SRS : doing more with less

RD51 Miniweek, WG5 meeting Tue 23 April 2013

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SRS main activities

Selected topics for this talk

- SRS production /sales via CERN store: ➔ ongoing, new productions, new devices
- Timepix SRS ➔ ongoing at by Bonn Univ. 8 timepix array readout ➔ Talk by Michael
- New FEC V6 card design & proto production ➔ ongoing with Bari and Valencia ➔ talk by Curro
- New Digital SRS card (VFAT –like chips) ➔ ongoing PCB mounting and tests ➔ talk by Mihai
- VMMx longterm successor of APV hybrid ➔ started BNL and IFIN-HH ➔ talk by Sorin
- SRS integration into ATLAS ➔ continuing ➔ talk by Andre
- DTCC links 4 wire and 2 wire / fiber versions, ➔ being finalized
- 10Gbit readout architectures ➔ ongoing with ALICE, LMU, BARI, LUND, ATLAS, CERN
- ADV active HV divider for GEMs ➔ prototype test ongoing
- Trigger pickup box for Mesh self-trigger and gain measurement ➔ prototypes in use, PCB revision needed
- Quad Preamplifier for MPGD signal monitoring ➔ started 1st board tested , revision required
- SRS-ATCA pilot systems ➔ ongoing, 3 systems to be delivered in Mai (ATLAS, ALICE, NEXT) ➔ talk y EicSys

Planned

let's talk about these in the next WG5 meeting

- GEMROC chip adapter ➔ under discussion, potentially no export problem
- SRS shaper-Discriminator card ➔ planned
- HV generator card for MicroMegas with HV control via SRS and pA readout ➔ schematics started

SRS user status 2013

1. ALICE EMCal Calorimeter upgrade, ORNL, SRS readout backend via DTCC links and 24 SRU's , DATE Online system, being installed
2. ATLAS upgrade CERN, MAMMA project NSW , µMEGAS , APV frontend SRS Eurocrates-SRU, MMDAQ Online, installed
3. ATLAS upgrade Mainz, µMEGAS for MBTS, APV frontend- SRS Eurocrate, MMDAQ Online, waiting delivery
4. ATLAS Muon upgrade R&D, INFN Rome, APV frontend SRS Eurocrate, MMDAQ Online, delivered
5. ATLAS Saclay, µMEGAS R&D, APV frontend SRS Minicrate, MMDAQ Online, delivered
6. NA62 CERN straw tracker upgrade with µMEGAS, APV frontend with SRS Minicrate, MMDAQ Online, delivered
7. CMS upgrade CMS GEM collaboration CERN, Muon Endcaps, design of VFAT frontend digital readout SRS, ongoing with IFIN-HH
8. TOTEM upgrade GEMs Baris testlab, OPTO-Rx card design, Minicrate,Eurocrate, SRU, DATE Online, delivered
9. BNL GEM detectors, APV frontend-SRS Minicrate, RCDAQ Online, delivered
10. Stony Brook GEM detector R&D, APV frontend SRS Minicrate, RCDAQ Online, delivered
11. Bonn Phys. Inst. R&D for ILC, T24 DESY testbeam, Timepix Array Ingrid Module adapter for SRS , Eurocrate, Online unknown, ongoing
12. Florida Inst Tech GEMs, Muon Tomografy for Homeland security, 15k channel SRS prototype Eurocrate, DATE Online, delivered
13. Géosciences Azur-CNRS-UNSA, Muon Tomography w.µMEGAS for geology, APV frontend SRS Eurocrate, Date Online, delivered
14. GDD lab RD51, CERN, R&D for GEM and µMEGAS, APV frontend SRS Euro and Minicrates, DATE, Labview MMDAQ, delivered
15. HIP, HELSINKI, characterization MPGAD detactors, APV frontend SRS Eurocrate, DATE and Labview, delivered
16. INFN Napoli, ATLAS. Development of SRS Hardware and Firmware, Labview, delivered
17. Jefferson Lab, Virginia UVa upgrade GEM readout system, APV frontend SRS Eurocrate, DATE online, partially delivered
18. Yale University , GEM development ALICE, APV frontend SRS Eurocrate, DATE Online, delivered
19. NEXT Coll. small Xenon TPC with PM and Si PMs, SRS readout electronics co-development, SRS Eurocrate and SRU, DATE, delivered
20. UNAM, MEXICO, MX , R&D on THGEM, APV frontend SRS Minicrate, DATE Online, delivered
21. Radiation Laboratory, Nishina Center, RIKEN , APV frontend SRS Eurocrate, Online unknown, delivered
22. J-PARC /E16 experiment, GEM based tracking, APV frontend SRS Minicrate, Online Unknown, partially delivered
23. Jefferson Lab SHM spectrometer triple GEM, APV frontend SRS Eurocrate, DATE Online, waiting
24. Harward Univ. Physics, APV frontend SRS Minicrate, Online unknown, waiting
25. Tokyo Univ. ATLAS, APV frontend SRS Eurocrate, Online unknown, waiting
26. WIS and Aveiro Univ. GEM validation, APV Frontend SRS Eurocrate, MMDAQ and Labview, being delivered
27. East Carolina University, Health Physics, APV frontend, SRS Eurocrate, Labview, waiting
28. Munich LMU / ATLAS µMEGAS, APV frontend SRS Eurocrate –SRU, MMDAQ Online, partially delivered
29. NCSR Democritos ATHENS, APV frontend SRS Minicrate, Online unknown, waiting
30. IFIN-HH-Bucharest new Detector lab, APV and VFAT frontend, SRS Eurocrate and SRU, Labview, delivered
31. ATLAS NSW CERN, SRS-ATCA pilot system, MMDAQ Online, waiting
32. ALICE FOCAL ORNL, SRS-ATCA pilot system, DATE Online, waiting
33. NEXT Collaboration, SRS-ATCA pilot system, DATE Online, waiting
34. Lunds Univ, ILC TPC, SRU for 24 channel DTCC link readout, Online unknown, delivered

SRS @ CERN store

Group: 07.89

07.89.00 - RD51 SRS PROJECT

For any further technical information additionnal - click here

General description

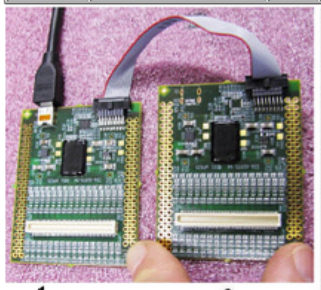
LOW CAP DIODE NUP4114UPXV6T1G : 08.51.49.960.0

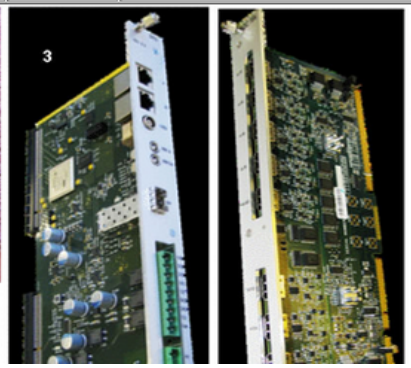
FEMALE CONNECTOR 130 CONTACTS : 09.55.42.400.3

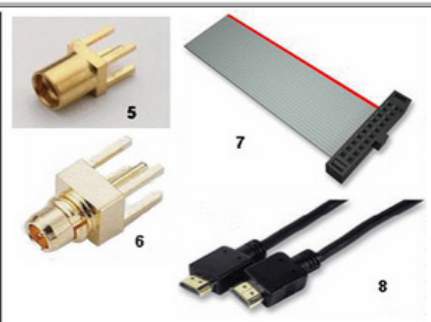
MALE CONNECTOR 130 CONTACTS : 09.55.42.410.6

You need a CERN team account and access to edh.cern.ch
Goods will only be delivered to CERN addresses

Buy	SCEM Code	Unit	Unit Price	DESIGNATION	TYPE / REF	FIG.
	07.89.00.005.9	PC	144.0	RD51 APV25 HYBRID MASTER	EDA-02075-V4-0	1
	07.89.00.010.2	PC	128.0	RD51 APV25 HYBRID SLAVE	EDA-02075-V4-0	2
	07.89.00.020.0	PC	722.0	MINICRATE CHASSIS	-	-
	07.89.00.030.8	PC	736.0	EUROCRATE CHASSIS	-	-
	07.89.00.100.1	PC	1450.0	RD51 SRS FEC CARD	-	3
	07.89.00.105.6	PC	1123.54	RD51 SRS ADC CARD	-	4
	07.89.00.115.4	PC	109.0	TRANSCEIVER 1.25 GBD SFP 3.3V	AVAGO ABCU-5710RZ	-
	07.89.00.125.2	PC	282.0	PLATFORM CABLE IIG	XILINX HW-USB-IIG	-
	07.89.00.200.8	PC	4.8	MMCX 50 OHM MICRO MINI CONNECTOR VERTICAL THROUG-HOLE FEMALE	SAMTEC MMCX J P H ST TH1	5
	07.89.00.205.3	PC	4.8	MMCX 50 OHM MICRO MINI CONNECTOR VERTICAL THROUG-HOLE MALE	SAMTEC MMCX P P H ST TH1	6
	07.89.00.210.6	PC	28.5	FLAT CABLE MASTER-SLAVE CONNECTION 100 mm	SAMTEC FFSD-08-D-04.00-01-N	7
	07.89.00.211.5	PC	21.6	FLAT CABLE MASTER-SLAVE CONNECTION 200mm	SAMTEC FFSD-08-D.00-01-N	7
	07.89.00.215.1	PC	26.9	HDMI CABLE D-A 2m STANDARD CABLE	MOLEX 68786-0003	8
	07.89.00.216.0	PC	51.45	HDMI CABLE A-A 5m STANDARD CABLE	PRO SIGNAL 127810	8
	07.89.00.217.9	PC	18.81	ADAPTOR HDMI FEMALE-HDMI FEMALE	MULTICOMP 1901119	-





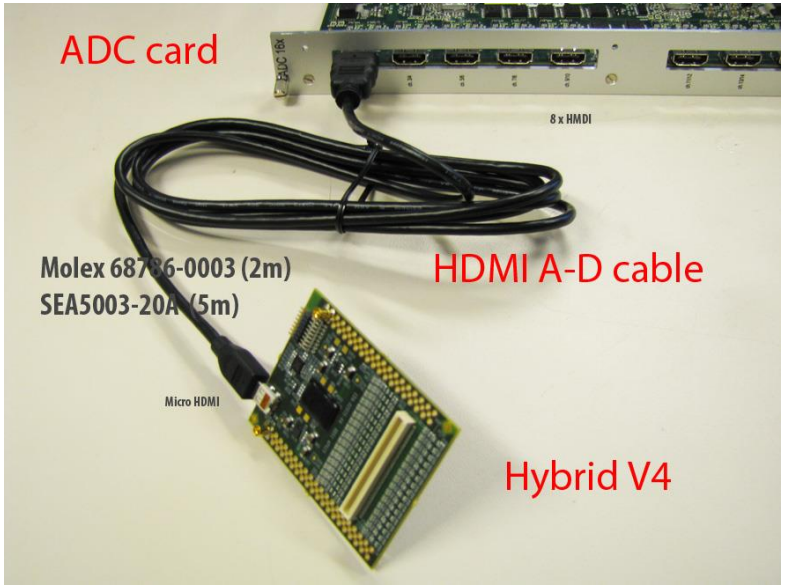


In order to pick up APV hybrids you need to bring a signed "**letter of compliance**" and comply to the US export country list

SRS frontend readout via HDMI

APV hybrids get powered via HDMI

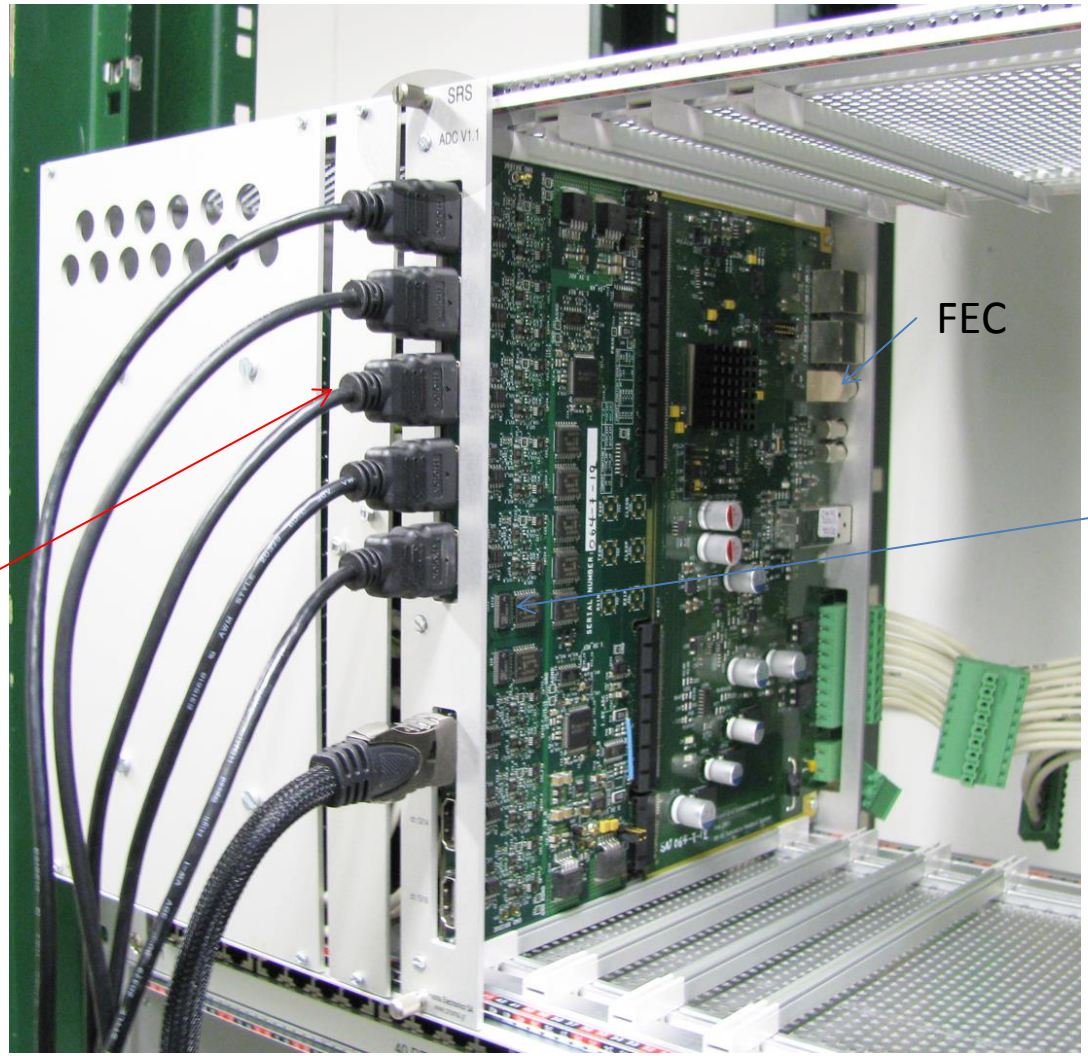
HDMI-MICRO D	HDMI -MINI C	HDMI-standard A	SRS	SRS	SRS	HDMI 1.4	Color	Color	Color
SRS APV Hybrid V4		SRS ADC, Digital card	APV	VFAT	Beetle	HDMI signal Assignment	32 AWG	34 AWG	36 AWG
BEETLE V1, VFAT V1	Hybrid V2.3 via A-C adapter	(SRS Hybrid V2,V3)	chiplink	chiplink	chiplink				
1	19	19	SCL_B	DACO_V	TGOUT	hot plug detect	black	orange	red
2	17	14	SDA_B	DACO_I	TGOUT*	Utility	brown	brown	blue
3	2	1	AOUT0	DATAOUT	AOUTA	TDMS DATA2+	white	white	white
4	1	2	VSS/G	VSS/G	VSS/G	TDMS Data 2 Shield	drain wire	drain wire	drain wire
5	3	3	AOUT0*	DATAOUTB	AOUTA*	TDMS Data2-	red	red	red
6	5	4	AOUT1	S<1>	AOUTB	TDMS Data1+	white	white	white
7	4	5	VSS/G	VSS/G	VSS/G	TDMS Data 1 Shield	drain wire	drain wire	drain wire
8	6	6	AOUT1*	SB<1>	AOUTB*	TDMS Data1-	green	green	green
9	8	7	TRGIN	T1	TRGIN	TDMS Data0+	white	white	white
10	7	8	VSS/G	VSS/G	VSS/G	TDMS Data 0 Shield	drain wire	drain wire	drain wire
11	9	9	TRGIN*	T1B	TRGIN*	TDMS Data0-	blue	brown	blue
12	11	10	BCLK	MCLK	BCLK	TDMS CLK+	white	white	white
13	10	11	VSS/G	VSS/G	VSS/G	TDMS CLK Shield	drain wire	drain wire	drain wire
14	12	12	BCLK*	MCLKB	BCLK*	TDMS CLK-	yellow	blue	brown
15	14	13	RST*	RST*	RST*	CEC	red	red	white
16	13	17	VSS/G	VSS/G	VSS/G	CEC/CEC (I2C) GROUND	yellow	yellow	green
17	15	15	SCL_C	SCL	SCL_C	SCL (I2C clock)	green	green	brown
18	16	16	SDA_C	SDA	SDA_C	SDA (I2C data)	blue	blue	yellow
19	18	18	P3V3/G	Power	5V	5V Power	white	white	orange
SHELL	SHELL	Shell	VSS/Ground		VSS/Ground	cable shell	braid	braid	braid



More distance than 5 me needed ?

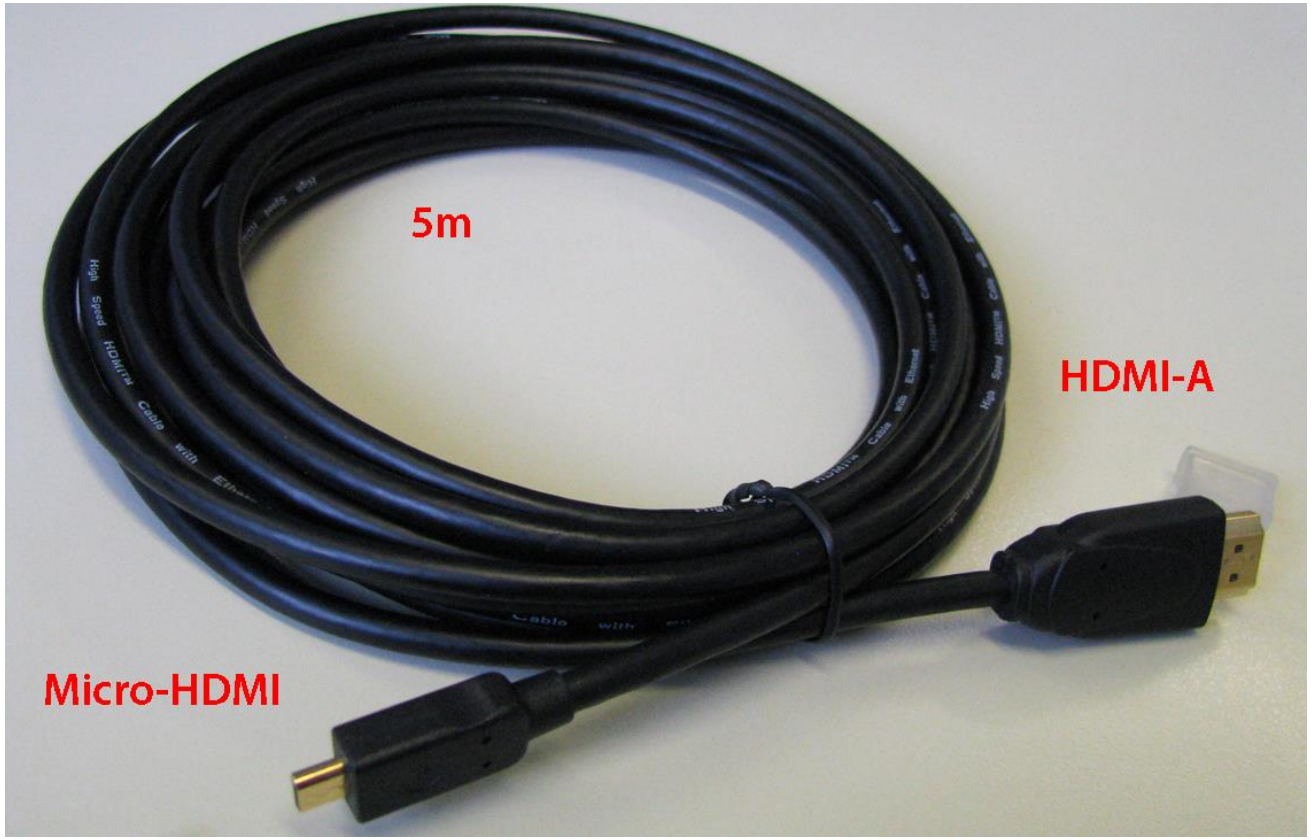
Prolongator plugs
For extension with standard HDMI A-A cables

Backside of SRS Eurocrate adapter cards and chiplinks



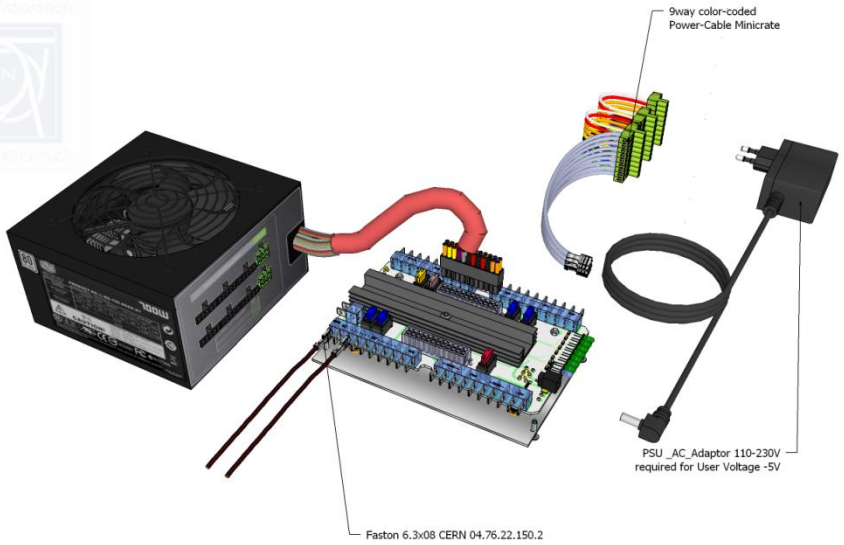
Up to 8 HDMI chiplinks per Adapter card

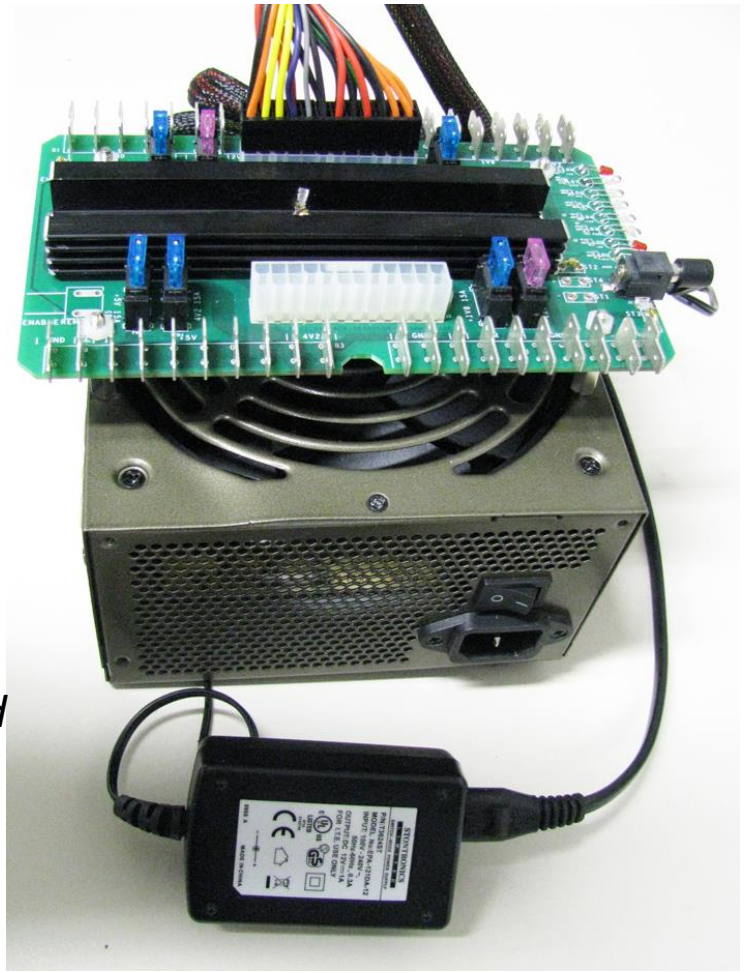
New 5m HDMI cables (SEA 5003-20A)



Should become a CERN store SRS item soon

Desktop ATX power for SRS





SRS ATX adapter/filter board
fused , Faston connectors 6.3 x0.8

ATX Power Supply Thermaltake TR2
450 Watt, 24 pin power connector
115-230VAC

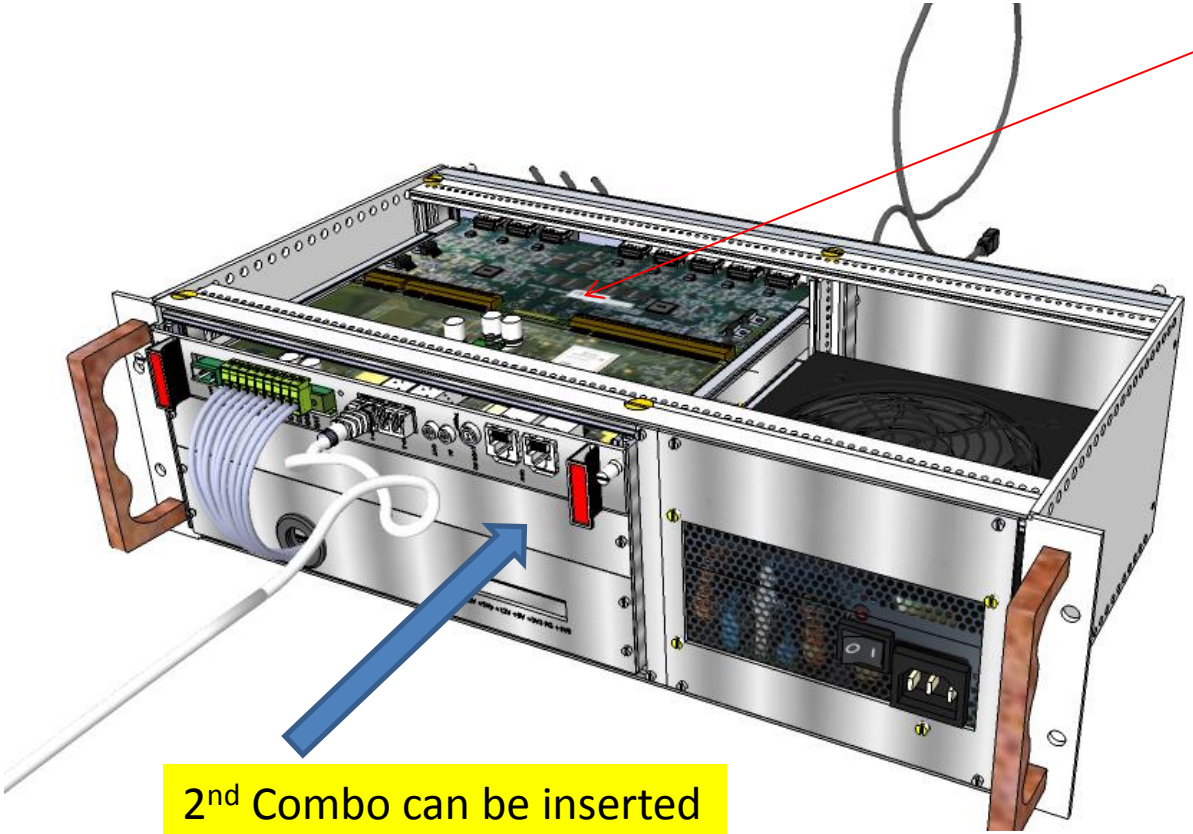
PSU 5V, 2.6 A (-5V for ADC card)
110-240VAC Stontronics T3586ST 0

9pin power connector for FEC
PHOENIX MSTB 2,5 HC/9-ST-5,08

We have asked the CERN store to add these parts

SRS Minicrate AB

a portable solution for up to 4k gas channels



2nd Combo can be inserted in new Minicrate AB

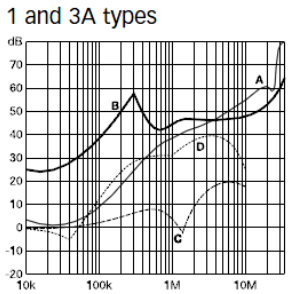
1 x FEC -ADC card Combo

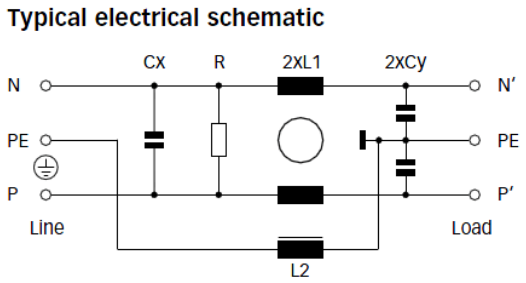
CERN store items
SCEM 07.89.00.100.1 (FEC)
SCEM 07.89.00.105.6 (ADC)

Minicrate
CERN store SCEM 07.89.00.020.0
15 new ones to be produced

Noise/Ground loop filter

All new SRS crates are grounded via the earth pin of the AC mains plug
We recommend to insert AC + Earth filters (as shown) into the power cable



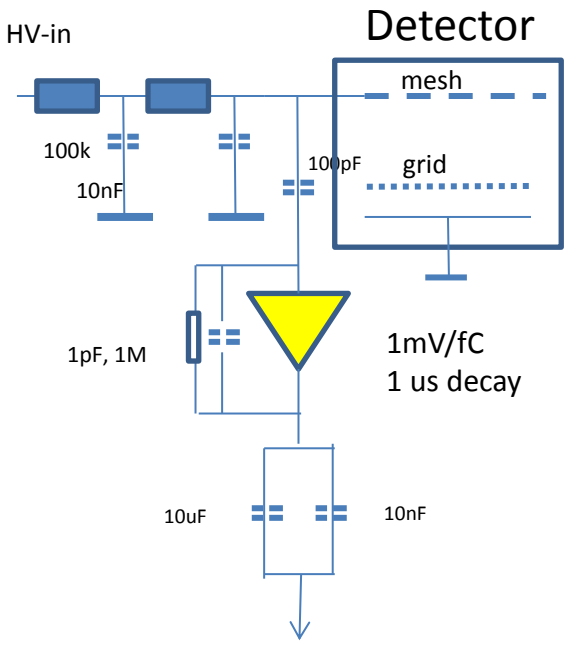


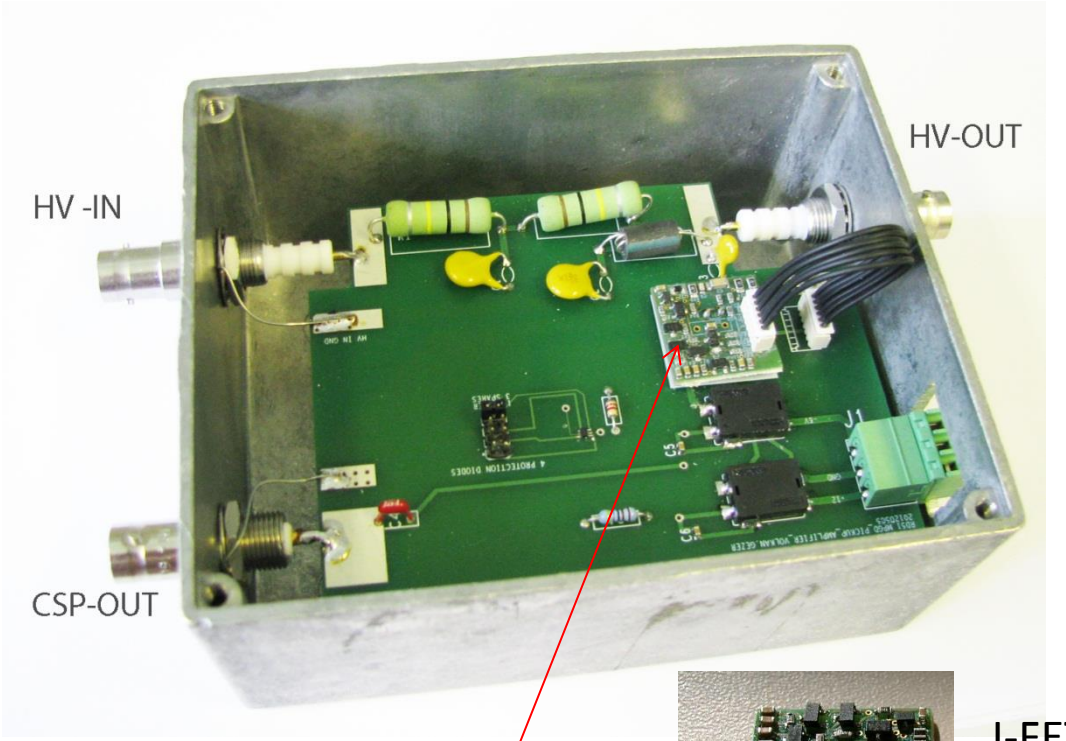
Schaffner FN9222E inlet filters

SRS users: if you want one for test, contact us

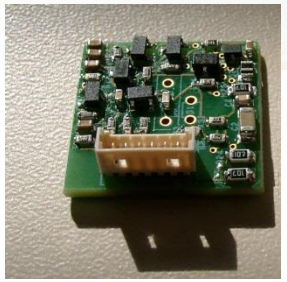
Trigger pickup box

Designed to pick up induced charge on grid or mesh
Converts charge to voltage via our proprietary CSP amplifier
50 OHM fast signal for external shaper /discriminator





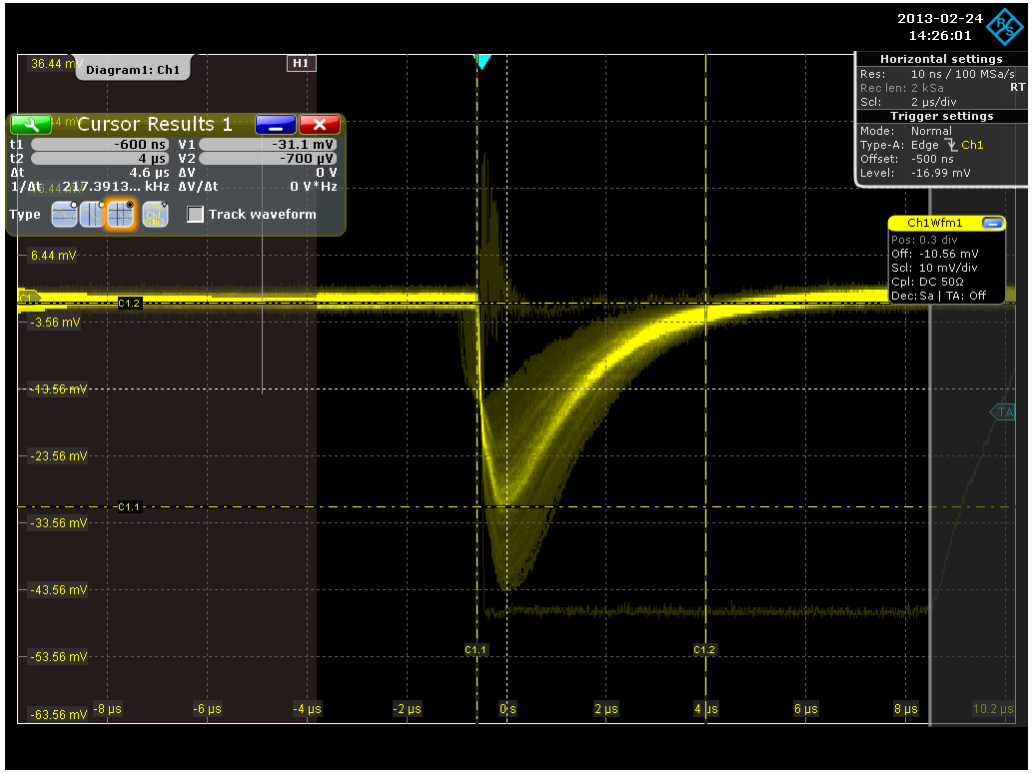
CSP
1mV/fC
1 us discharge



J-FET
based CSP

10x10 chamber grid trigger (400V)

a.) rate corresponds to the expected cosmic rate
b.) much larger discharge rate starts above working voltage

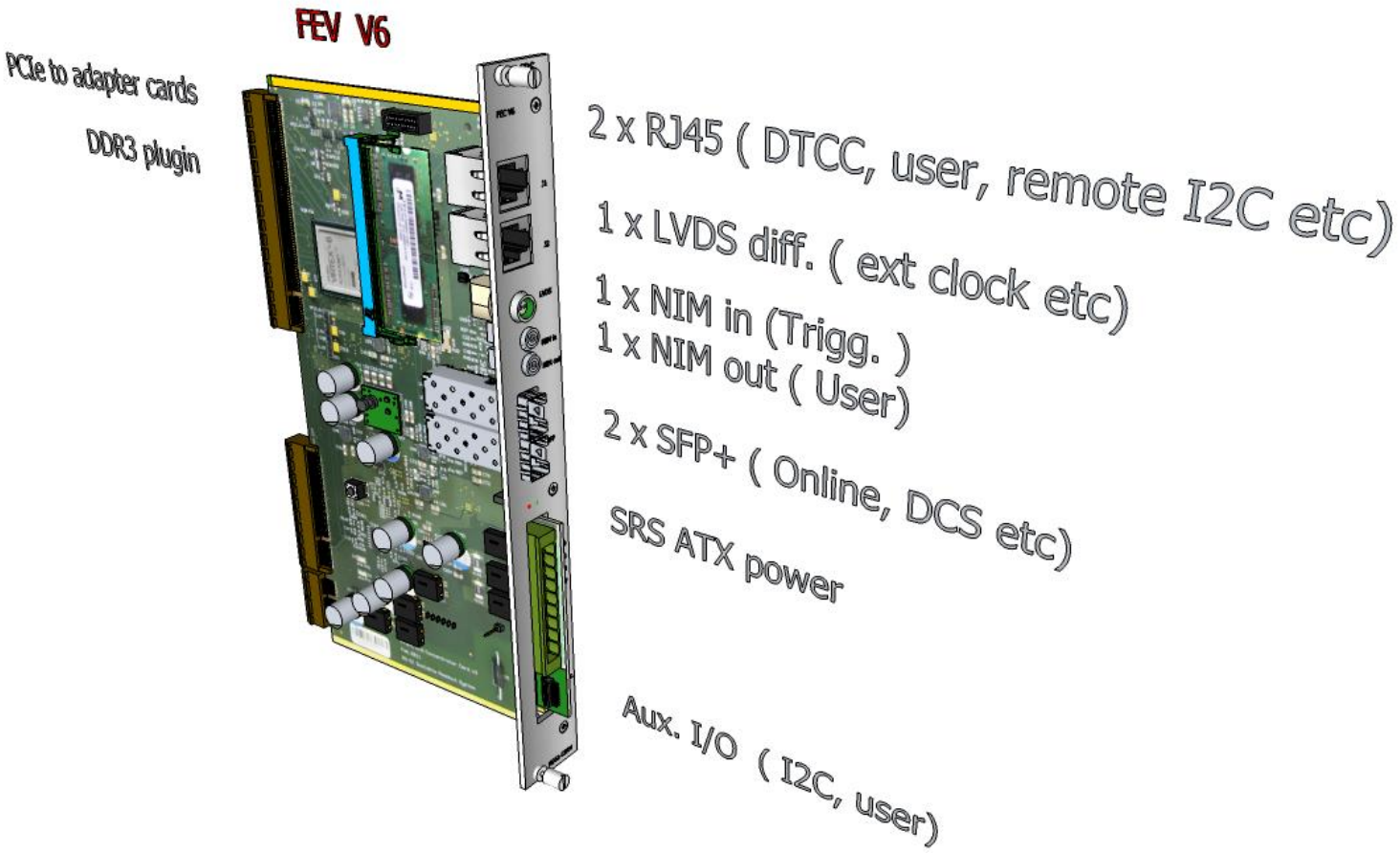


Total charge
31 mV over 1pF
⇒ 31 fC
⇒ 192.000 e-
⇒ 30 pairs average (Strontium Beta source)
⇒ single electron amplification 6400

New FEC card

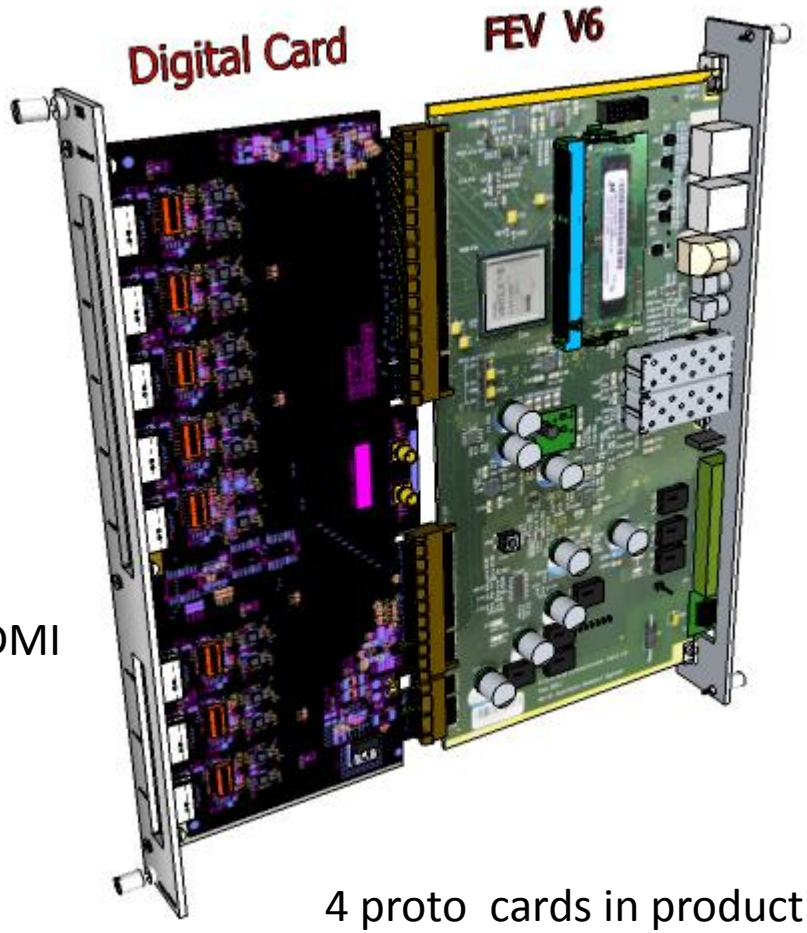
(Virtex 6 Lx130T)

See talk by Curro



New digital Combo

See talk by Mihai

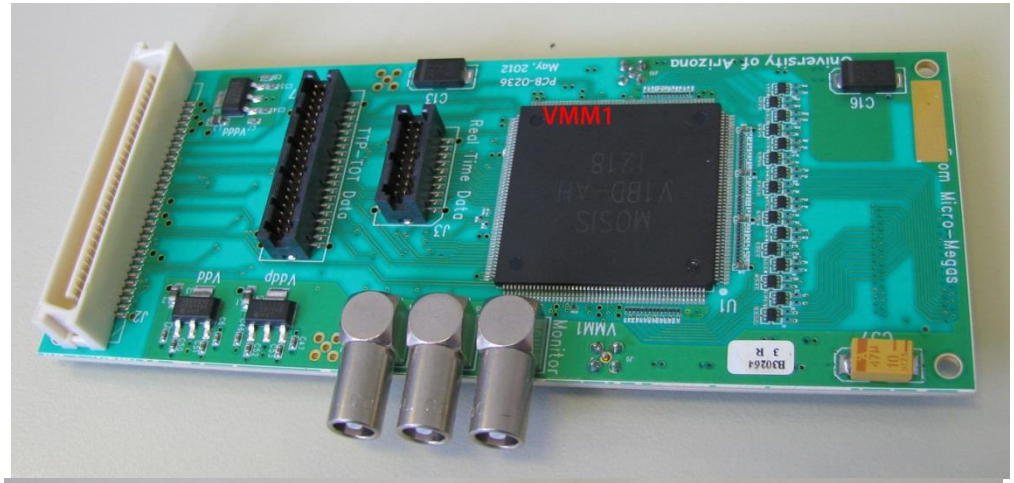


8 x HDMI

4 proto cards in production by Univ. Bonn

VMMx based frontend

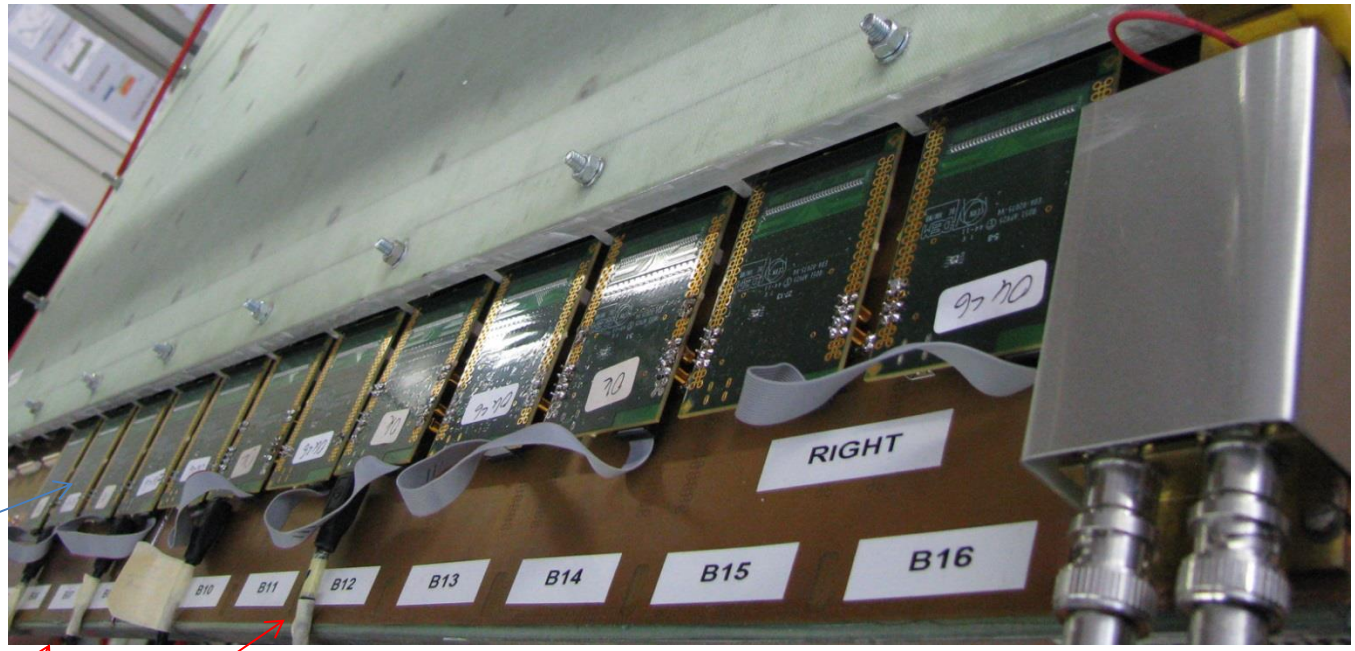
See talk by Sorin



SRS integration into ATLAS NSW

talk by Andre

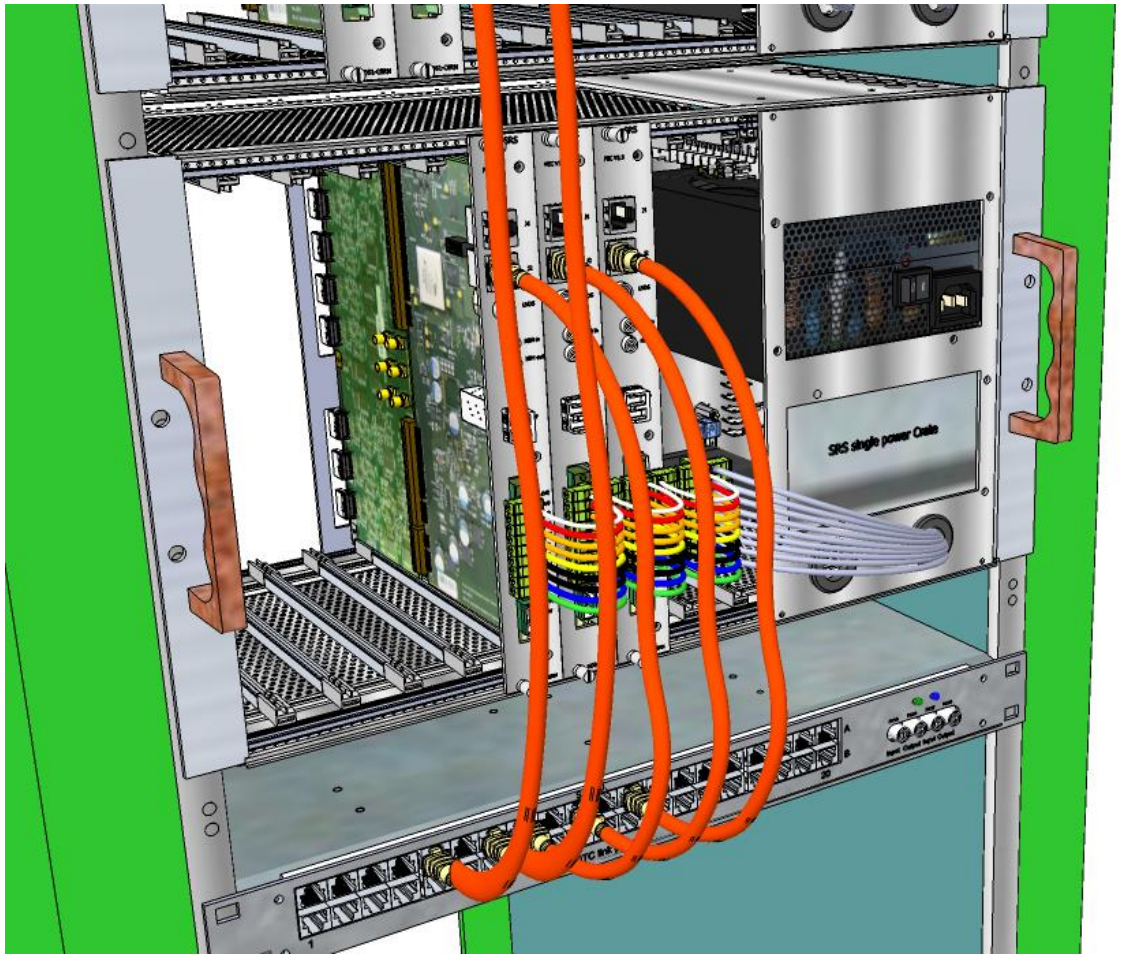
Large uMegas chambers for New Small Wheel

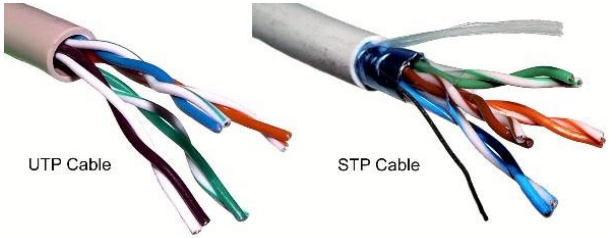


APV hybrids

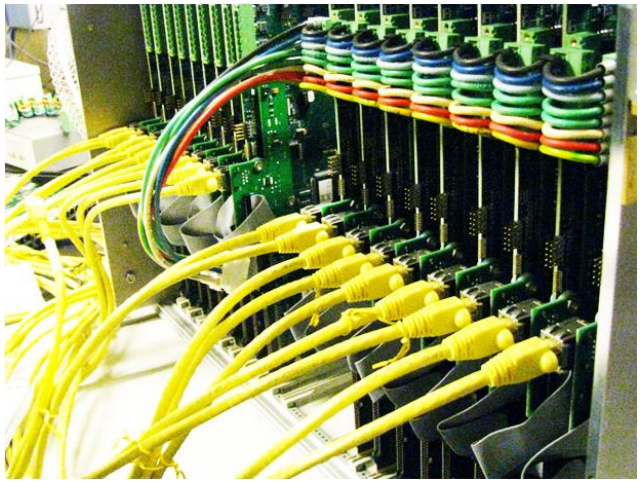
HDMI cables to SRS readout system

DTCC links





First version DTC already used by EMCal with SRU, photo

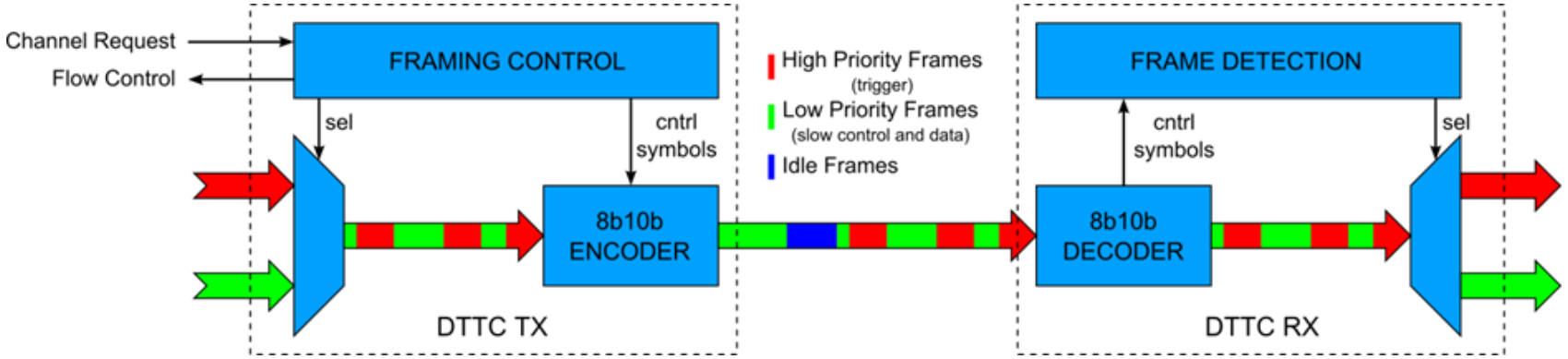


DTCC links *

Transmit **D**ata, **T**rigger, **C**ontrols and **C**lock via 2 or 4 wires/fibers

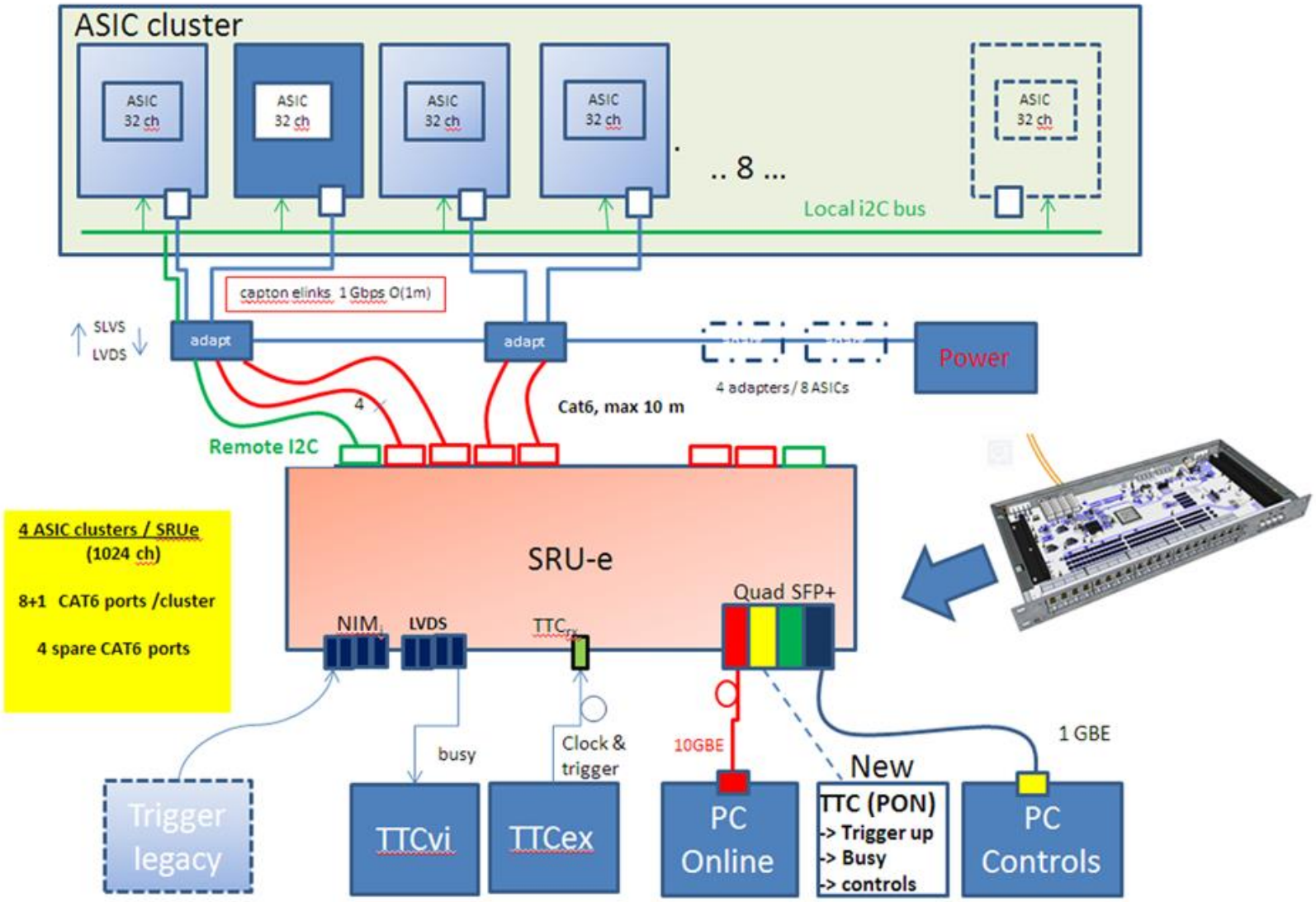
DTCC-4 : 2 downlinks and 2 uplinks (CAT6 cables)
DTCC-2 : 1 downlink and one uplink (Micro-twinax, fiber optics)

Mixed datatypes via 8b/10b frames of different priority



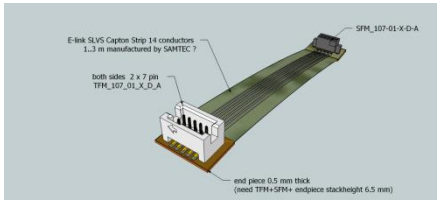
*Alfonso Tarazona Martinez

Emulation of 10 Gbit Readout Unit using the SRU



Micro copper frontend links
(0.4 mm typ.)

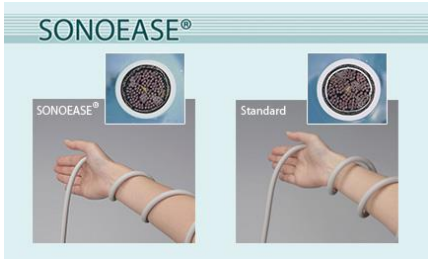
- Kaptons (may break!)



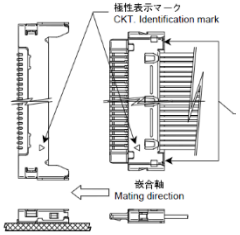
- Hitachi Sonoease

AWG*	Stranding / No. (mm)	High Capacitance (pF/m) Low			
		110pF/m	60pF/m	50pF/m	40pF/m
36	7 / 0.050	0.54			
38	7 / 0.040	0.44			
40	7 / 0.030	0.32	0.41	0.47	
42	7 / 0.025	0.29	0.35	0.40	
43	7 / 0.023	0.27	0.31	0.36	0.48
44	7 / 0.020	0.25	0.26	0.32	0.41
46	7 / 0.016	0.20	0.23	0.25	
48	7 / 0.013	0.16			
50	7 / 0.010	0.14			

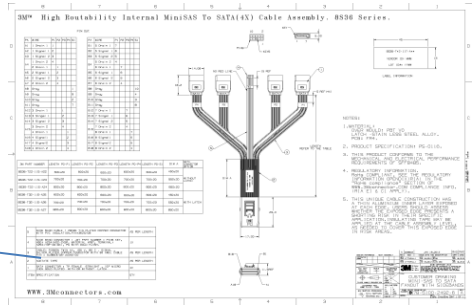
*American Wire Gauge



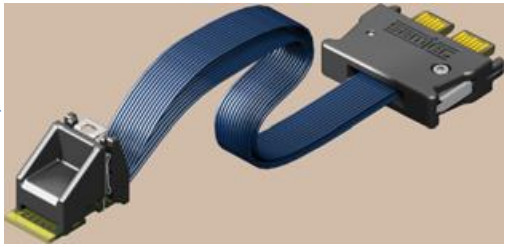
- Molex Micro IDT (non standard)



- 3M Micro SAS

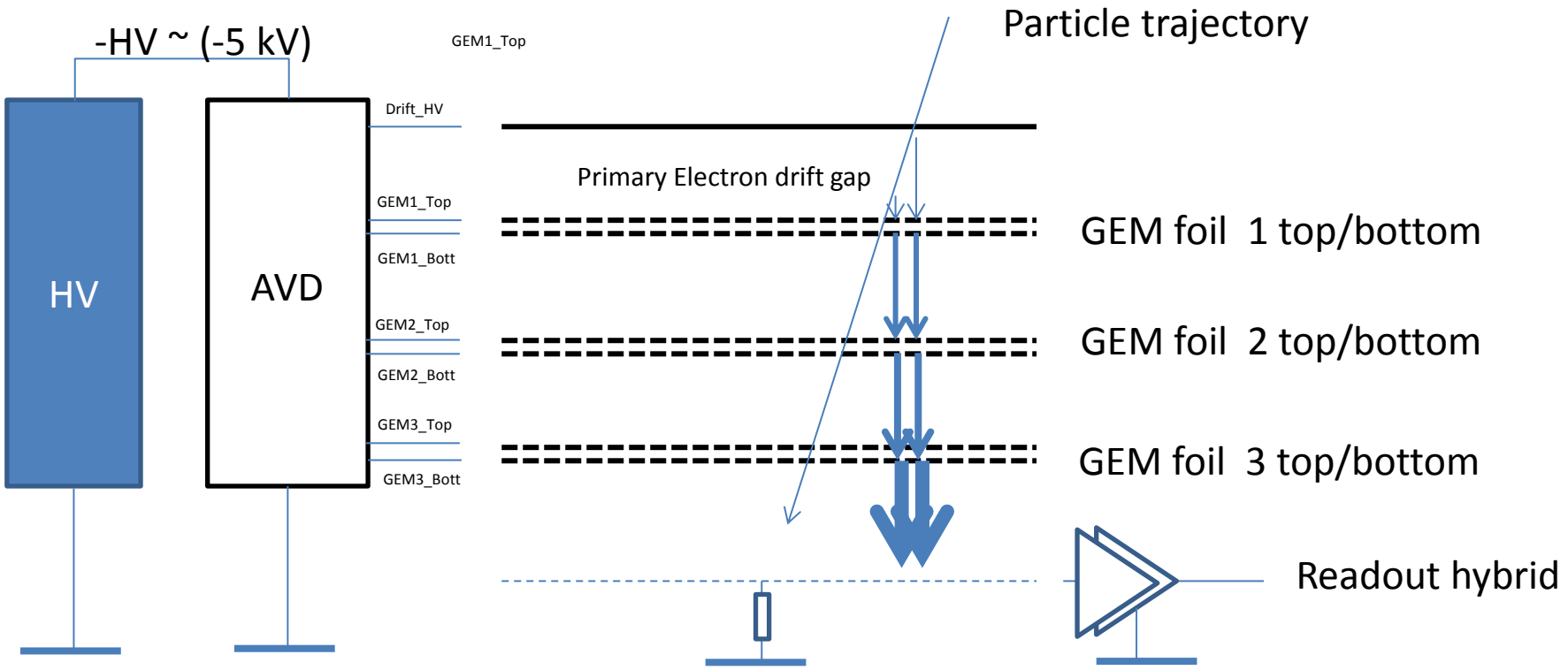


- **Samtec ECUE**

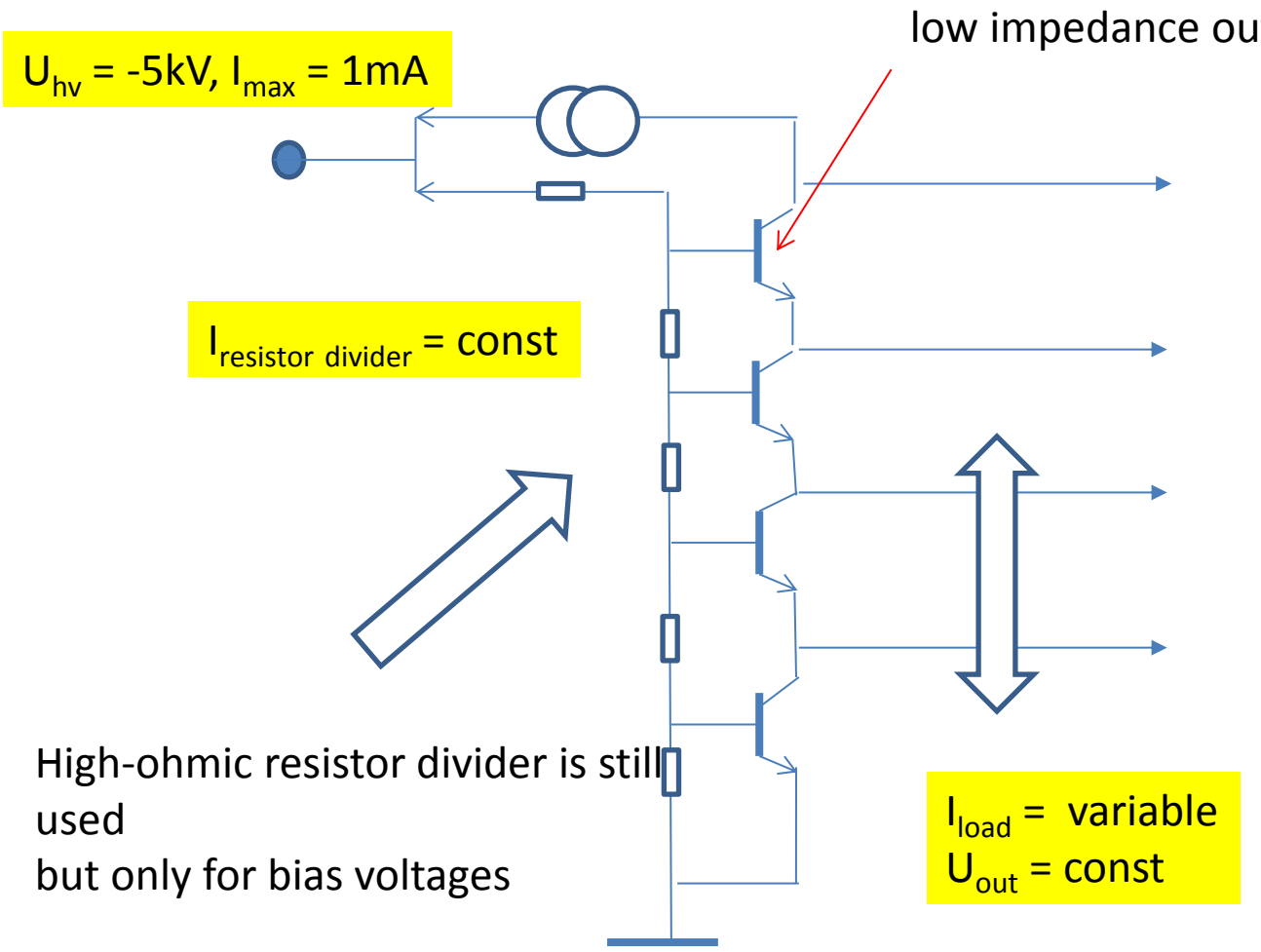


Active Voltage Divider for GEMs

Overcome efficiency and protection issues of purely resistive HV dividers

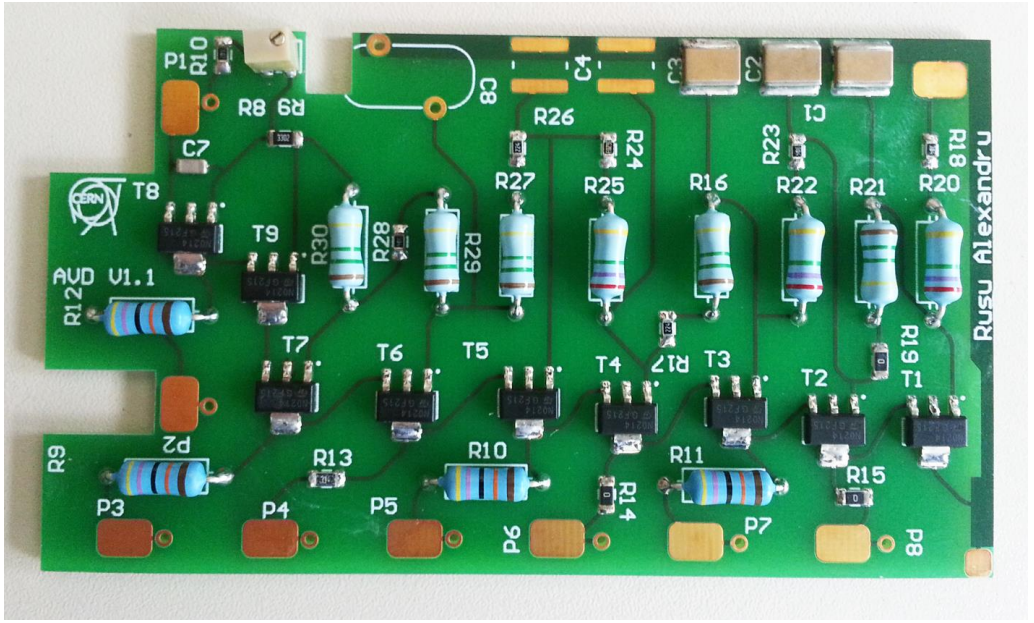


AVD principle

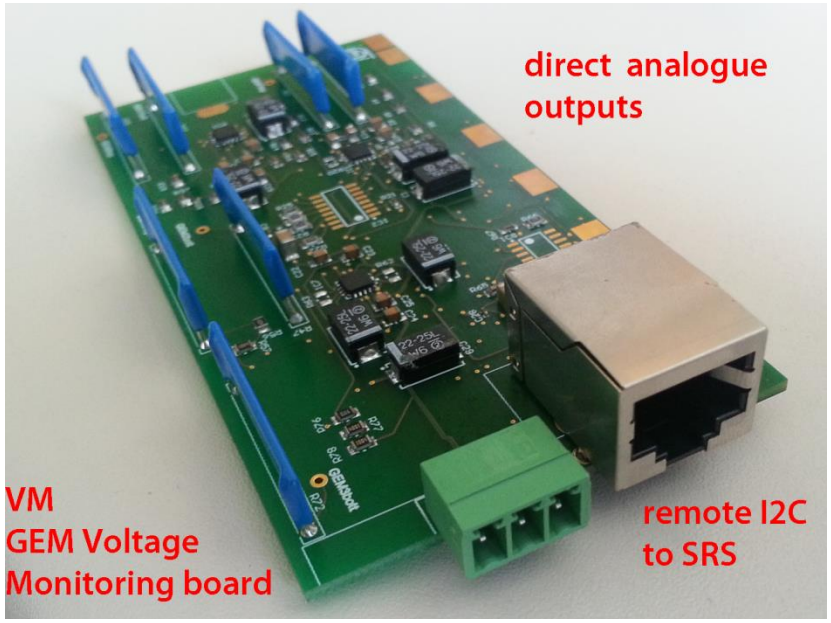


Implementation*

AVD



VM



to be tested these days

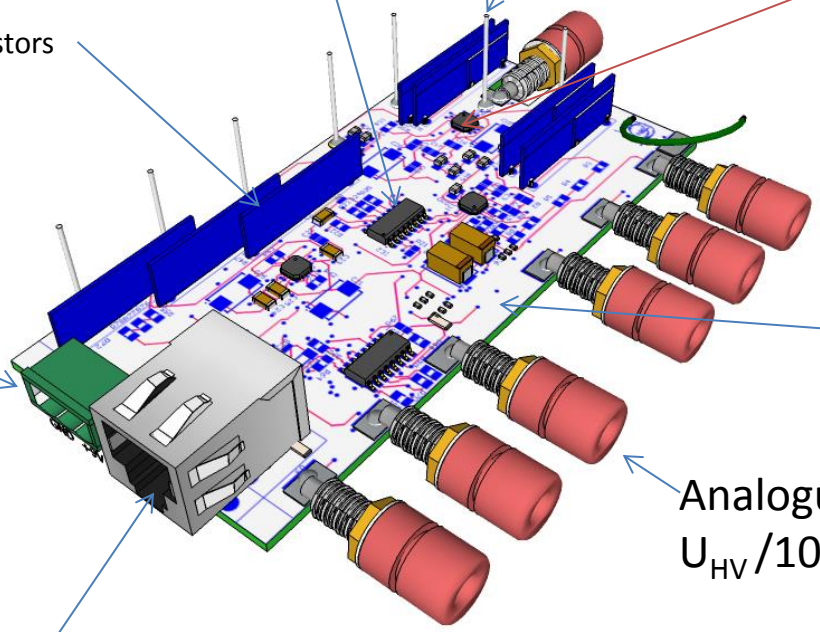
AVD first tests at 5kV

- All Voltages OK
- cable shock tests OK
- Long duration tests OK , but HV tripped

Altium designer: trainee Alexandru Rusu

HV monitoring board

(installed below active divider board)



Pickup wires from AVD

12 bit ADC
Temperature probe

Instrumentation amplifiers
5 pA leakage

Giga-OHM divider resistors

Power connector

Humidity sensor below

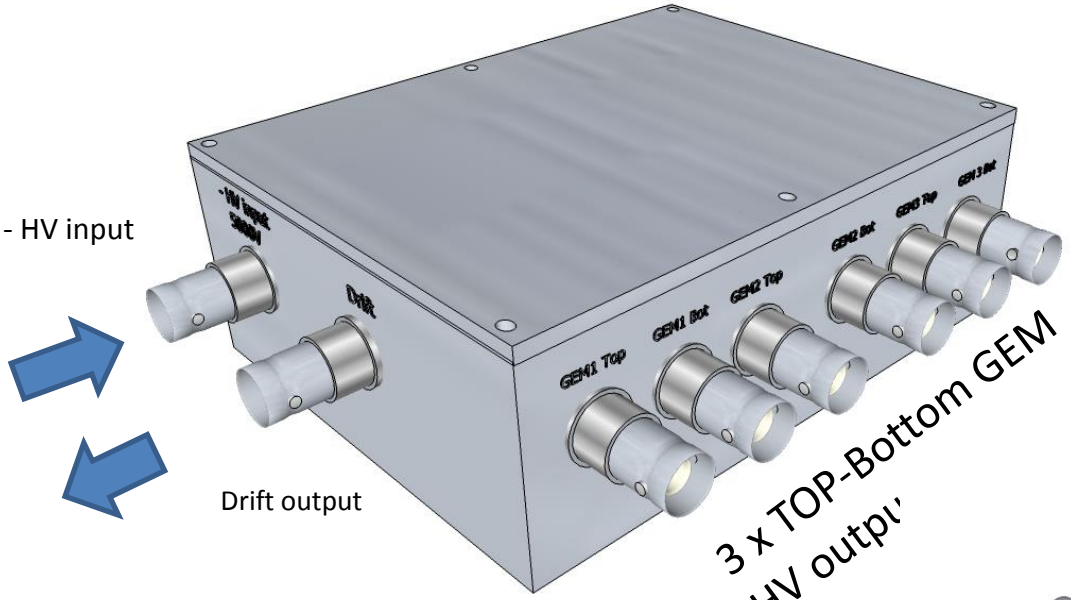
Analogue Outputs
$U_{HV}/1000$

I2C readout via remote
LVDS cable to FEC card SRS

Hans.Muller@cern.ch

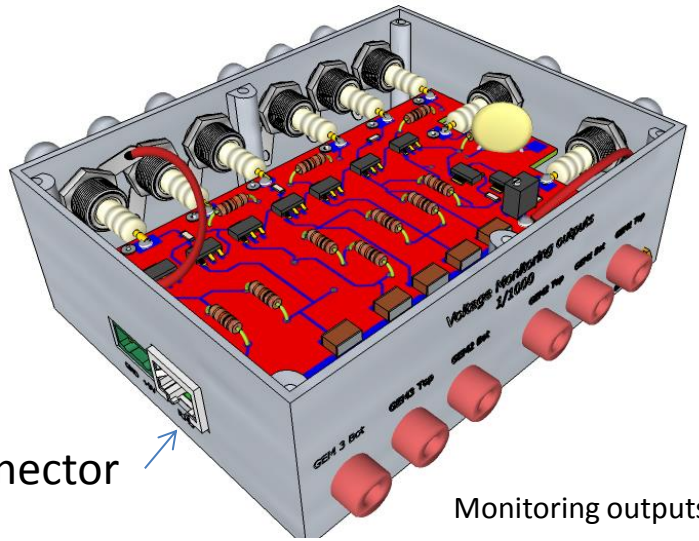
AVD box

- HV input



Drift output

3 x TOP-Bottom GEM HV outpu



SRS readout cable connector

Monitoring outputs HV/1000

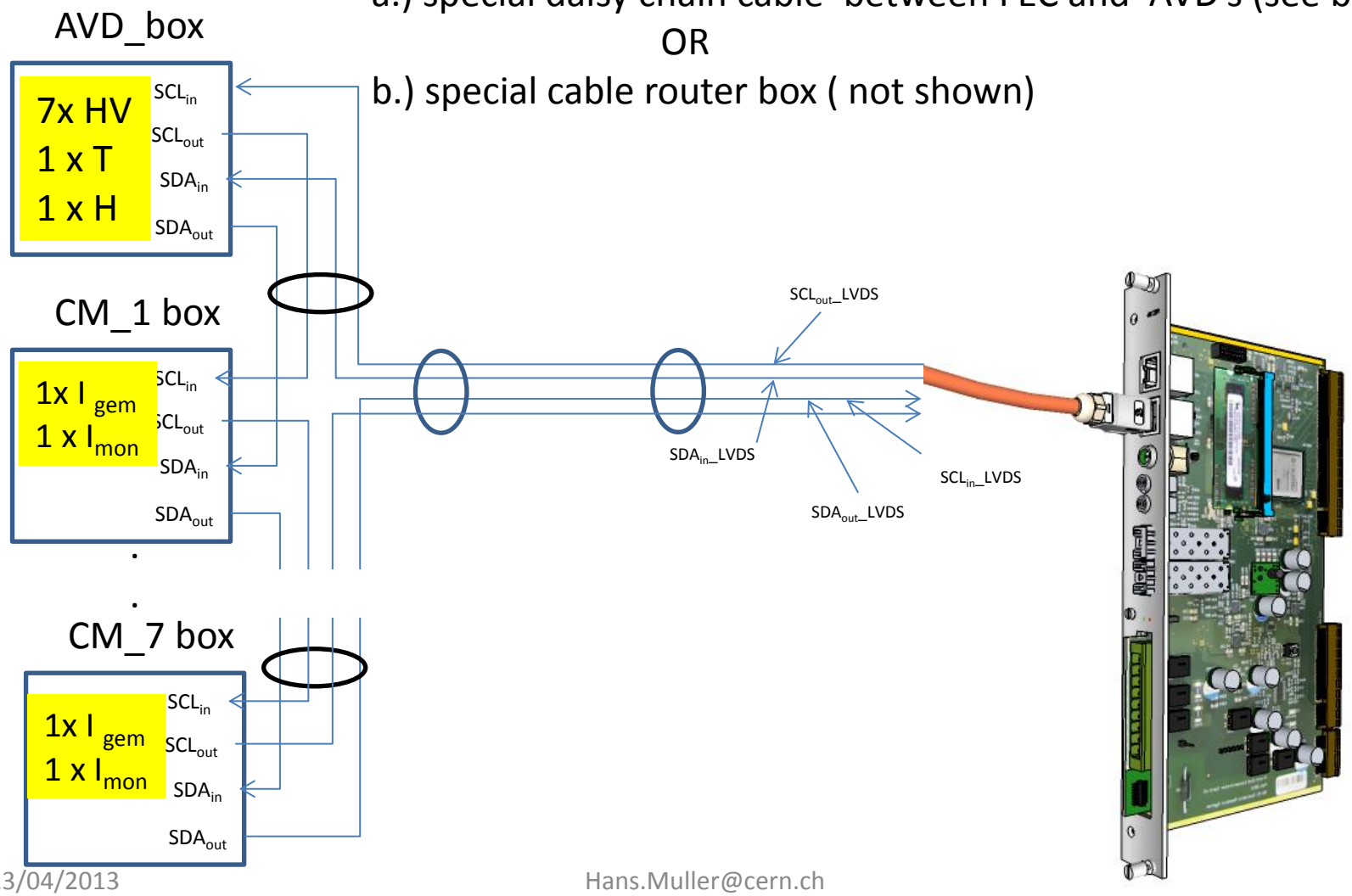
Hans.Muller@cern.ch

kVolt and pA readout via SRS

a.) special daisy chain cable between FEC and AVD's (see below)

OR

b.) special cable router box (not shown)



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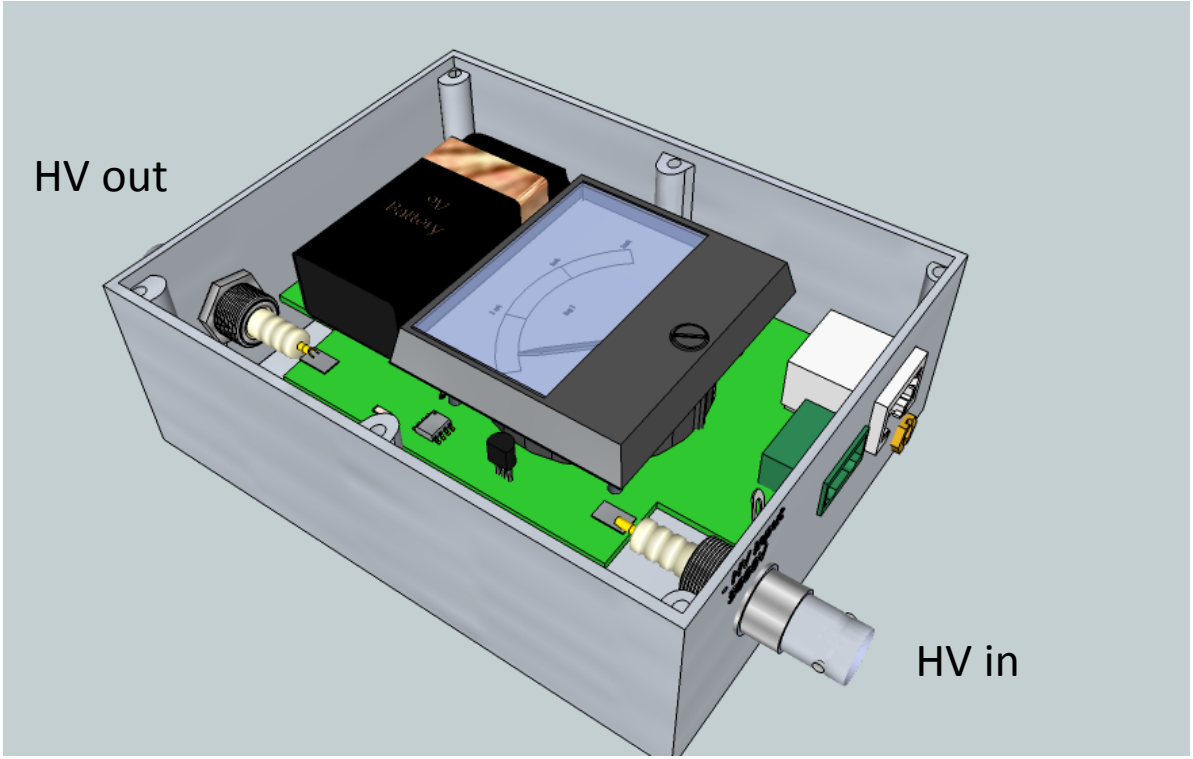
PicoAmp box (planned)



Log range 10 pA .. 100 uA

SRS readout cable connector

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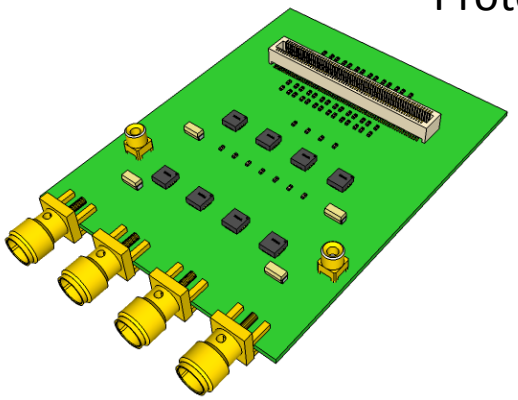
QSP Quad Signal Preamplifier

Prototype



2.4 GHz preamplifiers
4 neighboring detector channels.
Gain Vout/Vin = 20
⇒ Monitor detector signal dynamics
below the millivolt level
at full BW

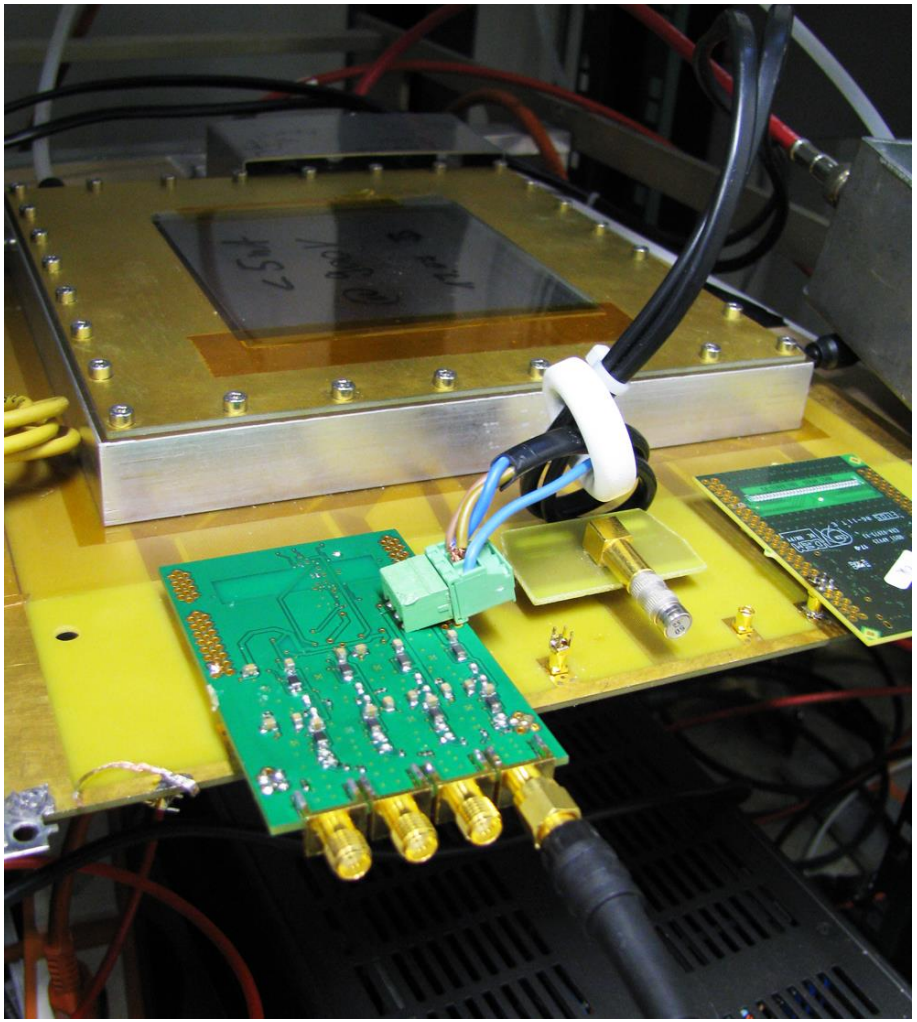
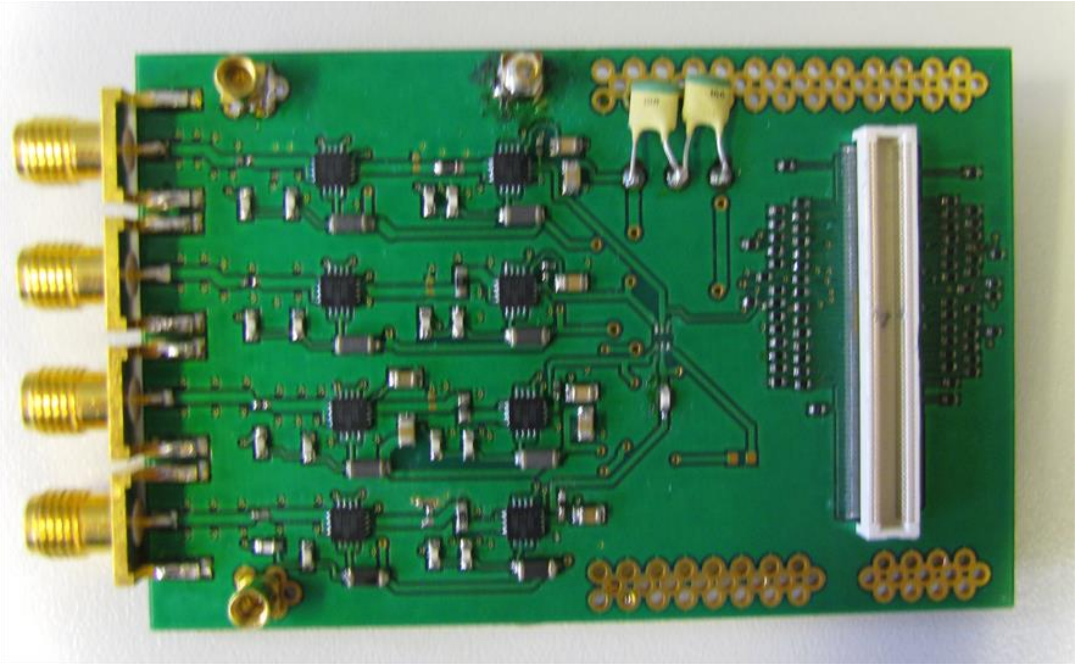


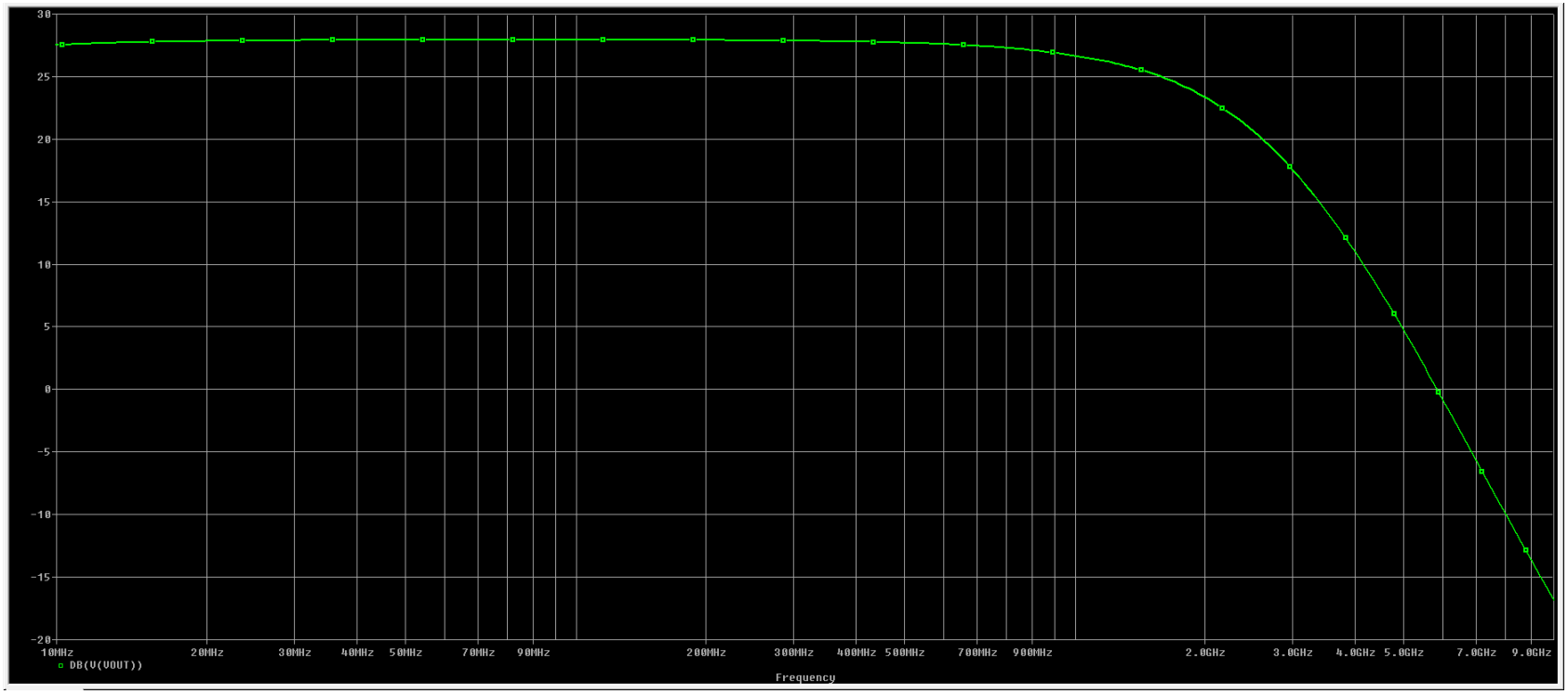
Photo QSP prototype

to GHz Oscillocope, also DRS4



PCB revision needed => tendency to ringing must be suppressed

Frequency simulation*

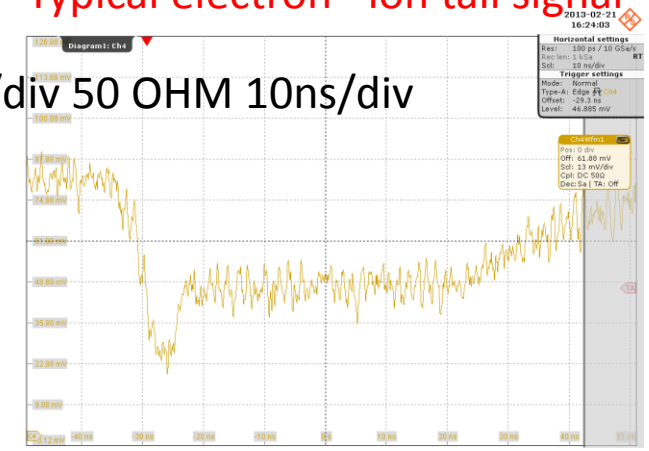


* A.Tarazona

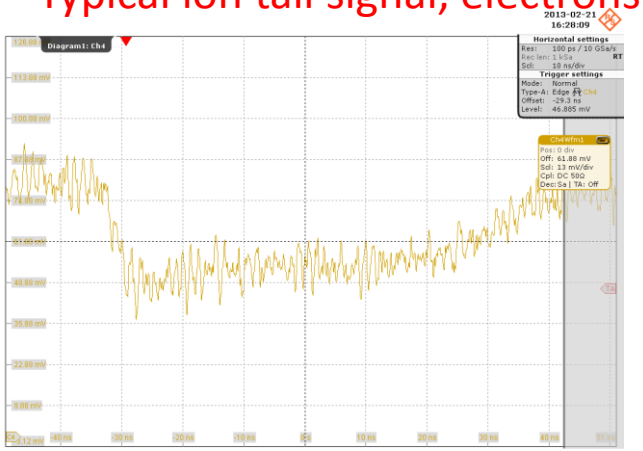
QSP signals on MM strip detector

Typical electron –ion tail signal

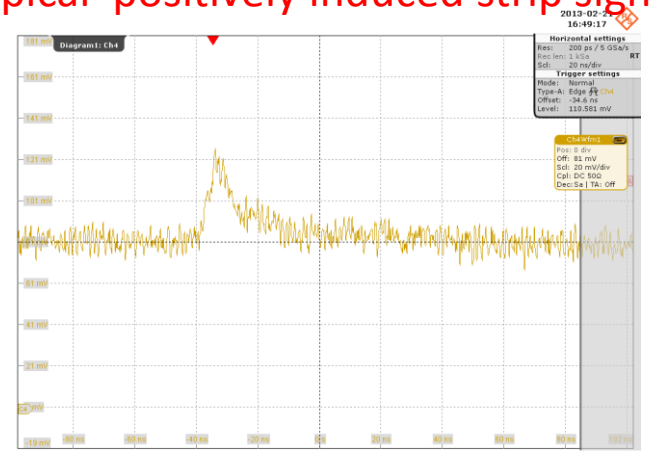
13mV/div 50 OHM 10ns/div



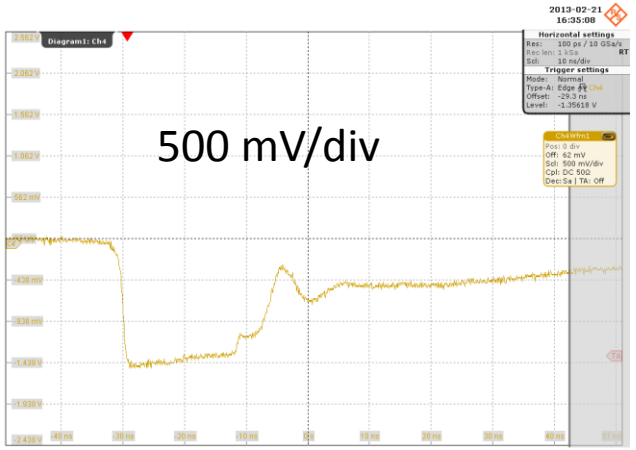
Typical ion tail signal, electrons suppresed



Typical positively induced strip signal



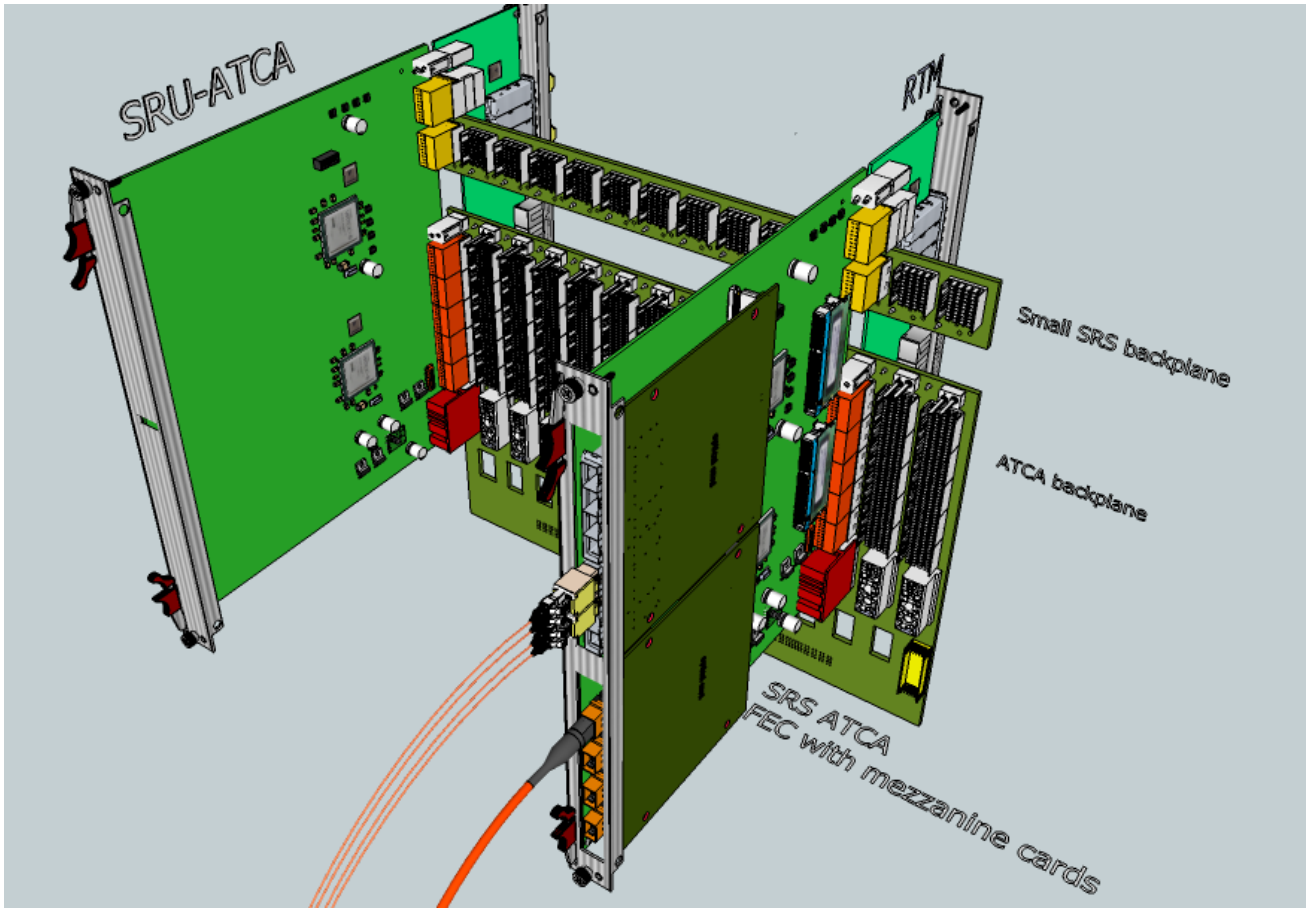
Typical discharge (large vertical scale)



SRS ATCA*

talk Wojciech Jalmuzna

fully commercial SRS in certified ATCA Crates



*AdvancedTCA (Advanced Telecommunication Computing Architecture)
an open industry standard developed by PICMG 3.0

Summary

- More than 34 SRS user teams, more waiting
- CERN store new SRS production, new SRS utilities
- New, fully commercial SRS_ATCA awaited
- New FECV6, Digital card, ASIC hybrid being worked on
- Timepix array readout first data
- SRS integrated in LHC experiment upgrades
- DTCC link: Data, Trigger Clock Control over 4 wires/ 2 wires,fibres
- SRU 10 Gbit emulation platform for 10 Gbit readout of ASICs
- Active HV Divider for improved efficiency and safety of GEMs
- Remote I2C readout of kV, pA, T and P via FEC
- Quad Oscilloscope probe for 2 GHz MPGD signals in preparation