

Status and R&D for IDEA Drift Chamber for future colliders



N. De Filippis, Politecnico/INFN Bari
F. Grancagnolo, INFN Lecce
on behalf of the full team



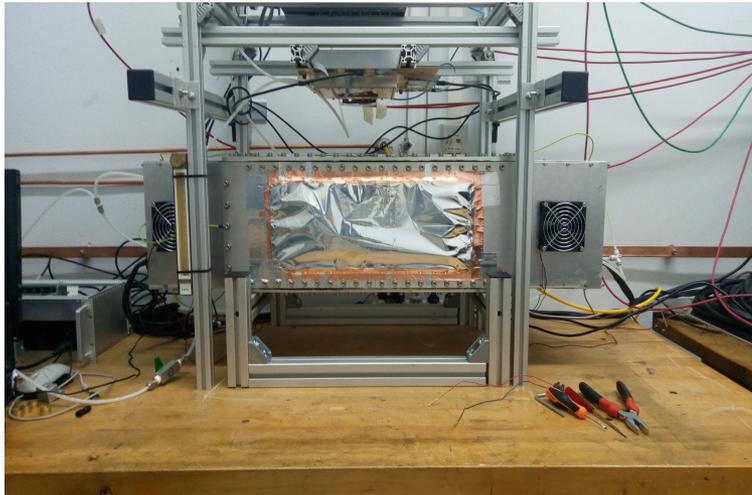
CepC meeting
December 30, 2019

Status of activities in 2019

- 1. Test of a prototype of a drift chamber in the INFN-Lecce lab**
- 2. Analysis of test beam data collected at CERN in 2018**

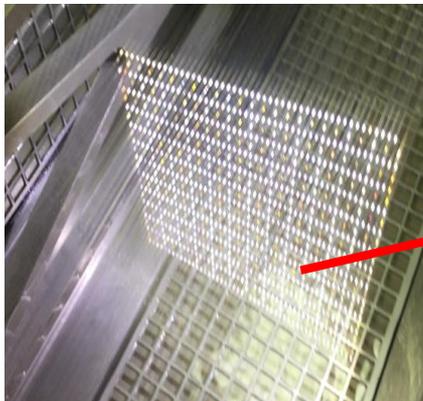
1. Test of a prototype in the lab

Goal: test of a drift chamber prototype for the IDEA experiment, e^+e^- collider



Multiwire drift chamber designed and developed in the INFN Lecce lab

- <<ultralight drift chamber>>
- track reconstruction with high spatial resolution
- minimization of the multiple scattering



- **Drift cell:** 1 cm squared, anodic wire in the center (tungsten coated with gold, 20 μm diameter) and field wires (aluminium coated with silver, 40 μm diameter)
- **Gas mixture:** helium-isobutane

Steps for the test:

- 1) measurement of the gain of the readout electronic cards
- 2) signal acquisition with a small group of cells and treatment of the noise
- 3) measurement of the gain of the chamber

1. Test of a prototype: noise treatment

Signal from cosmic rays, taken in different configurations:

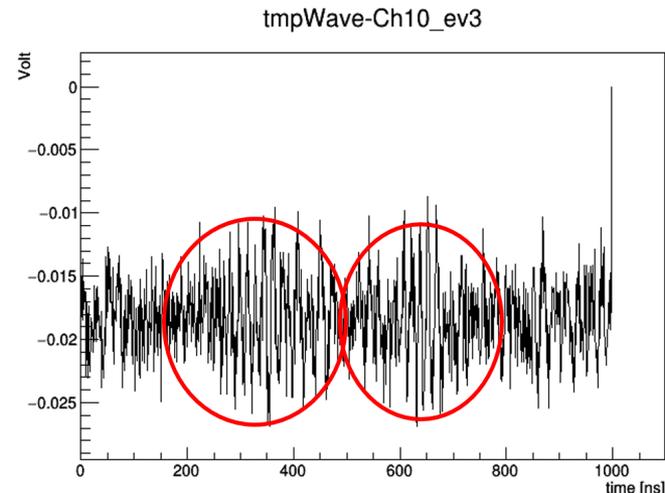
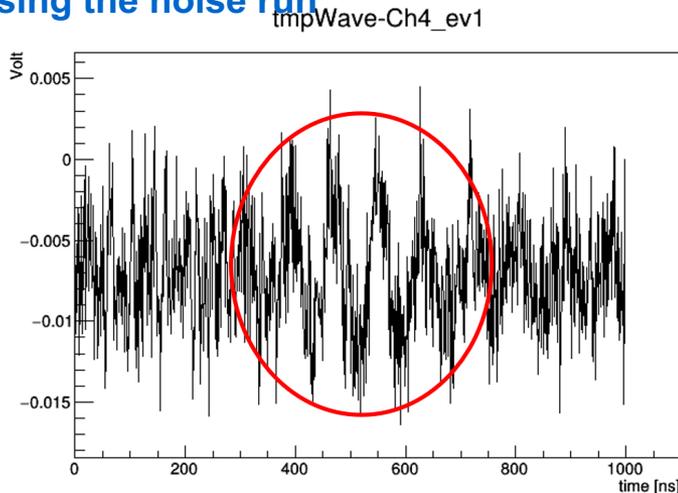
- 1) 90% helium- 10% isobutane, HV: 1490 V-1570 V
- 2) 85% helium-15% isobutane, HV: 1650 V-1720 V

Distorsions caused by noise ➔ filter procedure

Run analysed:

- 1) Run 28 (noise) with HV 200 V, below the gas amplification range
- 2) Run 33 (signal) with HV 1710 V, mixture 85-15 and *layer 2-3-4*

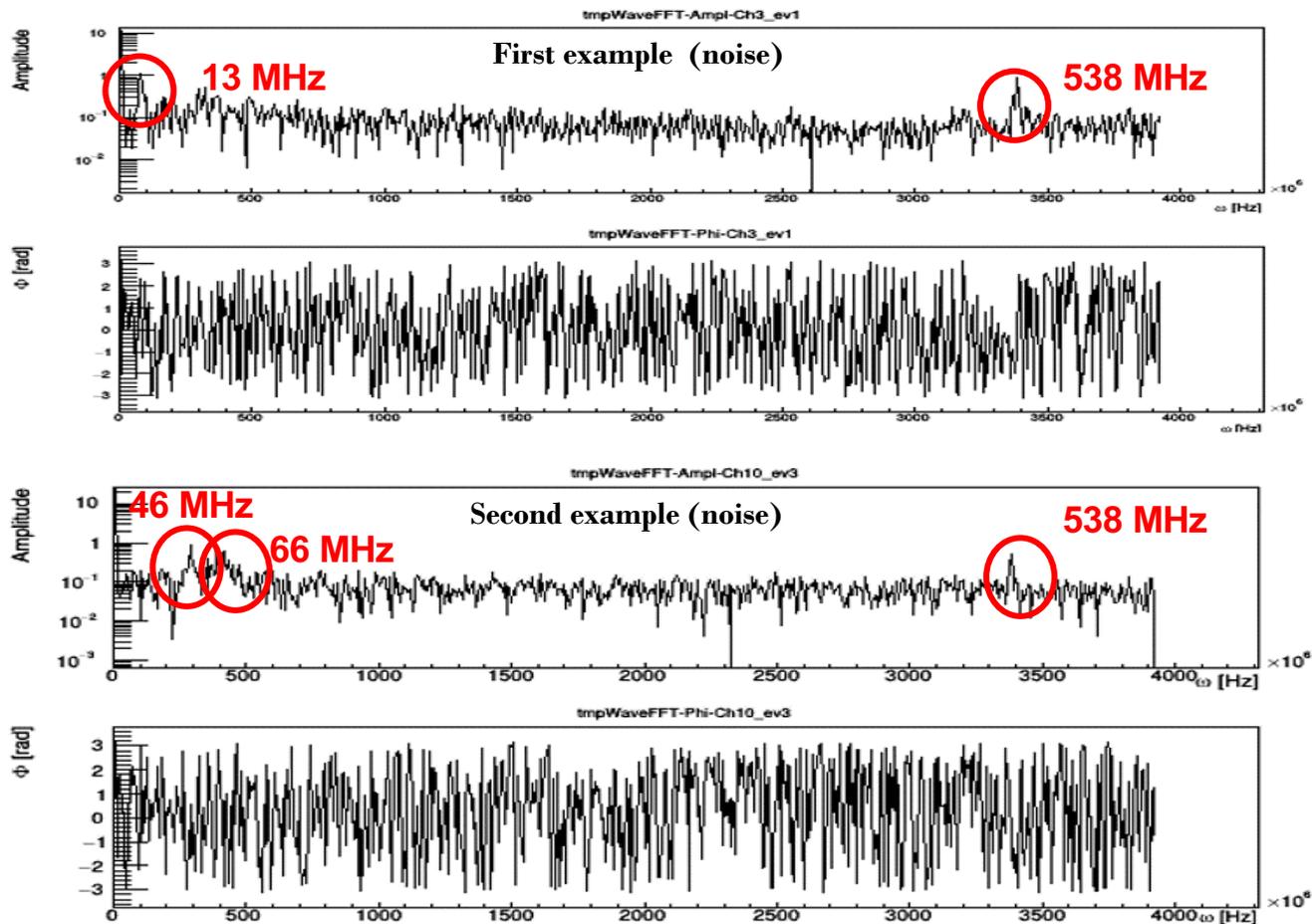
..analysing the noise run



1. Test of a prototype: noise treatment

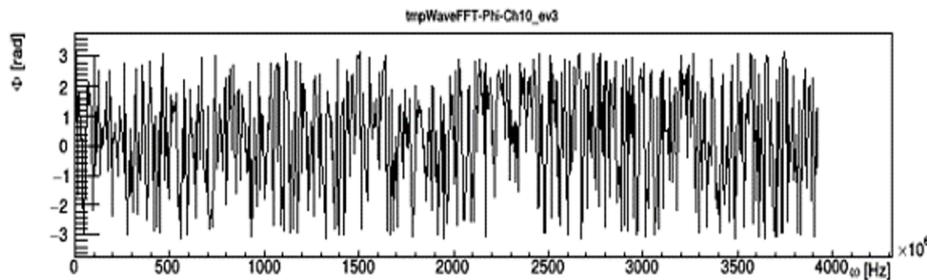
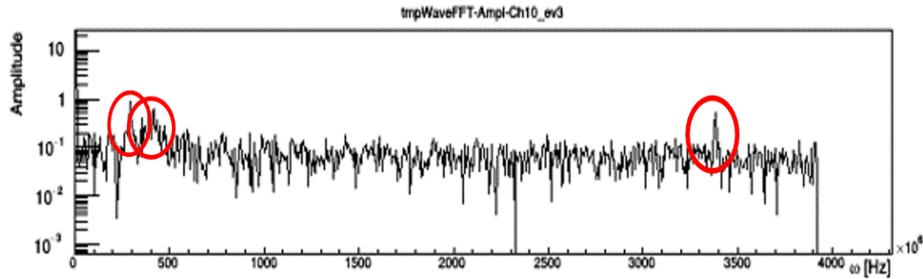
Method of the Fourier Transform and *notch* filter

Study of the waveform in the frequency domain to search for noise frequencies → complex procedure for noise treatment (see schema in backup slides)

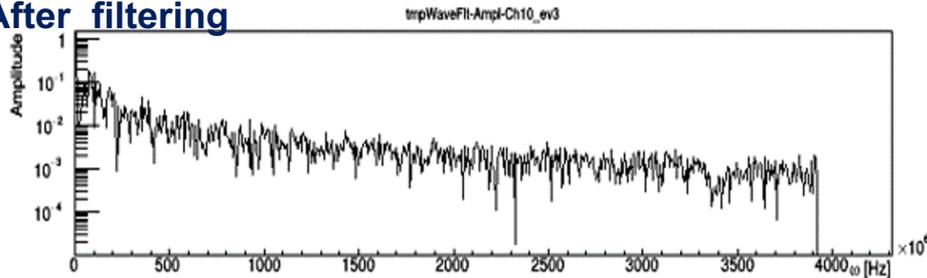


1. Test of a prototype: noise treatment

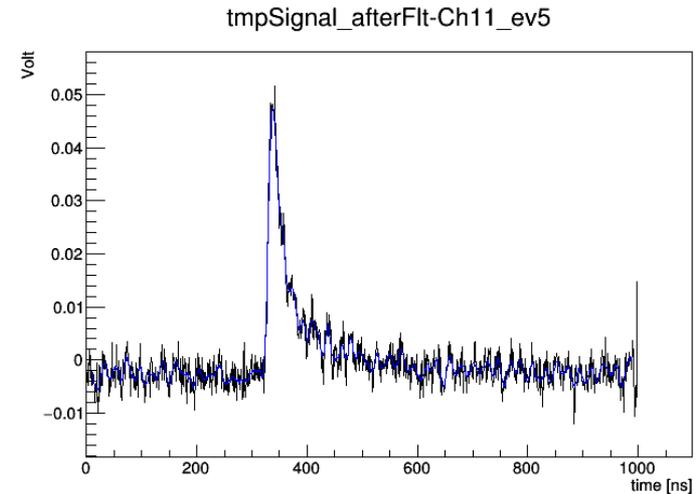
Before the procedure of filtering



After filtering



MIP signal reconstructed after the filter procedure



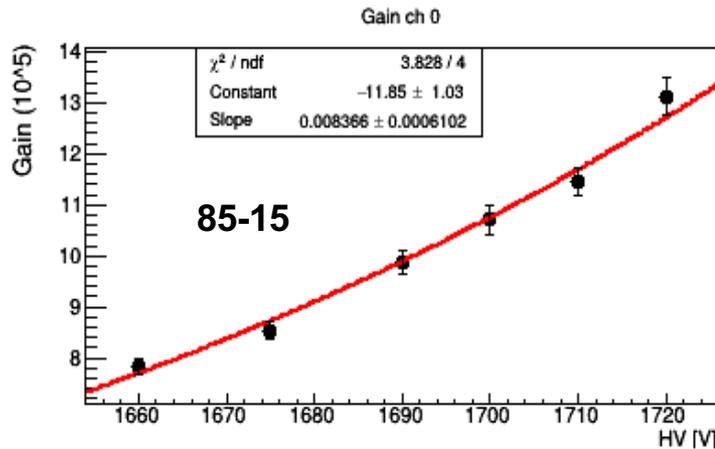
1. Test of a prototype: gain of the chamber

From the most probable value (MPV) we derive the gain of the chamber while varying the gas mixture and the voltage applied to each channel

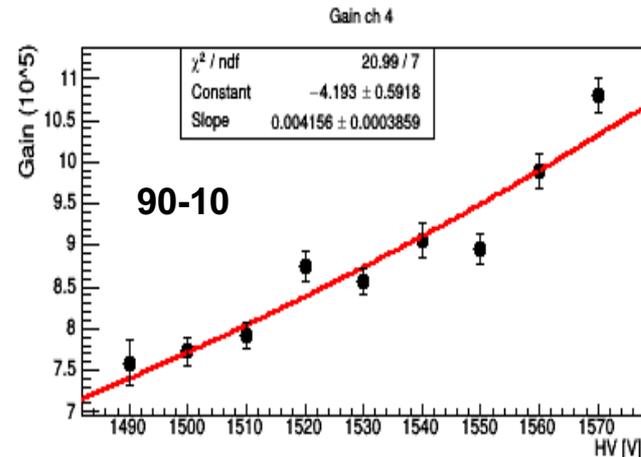
$$G = \frac{MPV[V] \cdot 0.8[ns]}{(330[\Omega] \cdot 9.47 \cdot e[C])} \cdot 0.5$$

Annotations for the equation:

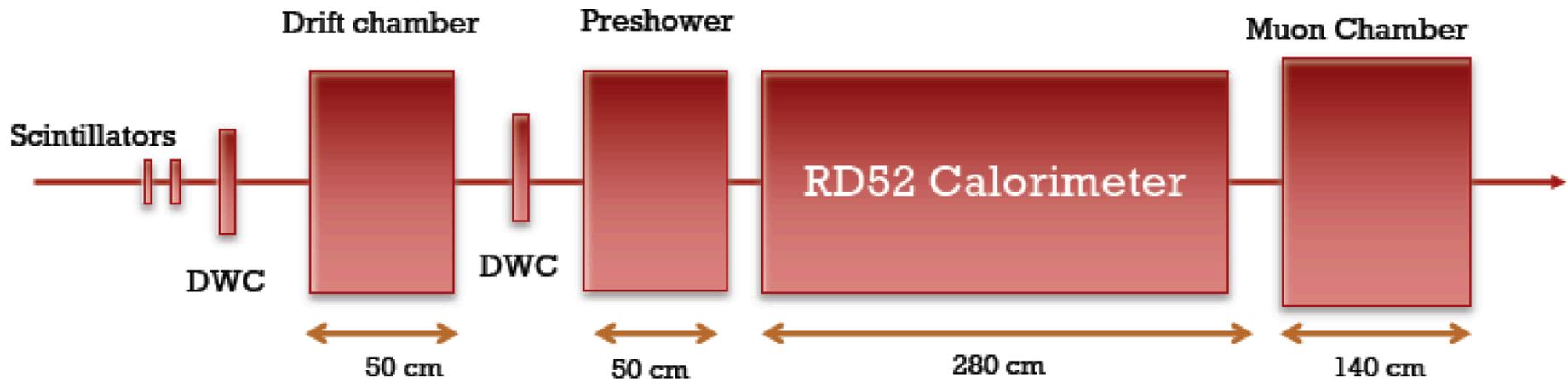
- Time resolution (points to 0.8[ns])
- Lost factor (points to 0.5)
- Electron charge (points to e[C])
- Gain of the electronics (points to 9.47)
- Characteristic Impedence of the front-end (points to 330[Ω])



G in the range 7×10^5 and 1.2×10^6 , in agreement with what expected by the theory



2. Analysis of test beam data in 2018: H8 area



- Trigger with 2 scintillators in coincidence + 1 veto (if needed)
- 2 DWC (Delayed Wire Chamber)
- CEDAR (Differential Cherenkov detector)
- Drift Chamber Prototype
- Preshower with GEM
- Few different Dual Readout prototypes
 - RD52 calorimeter with PMT readout
 - RD52 calorimeter with longitudinally displaced fibers
 - Small calorimeter module with SiPM readout
- Muon chamber 1 layer GEM + 2 layers μ RWell

2. Analysis of test beam data in 2018

- The chamber is exposed to different types of beams (Muons, Electrons, Pions and Kaons) with energy 20-60GeV
- The setup during the testbeam:



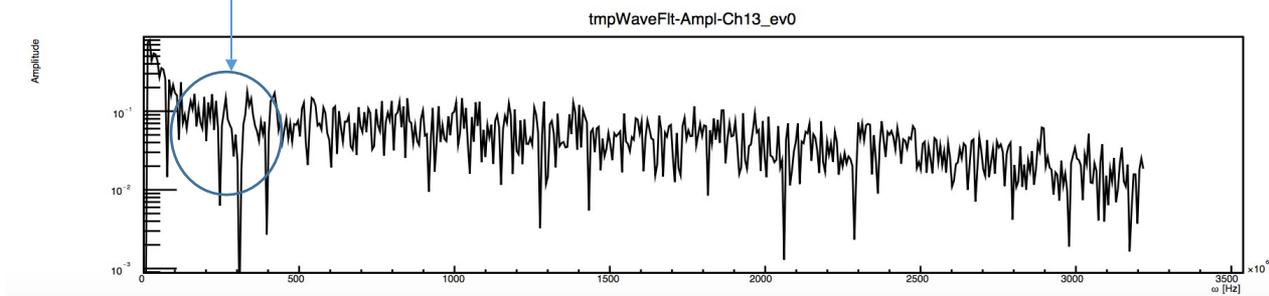
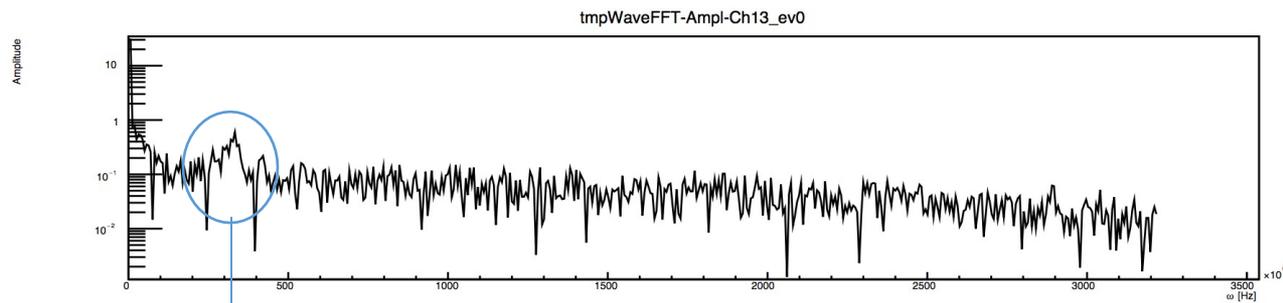
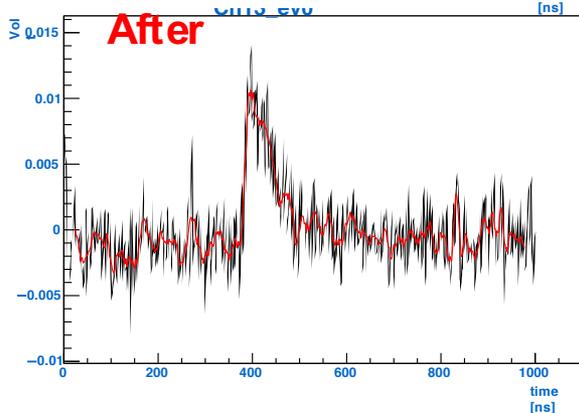
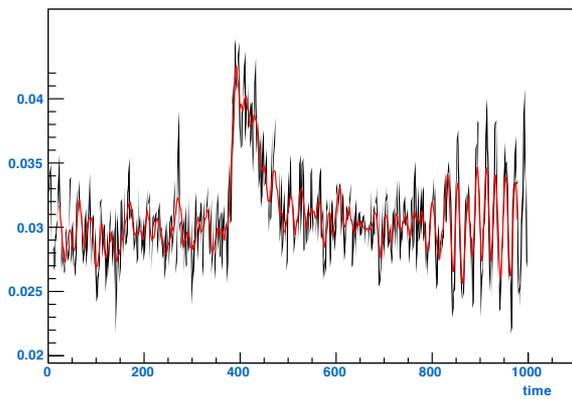
- During the test beam:
 - We read **just 20 cells** in the central core (**Layer 7 was broken**).
 - Data are available via rdfa virtual organization accessible via grid tools in the path: <srm://storm-se-01.ba.infn.it:8444/srm/managerv2?SFN=/rfda/TestBeam>

2. Analysis of test beam data in 2018: noise

➤ The result of the signal wave form:

CH13– Event 0

Before



- We notched the low frequency safely without affecting the signal

R & D activities in 2020

1. Cluster counting / timing technique

- a. *Development of new wire materials*
- b. *Development of a DAQ board specific to Cluster Counting/Timing for data reduction and pre-processing of drift chamber signals sampled at high rates*
- c. *Construction of a full length drift chamber prototype*

2. Development of a monitoring chamber for the drift velocity

1a: Development of new wire material

Electrostatic stability condition $T > \frac{C^2 V_0^2 L^2}{4\pi\epsilon w^2}$

T = wire tension
 C = capacitance per unit length
 V_0 = anode-cathode voltage
 L = wire length, w = cell width

IDEA Drift Chamber: $C = 10$ pF/m, $V_0 = 1500$ V, $L = 4.0$ m, $w = 1.0$ cm

$$T > 0.32 \text{ N}$$

- ❖ 20 μm W sense wire (Y.S. ≈ 1200 MPa): $T_{max} = 0.38$ N (marginal)
- ❖ 40 μm Al field wire (Y.S. ≈ 300 MPa): $T_{max} = 0.38$ N (marginal)
 - => shorten chamber (loss of acceptance)
 - => widen cell size (increase occupancy)
 - => increase wire diameter (increase multiple scattering and endplate load)

or,

replace 40 μm Al with 35 μm Carbon monofilament
(Y.S. > 860 MPa): $T_{max} > 0.83$ N

1a: New wire material: carbon monofilaments

SPECIALTY MATERIALS, INC.

Manufacturers of Boron and SCS Silicon Carbide Fibers and Boron Nanopowder

CARBON MONOFILAMENT



TYPICAL PROPERTIES

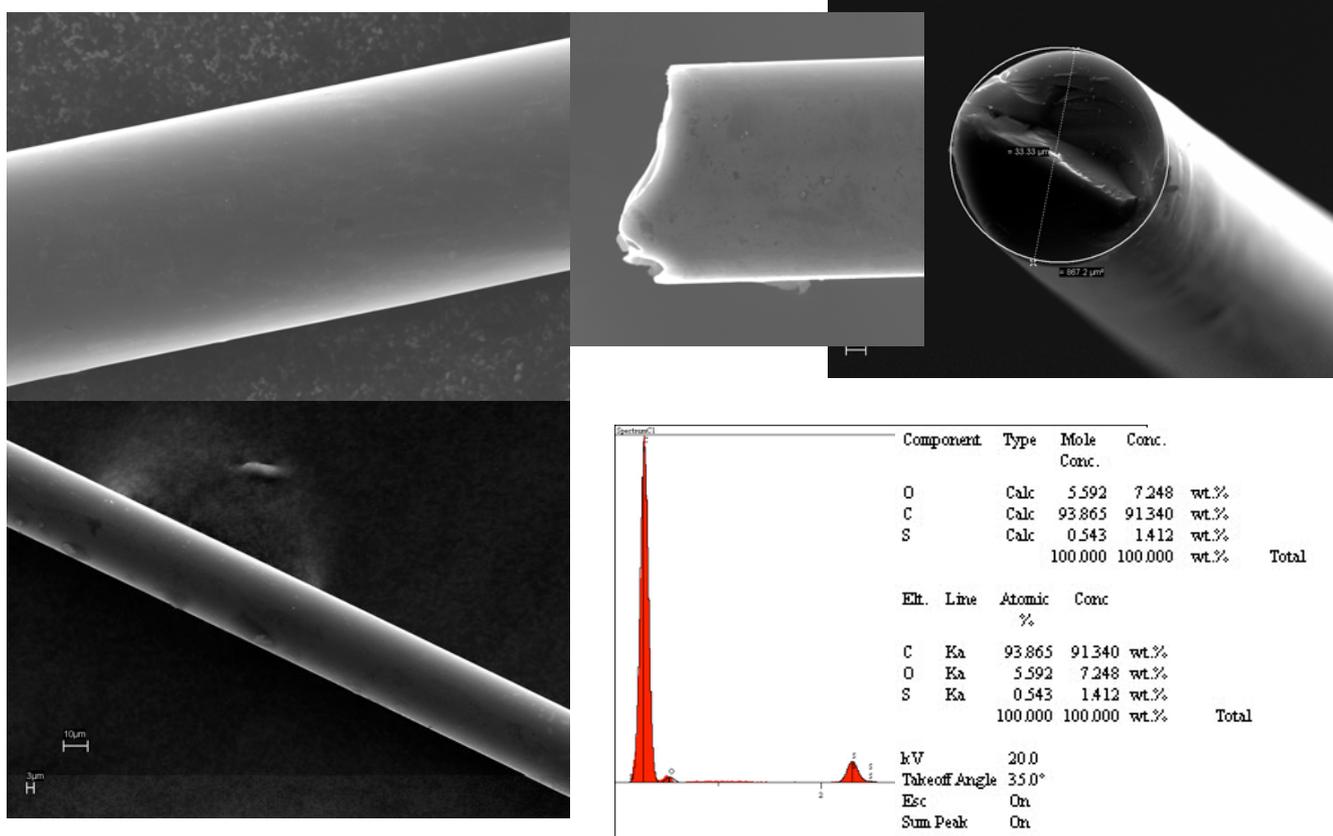
Diameter: 0.00136 +/- 0.0001" (34.5 +/- 2.5 μm)
Tensile Strength: 125 ksi (0.86 GPa)
Tensile Modulus: 6 msi (41.5 GPa)
Electrical Resistivity: 3.6×10^{-3} ohm cm
Density: 1.8 g/cc

Specialty Materials, Inc.
 1449 Middlesex Street
 Lowell, Massachusetts 01851

CARBON MONOFILAMENT PRODUCT PRICE LIST Effective October 1, 2017

Product	Quantity	Price LF
CARBON MONOFILAMENT	1 Million LF	\$0.02
	500,000 LF	\$0.03
	1,000 LF	\$0.93

Phone: 978-322-1900
 Fax: 978-322-1970

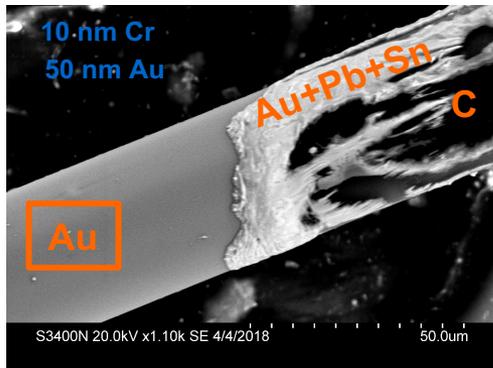


1a: New wire material: C wire metal coating

HiPIMS: High-power impulse magnetron sputtering

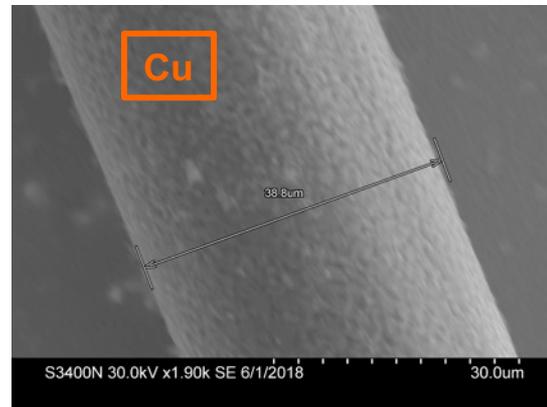
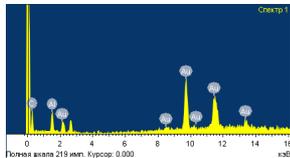
physical vapor deposition (PVD) of thin films based on magnetron sputter deposition
(extremely high power densities of the order of kW/cm^2 in short pulses of tens of microseconds at low duty cycle $<10\%$)

BINP
A. Popov
V. Logashenko

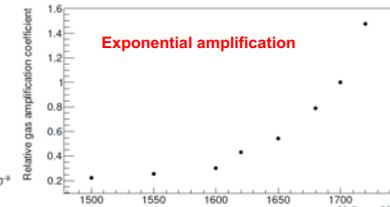
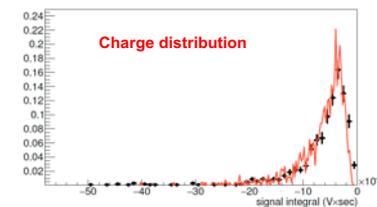
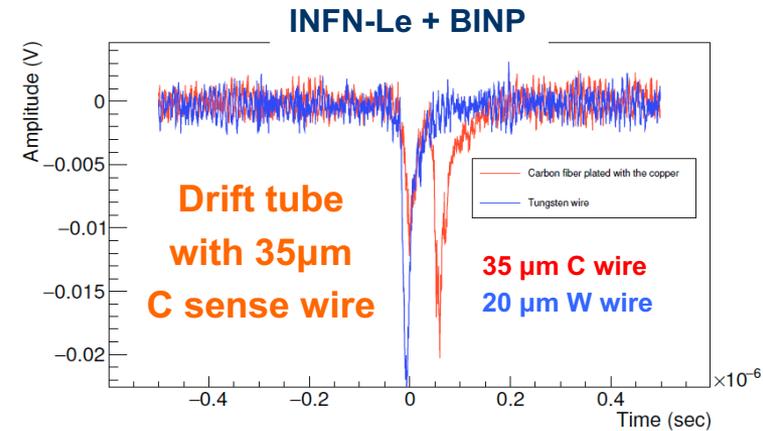
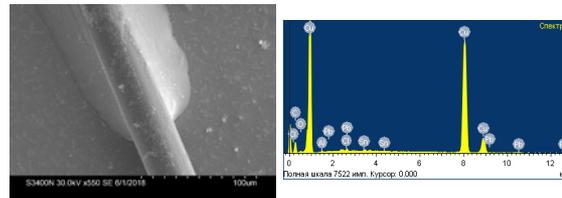


soldering attempt

Lead forms intermetallic compound with gold and completely dissolves the 50 nm Au layer.



good solder wettability on Cu



- Cu coating test of $35 \mu\text{m}$ carbon monofilament very successful on short samples with HiPIMS at BINP, Novosibirsk
- Investigation of magnetron sputtering facilities elsewhere (INFN LNL?)
- Industrialization of process for coating continuous spooled monofilament under study

1a: C wire soldering without metal coating

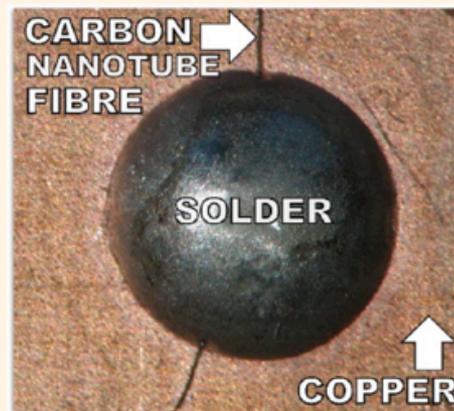
Soldering of Carbon Materials Using Transition Metal Rich Alloys

Published online August 09, 2015
10.1021/acsnano.5b02176

Marek Burda,^{*,†} Agnieszka Lekawa-Raus,[†] Andrzej Gruszczyk,[‡] and Krzysztof K. K. Koziol^{*,†}

[†]Department of Materials Science and Metallurgy, University of Cambridge, 27 Charles Babbage Road, CB3 0FS, Cambridge, U.K. and [‡]Welding Department, Silesian University of Technology, Konarskiego 18a, 44-100 Gliwice, Poland

ABSTRACT Joining of carbon materials *via* soldering has not been possible up to now due to lack of wetting of carbons by metals at standard soldering temperatures. This issue has been a severely restricting factor for many potential electrical/electronic and mechanical applications of nanostructured and conventional carbon materials. Here we demonstrate the formation of alloys that enable soldering of these structures. By addition of several percent (2.5–5%) of transition metal such as chromium or nickel to a standard lead-free soldering tin based alloy we obtained a solder that can be applied using a commercial soldering iron at typical soldering temperatures of approximately 350 °C and at ambient conditions. The use of this solder enables the formation of mechanically strong and electrically conductive joints between carbon materials and, when supported by a simple two-step technique, can successfully bond carbon structures to any metal terminal. It has been shown using optical and scanning electron microscope images as well as X-ray diffraction patterns and energy dispersive X-ray mapping that the successful formation of carbon–solder bonds is possible, first, thanks to the uniform nonreactive dispersion of transition metals in the tin-based matrix. Further, during the soldering process, these free elements diffuse into the carbon–alloy border with no formation of brazing-like carbides, which would damage the surface of the carbon materials.



1a: C wire soldering without metal coating

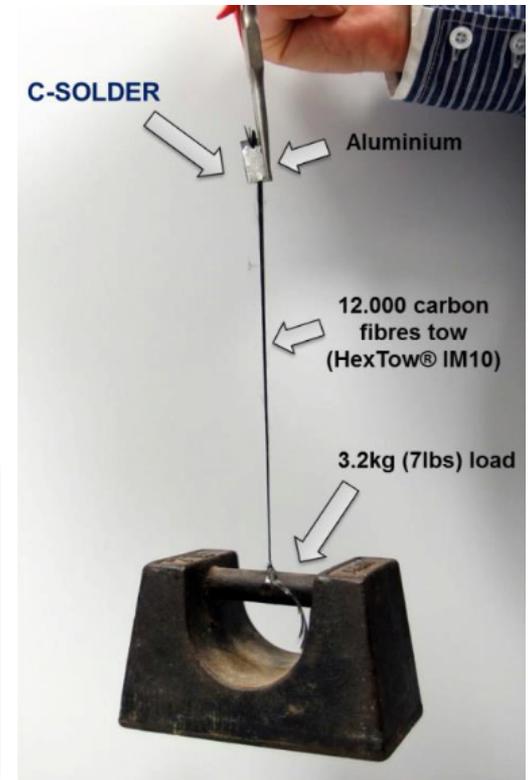
Up to now it has not been possible to apply soldering to graphitic materials as they are not wetted by the commercially available alloys.

C-SOLDER is a trade name for a group of new tin-based lead-free low-temperature soldering alloys which enable joining of various carbon materials including carbon fibres or carbon nanotube fibres in both carbon-carbon and carbon-metal arrangements.

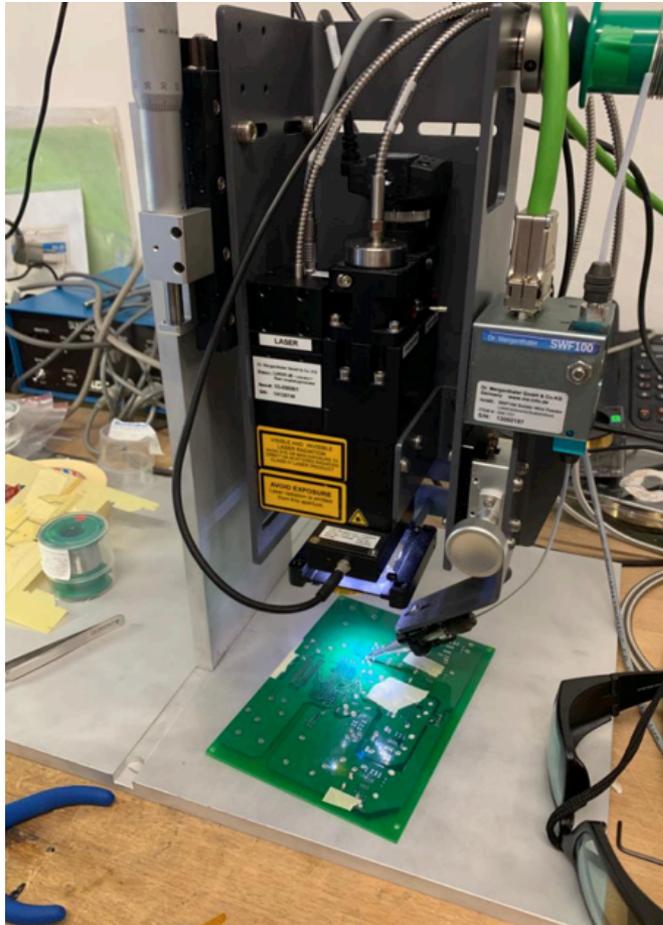
The use of these alloys allows fast formation of mechanically strong bonds which are electrically conductive simultaneously.

C-SOLDER Type: SAC-1B:

- Excellent wetting of carbon materials: graphite, carbon fibres, carbon nanotube fibres, graphene, etc.
- Suitability for bonding in carbon-carbon and carbon-metal systems.
- Soldering temperatures below 450°C.
- Good mechanical and electrical properties.
- Lead free.
- Flux free.



1a: C wire without metal coating: laser soldering



The Infrared laser system of the MEG2 wiring robot makes use of 0.5 mm soldering wire



For 3Kg we will make 0.5 mm. We can also give it a try to go below 0.5 mm with no extra fee.

2-3 Kg at the cost ~ £1500/500g (4 times cheaper as compared to £122.00/10g offered by Goodfellow).

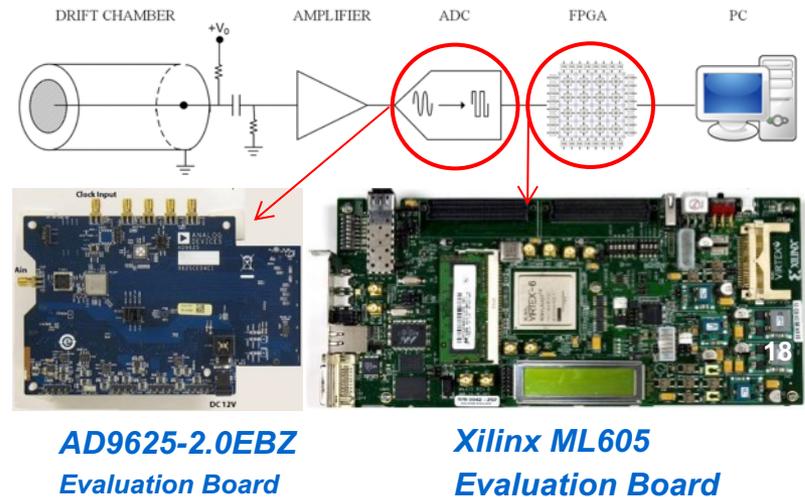
1b: DAQ board for Cluster Counting/Timing

A verified solution for a single channel

The solution consists in transferring, for each hit drift cell, **instead of the full spectrum of the signal**, only the minimal information relevant to the application of the cluster timing/counting techniques, i.e. **the amplitude and the arrival time of each peak associated with each individual ionisation electron**.

This is accomplished by using a **FPGA** for the real time analysis of the data generated by the drift chamber and successively digitized by an ADC.

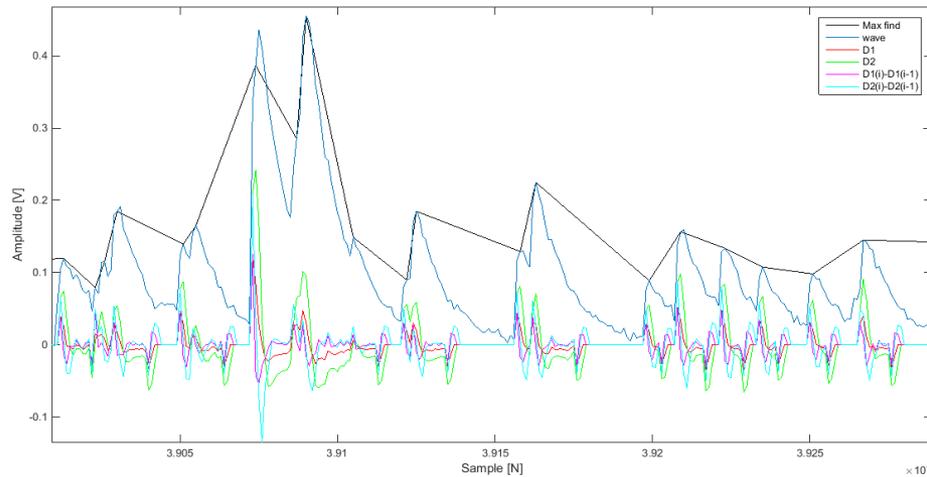
A fast readout algorithm (**CluTim**) for identifying, in the digitized drift chamber signals, the individual ionization peaks and recording their time and amplitude has been developed as **VHDL/Verilog** code implemented on a **Virtex 6 FPGA**, which allows for a maximum input/output clock switching frequency of **710 MHz**. The hardware setup includes also a 12-bit monolithic **pipeline sampling ADC** at conversion rates of up to **2.0 GSPS**.



G. Chiarello, C. Chiri, G. Cocciolo, A. Corvaglia, F. Grancagnolo, M. Panareo, A. Pepino and G. Tassielli
The Use of FPGA in Drift Chambers for High Energy Physics Experiments
ISBN 978-953-51-3208-0, Print ISBN 978-953-51-3207-3, May 31, 2017, doi:10.5772/66853

1b: Cluster Counting/Timing: CluTim algorithm

At the beginning of the signal processing procedure, a counter starts to count, providing the timing information related to the signal under scrutiny. The determination of a peak is done by relating the i -th sampled bin to a number n of preceding bins, where n is related to the rise times of the signal peak. Once a peak is found, it is sent to pipeline memories which are continuously filled as new peaks are found. When a trigger signal occurs at time t_0 , the reading procedure is enabled and only the data relative to the found peaks in the $[t_0; t_0 + t_{\max}]$ time interval are transferred to an external device



Input signal, values of the auxiliary functions and found peaks.

2. Development of a monitoring chamber for v_{drift}

Numbers in literature

Variation of the drift velocity of the order of % affects the spatial resolution with a contribution of $50\mu\text{m}$, over a drift distance of 5mm .

- monitoring of factors affecting the drift velocity
- real time correction of space-time parametrization

A continuous monitoring of the drift velocity at the level of $\pm 1 \times 10^{-3}$ in range of few tens of seconds allows to detect:

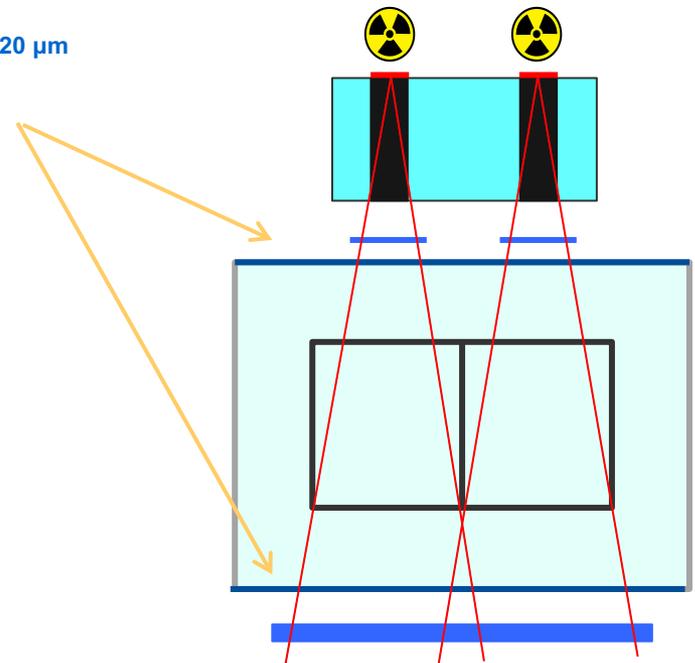
- variation of the electric field of about 2V/cm ;
- variation of the percentage of isobutane of about 4.3×10^{-3} ;
- variation of the pressure of the gas mixture of about 0.8 mbar ;
- variation of water vapour of about $_{-150}^{+80}$ ppm.

2. Development of a monitoring chamber for v_{drift}

Setup

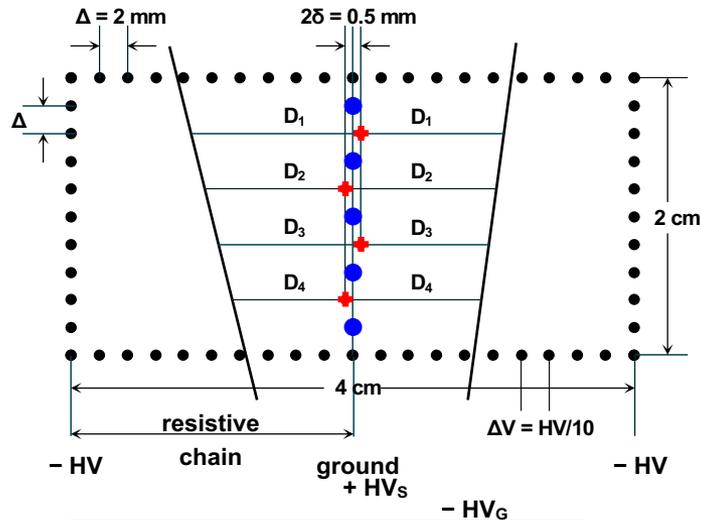
- ^{90}Sr β source
 - (2.3 MeV e.p.) \approx 5 MBq activity
- Fe collimators
 - 5 mm diameter \times 1.5 cm, $\Delta\Omega = 0.087\text{sr}$
- trigger scintillators
 - 2 (top): 1 cm \times 1 cm \times 1.5 mm
 - 1 (bottom): 5 cm \times 5 cm \times 1 cm
- monitor chamber gas envelope
 - 6 cm \times 4 cm \times 30 cm
- monitor drift cell
 - 4 cm \times 2 cm \times 20 cm

Thin windows
5 cm \times 5 cm \times 20 μm

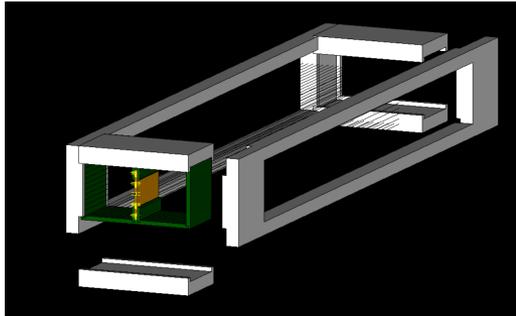


2. Development of a monitoring chamber for v_{drift}

cell



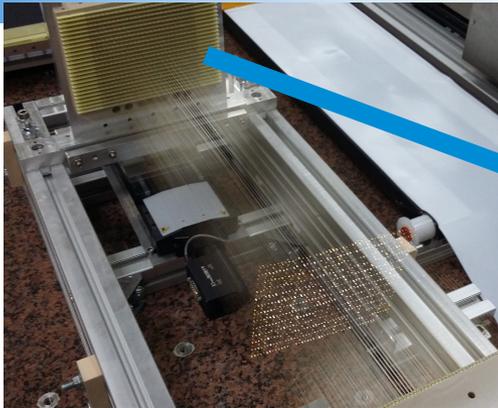
- 4 cm x 2 cm transverse cell size
- 20 cm length
- constant E-field by graded potential
- constant drift velocity $D = v_d \times T$
- 4 sense wires (20 μm W(Au)) @ $+HV_S$
 - sense wires staggering $\delta = \pm 250 \mu\text{m}$
- 60 field wires (50 μm Al(Au))
 - field wire spacing $\Delta = 2 \text{ mm}$
- 5 guard wires (120 μm Al(Au)) @ $+HV_G$



Conclusions

- 1. On going activities are progressing well**
- 2. R&D activities going to start**
- 3. Manpower and funding available (FEST, CREMLIN+ projects)**

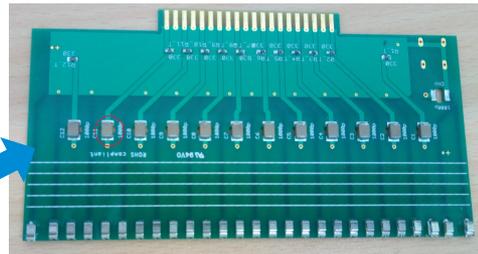
Backup



Anode wires (20 μm) made of tungsten coated with gold
Cathode wires (40 μm) in aluminium coated with silver



Soldering on PCB



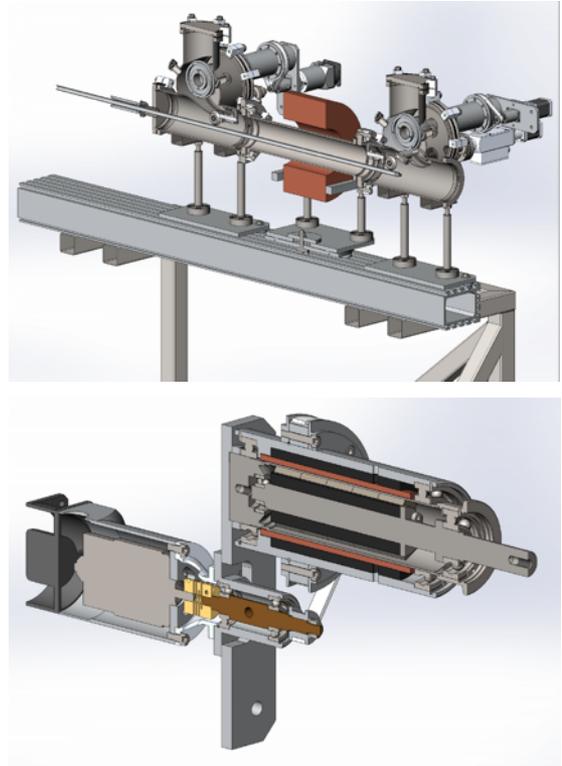
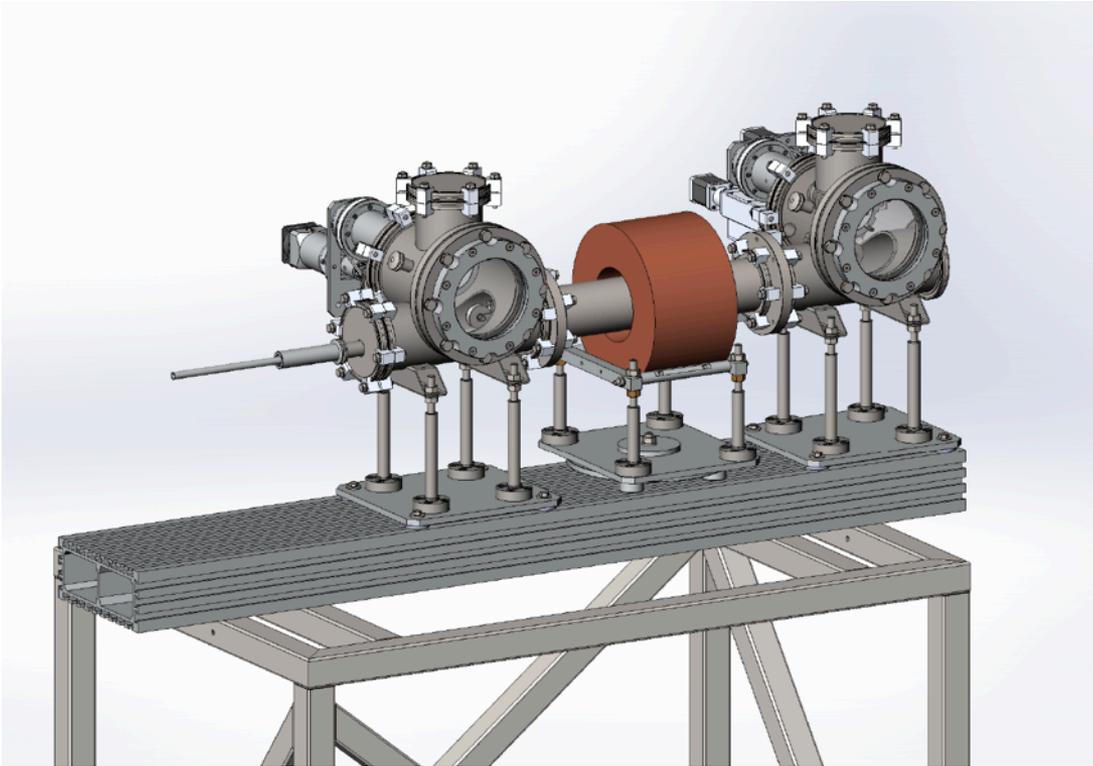
Cards for voltage
powering

Front-end
cards



1a: New wire material: C wire metal coating (BINP)

BINP
A. Popov
V. Logashenko



1a: New wire material: C wire Ag gluing

EPOXY TECHNOLOGY

EPO-TEK® H20E

Technical Data Sheet
For Reference Only
Electrically Conductive, Silver Epoxy

June 2018
Rev: XV
No. of Components: Two
Mix Ratio by Weight: 1 : 1
Specific Gravity: Part A: 2.03 Part B: 3.07 Springs 2.87
Pot Life: 2.5 Days
Shelf Life - Bulk: One year at room temperature
Shelf Life - Springs: One year at -40°C

NOTES:
1. Components should be kept closed when not in use.
2. Filled systems should be stored thoroughly before using and prior to use.
3. Performance properties (strength, conductivity, adhesion) of the product may vary from those stated on the data sheet when to-peak/hygiene packaging or post processing of any kind is performed. Epoxy's warranties shall not apply to any products that have been reprocessed or repackaged from Epoxy's delivered sub-component into any other container of any kind, including but not limited to syringes, syringe cartridges, pistons, tubes, capsules, films or other packages.
4. Product Description: EPO-TEK H20E is a two component, 100% solids silver-filled epoxy system designed specifically for chip bonding in microelectronic and optoelectronic applications due to its high thermal conductivity. It has proven itself to be extremely reliable over many years of service and is still the conductive adhesive of choice for new applications. Also available in a single component frozen syringe.
5. Typical Properties: Cure condition: 150°C / 1 hour. Different batches, conditions & applications yield differing results. Data shown is not guaranteed. To be used as a guide only, not as a specification. * denotes test on lot acceptance basis

PHYSICAL PROPERTIES		Part A: Silver	Part B: Silver
Color (before cure)		Smooth	Electrically paste
Consistency		2,200 - 3,200 cPs	
Viscosity (23°C) @ 100 rpm		4.6	
Thixotropic Index		4.6	
Glass Transition Temp:		8.60 °C (Dynamic Cure: 20-200°C/180-20 Min. Retire: 10-200°C)	
Coefficient of Thermal Expansion (CTE)			
Below Tg		31 x 10 ⁻⁶ /in/°C	
Above Tg		158 x 10 ⁻⁶ /in/°C	
Shore D Hardness		75	
Lap Shear @ 23°C		1,475 psi	
Die Shear @ 23°C		9.10 Kg	3,596 psi
Degradation Temp:		425 °C	
Weight Loss:			
@ 200°C		0.59 %	
@ 250°C		1.09 %	
@ 300°C		1.87 %	
Suggested Operating Temperature:		+3200 °C (Intermittent)	
Storage Modulus:		858,700 psi	
Ion Content:		Cl ⁻ : 73 ppm Na ⁺ : 2 ppm	
		NH ₄ ⁺ : 98 ppm K ⁺ : 3 ppm	
* Particle Size:		1.45 microns	

ELECTRICAL AND THERMAL PROPERTIES

Thermal Conductivity	2.5 W/mK based on standard method: Laser Flash
Thermal Conductivity	29 W/mK based on Thermal Resistance Data R = 1 x 10 ⁻⁴ K ² /A ²
Thermal Resistance (Junction to Case)	TO-18 package with nickel-gold metallized 20 x 20 mil chips and bonded with H20E (2milts thick)
	EPO-TEK H20E: 6.7 to 7.0°C/W
	Solder: 4 to 5°C/W
* Volume Resistivity @ 23°C:	< 0.0004 Ohm-cm

LOCTITE

LOCTITE ABLESTIK 84-1LMI

Technical Data Sheet

October 2014

PRODUCT DESCRIPTION
LOCTITE ABLESTIK 84-1LMI provides the following product characteristics:
Technology: Epoxy
Appearance: Silver
Cure: Heat cure
Product Benefits:
• Electrically conductive
• Low bleed
• Low outgassing

Estimate Item Content, ppm:
Chloride (Cl-) 450
Sulfate (SO₄) 150
Potassium (K+) 110
Water Extract Conductivity (µmhos/cm) 15
Weight Loss @ 300°C, % 0.18

Volume Resistivity, Ohm-cm 0.0004

TYPICAL PERFORMANCE OF CURED MATERIAL
Die Shear Strength: 18
Lap Shear Strength @ 23°C: 18
A-B-LMI: 13 (1000)

ML-870-883
LOCTITE ABLESTIK 84-1LMI meets the requirements of MIL-STD-883, Method 2011.

TYPICAL PROPERTIES OF UNCURED MATERIAL
Thermal Index (T₅₀) 4.0
Viscosity (Brookfield CPS) 25 °C, mPa·s (cP) 30,000
Shore D 30
Wet-Lift @ 23°C, days 91
Shore-Lift (from date of manufacture) 91
@ 10°C, days 183
@ 15°C, days 183
@ 40°C, days 385

GENERAL INFORMATION
For safe handling information on this product, consult the Material Safety Data Sheet (MSDS).

TRAINING:
1. Allow container to reach room temperature before use.
2. After removal from the freezer, stir the syringe to blend uniformly while heating.
3. Refer to the Syringe Thaw Time chart for the thaw time recommendation.
4. DO NOT open the container before contents reach 20°C temperature. Any moisture that collects on the threaded container should be removed prior to opening the container.
5. DO NOT re-heat. Once thawed to 40°C, the adhesive should not be re-heated.

Cure Schedule
1 Hour @ 150°C
Alternate Cure Schedule
1 Hour @ 150°C

TYPICAL PROPERTIES OF CURED MATERIAL
Physical Properties:
Coefficient of Thermal Expansion:
Below Tg (ppm/°C) 35
Above Tg (ppm/°C) 185
Glass Transition Temperature (Tg to TMA, °C) 103
Thermal Conductivity (W/m·K) 2.4

Temperature, °C
Syringe Thaw Time, Minutes



drawbacks

- curing time 1 hr at 150° C
- dispensing expensive dispensers
- cost Epo-TEK H20E. 12.5 €/g
ABLEBOND 84-1LMI 54.0 €/cc

solution (?)

- curing time pulsed infrared laser (from MEG2 wiring robot)?

EPO-TEK H20E Adhesive, 1oz

MSDS
Price: \$273.00 - \$103.00 (Shipping)
• Epo-TEK H20E Adhesive
• 10 year shelf life (unopened)

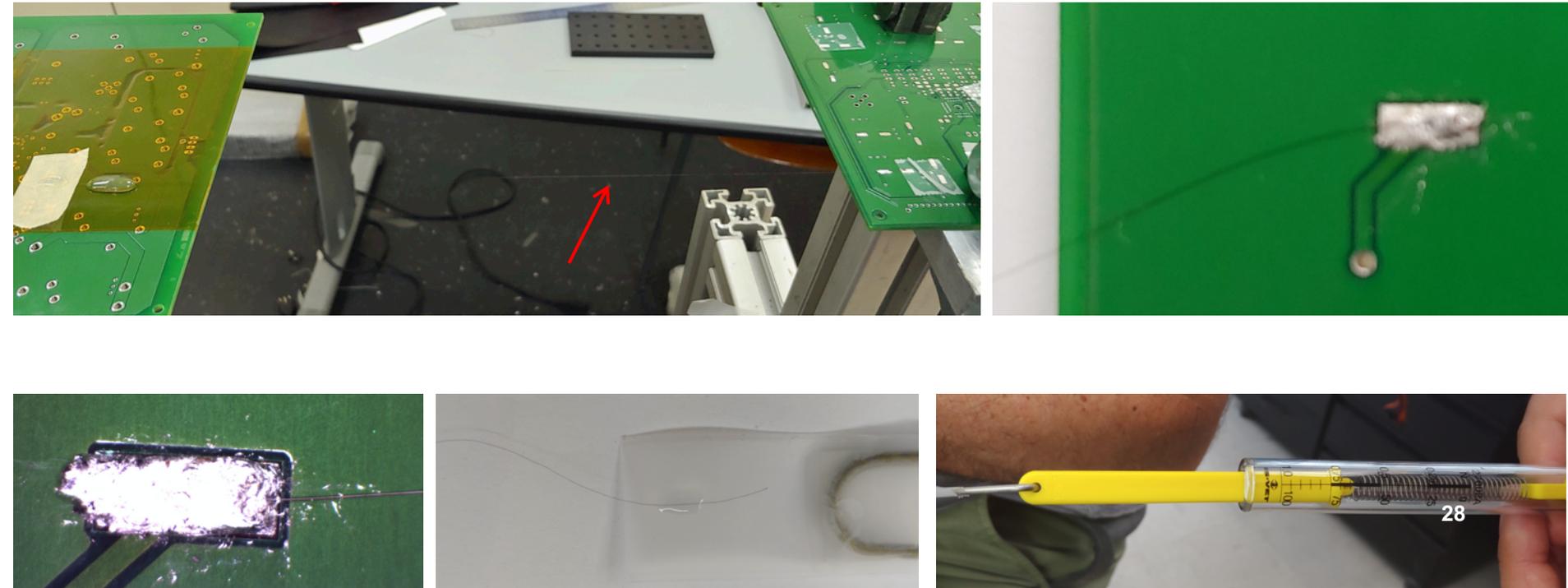


ALL HUGHES



1a: C wire manual soldering

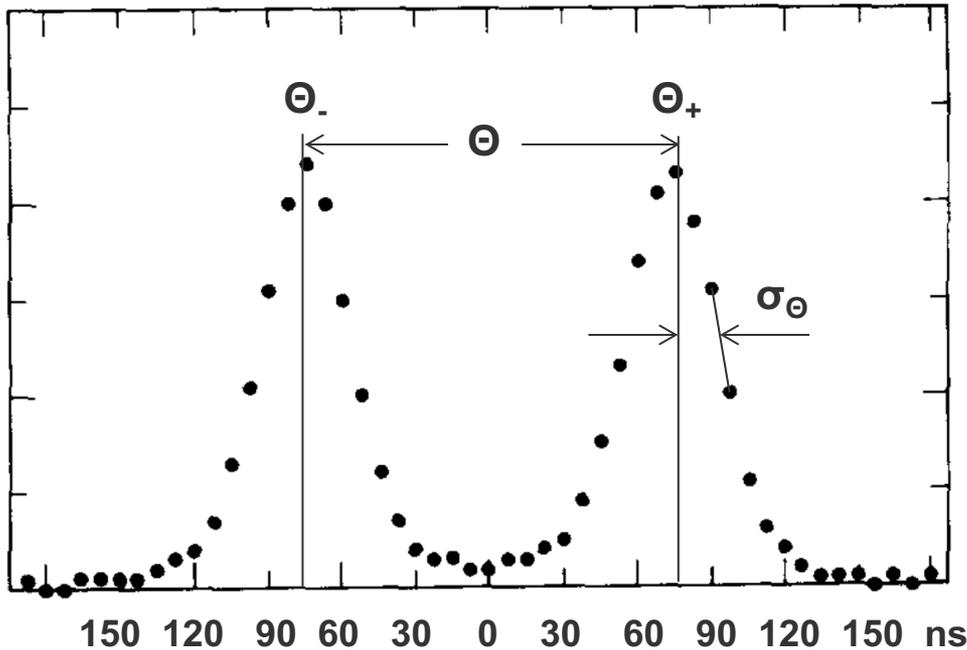
without metal coating



28

2. Development of a monitoring chamber for v_{drift}

Principles of the measurement



for tracks on the left side:

$$T_1 + T_3 = 2T_2 + 4\delta/v_d \quad T_2 + T_4 = 2T_3 - 4\delta/v_d$$

$$\Theta_+ = (T_1 + T_3 - 2T_2) - (T_2 + T_4 - 2T_3) = 8\delta/v_d$$

analogously, on the right side:

$$\Theta_- = (T_1 + T_3 - 2T_2) - (T_2 + T_4 - 2T_3) = -8\delta/v_d$$

two peaks separated by

$$\Theta = 16\delta/v_d \approx 160 \text{ ns}$$

$$\text{assuming } \sigma_T = \sigma_D/v_d \approx 5 \text{ ns} \quad \sigma_\Theta = \sqrt{24} \sigma_T = 24 \text{ ns}$$

$$(\sigma_D \approx 120 \mu\text{m and } v_d = 2.5 \text{ cm}/\mu\text{s at } E = 1 \text{ kV/cm})$$

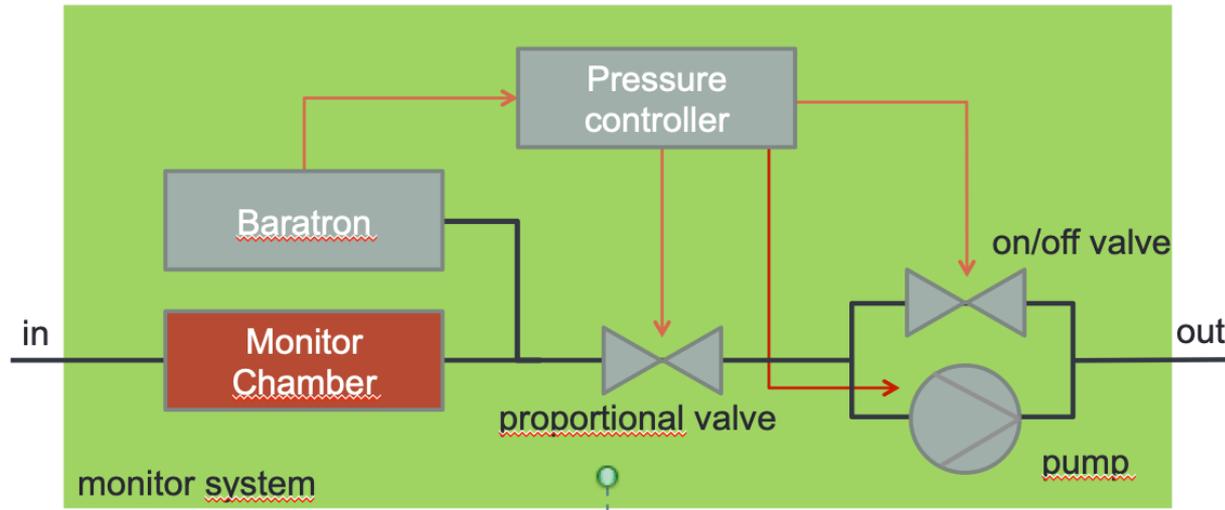
$$\sigma_\Theta = 24 \text{ ns}$$

with 10^4 tracks (10 s at 1 kHz!)

$$\text{sensitivity on } v_{\text{drift}} \leq 1.5 \times 10^{-3}$$

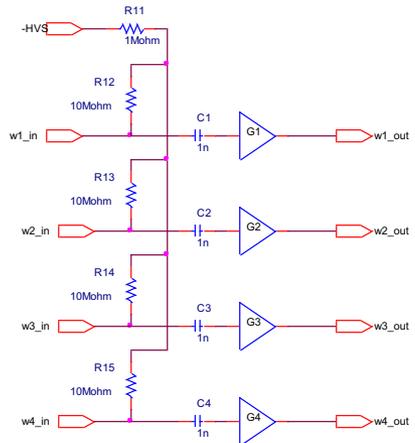
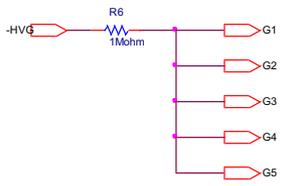
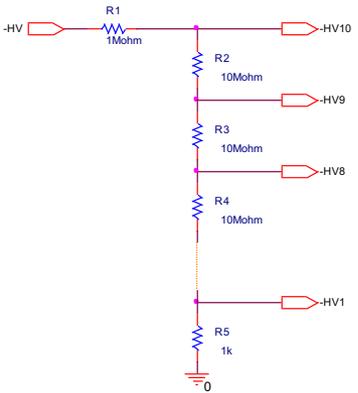
2. Development of a monitoring chamber for v_{drift}

Monitoring system



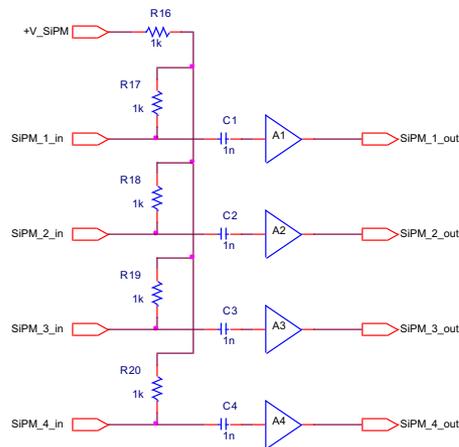
- Baratron: MKS mod. 631D range 0.1 ÷ 1000Torr
- Pressure controller: MKS mod. 250E-1D
- Proportional valve: MKS mod. 248D
- Pump: 5l/min 120kPa

Monitor chamber: biasing/amplifying – DC and



- Biasing
 - 20 (2x10) precision resistors for wires biasing
 - 1 resistor for guards wires biasing
 - 5 resistors for sense wires biasing
- Amplifying
 - 4 low-noise/distortion gain (~10) channels
- Digitizing
 - 4-channels WaveDream board

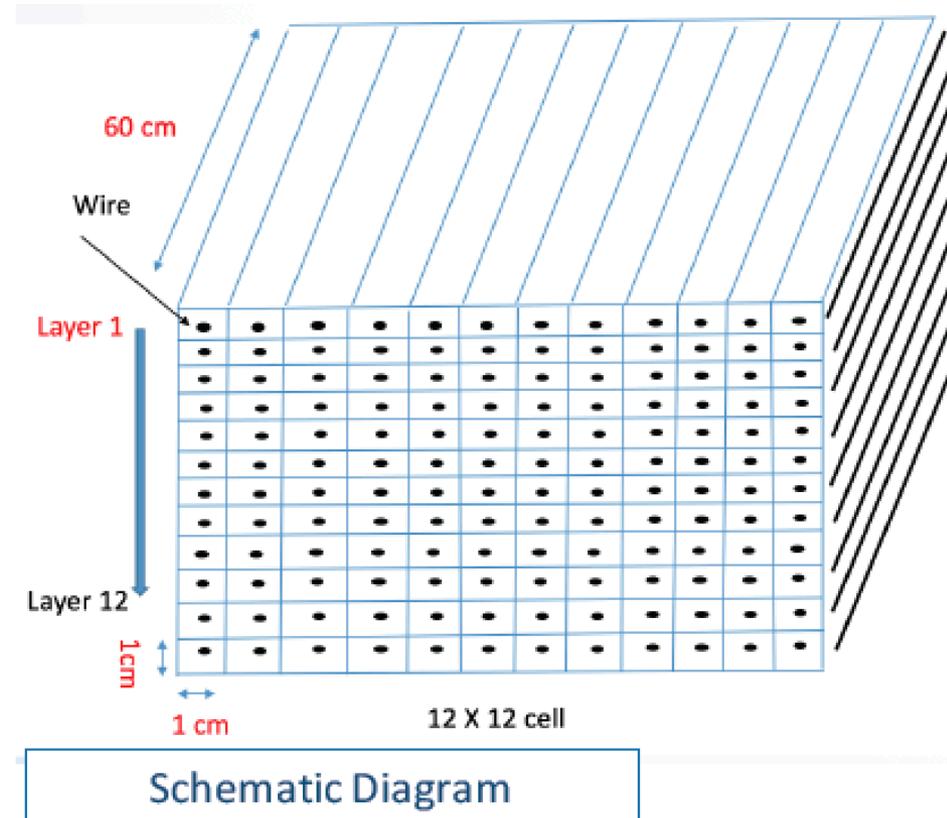
Monitor chamber: biasing/amplifying - SiPM



- Biasing
 - 30V dc
- Amplifying
 - 4 low-distortion gain channels

I nostri interessi: Camera a deriva

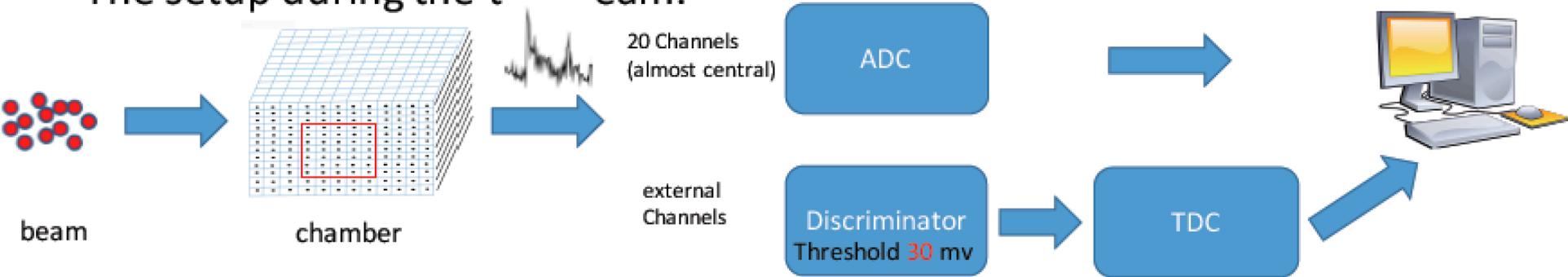
- The chamber consists of 12 x 12 cell
- Each cell is 1 cm x 1 cm
- the wire length is 60 cm
- The voltage applied to each wire is about 1475V (depends by the runs)
- The gas used is 90% He 10 % i-C4H10



Rivelatore costruito e testato a INFN Lecce

I nostri interessi: Setup per camera a deriva

- The chamber is exposed to different types of beams (Muon , Electron, Pion and Kaon) with energy 20-60GeV
- The setup during the test beam:



- During the test beam:
 - We read **just 20 cells** in the central core (**Layer 7 was broken**).
 - Data are available via rfa virtual organization accessible via grid tools in the path:
<srm://storm-se-01.ba.infn.it:8444/srm/managerv2?SFN=/rfa/TestBeam>

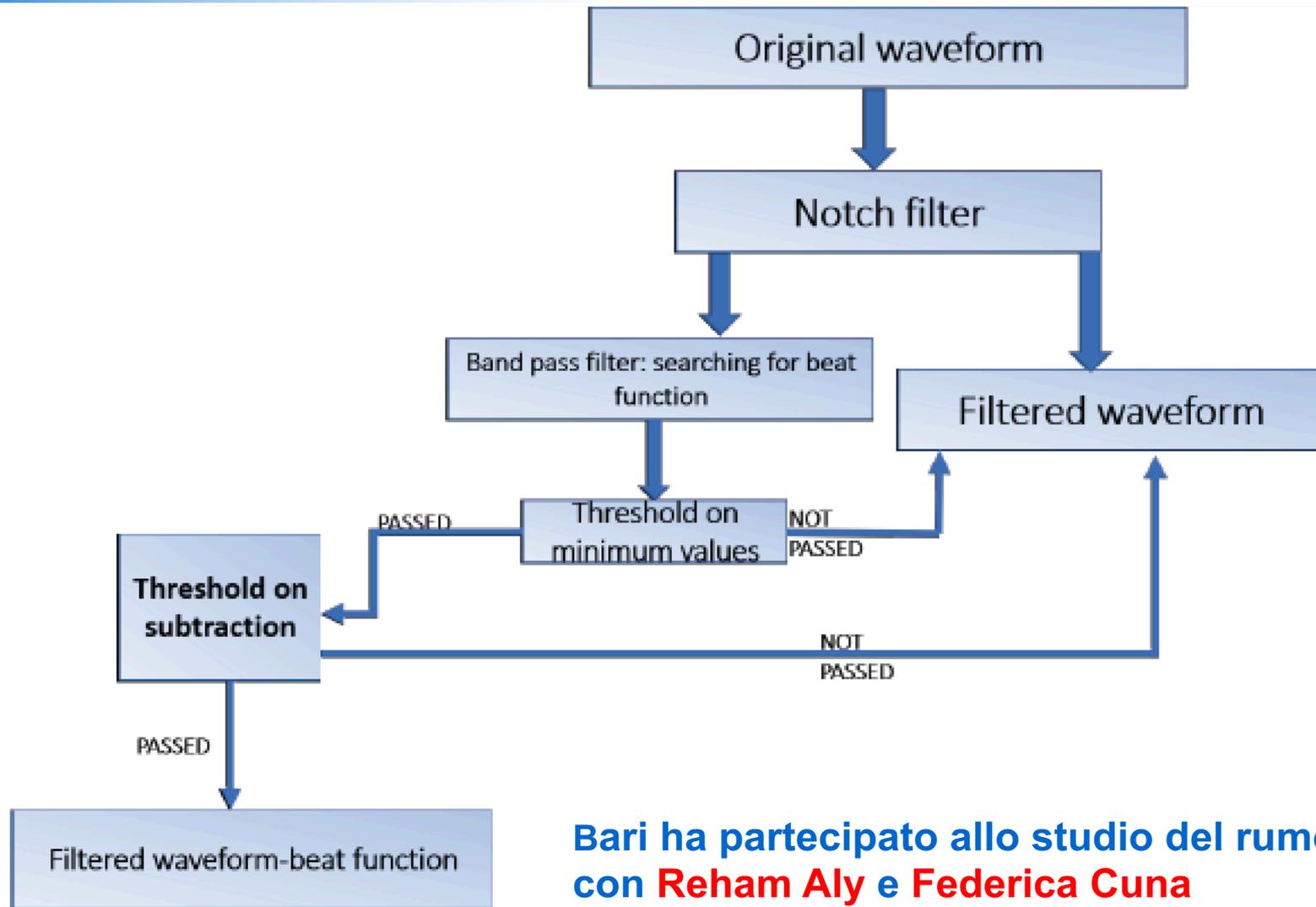
Le misure previste

Derive performance of the chamber in terms of potential for particle tracking and particle ID

- This is the request:
 - Goal: Pion / kaon separation at different energies
 - External detector for particle ID (CEDAR)
 - Beam Energies: 6, 10, 20, 40, 50, 60, 100
 - 10k events per particle type and energy
- Measurement with 2 gas mix for 2 energies
- High Voltage scan for one energy

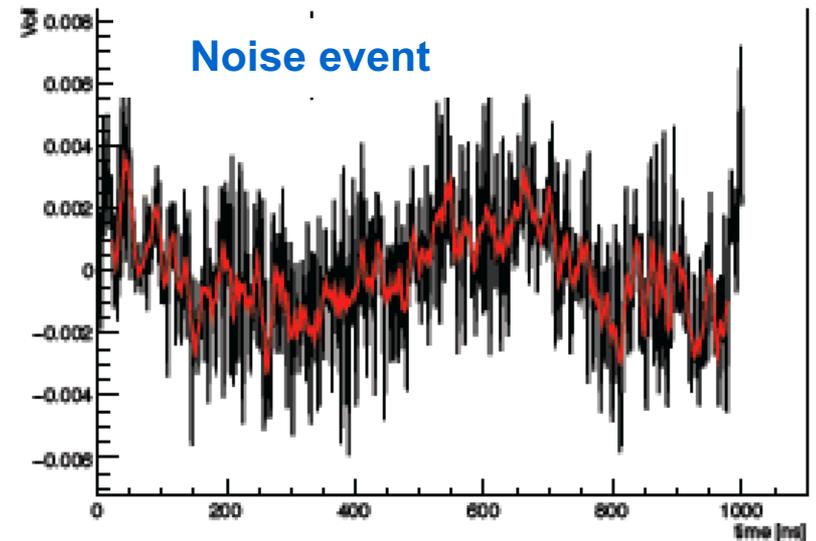
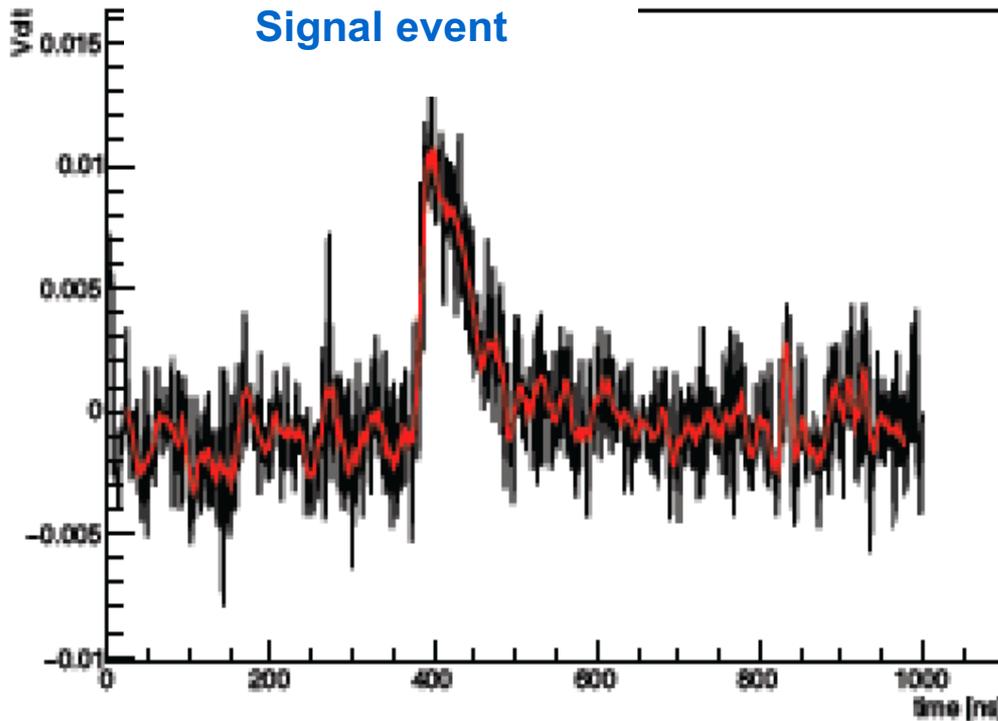
Il team barese ha partecipato a tutte le fasi dell'analisi che è ancora in corso.

Trattamento del rumore



Bari ha partecipato allo studio del rumore con **Reham Aly** e **Federica Cuna**

Trattamento del segnale e del rumore



**Definito l'algoritmo per la definizione del segnale e del rumore
→ pronti per ricostruire gli hit e le tracce**

Calcolo per RD_FA

Calcolo per RD_FA

- E' stata creata una “virtual organization” **rdfa** per attività RD_FA in GRID:
 - una coda del CNAF associato alla VO e 10TB di disco
- Il **centro ReCaS Bari** è il primo Tier2 che supporta la VO **rdfa** quanto:
 - ci sono le risorse per ospitare le simulazioni per RD_FA
 - c'è il know-how su strumenti di calcolo
 - Il ranking come Tier2 di CMS (ed Alice) è buono
- I **dati del testbeam del 2018** sono storiati a **Bari** ed accessibili via grid da chiunque sia sottoscritto alla VO **rdfa**

Partecipazione a progetti

Proposal for Call: H2020-MSCA-RISE-2019 – approved

• “Future Experiments seek Smart Technologies (FEST)”

- N. De Filippis – 4months, R. Aly – 4 months, I. Margjeka – 4 months, W. Elmetenawee – 4 months, F. Cuna – 4 months

Proposal for CREMLIN+ submitted

- “Development and design of Particle Identification and tracking systems”

Proposals for AIDA++:

with INFN Lecce

- “Cluster Counting/Timing: data reduction and pre-processing of drift chamber signals sampled at high rates”
- “ A prototype of an ultra-light drift chamber with new materials for the next generation of lepton colliders”
- “Development of innovative planar gaseous detectors with high time and spatial resolution and improved rate capability for FCC”
- “Innovative neutron gaseous detectors with solid converters and imaging capabilities “

Anagrafica e richieste 2020

Anagrafica FCC 2020

INFN- Bari	2020
N. De Filippis (Assoc. Prof.)	20%
M. Abbrescia (Assoc. Prof.)	10%
R. Aly (PhD)	20%
I. Margjeka (PhD)	10%
W. Elmetenawee (PhD)	10%
A. Colaleo (INFN)	10%
M. Maggi (INFN)	10%
TOT	0.9 FTE

Richieste finanziarie per FCC 2020 (1)

Missioni: meeting/workshop

INFN- Bari	k€
N. De Filippis	2
M. Abbrescia	1
R. Aly	2
I. Margjeka	1
W. Elmetenawee	1
M. Maggi	1
A. Colaleo	1
TOT	9k€

Per quanto riguarda i **consumi** → nuove prospettive di test in lab. per il 2020

Prospettive di test in lab. per il 2020

Test di una camera di monitor della velocità di drift

Motivazioni:

- Variazioni dell'ordine del per cento della velocità di drift incidono, su una distanza di drift di 5 mm, con un non trascurabile contributo di 50 μm alla risoluzione spaziale.
- E', pertanto, necessario monitorare tutti i parametri (campo elettrico, miscela di gas, pressione, vapori d'acqua) che possono indurre variazioni di velocità di drift al livello di qualche per-mille, in lassi di tempo molto brevi rispetto al tempo necessario alla raccolta di un numero sufficiente di tracce per effettuare un'affidabile parametrizzazione delle relazioni spazio-temporali, in modo da consentirne le opportune correzioni

Monitor chamber: numbers

Stato dell'arte:

test in letteratura dimostrano che un continuo monitoraggio della velocità di drift al livello del $\pm 1 \times 10^{-3}$ in tempi dell'ordine di poche decine di secondi consente di apprezzare:

- variazioni di campo elettrico di 2V/cm;
- variazioni relative di contenuto di isobutano del 4.3×10^{-3} ;
- variazioni della pressione della miscela di 0.8 mbar;
- variazioni di contenuto di vapori d'acqua di $_{-150}^{+80}$ ppm.

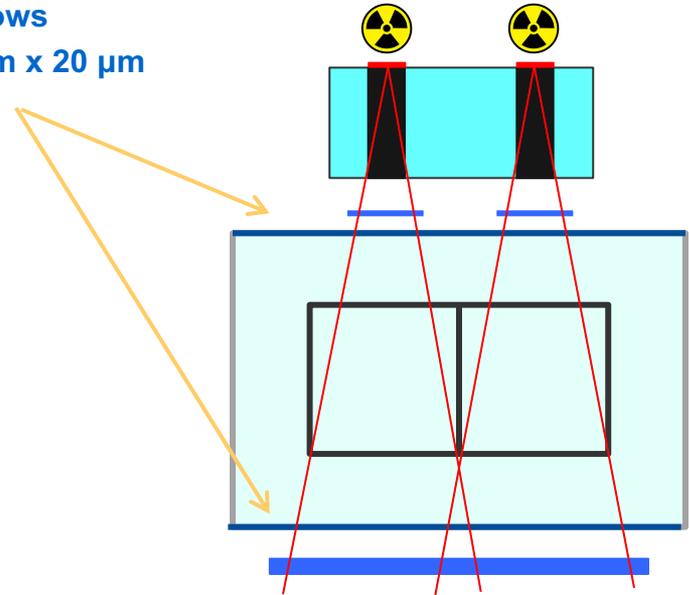
Goal:

si intende contribuire alla realizzazione di una camera di monitoring presso i laboratori INFN-Lecce, per poi installarla e testarla presso INFN Bari e Lecce per gli studi del rivelatore IDEA per FCC-ee

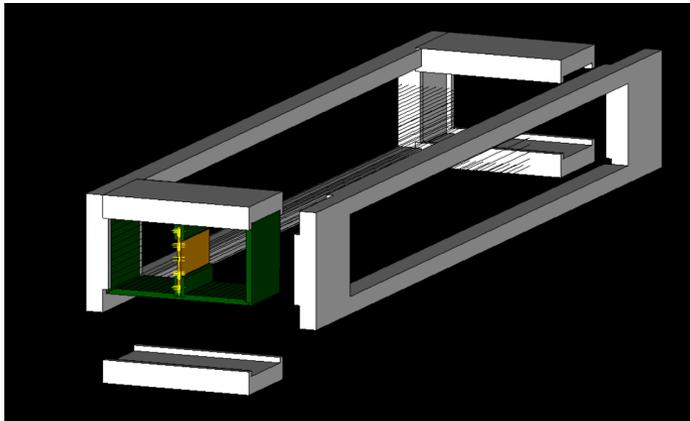
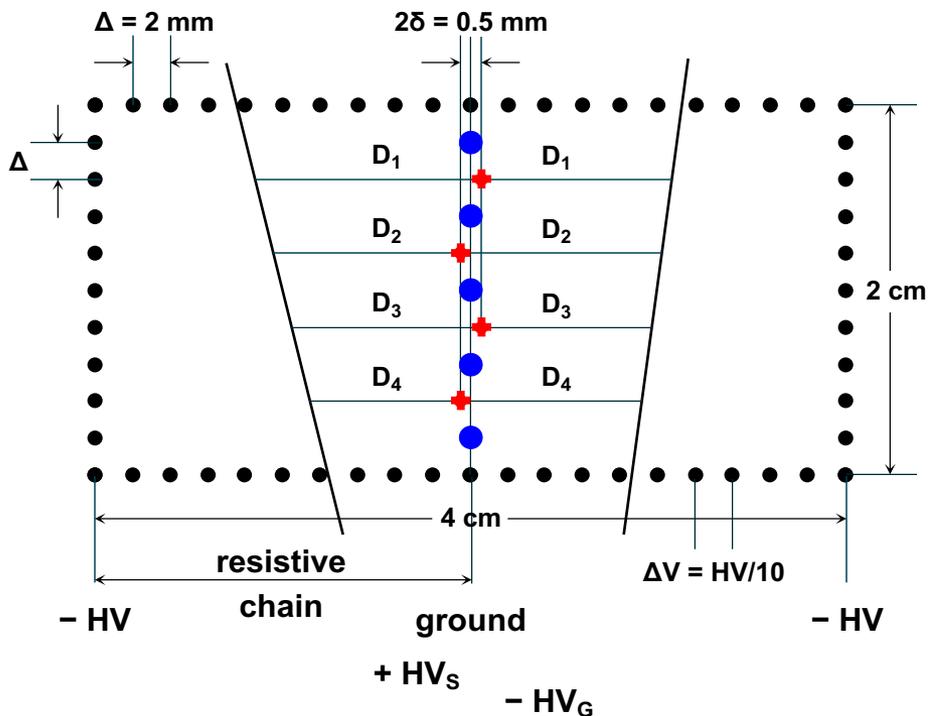
Monitor chamber: setup

- ^{90}Sr β source
 - (2.3 MeV e.p.) \approx 5 MBq activity
- Fe collimators
 - 5 mm diameter \times 1.5 cm, $\Delta\Omega = 0.087\text{sr}$
- trigger scintillators
 - 2 (top): 1 cm \times 1 cm \times 1.5 mm
 - 1 (bottom): 5 cm \times 5 cm \times 1 cm
- monitor chamber gas envelope
 - 6 cm \times 4 cm \times 30 cm
- monitor drift cell
 - 4 cm \times 2 cm \times 20 cm

Thin windows
5 cm \times 5 cm \times 20 μm

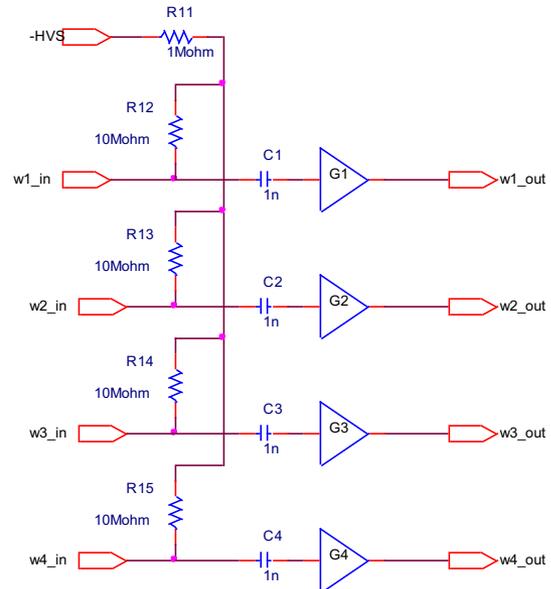
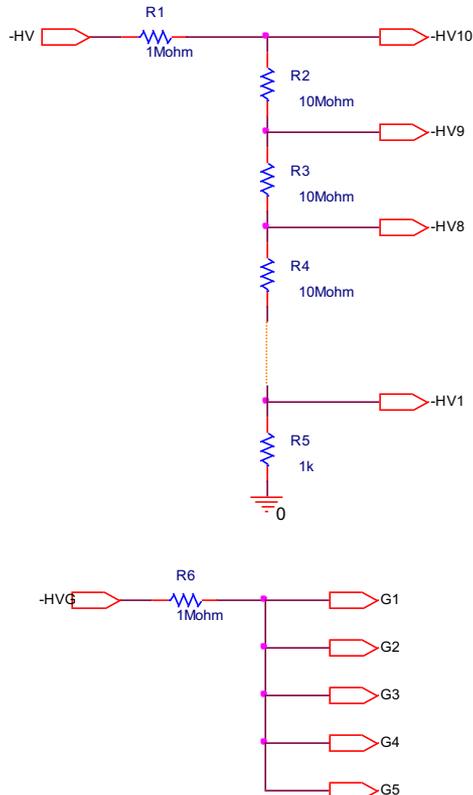


Monitor chamber: cell



- 4 cm x 2 cm transverse cell size
- 20 cm length
- constant E-field by graded potential
- constant drift velocity $D = v_d \times T$
- 4 sense wires (20 μm W(Au)) @ $+HV_S$
- sense wires staggering $\delta = \pm 250 \mu\text{m}$
- 60 field wires (50 μm Al(Au))
- field wire spacing $\Delta = 2 \text{ mm}$
- 5 guard wires (120 μm Al(Au)) @ $+HV_G$

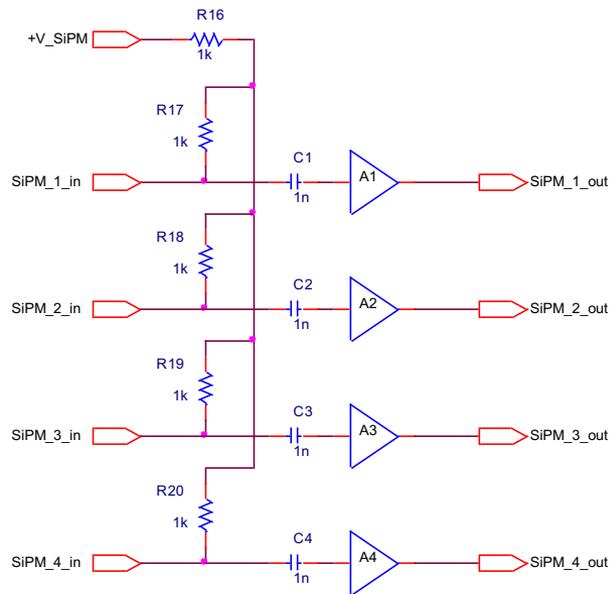
Monitor chamber: biasing/amplifying - DC



- Biasing
 - 20 (2x10) precision resistors for wires biasing
 - 1 resistor for guards wires biasing
 - 5 resistors for sense wires biasing
- Amplifying
 - 4 low-noise/distortion gain (~10) channels
- Digitizing
 - 4-channels WaveDream board

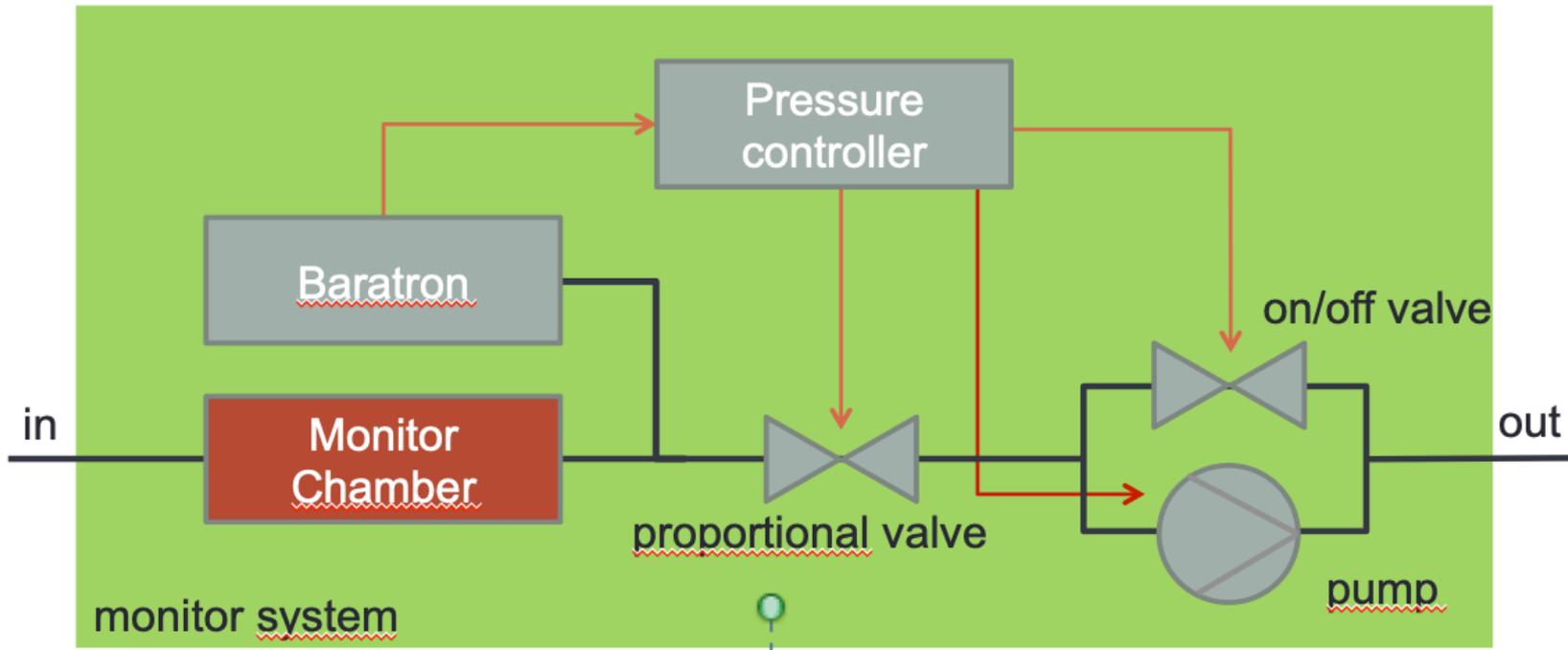


Monitor chamber: biasing/amplifying - SiPM



- Biasing
 - 30V dc
- Amplifying
 - 4 low-distortion gain channels

Monitor chamber: monitoring system



- Baratron: MKS mod. 631D range 0.1 ÷ 1000Torr (1383.00)
- Pressure controller: MKS mod. 250E-1D (2950.00)
- Proportional valve: MKS mod. 248D (832.00)
- Pump: 5l/min 120kPa (17.70)

Richieste finanziarie per FCC 2020 (2)

Consumi: supporto lab per “ v_{drift} monitoring chamber”

Quantità	Descrizione	Modello	costo unitario	costo totale
gas				
1	Baratron	MKS mod. 631D	€ 1.383,00	€ 1.383,00
1	Pressure controller	MKS mod. 250E-1D	€ 2.950,00	€ 2.950,00
1	Proportional valve	MKS mod. 248D	€ 832,00	€ 832,00
1	Pump	5l/min 120kPa	€ 17,00	€ 17,00
1	Valvole per switch, raccordi, ecc		€ 600,00	€ 600,00
totale gas + IVA				€ 7.054,04
biasing				
2	convertitore DC/DC HV	CAEN A7502N, -2.1kV	€ 180,00	€ 360,00
2	alimentazione per SiPM		€ 200,00	€ 400,00
40	Resistenze HV	HVC2512-1G0JT18	€ 1,53	€ 61,20
8	wire pcb		€ 120,00	€ 960,00
totale biasing + IVA				€ 927,20
elettronica				
4	canali FE per fili		€ 70,00	€ 280,00
4	canali formazione SiPM		€ 50,00	€ 200,00
1	connettori, pcb		€ 200,00	€ 200,00
1	4-ch's WaveDream Board		€ 1.345,00	€ 1.345,00
totale elettronica + IVA				€ 2.470,50
totale				€ 10.451,74

Backup slides

1. Test of a prototype: noise treatment

Schema for the filter procedure

