

Electronics and DAQ for the GEM Detector

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MAGIX Collaboration Meeting 2017



Hardware

Electronics Periphery



HV Power Supply

- Need 7 channels per module or voltage divider
- Up to 4 kV
- Trip control
- Current monitoring $\sim 50\text{pA}$

Gas-Flow and -Quality Control

- Flowmeter
- Moisture and oxygen sensors

Current Control

- Measure leakage current with a pico amperemeter

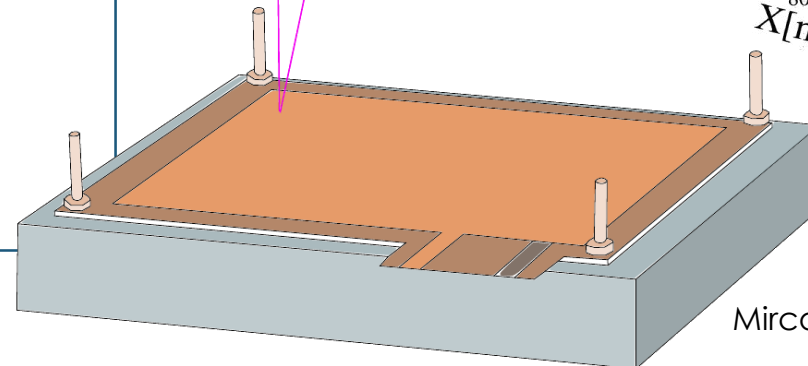
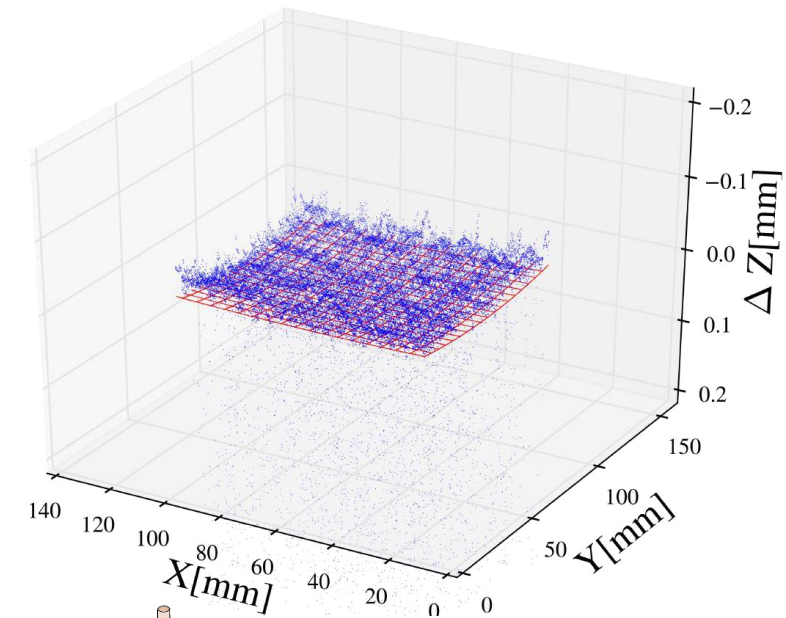
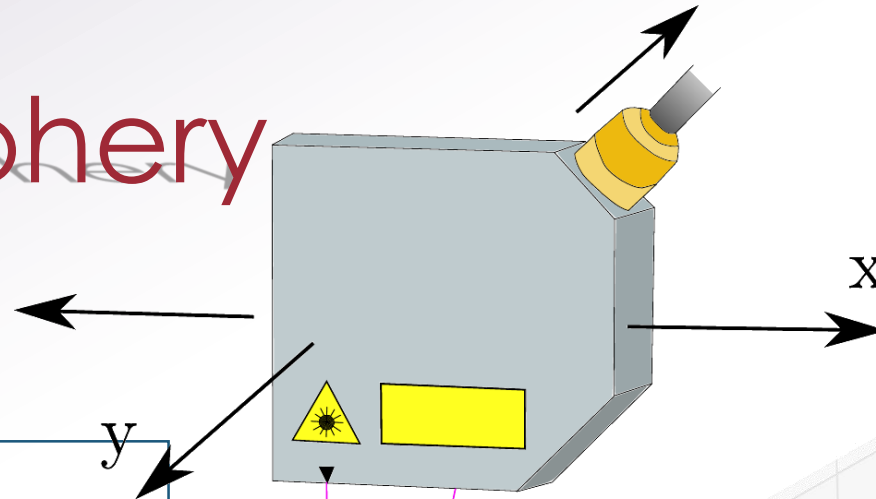


Mirco Christmann *Diploma Thesis* 2016

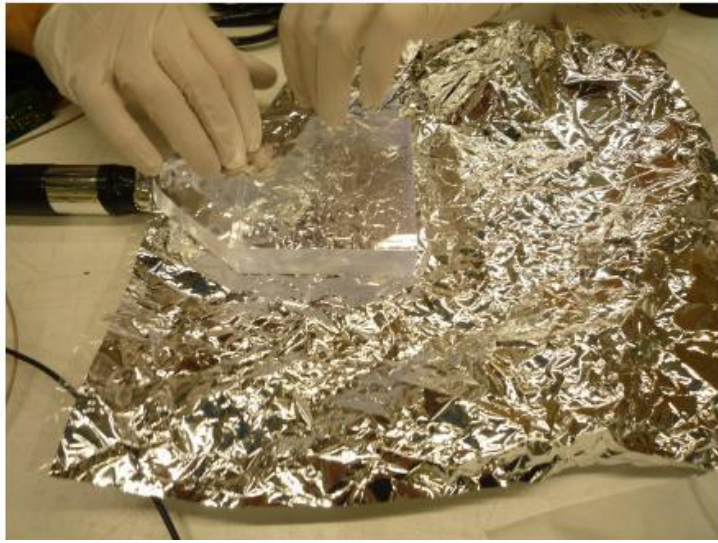
Electronics Periphery

Profile Laser

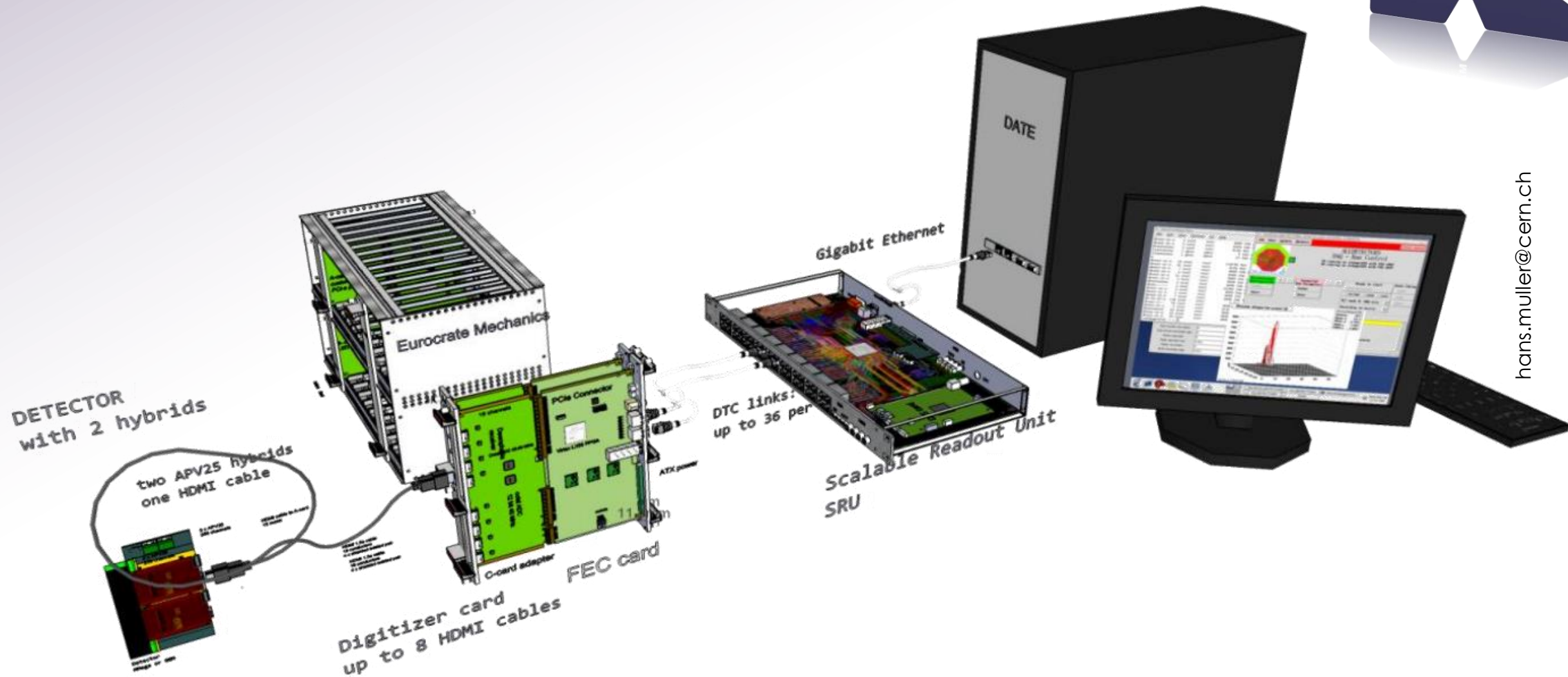
- Accurate distance measurement
- $\sim 1.8 \times 0.8 \text{ m}^2$
- Quality control of stretching



Trigger

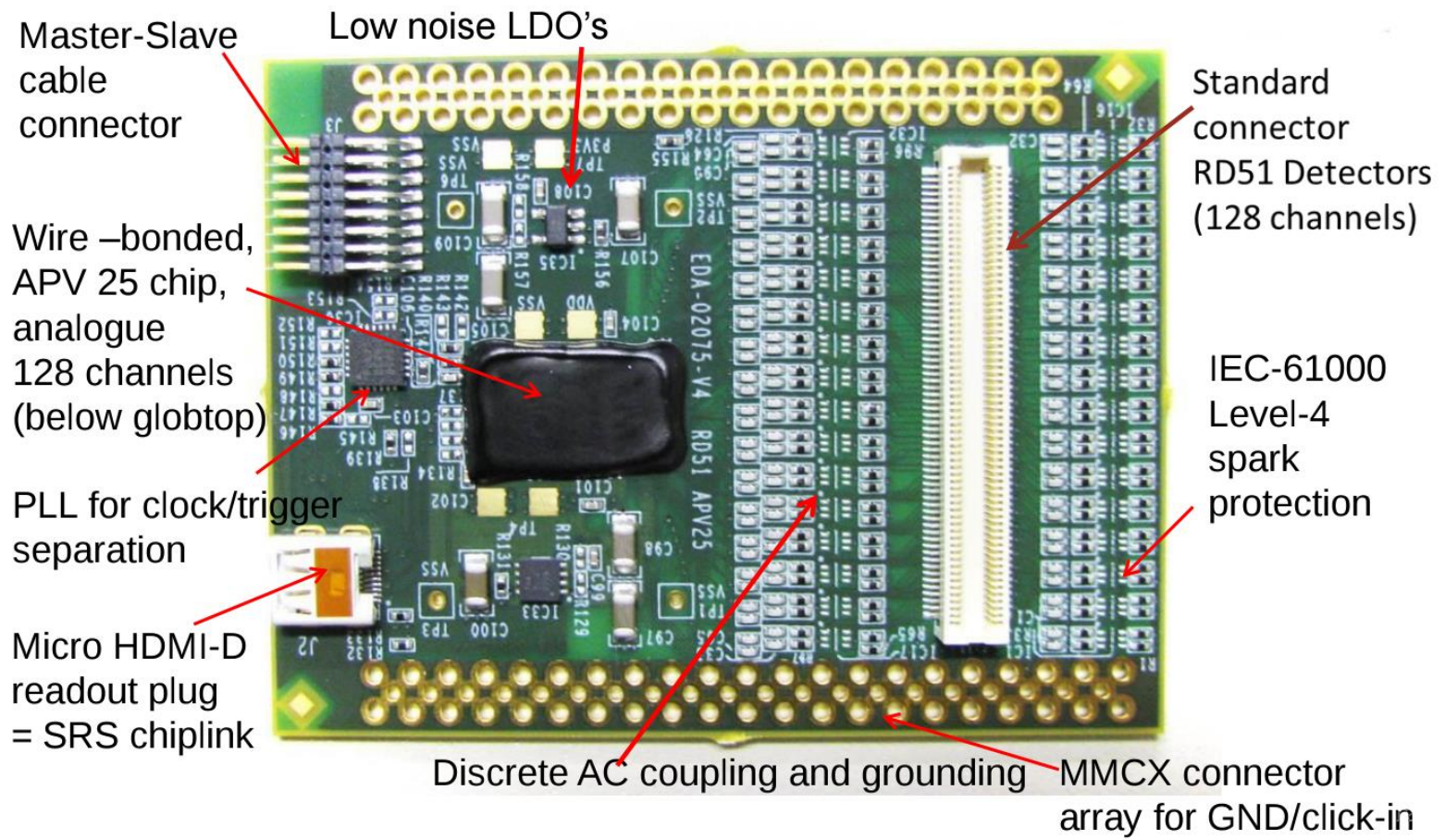
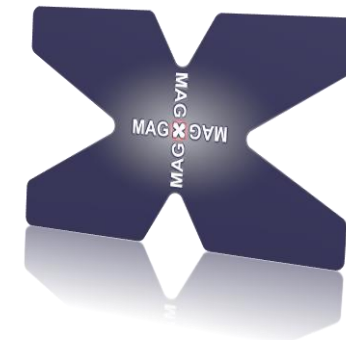


SRS – Scalable Readout System



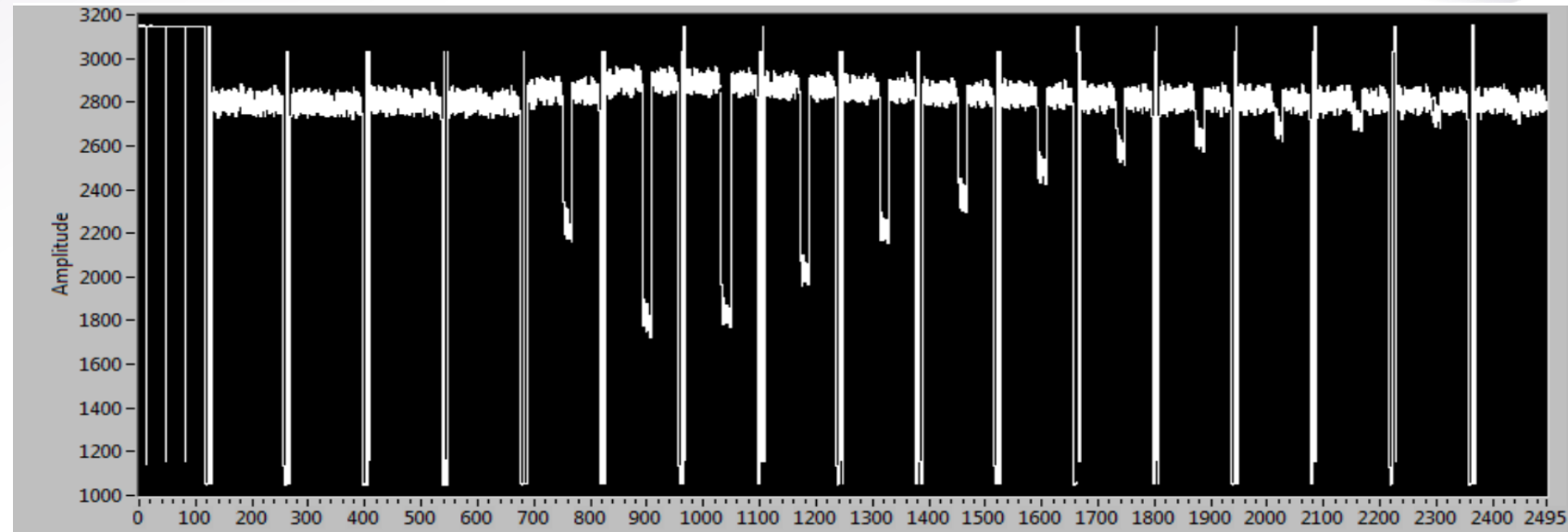
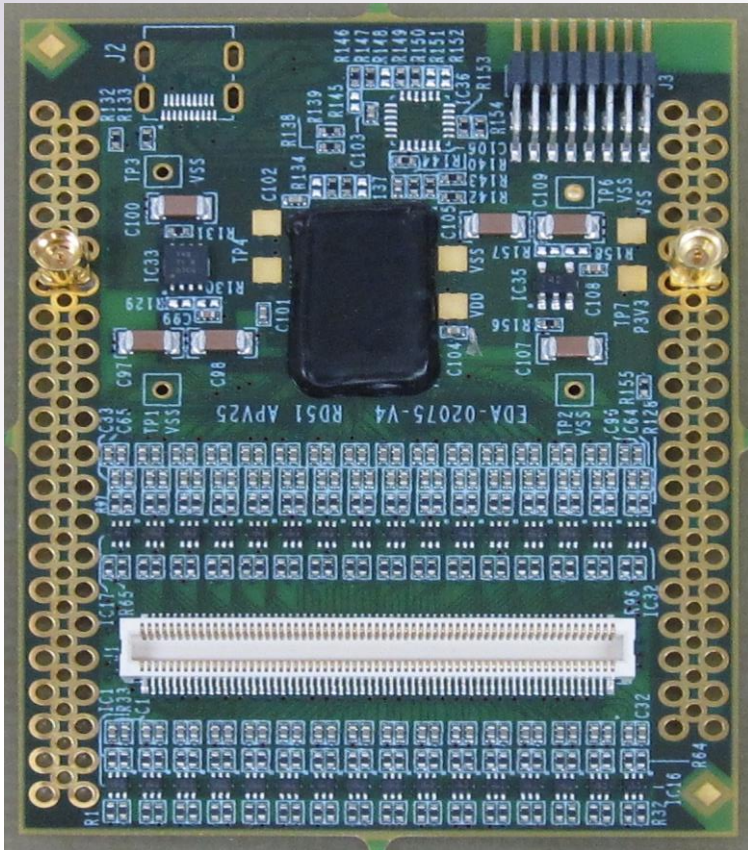
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APV25 – Frontend Card



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APV25 – Frontend Chip



128
Channels

40 MHz

192 steps
data matrix

No trigger

APV25 – Problems

- Waveforms -> Nice for R&D
- Not capable of required rates
- Highest rate achieved ~7 kHz
- We need $O(\text{MHz})$
-> **new frontend chip VMM**



VMM3

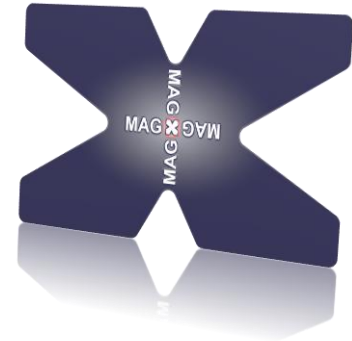
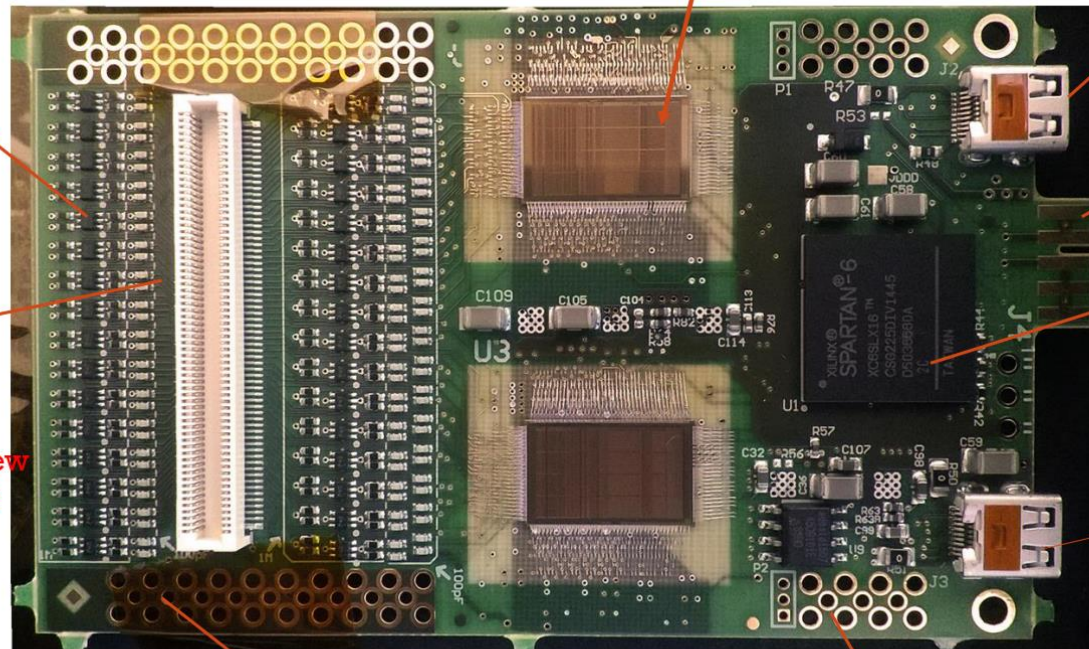


Photo: 2 x wire-bonded VMM2 chips -> new VMM3 board fully routed

AC coupling
&
spark protection

Panasonic 130 pin
connector for MPGDs
Will be replaced by new
140 pin HRS connector



HDMI link 1 DTCCP

JTAG

Companion FPGA

HDMI link 2 DTCCP

Detector GND MMCx

Neighbor-channel via MMCX

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Final Detector Requirements

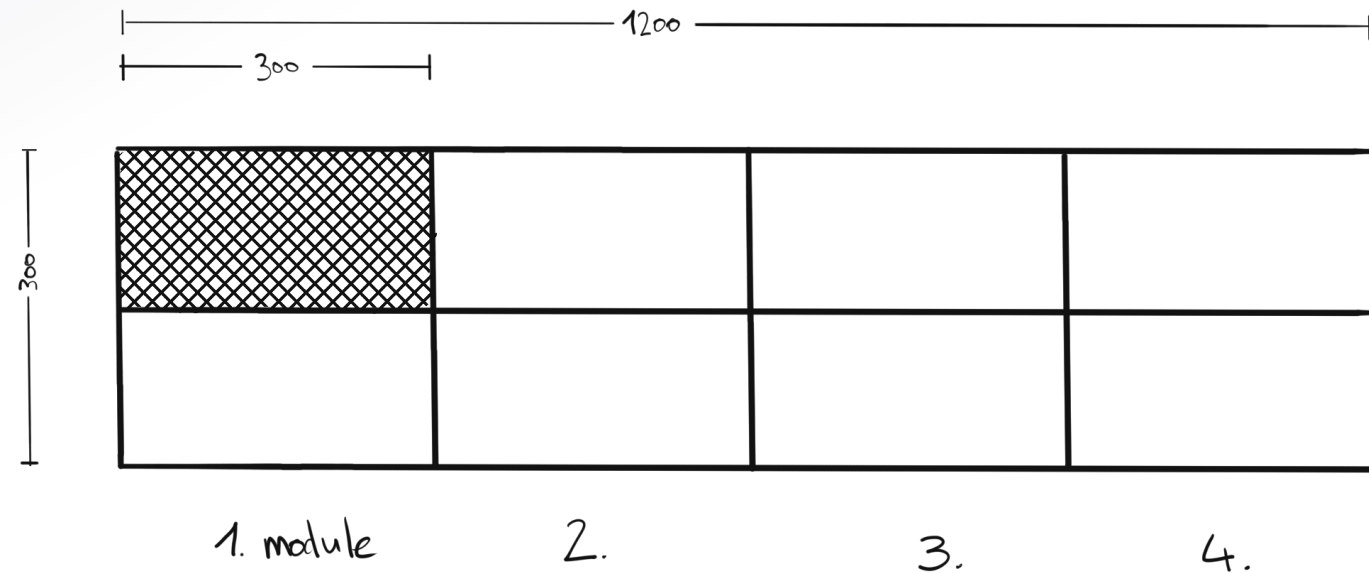


1 section

- 1500 channels
- 12 APVs/VMMs

1 module

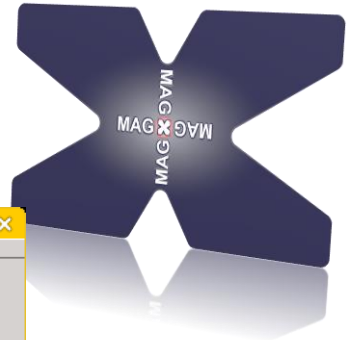
- 8 sections
- 10 k channels
- 96 APVs/VMMs





Software

SRS - Configuration



SRS SDC

- Scalable Detector Control
- Developed at NTUA

APV

- Set baseline
- Set gain
- Set latency

FEC

- Set active APVs
- Set trigger mode

TODO

- Include to our slow control
-> Stefan L.

The screenshot displays the SRS configuration software interface, consisting of a main window and a sub-window.

Main Window:

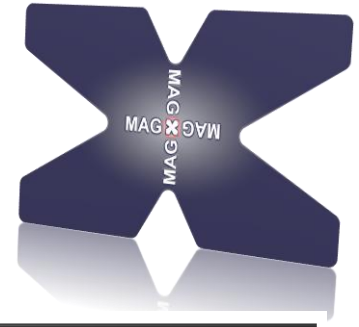
- FEC:** Address: 10.0.0.2, v1.5.4
- Configuration:**
 - Select Mode: PLL, Master APV, Slave APV, Both APVs
 - Select Channel(s): Channel 1, Channel 2, Channel 3, Channel 4, Channel 5, Channel 6, Channel 7, Channel 8, Select All
 - Select Command Type: Write Pairs, Write Burst, Read Pairs, Read Burst, Reset
- Select Peripheral:** APV Hybrid, APV Application, ADC Card, PLL
- Configuration Files:** Load, Download To H/W
- Acquisition:** On, Off
- Trigger:** Internal, External
- Zero Suppression:** Threshold: 0, Force Pedestal to Zero, Force Signal Detect
- Control APV Processor:** Bypass on, Bypass off, Reset APV, Select APV, Start Pedestal
- Resets:** Warm Init, Force Reboot, Enable Expert Mode

SRSDCS Sub-window:

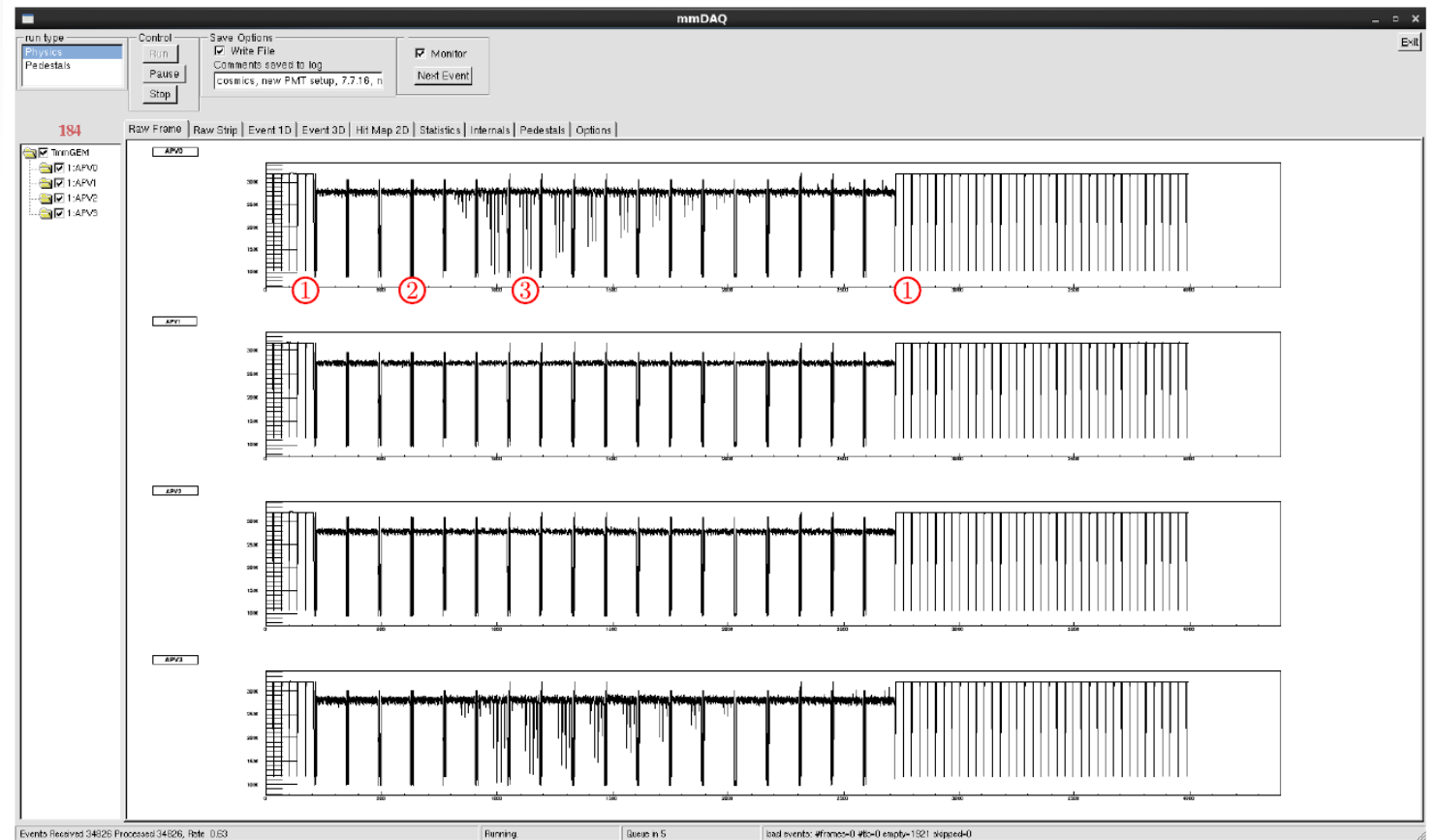
- APV Port: 6263
- That's the Default Settings
- APV Registers:

Register	Value 1	Value 2	Check
<input type="checkbox"/> MODE	0000001	11001	<input checked="" type="checkbox"/>
<input type="checkbox"/> LATENCY	0000010	105	<input checked="" type="checkbox"/>
<input type="checkbox"/> MUXGAIN	0000011	100	<input checked="" type="checkbox"/>
<input type="checkbox"/> IPRE	0010000	98	<input checked="" type="checkbox"/>
<input type="checkbox"/> IPCARC	0010001	52	<input checked="" type="checkbox"/>
<input type="checkbox"/> IPSF	0010010	34	<input checked="" type="checkbox"/>
<input type="checkbox"/> ISHA	0010011	34	<input checked="" type="checkbox"/>
<input type="checkbox"/> ISSF	0010100	34	<input checked="" type="checkbox"/>
<input type="checkbox"/> IPSP	0010101	55	<input checked="" type="checkbox"/>
<input type="checkbox"/> IMUXIN	0010110	16	<input checked="" type="checkbox"/>
<input type="checkbox"/> ICAL	0011000	100	<input checked="" type="checkbox"/>
<input type="checkbox"/> VPSP	0011011	40	<input checked="" type="checkbox"/>
<input type="checkbox"/> VFS	0011010	60	<input checked="" type="checkbox"/>
<input type="checkbox"/> VFP	0011001	30	<input checked="" type="checkbox"/>
<input type="checkbox"/> CDRV	0011100	11101111	<input checked="" type="checkbox"/>
<input type="checkbox"/> CSEL	0011101	11110111	<input checked="" type="checkbox"/>

DAQ – mmdaq2



- Developed for Micromegas
- Based on root
- Load pedestals for APVs
- Monitor analog input
- Nice online statistics



Working Setup

- We have a fully working DAQ
- Now:
 - Write own slow control
 - Set up own DAQ
 - Get hands on VMMs





THANK YOU FOR YOUR ATTENTION!

<http://magix.kph.uni-mainz.de>



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University of Ljubljana



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Backup



APV - VMM

APV (ANALOGUE)

APV (250 nm CMOS)

- Pipeline depth: max. 192 clocks
- Trigger latency: max. 3 us
- Noise: < 500 e- intrinsic >750..1400 e- on detector
- dynamic range: 25 fC
- Detector capacity: 18... < 60pf
- ADC ext. 4096/1000 [counts/baseline]
- Gain: fixed CSA gain 100uA/mip, 5 output signal gains (in step of 20%)
- Timing jitter : $\frac{1}{2} (1/fc)$ [+ - 12ns]
- Shaping times: 50 ns adjustable to 80 ns
- max readout rate: 7 kHz

VMM (DIGITAL)

VMM (130nm CMOS)

- Pipeline depth: 64 digital frames (peak)
- Trigger latency: (self triggered) or L0 (12.8us)
- noise : < 400 e- on 10x10 detector reported
- dynamic range: expect >> 25 fC
- Detector capacity: 30pF ... < 1nF
- ADC: embedded, 10 bit
- Gains: 8 CSA gains [0.5..16mV/fC]
- Timing jitter: 20 bit t-stamp, 1ns resolution
- Shaping times: 4 [25... 200ns]
- max readout rates: estimated 4 MHz/ch

SRS
Scalable Readout System

