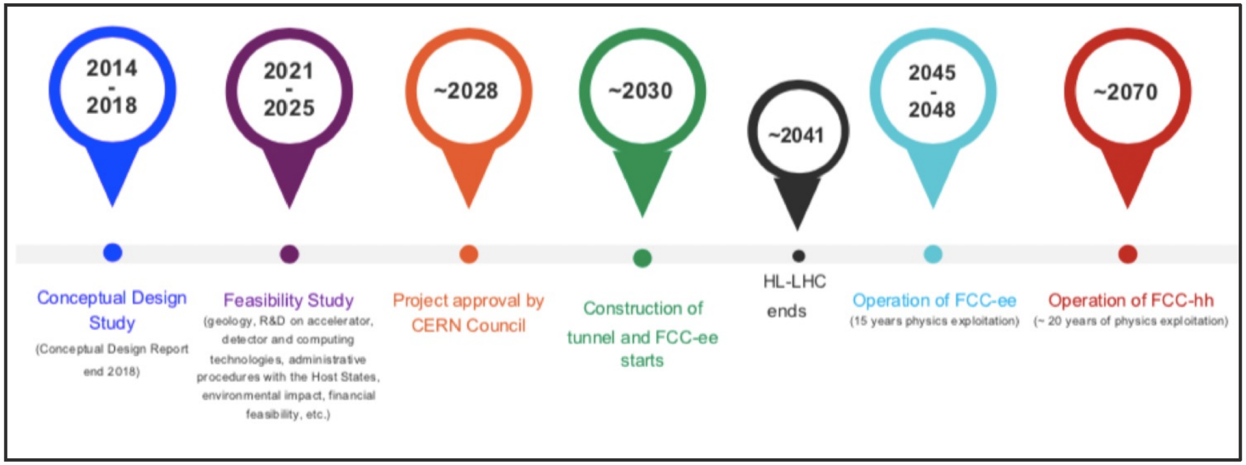
RD_FCC: attività, anagrafica e richieste finanziarie per 2025

N. De Filippis
Politecnico/INFN Bari

Bari
Giugno/Luglio 2024

Report by F. Gianotti at FCCweek@SanFrancisco



1st stage collider FCC-ee:
electron-positron collisions 90-360 GeV:
electroweak and Higgs factory
2nd stage collider FCC-hh:
proton-proton collisions at ~ 100 TeV

"Realistic" schedule taking into account:

- ❑ past experience in building colliders at CERN
- ❑ the various steps of approval process: ESPP update, CERN Council decision
- ❑ HL-LHC will run until ~ 2041

→ ANY future collider at CERN cannot start physics operation before ~ 2045 (but construction will proceed in parallel to HL-LHC operation)

Care should be taken when comparing to other proposed facilities, for which in most cases only the (optimistic) technical schedule is shown. In particular, studies related to **territorial implementation** (surface sites, roads, connection to water and electricity, environmental impact, admin procedures, etc.), which for FCC are being carried out in the framework of the Feasibility Studies, **take years.**

Next steps:

- ❑ Complete Feasibility Study by March 2025
- ❑ ESPP update: process started by Council in March → to be completed in June 2026 → see next slide
- ❑ Preparation for Council decision on FCC end 2027/beg 2028: "pre-TDR phase"

Feasibility Study Mid-Term Review passed !

The goal of the FCC FS mid-term review is to assess the progress of the Study towards the final report.
Deliverables approved by the Council in September 2022:
https://indico.cern.ch/event/1197445/contributions/5034859/attachments/2510649/4315140/spc-e-1183-Rev2-c-e-3654-Rev2_FCC_Mid_Term_Review.pdf

Deliverables:
D1 : Definition of the baseline scenario
D2 : Civil engineering
D3 : Processes and implementation studies with the Host States
D4 : Technical infrastructure
D5 : FCC-ee accelerator
D6: FCC-hh accelerator
D7: Project cost and financial feasibility
D8: Physics, experiments and detectors


Future Circular Collider
Midterm Report

February 2024

Edited by:
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This document has been produced by the organisations participating in the FCC feasibility study. The studies and technical concepts presented here do not represent an agreement or commitment of any of CERN's Member States or of the European Union for the construction and operation of an extension to CERN's existing research infrastructures.
The midterm report of the FCC Feasibility Study reflects work in progress and should therefore not be propagated to people who do not have direct access to this document.

Full Report
8 Chapters/Deliverables
~ 700pp document
~ 16 editors
~ 500 contributors

Many thanks to the SAC, CRP, SPC, FC and the Council for the very useful reviews!

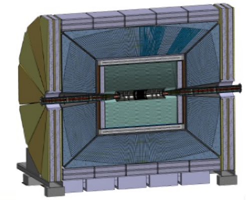
Documents:
- ❑ Mid-term report (all deliverables except D7)
- ❑ Executive Summary of mid-term report
- ❑ Updated cost assessment (D7)
- ❑ Funding model (D7)

Review process:
- ❑ Oct 2023: Scientific Advisory Committee (scientific and technical aspects) and Cost Review Panel (ad hoc committee; cost and financial aspects)
- ❑ Nov 2023: SPC and FC
- ❑ 2 Feb 2024: Council

All deliverables met, no technical showstoppers

→70-80 recommendations

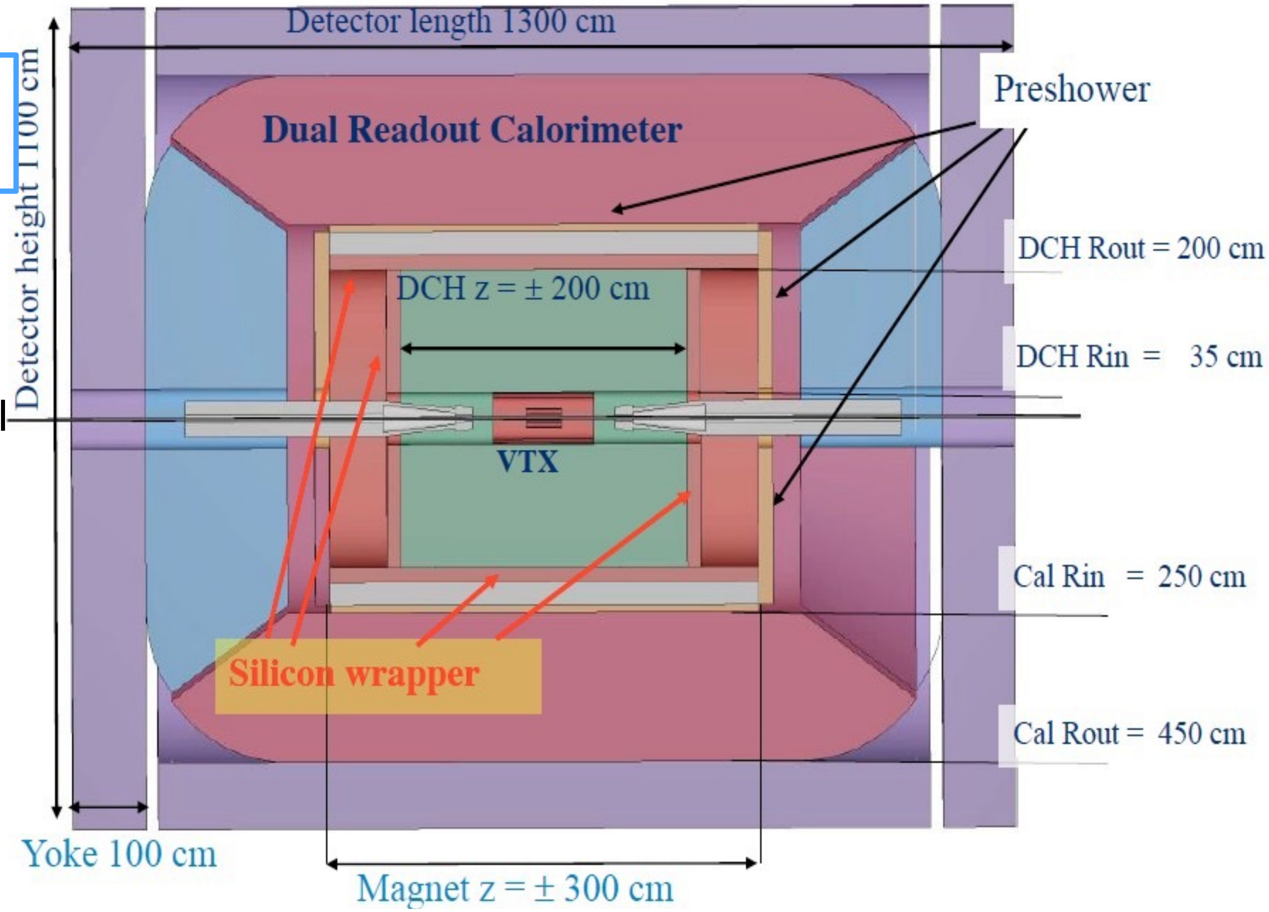
The IDEA detector at e^+e^- colliders



Innovative Detector for E+e- Accelerator

IDEA consists of:

- a silicon pixel vertex detector
- a large-volume extremely-light **drift chamber**
- surrounded by a layer of silicon micro-strip detectors
- a thin low-mass superconducting solenoid coil
- a preshower detector based on **μ-WELL technology**
- a dual read-out calorimeter
- muon chambers inside the magnet return yoke, based on **μ-WELL technology**



Low field detector solenoid to maximize luminosity (to contain the vertical emittance at Z pole).

→ optimized at 2 T

→ large tracking radius needed to recover momentum resolution

The Drift Chamber

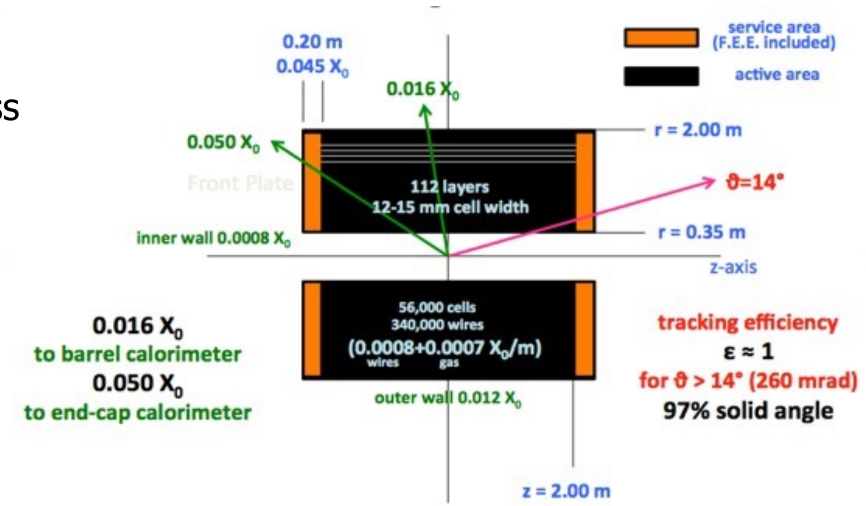
The DCH is:

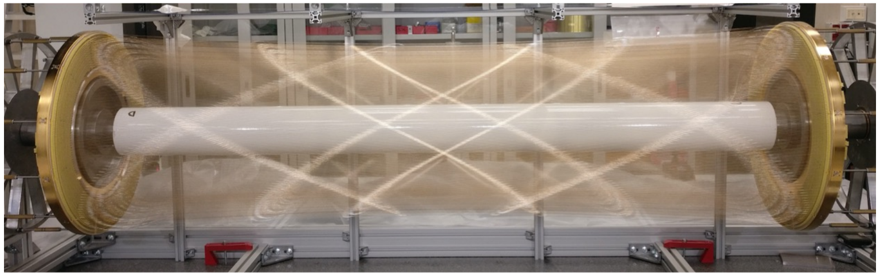
- a unique-volume, high granularity, fully stereo, low-mass cylindrical
- gas: He 90% - iC_4H_{10} 10%
- inner radius R_{in} = 0.35m, outer radius R_{out} = 2m
- length L = 4m
- drift length ~1 cm
- drift time ~150ns
- $\sigma_{xy} < 100\ \mu m$, $\sigma_z < 1$ mm
- 12÷14.5 mm wide square cells, 5 : 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 novel wiring procedure developed for the construction of the ultra-light MEG-II drift chamber

Overview delle attività di RD_FCC Bari nel 2024

Hardware (in sinergia con INFN Lecce):

- setup ed *operation* del laboratorio FCC Bari
- setup tubi a drift per testbeam 2024 al CERN

Simulazione e progettazione:

- studi di simulazione del cluster counting con la camera a drift per IDEA FCC-ee → ottima collaborazione con il gruppo *software* del CERN FCC
- studi di progettazione meccanica della camera a drift per IDEA FCC-ee e di un prototipo «full lenght» per il 2025 (in sinergia con INFN Lecce e IHEP)

Analisi dati/fisica:

- analisi dati del testbeam 2021, 2022 e 2023 (in sinergia con INFN Lecce) → pubblicazioni in preparazione + numerosi talk a conferenze – risultati importantissimi
- analisi ee→HZ, H→hadrons, Z->$\nu\nu$ o hadrons per misura di accoppiamenti Higgs a quark (per il mid-term report) e ripartita adesso (contributo per FCC week)
- analisi per higgs self-coupling ad FCC-hh

Attività di coordinamento: software, fisica e calcolo per FCC Italia

Partecipazione a numerosi workshop/conferenze/meeting

Organizzazione della scuola Eurizon 2023 e DRD1 2024: lezioni e tutorial

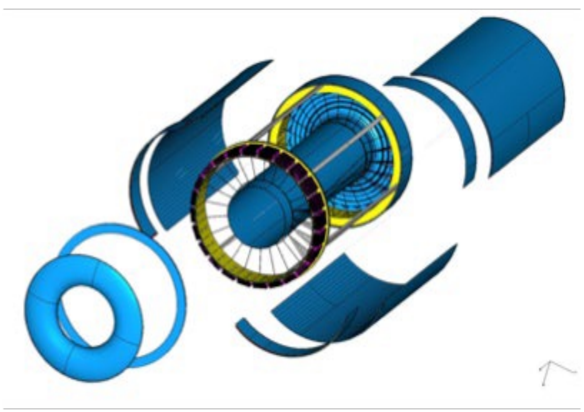
Partecipazione a DRD1 per gas detector (WP2 e Management Board)

Attività di hardware, progettazione meccanica e simulazione

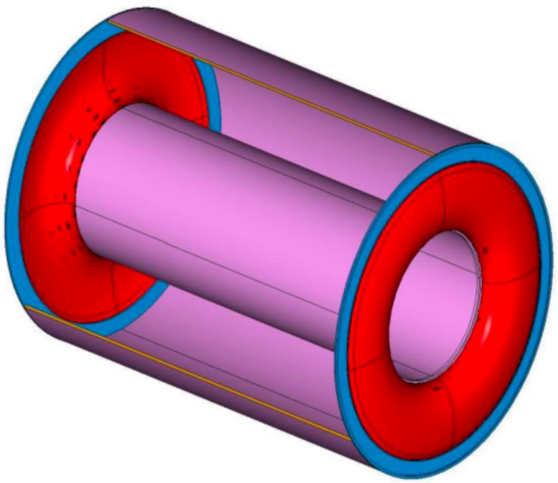
Mechanical structure

New concept of construction allows to reduce material to $\approx 10^{-3} X_0$ for the barrel and to a few x $10^{-2} X_0$ for the end-plates.

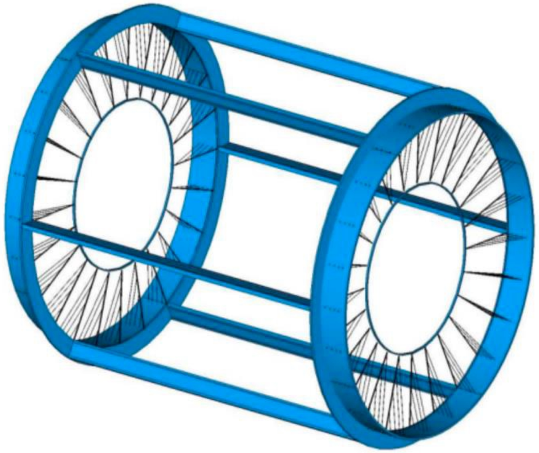
- separation of functions



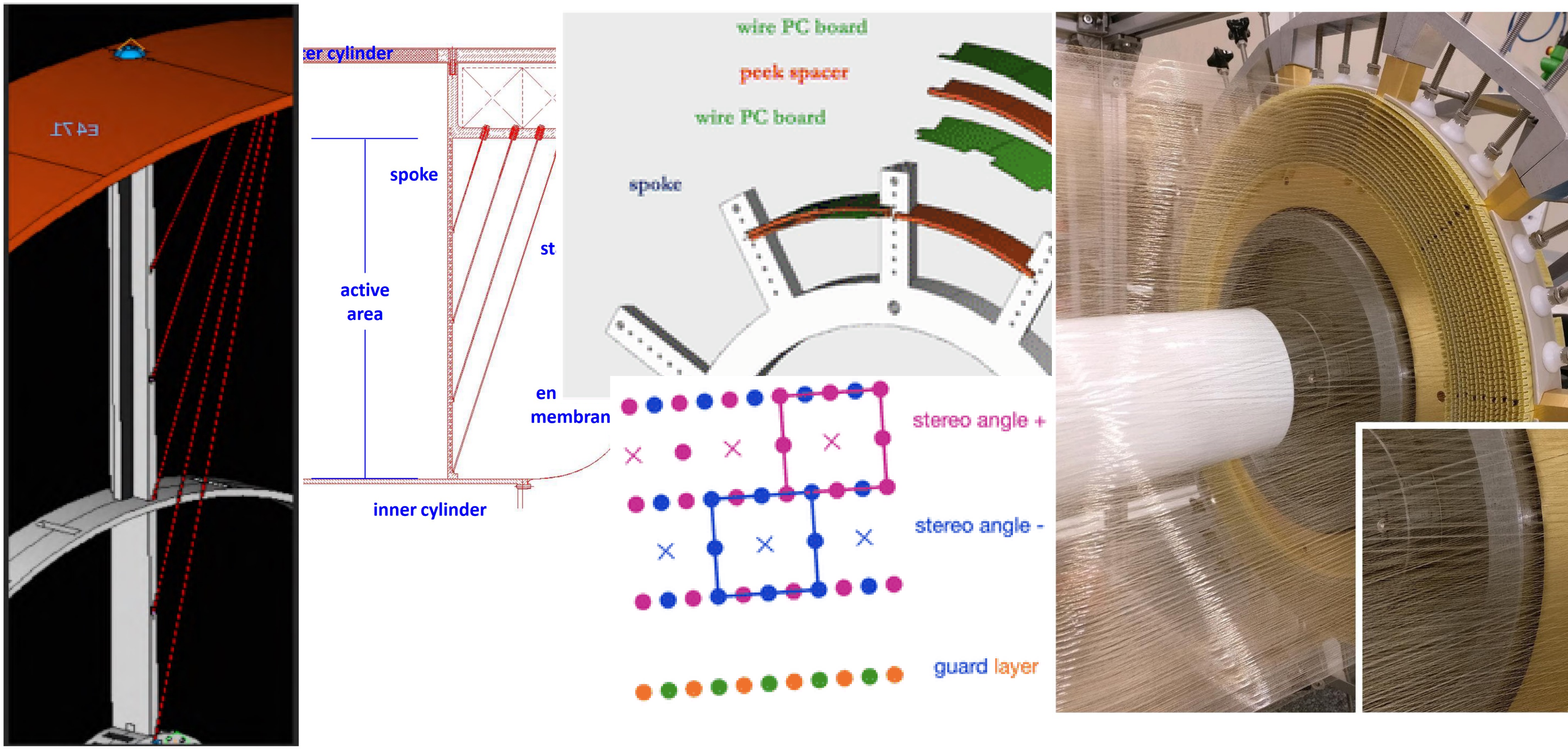
Gas containment
Gas vessel can freely deform without affecting the internal wire position and mechanical tension.



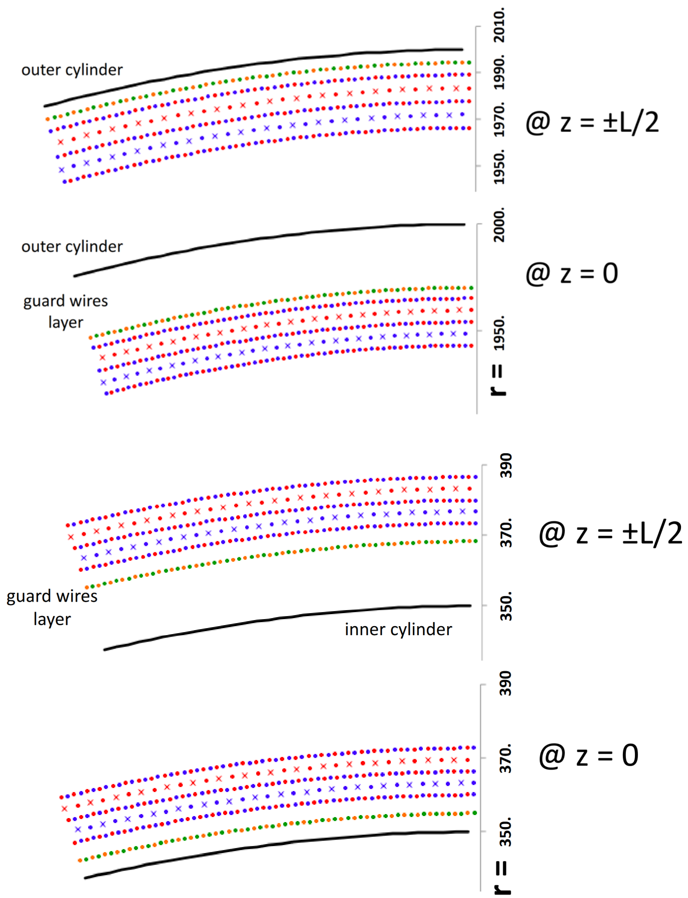
Wire cage
Wire support structure not subject to differential pressure can be light and feed-through-less



Mechanical structure: wire cage



Mechanical structure: layout



Radii (at z = 0)		
Inner Cylinder	350	mm
Guard wires layer	354	mm
First active layer	356	mm
Last (112th) active layer	1915	mm
Guard wires layer	1927	mm
Outer Cylinder	2000	mm

Radii (at end plate)		
Inner Cylinder	350	mm
Guard wires layer	366	mm
First active layer	369	mm
Last (112th) active layer	1982	mm
Guard wires layer	1995	mm
Outer Cylinder	2000	mm

Active length	2000	mm
Number of super-layers (8 layers) Number of sectors	(14x8) = 112 24	
Number of cells per layer / per sector	192÷816 / 16	
Cell size (at z=0)	11.8 ÷ 14.9	mm
2α angle	30°	
Stereo angle	43 ÷ 223	mrad
Stereo drop	12.5 ÷ 68.0	mm

sense wires	56 448
field wires	284 256
guard wires	2 016
Total wires	342 720

Challenges:

- the accuracy of the position has to be in the range of 100-200 μm
- the position of the anodic wire in space must be known with an accuracy better than 50μm at most
- the anodic and cathodic wires should be parallel in space to preserve the uniformity of the electric field
- a 20μm tungsten wire, 2m long, will bow about 100 μm at its middle point, if tensioned with a load of approximately 30gr → 30gr tension for each wire → 10 tons of total load on the endcap → simulation studies with FEM

Mechanical structure: the FEM simulation

Parametric Design exploration: varying input parameters in some possible ranges in order to see how the system responds - Response Surface Methodology (RSM) is used.

The input parametric variables are:
1. Height and thickness of the outer cylinder;
2. Dimensions (breadth and depth) of the spokes;
3. Dimensions (radius) of the cables;
4. Thickness of the inner cylinder.

Change the material: from carbon fiber to Epoxy Carbon Unidirectional Prepeg

- select the optimal dimensions of the drift chamber
- **total deformation of the model from 135,03 mm to 21,64 mm → still too high!**

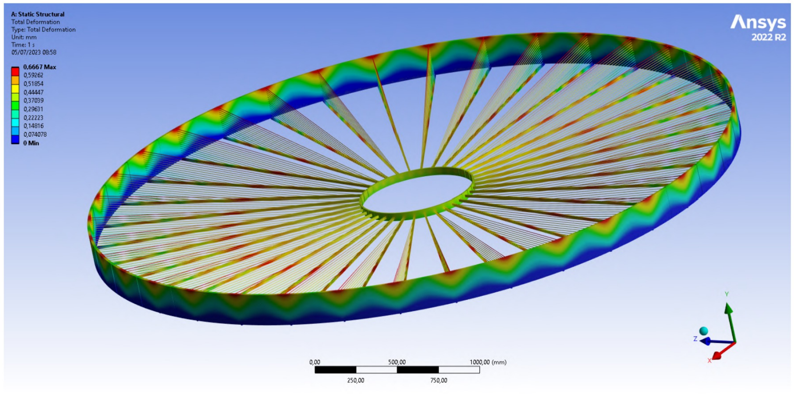
Parameters:	
Height:	200 mm
Innerthickness:	10 mm
Outerthickness:	14.4 mm
Rectangle_B:	9.6 mm
Rectangle_H:	16.6 mm
Circle_R:	1.5 mm

Responses:	
Maximum_Deformation:	22.995 mm (Linear Analysis)
Maximum_Deformation:	21.643 mm (Non-Linear Analysis)
Total_Mass:	2.6269 kg per sector
Total_Deformation_Load_Multiplier:	2.2068

Mechanical structure: prestressing

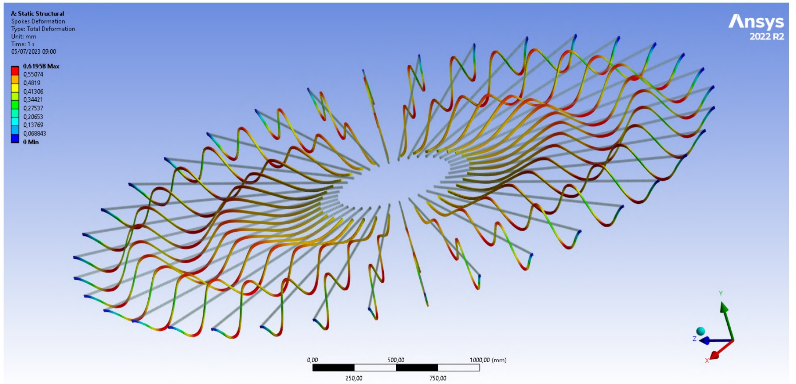
Goal: minimizing the deformation of the spokes using prestressing force in the cables

Finding the correct prestressing force in 14 cables → solving 15 dimensional optimization problem



Total deformation (mm) of the drift chamber with the edge of the outer cylinders fixed

No prestress		Prestress in the cables	
Spokes	Outer cylinder	Spokes	Outer cylinder
14.099	0.63	0.62	0.67



N.B.

- Prestressing not yet optimized
- 24 → 36 spokes considered for this study

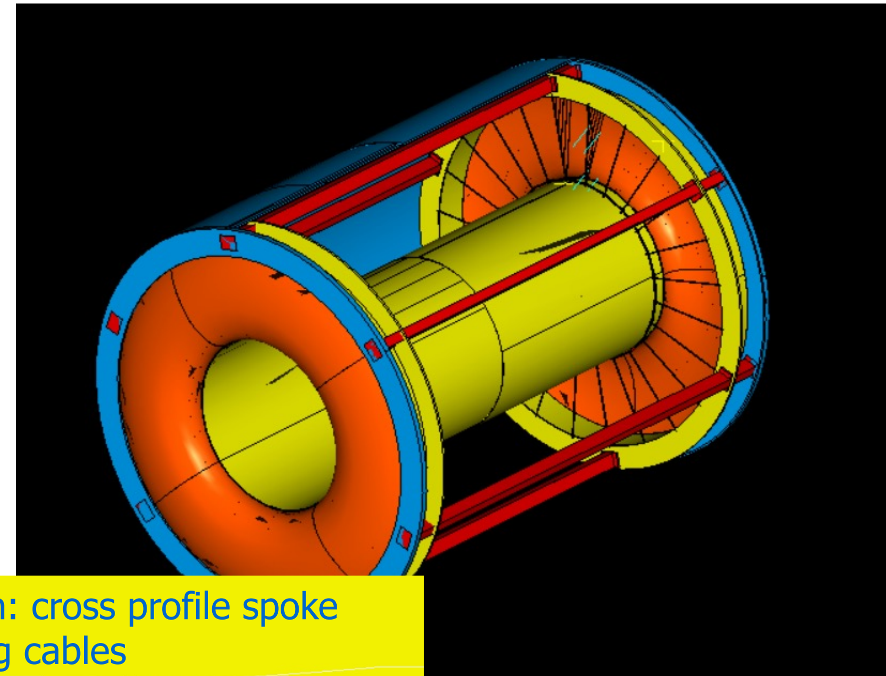
The structure exhibited a deformation of 600 µm but our goal was to limit the deformation of the spokes to 200 µm while ensuring the structural integrity.

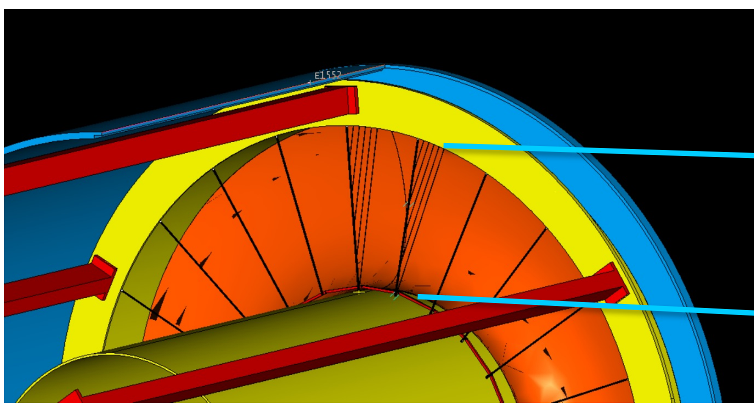
Mechanical structure: a complete model

A realistic complete model almost ready:
- mechanically accurate
- precise definition of the connections of the cables on the structure
- connections of the wires on the PCB
- location of the necessary spacers
- connection between wire cage and gas containment structure

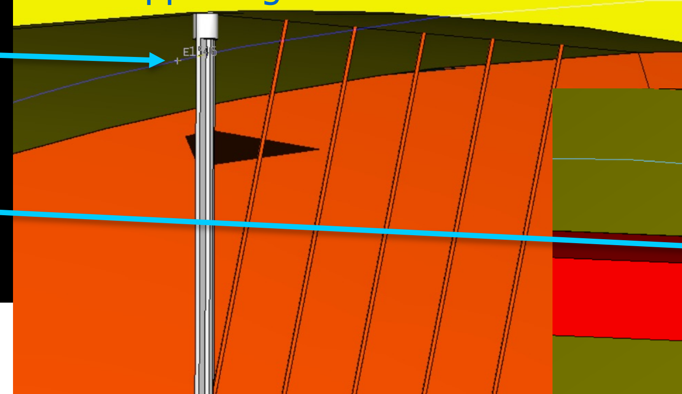
→

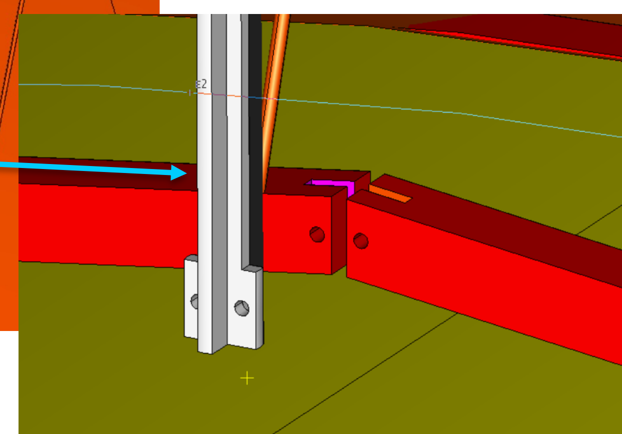
the final project will be ready by the end of 2023





Upper junction: cross profile spoke and supporting cables





Plan to start the construction of a DCH prototype full lenght, one sector, next year.

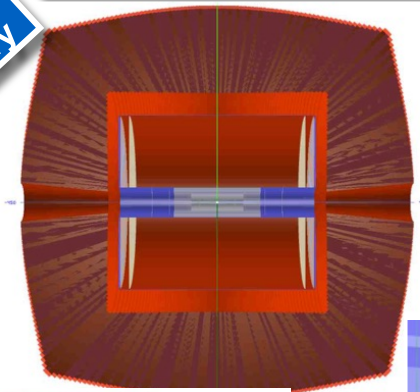
Lower junction: joint design

Geant4/DD4HEP simulation and cluster counting

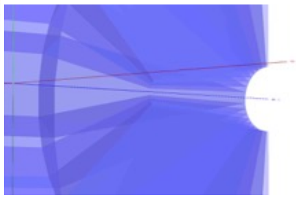
The integration of the Calorimeter geometry description with IDEA Silicon Vertex (SVX), Drift Chamber (DCH) has been performed. The code is available in the HEP-FCC githup area: https://github.com/HEP-FCC/IDEADetectorSIM

(calorimeter+Drift chamber)

Visualization for the Integrated Geometry



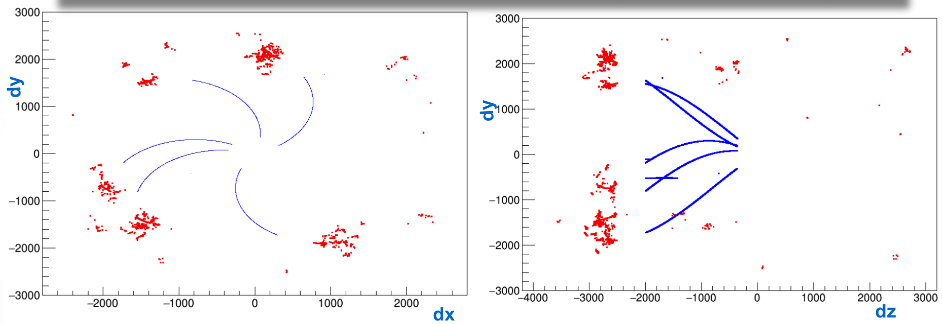
Phi volume (barrel)



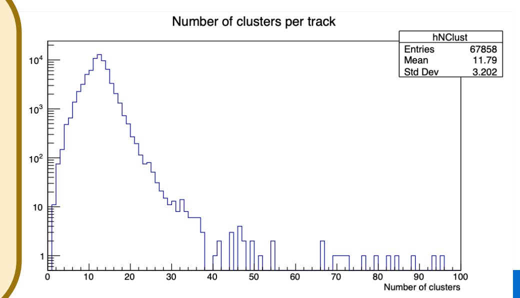
Phi volume (Endcap)

Hits display

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



Goal: to implement the cluster counting algorithm to the simulation of the drift chamber in the Geant 4 IDEA Full SIM framework. The basic idea is to develop an algorithm which can use the energy deposit information provided by Geant4 to reproduce, in a fast and convenient way, the clusters number distribution and the cluster size distribution. Muons at 300 MeV traversing 200 cells, are used in the validation. The results obtained from Geant 4 are in a good agreement with the ones from Garfield and with the expectation.

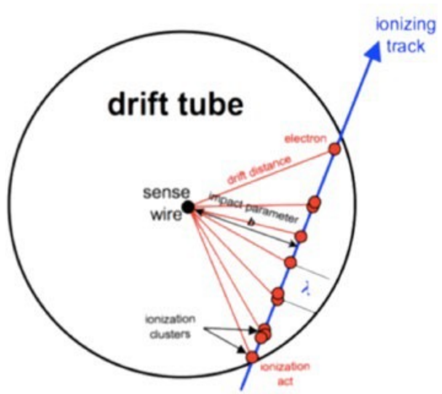


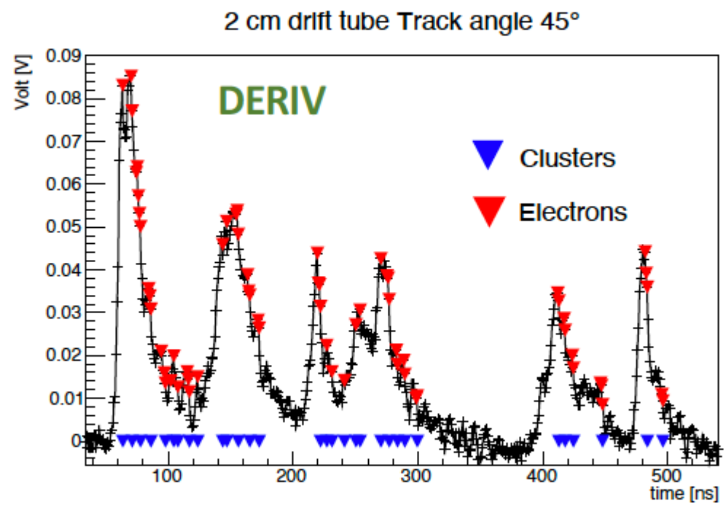
Attività di analisi dati

The Drift Chamber: Cluster Counting/Timing and PID

Principle: In He based gas mixtures the signals from each ionization act can be spread in time to few ns. With the help of a fast read-out electronics they can be identified efficiently.

- By counting the number of ionization acts per unit length (dN/dx), it is possible to identify the particles (P.Id.) with a better resolution w.r.t the dE/dx 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

- Landau distribution of dE/dx originated by the mixing of primary and secondary ionizations, has large fluctuations and limits separation power of PID → primary ionization is a Poisson process, has small fluctuations

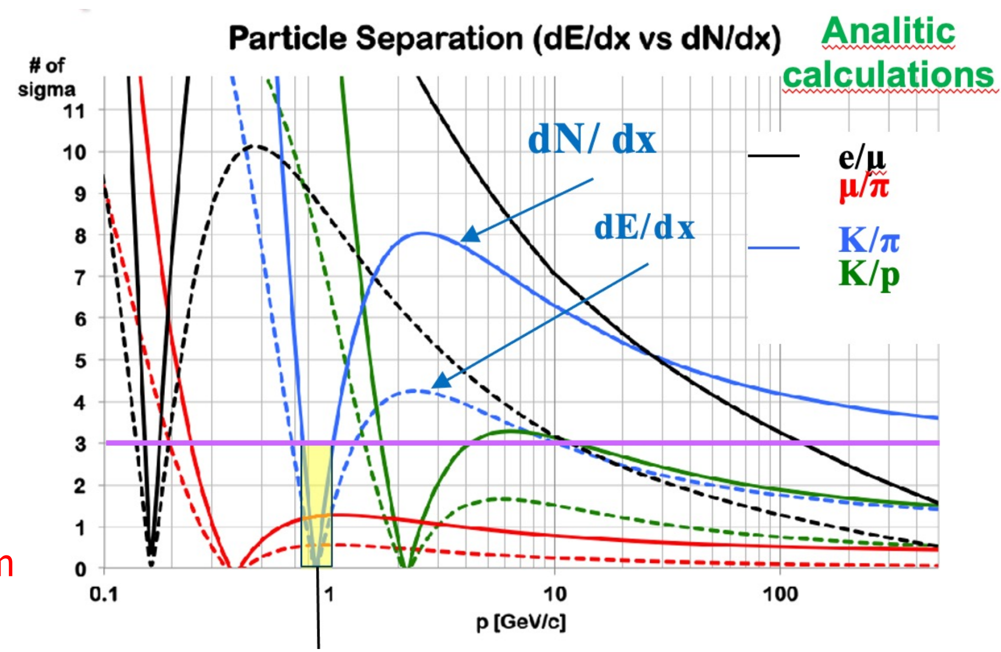
- The cluster counting is based on replacing the measurement of an ANALOG information (the [truncated] mean dE/dX) with a DIGITAL one, the number of ionisation clusters per unit length:

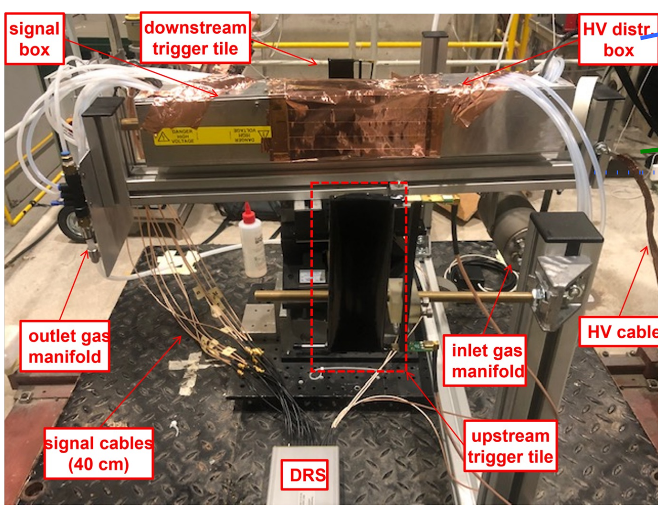
dE/dx: truncated mean cut (70-80%), with a 2m track at 1 atm give $\sigma \approx 4.3\%$

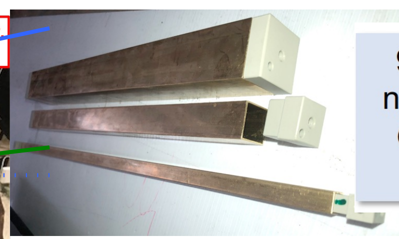
dN_{cl}/dx: for He/iC_4H_{10}=90/10 and a 2m track gives $\sigma_{dNcl/dx}$ **$/(dN_{cl}/dx)$** $< 2.0\%$

The Drift Chamber: Cluster Counting/Timing and PID

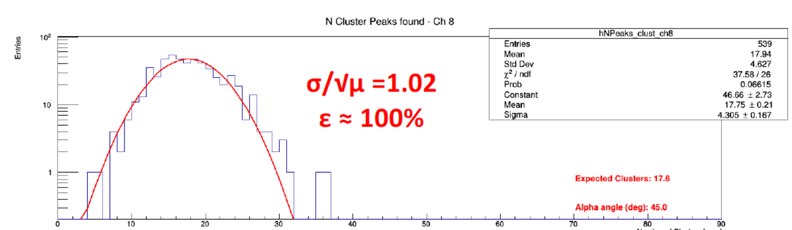
- Analitic calculations: Expected excellent K/π separation over the entire range except 0.85<p<1.05 GeV (blue lines)
- Simulation with Garfield++ and with the Garfield model ported in GEANT4:
  - the particle separation, both with dE/dx and with dN_{cl}/dx, in GEANT4 found considerably worse than in Garfield
  - the dN_{cl}/dx Fermi plateau with respect to dE/dx is reached at lower values of βγ with a steeper slope
  - finding answers by using real data from beam tests at CERN in 2021, 2022 and 2023







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

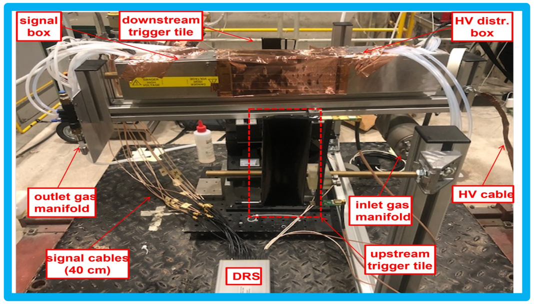


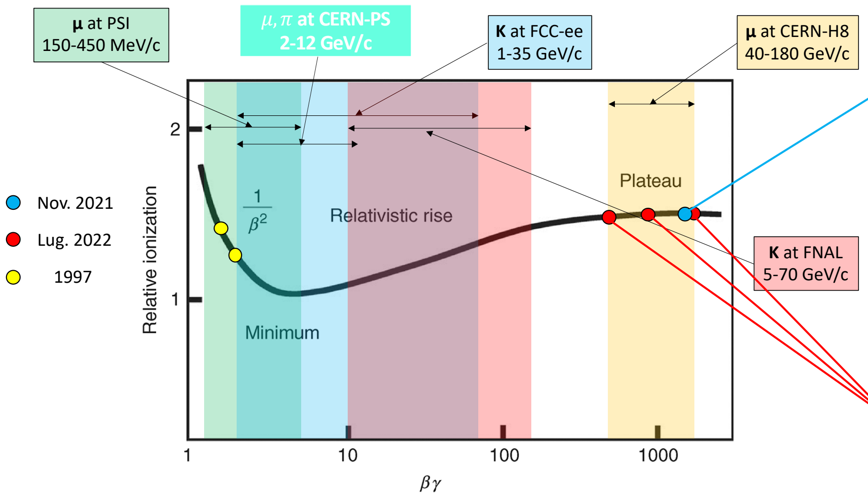
- Poissonian behaviour of the number of clusrers
- Meaurements vs predictions about the number of clusters are in very good agreement
- Same results in independent drift tubes

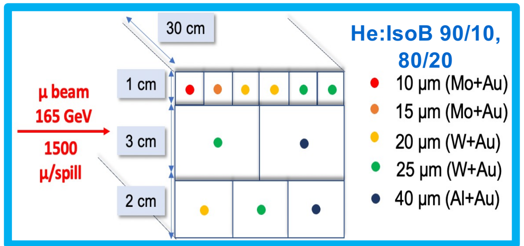
Beam tests in 2021, 2022 and 2023

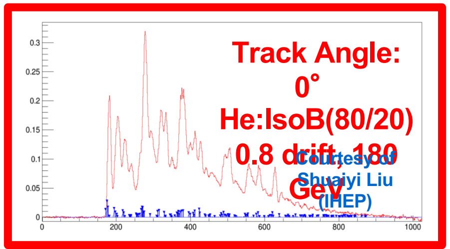
Beam tests to experimentally asses and optimize the **performance of the cluster counting/timing** techniques in strict collaboration with the IHEP Beijing group:

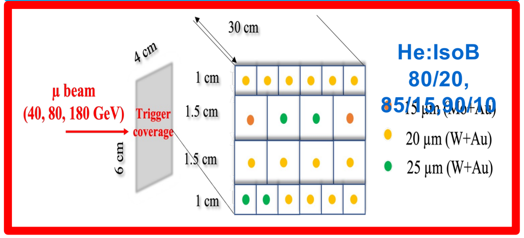
- Two **muon beam tests** performed at **CERN-H8 (βγ > 400)** in Nov. 2021 and July 2022.
- **Muon beam test** in 2023 at **CERN** with 2-12 GeV muons).
- Ultimate test at **FNAL-MT6** with π and **K (βγ = 10−140)** to fully exploit the relativitic rise, planned for 2025

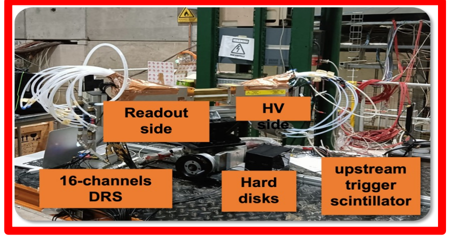




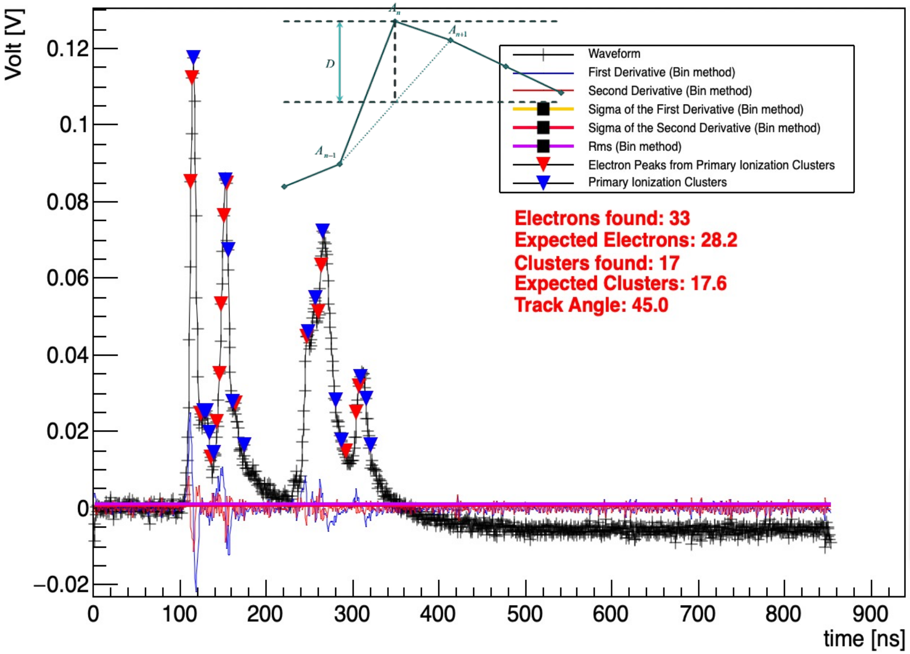






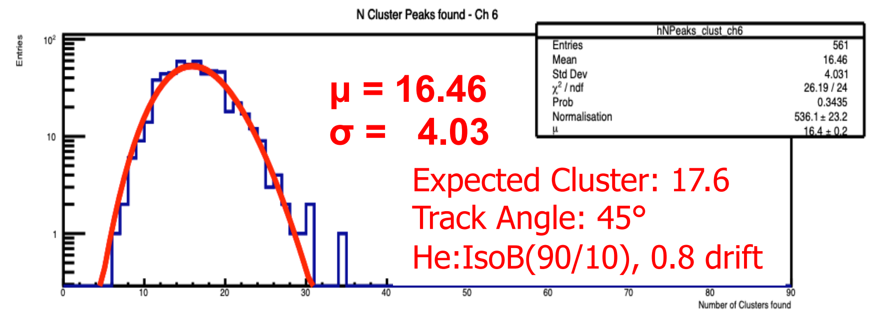


2022 Beam test results: number of clusters



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)

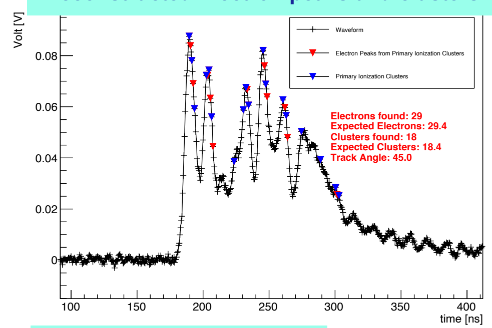
- α is the angle of the muon track w.r.t. normal direction to the sense wires
- δ cluster/cm (mip) changes from 12, 15, 18 respectively for He:IsoB 90/10, 85/15 and 80/20 gas mixtures
- Actual drift tube size are 0.8, 1.2, and 1.8 respectively for 1 cm, 1.5 cm, and 2 cm cell size tubes

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

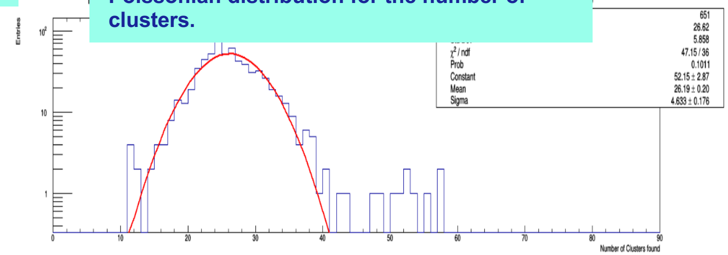
2021 and 2022 Beam test results: performance

- ✓ Derivative Algorithm (DERIV)
- ✓ and Running Template Algorithm (RTA)
- Poissonian distribution for the number of clusters as expected.
- Different scans have been done to check the performance: (HV, Angle, gas gain, template scan).

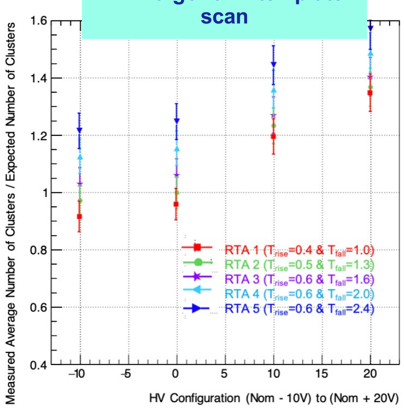
Example for the wave form with reconstructed Electron peaks and clusters



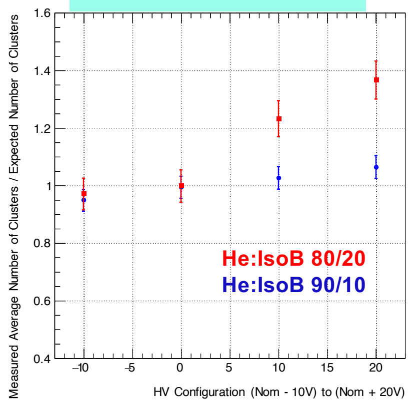
Poissonian distribution for the number of clusters.



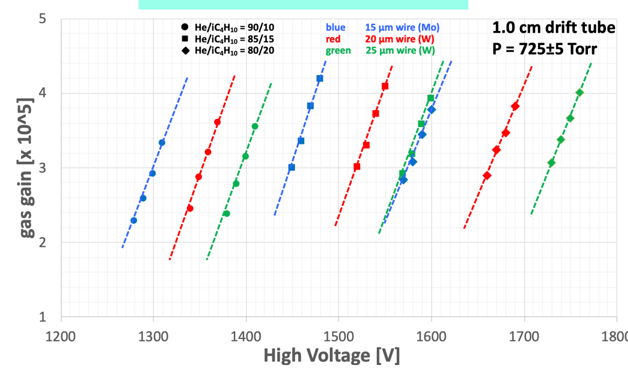
RTA algorithm template scan



HV scan



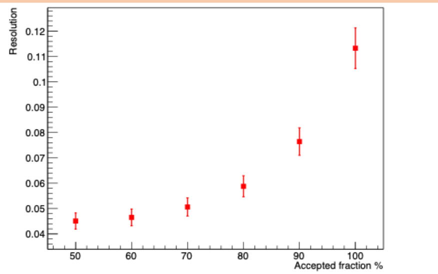
Gas gain scan



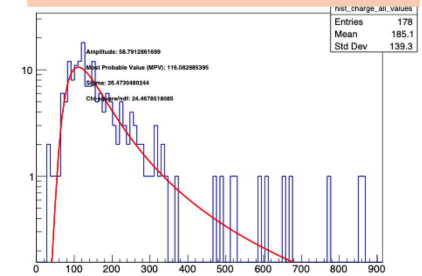
2021 and 2022 Beam test results: resolutions

- Landau distribution for the charges.
- Optimize truncation empirically (⇨best dE/dx resolution).
- Tested the resolution for each for each truncation cut.
- Selected the distribution with 80% of the charges to be compared with dN/dx.

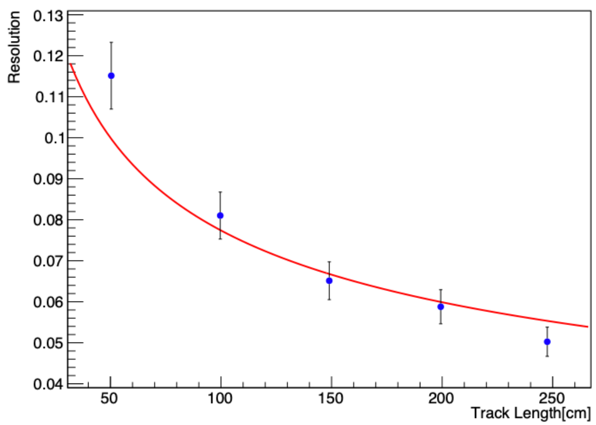
dE/dx Resolution Scan Vs accepted fraction of charge



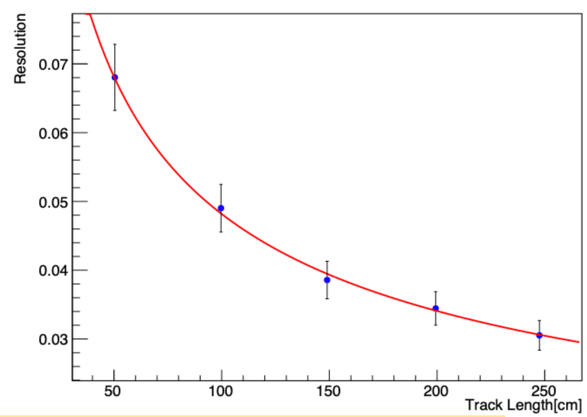
Integral charges a long a 2 m track length



dE/dx Resolution scan vs track lenght



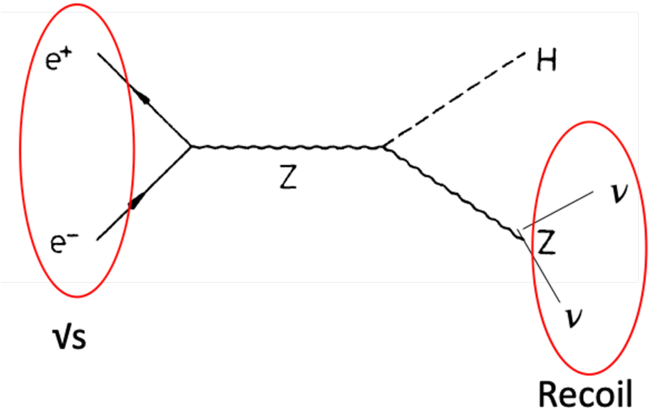
dN/dx Resolution scan vs track lenght



~ 2 times improvement in the resolution using dN/dx method

Full results to be presented by W. Elmetenawee at ICHEP 2024 → paper

ZH analysis: ee→HZ, H→hadrons, Z→$\nu\nu$ o hadrons

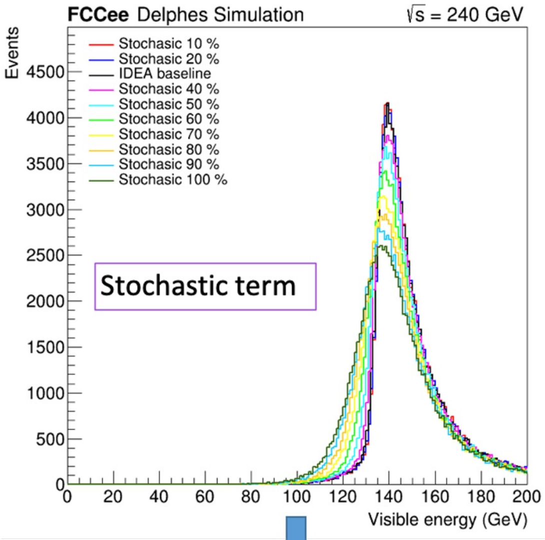


"Case study" to determine the requirements on the track momentum resolution and calorimeter performance. Study performed in the context of the FCC-ee "Higgs Physics group. "

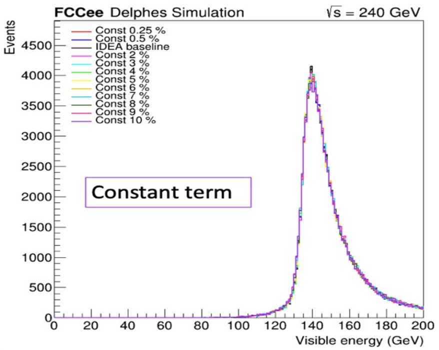
Since the calorimeter energy resolution playing an important role in the jet energy measurement, we studied the effect of

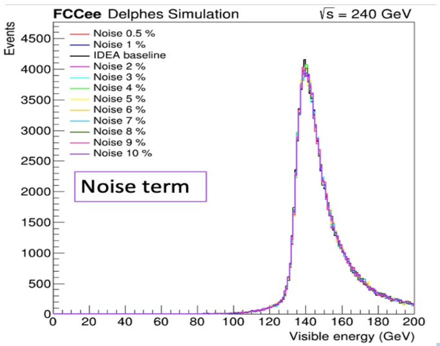
- tuning HCAL energy resolution parameters:
- tuning the stochastic, constant terms in Delphes cards
- adding Noise term to energy resolution calculation
- tuning the minimum energy threshold
- tuning the energy significance
- studying the calorimeter granularity impact on the analysis
- comparing with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



Main contributor





Responsabilità/Coordinamento RD:FCC:

N. De Filippis: Fisica, Simulazione e Software di RD_FCC Italia

Overview delle attività di RD_FCC Bari nel 2025

Hardware (in forte sinergia con INFN Lecce):

- setup tubi a drift per testbeam 2025 a Fermilab
- **inizio costruzione di un prototipo full lenght della DCH per IDEA**
- proposta di una **camera pulita** per assemblaggio/filatura

Simulazione e progettazione:

- f*ull simulation (***digi+ tracking algorithms***)* della camera a drift per IDEA FCC-ee
- studi di beam related background in connessione co il gruppo CERN e Frascati
- progettazione meccanica di un nuovo prototipo in scala di camera a drift per IDEA FCC-ee per studi di tracking performance

Analisi dati/Fisica:

- finalizzazione analisi dati del testbeam 2023 (in sinergia con INFN Lecce), note e paper
- Analisi di fisica Higgs per FCCee e FCC-hh

Attività di coordinamento: software, fisica e calcolo per FCC Italia

Partecipazione a workshop/conferenze/meeting FCC

Partecipazione a DRD1 per gas detector (WG2)

Full-length prototype for the IDEA DCH @ FCC-ee

Goals:

- ► Check the limits of the wires' electrostatic stability at full length and at nominal stereo angles
- ► Test different wires: uncoated Al, C monofilaments, Mo sense wires, …, of different diameters
- ○ Test different wire anchoring procedures (soldering, welding, gluing, crimping, …) to the wire PCBs
- ○ Test different materials and production procedures for spokes, stays, support structures and spacers
- ○ Test compatibility of proposed materials with drift chamber operation (outgassing, aging, creeping, …)
- ► Validate the concept of the wire tension recovery scheme with respect to the tolerances on the wire positions
- ○ Optimize the layout of the wires' PCBs (sense, field and guard), according to the wire anchoring procedures, with aim at minimizing the end-plate total material budget
- ► Starting from the new concepts implemented in the MEG2 CDCH robot, optimize the wiring strategy, by taking into account the 4m long wires arranged in multi-wire layers
- ► Define and validate the assembly scheme (with respect to mechanical tolerances) of the multi-wire layers on the end plates
- ○ Define the front-end cards channel multiplicity and their location (cooling system necessary?)
- ► Optimize the High Voltage and signal distribution (cables and connectors)
- ► Test performance of different versions of front-end, digitization and acquisition chain

Timeline

- First phase of **conceptual design of full chamber completed as of today** by a collaboration of **EnginSoft** and **INFN-LE mechanical service** (+ a Master student from **Torino Politecnico** and a PhD student from **Bari Politecnico**): final draft of technical report ready, to be finalized in next weeks
- Full **design of full-scale prototype completed by summer 2024** by **EnginSoft** (**purchase order issued**) with **INFN-LE mechanical service**
- Preparation of samples of **prototype components** (**molds and machining**) **ready by fall 2024** by **CETMA** consortium (**purchase order issued**)
- All mechanical parts (**wires**, **wire PCBs**, **spacers**, **end plates**) **ready by end of 2024**
- MEG2 CDCH2 **Wiring robot** transported from **INFN-PI** (being used for MEG2 CDCH2 until May 2024) to **INFN-LE/BA**, refurbished and re-adapted, to be operational **by spring 2025**
- Wiring and assembling **clean rooms**:
  - INFN-LE clean room currently occupied by ATLAS ITK assembly (until 2026 ?)
  - Investigating the possibility of using clean rooms at INFN-BA (depending on CMS occupation) or at CNR-LE (subject to agreement between INFN and CNR)
- **Wiring and assembling operations** would occur during **second half of 2025**
- **Prototype built by end of 2025 (+6 months contingency) and ready to be tested during 2026**

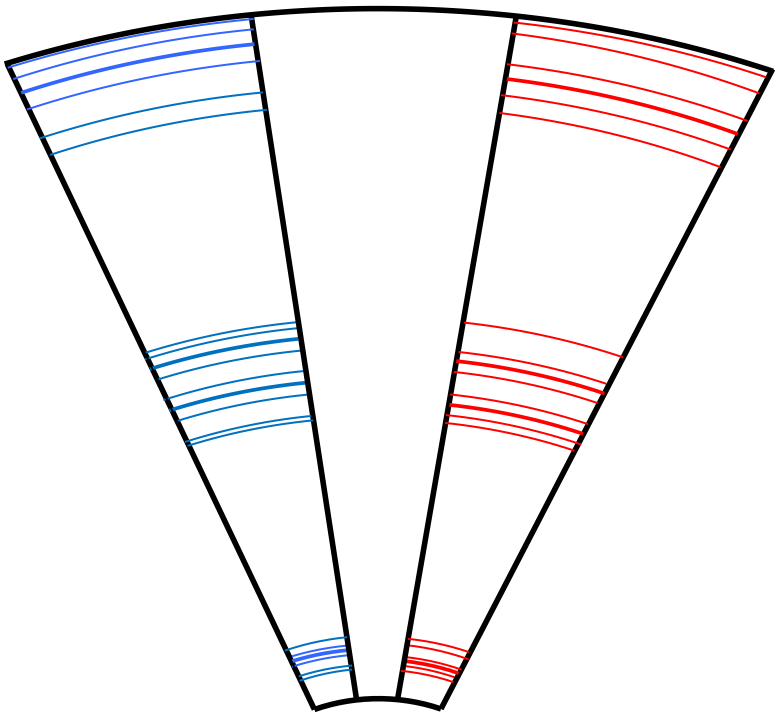
Costs

- Drift Chamber conceptual design (20 k€ from EURIZON-LE, invoice paid to EnginSoft)
- Full-Scale Prototype design (20 k€ from EURIZON-LE, purchase order issued to EnginSoft)
- Full-Scale Prototype design and material tradeoffs (molds and machining) (20 k€ from EURIZON-LE,
  purchase order issued to CETMA)
- Full-Scale Prototype components (inner cylinder and 8 spokes) (20 k€ from EURIZON-LE, purchase order issued to CETMA)
- Wires from Specialty Materials: 900 m of 35 μm C monofilament (5 k€ from EURIZON-LE)
- Wiring robot from MEG2 CDCH CSN1 funds to INFN-LE (estimated 100 k€)

Costs to be borne (late 2024 and 2025)

- Additional wires
- Peek plates for spacers: 6 m^2 x 10 mm
- Wiring robot refurbishing
- Mechanical support and gas envelope
- Front-end, digitizers and acquisition electronics

Wiring proposal



First two layers of superlayer #1
V and U guard layers (2 x 9 guard wires)
V and U field layers (2 x 18 field wires)
U layer (8 sense + 9 guard)
U and V field layers (2 x 18 field wires)
V layer (8 sense + 9 guard)
V and U field layers (2 x 18 field wires)
V and U guard layer (2 x 9 guard wires)

Last two layers of superlayer #7
V and U guard layers (2 x 21 guard wires)
V and U field layers (2 x 42 field wires)
U layer (20 sense + 21 guard)
U and V field layers (2 x 42 field wires)
V layer (20 sense + 21 guard)
V field layer (42 field wires)

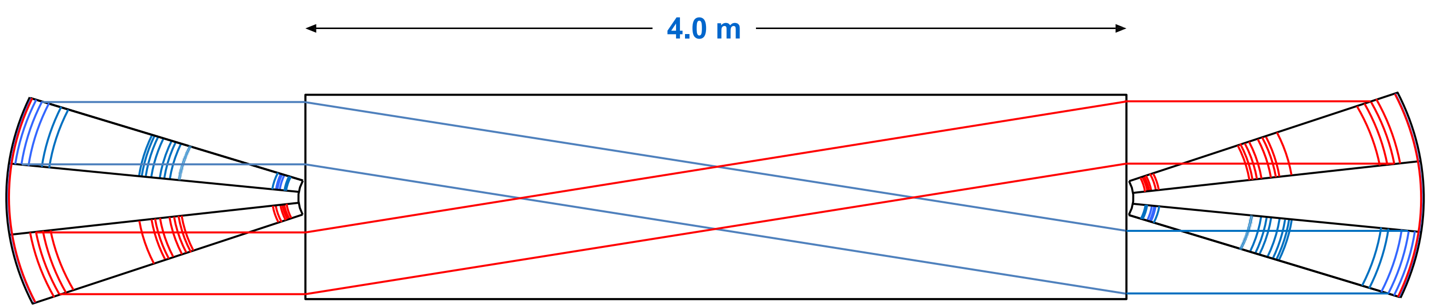
First two layers of superlayer #8
U field layer (46 field wires)
U layer (22 sense + 23 guard)
U and V field layers (2 x 46 field wires)
V layer (22 sense + 23 guard)
V and U field layers (2 x 46 field wires)
V and U guard layer (2 x 23 guard wires)

Last two layers of superlayer #14
V and U guard layers (2 x 35 guard wires)
V and U field layers (2 x 70 field wires)
U layer (34 sense + 35 guard)
U and V field layers (2 x 70 field wires)
V layer (34 sense + 35 guard)
V and U field layers (2 x 70 field wires)
V and U guard layer (2 x 35 guard wires)

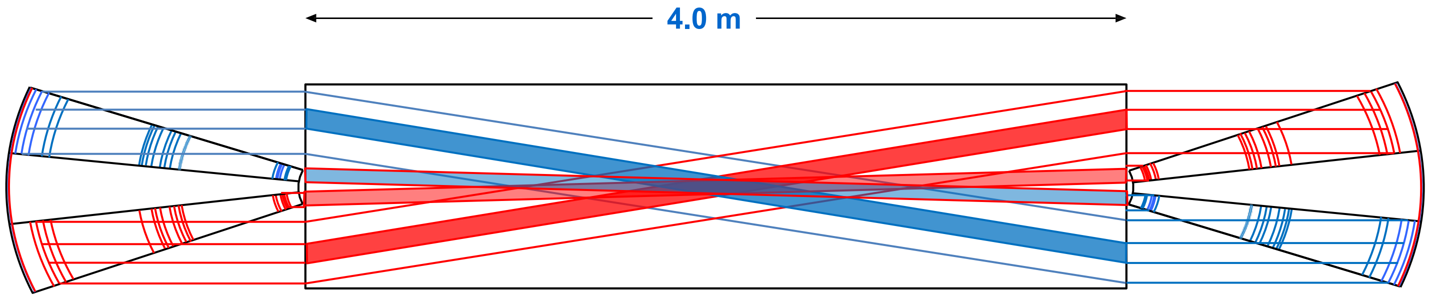
TOTAL LAYERS: 8
Sense wires: 168
Field wires: 965
Guard wires: 264

PCBoards wire layers: 42
Sense wire boards: 8
Field wire boards: 22
Guard wire boards: 12
HV values: 14

Readout channels: 8+8 + 16+16+16+16 + 16+16 = 112



ELECTRONICS COVERAGE



Minimum stereo angle	50 mrad
Maximum stereo angle:	250 mrad

Anagrafica e richieste 2024

Anagrafica RD_FCC 2025

INFN- Bari	2025
N. De Filippis (Assoc. Prof.)	25%
M. Abbrescia (Assoc. Prof.)	20%
M. Louka (PhD)	30%
B. D'Anzi (PhD)	30%
M. Barbieri (PhD)	30%
M. Anwar (PhD)	20%
W. Elmetenawee (Ass. Ricerca)	70%
D. Diacono (Tecn. INFN)	10%
F. Procacci (PhD)	90%
G. Pappalettera (Assoc. Prof.)	20%
F. Loddo (Tecn. INFN)	20%
TOT	**3,65 FTE**

Richieste per personale e servizi

- **Richiesta di servizio di officina meccanica (2 m.u) e progettazione meccanica (1m.u.)** per realizzazione di componenti per vari prototipi di camera a a drift e progettazione di un nuovo prototipo in scala

  In contatto con:
  - C. Pastore (OM)
  - M. Mongelli (SPM)

- **Richiesta di servizio elettronico (1 m.u.)** per test componenti elettronici

  In contatto con:
  - F. Loddo

Richieste finanziarie per RD_FCC 2024

Consumi/Inventariabile:

- strumentazione per tubi a drift e prototipo full size:

  Spese meccanica:
  - lastre di peek (spaziatori e costi di lavorazione): 10k
  - filatura su piano: sistema di trasporto dei fili su 4m + saldatura a infrarossi + motori passo passa delle National insturments, scheda di controllo, decoder → 15k€ per modificare il robot usato da MEG
  - trigger: tile di scintillatori (24 tile 30x30) con SiPM 8k → 12k€ con elettronica con schede + support
  - rotating table per testbeam – 1k€
  - costi ulteriori per testbeam Fermiklab (gas+servizi): 2k€

  Totale: 40k€

Facility per costruzione prototipi → camera pulita

- individuata area disponibile da attrezzare con filtri, condizionamento, rivestimento pareti adeguato, certificazione 10000 -> preventivo di circa 200k€ (discussione in corso)

Richieste missioni per RD_FCC 2025

- Testbeam al Fermilab a luglio 2025:
  - missioni per 2 settimane, 3 persone: 10k€
  - costi ulteriori (gas+servizi per testbeam): 2k€
- missioni a INFN Lecce – 5k€
- missioni per meeting, workshop, trasferte (3.65 FTE) 18kE

Totale: 35 k€

Attività DRD1 WP 2

N. De Filippis:

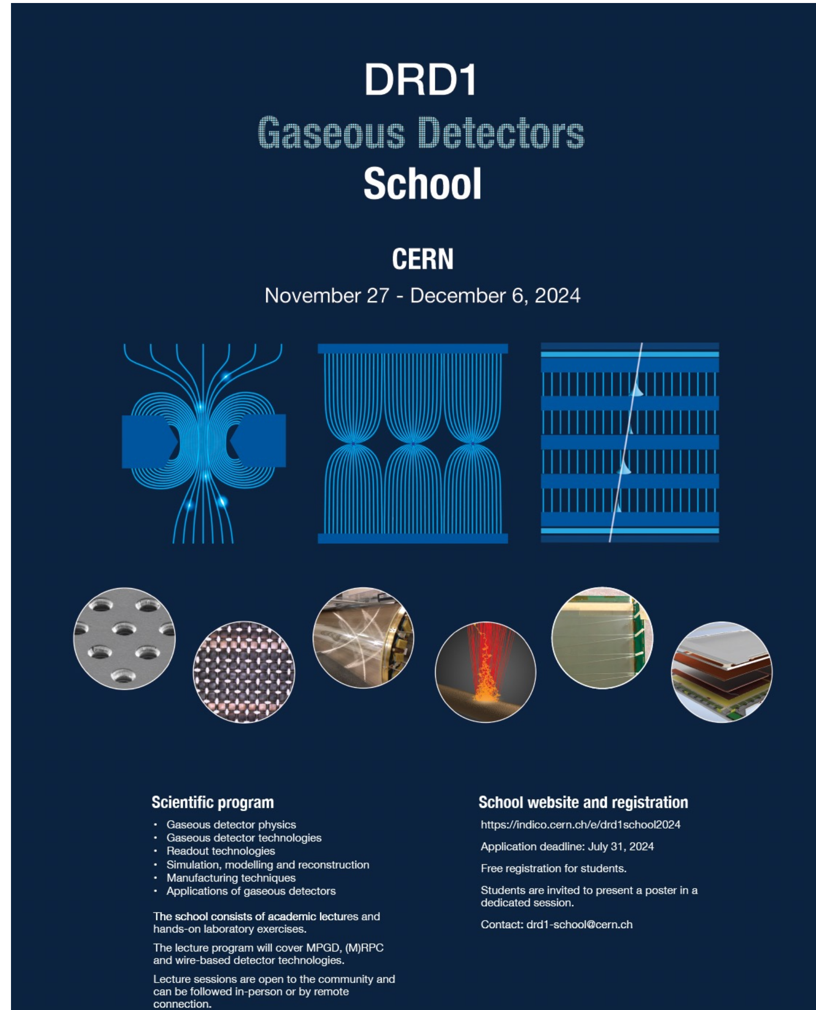
convener del WP2
«Inner and Central Tracking with Particle Identification Capability – Drift Chambers»

Technological representative nel DRD1 Management Board

#	Task	Performance goal	DRD1 WGs	ECFA DRDT	Milestones/Deliverable			Institutes
					12M	24M	36M	
T1	Front-end ASIC for cluster counting	- High bandwidth - High gain - Low power - Low mass	WG5, WG7.2	1.1 1.2	M1: **Achieving efficient cluster counting and cluster timing** performances by using FPGA based architecture → prototype of the front-end ASIC for cluster counting [T1]	M2: **Completion of a cylindrical sector** of a full length drift chamber prototype aimed at testing all mechanical properties [T3]	D: **Performance of K-pi separation** in the momentum range from 2 to 30 GeV/c based on a scalable front-end/digitizer/DAQ electronics chain for cluster counting.[T2]	INFN-BA, INFN-LE, INFN-RM BNL, FIT, U. Mass Amherst, U. Michigan, Irvine, Tufts U., U. Florida, U. Wisconsin IHEP-CAS, Nankai U., Tsinghua U.. USTC, IMP-CAS, Wuhan U, Jilin U., IJCLab-IN2P3. Bose. .
T2	Scalable multichannel DAQ board	- High sampling rate - Dead-time-less - DSP and filtering - Event time stamping - Track triggering	WG5 WG7.2	1.1 1.2				
T3	Mechanics: wiring procedures New endplate concepts	- feed-through-less wiring procedures - More transparent endplates (< 5% X_0) - transverse geometry	WG3 3.1C	1.1 1.3				
T4	High rate High granularity	- smaller cell size and shorter drift time - higher field-to-sense ratio	WG3 3.2E, WG7.2	1.3				
T5	New wire materials and wire metal coating	- Electrostatic stability - High YTS - Low mass, low Z - High conductivity - Aging	WG3 3.1C	1.1 1.2				
T6	Ageing of new wire types	- Establish charge collection limits for carbon wires as field and sense wires	WG3 3.2B WG7.3,4	1.1 1.2				
T7	Gas mixing, recuperation, purification and recirculation systems	- Non-flammable gas - High quenching power - Low-Z - High radiation length - High primary ions	WG3 3.1B 3.2C WG4, WG7.4	1.3				

Organization of detector schools

N. De Filippis, M. Abbrescia nel comitato organizzatore
M. Abbrescia: lezioni su gas detector
N. De Filippis, B. D'Anzi, F. Procacci per tutorial con tubi a drift
M. Louka: partecipazione come studente



N. De Filippis, et al. per tutorial con tubi a drift

Richieste finanziarie per DRD1-WP2

- Prototipo di camera a drift per tracciamento: 20k€
- Elettronica di lettura: digitizer VX2751 CAEN: 25k€
- Contributo missioni per tutorial detector school: 2k€

VX2751 ★ Coming Soon

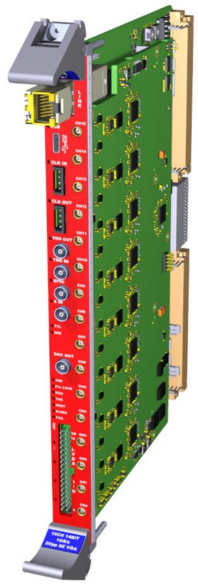
16 Channel 14 bit 1 GS/s Digitizer with programmable Input Gain

Request a quote

Features

- 14 bit @ 1 GS/s ADC
- 16 single-ended analog inputs on MCX connectors
- 2Vpp input range with software selectable analog gain
- Open FPGA programming through the graphical tool SCI-Compiler
- Wide range of applications (from Nuclear and Particle Physics to High Timing Resolution, Fast Neutron Spectroscopy, Dark Matter and Astroparticle, Fusion Plasma diagnostic, and Homeland Security)
- Suited for signals from fast organic, inorganic and liquid scintillators coupled to PMTs or SiPMs, Diamond detectors and others
- On-board live selection between scope mode (common trigger) and DPP mode (independent channel self-trigger)

More info



Partecipazione di INFN Bari a progetti

Progetti internazionali e nazionali in corso

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

"Future Experiments seek Smart Technologies (FEST)"

- bloccato per il COVID-19
- mobilità in corso per quest'anno e l'anno prossimo

Backup

Anagrafica RD_FCC 2025

INFN- Bari%	Sigle sinergiche a CMS	RD_FCC	CMS	AI_INFN
N. De Filippis (Assoc. Prof.)	20%	25%	70%	5%
M. Abbrescia (Assoc. Prof.)	20%	20%	80%	
M. Louka (PHD)	30%	30%	70%	
B. D'Anzi (PhD)	30%	30%	70%	
M. Barbieri (PhD)	30%	30%	70%	
M. Anwar (PhD)	20%	20%		
W. Elmetenawee (Ass. Ricerca)	70%	70%	30%	
D. Diacono (Tecn. INFN)	10%	10%		
F. Procacci (PhD)	90%	90%	10%	
G. Pappalettera (Assoc. Prof.)	20%	20%		
F. Loddo (Tecn. INFN)	20%	20%		
TOT	**3,6 FTE**	**3,60 FTE**		**3,65 FTE**

Richieste finanziarie per RD_FCC 2024

Consumi/Inventariabile:

- strumentazione per tubi a drift e prototipo full size:
  - Spese meccanica:
    - lastre di peek (spaziatori e costi di lavorazione) – 10k
    - schede di elettronica PCB board per fili (alta tensione, disaccoppiamento, 200 di 42 tipi diversi + component + extra costi) – 15k
    - spokes ci sono (100k)
    - porzione di cilindro interno ed esterno (anello) – ci sono
    - pannelli nido d'ape di carta e alluminio 1.6x4m
    - 1000 fili di campo per 5m – 10 km di fili di campo
    - 250 m^2 stays – 1000 euro – strain cage
    - sostegno prototipo - stand static – 3k€
    - filatura su piano: sistema di trasporto dei fili su 4m + saldatura a infrarossi + motori passo passa delle National insturments, scheda d controllo, decoder → 15k€ per modificare il robot usato da MEG
    - trigger: tile di scintillatori (12 tile 30x30) con SiPM 8k → 12k€ con elettronica con schede + supporto

Camera pulita: supporto per camera pulita per prototipo →

- field wires: Aluminium wire (40 e 50µm 1000m x2) 3000 k€

Richieste finanziarie per RD_FCC 2024

Consumi/Inventariabile:

- strumentazione per tubi a drift e prototipo full size:
  - contributo per camera pulita per prototipo … →
  - contributo per robot per filatura
  - field wires: Aluminium wire (40 e 50mm, 1000m x2) - 3000 k€
  - schede di alimentazione alta tensione
  - schede di lettura del segnale
  - cavi sma
  - peek…. €
  - tavolo rotante
  - slitta micrometrica / strain gage
  - In coda: elettronica CAEN VX2751 a 16 canali
- **RICHESTA: 5** k€

Missioni: meetings/workshops/testbeams

Costing for large-volume drift chambers project for IDEA

	A[Meuro]	#ch.	B[euro]	TOTAL [Meuro]
Gas Envelope	1.6	1	0	1.6
Wire Cage	1.0	60,000	108	7.0
Assembly	2.9	60,000	52	6.0
Electronics	3.0	120,000	143	20.1
HV/LV systems	0.06	60,000	16	0.9
Gas system	0.7	1	0	0.7

	savings	cost savings	comments
reduce outer radius R_{out} = 200 → 180cm ($R_{out} - R_{in}$ = 165 → 145cm)	14 → 12 superlayers 112 → 96 layers 56448 → 43776 channels (- 22.5%)	4.0 Meuro (11% of total cost)	40% deterioration of $\Delta p_t/p_t$ (8% from √N + 30% from L^2) 6.7% deterioration of PID
increase cell size 12/15 → 12/22 mm	14 → 12 superlayers 112 → 96 layers 56448 → 37904 channels (- 33.0%)	5.9 Meuro (16% of total cost)	8% deterioration of $\Delta p_t/p_t$ (8% from √N) 50% longer drift time (600ns)
reduce outer radius R_{out} = 200 → 190cm AND increase cell size 12/15 → 12/21 mm	14 → 11 superlayers 112 → 88 layers 56448 → 33216 channels (- 41.0%)	7.3 Meuro (20% of total cost)	28% deterioration of $\Delta p_t/p_t$ (13% from √N + 13% from L^2) 3.2% deterioration of PID 50% longer drift time (600ns)
reduce chamber length 400 → 360cm	mainly wire cost	0.5 Meuro (1.3% of total cost)	25 mrad loss in angular coverage gain in electrostatic stability
use of Carbon monofilaments as field wires	0.07 euro/m	3.8 Meuro (10% of total cost)	improve $\Delta p_t/p_t$ for low p_t tracks