Thermal neutron GEM detector with VMM3/SRS readout

Temur Enik (JINR)

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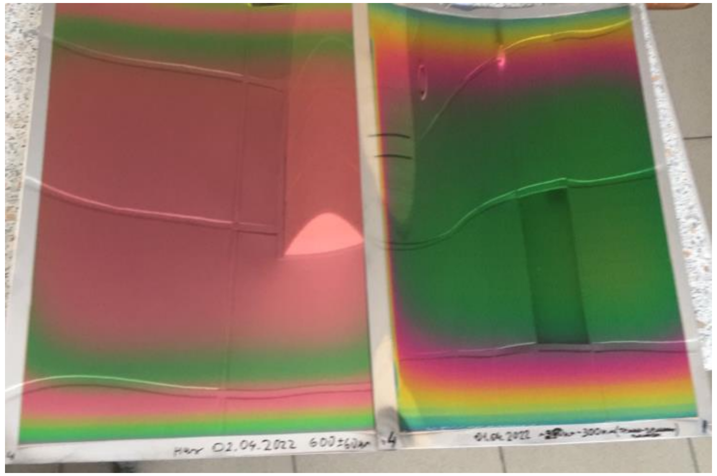
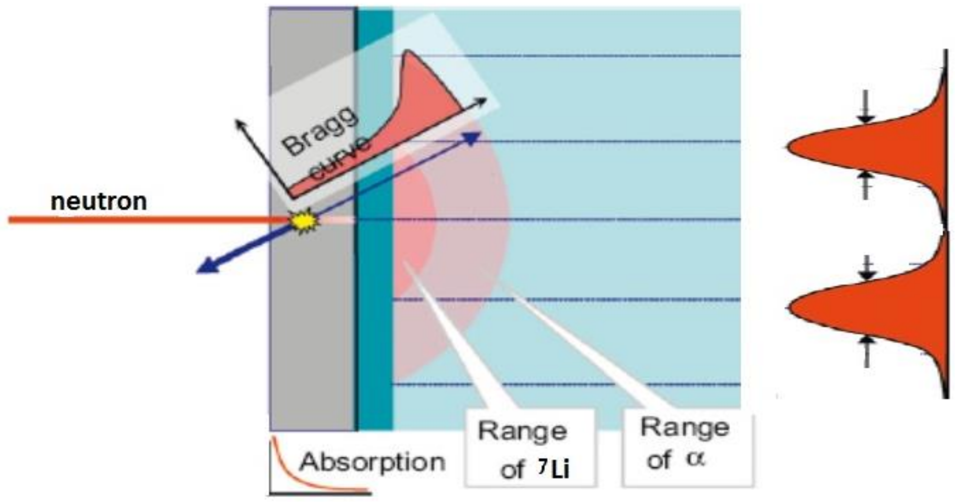
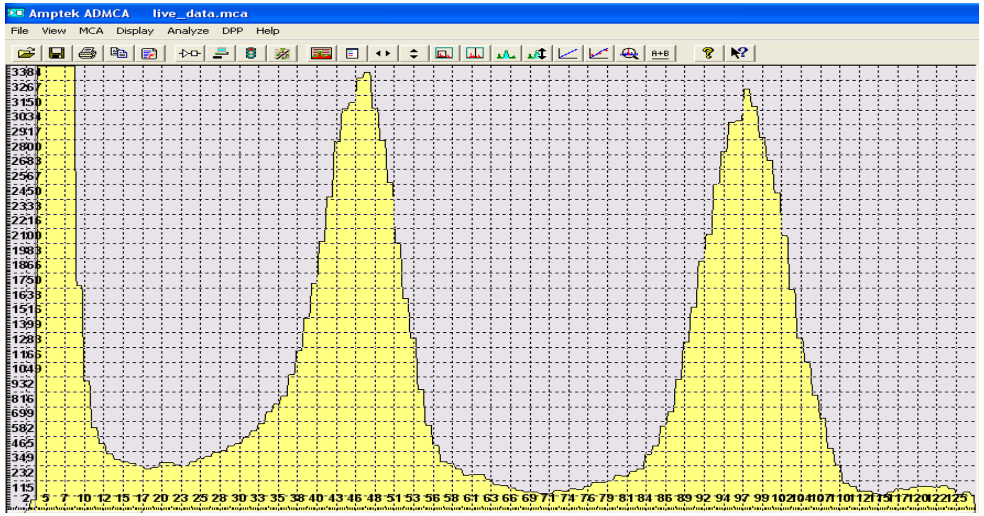
Facility for Coating in FLNP JINR



We propose use of B4C windows for the standard RD51 detectors in order to provide widely available neutron detectors

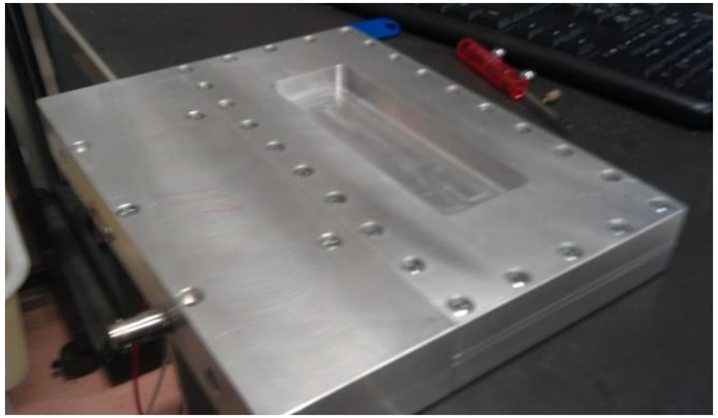
Neutron detector development in JINR





$^{10}B+n \xrightarrow{93.7\%} \alpha(1.47MeV)+{}^{7}Li(0.84Mev)+\gamma(0.48MeV)$ $\sigma_a = 3835$ barn

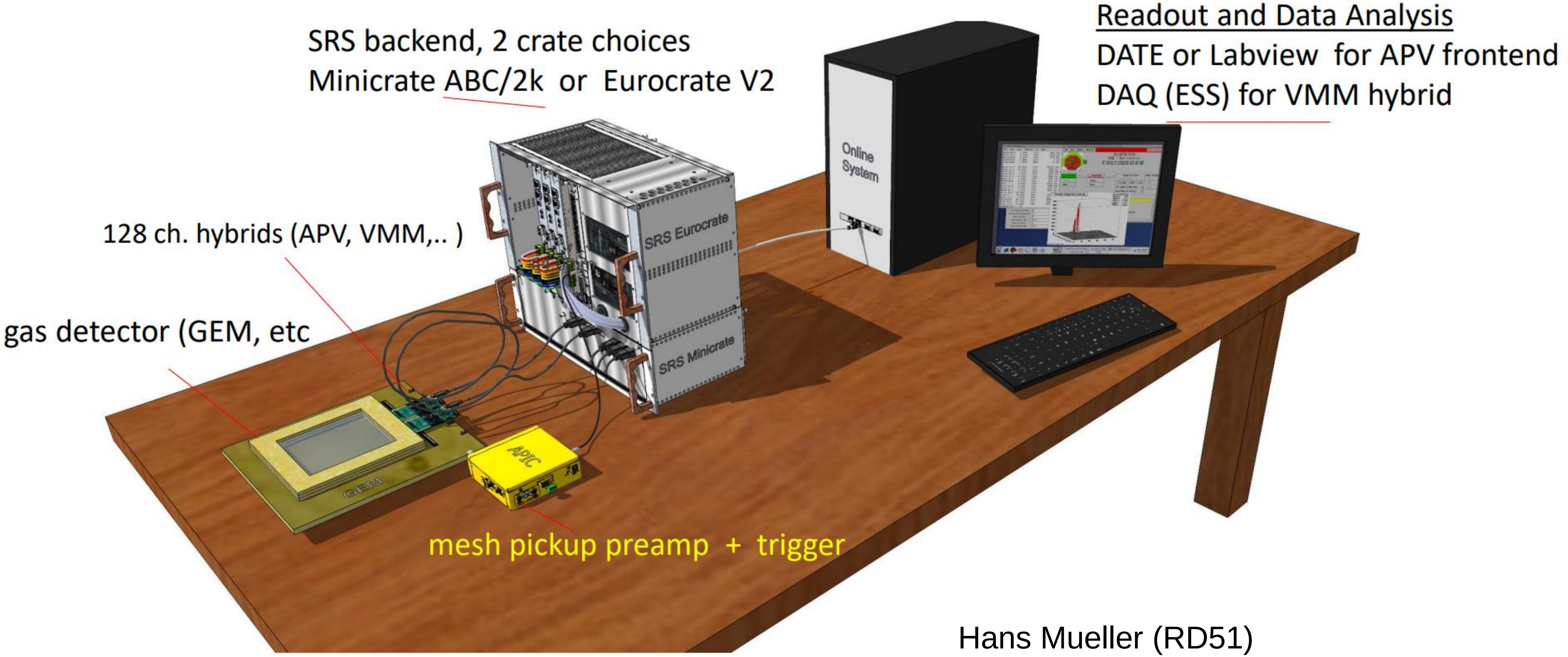
$\xrightarrow{6.3\%} \alpha(1.78MeV)+{}^{7}Li(1.01MeV)$



Neutron detector:

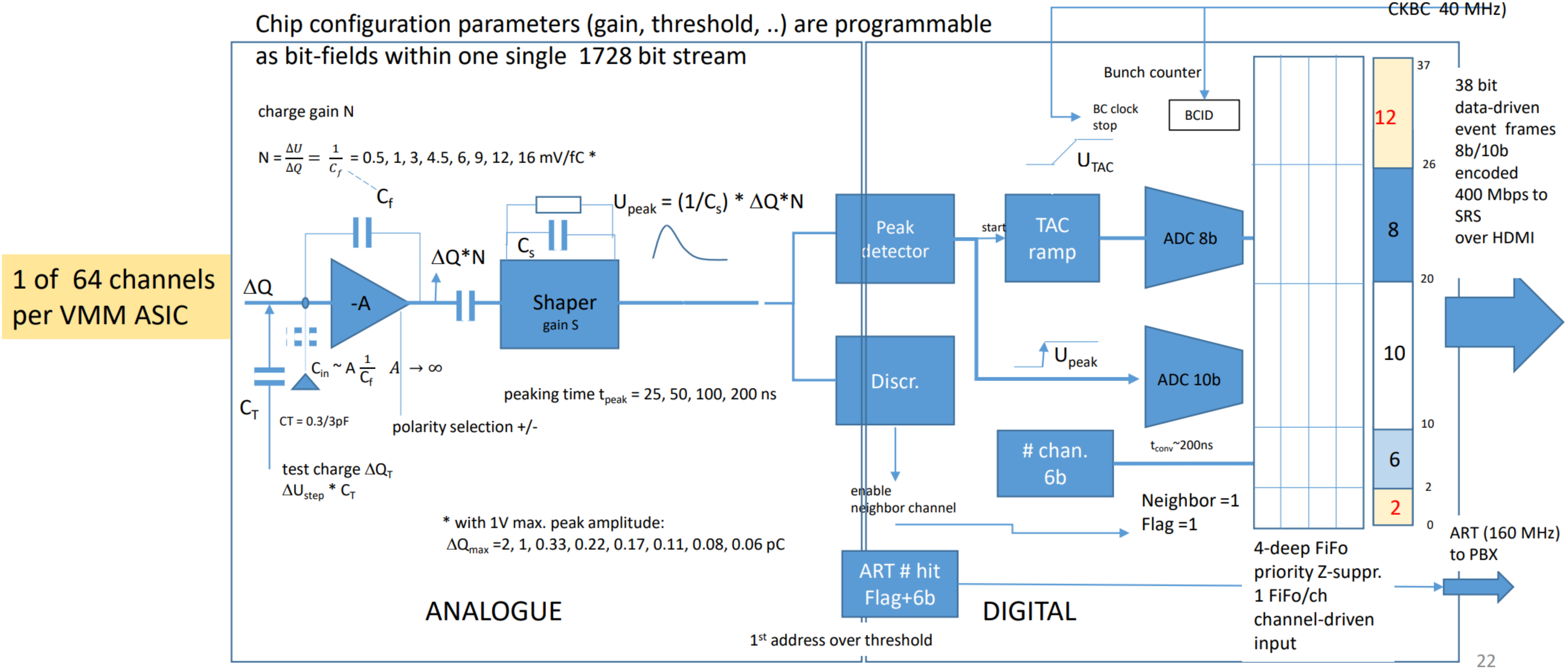
- MWPC, A-C gap h=6mm, wire step S=3 mm, anode wire D=20 µm
- B10 convertor thickness - h=0.1 µm, sensitive area: 144x48 mm2
- Ar/CO2, 70:30, gas flashing or filling up to dP=3 Bar
- HV=(300-1500) V

Modern readout solutions – SRS+VMM3a hybrid by RD51 (CERN)



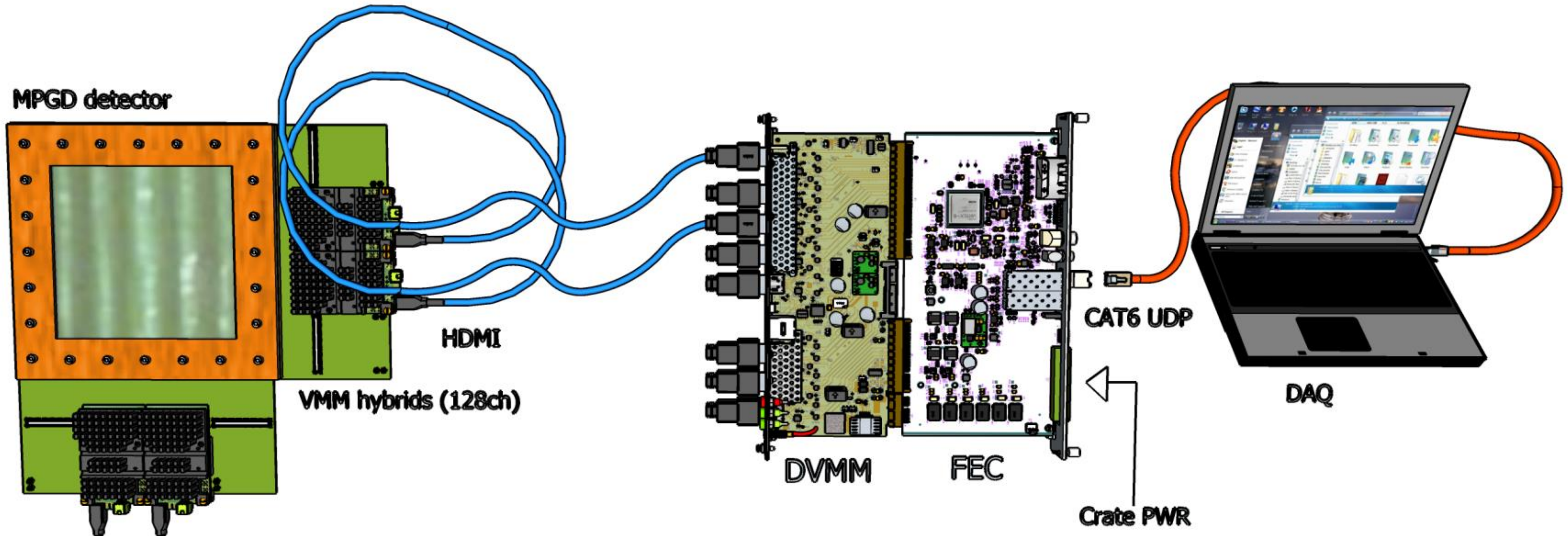
Hans Mueller (RD51)

Frontend - VMM3a



Scalable Readout System(SRS)

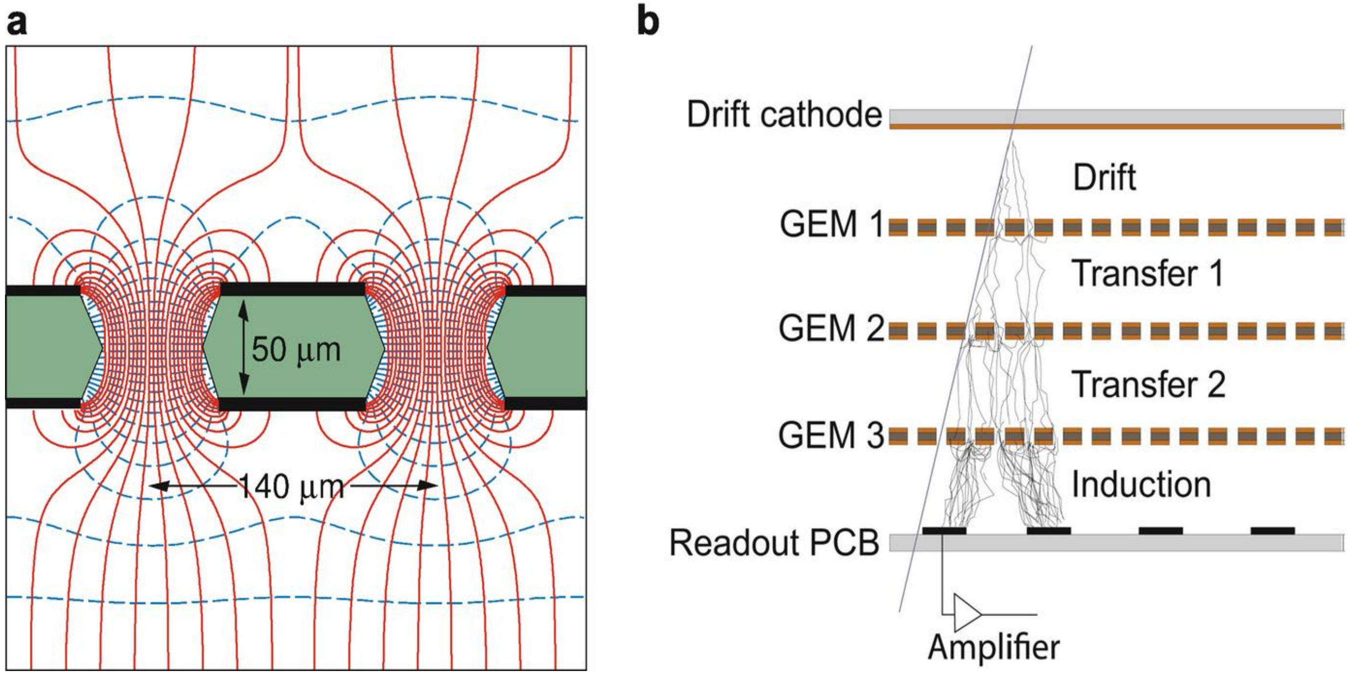
SRS with VMM frontend, so far implemented as a triggerless, scalable multichannel readout system for gas and photon detectors.



SRS -VMM readout slice (1k ch)

- 1 FEC for 8 VMM hybrids / 1024 detector channels connected via HMDI AD cables to DVMM.
- 2 FEC's with CTF (common clock) for 16 hybrids , 2048 ch.
- DVMM cards with octal HDMI connector including 70 W power for 16 VMM hybrids.
- Power / housing for 2 FECs and CTF via 1 Minicrate (not shown).
- 1 GB Ethernet /UDP uplink from FEC to Network via SFP+ jack, fiber or optical 1 GBE for network.
- ESS DAQ Software with Vmm Controls installed under Linux.

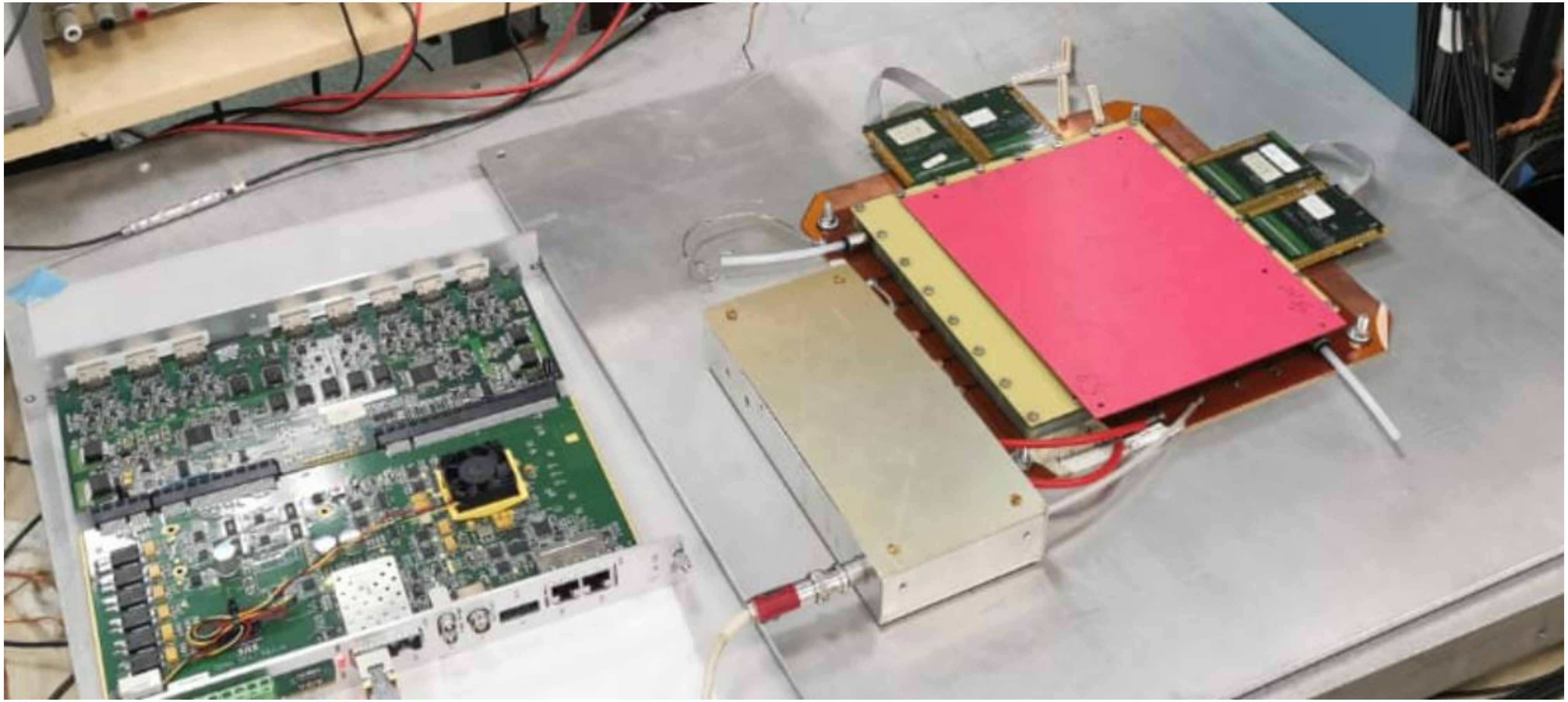
triple-GEM detector



a) Schematic view and typical dimensions of the hole structure in the GEM amplification cell. Electric field lines (solid) and equipotentials (dashed) are shown (Sauli and Sharma 1999);

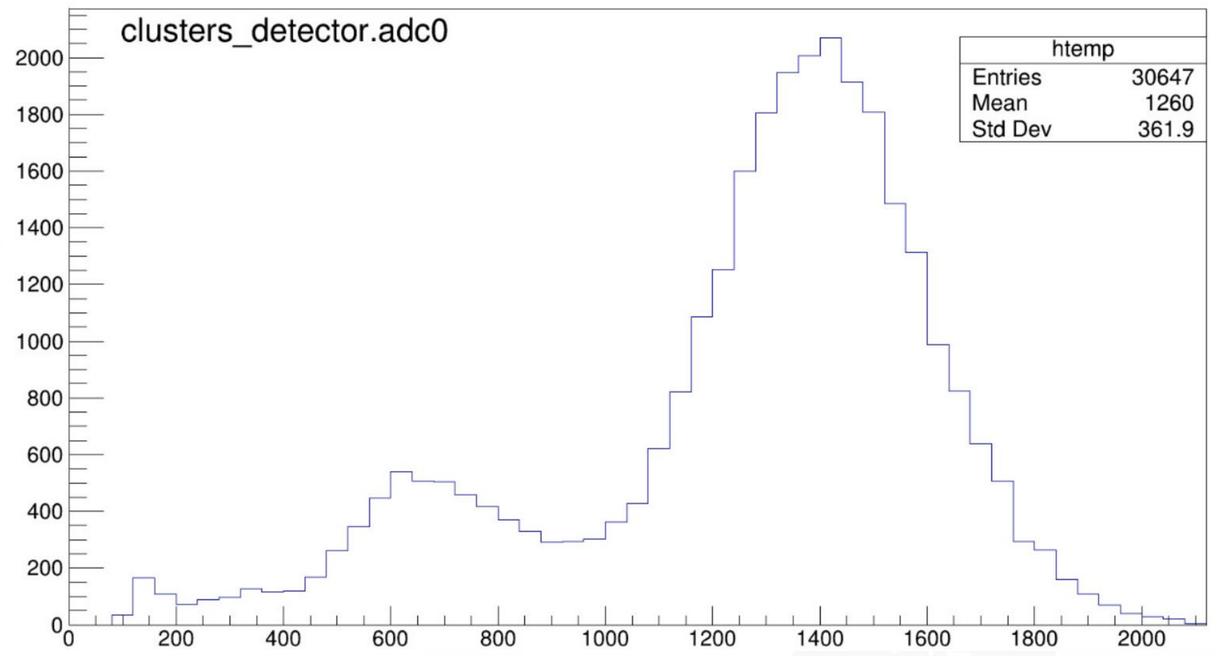
a) Schematic view of the triple-GEM detector. The original ionization occurs in the region labeled “Drift’,” and the ionization electrons are drawn downward to the GEM foil. The amplified electrons emerging from the first GEM are drifted to the second GEM, where they again multiplied. One more GEM stage provides further amplification, and the output is collected at the readout plane (Sauli 2007) (reproduced with permission from F. Sauli, 2012)

Detector and Reading System

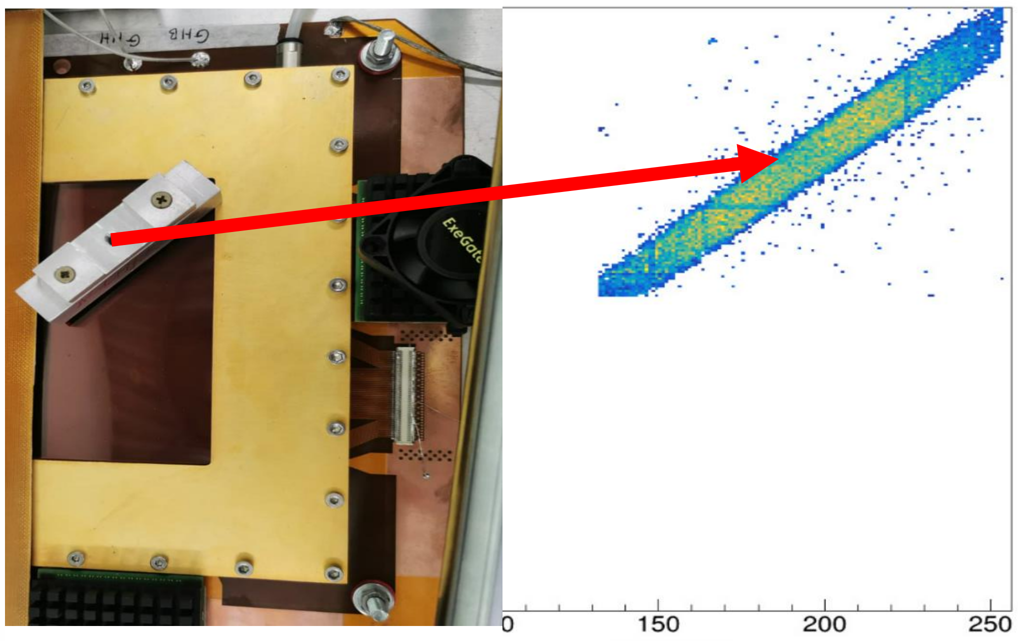


Testing basic configuration (standard tripleGEM+VMM3a hybrid+SRS) with 55Fe

Amplitude spectrum of 5.9 keV ^{55}Fe

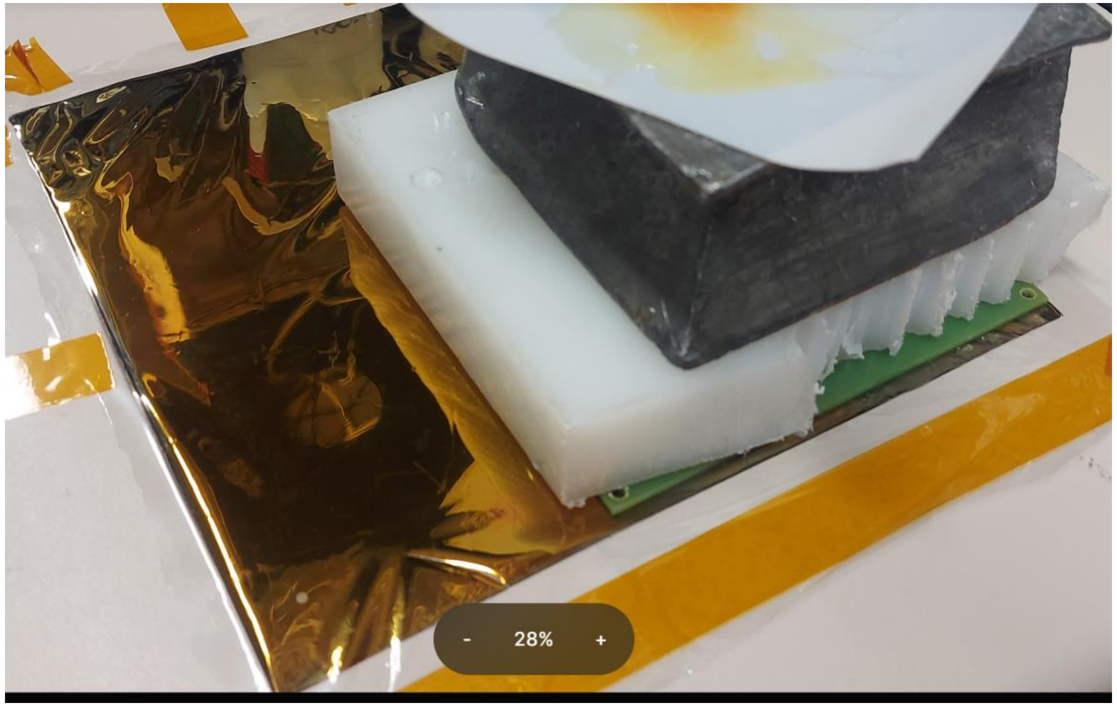


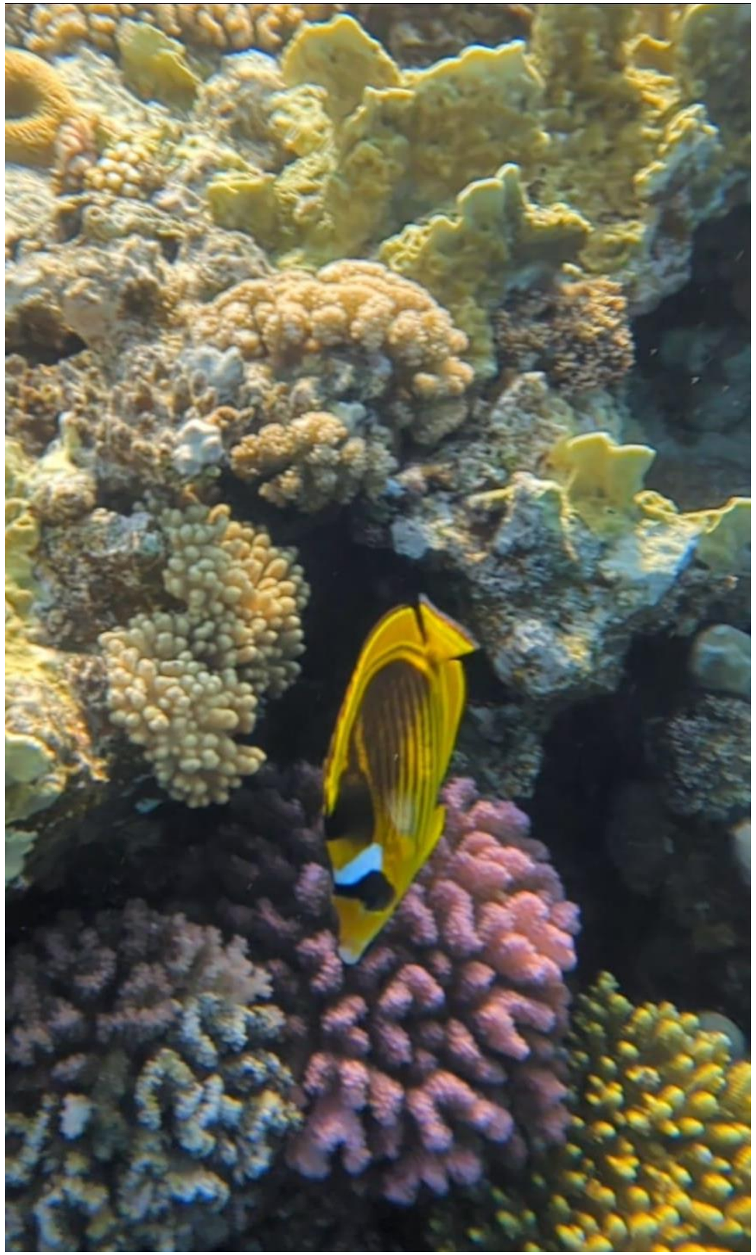
Coordinate distribution of illumination through a slit aluminum collimator



Replacement of the detector entrance window with a film with a coating B4C at JINR

thickness of the coating is about 60 nm





Conclusion

- We proved that gaseous detectors with B_4C windows can be used as neutron detectors
- RD51 Collaboration (CERN) develops and provides standardized solutions for small-area gaseous detectors of ionizing radiation
- We propose use of B_4C windows for the standard RD51 detectors in order to provide efficient and widely available thermal neutron detectors