## December 7, 2017: Lund update

As advertised, after the previous weeks' testing of chips for samples to different groups, spent the past week looking at some more details. To start with, we did similar scans, as done previously for MPW2, now for V3 and V4 chips, and looking at noise as a function of capacitance, and series resistor values.

So far, noise and gain look quite similar to V2 chips.
For next week, plan to look at other gain settings and frequencies, look at cross-talk, and shaping time.

Plots also collected under:
http://www.hep.lu.se/staff/silvermyr/SAMPA/anaOut.2017/

In these slides - all with $20 \mathrm{mV} / \mathrm{fC}$ and 10 MHz :
Reminder of MPW2 results, then comparisons with V3 and V4 results.

In principle, we want to study a multi-dim space of noise variations: for different chips. vs capacitance, resistors, gain settings, sampling frequency, temperature, ...

For MPW2, we studied 3 chips in detail, with internal and external voltages, 7 capacitor values, 5 resistors, 3 gain settings, 2 frequencies, and 5 different temperatures, but typically only varied one parameter at a time to avoid studying all possible $3^{*} 2^{*} 7^{*} 5^{*} 3^{*} 2^{*} 5=6300$ combinations.

Now for V3 and V4 (3 chips for each kind), and 5 capacitance values, and 3 resistor values, for a total of 90 different combinations/measurements (each takes about 10 min to measure). Only show a subset today, for one chip of each kind but all plots are available online.

Reminder:

- Chip numbers less than 2000 are V2
- Chip numbers 2000-5999 are V3
- Chip numbers $\geq 6000$ are V4


## MPW2 = V2; Noise vs Capacitance (100 Ohm resistor)

First, a reminder for MPW2: we measure the sigma value in ADC and can convert that to an estimate of \# of electrons, equivalent:

Noise (ADC) vs Cap : pcca1_100ohm_20mV_10mhz


Noise (Electrons) vs Cap : pcca1_100ohm_20mV_10mhz


Show the values for all 32 channels in a chip. This V2 chip had one channel broken/unconnected.

## V3 (chip \#2128); Noise vs Capacitance (100 Ohm resistor) 4

One of 3 tested V3 chips : similar values as seen for $\mathrm{V} 2(18 \mathrm{pF}$ value similar, 68 pF approx. $10 \%$ better for V3; other V3 chips more similar to V2 values).


Note the that range is a little different here: values 0 pF to 68 pF , while it was 10 pF to 100 pF for the V2 plot.

## V4 (chip \#6115); Noise vs Capacitance (100 Ohm resistor) 5

One of 3 tested V4 chips : similar values as seen for V2 and V3


## MPW2 = V2; Noise vs Resistor value (for 0 pF and 18 pF )) 6

Next, let's also look at noise vs resistor value, for 2 different cap values (only show noise in electron equivalents).



As expected, see differences between 0 pF vs 18 pF (scale in left vs right plot), but not much variation with resistor values (within right plot, perhaps $\sim 10 \%$ increase from 0 Ohm to 100 Ohm).

## V3 (chip \#2128); Noise vs Capacitance (100 Ohm resistor) 7

One of 3 tested V3 chips : similar values as seen for V2


## V4 (chip \#6115); Noise vs Capacitance (100 Ohm resistor) 8

One of 3 tested V4 chips : similar values as seen for V2 and V3


## Summary / Outlook

So far, noise seems quite similar for V3 and V4, as seen earlier for V2 (MPW2)

Similar variation with capacitance for V3 and V4, as seen earlier for V2. Smaller variation vs resistor values for all.

Will continue with more measurements (with nominal capacitance and resistor values), in the other dimensions (gain settings, ...), as described on the first slides.

