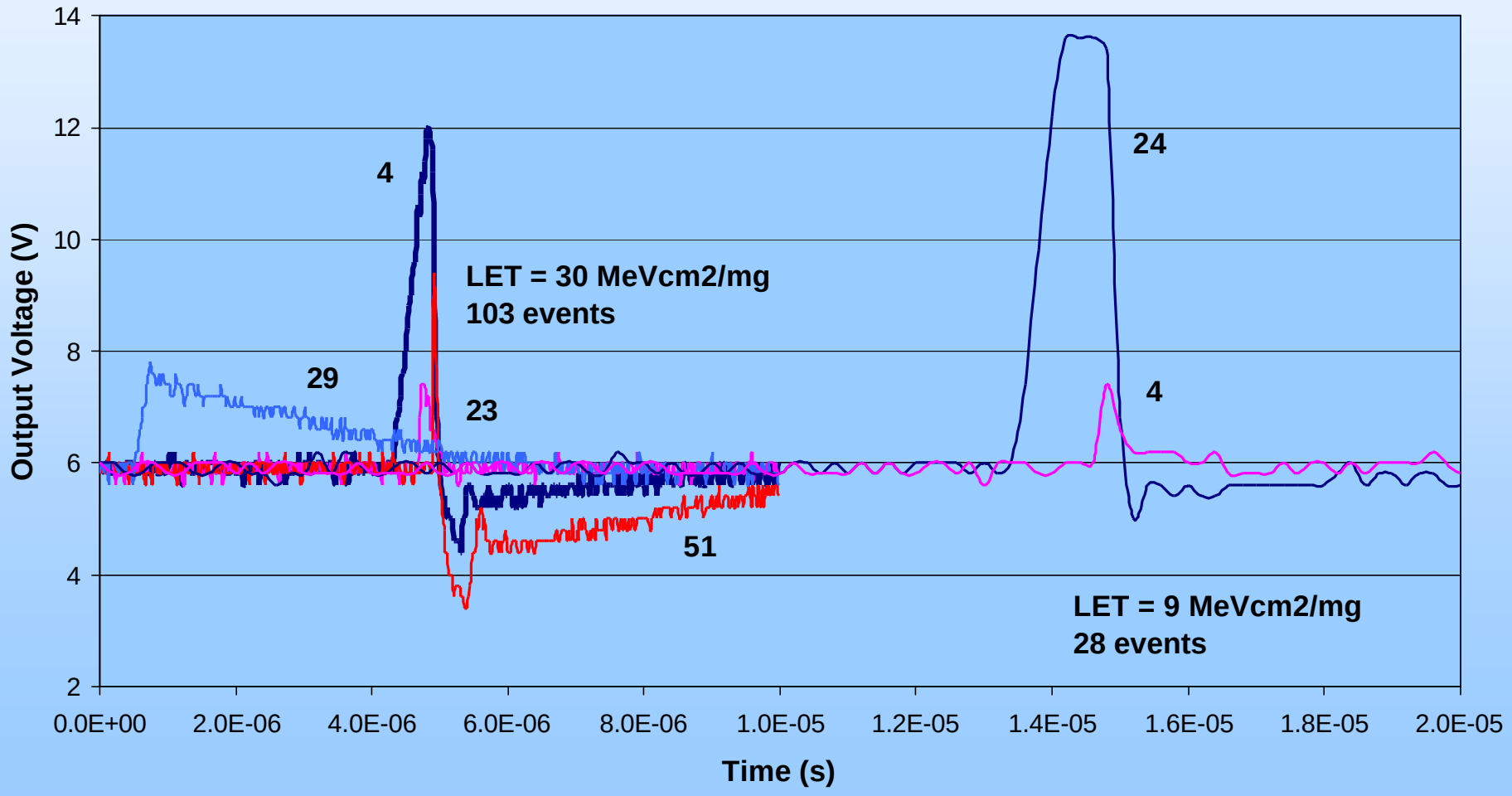


Various transient waveforms can be collected

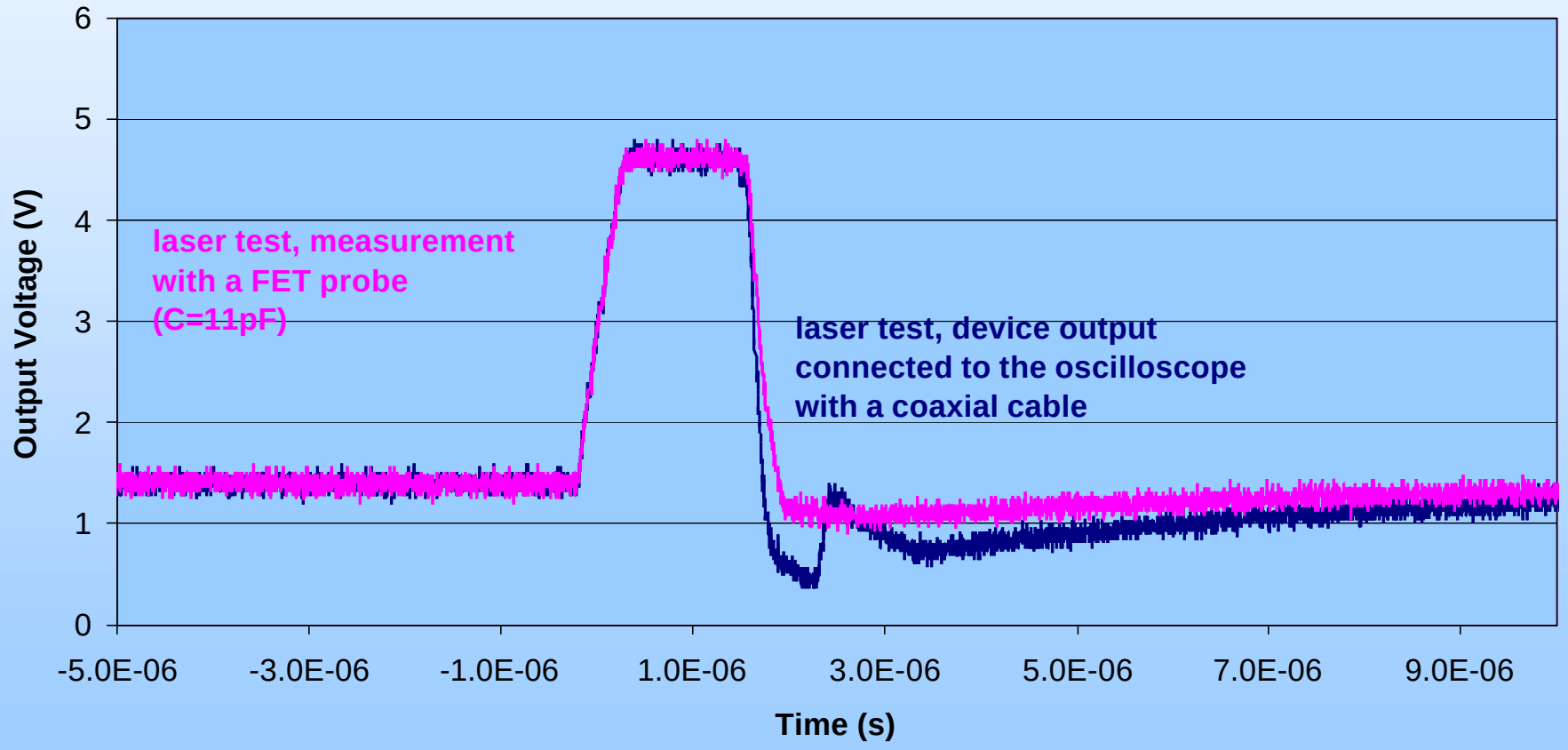
LM124 Non inverting gain x11 Vcc=+/-15V Vin=0.5V
TAMU LET= 30 MeVcm2/mg



Transient characteristics vary with LET

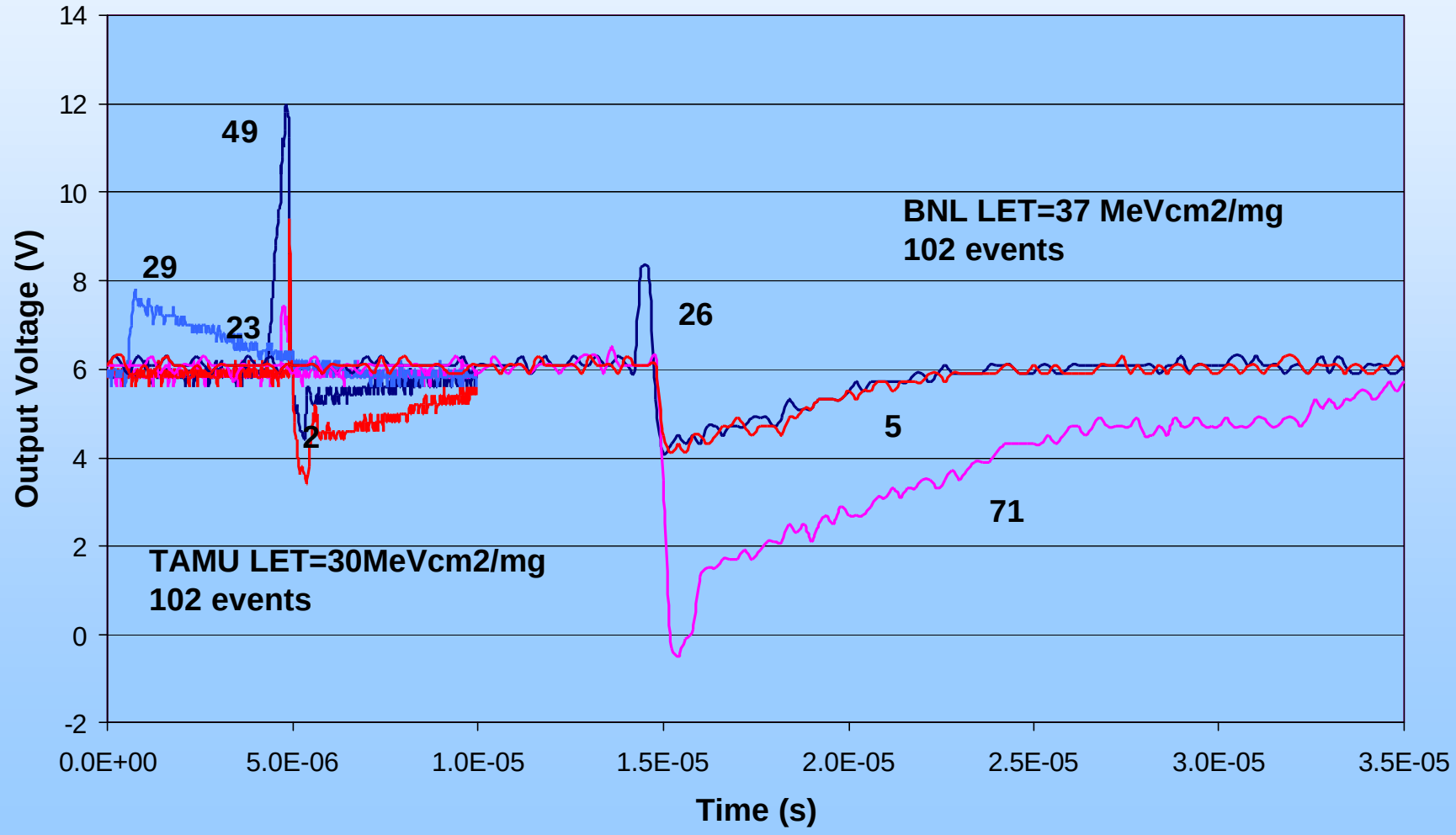


Test set-up may have significant effects on the collected transient waveforms

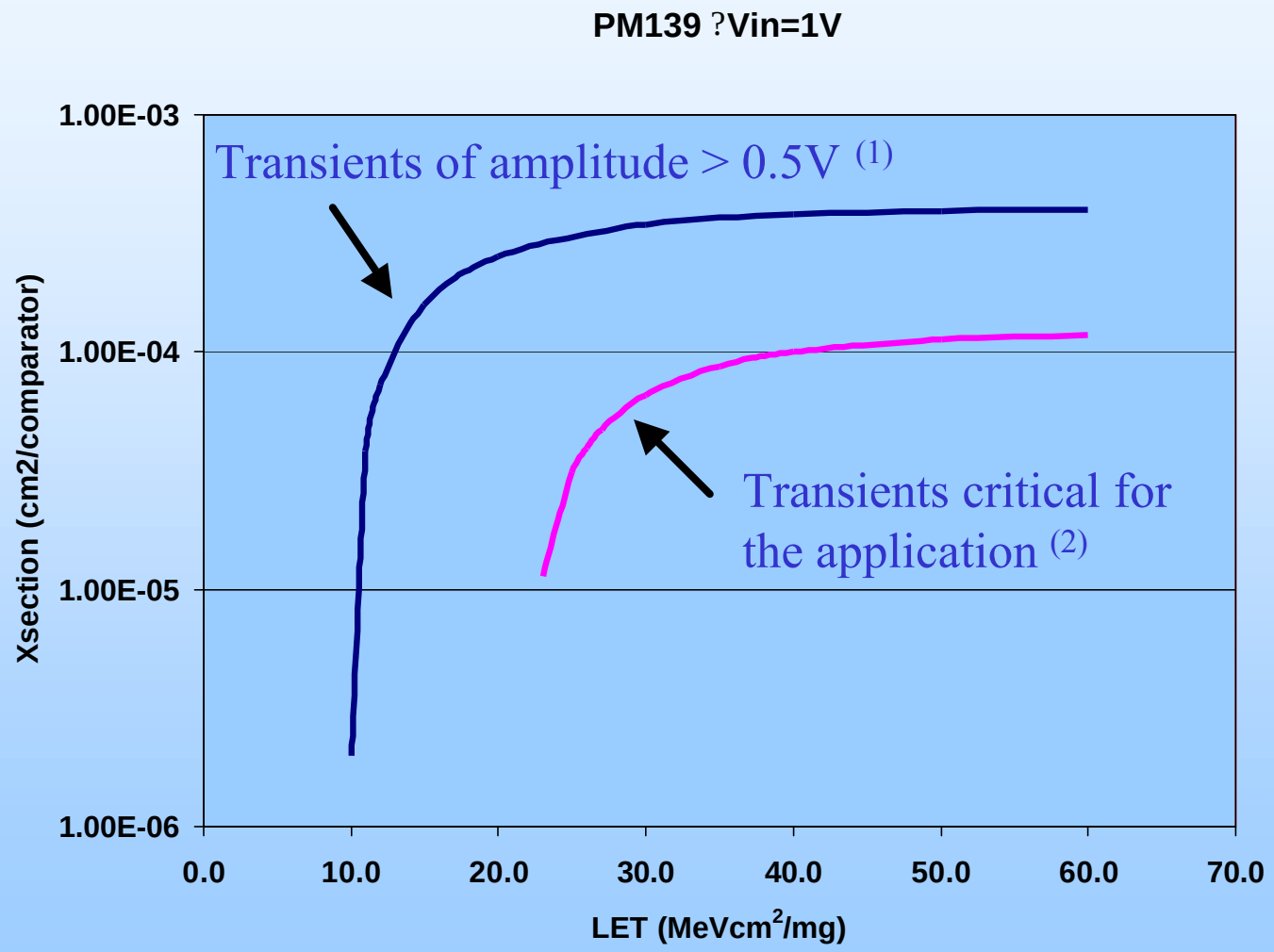


Test set-up may have significant effects on the collected transient waveforms

LM124 Non inverting gain x11 Vcc=+/-15V Vin=0.5V



How good is the data to assess the SET impact on applications?



(1) After A. Johnston, IEEE Trans. on Nuc. Sci., vol. 47-6, p2624, Dec. 2000.
(2) After Boeing data.

Testing Guidelines
Irradiation Conditions

- Use of tilted beam should be avoided
- Flux must remain low enough not to cause pile-up of data collection
- A sufficient number of transient needs to be collected to get a significant number of all the different transient waveforms:

  >200 events

- Minimum penetration range of ions:

  > 30 ?m

Testing Guidelines
Bias Conditions

- A large set of different bias conditions is necessary to try to understand the device behavior and define worst case bias conditions.
- It is not often possible to define worst case bias conditions.
- It is often necessary to test the parts in their application conditions.
  - Laser testing and modeling may be useful to check other bias conditions.

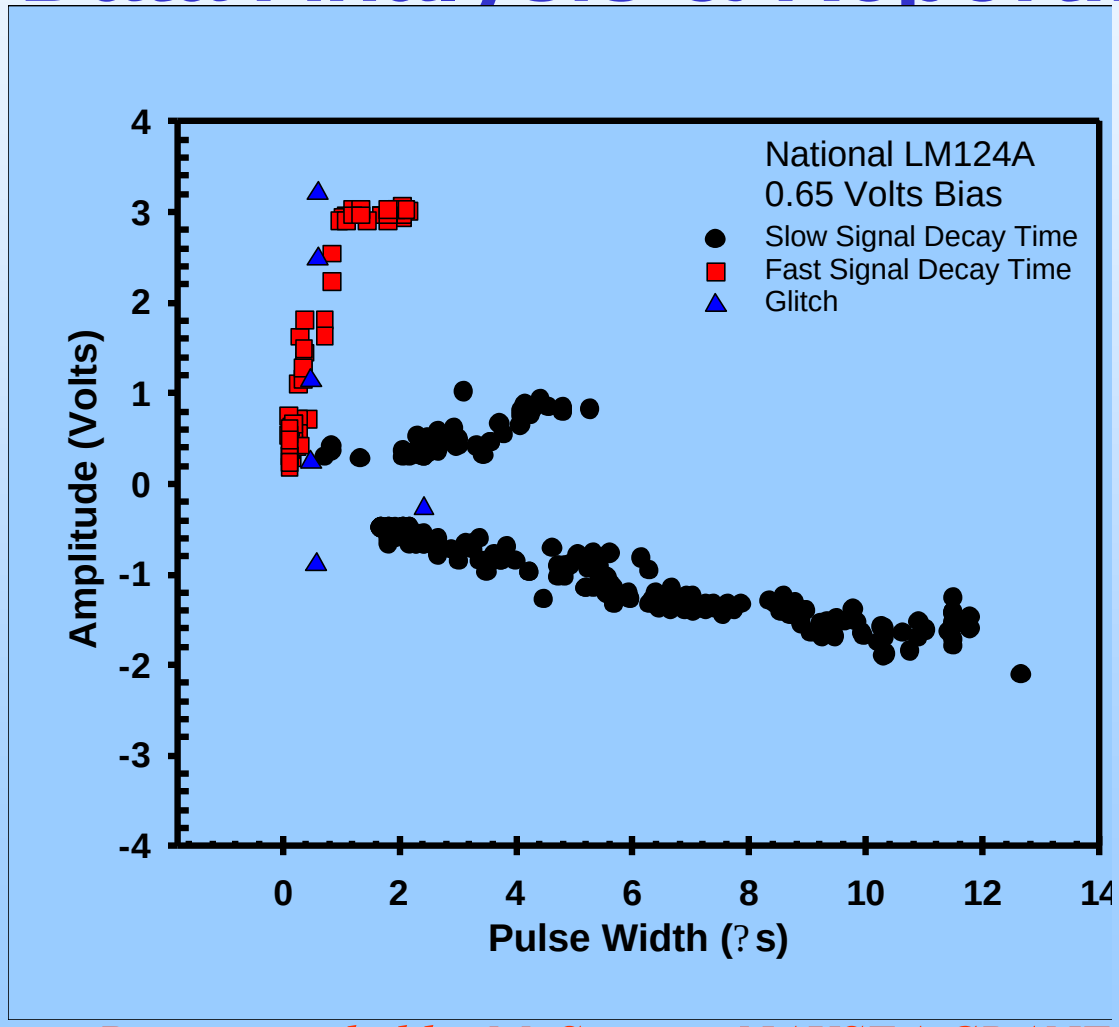
Testing Guidelines
Data collection techniques

- Care must be taken to the type of oscilloscope probe that should be used
  - Low capacitance active FET probe.
- All the transients collected need to be stored for further analysis.

Testing Guidelines
Data Analysis & Reporting

- At minimum the report should include:
  - bias conditions
  - measurements conditions (triggering conditions)
  - the total cross section curve
  - the picture of the different types of waveforms collected with worst case characteristics (amplitude, duration) and how they contribute to the total cross section curve.

Testing Guidelines
Data Analysis & Reporting



Data provided by M. Savage, NAVSEA CRANE