LC Environments - RF Pickup

ChD

30/3/03

- Beam-Related RF Radiation <u>Through</u> Beam-Pipe (Even 0.25 mm Be?) Presumably Negligible (Unless it's CF As in UA1!)
- However, Flanges, BPM Cables, Etc Can Produce Ferocious Radiation

- SLD Experience:
  - Analogue Signals Stored Securely In CCD Buried Channel
  - Digital Logic (PLL in Optical Links) Were Disrupted - Fortunately Could Be Restored Within Some μs Of End Of Bunch (Train)

- NLC/JLC 190 @ 1.4 ns ⇒ 266 ns
  CLIC 154 @ 0.6 ns ⇒ 92 ns
  } ≈ Instantaneous

  Rep Rate 120 Hz (or 50-200 Hz For CLIC)
  ⇒ Settling Time Plus Readout Time OK For All Silicon Pixel Technology Options

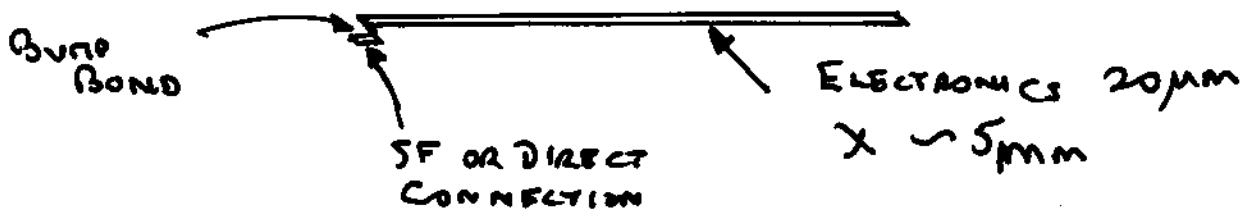
- TESLA 500 GeV 2820 @ 337 ns ⇒ 950 μs
  - Read Layer 1 Repeatedly @ 50 ms During Train, To Sparsified Internal Data Store

- READ DATA FROM ~20 FRAMES TO EXTERNAL DATA STORE DURING 200ms BETWEEN FRAMES

NB: EACH FRAME READOUT (INTERNAL) SPANS ~150 BUNCH CROSSINGS, SO THE ELECTRONICS IS HIT REPEATEDLY DURING READOUT BY WHATEVER RF RADIATION IS PRESENT

- FOR SLD VTX, THIS WOULD HAVE BEEN FATAL (LIKE THE BEAM PIPE OF UA1)

- MAYBE OK FOR CPCCD. CIRCUITRY IS A BIT MORE COMPACT



- BUT, AS PART OF VERIFICATION OF ANY PROTOTYPE LADDER, IN ANY TECHNOLOGY, SUGGEST TESTING IN A <u>FINAL FOCUS LAB</u> WHERE MACHINE BUNCHES ARE SIMULATED BY CURRENT PULSES DOWN WIRES IN THE BEAM-PIPE, & ALL OTHER FF EQUIPMENT IS INSTALLED & OPERATING.
- SUCH A FF LAB SHOULD BE BUILT WITHIN THE GAN / GDN FACILITIES

CORRELATED DOUBLE SAMPLING: WHAT DOES IT MEAN FOR YOU ?

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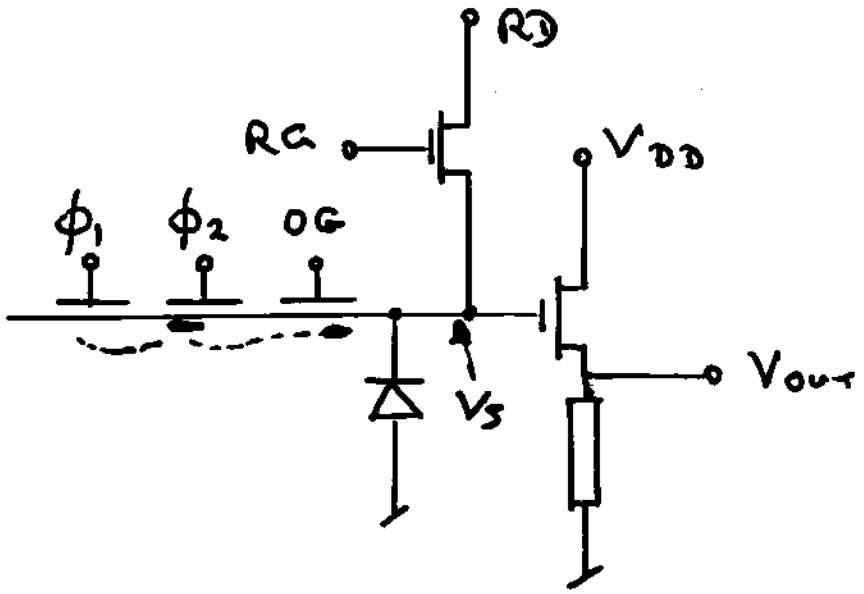
- CDS IS TERM INVENTED ORIGINALLY FOR THE FORM OF PEDESTAL SUBTRACTION ASSOCIATED WITH THE RESET NOISE IN CCD READOUT CIRCUITS



WITH $C_{DET} \sim$ 10s OF fF, $Q_{NOISE} \sim$ 100s OF e^- FROM FLUCTUATIONS IN POST-RESET NODE VOLTAGE V_S

- SIMPLEST CDS INVOLVES

  RESET / MEASURE V_S / TRANSFER SIGNAL CHGE / RE-MEASURE V_S

  $\Rightarrow \sim 1|e^-$ READOUT NOISE

- CAN GAIN MORE. FOR GIVEN SHAPING TIME T_S, OBTAIN SOME FET-CHANNEL RELATED NOISE. EVENTUALLY, LONGER T_S DOESN'T HELP ($1/f$ NOISE).

- CAN DESIGN CCD OUTPUT TO PERMIT MULTI-SAMPLING WHERE Q_{SIG} IS REPEATEDLY TRANSFERRED ON & OFF THE FET GATE

$$\text{RESULTANT NOISE} \propto \frac{1}{\sqrt{N_{SAMPLES}}}$$

- DEPFET WAS ROBUST CDS CAPABILITY, IN LC APPLICATION.
  - ~ 50μs SIGNAL INTEGRATION
  - READ PEDESTAL + SIGNAL
  - RESET
  - READ PEDESTAL ALONE

  → Δ OVER ~ 20ns

- CCD IS SIMILARLY ROBUST
  - READ PEDESTAL + SIGNAL CHGE FROM EARLIER IN THE ROW
  - TRANSFER SIGNAL FROM NEXT PIXEL
  - READ ACCUMULATED CHGE

  → Δ OVER ~ 20ns

- CDS FOR MAPS INVOLVE SUBTRACTION OVER FRAME PERIOD OF 50μs OR WHATEVER.
- COULD IN PRINCIPLE BE SOLVED BY INCLUDING

1- PIXEL CCD, OF DEPFET STRUCTURE, WITHIN THE CMOS PIXEL

- CDS WITH $\Delta T = 50\,\mu s$?

  SLD WAS OK IN INTER-TRAIN PERIOD WITH 200ns. NO EXPERIENCE BEYOND THIS

  - MIGHT GET AWAY WITH IT AT NLC, AFTER SOME SETTLING TIME
  - MIGHT NOT WORK AT TESLA

⇒ ONE GOOD REASON FOR BUILDING THE FF LAB SOMEWHERE