Drift chamber for RD_FCC: attività, anagrafica e richieste finanziarie per il 2024

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The Drift Chamber

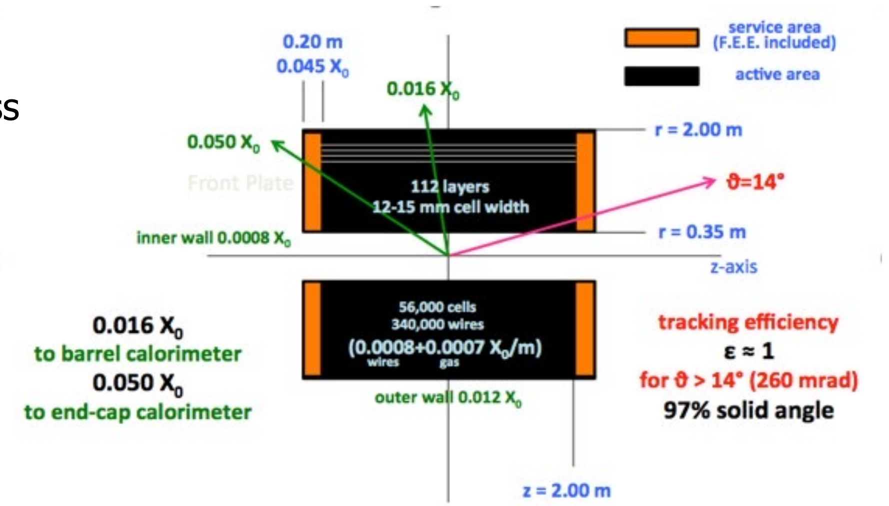
The DCH is:

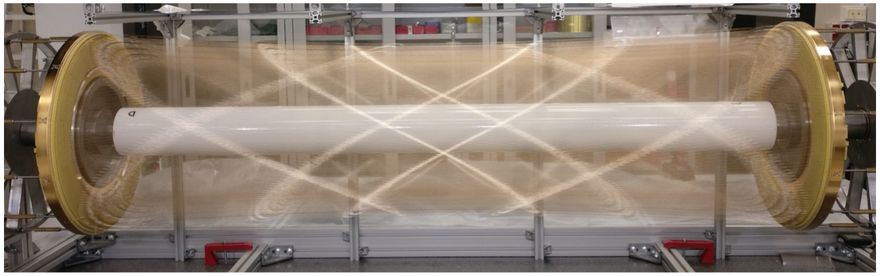
- a unique-volume, high granularity, fully stereo, low-mass cylindrical
- gas: He 90% - iC_4H_{10} 10%
- inner radius R_{in} = 0.35m, outer radius R_{out} = 2m
- length L = 4m
- drift length ~1 cm
- drift time ~150ns
- σ_{xy} < 100 μm, σ_z < 1 mm
- 12÷14.5 mm wide square cells, 5 : 1 field to sense wires ratio
- 112 co-axial layers, at alternating-sign stereo angles, arranged in 24 identical azimuthal sectors, with frontend electronics
- 343968 wires in total:

  sense vires: 20 μm diameter W(Au) => 56448 wires

  field wires: 40 μm diameter Al(Ag) => 229056 wires

  f. and g. wires: 50 μm diameter Al(Ag) => 58464 wires





- the wire net created by the combination of + and – orientation generates a more uniform equipotential surface → better E-field isotropy and smaller ExB asymmetries)

- a large number of wires requires a non standard wiring procedure and needs a feed-through-less wiring system → a wiring procedure developed for the construction of the ultra-light MEG-II drift chamber

Overview delle attività di RD_FCC Bari+Lecce nel 2023

Hardware:

- preparazione e setup tubi a drift per testbeam 2023 al CERN
- *operation* del laboratorio FCC Bari

Simulazione e progettazione:

- numerosi studi di simulazione della geometria della camera a drift per IDEA FCC-ee e del *cluster counting* → ottima collaborazione con il gruppo *software* del CERN FCC
- studi di progettazione meccanica della camera a drift per IDEA FCC-ee in collaborazione con Politecnico di Torino, di Bari ed Enginsoft s.p.a.

Analisi dati/Fisica:

- analisi dati del testbeam 2021 e 2022
- analisi ee→HZ, H→hadrons, Z->$\nu\nu$ o hadrons per misura di accoppiamenti Higgs a quark
- analisi di fisica per misurare le higgs self-coupling ad FCC-hh

Attività di coordinamento software, fisica e calcolo per FCC Italia (N. De Filippis)

Partecipazione a numerosi workshop/conferenze/meeting FCC

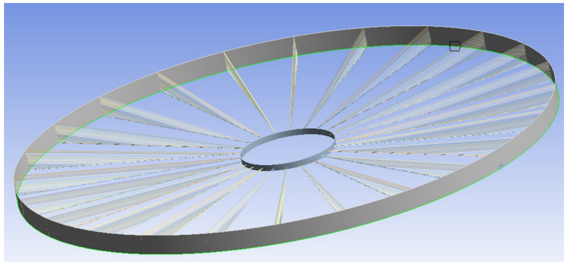
Organizzazione della Detector Eurizon School : lezioni e tutorial

Partecipazione a DRD1 per gas detector (WG2) (contact: F. Grancagnolo, M.Panareo, N. De Filippis)

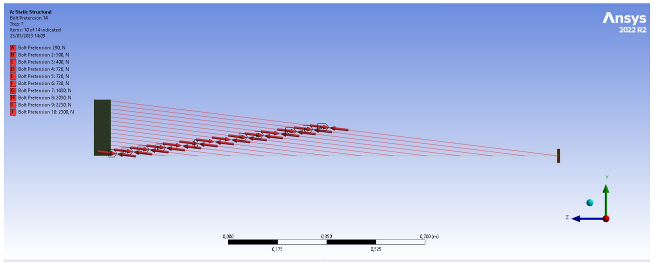
Partecipazione a ECFA Higgs Factory Study WG3 (contact M. Primavera)

Mechanical design of the IDEA drift chamber

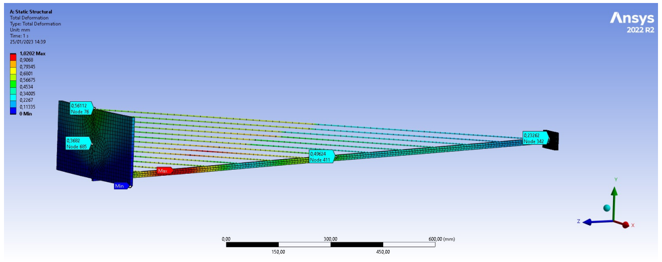
Boundary conditions of the end-plate model



Pre-stressing of stays to compensate DC wires tension



Stays and spoke deformation (to be fully optimized)



- Conceptual design of the IDEA drift chamber completed.
- Finite Element Analysis with homogeneous materials completed.
- Working solution to be optimized with composite materials.

- Goal is to complete the full design by end of 2023 and to start construction of a full-length, 1/12 wedge, prototype

Collaborazione con EnginSoft per:

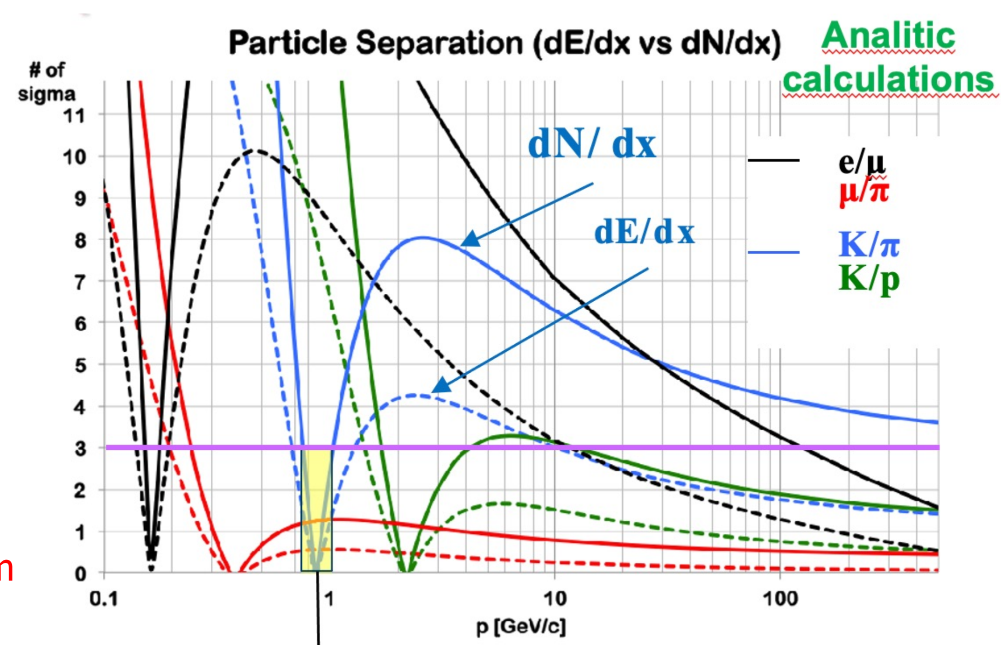
a) modellazione geometrica 3D e definizione completa delle condizioni operative di esercizio

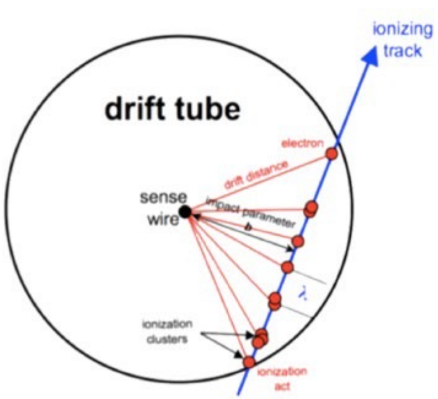
b) Simulazione e ed ottimizzazione multiobiettivo – Ansys

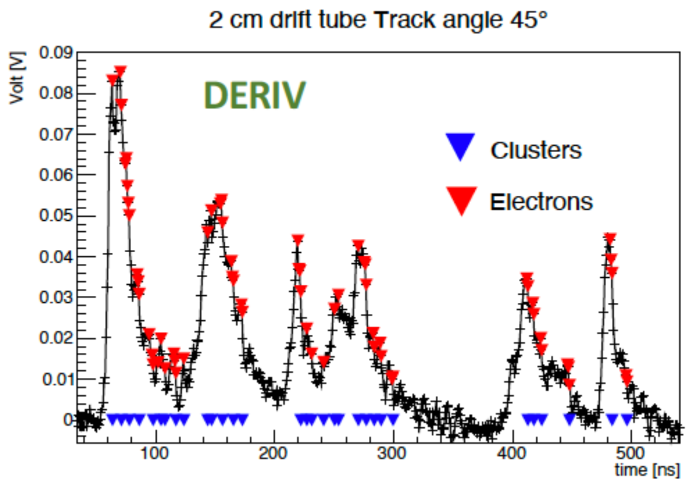
The Drift Chamber: Cluster Counting/Timing and PID

- Analitic calculations: Expected excellent K/π separation over the entire range except $0.85<p<1.05$ GeV (blue lines)

- Simulation with Garfield++ and with the Garfield model ported in GEANT4:
  - the particle separation, both with dE/dx and with dN_{cl}/dx, in GEANT4 found considerably worse than in Garfield
  - the dN_{cl}/dx Fermi plateau with respect to dE/dx is reached at lower values of $\beta\gamma$ with a steeper slope
  - finding answers by using real data from beam tests at CERN in 2021, 2022 and 2023







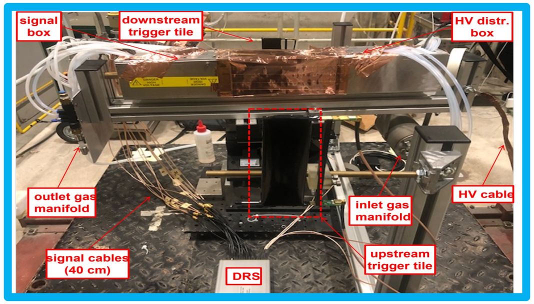
Cluster counting method:

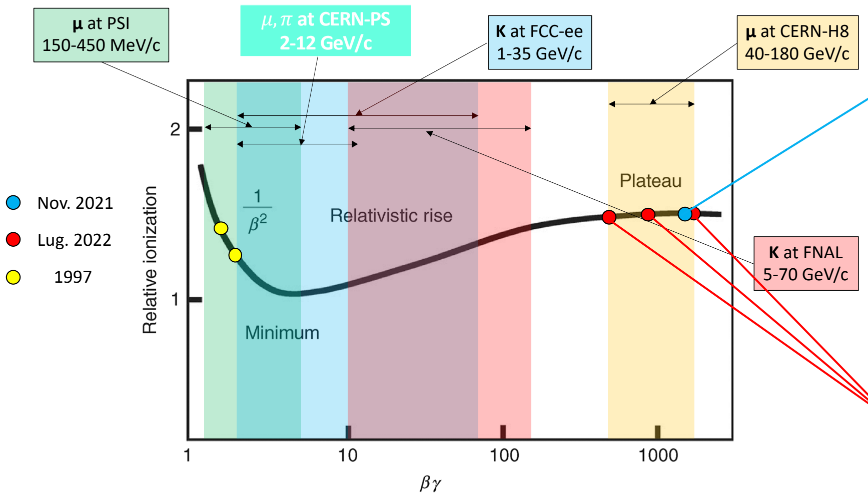
- collect signal and identify peaks
- record the time of arrival of electrons generated in every ionisation cluster
- reconstruct the trajectory at the most likely position

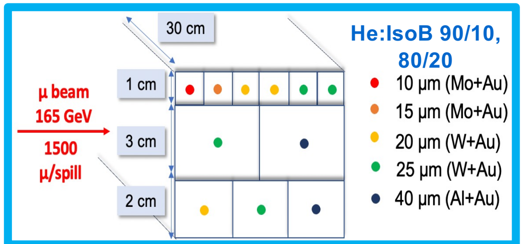
Beam tests in 2021,2022 and 2023

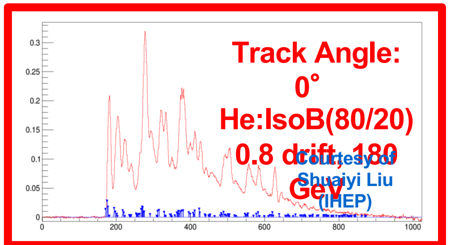
Beam tests to experimentally asses and optimize the **performance of the cluster counting/timing** techniques in strict collaboration with the IHEP Beijing group:

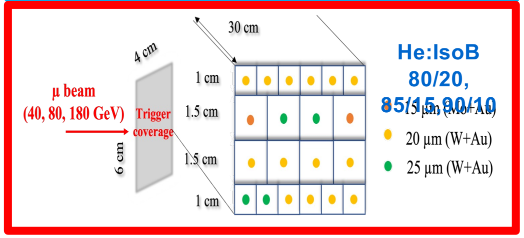
- Two **muon beam tests** performed at **CERN-H8 (βγ > 400)** in Nov. 2021 and July 2022.
- A **muon beam test** (from 4 to 12 GeV momentum) in 2023 performed at **CERN**.
- Ultimate test at **FNAL-MT6** in 2024 with π and **K (βγ = 10−140)** to fully exploit the relativitic rise.

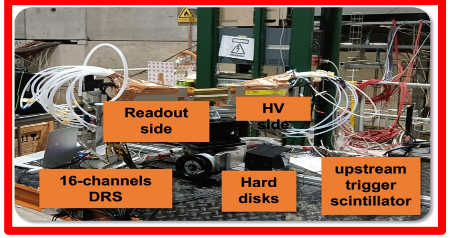






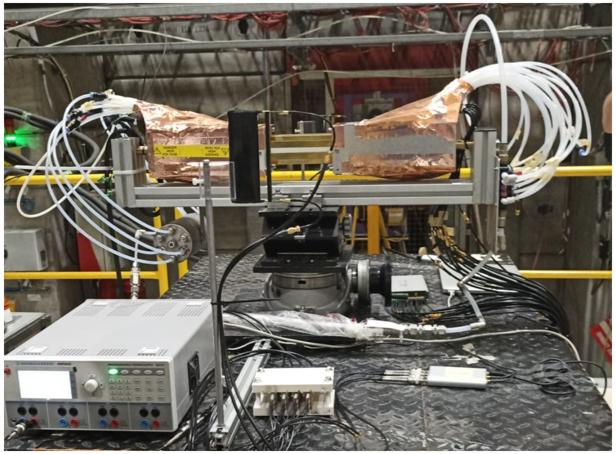


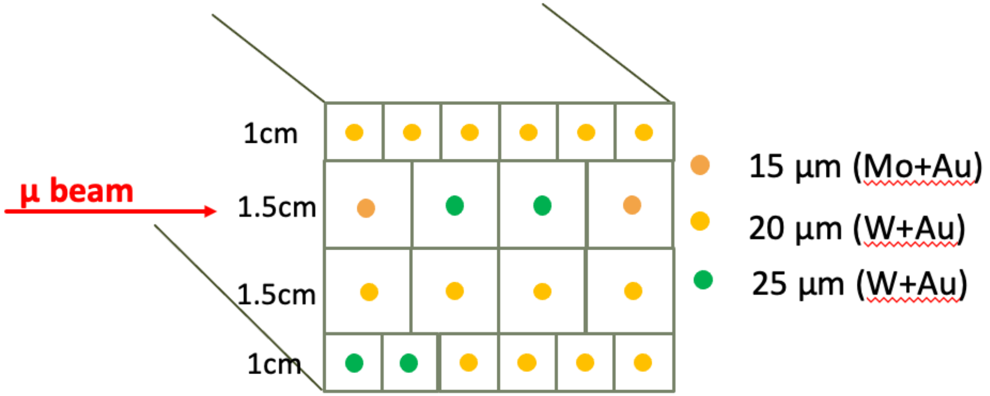


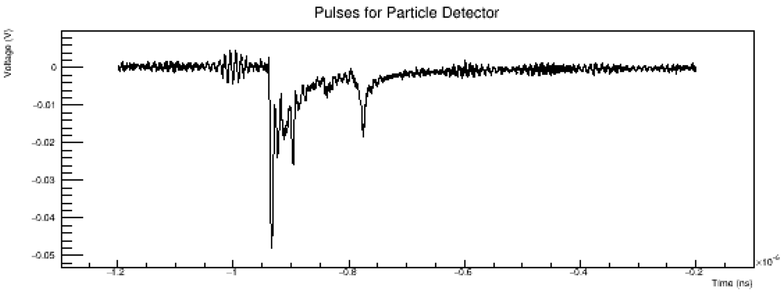


Beam test setup at T10/CERN in 2023

- 20 tubes with different wires (different material and diameter) and different cell size.
- 1 16-channel DRS
- 2 4-channel DRS
- custom PCBs for the 2 trigger scintillators.
- two external hard disk to store the data collected

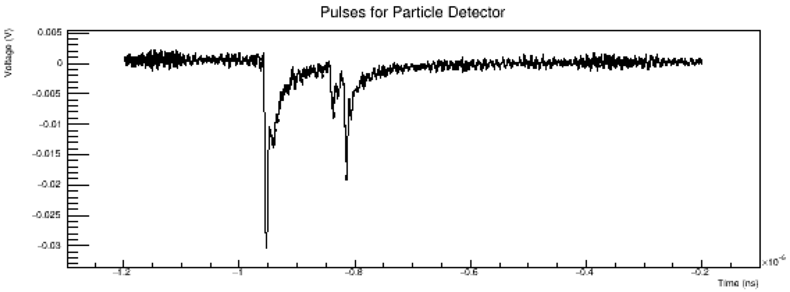




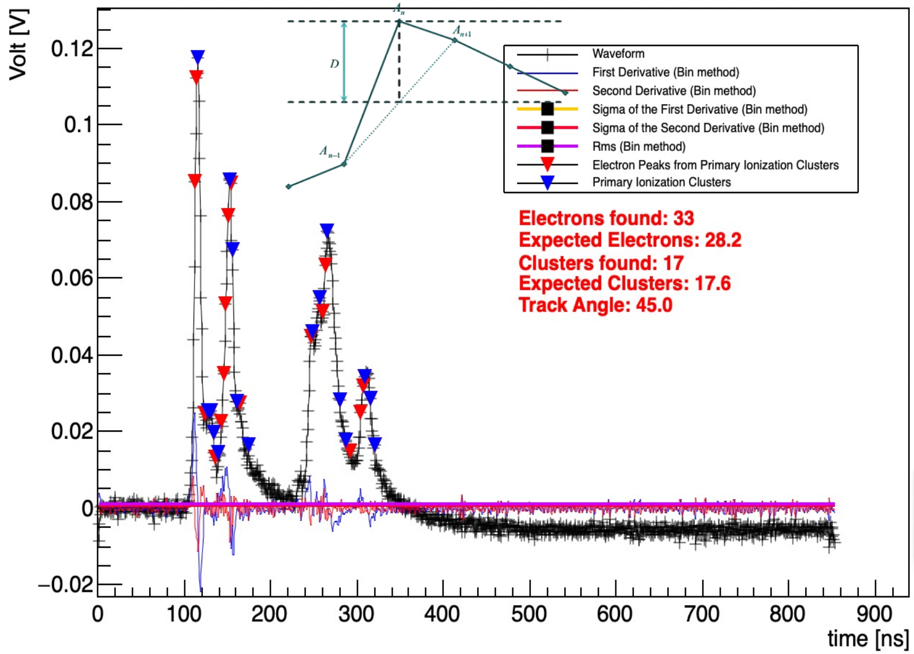


- Data collected at different percentages of helium and isobutane: 90-10. , 85-15, 80-20.

- Data to be collected with muon beam momentum between **1 and 12 GeV**

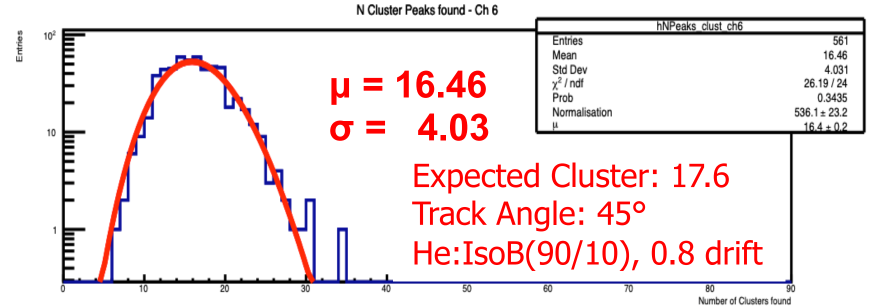


2021/2022 testbeam: number of clusters



Sense Wire Diameter 10 um – Cell Size 1.0 cm – Track Angle 45° – 1.2 GSa/s – Gas Mixture He:IsoB 90/10 – 165 GeV

Number of Cluster Distribution



Expected number of cluster = δ cluster/cm (MIP) x drift tube size [cm] x 1.3 (relativistic rise) x 1/cos(α)

- α is the angle of the muon track w.r.t. normal direction to the sense wires
- δ cluster/cm (mip) changes from 12, 15, 18 respectively for He:IsoB 90/10, 85/15 and 80/20 gas mixtures
- actual drift tube size are 0.8, 1.2, and 1.8 respectively for 1 cm, 1.5 cm, and 2 cm cell size tubes

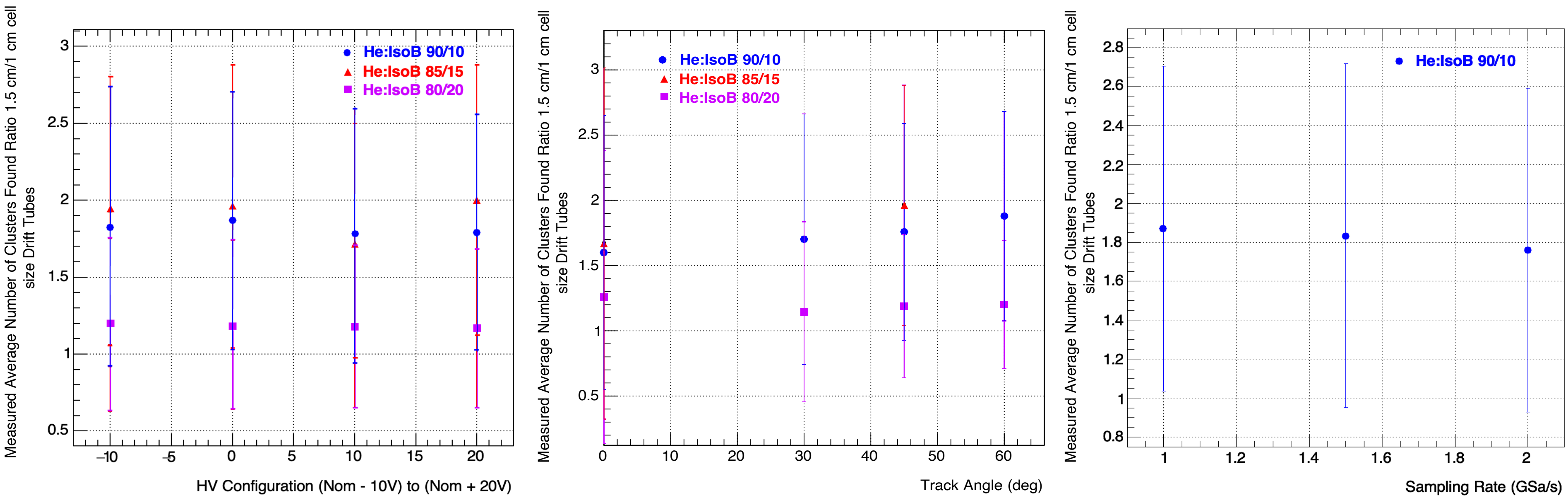
- Poissonian behaviour
- Meaurements and predictions about the number of clusters are in very good agreement, with 1cm cell size

2021/2022 testbeam: recombination and attachment

Efficiency w.r.t. Expected Number of Electrons (Clusters) above ~85%. What about being independent from theoretical assumptions?

in Ratios

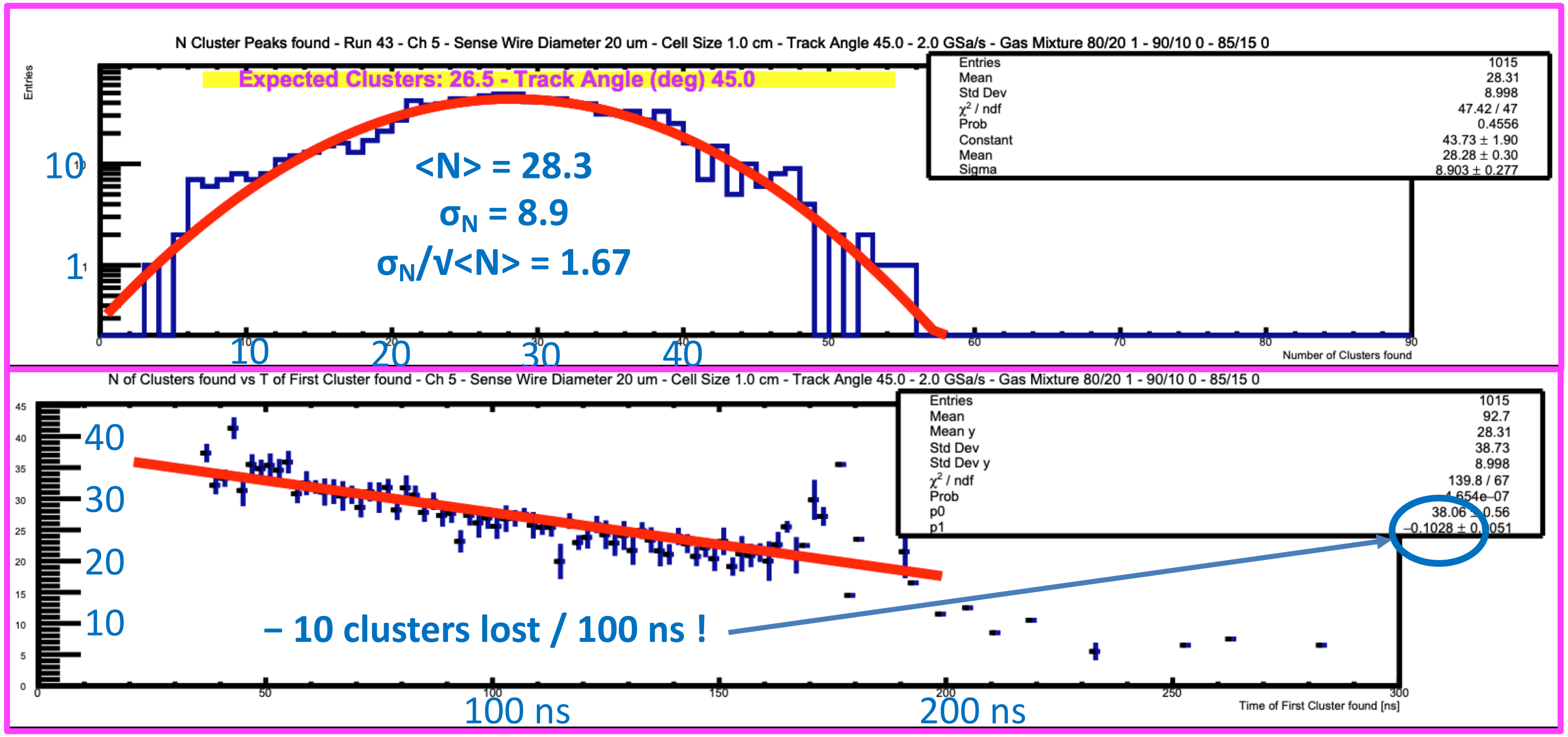
Expected number of cluster= δ cluster/cm (MIP) x drift tube size [cm] x 1.3 (relativistic rise) x 1/cos(α)



Space charge + attachment + recombination effects affect the experimental CC efficiency!

- The **loss of efficiency at small angles** is due to the partial shielding of the electric field due to the space charge.
- The **loss of efficiency at large angles** is partially due to the fact that increasing the number of clusters in the same drift time, increases the probability of pileup, then decreasing the counting efficiency.
- The **lower counting efficiency in 2cm** tubes compared to 1cm ones is only partially explained by the effects of recombination and attachment; other possible effects under investigation

2021/2022 testbeam: recombination and attachment

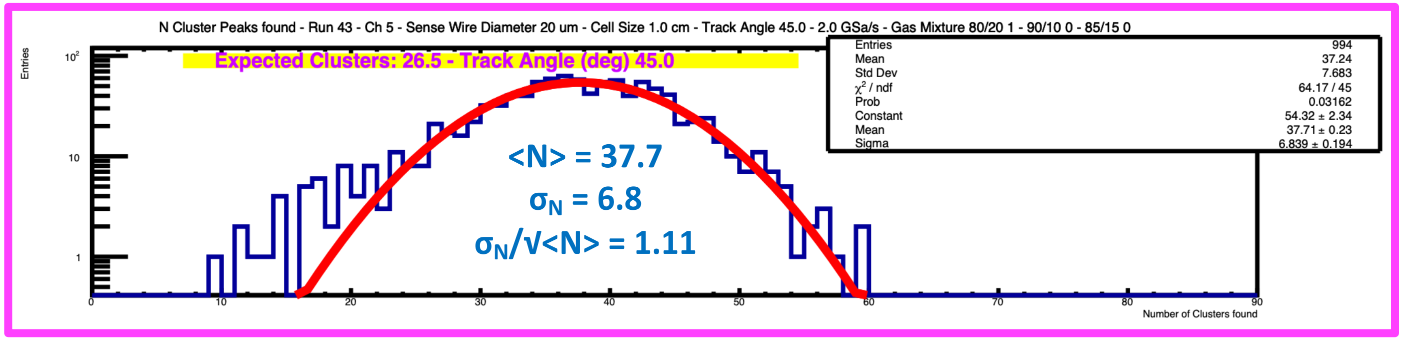


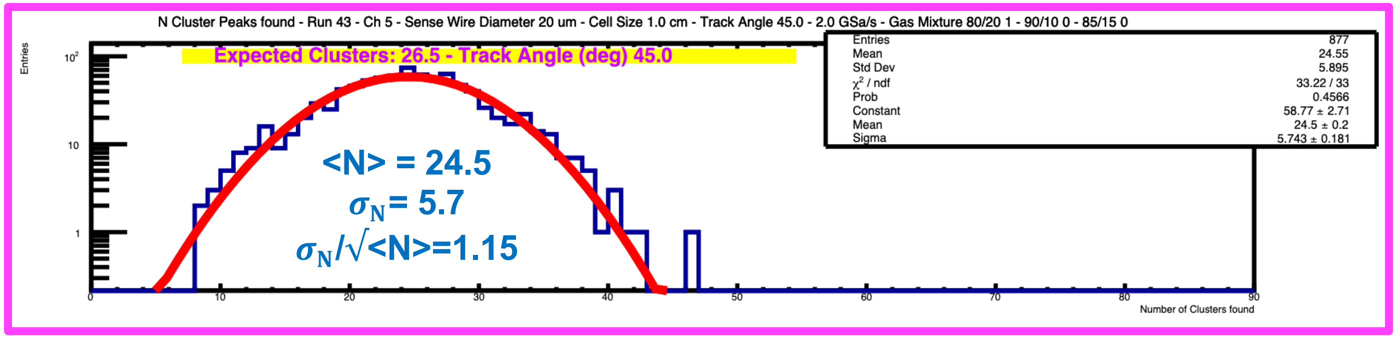
Number of Clusters found by DERIV+CLUSTER algorithms

Average Number of Clusters found(@drift time) vs drift time

Combined action of recombination, electron attachment and E-field suppression due to space charge

2021/2022 testbeam: applying corrections





Cuts on the derivative algorithm, which were optimized without including the recombination and attachment effects, need to be reformulated.

Also, these corrections, strongly depend on the drift length and, therefore, on the drift tube size and must be calculated for each different drift tube configuration.

First attempt of re-tuning cuts on the DERIV algorithm for a 1 cm cell size drift tube

Piano delle attività di RD_FCC Bari+Lecce nel 2024

Hardware:

- setup tubi a drift per testbeam al CERN (luglio 2024) e **Fermilab (fine 2024 con π/k)**
- **inizio construzione di un prototipo full scale della DCH per IDEA**

Progettazione e simulazione:

- finalizzazione di progettazione meccanica della camera a drift per IDEA FCC-ee
- *full simulation* (**geometria, hits, digi**) della camera a drift per IDEA FCC-ee e del *cluster* → consolidamento collaborazione con il gruppo *software* del CERN FCC

Analisi dati/Fisica:

- finalizzazione analisi dati del testbeam 2021, 2022 e 2023, note e paper
- analisi dati testbeam 2024
- uso di tecniche di *machine learning* per il *cluster counting* (originariamente sviluppato dai colleghi di IHEP Beijing con dati da testbeam ed ora un PhD Bari sta iniziando)

Setup di una collaborazione internazionale:

  - partecipazione a DRD1 per gas detector (WG2) ed ECFA
  - collaborazione con IHEP Beijing
  - collaborazione con US people from BNL (proposta di finanziamento al DOE sottomessa)

Anagrafica RD_FCC/Eurizon/AIDAInnova 2024 - Bari

INFN- Bari	2024
N. De Filippis (Assoc. Prof.)	25%
M. Abbrescia (Assoc. Prof.)	20%
M. Louka (PhD)	30%
B. D’Anzi (PhD)	30%
W. Elmetenawee (Ass. Ricerca)	100%
D. Diacono (Tecn. INFN)	10%
G. Donvito (Tecn. INFN)	5%
V. Spinoso (Tecn. INFN)	15%
F. Procacci (PhD)	90%
G. Pappalettera (Assoc. Prof.)	20%
TOT	**3.45 FTE**

Richieste finanziarie per RD_FCC Bari 2024

Consumi/Inventariabile:

- strumentazione per tubi a drift e prototipo full size:
  - field wires: Aluminium wire (40 e 50mm, 1000m x2) - 3000 k€
  - tungsten wires (1000 m) – 1500 k€
  - cap for drift tubes 500 €
- **RICHESTA: 5** k€

Missioni: meetings/workshops/testbeams

- Testbeam al CERN T10 a luglio 2024:
  - missioni per 2 settimane, 3 persone: 10k€
- Testbeam al Fermilab a settembre 2024
  - missioni per 2 settimane, 3 persone: 10k€
  - spedizioni: 5 k€
- Missioni per meeting, workshop per 3.45 FTE: 5k€
- Trasferte a INFN Lecce: 4k€
- **RICHIESTA totale: 34** k€

DRD1, WG2, WP2, T3 - Fabbricazione e lavorazione di componenti di materiale composito per lo studio del tension recovery scheme per l'endplate per la camera a drift di IDEA: **20 k€**

Totale: 59 k€

Anagrafica RD_FCC/Eurizon/AIDAInnova 2024 - Lecce

AIDAInnova

Task 7.3.1 → A. Caricato, P. Creti, E.M.V. Fasanelli, A. Miccoli + nuovo AdR a partire da Ottobre

Task 7.4.1 → A. Corvaglia, E. Gorini, F. Grancagnolo, M. Panareo, M. Primavera, A. Ventura

Eurizon (ex CremlinPlus)

A. Corvaglia, E. Gorini, F. Grancagnolo, A. Miccoli, M. Panareo, M. Primavera, A. Ventura

AIDAInnova, Eurizon, RD_FCC sono progetti sinergici per la CSN1, in quanto attivita' su futuri acceleratori → le percentuali sui "libroni" INFN sono "condivise"

Ricercatori

Gorini 20%
Grancagnolo F. 0%
Grancagnolo S. 20%
Greco 10%
Miccoli 0% ma 20% su sigle sinergiche (AIDAInnova 10% e Eurizon 10%)
Panareo 10%
Primavera 0% ma 30% su sigle sinergiche (AIDAInnova 10% e Eurizon 20%)
Ventura 20%

Personale tecnico

Corvaglia

Responsabile: M. Primavera, ma fondi sotto Dotazioni 1

Totale: 0.8 (+0.50 su sigle sinergiche) FTE → 1.3 FTE

Richieste finanziarie per RD_FCC Lecce 2024

Consumi/Inventariabile:

- 4 k€ per setup di test con tubi a drift (tubi, meccanica, connessioni gas, cavi SMA/MCX, …)
- 5 k€ per trasporto del setup di test al CERN e al Fermilab

Missioni: meetings/workshops/testbeams

- Testbeam al CERN T10 a luglio 2024 (insufficienti statistica e configurazioni, dovute a malfunzionamento del fascio e a bassissimo rate a bassi momenti (< 5 GeV/c):
  - missioni per 2 settimane, 3 persone: 10k€
- Testbeam al Fermilab a settembre 2024 (fascio pi/K per test di separazione pi/K nel range di interesse di FCCee)
  - missioni per 2 settimane, 3 persone: 12k€ subjudice
- Missioni per meeting, workshop per 1.3 FTE: 1.5k€

DRD1, WG2, WP2, T3 - Digitizer CAEN (VX2751), digitizer NALU Scientific (HDSoC a 64 canali), moduli della piattaforma FERS-5200: **30 k€**

Totale: 62.5 k€

Backup

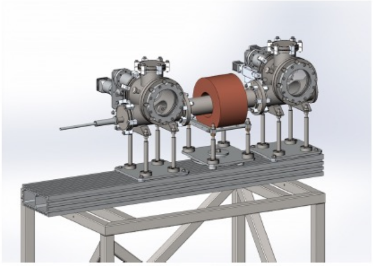
Challenges for large-volume drift chambers

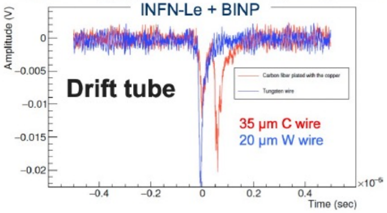
- **Electrostatic stability** condition: $\frac{\lambda^2}{4\pi\varepsilon}\frac{L^2}{w^2} < wire\ tension < YTS \cdot \pi r_w^2$

λ = linear charge density (gas gain)
L = wire length, r_w wire radius, w = drift cell width
YTS = wire material yield strength

The proposed drift chambers for FCC-ee and CEPC have lengths **L = 4 m** and plan to exploit the cluster counting technique, which requires gas gains **~5×10^5**.
This poses serious constraints on the drift cell width (**w**) and on the wire material (**YTS**).

⇒ **new wire material studies**





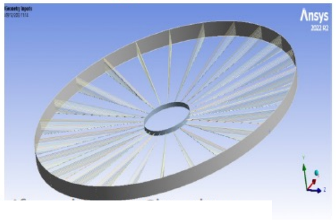
- **Non-flammable gas / recirculating gas systems**
Safety requirements (**ATEX**) demands stringent limitations on flammable gases;
Continuous increase of **noble gases cost**

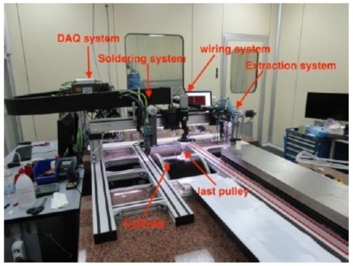
⇒ **gas studies**

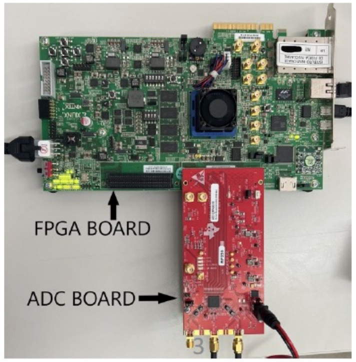
- **Data throughput**
Large number of channels, high signal sampling rate, long drift times (slow drift velocity), required for cluster counting, and high physics trigger rate (Z_0-pole at FCC-ee) imply data transfer rates in excess of **~1 TB/s**

⇒ **on-line real time data reduction algorithms**

- **New wiring systems for high granularities / / new end-plates / new materials**







Attività di hardware

The Drift Chamber: Cluster Counting/Timing and PID

- Analitic calculations: Expected excellent K/π separation over the entire range except 0.85<p<1.05 GeV (blue lines)

- Simulation with Garfield++ and with the Garfield model ported in GEANT4:
  - the particle separation, both with dE/dx and with dN_{cl}/dx, in GEANT4 found considerably worse than in Garfield
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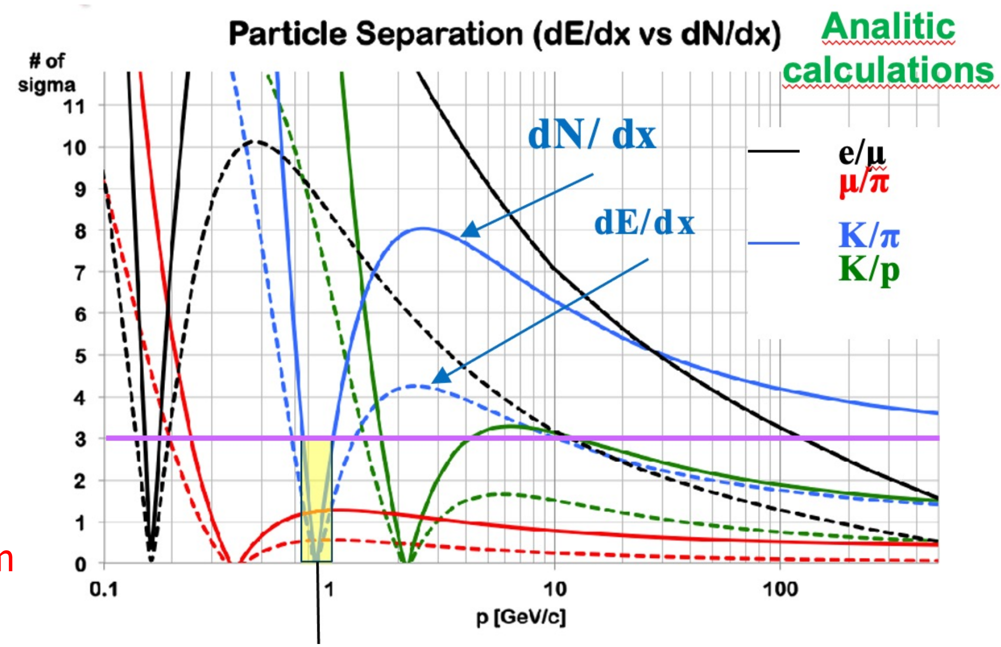
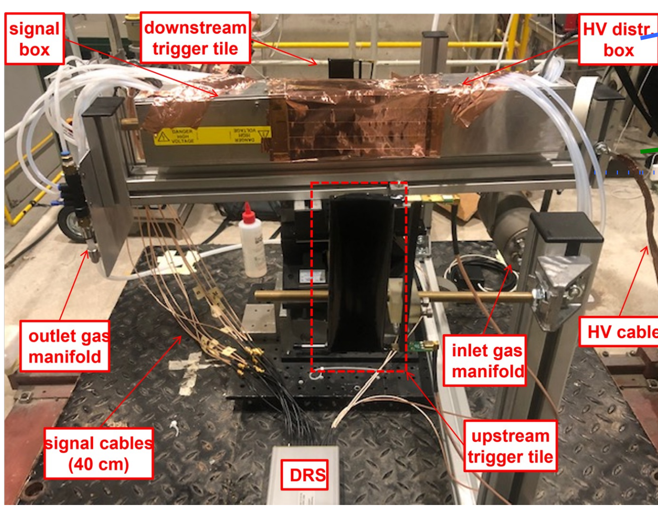
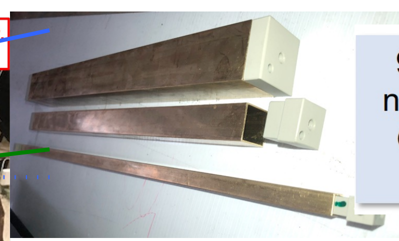
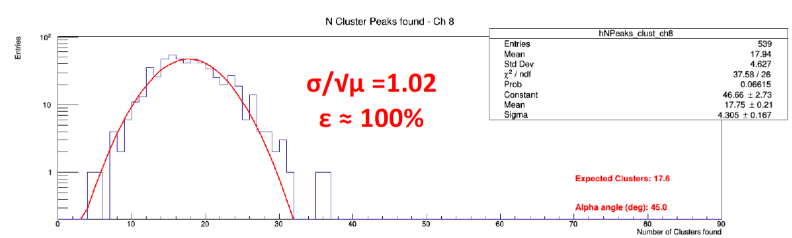
  - finding answers by using real data from beam tests at CERN in 2021 and 2022







90%He-10%iC_4H_{10}
nominal HV+20, 45°,
Gas gain ~ $2 \cdot 10^5$,
165 GeV/c



- Poissonian behaviour of the number of clusrers
- Meaurements vs predictions about the number of clusters are in very good agreement
- Same results in independent drift tubes

Beam tests: motivations

Beam test plans:

- Need to demonstrate the ability to count clusters:
  at a fixed βγ (e.g. muons at a fixed momentum) count the clusters by
  - doubling and tripling the track length and changing the track angle;
  - changing the gas mixture.

- Establish the limiting parameters for an efficient cluster counting:
  - cluster density (by changing the gas mixture)
  - space charge (by changing gas gain, sense wire diameter, track angle)
  - gas gain saturation

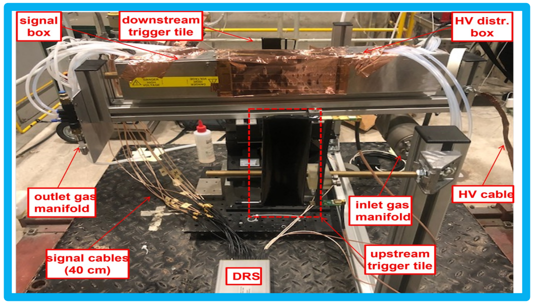
- In optimal configuration, measure the relativistic rise as a function of βγ, both in dE/dx and in dN_{cl}/dx, by scanning the muon momentum from the lowest to the highest value (from a few GeV/c to about 250 GeV/c at CERN/H8).

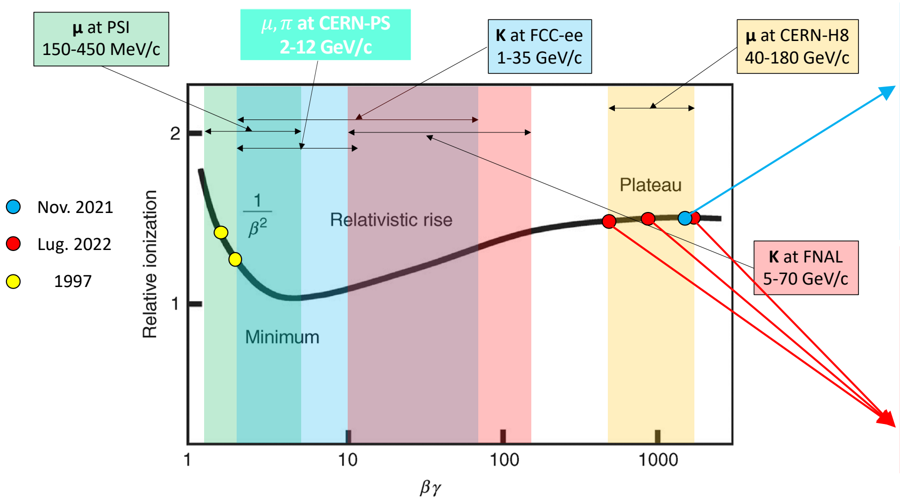
- Use the experimental results to fine tune the predictions on performance of cluster counting for flavor physics and for jet flavor tagging both in DELPHES and in full simulation

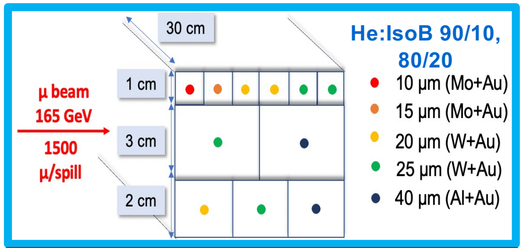
Beam tests in 2021, 2022 and 2023

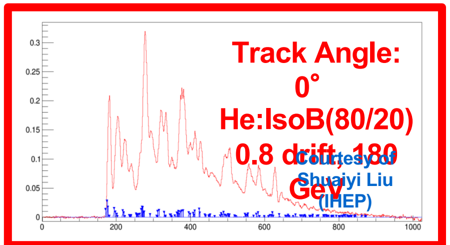
Beam tests to experimentally asses and optimize the **performance of the cluster counting/timing** techniques in strict collaboration with the IHEP Beijing group:

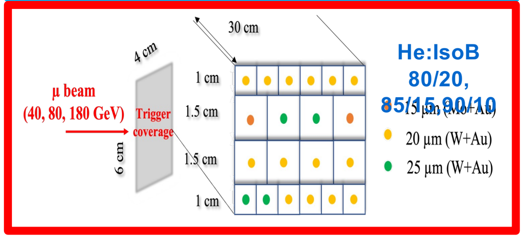
- Two **muon beam tests** performed at **CERN-H8 (βγ > 400)** in Nov. 2021 and July 2022.
- More **muon beam tests** planned in 2023 at **CERN** and **PSI (βγ = 1−4)** in 2023 (not foreseen).
- Ultimate test at **FNAL-MT6** with π and **K (βγ = 10−140)** to fully exploit the relativitic rise.

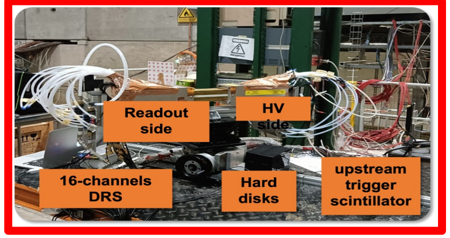












2021/2022 testbeam: find electron peaks algorithms

Find good electron peak candidates at position bin *n* and amplitude A_n:

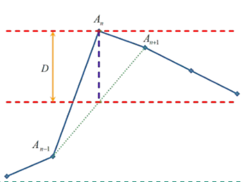
FIRST AND SECOND DERIVATIVE (DERIV) ALGORITHM

- Compute the first and second derivative from the amplitude average over two consecutive bins (1.6 ns for 1.2 GSa/s) and require that, at the peak candidate position, they are smaller than a r.m.s. signal-related small quantity and they increase (decrease) before (after) the peak candidate position of a r.m.s. signal-related small quantity.

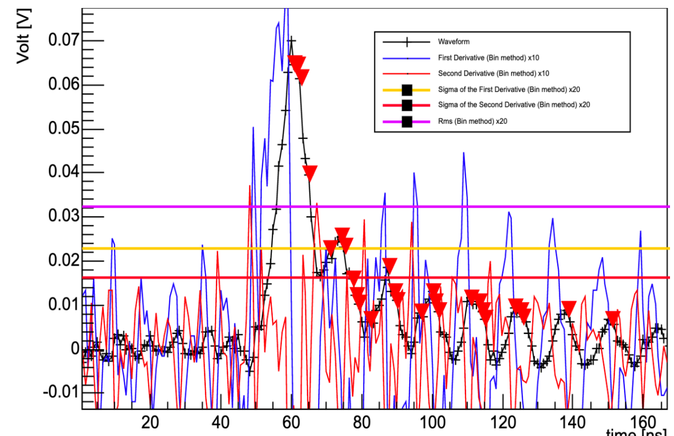
- Require that the amplitude at the peak candidate position is larger than a r.m.s. signal-related small quantity and the amplitude difference among the peak candidate and the previous (next) signal amplitude is larger (smaller) than a r.m.s. signal-related small quantity.

NOTE:

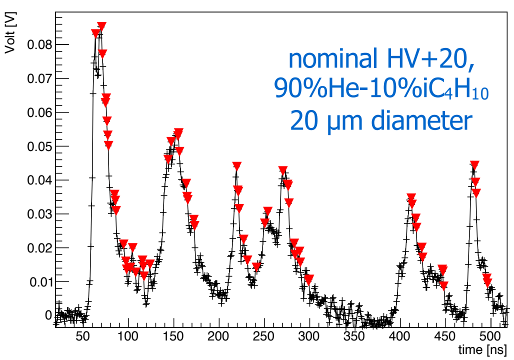
- R.m.s. is a measurements of the noise level in the analog signal



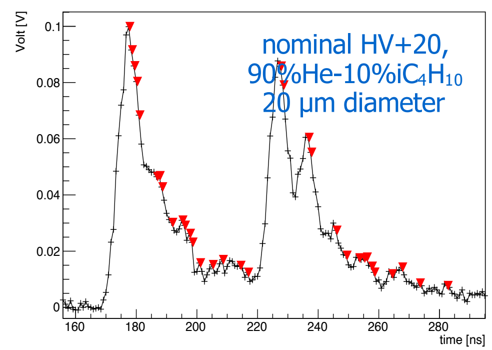
0°, nominal HV+20, 90%He-10%iC_4H_{10}
Tube with 1-cm cell size and 20 μm diameter



2 cm drift tube Track angle 45°



1 cm drift tube Track angle 45°



2021/2022 testbeam: find electron peaks algorithms

Find good electron peak candidates at position bin *n* and amplitude A_n:

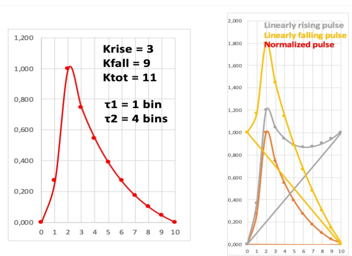
RUNNING TEMPLATE ALGORITHM (RTA)

- Define an electron pulse template based on experimental law with a raising and falling exponential over a fixed number of bins (K_{tot}) and digitized (A(k)) according to the data sampling rate.

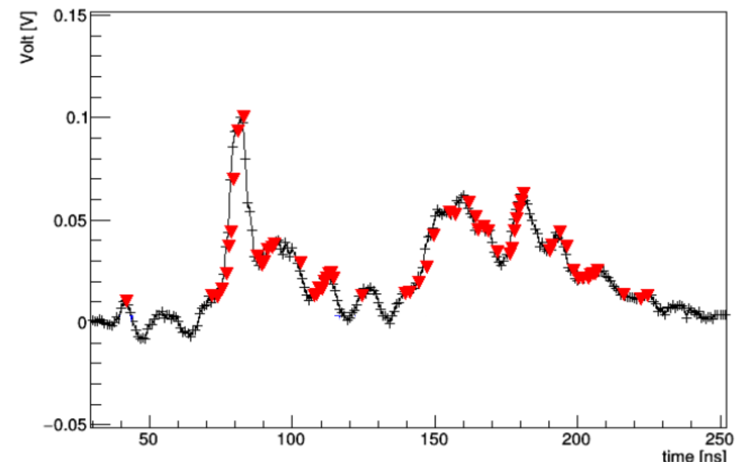
- Run over K_{tot} bins by comparing it to the subtracted and normalized data (build a sort of χ^2 and define a cut on it).

- Subtract the found peak to the signal spectrum and iterate the search and stop when no new peak is found.

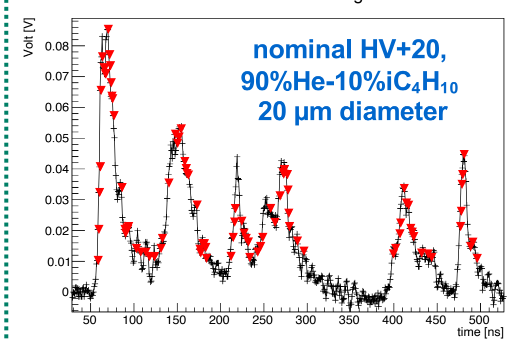
k	A(k)
0	0.0
1	0.269
2	1.0
3	0.744
4	0.545
5	0.390
6	0.269
7	0.175
8	0.102
9	0.044
10	0.0



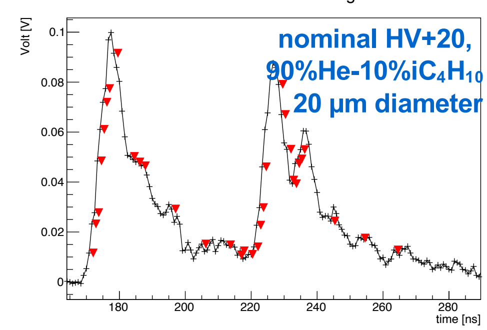
30°, nominal HV+20, 90%He-10%iC$_4$H$_{10}$
Tube with 1 cm cell size and 20 µm diameter



2 cm drift tube Track angle 45°

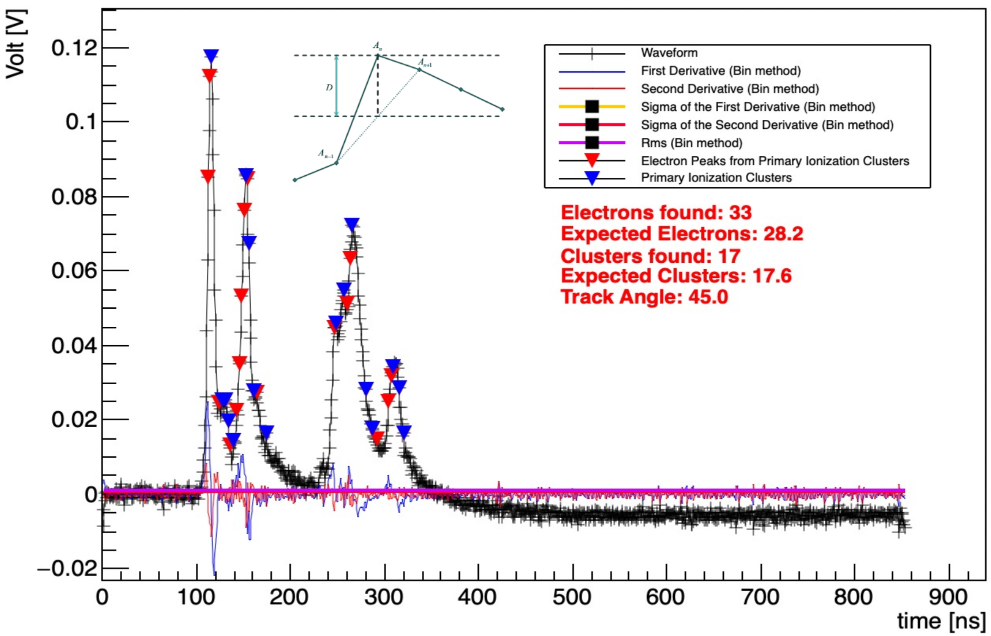


1 cm drift tube Track angle 45°

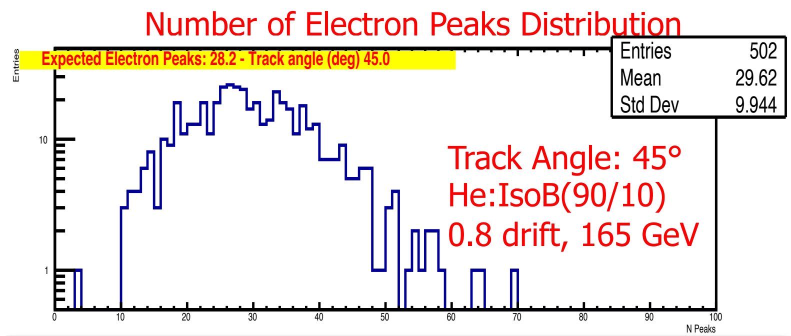


2021/2022 testbeam: number of electron peaks

Reconstruction of Electron Peaks (DERIV Algorithm)



Sense Wire Diameter 10 um – Cell Size 1.0 cm – Track Angle 45° – 1.2 GSa/s – Gas Mixture He:IsoB 90/10 – 165 GeV



Expected number of electrons = δ cluster/cm (M.I.P.) x drift tube size [cm] x 1.6 (cluster size) x 1.3 (relativistic rise) x 1/cos(α)

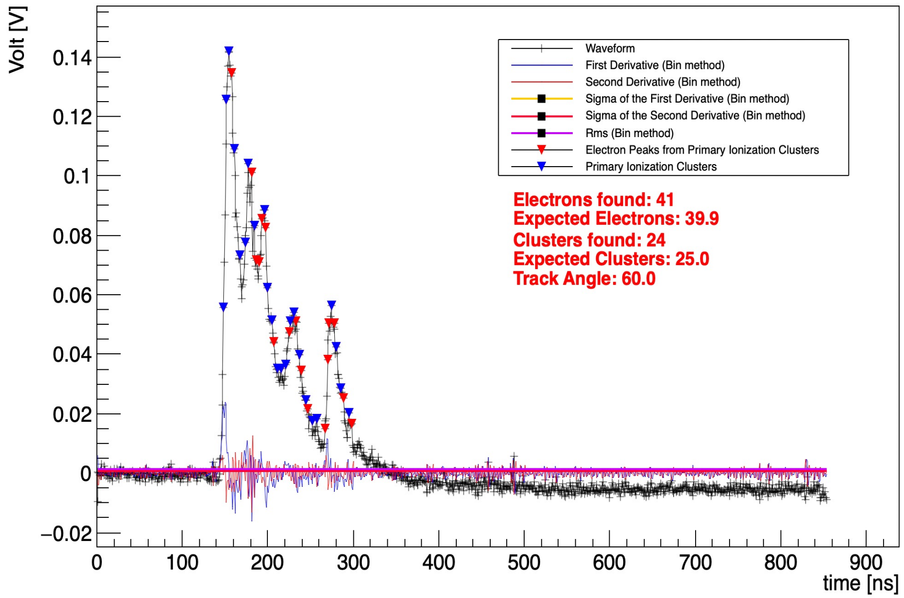
- α is the angle of the muon track w.r.t. normal direction to the sense wires
- δ cluster/cm (mip) changes from 12, 15, 18 respectively for He:IsoB 90/10, 85/15 and 80/20 gas mixtures
- Actual drift tube size are 0.8, 1.2, and 1.8 respectively for 1 cm, 1.5 cm, and 2 cm cell size tubes

[1] H. Fischle, J. Heintze and B. Schmidt, Experimental determination of ionization cluster size distributions in counting gasses, NIM A 301 (1991)
[2] R. G. Kepler, C. A. D'Andlau, W. B. Fretter and L. F. Hansen, Relativistic Increase of Energy Loss by Ionization in Gases, IL NUOVO CIMENT0 VOL. VII, N. 1 - 1 Gennaio 1958

2021/2022 testbeam: clusterization

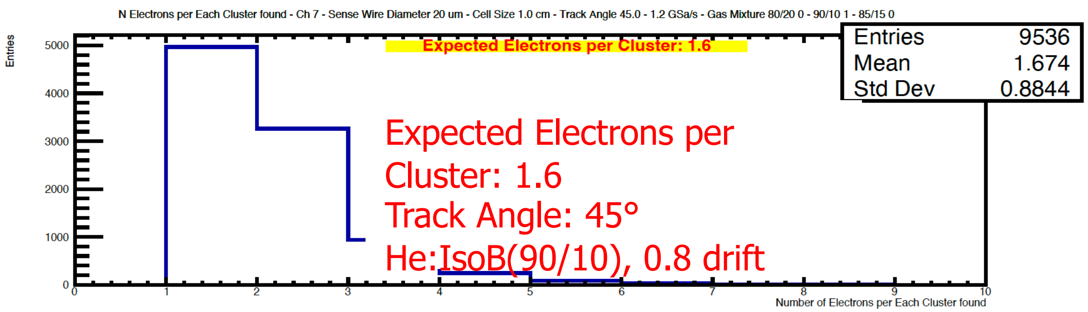
CLUSTERIZATION algorithm: Reconstruction of Primary Ionization Clusters

- Merging of electron peaks in consecutive bins in a single electron to reduce fake electrons counting
- Contiguous electrons peaks which are compatible with the electrons' diffusion time (it has a $\sim\sqrt{t_{ElectronPeak}}$ dependence, different for each gas mixture) must be considered belonging to the same ionization cluster. For them, a counter for electrons per each cluster is incremented.
- Position and amplitude of the clusters corresponds to the position and height of the electron having the maximum amplitude in the cluster. → Poissonian distribution for the number of clusters!



Sense Wire Diameter 20 um – Cell Size 1.0 cm – Track Angle 60° – 1.2 GSa/s – Gas Mixture He:IsoB 90/10 – 165 GeV

Electron per Clusters Distribution



Attività di simulazione e progettazione

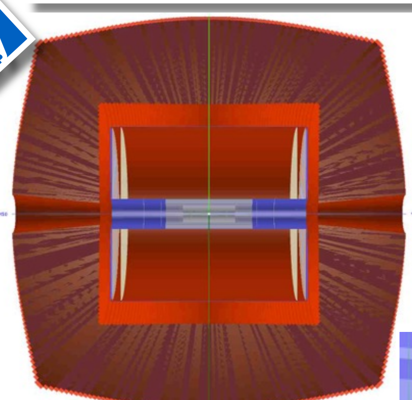
Geant4 and DD4HEP simulation of IDEA

The integration of the Calorimeter geometry description with IDEA Silicon Vertex (SVX), Drift Chamber (DCH) has been performed. The code is available in the HEP-FCC githup area:

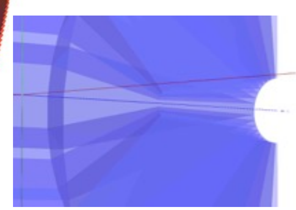
https://github.com/HEP-FCC/IDEADetectorSIM

Visualization for the Integrated Geometry

(calorimeter+Drift chamber)



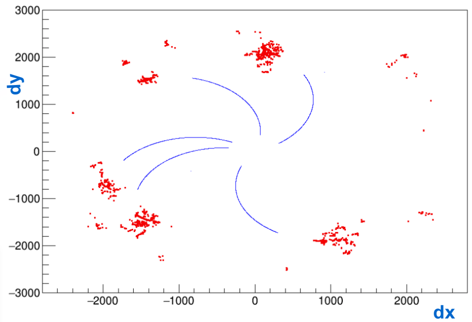
Phi volume (barrel)

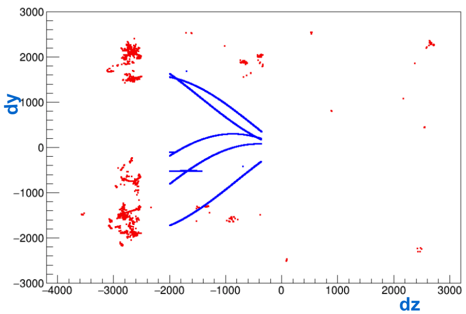


Phi volume (Endcap)

Hits display

Simple display for the hits of negative energy pions of 870 MeV as seen in the different detectors (DCH & DR calo).

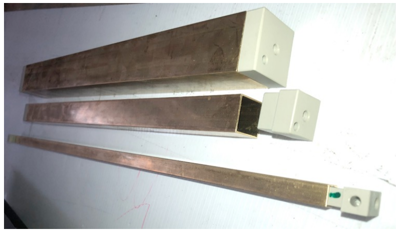


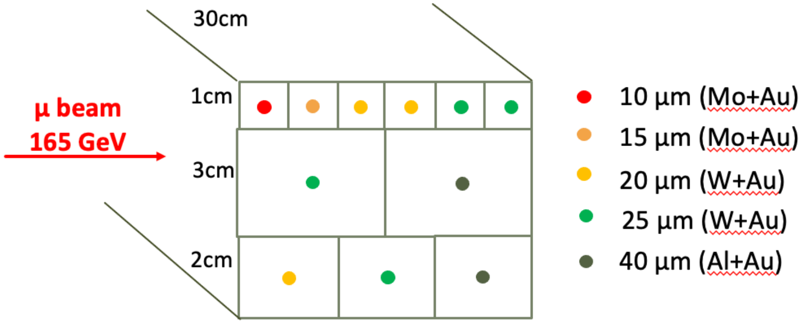


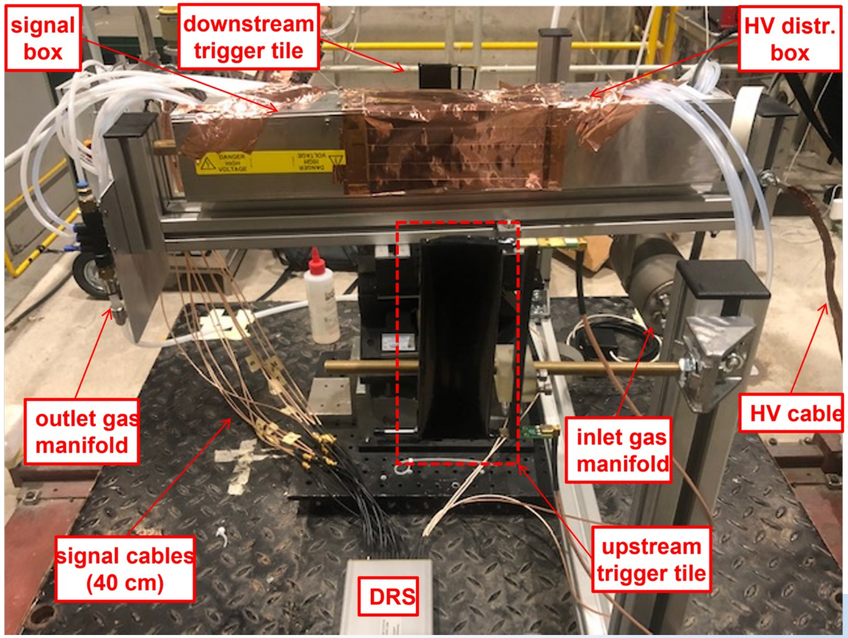
Attività di analisi dati

Beam test setup at H8/CERN in 2021

11 drift tubes with different cell size and different material wires and diameter wires







The setup consisted of:

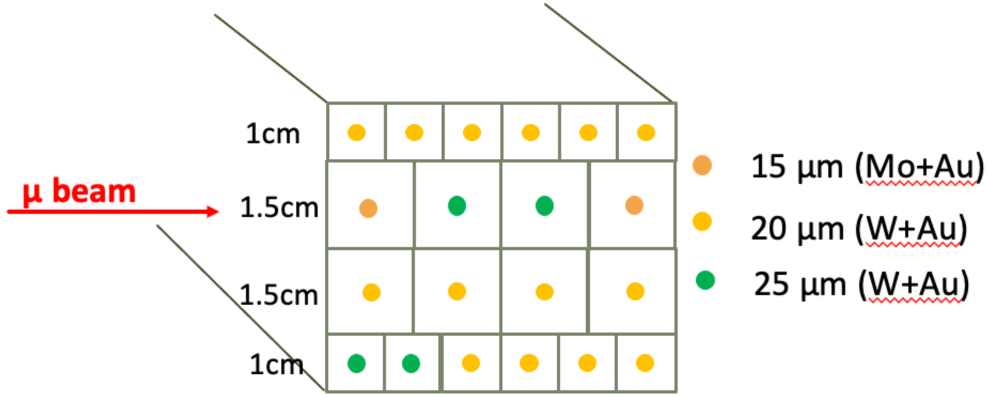
- 6 drift tubes 1 cm × 1 cm × 30 cm
  - 1 with 10 μm sense wire, 1 with 15μm, 2 with 20 μm, 2 with 25 μm
- 3 drift tubes 2 cm × 2 cm × 30 cm
  - 1 with 20 μm sense wire, 1 with 25 μm, 1 with 40 μm
- 2 drift tubes 3 cm × 3 cm × 30 cm
  - 1 with 20 μm sense wire, 1 with 40 μm
- DRS board for data acquisition
- Gas mixing, control and distribution (only He and iC_4H_{10})
- 2 trigger scintillators

Helium used because of:

- Low primary ionization density implies a large time separation
- low drift velocity means larger time separation ($v_{drift} \approx 2.5$ cm/μs)
- low average cluster size $\langle N_{electrons}/cluster \rangle \approx 1.6$
- low single electron diffusion (< 110 μm for 0.5 cm drift, or < 4.5 ns)

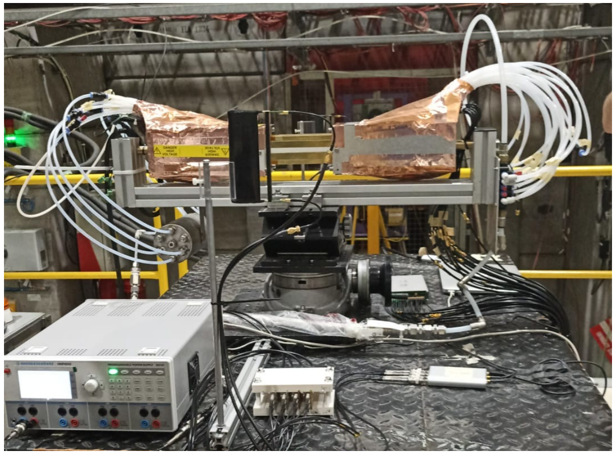
Beam test setup at H8/CERN in 2022

- 20 tubes with different wires (different material and diameter) and different cell size.
- 1 16-channel DRS
- 3 4-channel DRS
- the portable gas system
- custom PCBs for the 2 trigger scintillators.
- two external hard disk to store the data collected



- Data collected at different percentages of helium and isobutane: 90-10. , 85-15, 80-20.

- Data collected with muon beam with 180, 80 and 40 GeV momentum



NEW CONNECTION SCHEME

- Connect the 2 trigger scintillators to a 4-channels DRS
- Propagate the trigger signal to the 4-channel DRS and 16-channel DRS, where the tube are connected.

Data analysis in progress

Beam test at H8/CERN: components

SY 1527 Mainframe | **1535P 24ch** | **CAEN A996 Radiall 691803004** | 24 leads HV cable | **HV distribution board** | connecting pin | **drift tube end cap** | connecting pin | **HV decoupling board**

Trigger scintillator

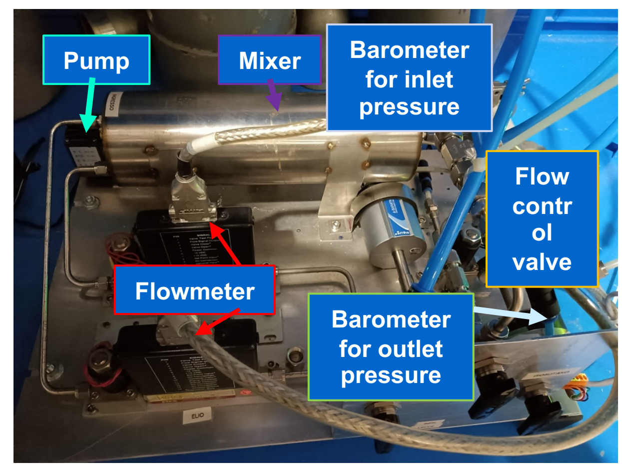
Two scintillator tiles (12 cm x 4 cm), placed upstream and downstream of the drift tubes pack, instrumented with SiPM.

courtesy of MEG2 timing counter

The gas system:

- sets the needed gas mixture
- checks the gas pressure at the entrance and at the exit of the tubes
- maintains constant the gas pressure inside the tubes, by using a proportional valve and a pump.

Portable gas system

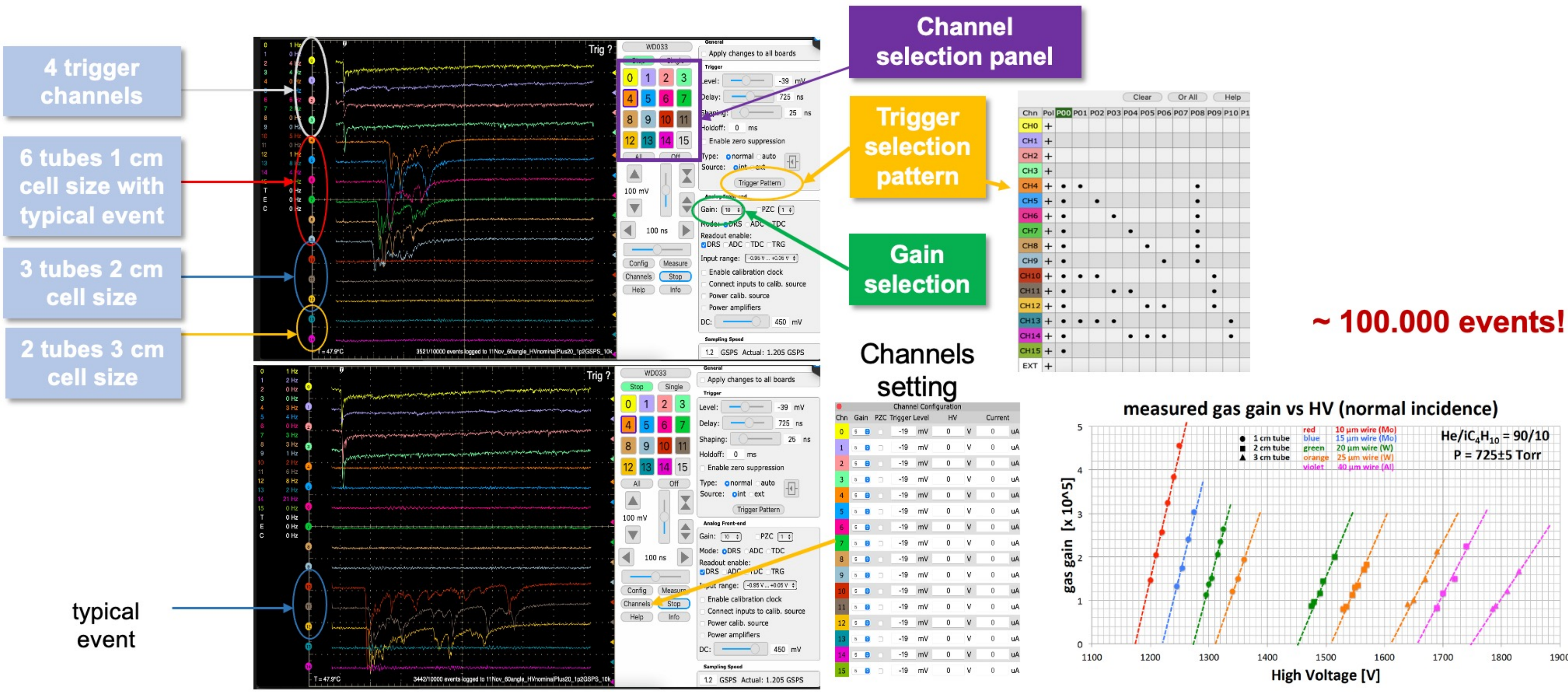


Beam test at H8/CERN: configurations

Data collected for different configurations:

- 90%He-10%iC_4H_{10}
- 80%He-20%iC_4H_{10}
- HV nominal (+10,+20,+30,-10,-20,-30)
- Angle 0°, 30°, 45°, 60°

WDB interface is similar to the interface of an oscilloscope with 16 channels:

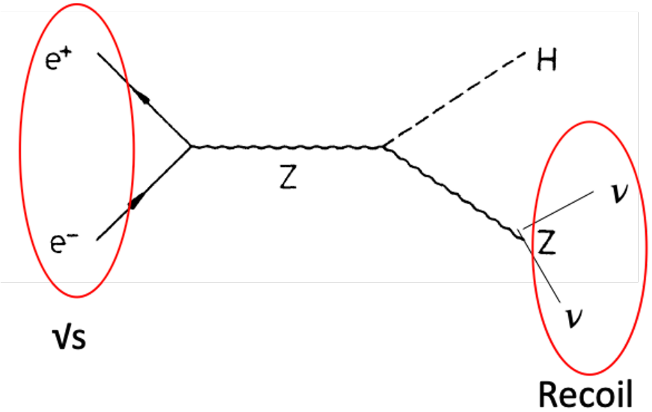


ZH analysis: ee→HZ, H→hadrons, Z→νν o hadrons

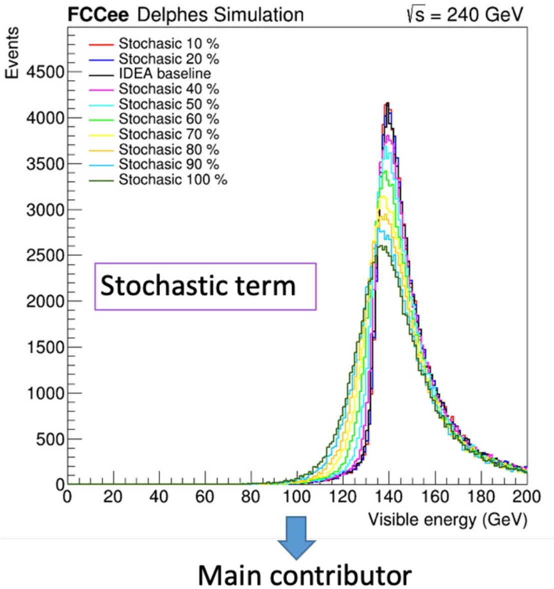
"Case study" to determine the requirements on the calorimeter performance.
Study performed in the context of the FCC-ee "Higgs Physics group. "

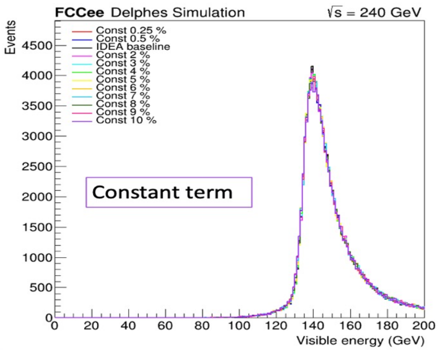
Since the calorimeter energy resolution playing an important role in the jet energy measurement, we studied the effect of

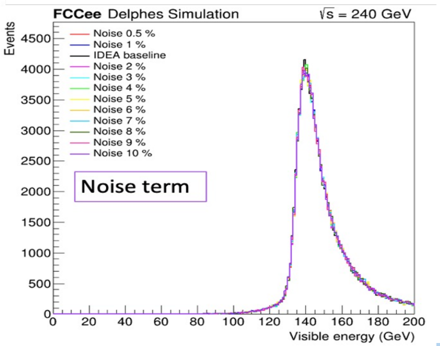
- tuning HCAL energy resolution parameters:
- tuning the stochastic, constant terms in Delphes cards
- adding Noise term to energy resolution calculation
- tuning the minimum energy threshold
- tuning the energy significance
- studying the calorimeter granularity impact on the analysis
- comparing with the full simulation



Explored decay modes: Z($\nu\nu$) H(bb), Z($\nu\nu$) H(cc), Z($\nu\nu$) H(gg), Z($\nu\nu$) H(qq)







Partecipazione di INFN Bari+Lecce a progetti

Progetti internazionali e nazionali

call H2020-MSCA-RISE-2019: progetto ”FEST” on going

“Future Experiments seek Smart Technologies (FEST)”

- bloccato per il COVID-19
- ripreso → mobilità da implementare l’anno prossimo

call H2020-INFRASUPP-2018-2020 progetto ”CREMLIN+/EURIZON” all’ultimo anno

“Connecting Russian and European Measures for Large-scale Research infrastructure” → “European network for developing new horizons for research infrastructures»

- “Development and design of Particle Identification and tracking systems” per FCC-ee
  - 6 mesi di ritardo per COVID-19

call AIDAinnova: on going

- “Cluster Counting/Timing: data reduction and pre-processing of drift chamber signals sampled at high rates” finanziato per INFN Lecce

Organization of the Eurizon detector school

N. De Filippis, M. Abbrescia nel comitato organizzatore

M. Abbrescia: lezioni su gas detector

N. De Filippis, B. D'Anzi, F. Procacci per tutorial pratici con tubi a drift

M. Louka: partecipazione come studente

On going studies and plans

- PID with a cluster counting technique is under study by using simulations and beam-test data
- Several algorithms for peak finding under development show agreement in data
- Results demonstrate the capability to count cluster with high efficiency at a fixed βγ
- Limiting conditions for an efficient cluster counting established:
  - gas gain saturation
  - cluster density (by changing the gas mixture)
  - space charge (gas gain, sense wire diameter, track angle)
  - recombination effects and electron attachment

Short term prospects:

- Finalization of Mechanical Structure and DAQ of the Drift Chamber
- Continuation of Beam Tests
- Construction of a prototype of a full scale wedge of the drift chamber:
  - to verify the electrostatic stability of different wire types (aluminum, titanium and carbon monofilamets for field and guard wires and tungsten, molybdenum for sense wires) of different diameters
  - to optimize the wire tension compensation scheme proposed to minimize the end-plates budget material

Notes in preparation:

- IDEA drift chamber proposal
- Results from cluster counting beam test
- Data acquisition system for cluster counting
- Preliminary studies on the IDEA drift chamber mechanical structure
- Preliminary estimate of the IDEA drift chamber costing