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Study of Irradiated ROCs

Eric Stachura

UIC

PAUL SCHERRER INSTITUT

PSI

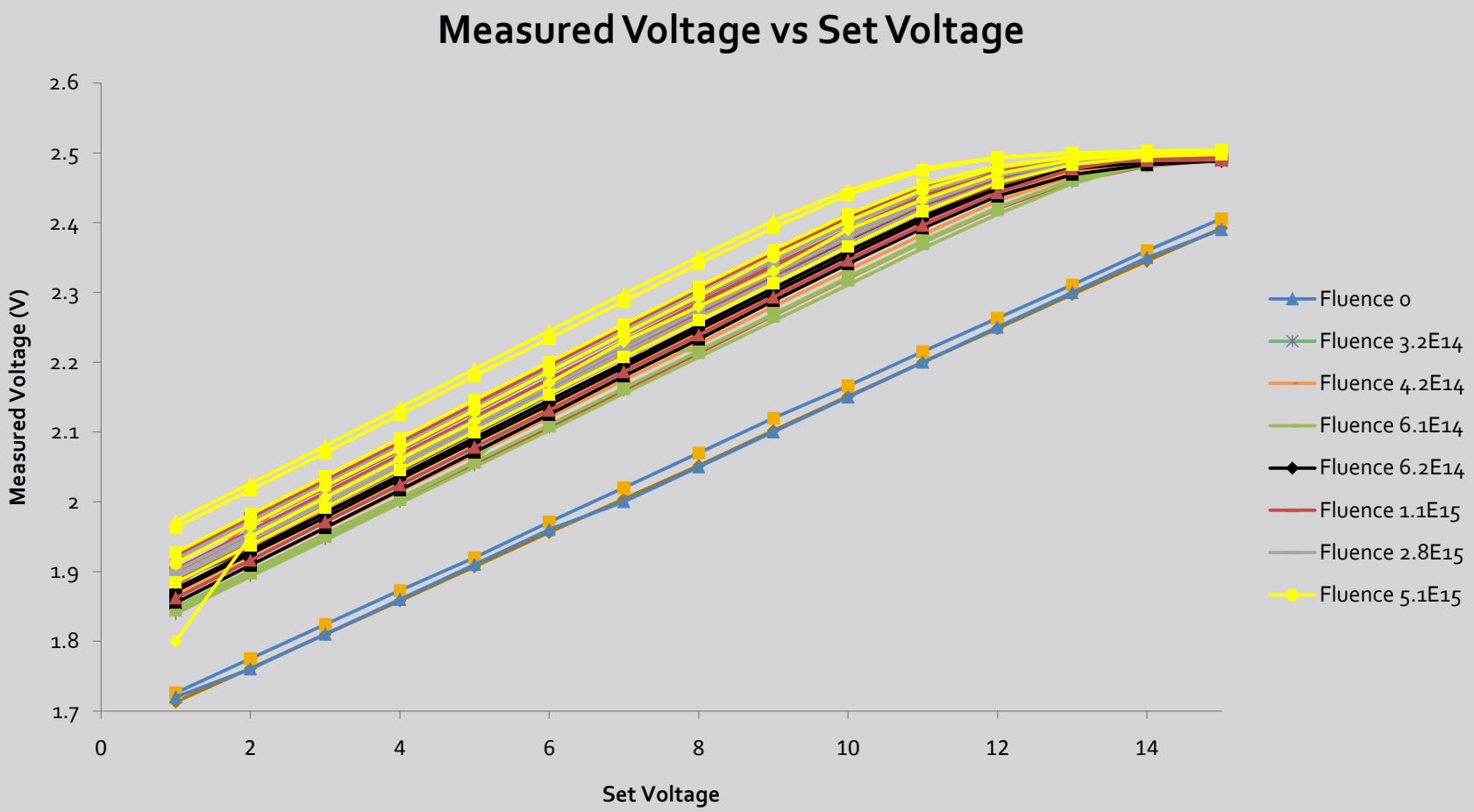
Research at PSI—Summer 2009

- Project 1: Digital Voltage Measurement (w/ Natalie)
- Project 2 (main research): Study of Irradiated ROCs (w/ Samvel)

Digital Voltage Measurements

- For each different radiation level, the digital voltage of the Read Out Chips were measured at set voltage points. Each were taken at constant, room temperature.
- Graphs for each fluence were plotted (digital voltage vs set voltage)
- Note: set voltage was meant not to exceed 15 V

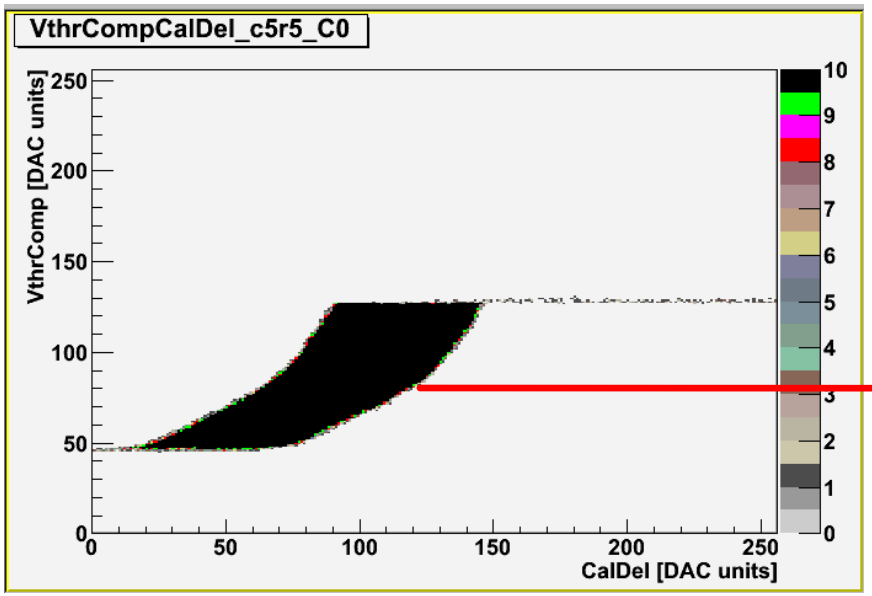
Digital Voltage Measurements: Results



Study of Irradiated ROCs: PulseShape

- The purpose of our PulseShape study was to extract the so-called Pulse Shape, and see how it changes with varying levels of radiation.
- The idea is to use the rising edge of the "tornado plot" to extract the Pulse Shape. Theoretically, we would use the error function, but linear function works just as well, and is simpler. (See Figure 1. (next slide)).

Study of Irradiated ROCs: PulseShape



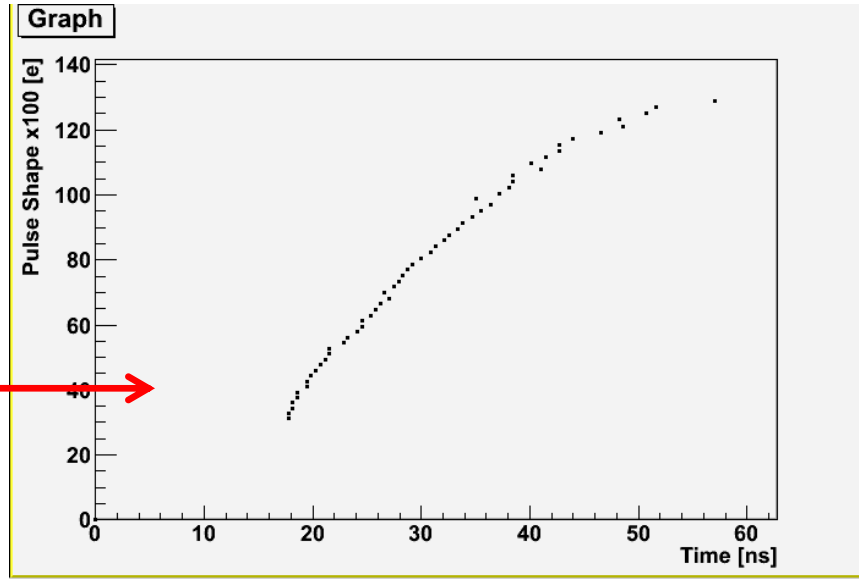


Figure 1. Tornado Plot and corresponding Pulse Shape.

Study of Irradiated ROCs: PulseShape

- We expect the rising time of the Pulse Shape to be ~ 25-30 ns. [Remember: the width of the tornado plot is (when converted to ns) 25 ns, and each bunch crossing is 25 ns apart.]
- Since we did not see this 25 ns rise time, we have taken 90% of the curve to see the rise time. This is often used in electronics since with 100% of the curve, there is a lot of noise.

Study of Irradiated ROCs: PulseShape

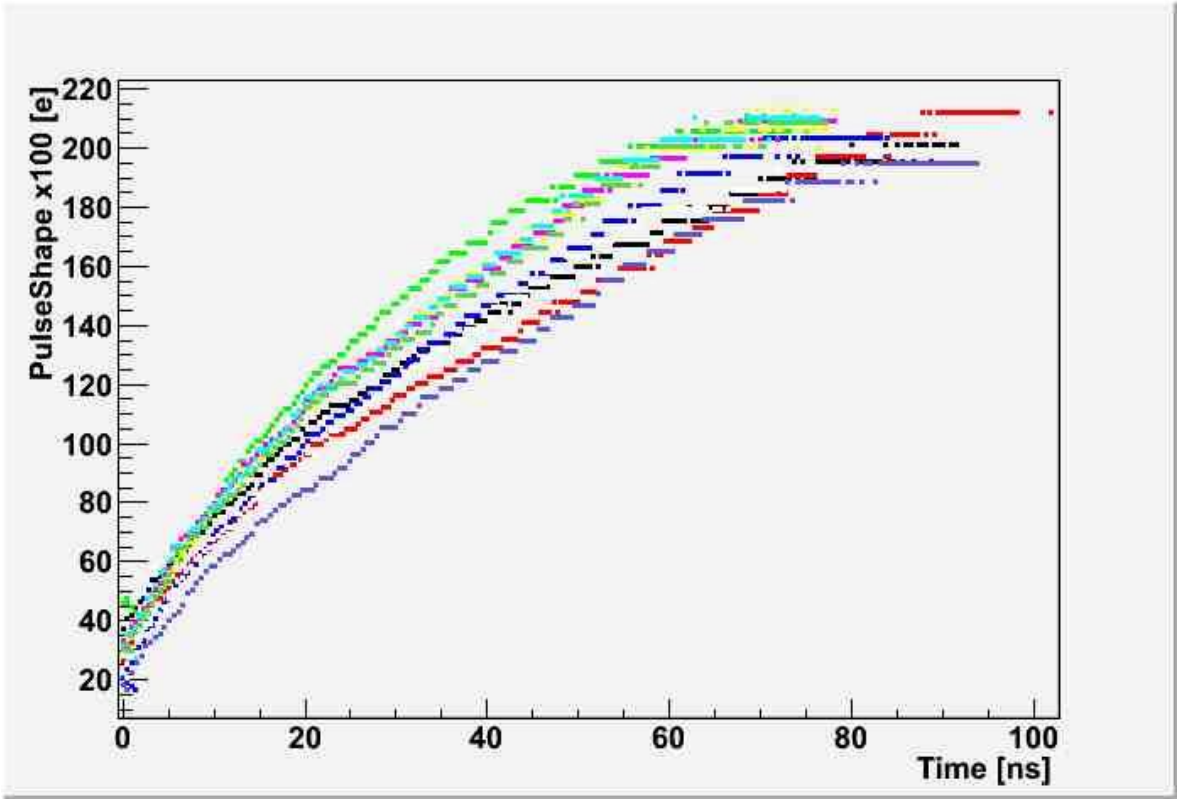


Figure 2. Example Pulse Shape's for $\boldsymbol{\Phi}$= 6.1E14.

Study of Irradiated ROCs: PulseShape--Procedure

- We need to cool each ROC to -10 C, and to do this we used a cooling box (see next slide).
- The use of a Peltier cooler, Nitrogen flux (to control humidity), and a voltage source allowed us to do this.
- Once at a constant temperature, we can begin with taking our measurements.

Study of Irradiated ROCs: PulseShape--Procedure

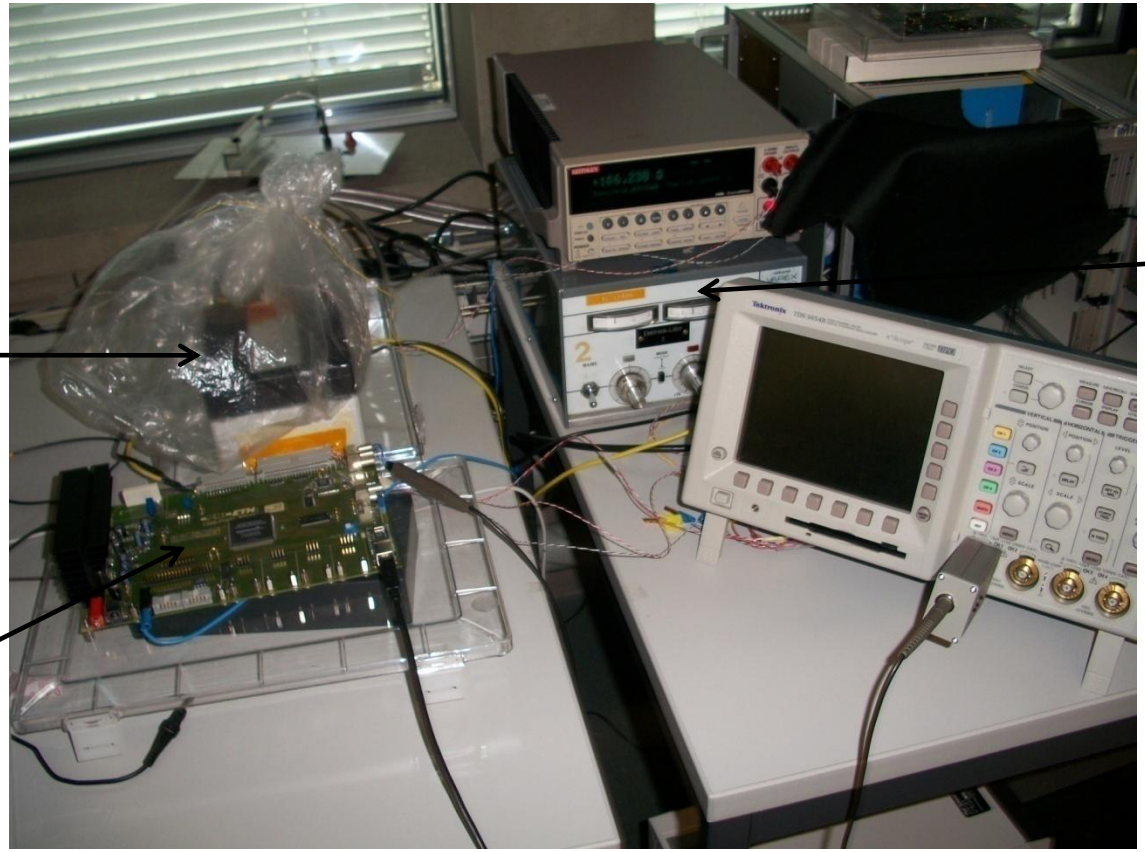


Figure 3. Test stand setup at PSI.

Study of Irradiated ROCs: PulseShape--Procedure

- Using psi46expert, we take DAC-DAC scans, and get the following plots: Vthr_vs_CalDel, Vcal_vs_CalDel, Vthr_vs_Vcal, Vthr_vs_Vcal _WBC-1 .We also find Vcal_vs_CalDel at the lowest working threshold. For Vthr_vs_Vcal, we take as many different WBCs as necessary to get enough points.
- Then, we run an algorithm to extract the Pulse Shape, using information from all of the above plots.
- For a much more detailed description of the measurements, plots, and analysis, see the UNL HEP TWIKI under the section "Study of Irradiated ROCs".

Concepts behind study

- The read out electronics allow for an injection of a calibration signal into the Pixel Unit Cell(see next slide). This amplitude is Vcal, an 8 bit DAC.
- Other DACs used in our study are CalDel, which is a delay; and Vthrcomp, which is the minimum signal needed to trigger the comparator.
- The "tornado" plot is an efficiency plot, and for our purposes, we injected Vcal several times. Vthrcomp_vs_CalDel is the efficiency plot showing this.

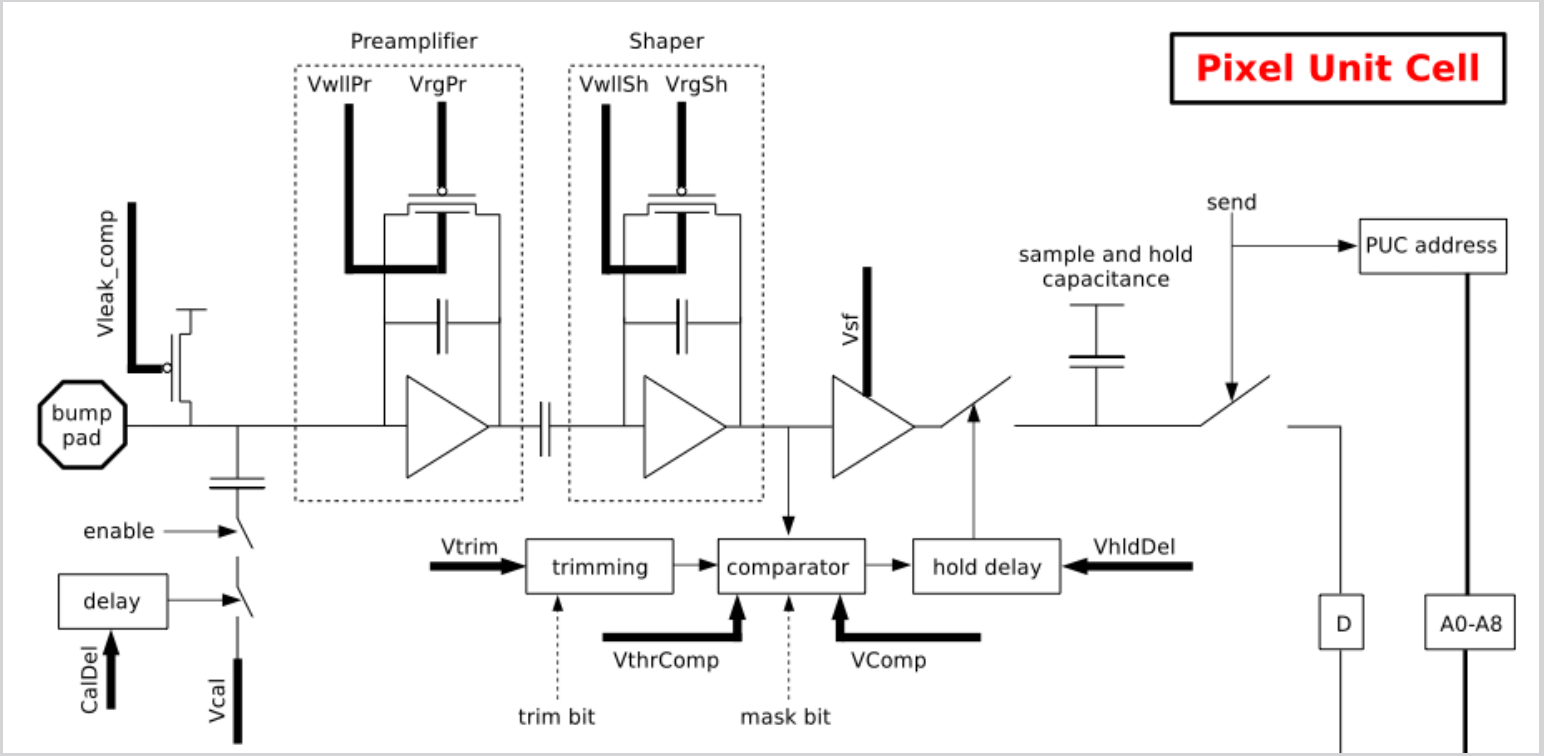


Figure 4. Schematic of Pixel Unit Cell

Results

- For the detailed results, stay tuned for Samvel's talk.
- However, needless to say, we have made a lot of progress, in that we are at the stage where we try to change different inputs to try and obtain the original Pulse Shape (the original Pulse Shape refers to the Pulse Shape obtained from the unirradiated ROC).