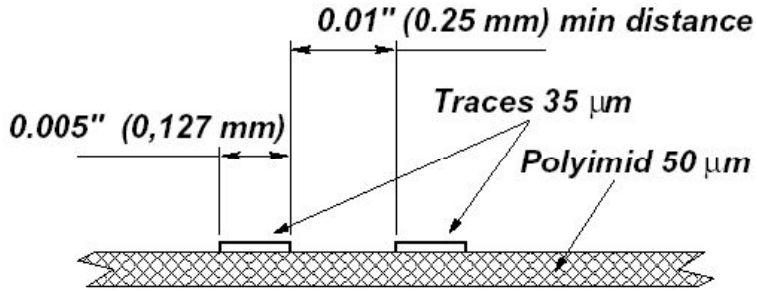
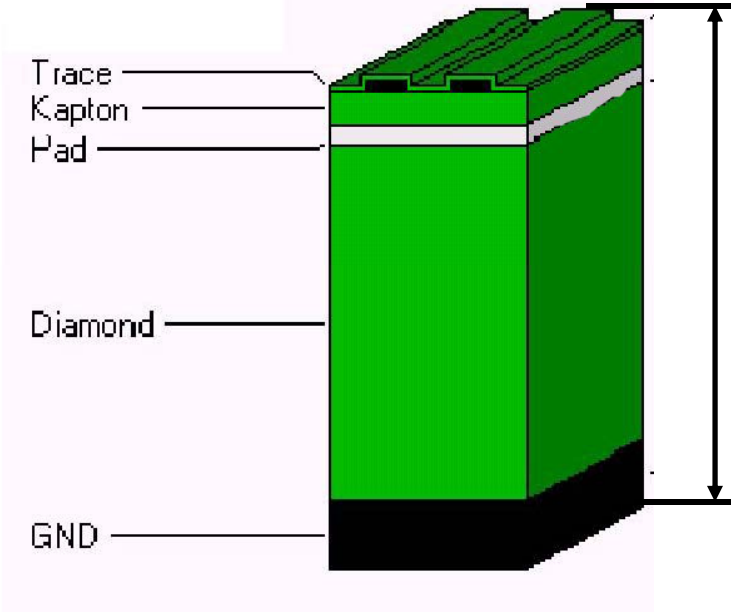
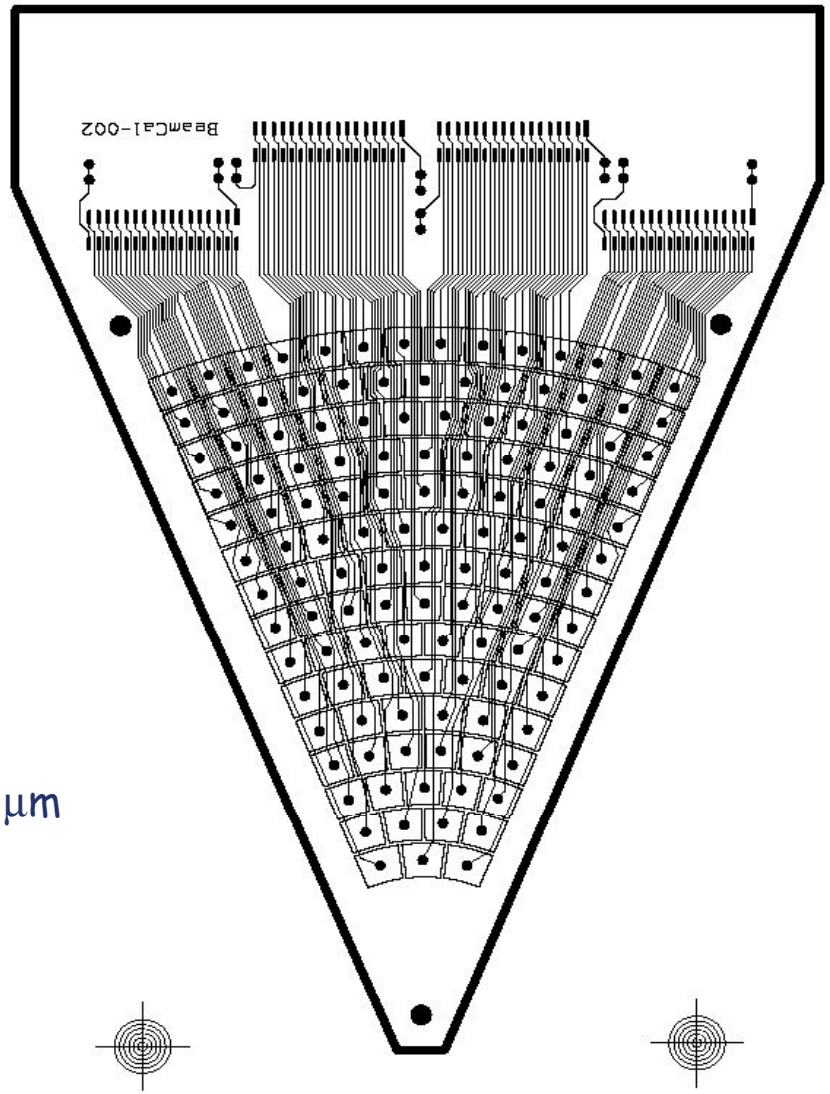
Investigation of crosstalk in the readout structure of the Beamcal

K.Afanaciev

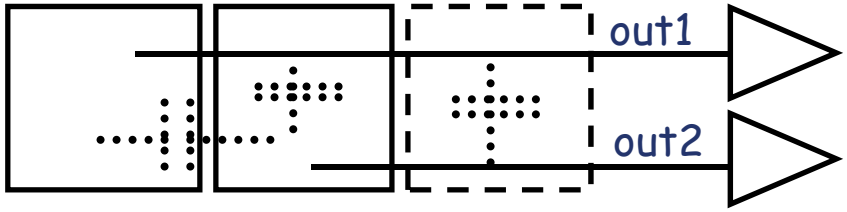


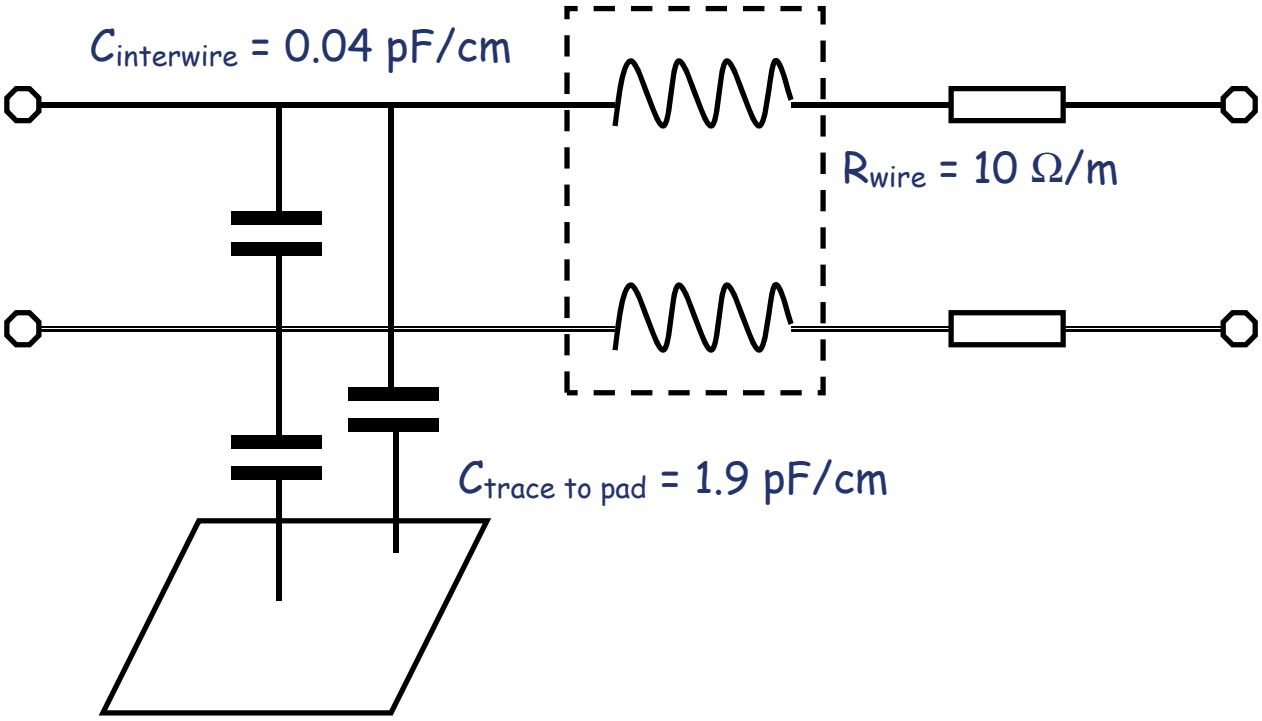




Design by Sergej Schuwalow

coupling

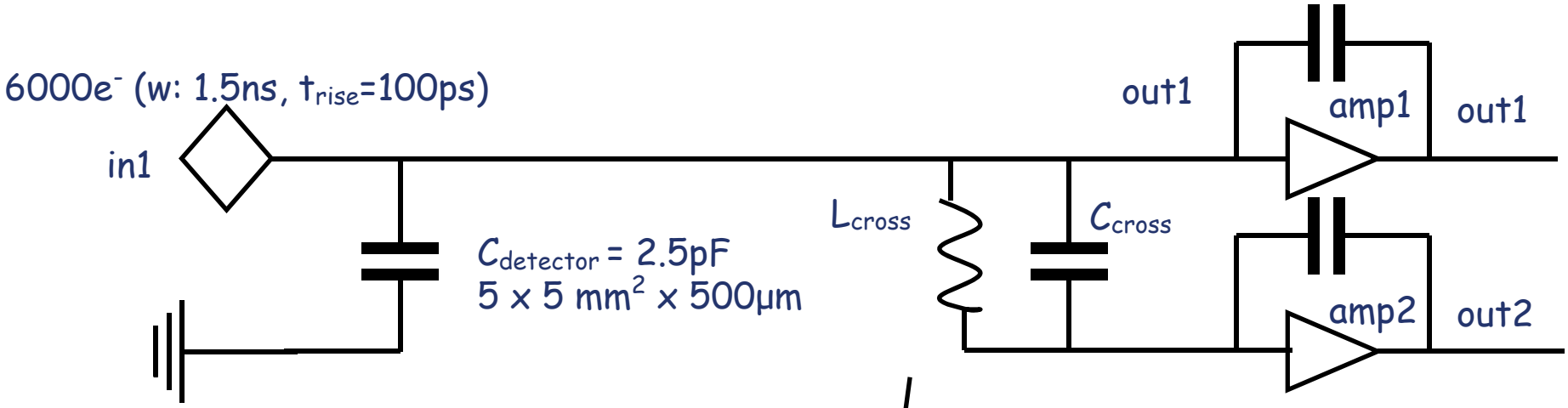




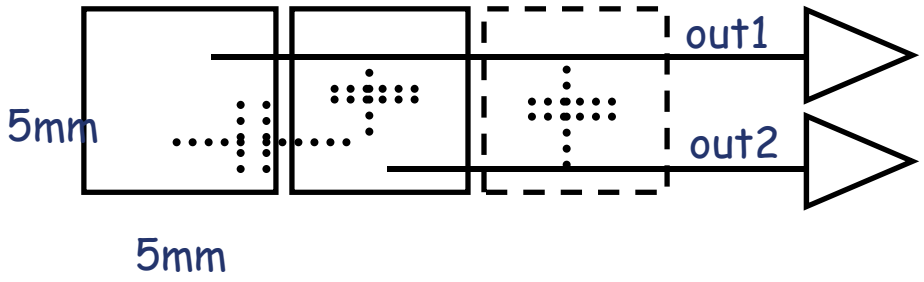
T. Sakurai, K. Tamaru, Simple formulas for Two- and Three-dimensional capacitances

setup

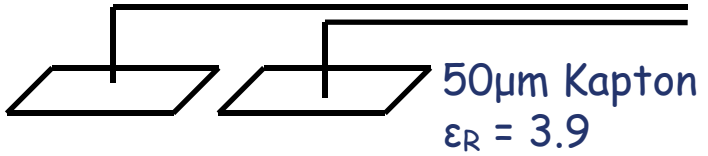
Schematics:



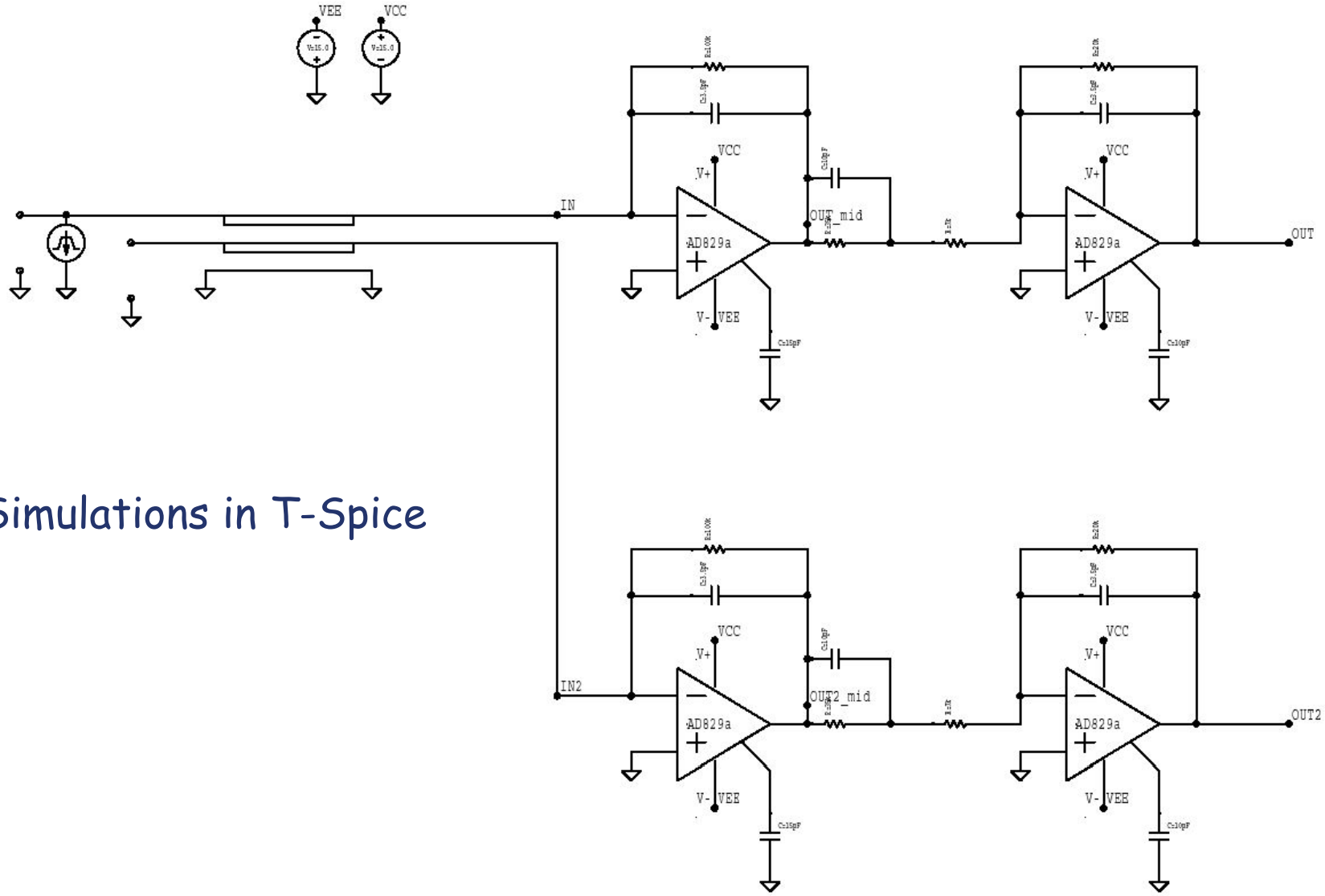
Physical:



trace: 17µm thick,
100 wide, 100 pitch, 15x5mm length

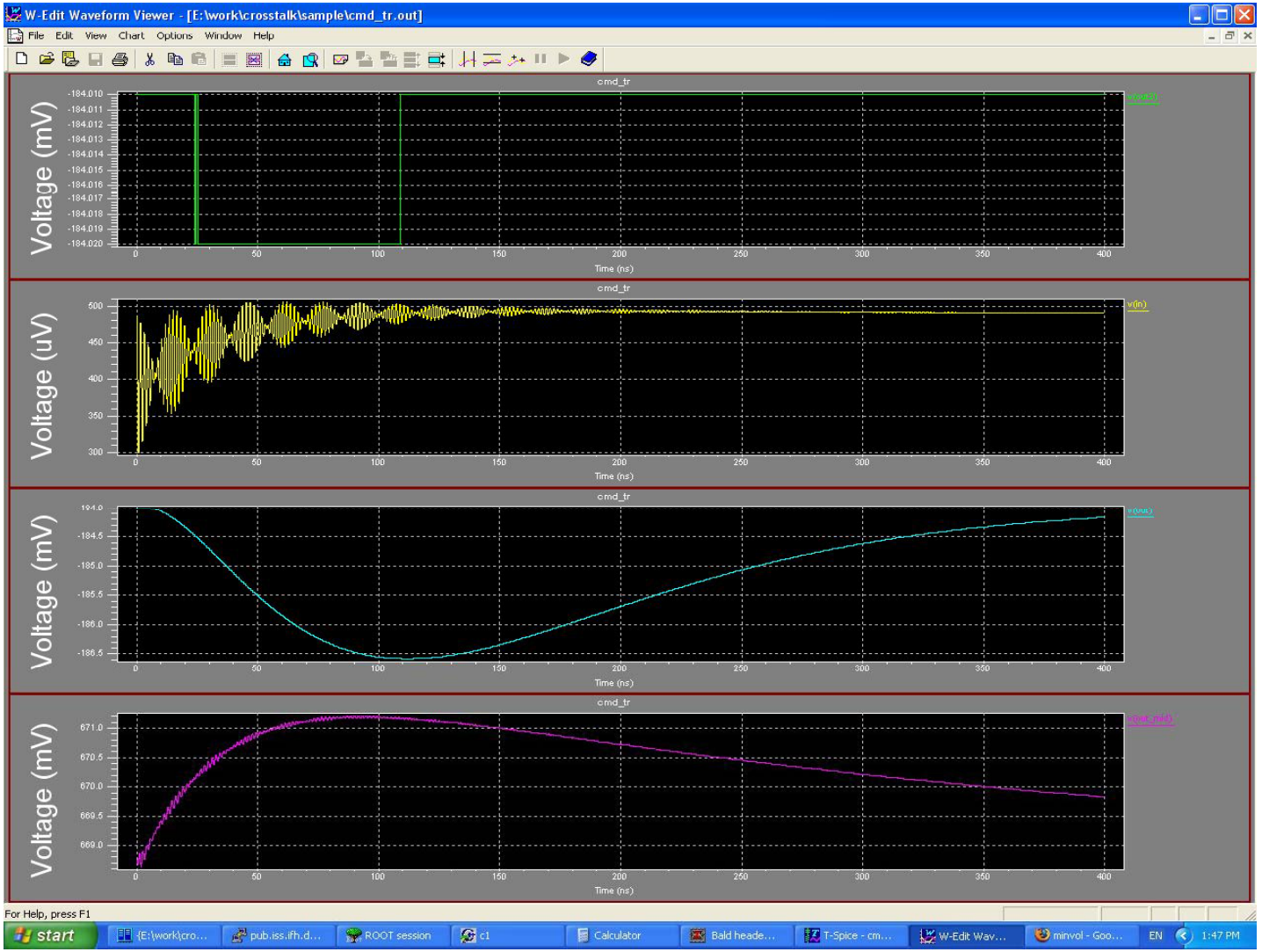


Improved model with charge sensitive amplifiers



Simulations in T-Spice

simulation result



Out2 = crosstalk channel output

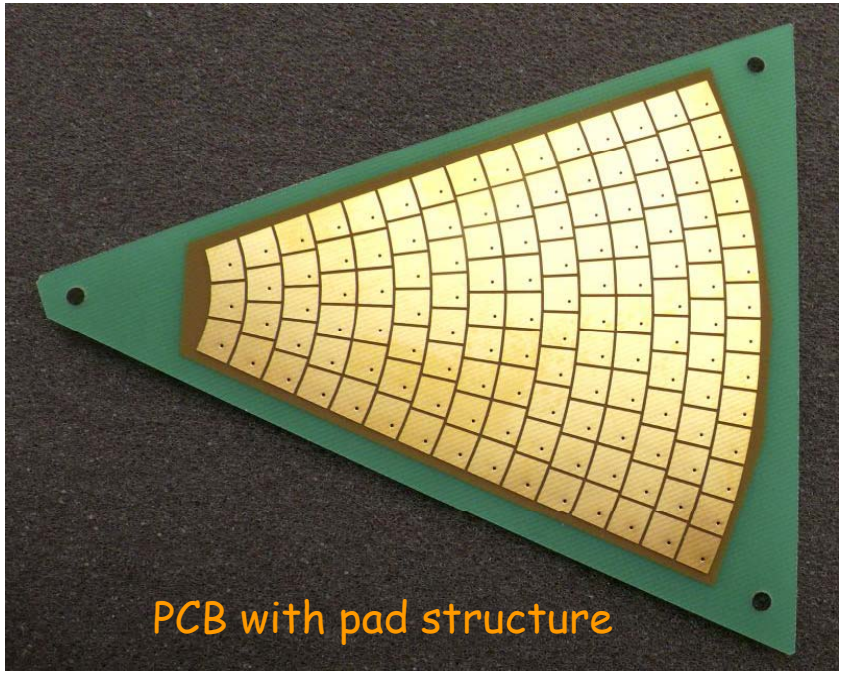
Out = main channel output

Ratio of area under the waveforms is about 1/300. Crosstalk estimate ≈ 0.3%

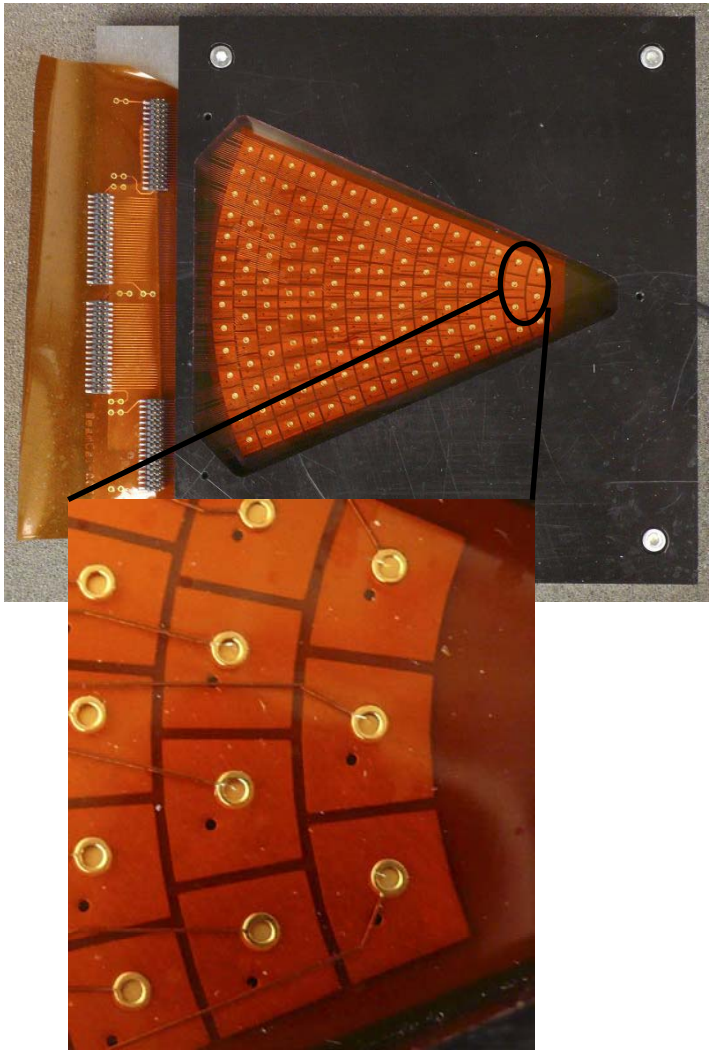
Prototype readout structure

Capton foil with conductive traces

+

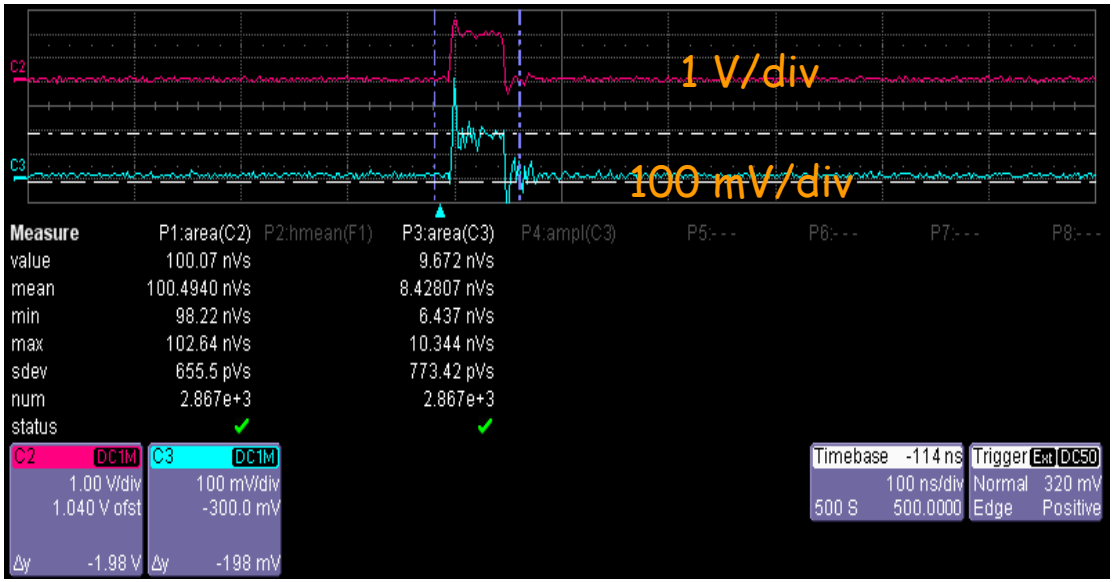


PCB with pad structure



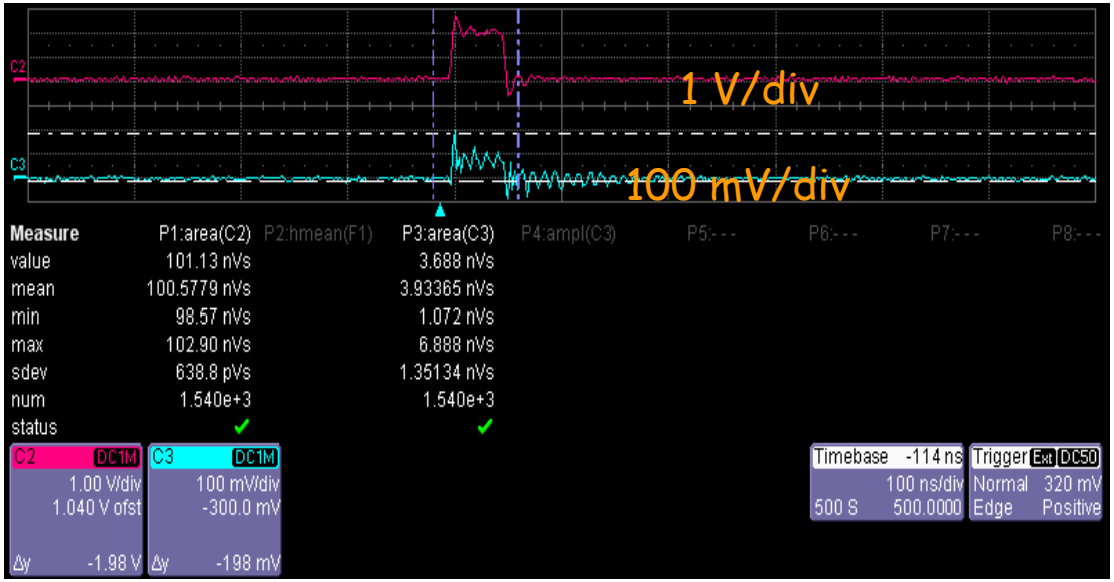
Readout structure prototype with metal pads bonded to capton readout

Prototype results



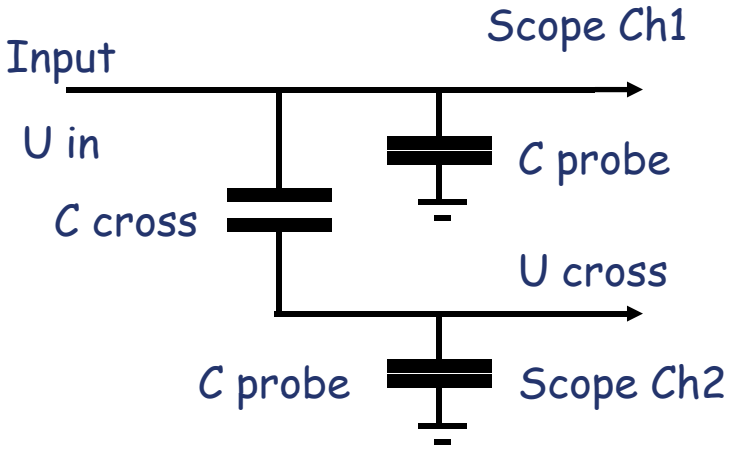
Simple experiment with signal generator and scope

Singnal to crosstalk ratio approx. 100/8
I.e. 8% crosstalk @ 9.5 pF input capacitance



4% crosstalk @ 19.5 pF input capacitance

Prototype results



In this case it works as a capacitive divider

$C_{cross} = C_{probe} * U_{cross} / U_{in}$

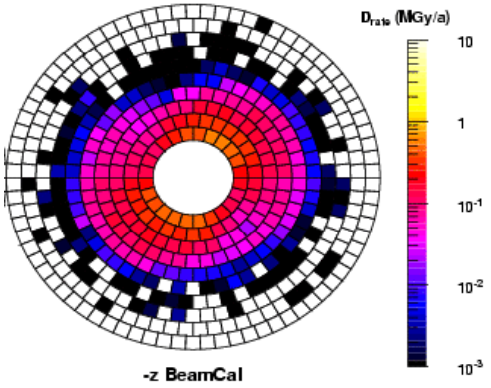
$C_{cross} \approx 0.8$ pF

From the geometry $C_{cross} \approx 0.7 - 0.95$ pF

To cut the crosstalk we need reasonably high input capacitances of the readout preamplifiers

Further investigation

"Realistic" crosstalk



Dynamic range of signals in BeamCal is estimated 1:1000

Even with readout crosstalk of 0.1% large signal from inner pads could generate crosstalk comparable with signal in outer pads.

Simulations with regard to this "realistic" crosstalk, readout design should be made with detector occupancy in mind

Include new preamplifiers in simulations

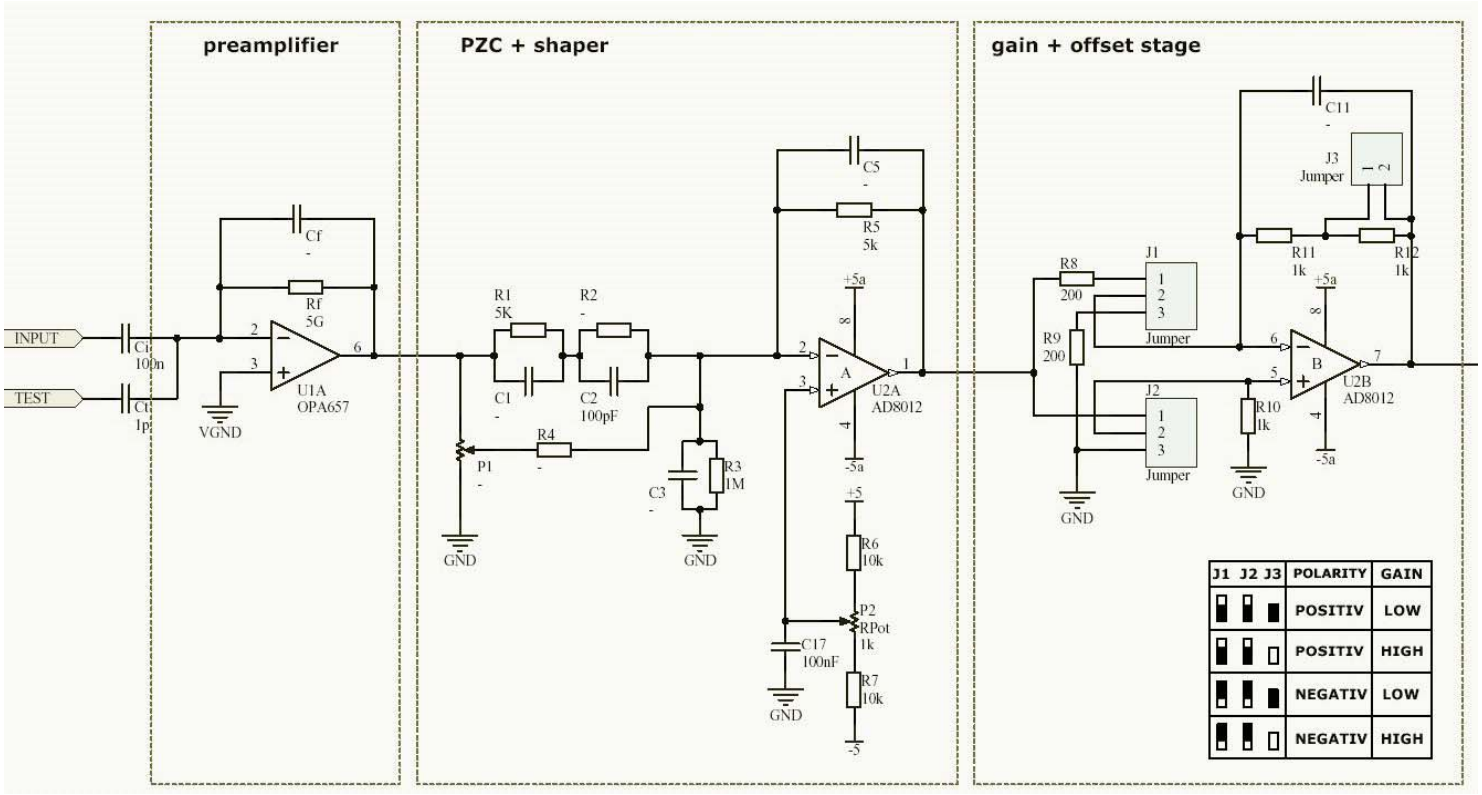
Prototype measurements with preamplifiers

Investigate screening by absorber layer

Preamplifier design

Szymon Kulis, Krakow AGH University for Science and Technology
Summer student at DESY Zeuthen

Developed a low noise charge sensitive preamlifier for lab use



http://www-zeuthen.desy.de/students/2007/doc/SzymonKulis_report.ps

Preamplifier design

Low noise. ENC $\approx 212\ e^- + 19.2\ e^-/pF$

Off the shelf components, reasonably low cost

4 channels per 130x125 mm PCB

OK performance, ability to change output polarity and gain on the fly

Could be used for lab measurements and with prototypes

Details could be found here

http://www-zeuthen.desy.de/students/2007/doc/SzymonKulis_report.ps