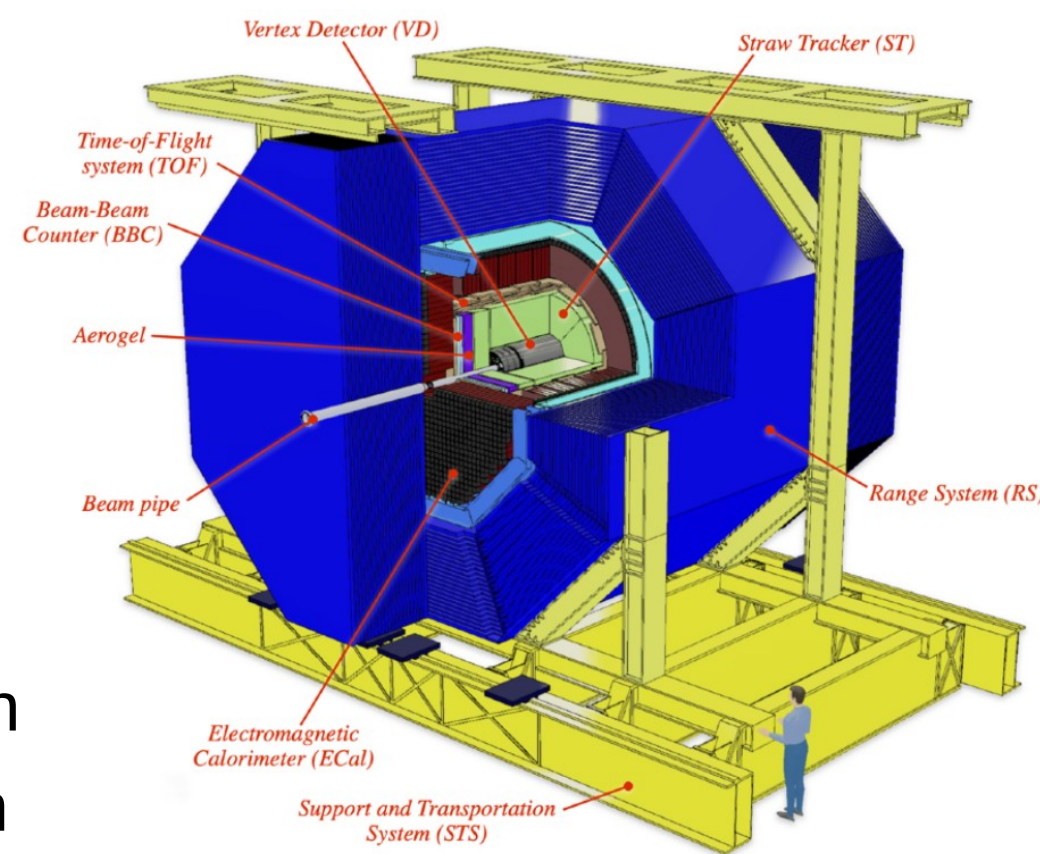# VMM3A-based Readout Solution
for the SPD Stage-I Straw Tracker

V. Bautin, T. Enik, K. Salamatin, D. Sosnov for the **StrawTrackerRD** team
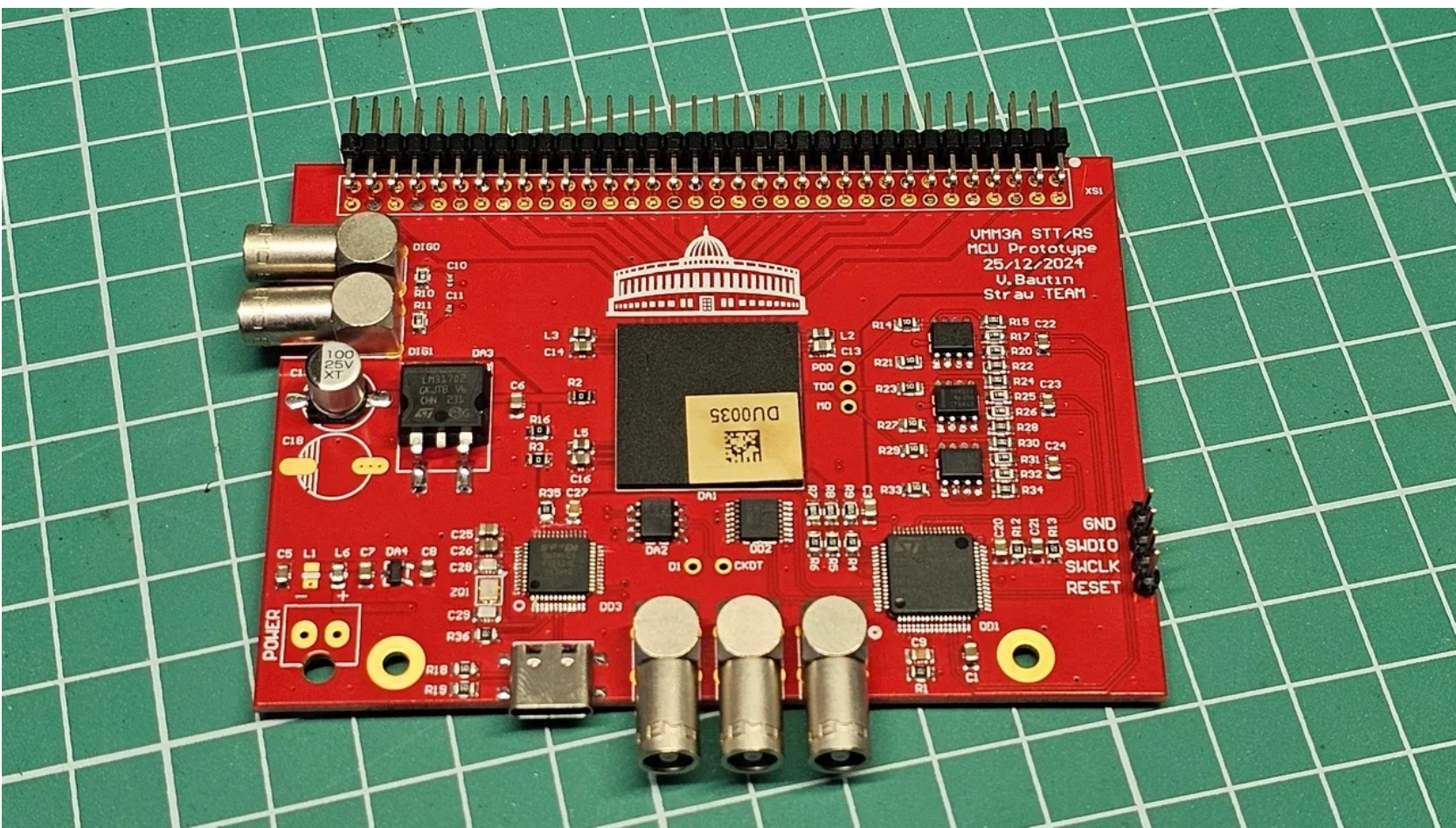
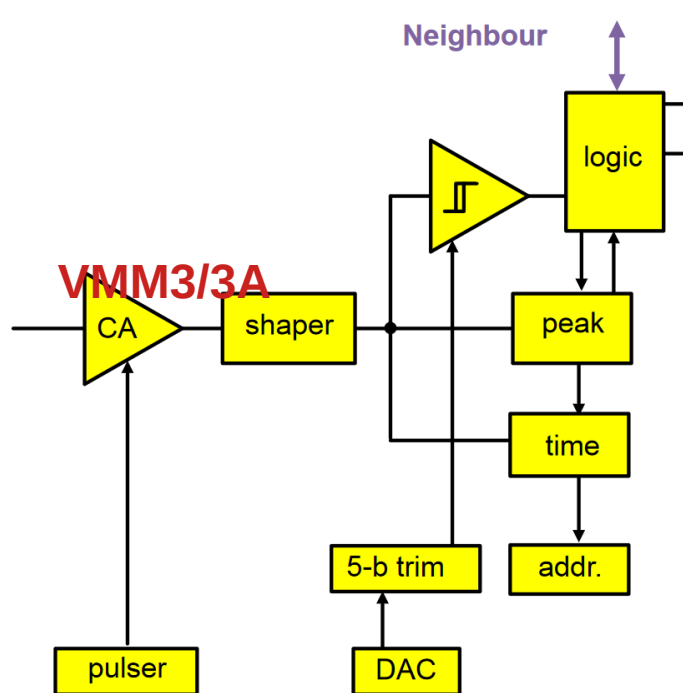**Motivation**:

• 30k+ channels
• 150um spatial resolution
• dE/dX charge resolution
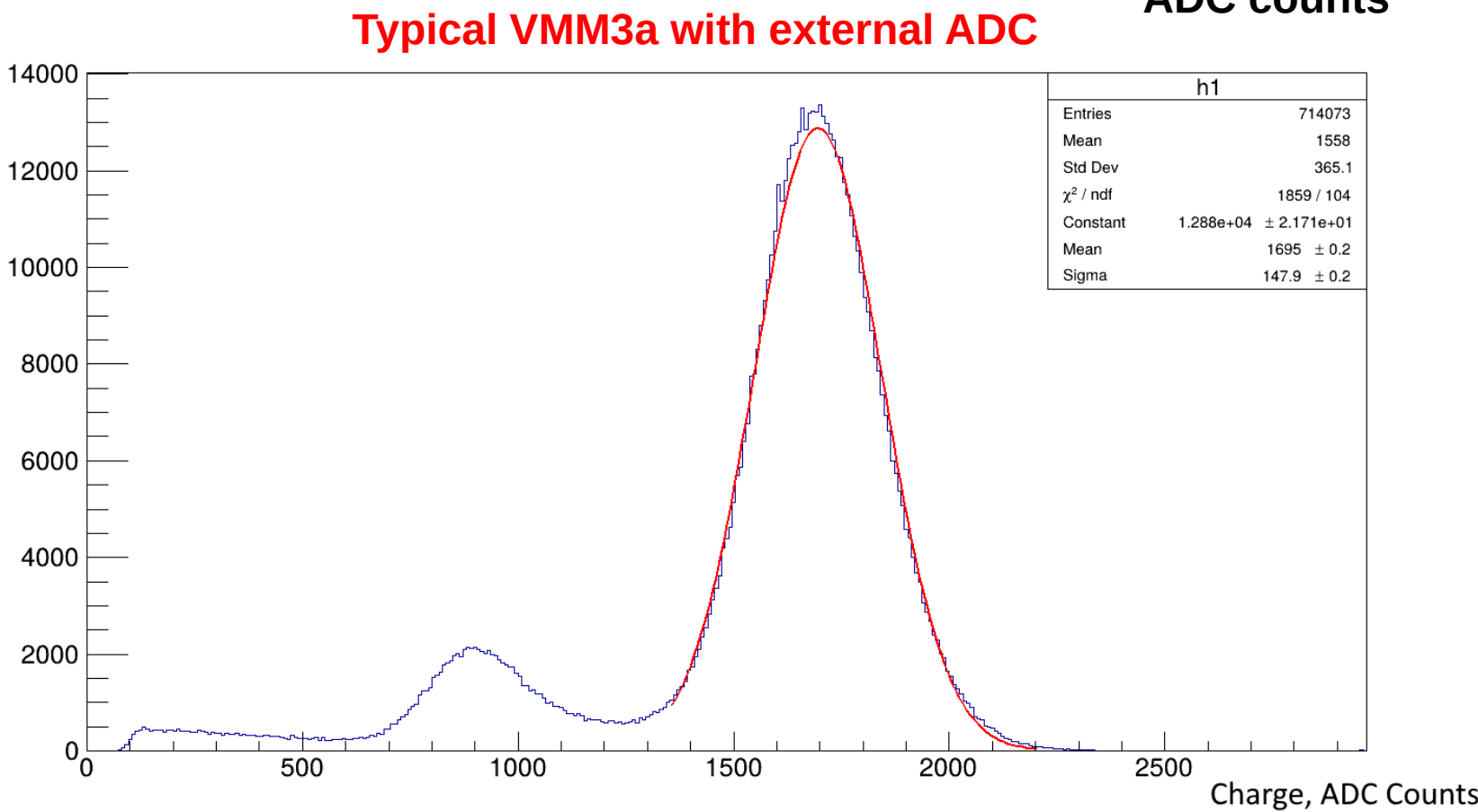• Simultanious Charge & Time measure

Investigating existing readout solutions

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Number of channels	64
Clock frequency	10...80 MHz
Input capacitance	<300 pF
Dynamic range	up to 2 pC
Gain	0.5, 1, 3, 4.5, 6, 9, 12, 16 mV/fC
Peaking time	25 / 50 / 100 / 200 ns
ENC (energy branch)	<3000 e⁻
TDC binning	~1 ns
Maximum event rate	140 kHz/ch
Consumption	15 mW/ch

VMM3/3A ASIC is well known chip for gaseous detectors. It has amplifier and shaper adjustable in a wide range. But it was not really done for the timing measurements so fastest shaping is 25ns and ToA mode has some issues.
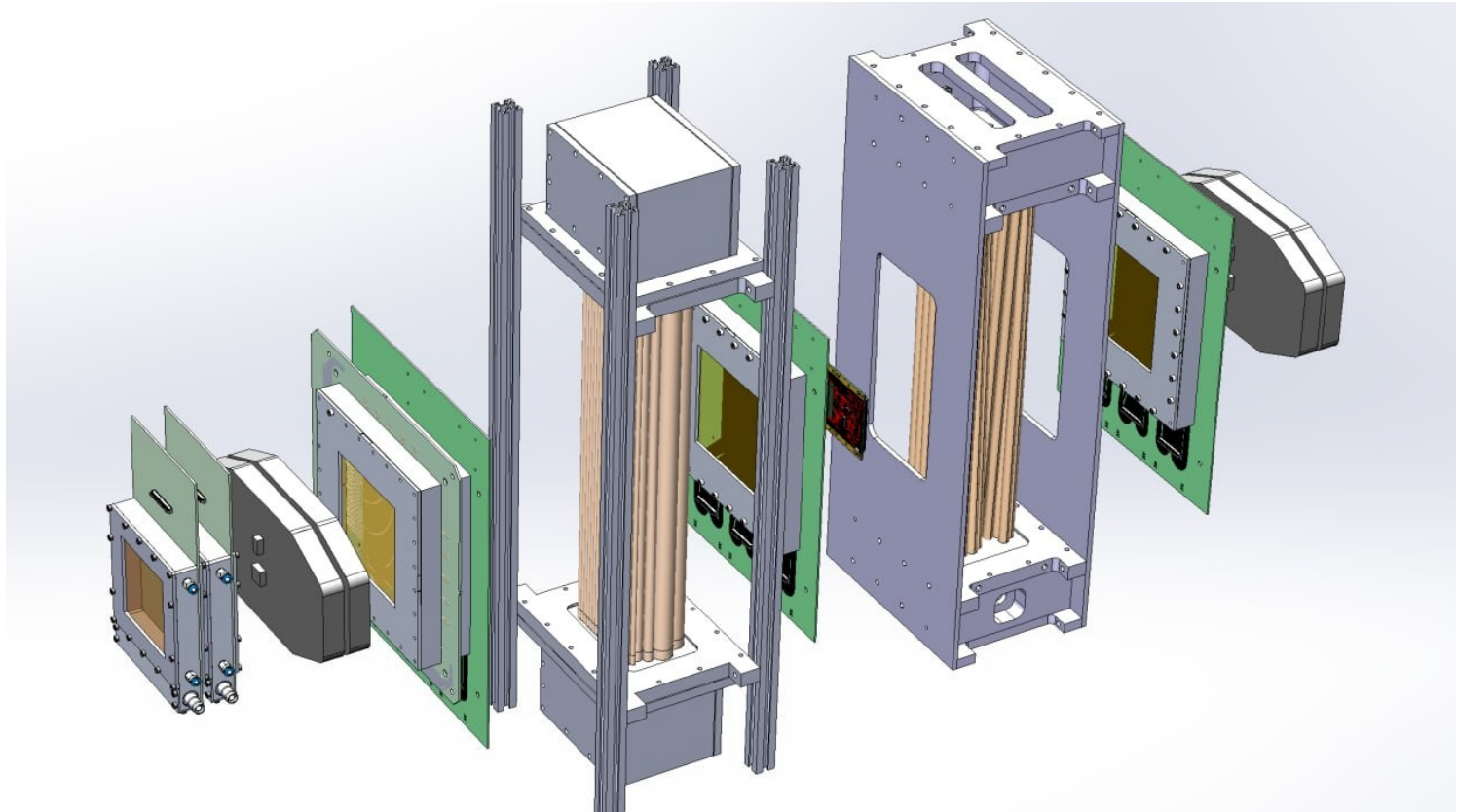

• Once the process is complete the **ASIC can be switched readout phase**. The first set of amplitude and time voltages is made available at the **analog outputs**. The **address of the channel is serialised** and made available at the digital output using **six data clocks**.
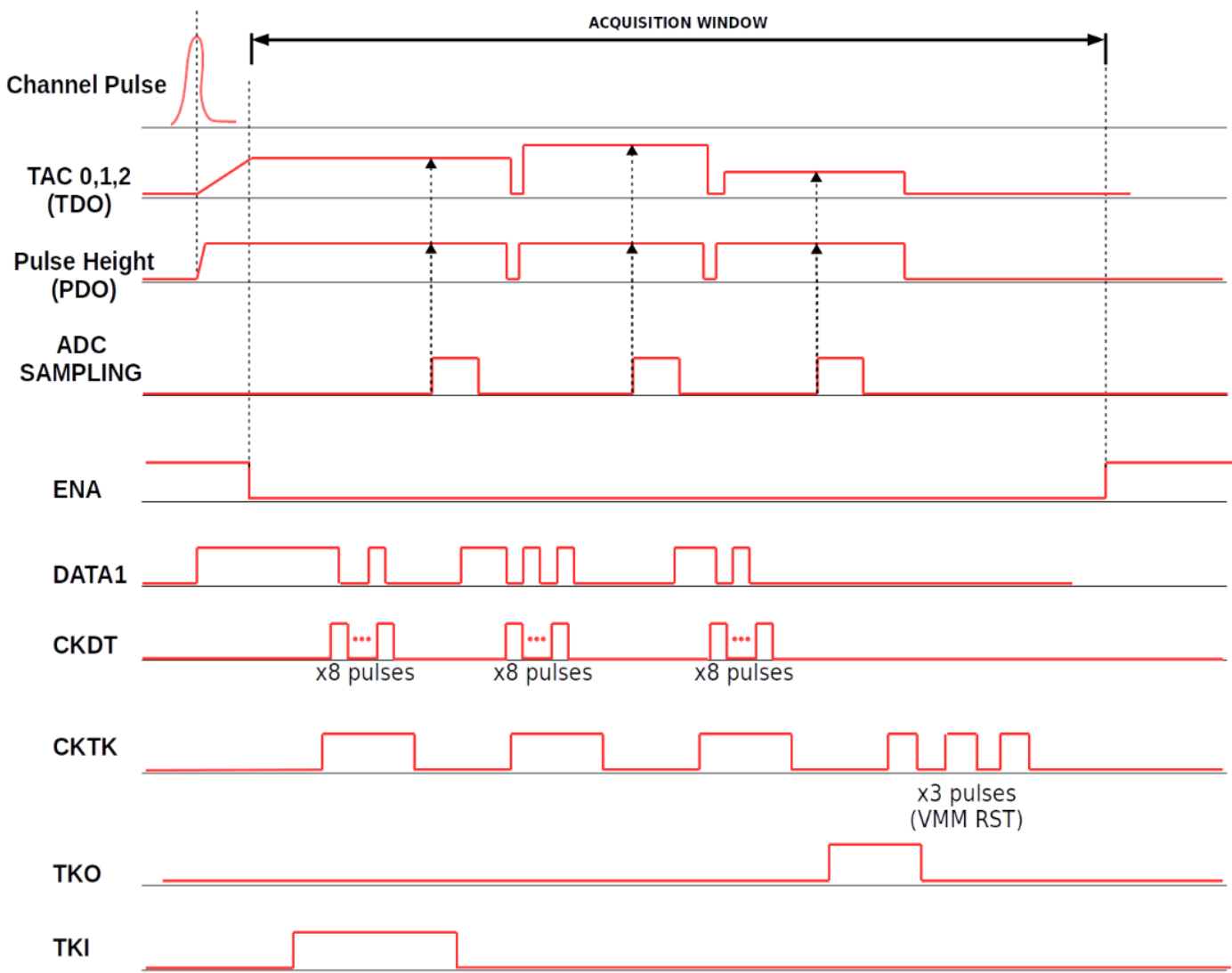
A series of dedicated testbeames has been held at CERN PS/SPS in order to test the performance of front-end electronics solutions. For the last 4 years we have researched straw-tracker performance with APV25, standard VMM3/3a, TIGER, ASD-8 and AST-1-1 ASICs. The first tests of our new design has been also installed for the first time this year. From the first measurements we see good and comparative performance. The analysis is ongoing.

New VMM3A FEB designed

The new design utilize a non-commonly used mode of operation for the VMM3a ASIC. One can see significant improvement in the digitization resolution ot the picture below. The main drawback is the speed. Operational hitrate has decreased to 10-20kHz per channel which is still feasible for the SPD Stage-I.

StrawTrackerRD setup at **CERN** (to be used in our nest FEE tests)
T_0: scintillator coincidence ~400 ps resolution. Reference tracking: micromegas + TIGER readout — track resolution: ~100 um

Conclusions:

• A new front-end electrics solution has been designed for the first stage of SPD-NICA Straw Tracker
• In order to achieve the best performance for the straw tubes, we have developed completely new schematic including differential bufferisation and external ADCs
• We managed to utilize the existing VMM3A ASIC originally designed for ATLAS Micromegas detector
• That helped us to achieve a low-cost design with a price of ~3-5$ per channel and a power consumption of about 20-30mW per channel
• The device is a complete multichannel solution for collection, amplification and digitization of incoming signals