CBC2 “shadow effect” investigations

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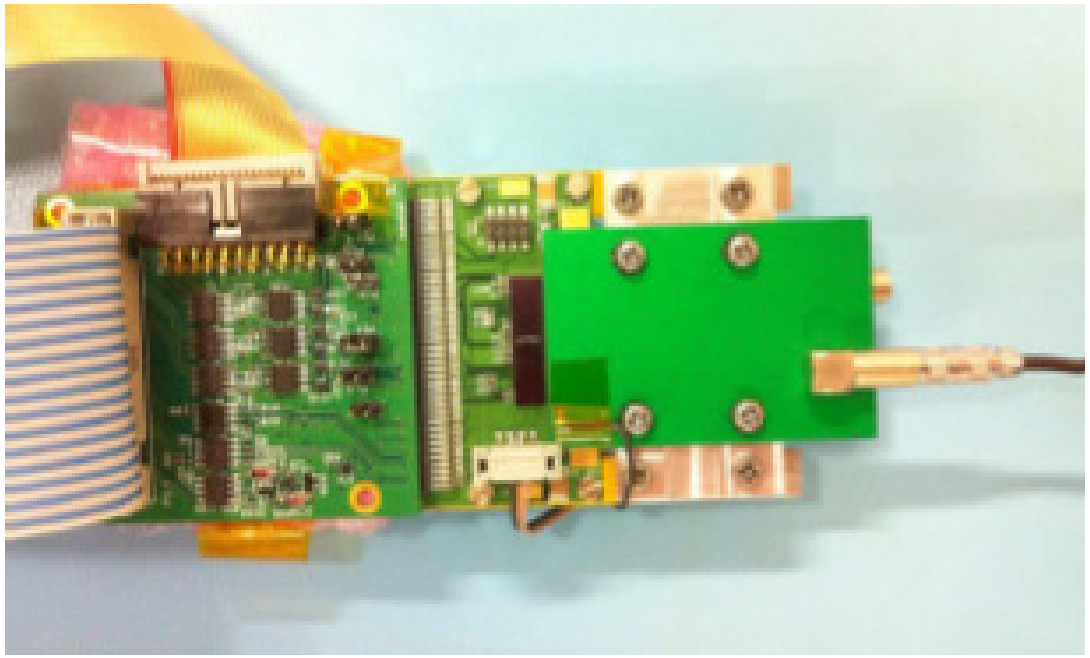
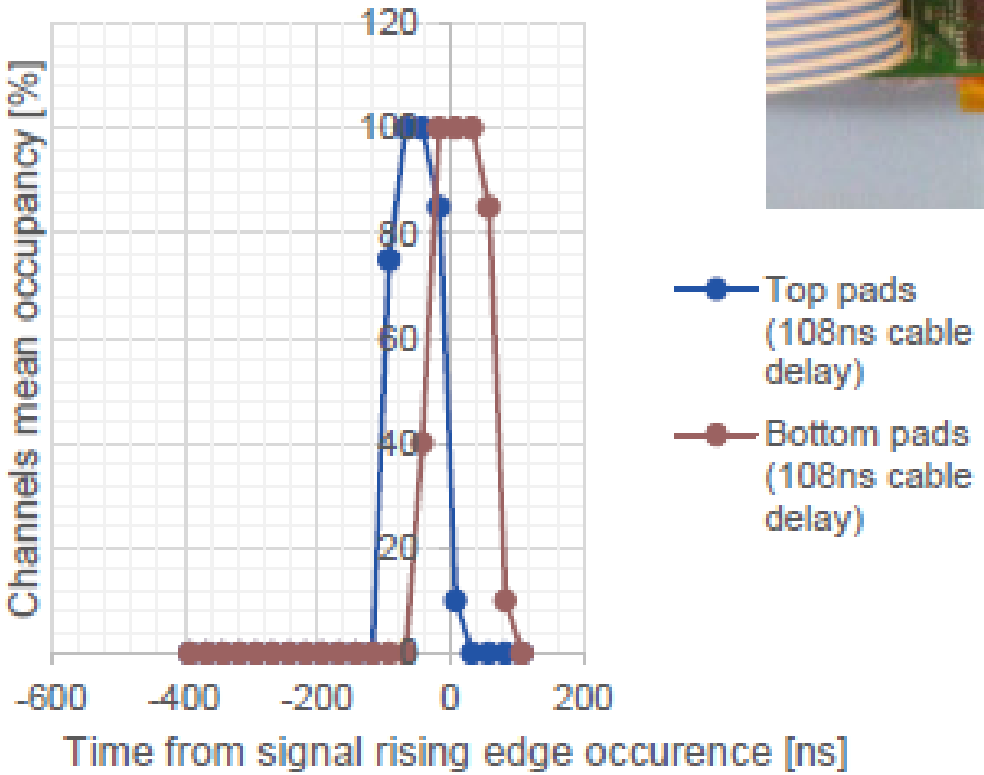
systems meeting, 14th April, 2015.

v. brief summary of Tomasz's observations

from Tomasz's talk last time

fire all 127 channels by coupling signal
to bondpads on hybrid top/bottom surface





see signals in top surface channels

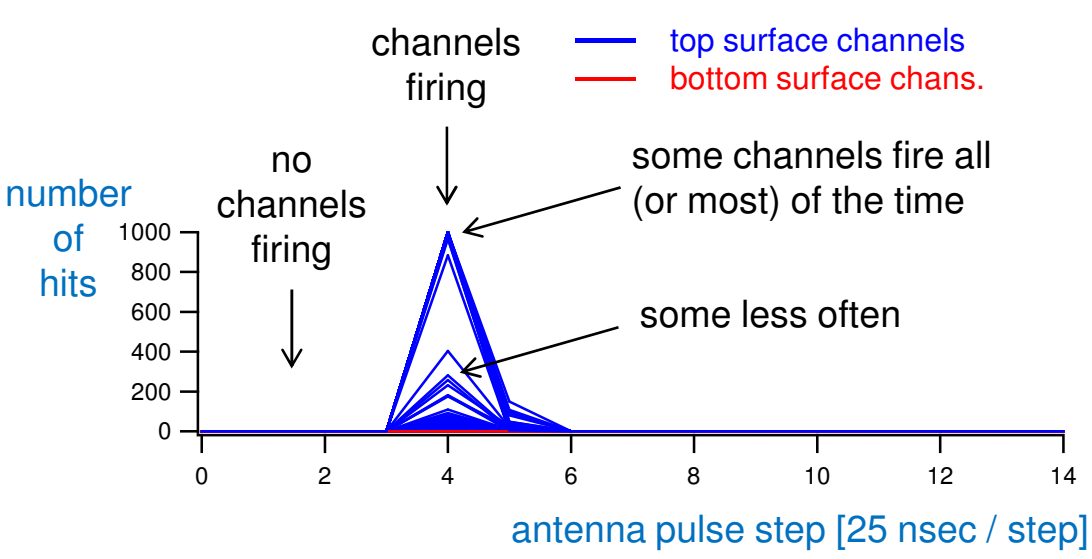
but also in bottom surface channels
with ~2 clock cycles (50ns) delay

=> "shadow effect"

repeat of Tomasz's observations at IC

using VME based DAQ (not standard GLIB-based system)

- trigger function generator to generate antenna pulse (rising edge charge injection)
- trigger CBC2 and read out data
- vary time of antenna pulse in 25 nsec steps
- repeat for fixed number of triggers (1000)



example result for 1V step on top surface antenna

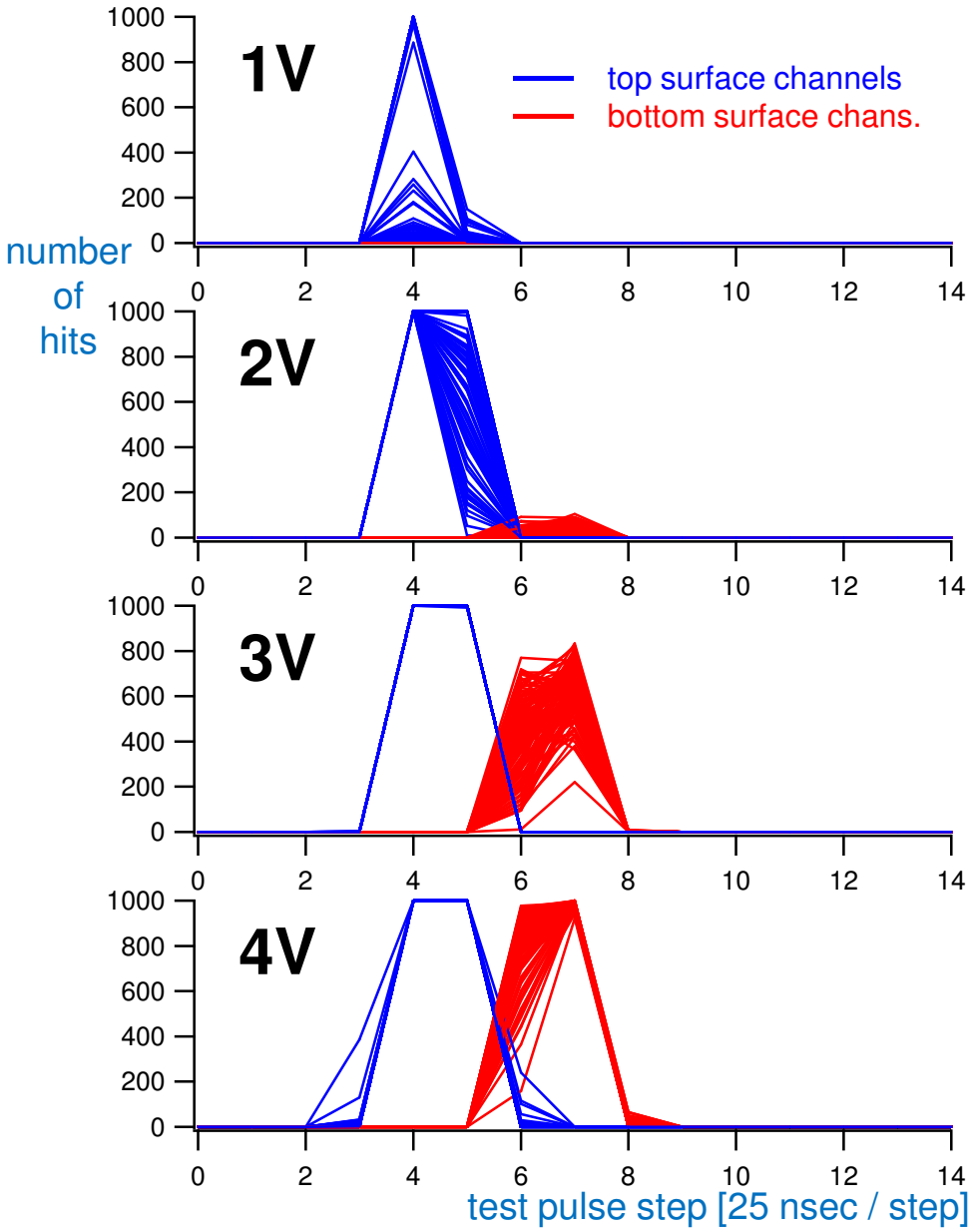
number of hits seen per channel vs. test pulse step

data from all 254 channels plotted

for this test pulse amplitude see only channels on top surface firing, but not all, and not all the time

now vary the test pulse amplitude

varying test pulse amplitude



varying antenna signal edge amplitude from 1 to 4 Volts

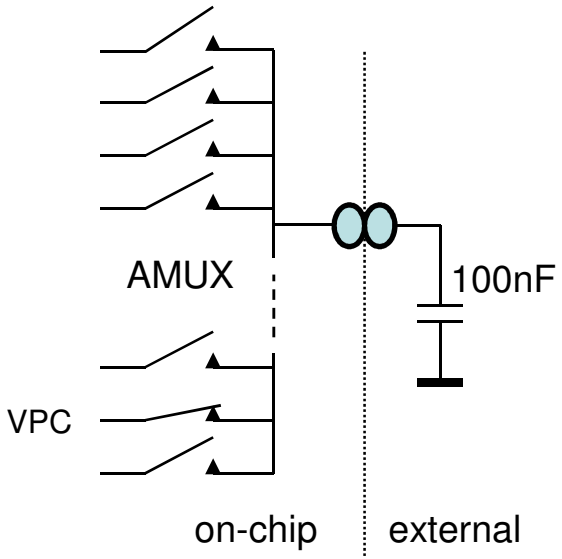
more top surface channels start to fire as amplitude increases

bottom surface channels start to fire as amplitude increases

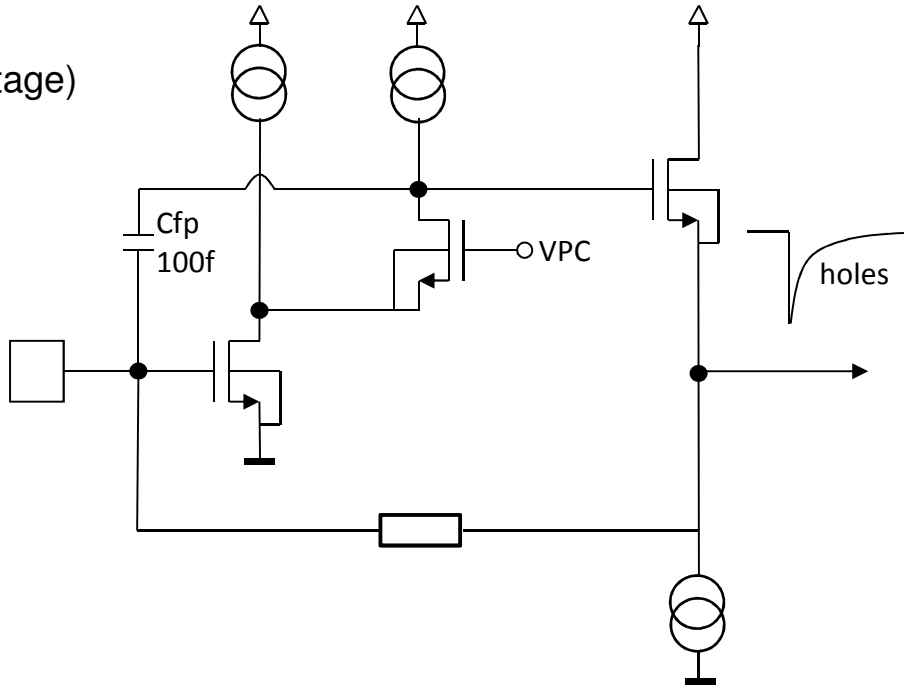
time offset between top and bottom channels ~2-3 time steps (50-75 nsec)

what's going on? - clues

by trial and error discovered that effect is much reduced if select VPC (the preamplifier cascode voltage) using the analog mux



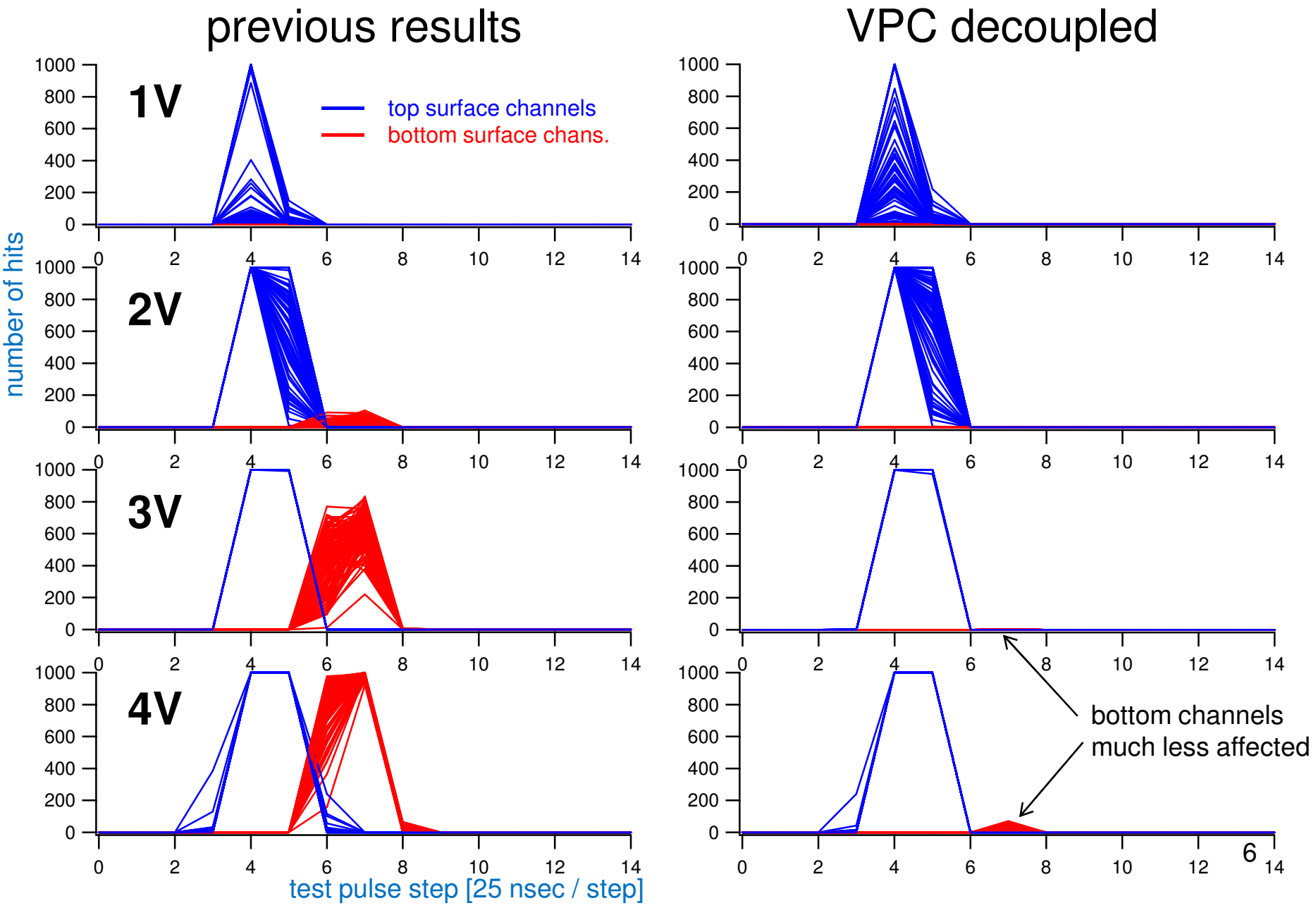
Preamp



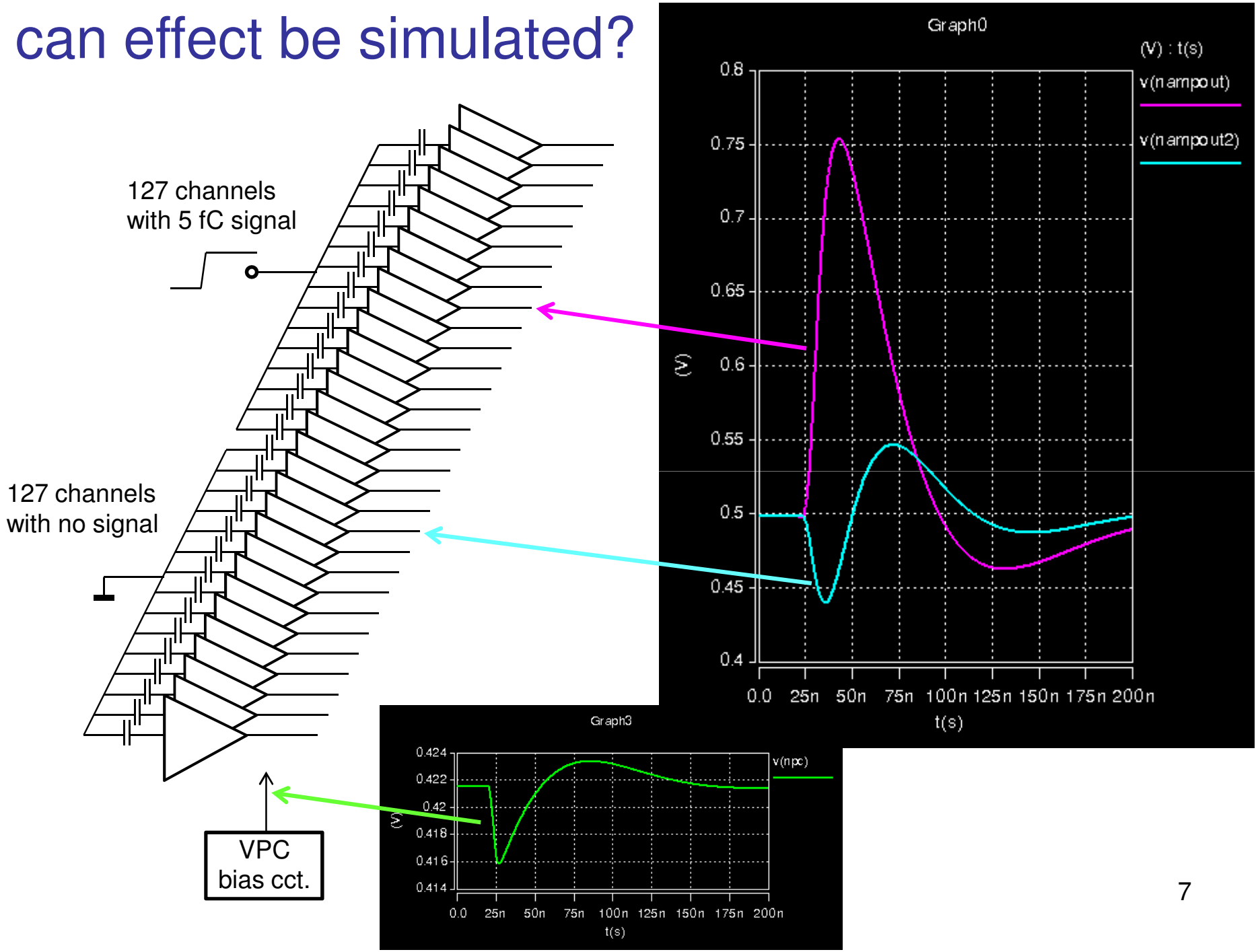
program Analog MUX to select VPC
AMUX O/P is decoupled to GND by 100nF capacitor on 2CBC2 support board

(set 5 bit AMUX field in TP Cntrol & Analog Mux register to b01011 - decimal 11)

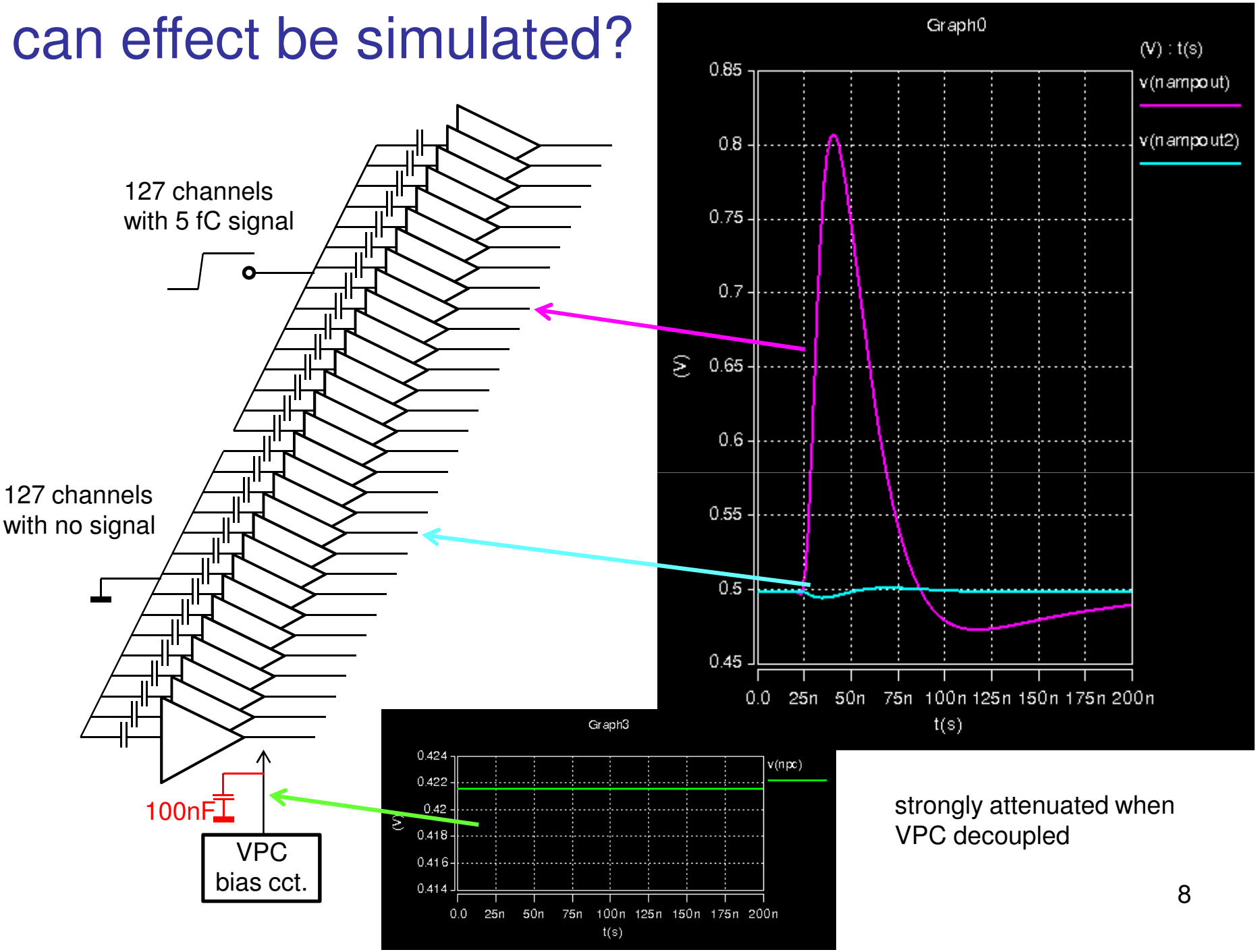
effect of decoupling VPC



can effect be simulated?

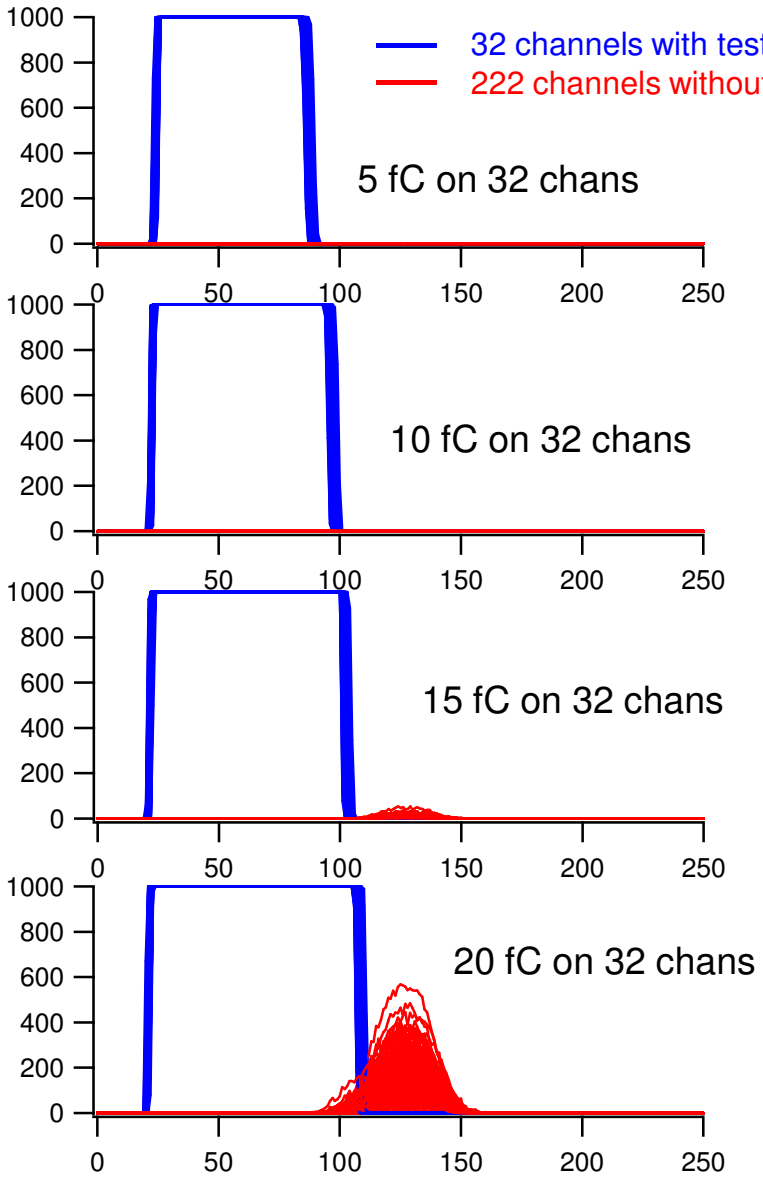


can effect be simulated?



strongly attenuated when
VPC decoupled

effect with test pulse

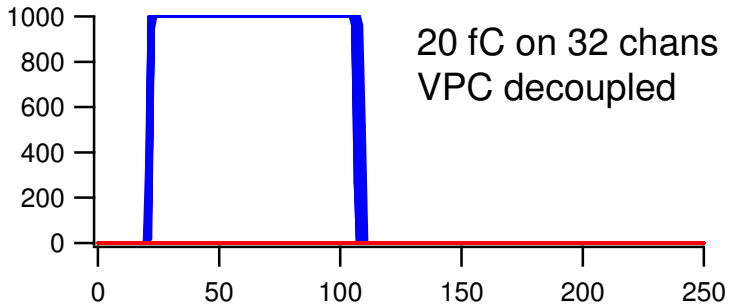


internal test pulse time of charge injection can be varied with 1 nsec resolution

effect is still visible with internal test pulse on 32 channels if signal size > ~10 fC

threshold at ~0.5 fC

goes away completely if VPC selected via analog MUX and externally decoupled



summary

shadow effect results from firing many channels simultaneously

- now reproduced in independent test system

strong evidence that effect results from disturbance to preamp cascode bias voltage

- significant improvement if VPC decoupled externally by selecting via analog MUX
- can be simulated

can also produce effect with internal test pulse for signals >10 fC on 32 channels

external decoupling may help when using the antenna technique to verify hybrids

note: shadow effect will <u>not</u> affect performance of CBC2 at normal occupancies