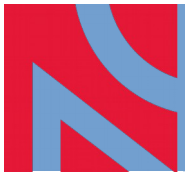
KATANA - a charge-sensitive trigger/veto array for the SπRIT TPC

Paweł Lasko,[1] Janusz Brzychczyk,[1] Piotr Hirnyk, Jerzy Łukasik,[2]
Piotr Pawłowski,[2] Aleksandra Snoch,[3] Zbigniew Sosin [1]

[1]Jagiellonian University, Institute of Physics, Kraków, Poland
[2]Institute of Nuclear Physics PAN, Kraków, Poland
[3]University of Wrocław, Poland

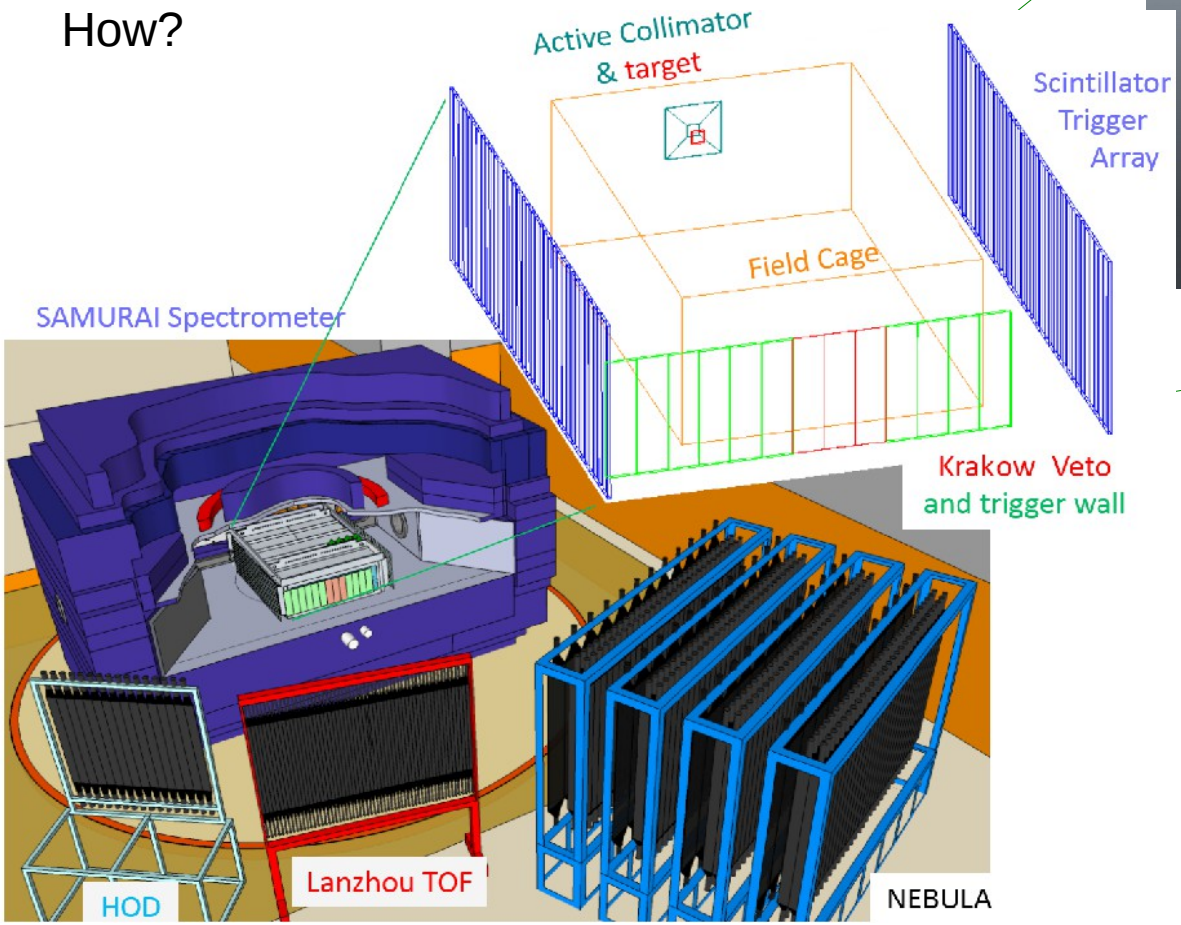
NuSYM15, Kraków, June 29 – July 2, 2015

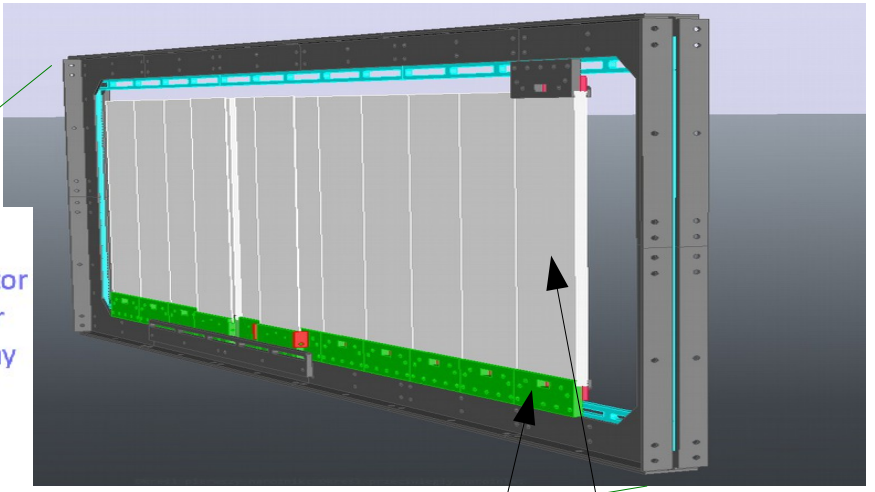


Work supported by Polish National Science Centre (NCN), contract Nos. UMO-2013/10/M/ST2/00624, UMO-2013/09/B/ST2/04064

KATANA – trigger & veto detector

What & Why?
Where?
How?



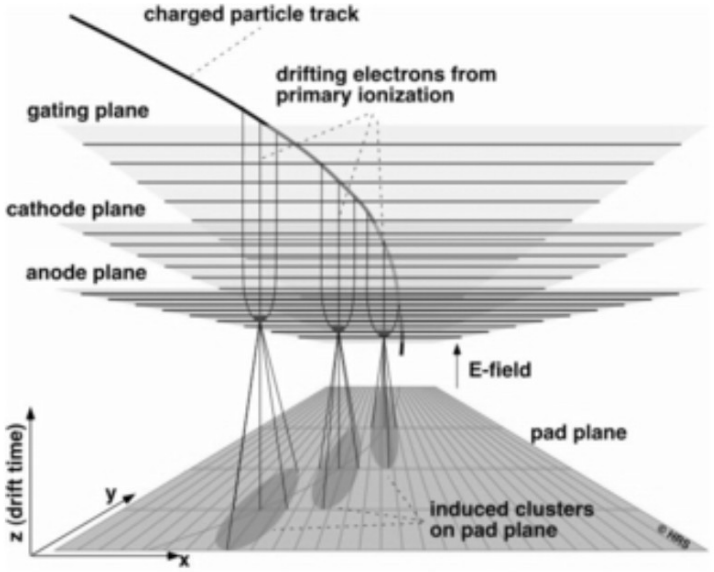


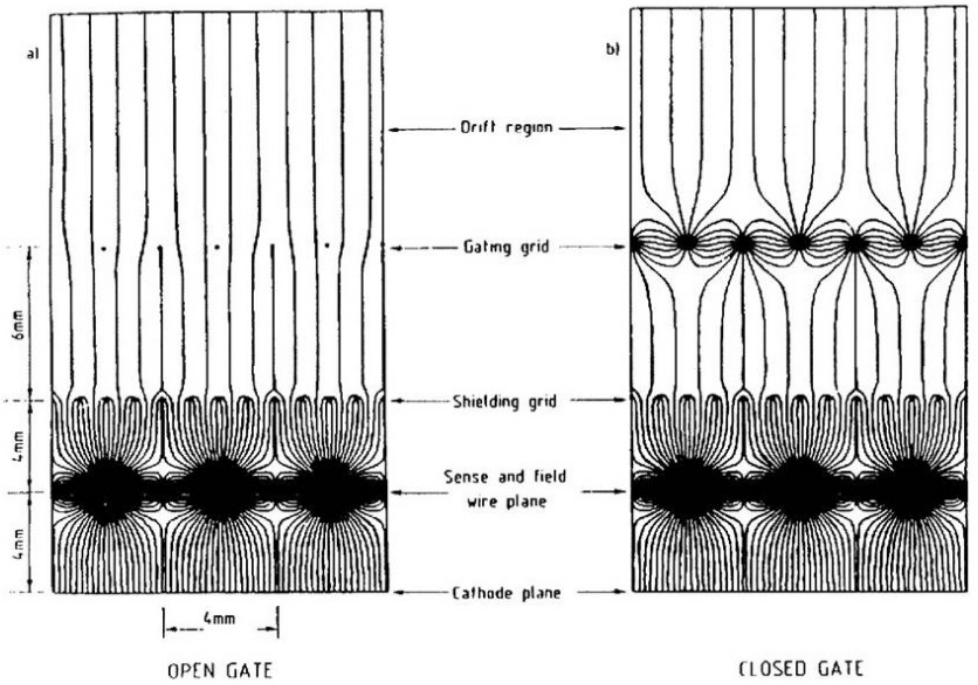
BC404
plastic
scintillator

MPPCs &
front-end
electronics

~15 paddles
3 x 1mm thick,
12 x 10mm thick

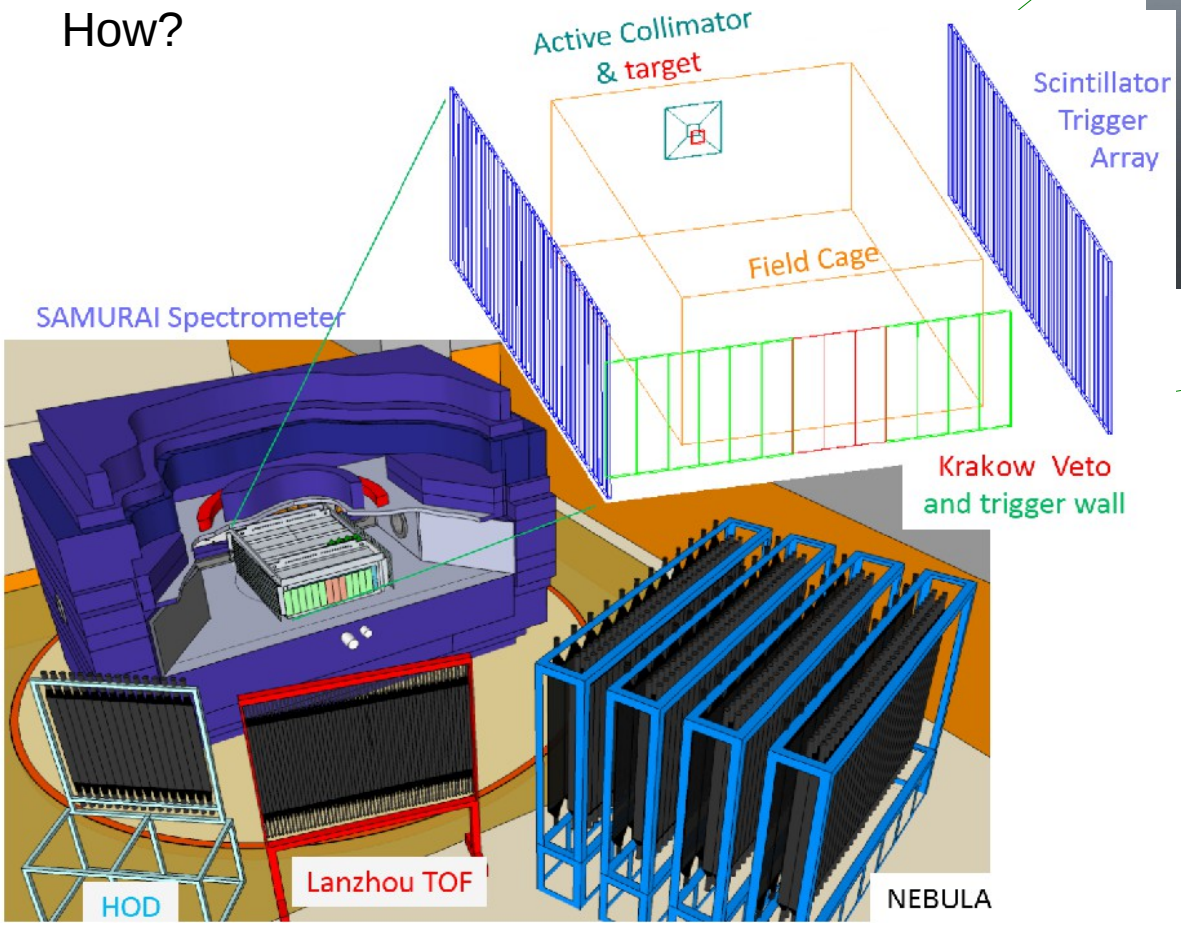
TPC digression

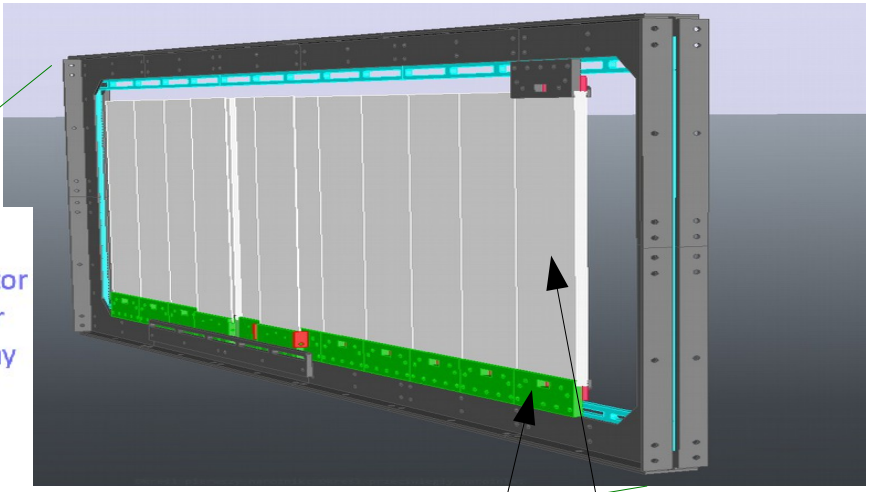




KATANA – trigger & veto detector

What & Why?
Where?
How?

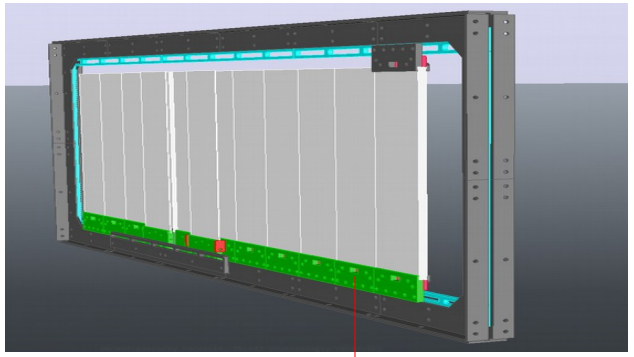




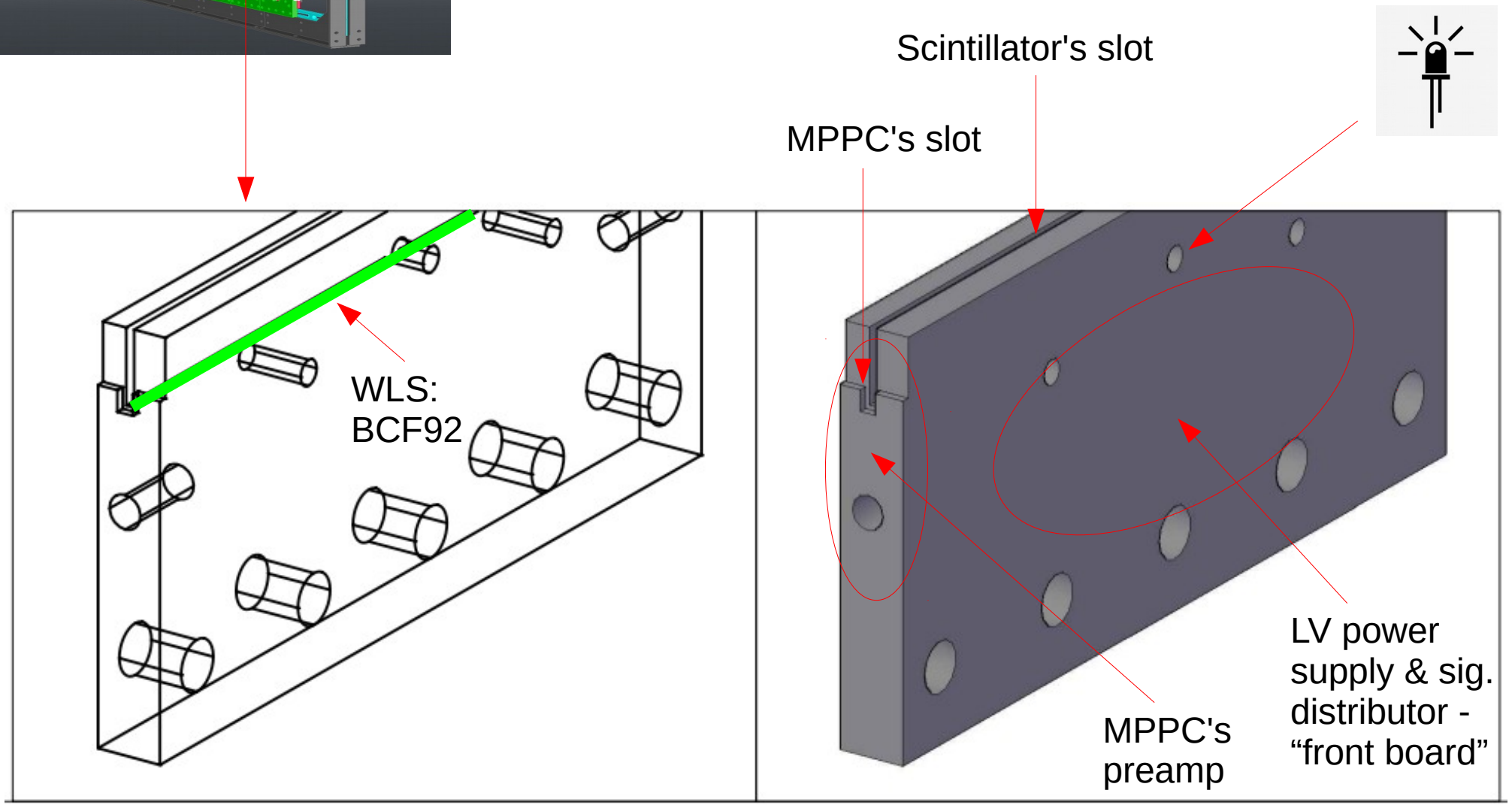
BC404
plastic
scintillator

MPPCs &
front-end
electronics

~15 paddles
3 x 1mm thick,
12 x 10mm thick



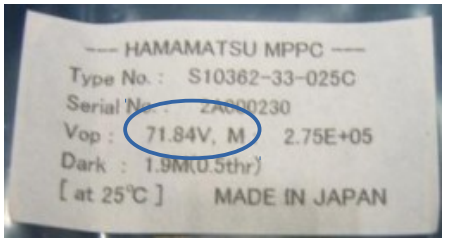
Detection elements and signal conditioning circuits



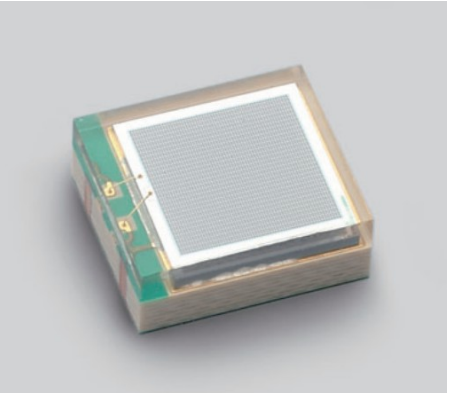
MPPC overwiev

MPPC is small and nonmagnetic

Multi-Pixel Photon Counter



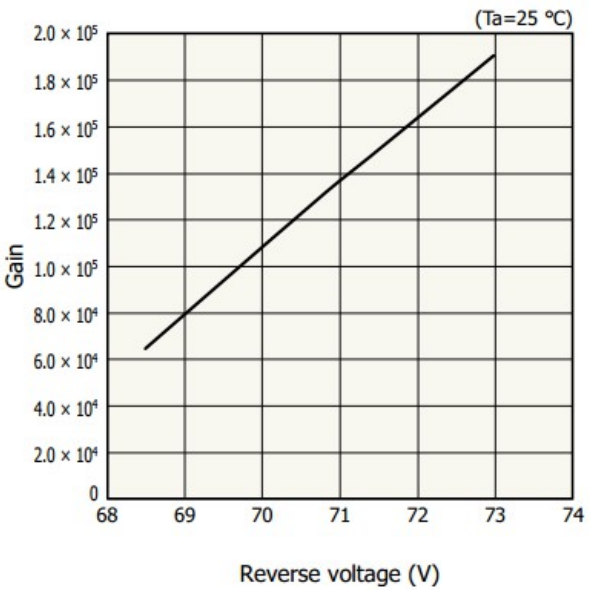
	S12571-010	S12572-025
Photosensitive area:	1x1mm	3x3mm
Number of pixels:	10000	14400
High gain:	1.35×10^5	5.15×10^5
Peak sensitivity WL:	470nm	450nm
Gain temp. coefficient:	1.6×10^3	8.2×10^3

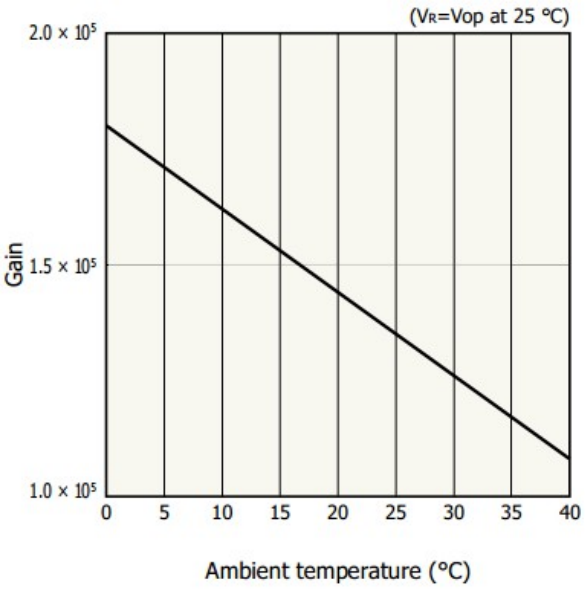


online compensation needed

High Voltage Requirements:

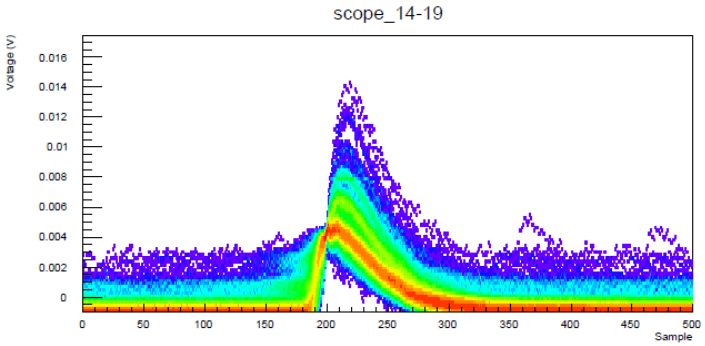
- 0.01V precise
- PC controlled
- multichannel
- current limiter
- ...with feedback info (sat/err)

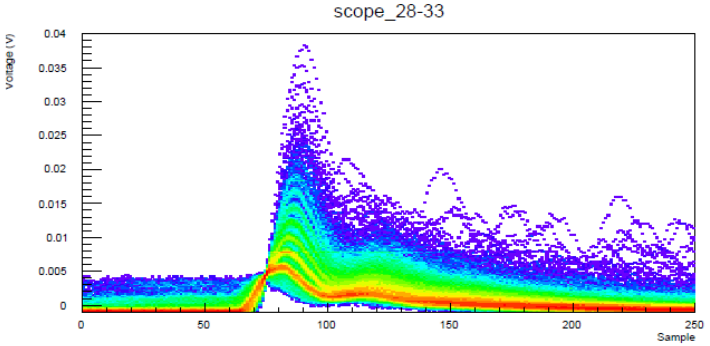


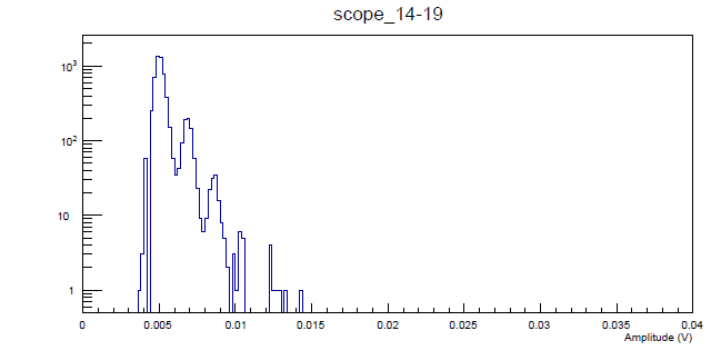


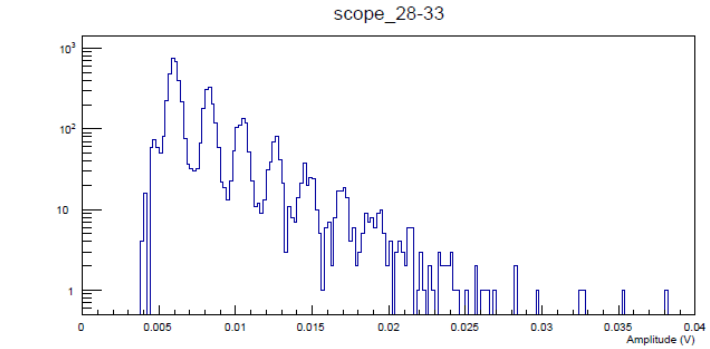
Electronics

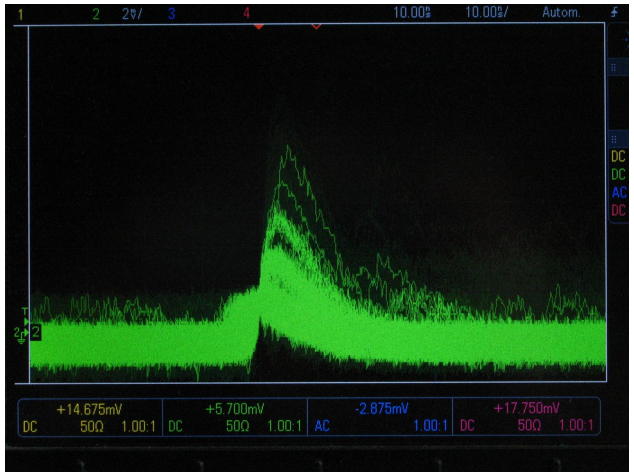
MPPC's preamp

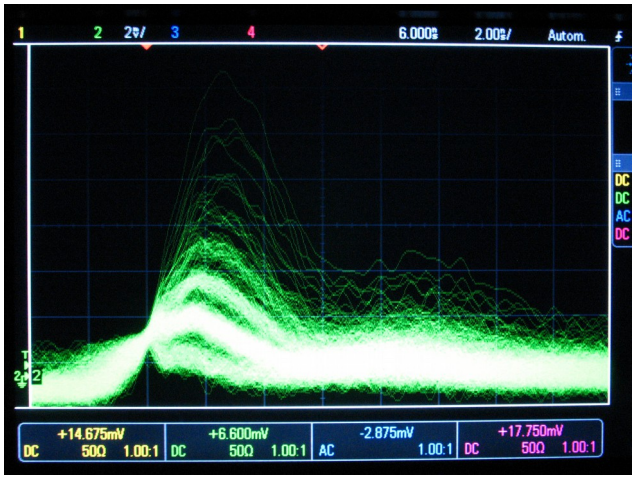


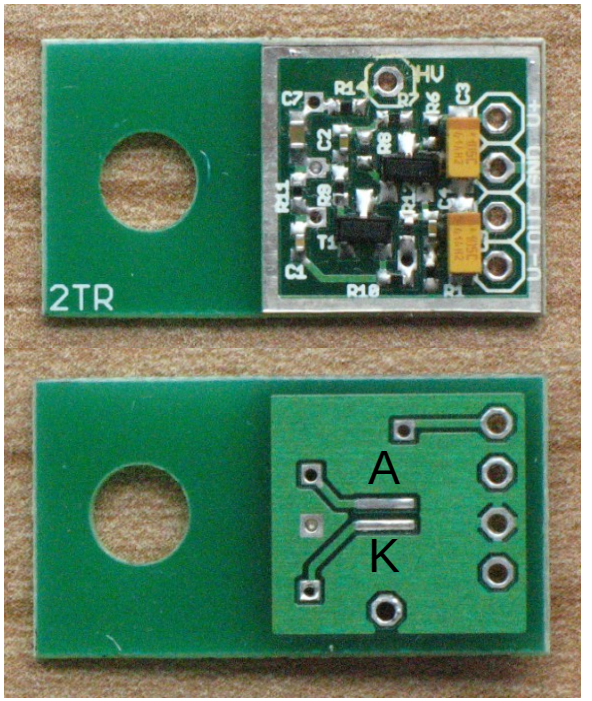


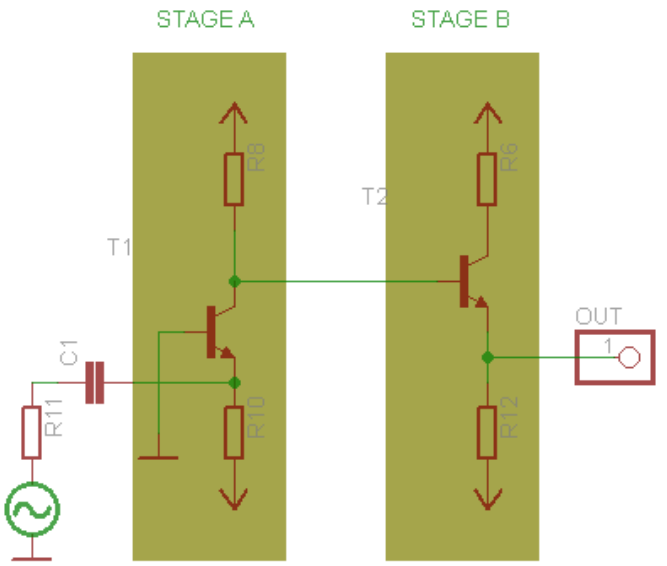








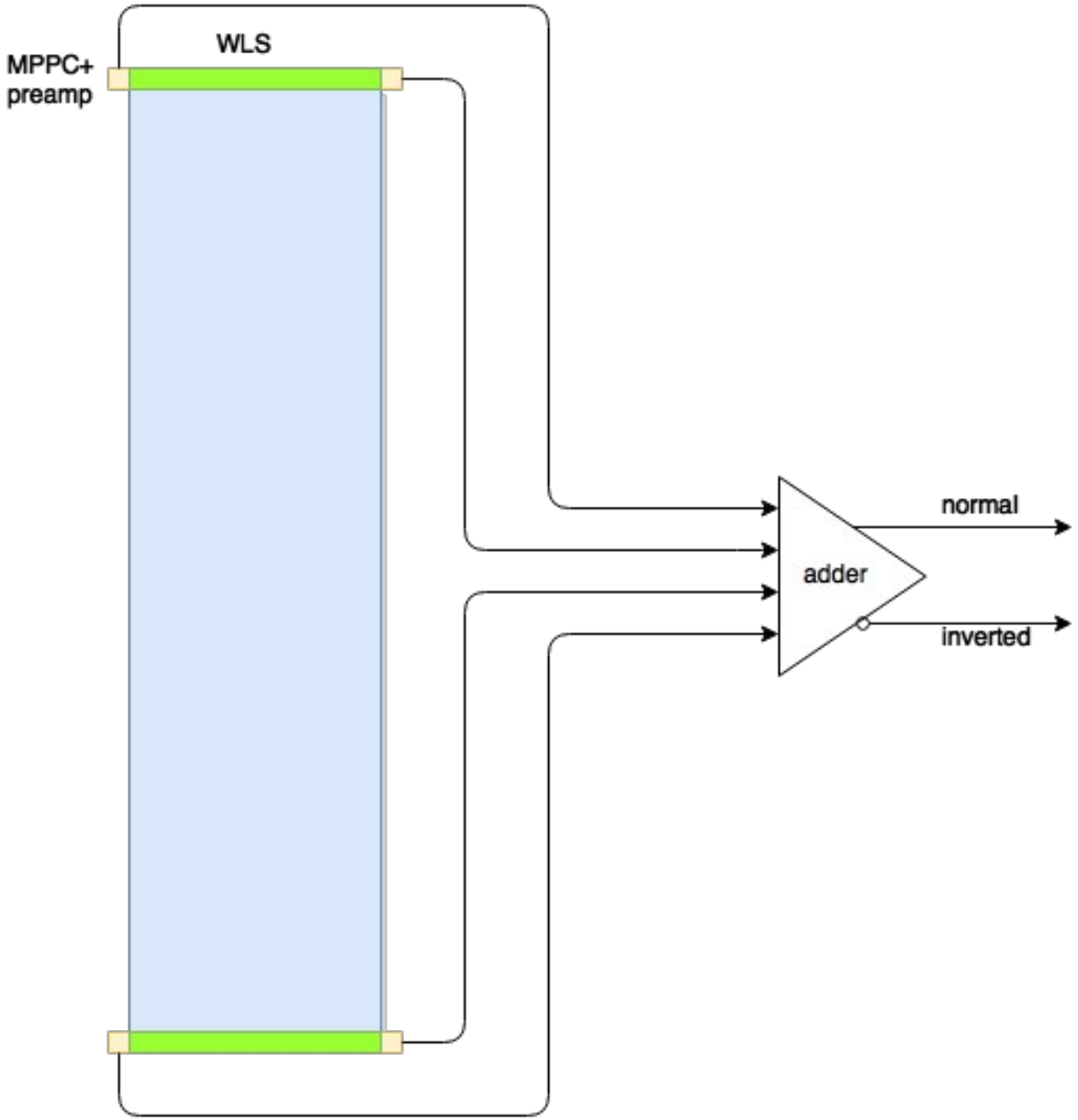


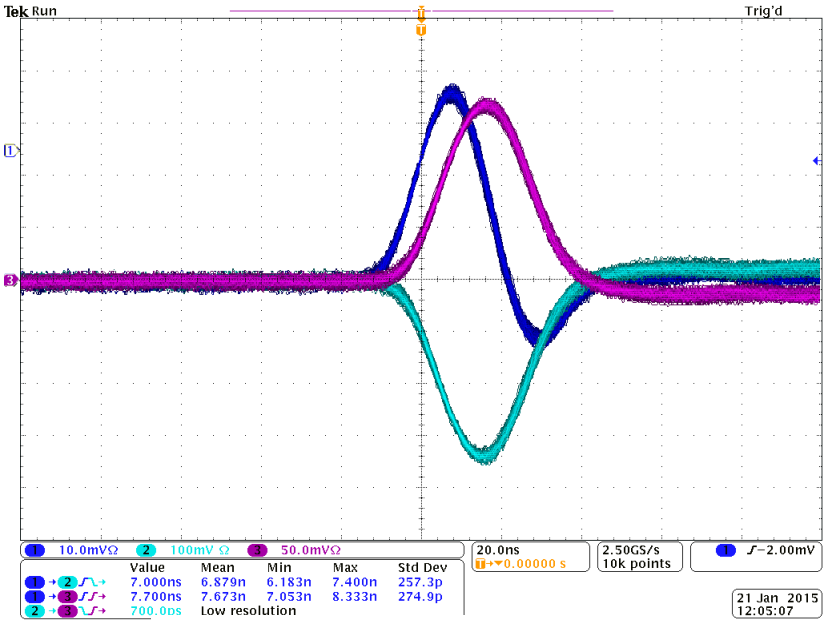


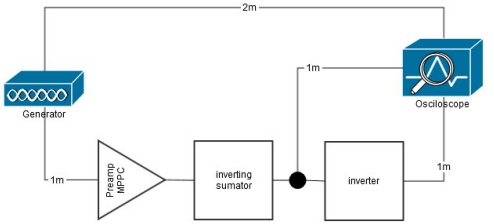
Common base

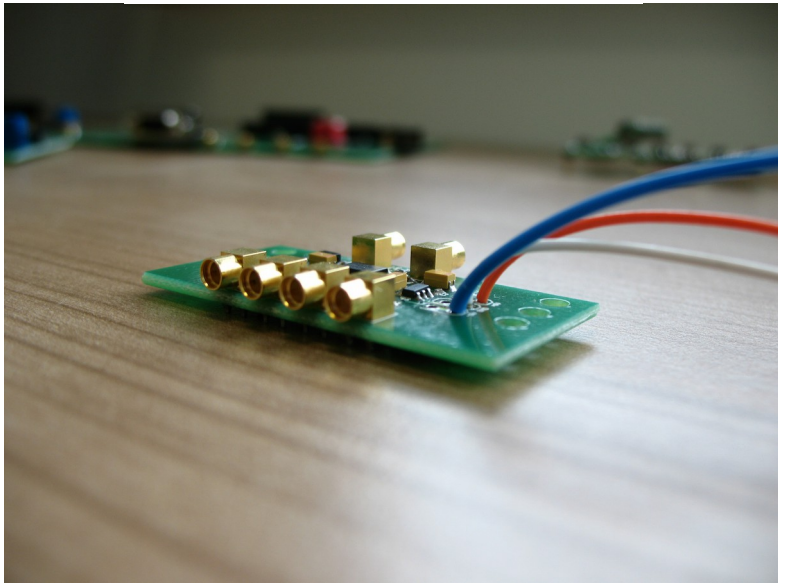
Common collector (emitter follower)

(after)Front-end

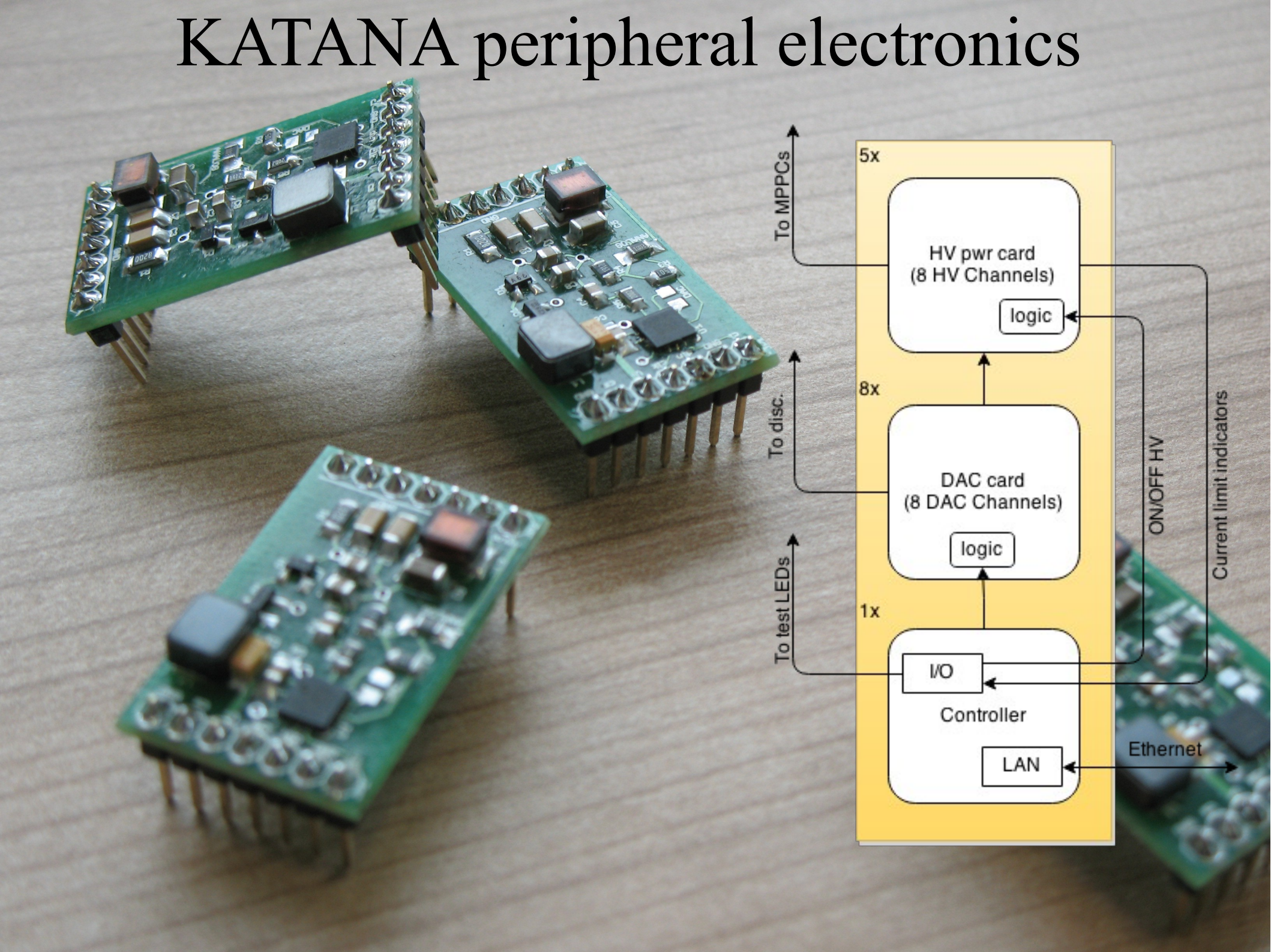


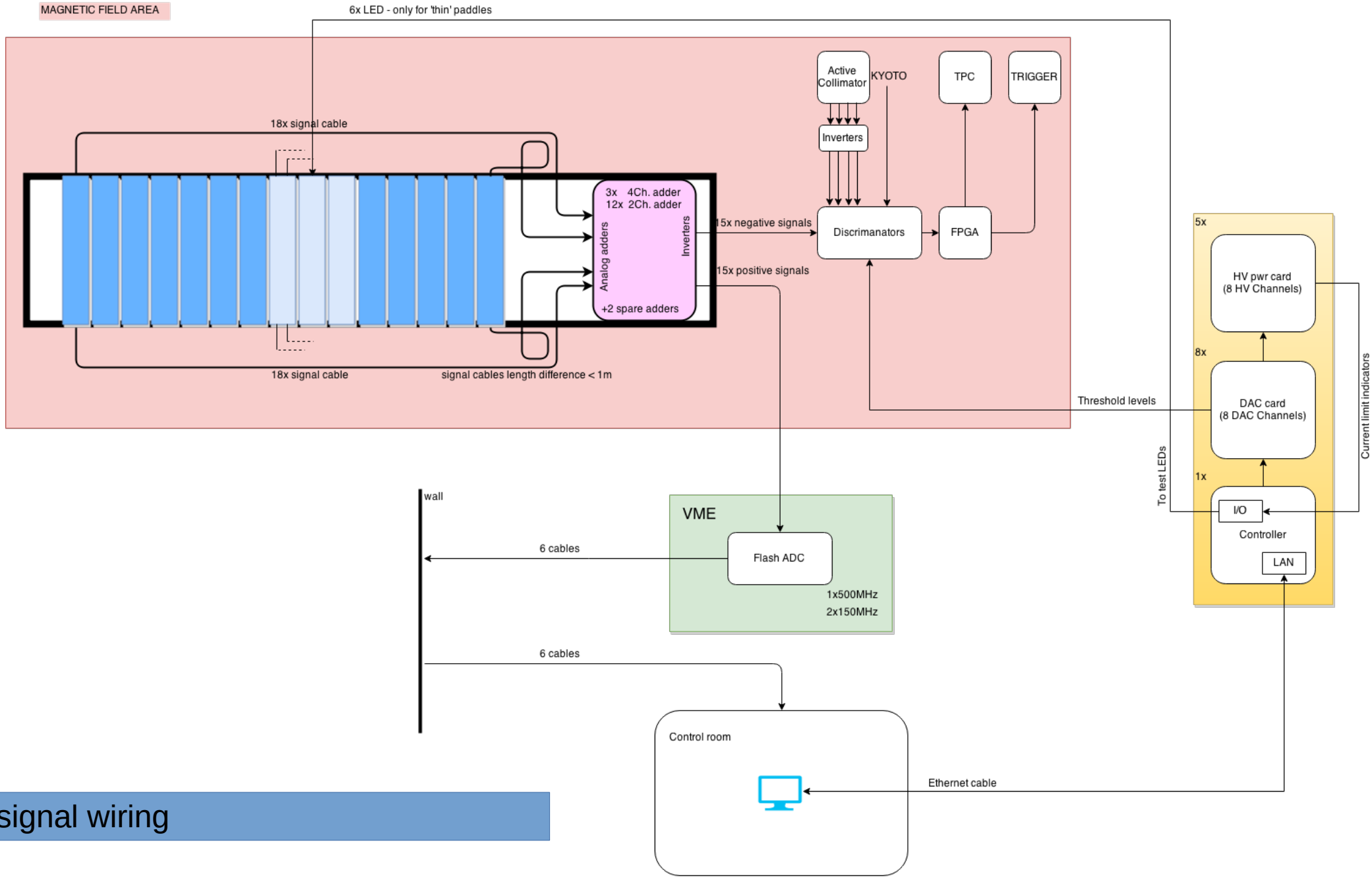






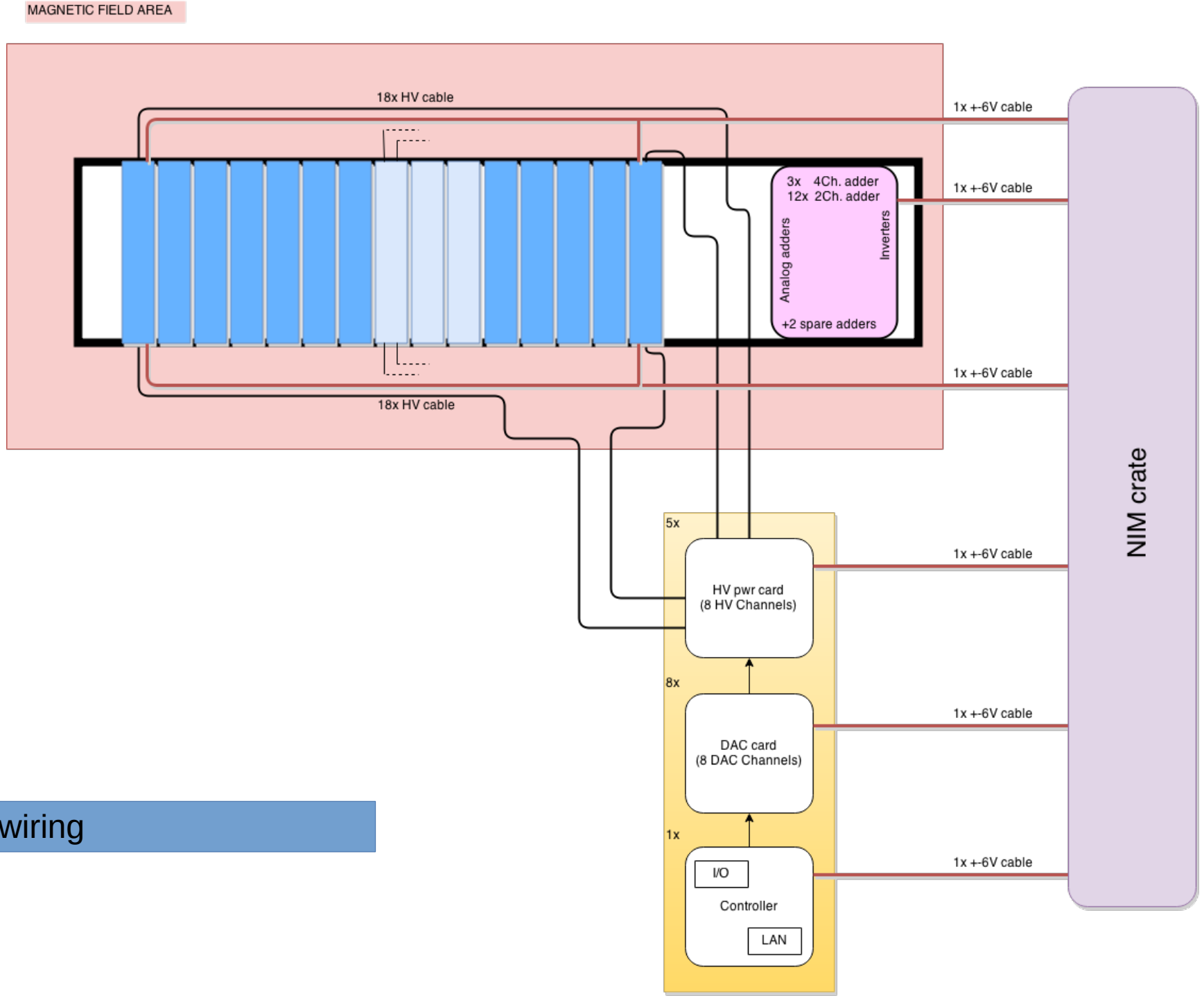
KATANA peripheral electronics





signal wiring

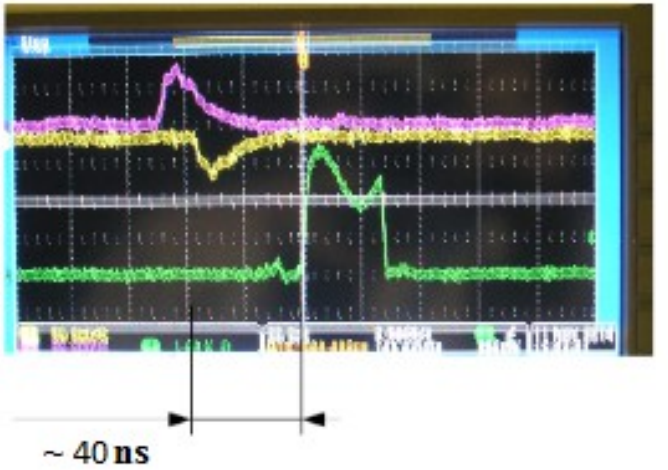
power supply wiring

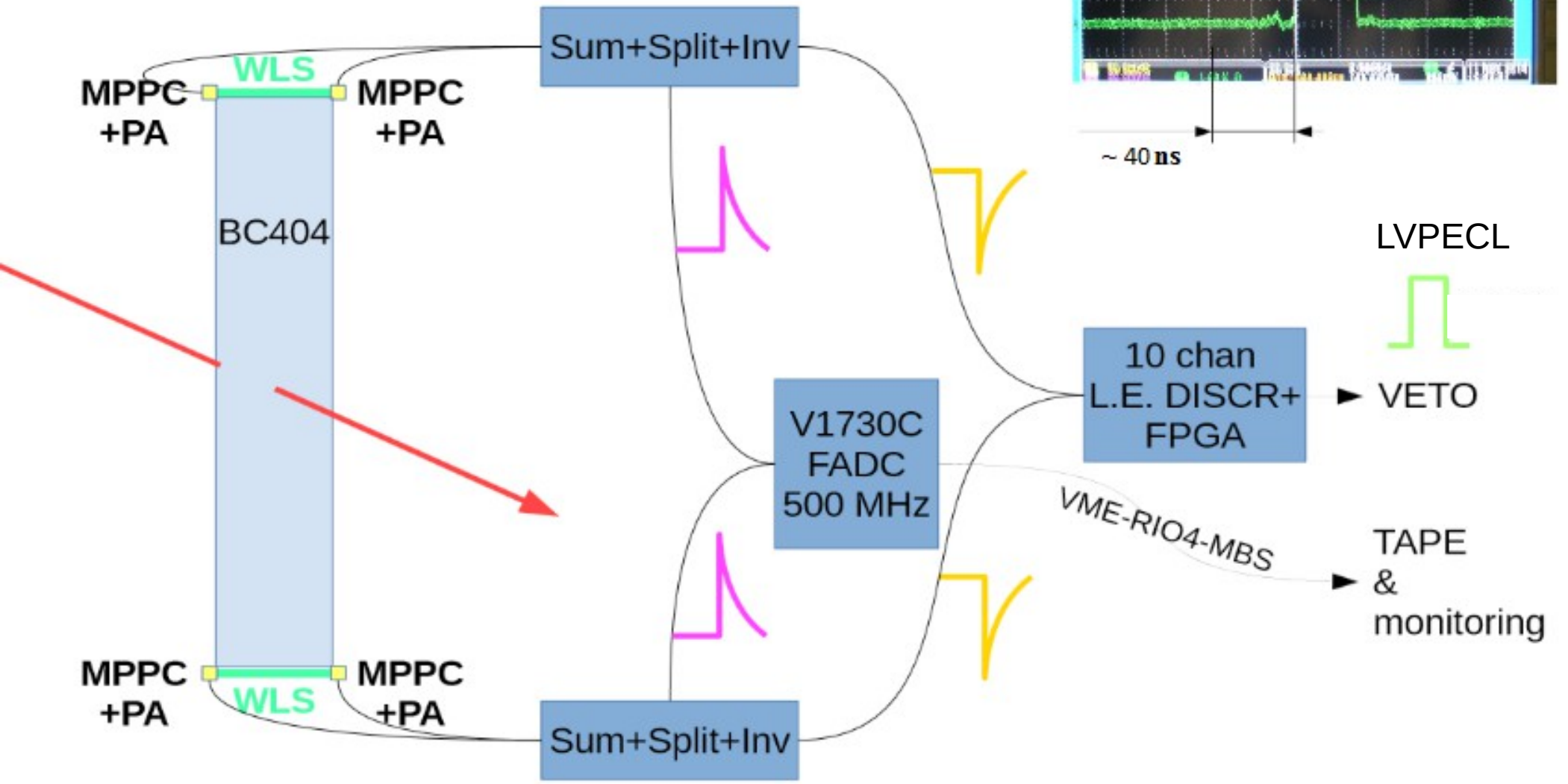


Test

HIMAC-test

Heavy Ion Medical Accelerator in Chiba

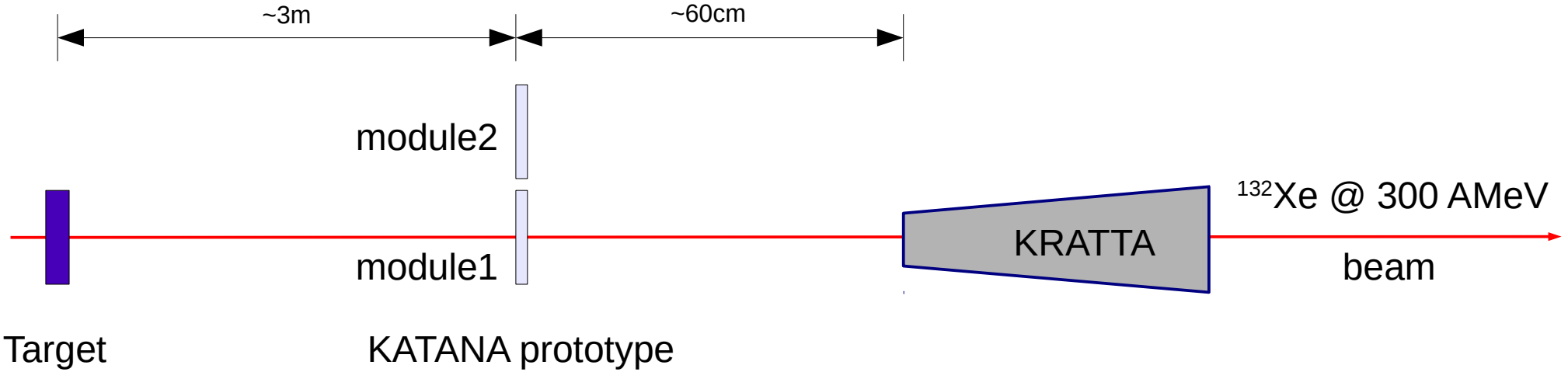




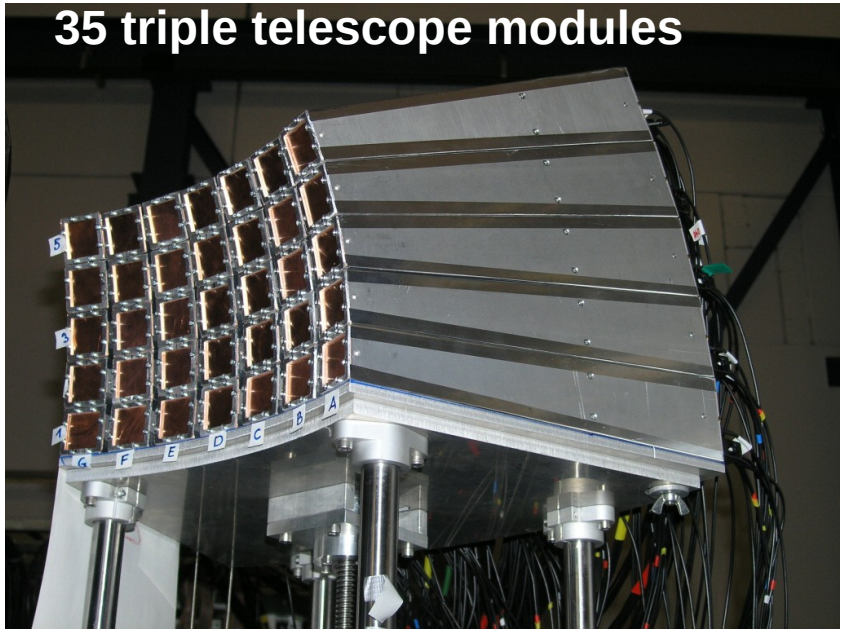
HIMAC-test

Heavy Ion Medical Accelerator in Chiba

Top view



KRATTA basics

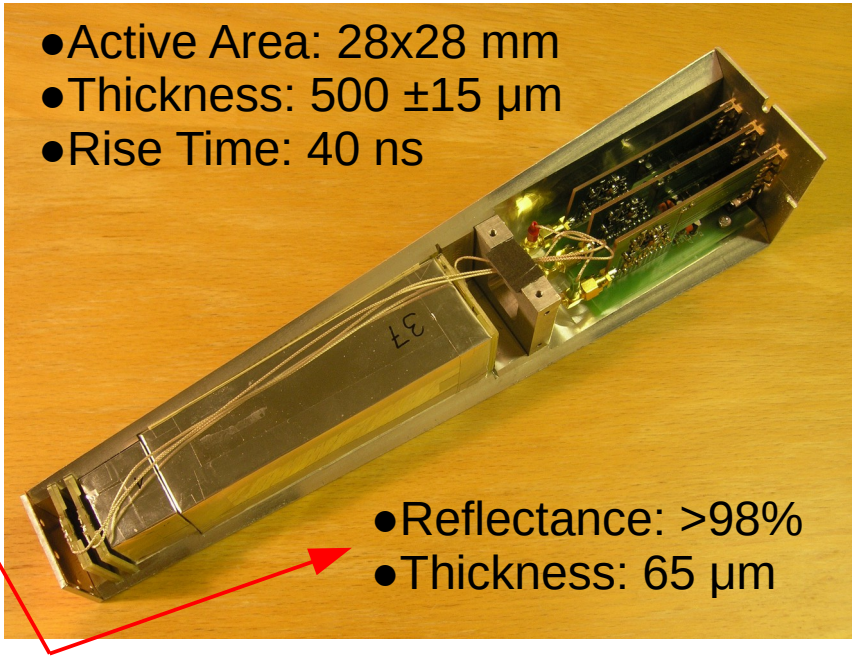


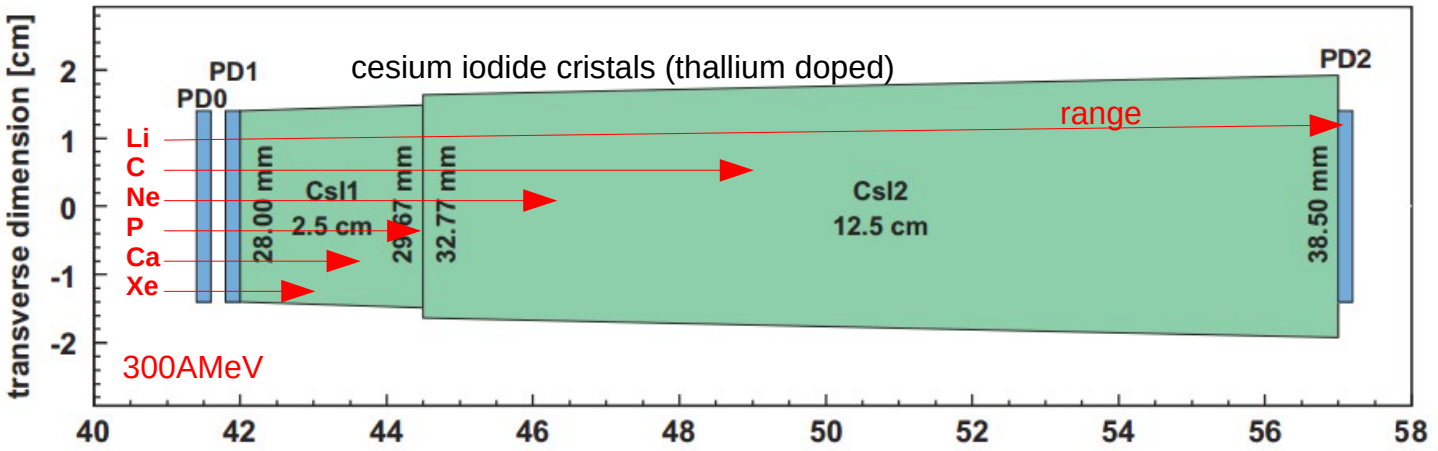
Photodiodes:
HAMAMATSU
S5377-02

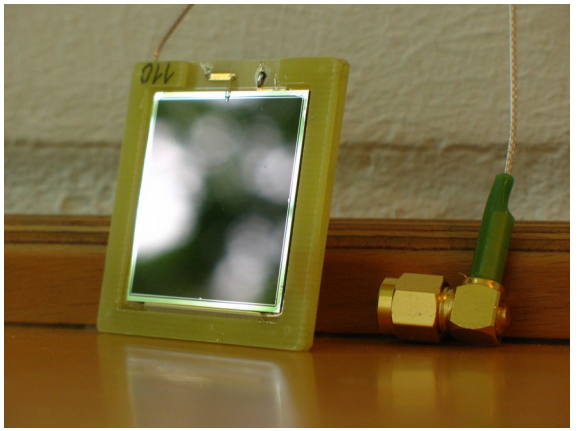
CsI(Tl):
IMP-CAS

Wrapping:
3M Vikuiti TM
ESR foil

Front-end:
Sosin, Lasko







HIMAC-test

Heavy Ion Medical Accelerator in Chiba

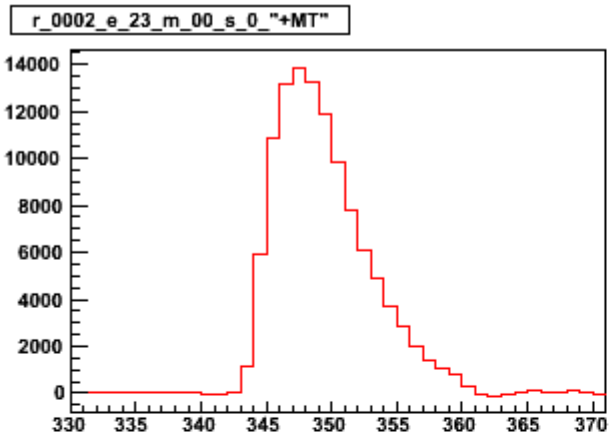
Pulses shapes

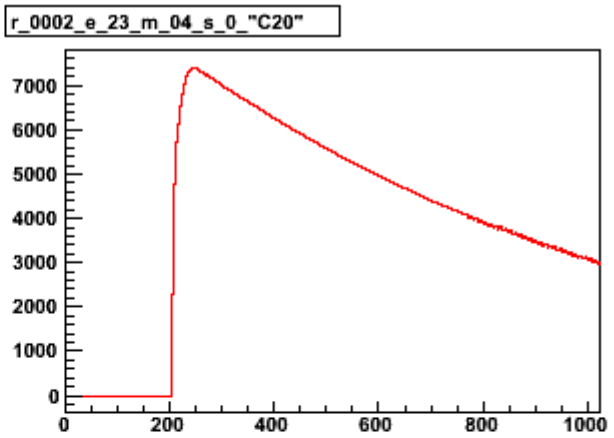
Plastic:
6-7 ns rise time
8-11 ns FWHM

KATANA module

KRATTA module

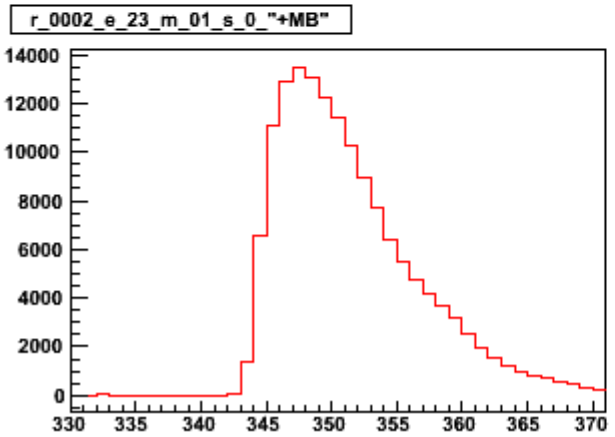
TOP

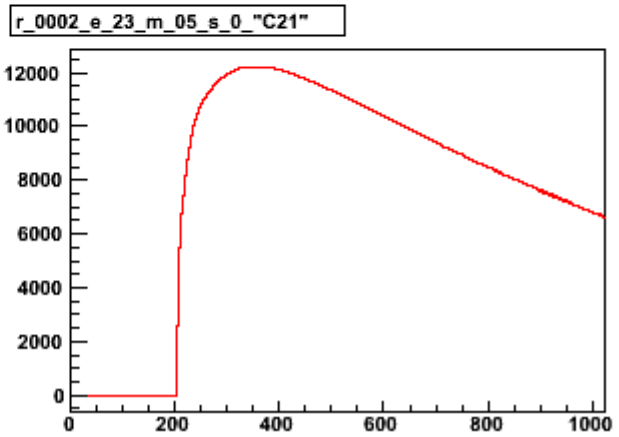




PD0

BOTTOM





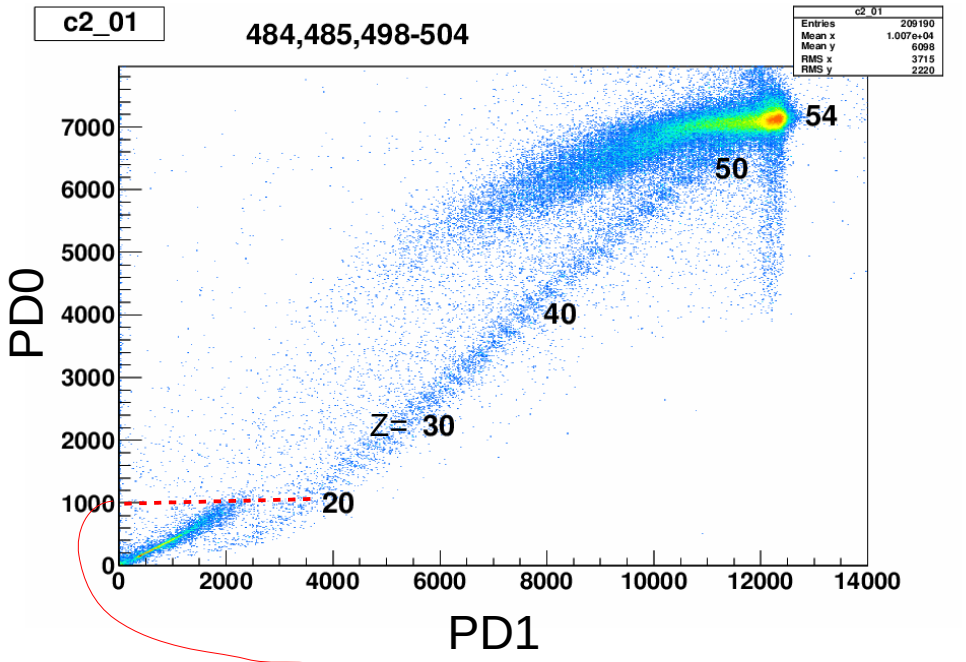
PD1

Time [2 ns/channel]

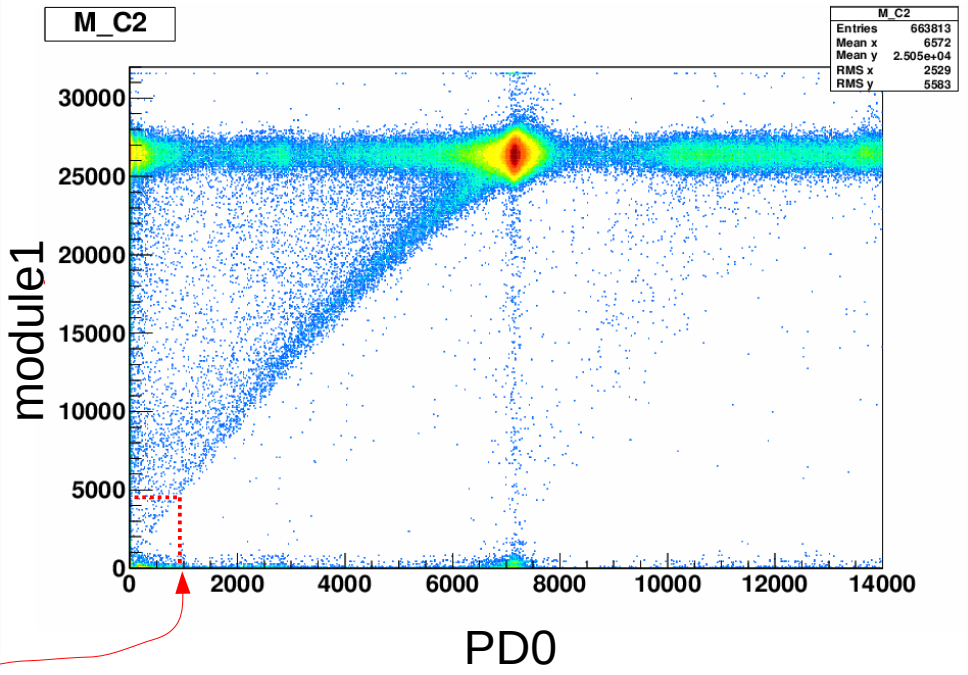
Time [10 ns/channel]

KRATTA and KATANA prototype module1 in coincidence

KRATTA: ΔE-E



Plastic (Top+Bottom) vs PD0



Z=20 appears at about 1/5 of the Xe amplitude → if we observe the Sn projectile peak in plastic we should be able to estimate the Z=20 amplitude threshold.

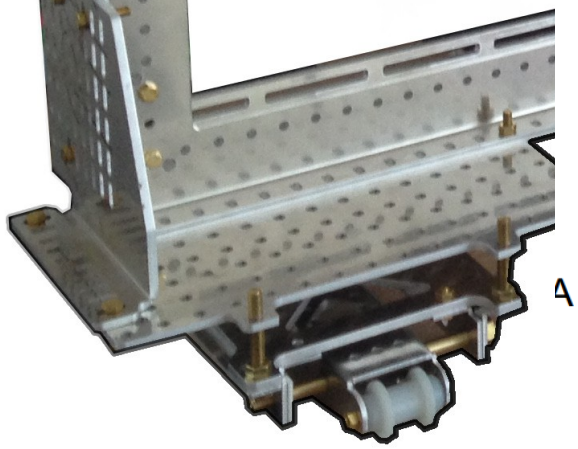
Mechanics

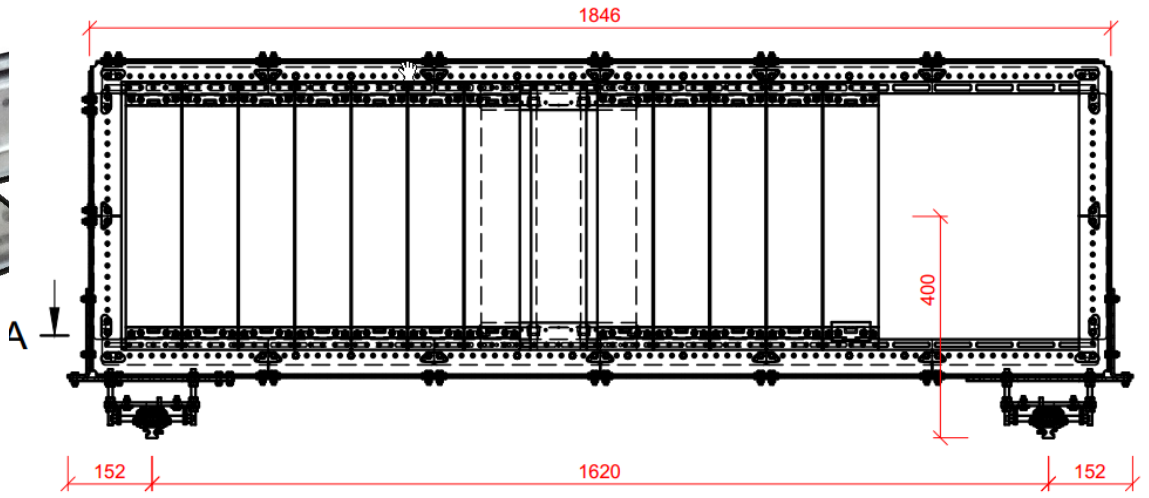
Piotr Hirnyk

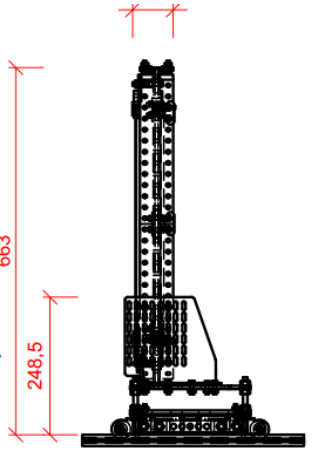
Mechanics

Used materials:
-aluminium PA6 – (Fe < 0.06%)
-brass
-poliamid

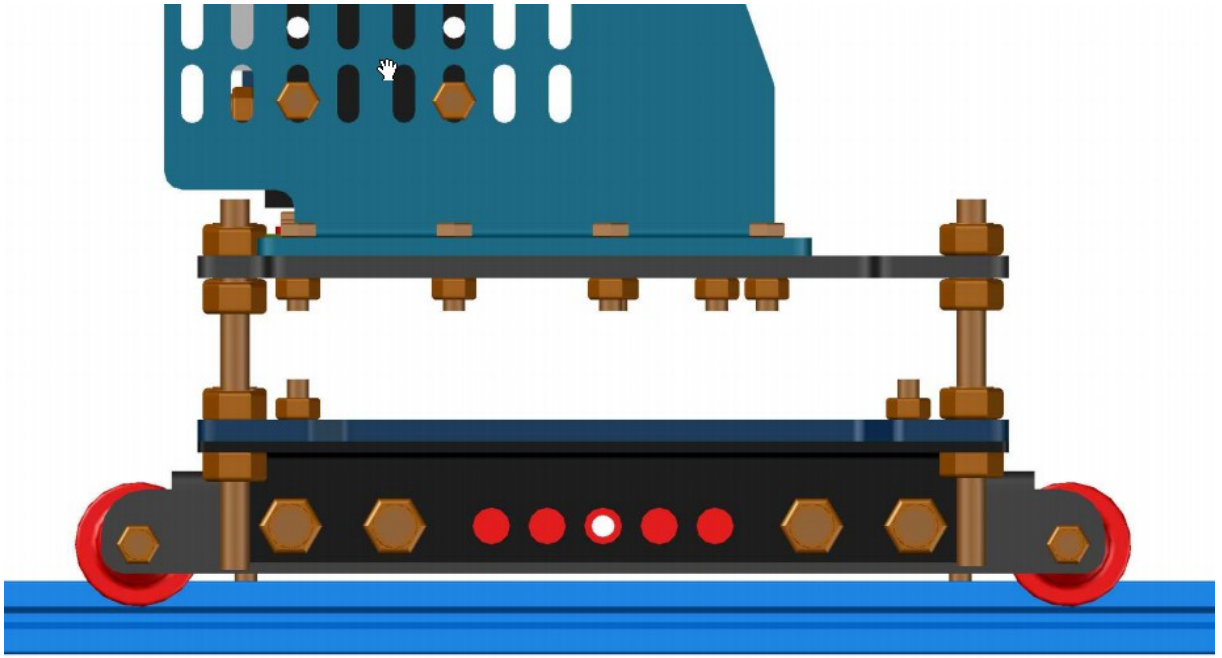
Weight
18kg
width: 1846mm
top (while freme is centered) at 685mm

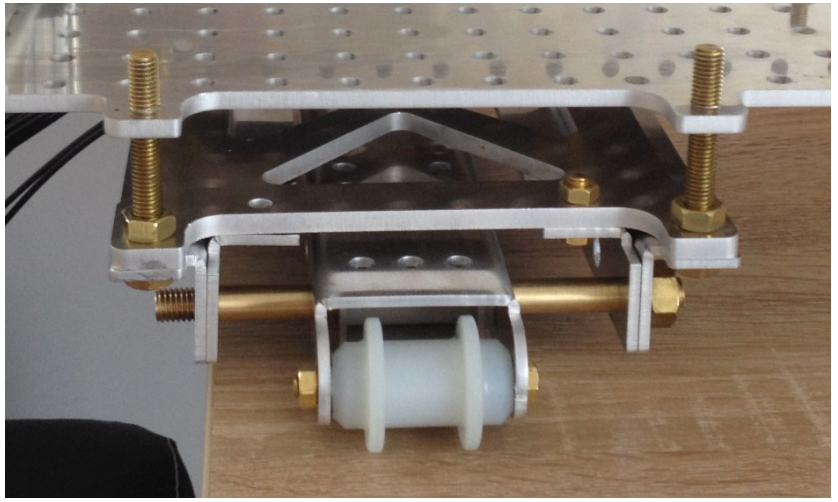


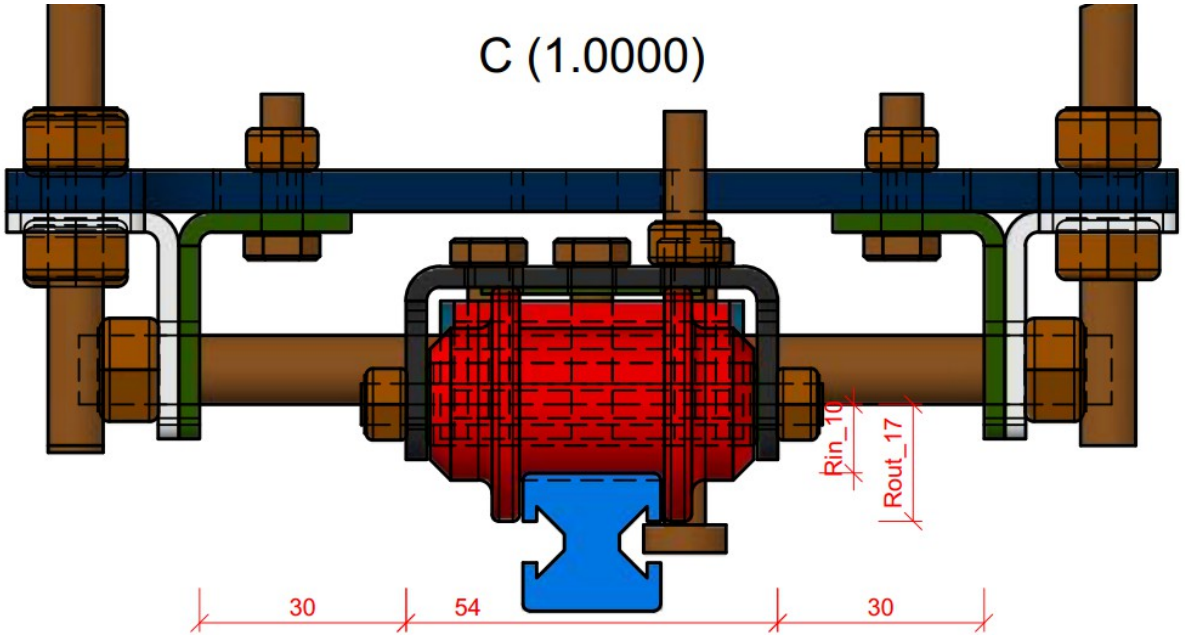




This construction gives possibility of X-Y-Z adjusment of the frame.





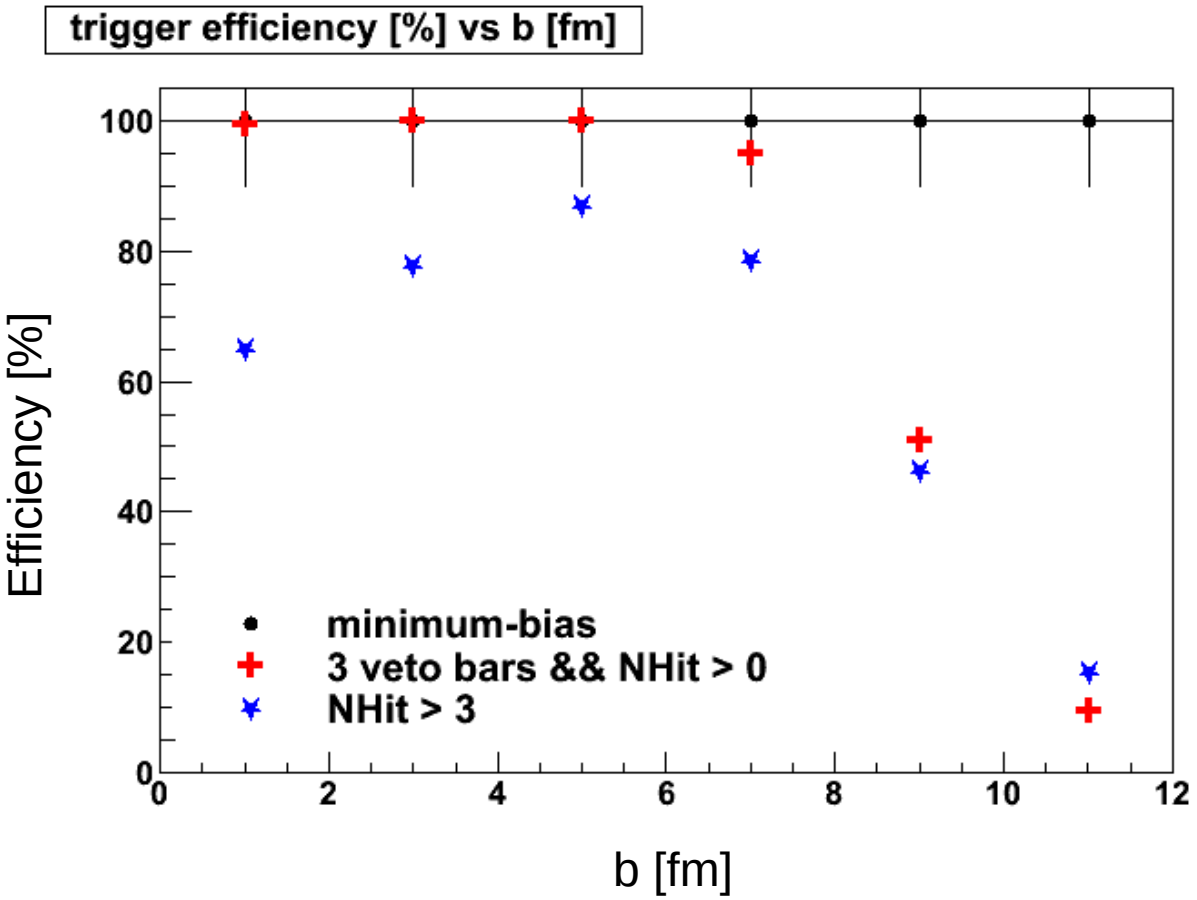


Thank You!

Pawel.Lasko@doctoral.uj.edu.pl

backup

Trigger efficiency



(assuming 100% MPPCs efficiency)

Discriminators + FPGA

Type	V_{ee}	V_{low}	V_{high}	V_{cc}
PECL	GND	3.4 V	4.2 V	5.0 V
LVPECL	GND	1.6 V	2.4 V	3.3 V