Measurement of Interstrip capacitance and Noise

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Main emphasis of RD50 has been the investigation of the signal from irradiated detectors, i.e. the collected charge after irradiation:
Depletion voltage -> active volume
Trapping -> charge collection distance
This tends to be a bulk problem.

But the performance of a tracker is characterized by the signal-to-noise ratio S/N

RMS noise = A +B*C (additional terms from leakage current, bias resistance, ..)
The interstrip capacitance is the major contributor to the capacitance, and thus the noise.
So it is prudent to start paying attention to the surface of **strip** detectors (NO PADS).

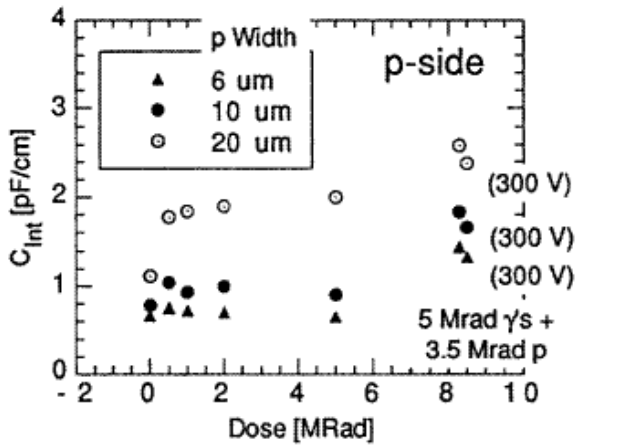


Fig. 3 Interstrip capacitance for p-side test structures.

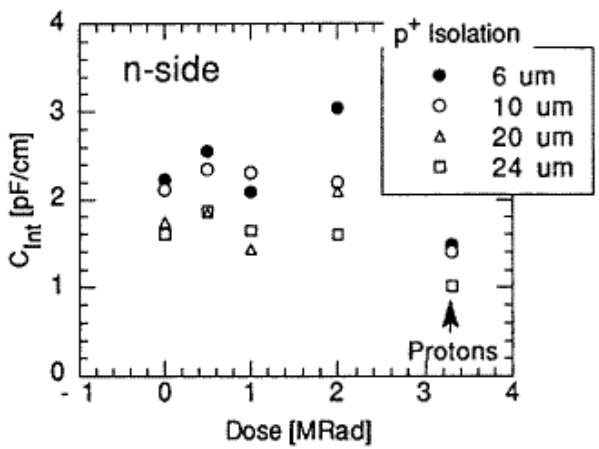


Fig. 4 Interstrip capacitance for n-side test structures of 10μm width.

HPK Double-sided SSD

E. Barberis et al,
IEEE TNS 41. 785, 1994

Interstrip Capacitance determined by 2 parameters:

(p-in-n): Strip width over pitch ratio w/p

(n-in-n, also n-in-p?): p+ isolation width and/or p-spray dose in addition to w/p

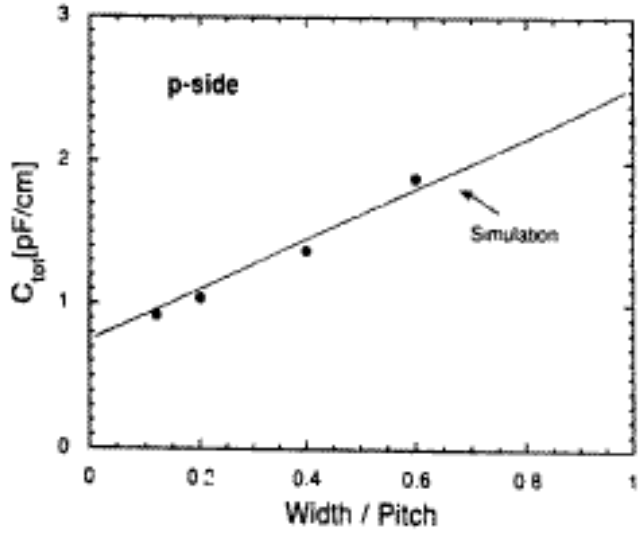


Fig. 4. Total capacitance for a 50 µm pitch p-side detector as a function of the ratio width over pitch w/p.

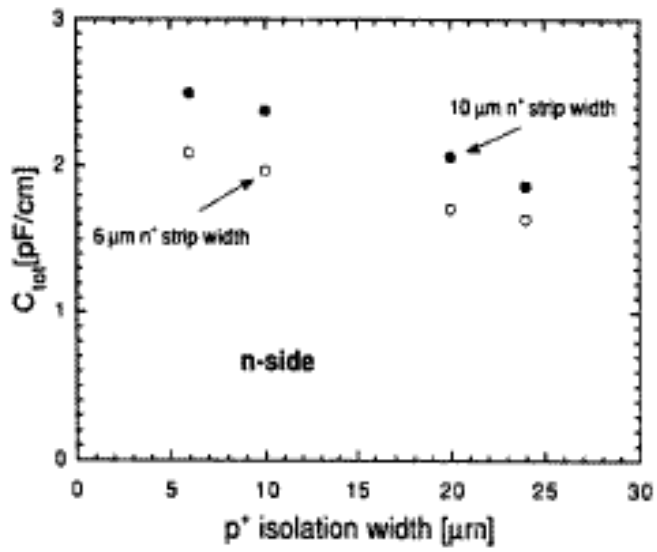
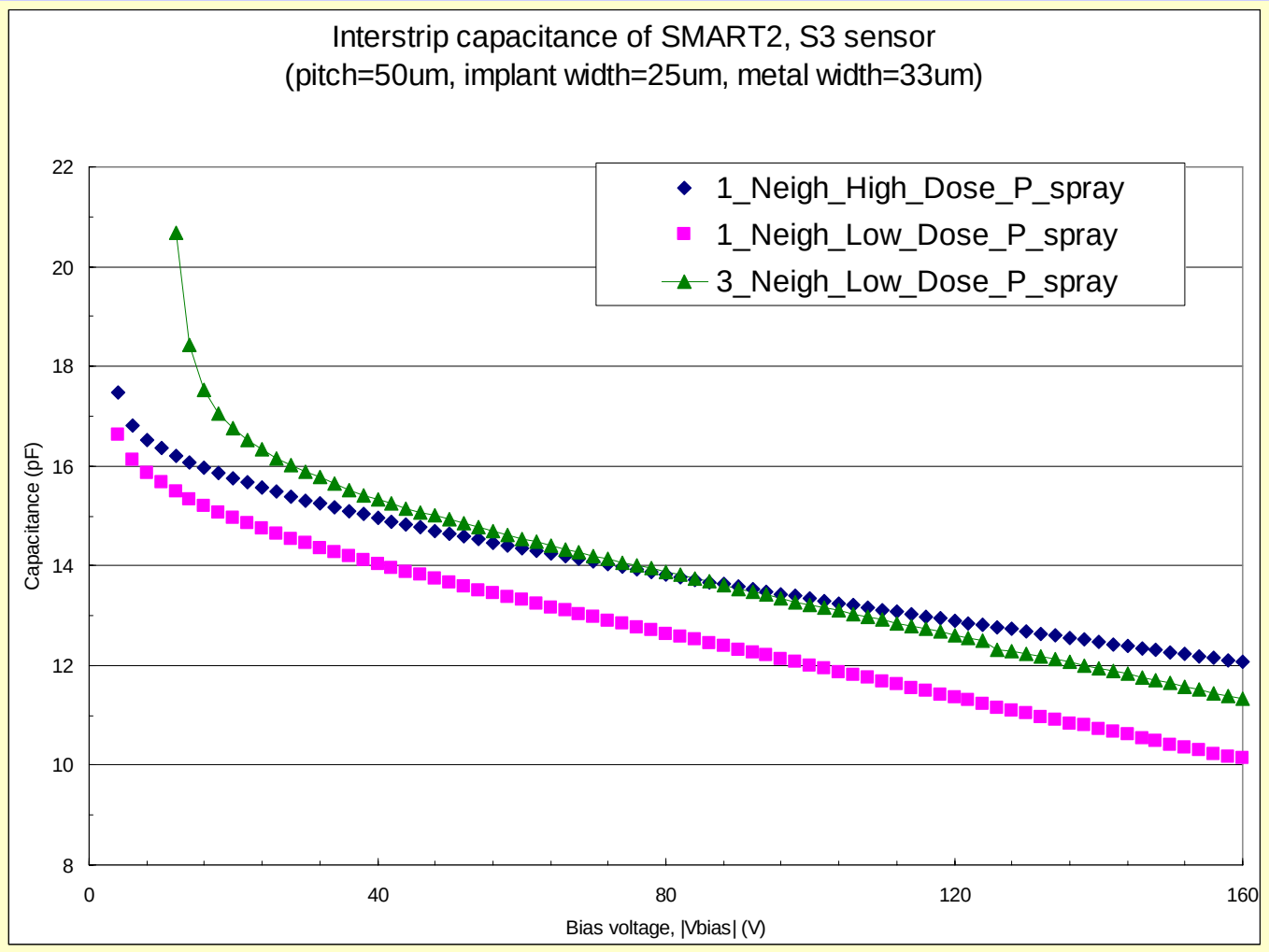


Fig. 5. Total capacitance for a 50 µm pitch n-side silicon detector as a function of p^+ isolation width for strip widths of 6 and 10 µm.

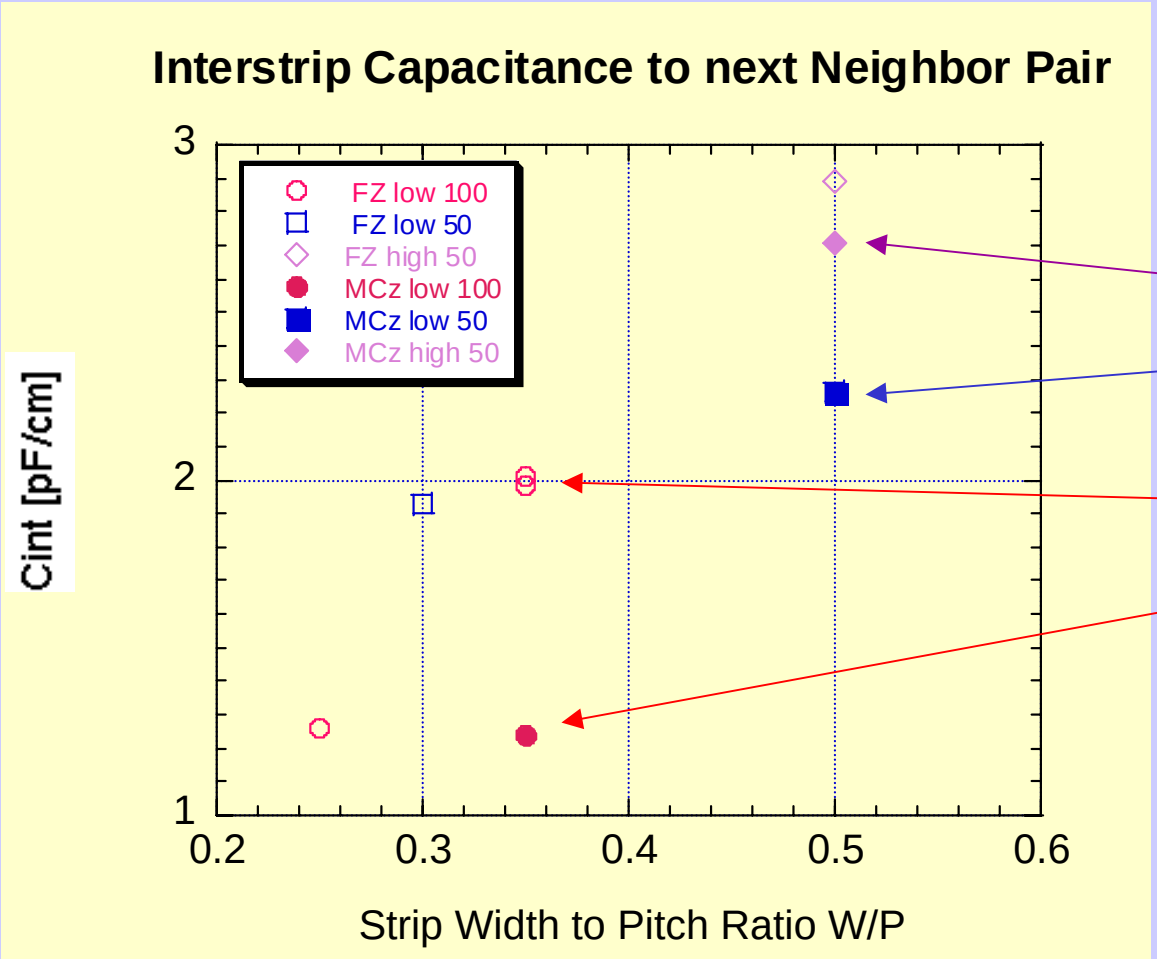
HPK Double-sided SSD E. Barberis et al, NIM A 342. 90, 1994

Measurement of Interstrip capacitance on SMART detectors
Cint to nearest 3 strip pairs only 10% larger than Cint to nearest neighbors



Cint ~ W/P

Need to design narrower strips (3pF/cm too large!)
Need to re- measure after irradiation.



High dose p-spray (5 *10^{12})

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Low dose p-spray (3*10^{12})

FZ.

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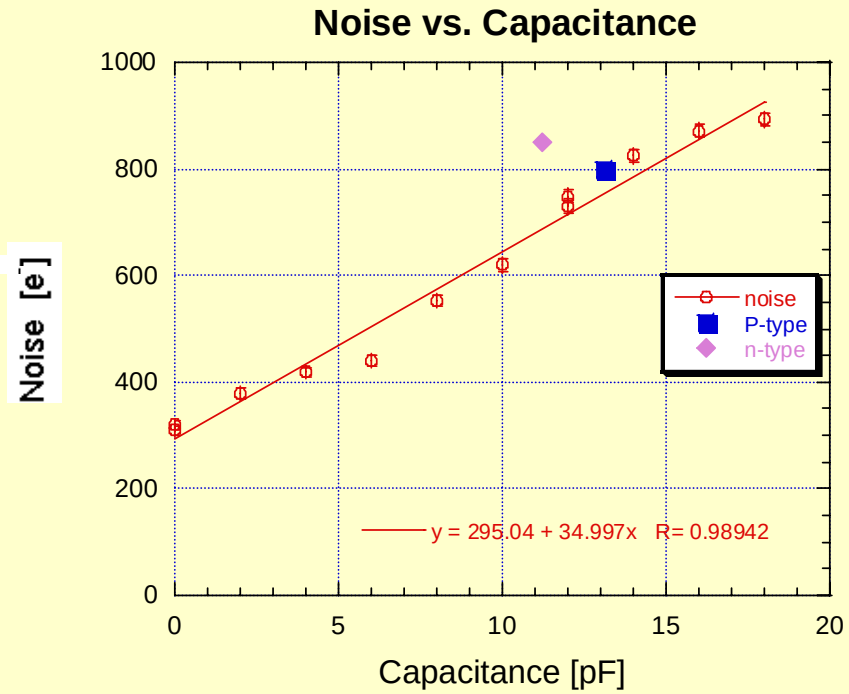
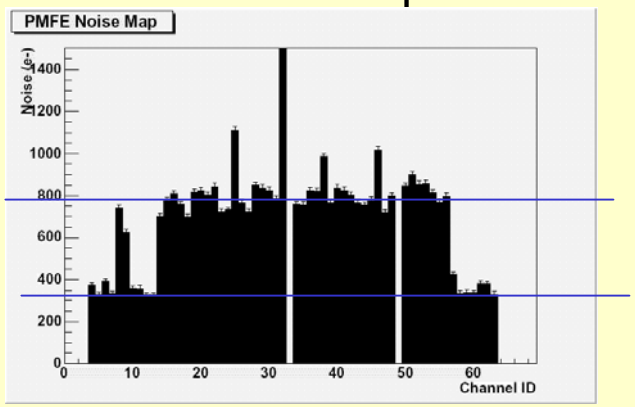
MCz

Noise measurement
(with 200ns shaping time)

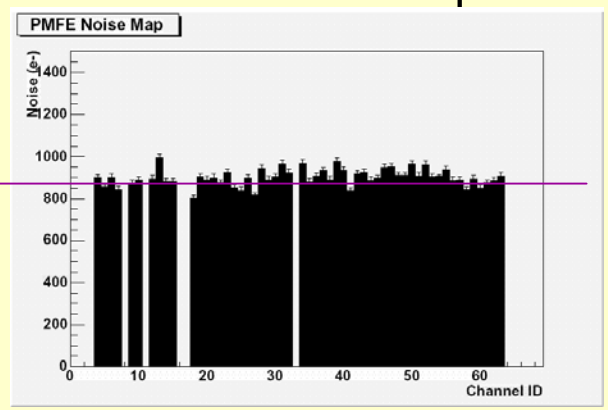
Noise RMS = A+B*C



N-in-p p = 50µm w = 25µm
l = 4.46 cm C = 13.1 pF



P-in-n p = 50µm w = 30µm
l = 5.88 cm C = 11.2 pF



Conclusions:

MCz has lower Cint than FZ

Low dose p-spray has lower Cint than high dose p-spray

In the next fabrication of strips, we have to start take care of the interstrip capacitance: minimize W/P .