MRPC for PID system (Protvino)

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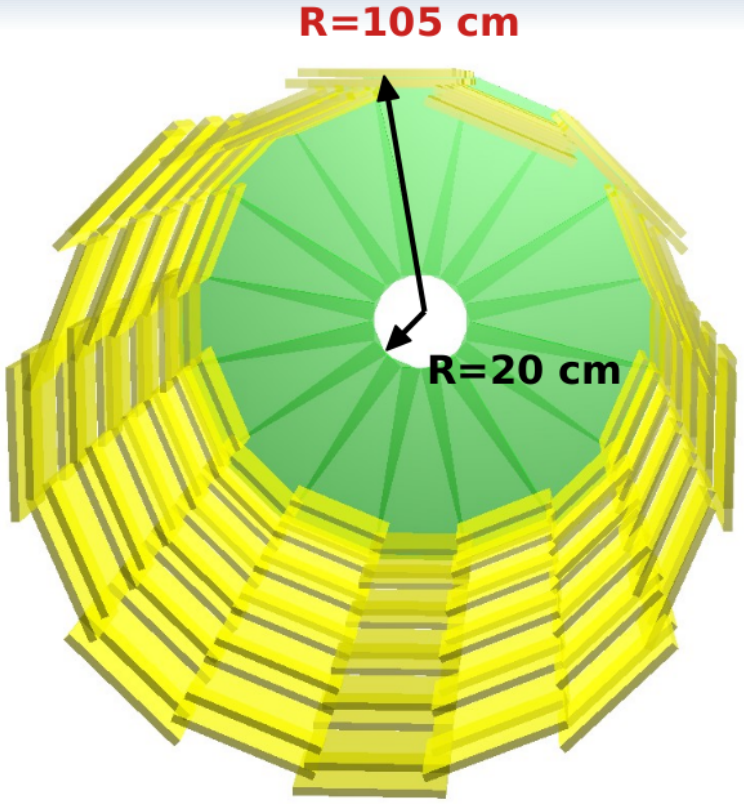
Hybrid TOF system

R=85 → 105 cm



Barrel-module (Protvino)

Length=40 → 44 cm
Width=33 cm
Height=2.5 cm

Geometry Barrel as from Protvino

End-cap-module (Tsinghua)

Width1=14.0 cm
Width2=34.0 → 42 cm
Length=70 → 85.0 cm
Height=3.0 cm

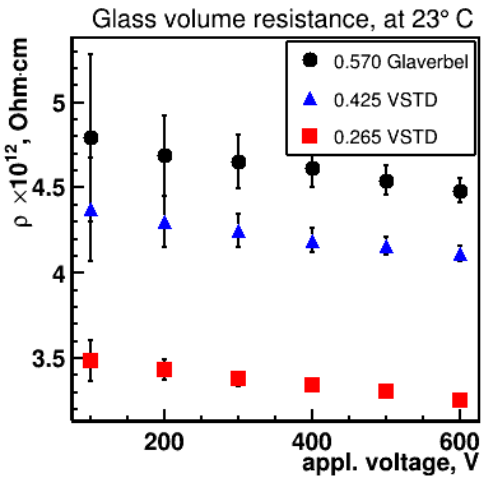
Geometry End-Cap as from Tsinghua

Three mrpc prototypes were produced for the Dubna test area.

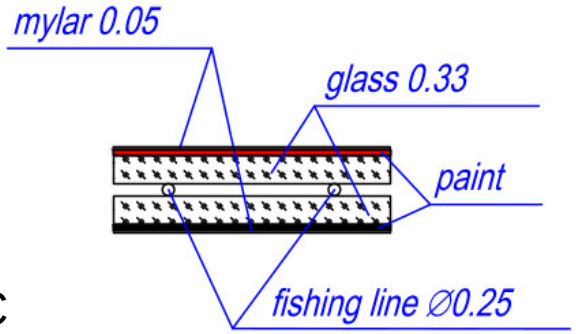
General requirements for mrpc as we understand it:

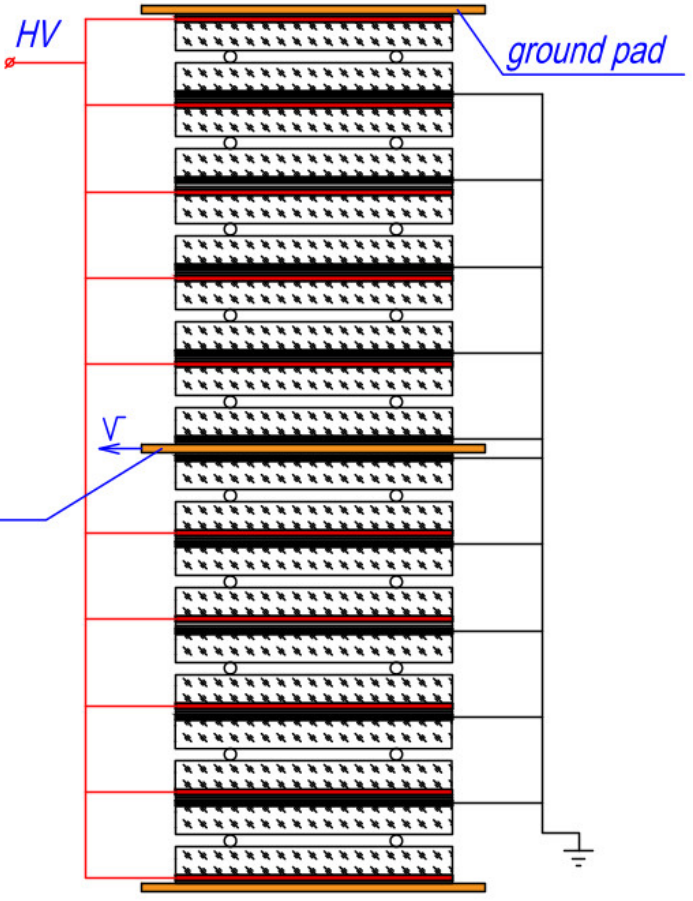
- For the detector have to be reasonable low operation voltage (~3kV)
- Mrpc's have to be made of thinner glass as it's possible. We choose the thickness of 0.33 mm
- Width of signal strips could be 2 cm, because the background rate is less than 1kHz/cm^2
- Mrpc module should be compact enough for easy installation in a large setup

External dimensions	460 x 406 x 18 mm
Sensitive area	400 x 340 mm
Strip size	410 x 20 mm
Number of strips	16
Number of gas gaps	10
Gas gap thickness	0.25 mm
Glass thickness	0.33 mm



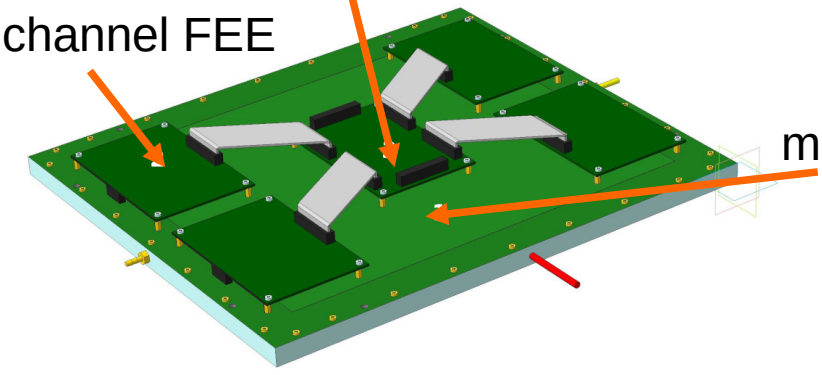
Our mrpc prototype schematic





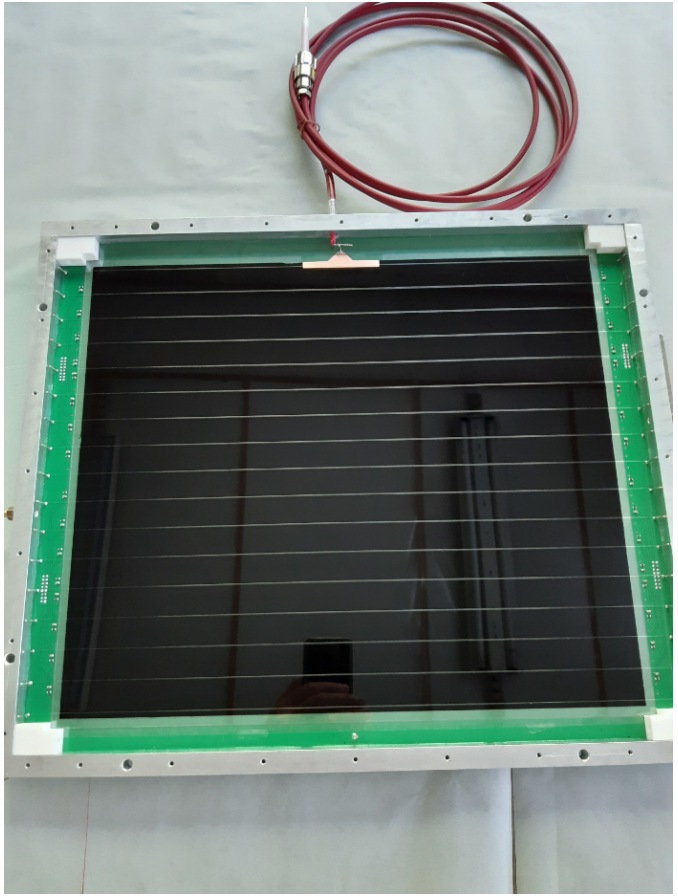
(future) on-board TDC

8 channel FEE

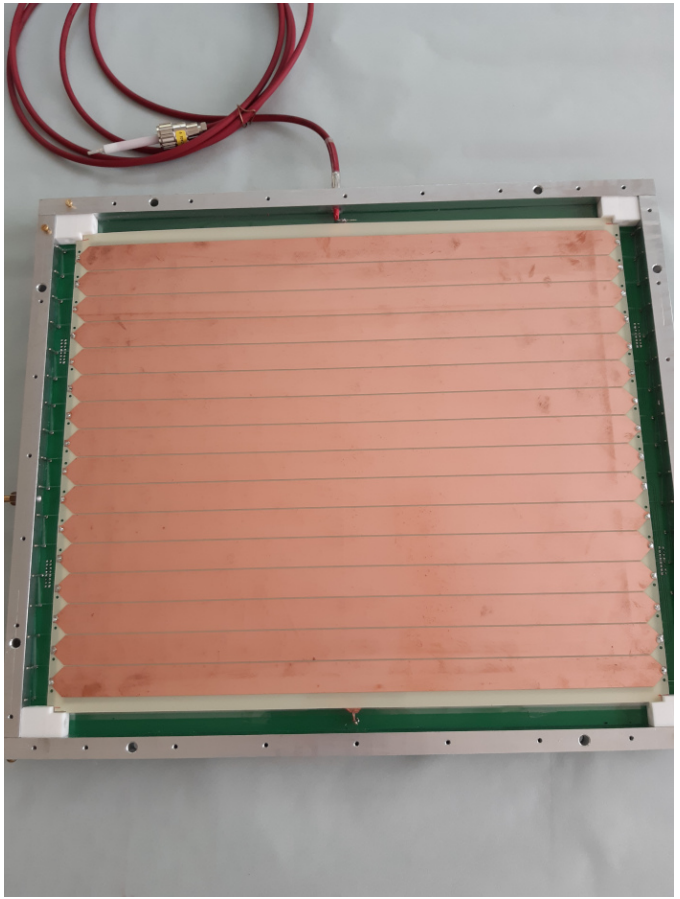


mrpc module

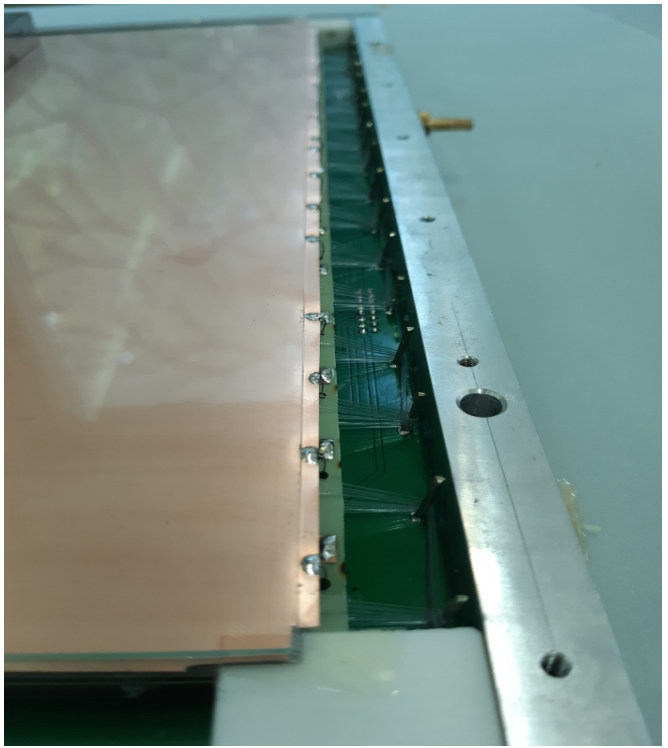
Photos of an assembling of the mrpc module



Box with glass electrode and spacers
(one half of gas gap)

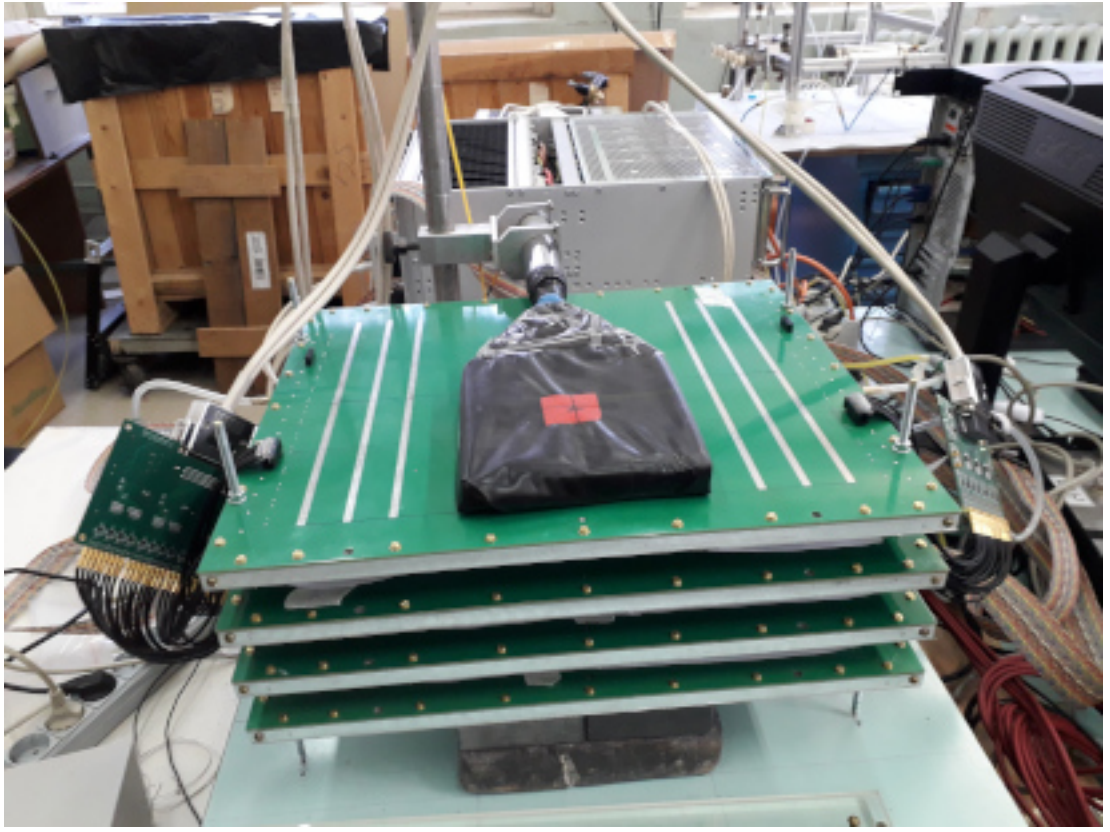


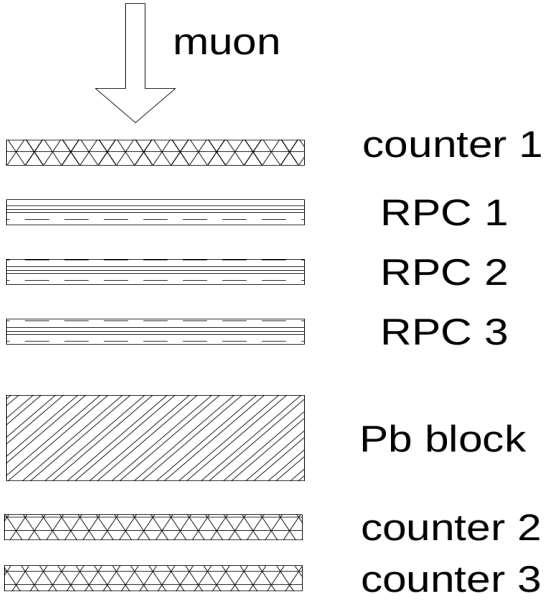
Adding of the readout strip plane



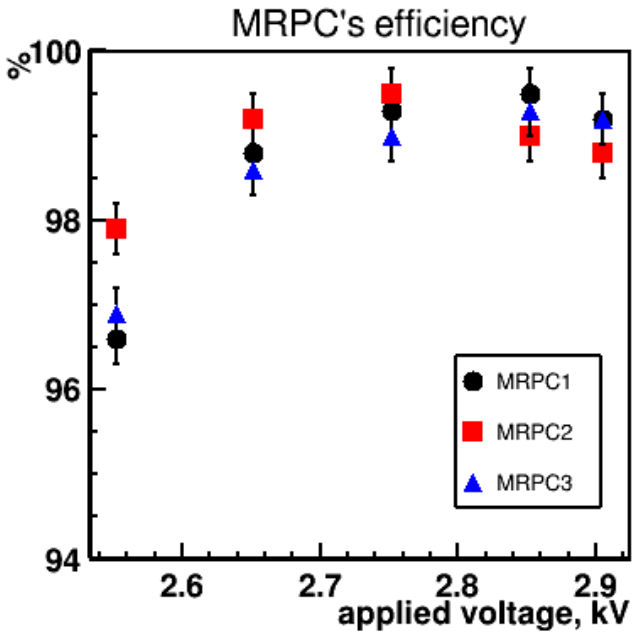
Ground pad is connected to the signal ground. The mrpc box work like a Faraday cage.

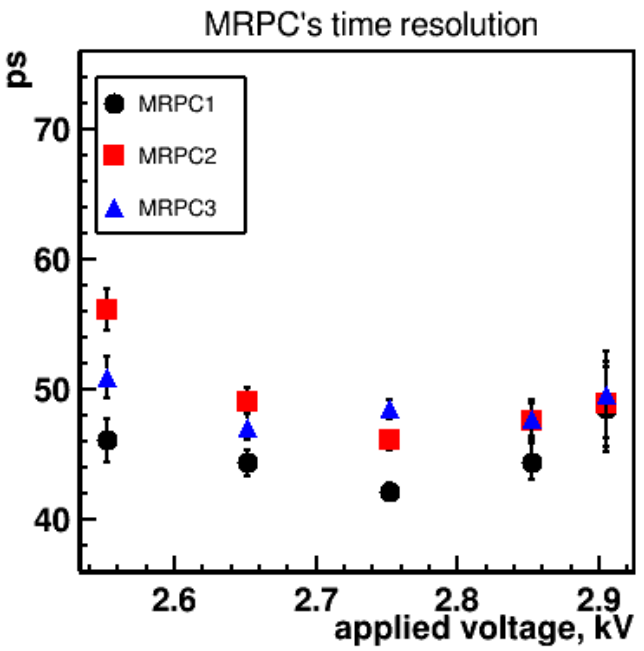
Cosmic setup for mrpc prototypes testing

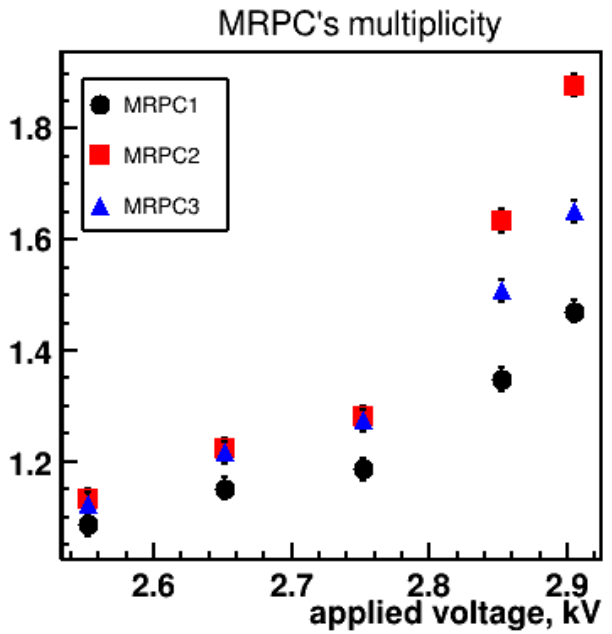




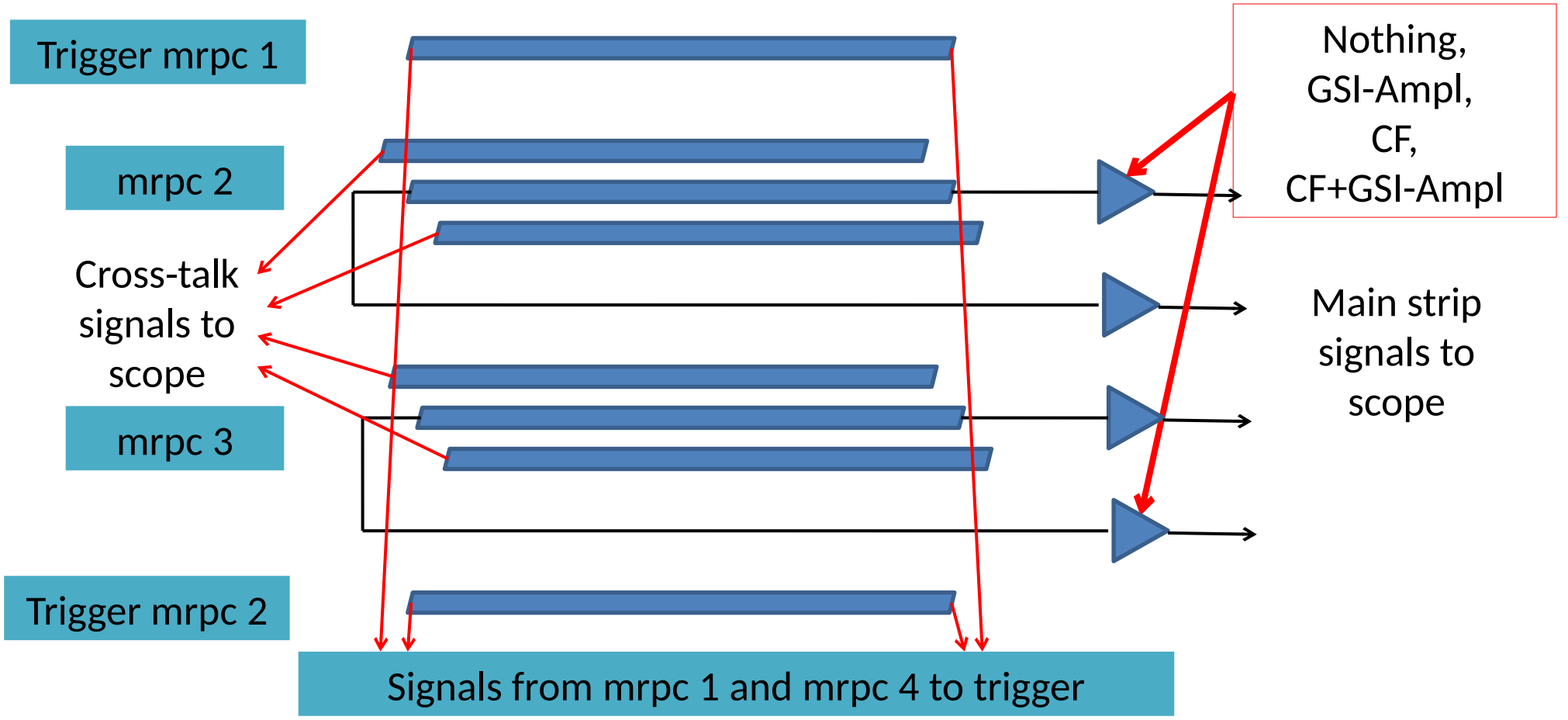
SPD mrpc prototypes characteristics are achieved with TOT method and BM@N FEE



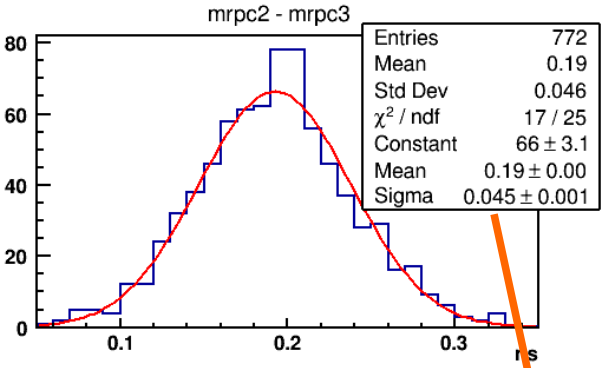


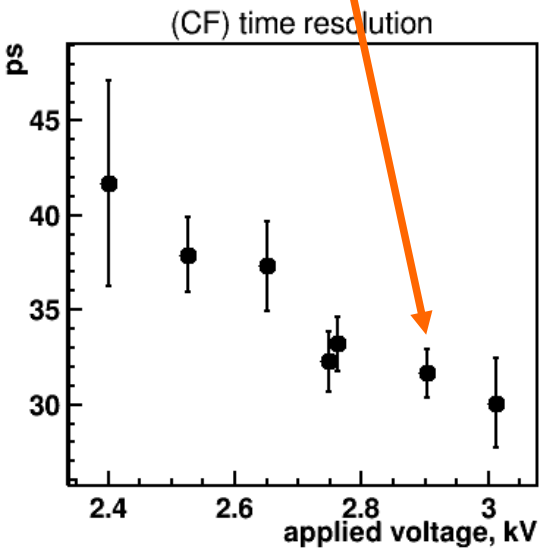


Schematic for measurements with the DPO4104b oscilloscope
Same as presented on 10.06.21 SPD meeting

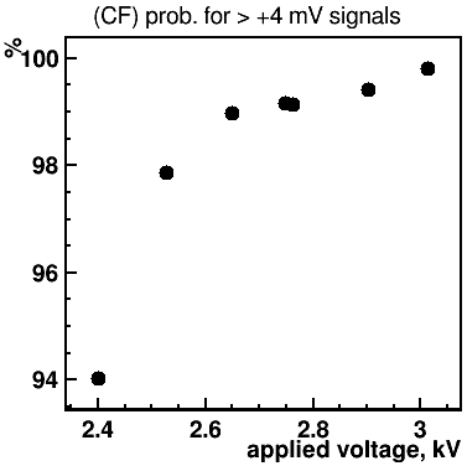


SPD mrpc prototypes characteristics are achieved with the constant fraction method (CF)

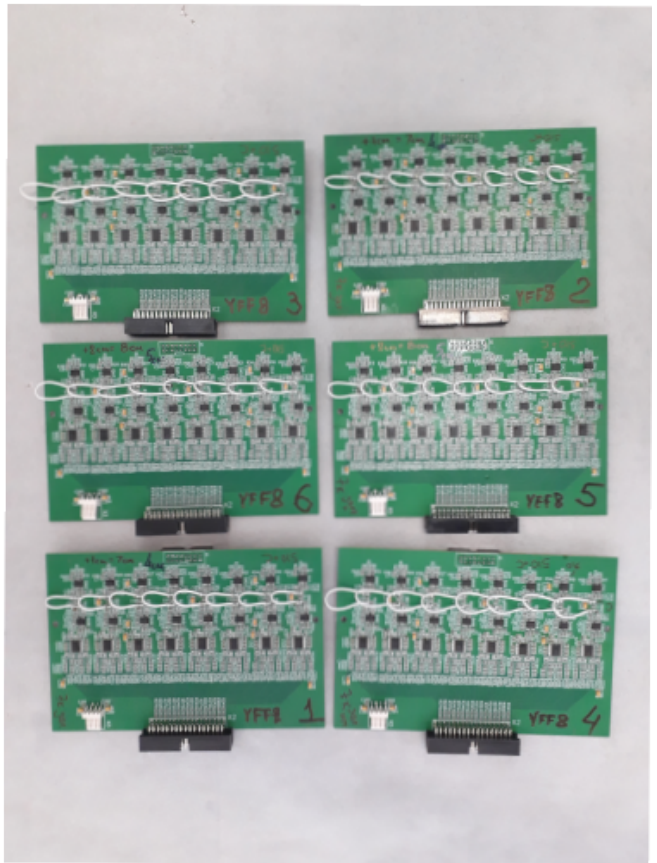


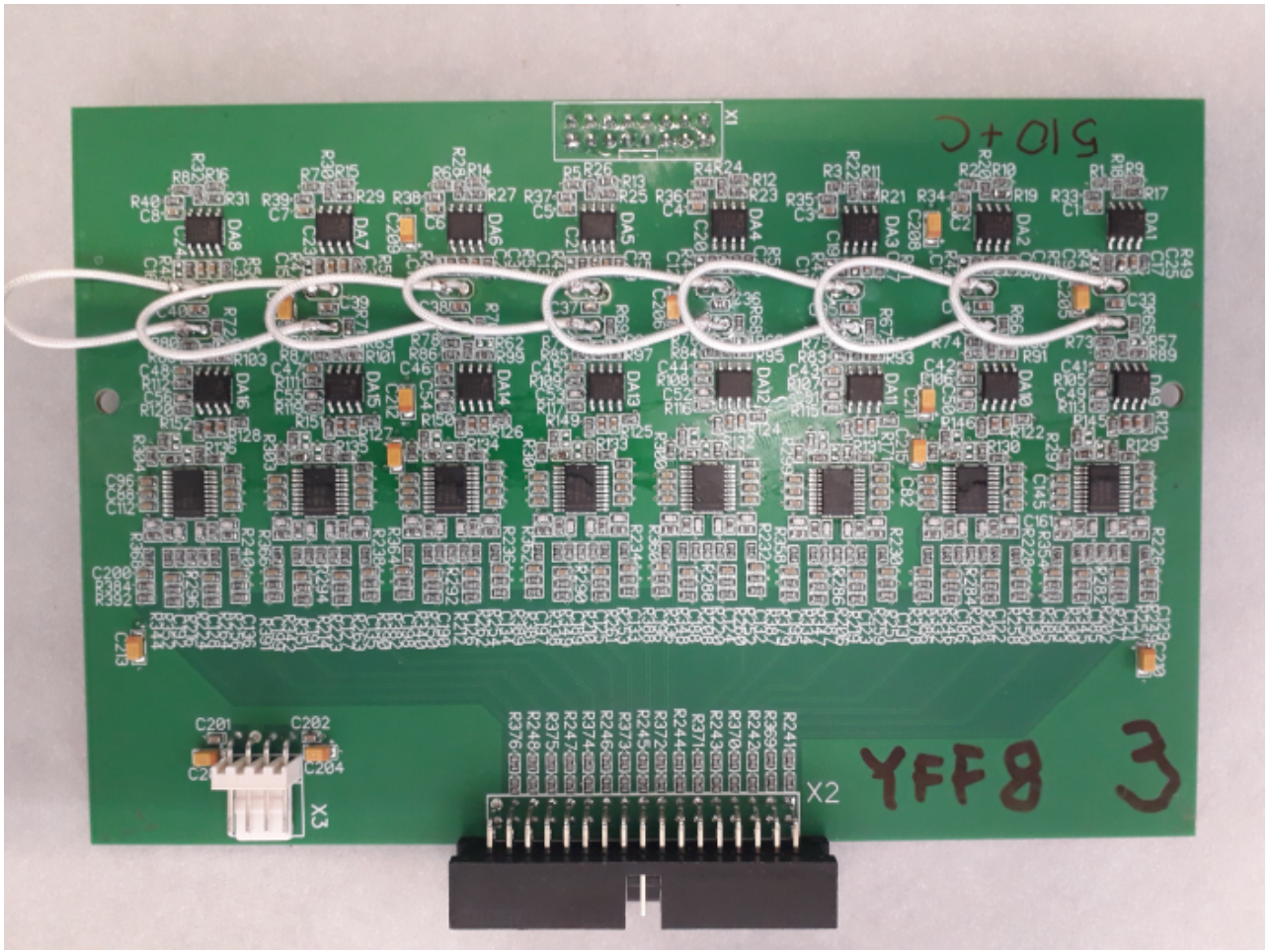


Efficiency estimation

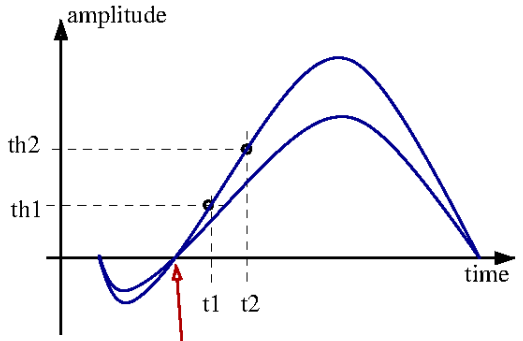


For the our experimental approach a new front-end electronics was designed and produced

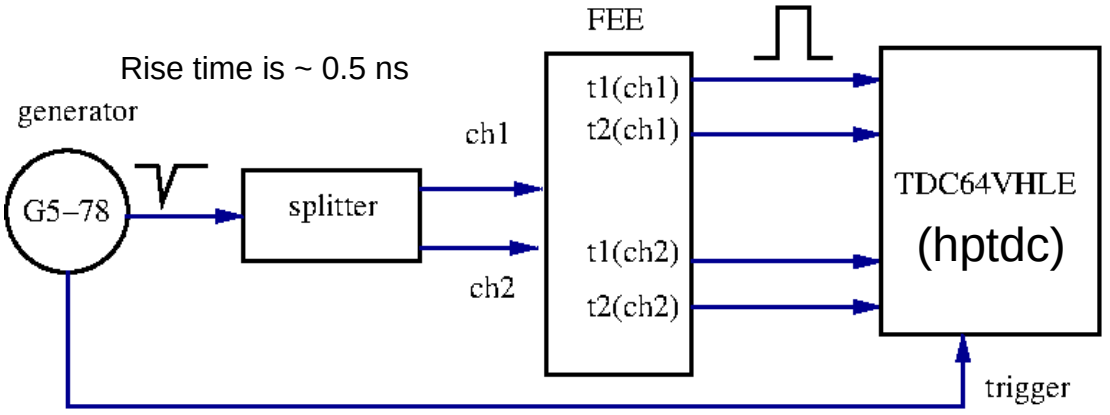


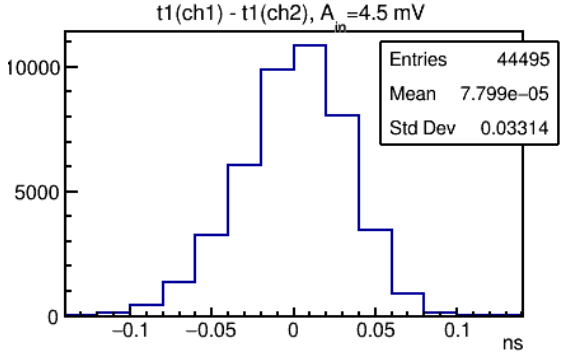


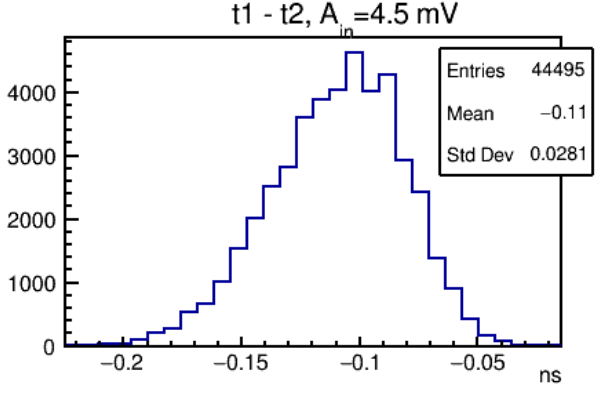
New front-end electronics test with a signal generator and the TDC64VHLE module



th1 = 1.3 mV
th2 = 2.1 mV

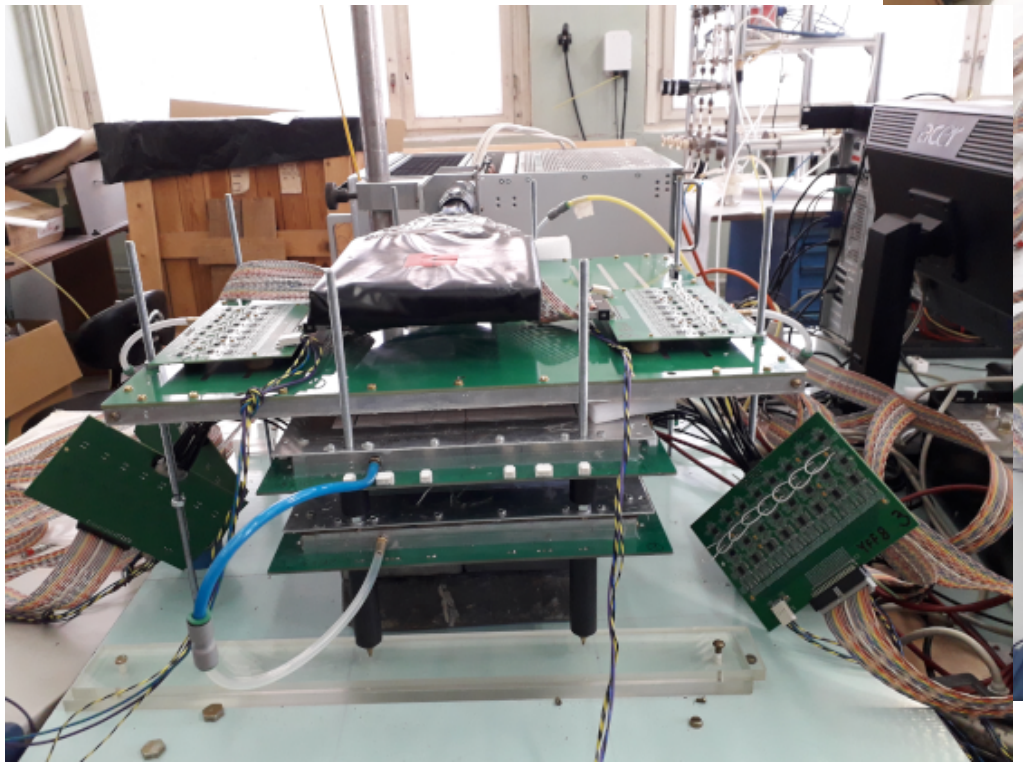


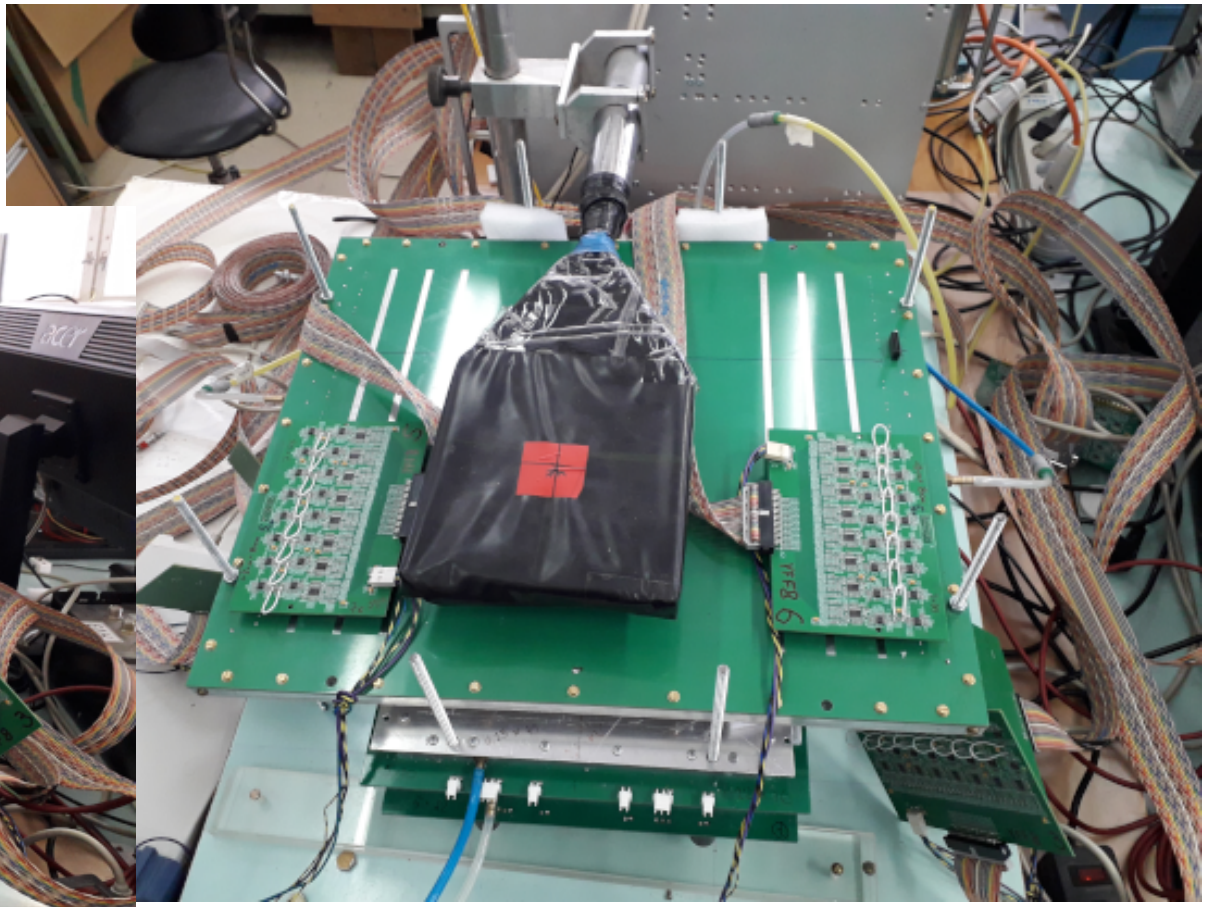




It looks like we got a too fast rising amplified signal. However for effective time correction the time span in between t1 and t2 have to be large than the TDC time resolution.

Cosmic setup for new FEE testing





First cosmic test with the new FEE

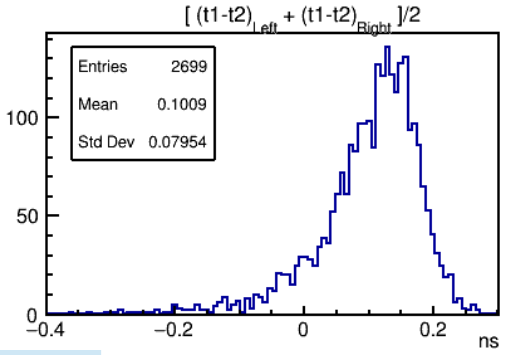
Test conditions:

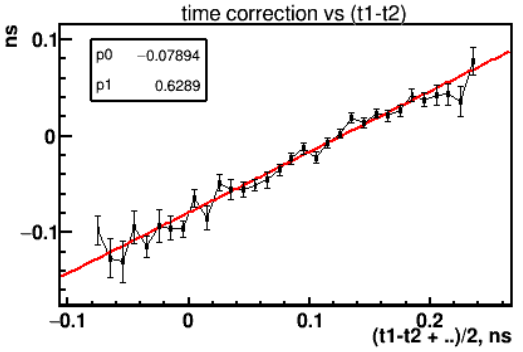
mrpc1 — SPD prototype
mrpc2 — 10x0.25 mm
mrpc3 — 12x0.25 mm

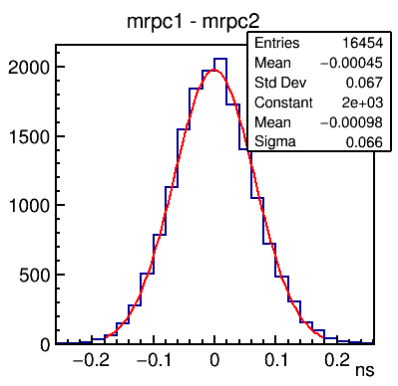
HV = 2.75 kV

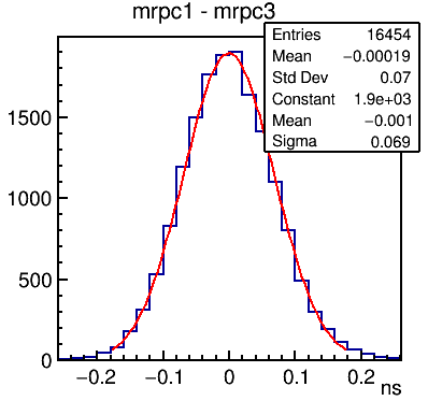
threshold 1 = 0.6 mV
threshold 2 = 2.4 mV

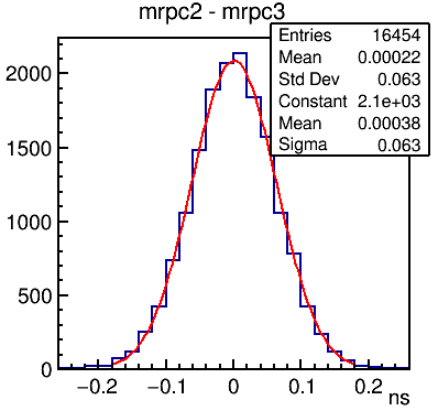
CF delays (1,2,3) are 250, 300, 200 ps











Results
Time resolution:

- mrpc1 — 51 ps
- mrpc2 — 42 ps
- mrpc3 — 46 ps

Efficiency(thresh. 2):

- mrpc1 — 93%
- mrpc2 — 92%
- mrpc3 — 88%

Summary

- 3 mrpc prototypes were produced for the Dubna test area
- Measurements with BM@N front-end show a good time resolution (<45 ps) and high efficiency (>99%) for produced prototypes
- ‘Zero’ version of FEE was designed and produced
- First tests with the new FEE and TDC64VHLE readout show the mrpc’s time resolution of about ~40 ps at efficiency > 90%
- Debugging/ modification of developed FEE board is still in progress
- For improving the detector time resolution TDC’s with a smaller time quantum are required