

Futuri acceleratori (RD_FCC): attività nella sezione INFN-Bari e richieste finanziarie per 2021



N. De Filippis
Politecnico/INFN Bari
per gruppo RD_FCC



in sinergia con **INFN Lecce** e **Università del Salento**

Bari
Luglio 2020

Organizzazione

- **Stretta collaborazione con INFN Lecce e Università del Salento**
- **Diverse aree di interesse ed attività:**
 - Misure di precisione per acceleratori e^+e^- (FCC-ee, CepC)
 - Misure di precisione per acceleratori pp (FCC-hh) e SppC
 - Prospettive di scoperta di nuova fisica
 - Infrastruttura di calcolo (BARI Tier 2 for RD_FCC)
- **Sono coinvolti fisici teorici e sperimentali**
- **Contributi forniti per CDR per CepC e FCC**
- **Decisioni della European Strategy for Particle Physics: 19 Giugno 2020**
- **Attività in sinergia con le attività di CMS**

Decisioni della European Strategy



2020 Strategy Statements

3. High-priority future initiatives

It is essential for particle physics in Europe and for CERN to be able to propose a new facility after the LHC

- There are two clear ways to address the remaining mysteries: Higgs factory and exploration of the energy frontier
- Europe is in the privileged position to be able to propose both: CLIC or FCCee as Higgs factory, CLIC (3 TeV) or FCChh (100 TeV) for the energy frontier
- The dramatic increase in energy possible with FCChh leads to this technology being considered as the most promising for a future facility at the energy frontier.
- It is important therefore to launch a feasibility study for such a collider to be completed in time for the next Strategy update, so that a decision as to whether this project can be implemented can be taken on that timescale.

a) ~~An electron-positron Higgs factory is the highest-priority next collider~~ For the longer term, the European particle physics community has the ambition to operate a proton-proton collider at the highest achievable energy. Accomplishing these compelling goals will require innovation and cutting-edge technology:

- *the particle physics community should ramp up its R&D effort focused on advanced accelerator technologies, in particular that for high-field superconducting magnets, including high-temperature superconductors;*
- *Europe, together with its international partners, should investigate the technical and financial feasibility of a future hadron collider at CERN with a centre-of-mass energy of at least 100 TeV and with an electron-positron Higgs and electroweak factory as a possible first stage. Such a feasibility study of the colliders and related infrastructure should be established as a global endeavour and be completed on the timescale of the next Strategy update.*

The timely realisation of the electron-positron International Linear Collider (ILC) in Japan would be compatible with this strategy and, in that case, the European particle physics community would wish to collaborate.

FCC-ee/CepC motivation

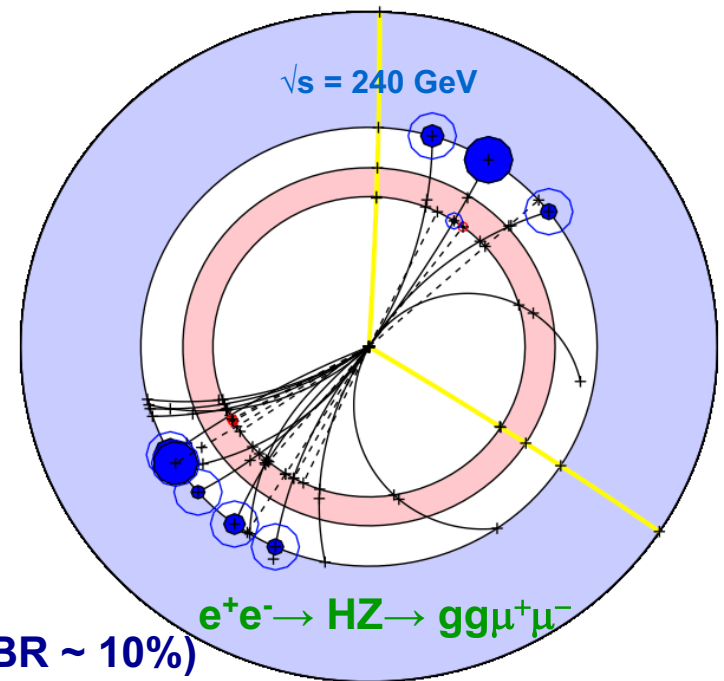
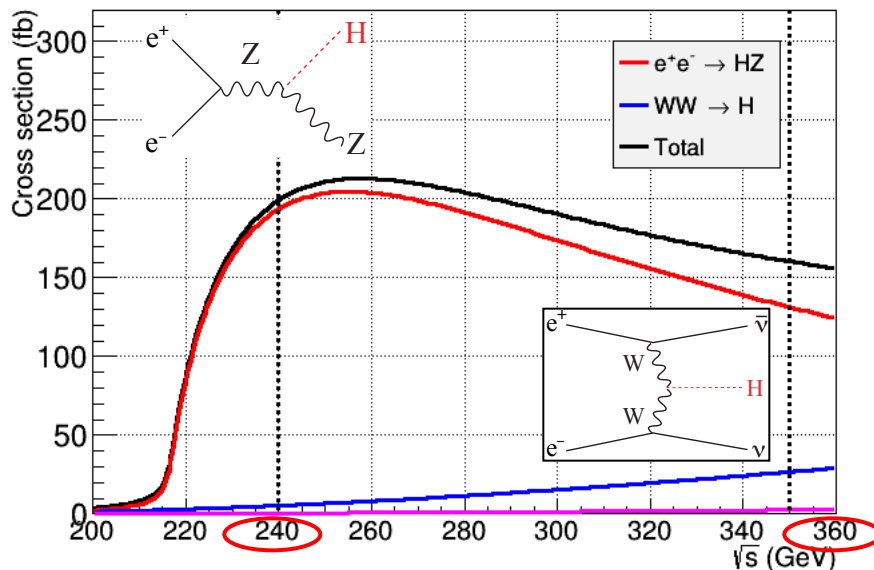
e) There is a strong scientific case for an electron-positron collider, complementary to the LHC, that can study the properties of the Higgs boson and other particles with unprecedented precision and whose energy can be

FCC-ee/CepC: focus on a 90-250 GeV e^+e^- machine (100 km circumf.)

5 ab^{-1} integrated luminosity to two detectors over 10 years $\rightarrow 10^6$ clean Higgs events

\rightarrow FCC-ee/CEPC measure the Higgs boson production cross sections and most of its properties with precisions far beyond achievable at the LHC

◆ Higgs-strahlung ($m_H = 125 \text{ GeV}$)



◆ The gluon can be studied with Higgs decays ($\text{BR} \sim 10\%$)

FCC-ee/CepC: Higgs factory at $\sqrt{s}=240$ GeV

Model-independent precision measurements

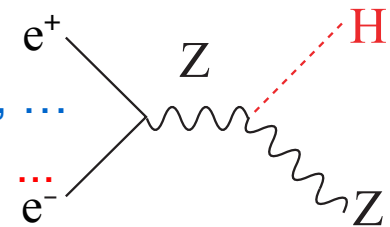
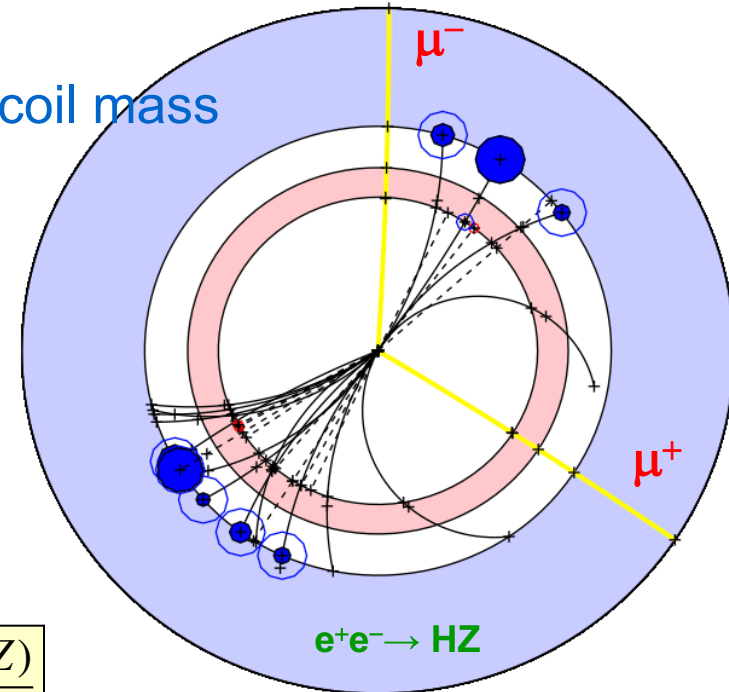
- A Higgs boson is tagged by a Z and the recoil mass

$$m_H^2 = s + m_Z^2 - 2\sqrt{s}(E_+ + E_-)$$

- Measure $\sigma(e^+e^- \rightarrow HZ)$
- Deduce g_{HZZ} coupling
- Infer $\Gamma(H \rightarrow ZZ)$
- Select events with $H \rightarrow ZZ^*$
- Measure $\sigma(e^+e^- \rightarrow HZ, \text{ with } H \rightarrow ZZ^*)$

$$\sigma(e^+e^- \rightarrow HZ \rightarrow ZZZ) = \sigma(e^+e^- \rightarrow HZ) \times \frac{\Gamma(H \rightarrow ZZ)}{\Gamma_H}$$

- Deduce the total Higgs boson width Γ_H
- Select events with $H \rightarrow bb, cc, gg, WW, \tau\tau, \gamma\gamma, \mu\mu, Z\gamma, \dots$
- Deduce $g_{Hbb}, g_{Hcc}, g_{Hgg}, g_{HWW}, g_{H\tau\tau}, g_{H\gamma\gamma}, g_{H\mu\mu}, g_{HZ\gamma}, \dots$
- Select events with $H \rightarrow$ “nothing”
- Deduce $\Gamma(H \rightarrow \text{invisible})$



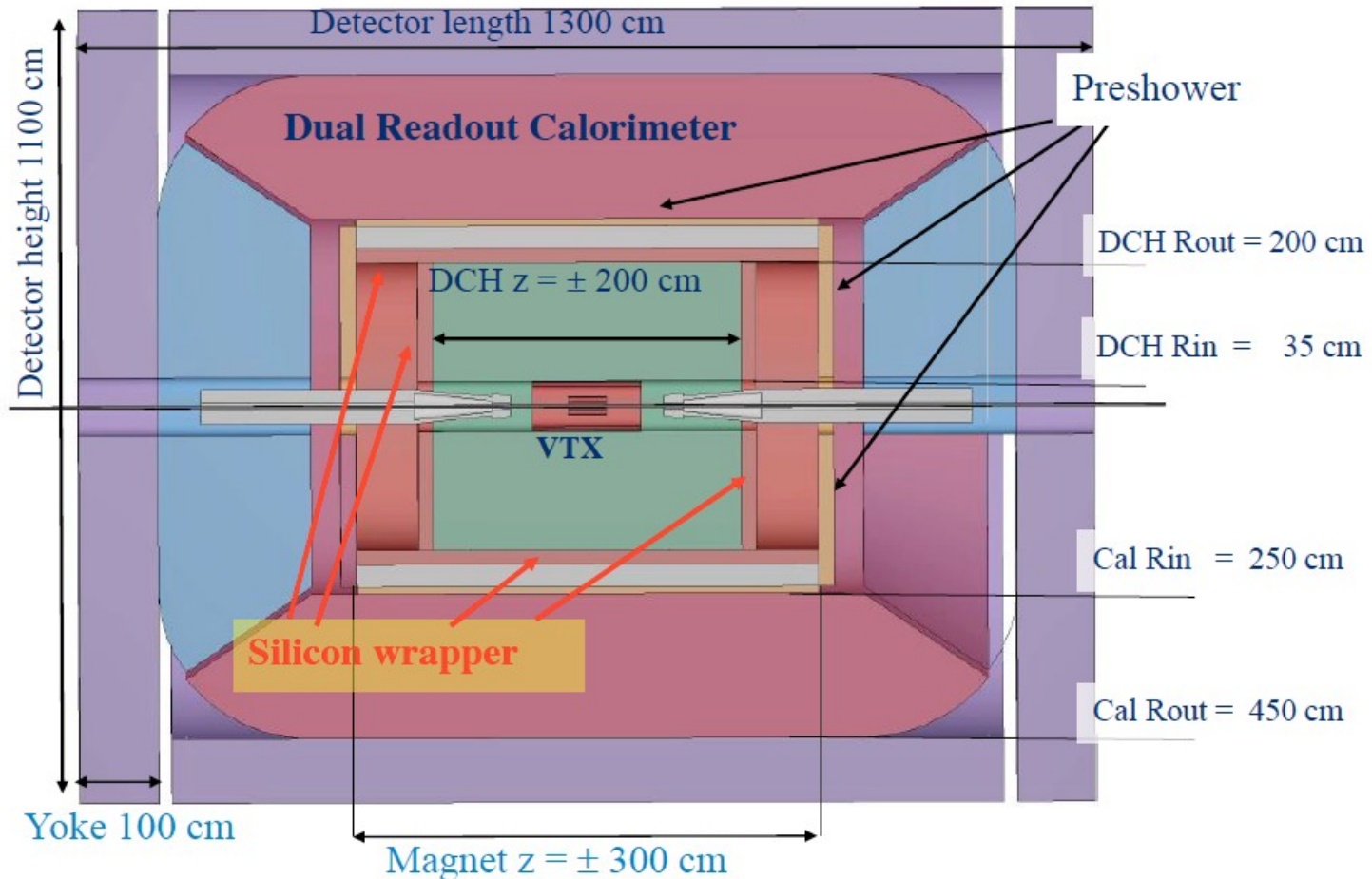
The IDEA experiment at FCC-ee/CepC

IDEA: proposta di
esperimento INFN

FCC-ee at CERN

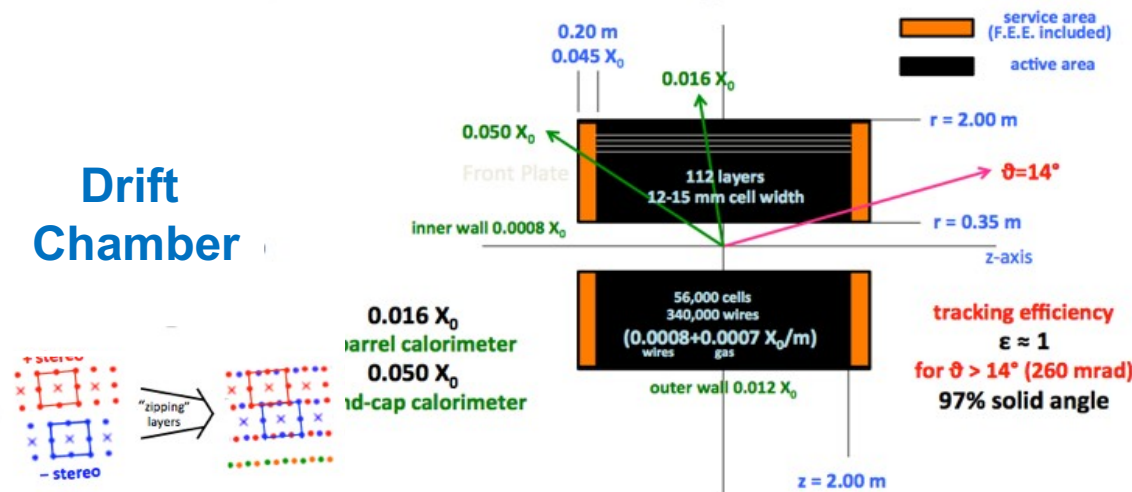


CEPC at IHEP-China

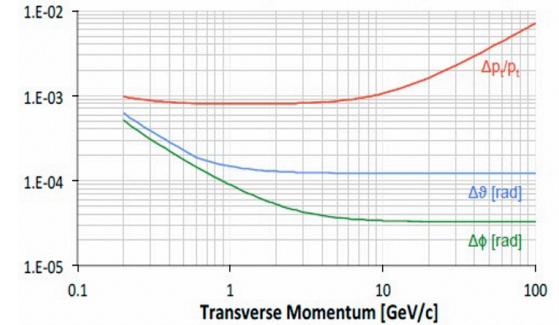


The Drift Chamber for the IDEA experiment

Drift Chamber



Momentum and Angular Resolutions (theta = 90)



$$\Delta p_t/p_t = (0.7p_t + 8.3) \times 10^{-4}$$

$$\Delta \theta = (1.1 + 9.4/p) \times 10^{-4} \text{ rad}$$

$$\Delta \phi = (0.33 + 9.4/p) \times 10^{-4} \text{ rad}$$

	R_{in} [mm]	R_{out} [mm]	z [mm]	thickness [mm]	inner wall	gas	wires	outer wall	service area
drift chamber	350	2000	± 2000		0.2	1000	1000	20	250
service area	350	2000	$\pm(2000+2250)$	X_0 [%]	0.08	0.07	0.13	1.2	4.5

# of layers	112	min 11.8 mm – max 14.9 mm	active volume	50 m ³	0.9 He- 0.1 iC ₄ H ₁₀
# of cells	56448	192 at first layer – 816 at last layer			
average cell size	13.9 mm	min 11.8 mm – max 14.9 mm			
average stereo angle	134 mrad	min 43 mrad – max 223 mrad			
transverse resolution	100 μ m	80 μ m with cluster timing			
longitudinal resolution	750 μ m	600 μ m with cluster timing			
readout channel	112,896	r.o. from both ends	max drift time	400 ns	800 \times 8 bit at 2 GHz

Progetti internazionali/nazionali e INFN Bari

call H2020-MSCA-RISE-2019: progetto "FEST" iniziato

"Future Experiments seek Smart Technologies (FEST)"

- bloccato per il COVID-19

call H2020-INFRA-SUPP-2018-2020 progetto "CREMLIN+" iniziato

"Connecting Russian and European Measures for Large-scale Research infrastructure"

- "Development and design of Particle Identification and tracking systems" per la SCT

call AIDAinnova: proposta accettata

- "Cluster Counting/Timing: data reduction and pre-processing of drift chamber signals sampled at high rates" finanziato con circa 20k€ per INFN Lecce

Progetti internazionali/nazionali e INFN Bari

Progetto di outreach per Call PhysicsInvolvingPeople "What Next? Il futuro spiegato ai giovani" – finanziato

- da Bari: N. De Filippis, M. Abbrescia, L. Silvestris, G. Iaselli
- organizzazione, attraverso il coinvolgimento di studenti dell'ultimo anno delle scuole superiori, di una giornata evento di divulgazione scientifica in cui gli studenti parteciperanno alla creazione di un cortometraggio che verrà proiettato durante gli eventi finali rivolti a tutta la cittadinanza e che saranno resi disponibili su varie piattaforme web.

Proposta per Call H2020-MSCA-RISE-2020 "NEPHTHYS" – sottomesso

"New Frontier for experimental particle physics and technology scouting"

Obiettivi:

- the EFT modeling for new physics and the interpretation of the Higgs and Dark Matter measurements provided by the LHC experiments within the EFT framework;
- the development of new technologies for silicon and gas detectors for charged particle detection and identification in future collider experiments;
- the development of applications for data analysis, data mining and scouting using machine learning techniques.

FEST e CREMIN+

Table B1 – Work Package (WP) List

Work Package No	Work Package Title	Activity Type (e.g. Research, Training, Management, Communication, Dissemination...)	Number of person-months involved	Beneficiary leading	Start Month	End month
1	BESIII CGEM-IT detector and Physics	Research, Training	211	INFN	1	48
2	Detectors for future experiments	Research, Training	118	INFN	1	48
3	Readout electronics for future experiments	Research, Training	55	INFN	1	48
4	Medical applications	Research, Training	10	INFN	1	48
5	Future accelerators Physics	Research, Training	56	INFN	1	48
6	Data Challenge	Research, Training	14	INFN	1	48
7	Dissemination and Outreach	Dissemination, Outreach	0	INFN	1	48
8	Management	Management	0	INFN	1	48

An ultra-low mass drift chamber could represent the ideal solution for a general purpose central tracking detector, making use of: low mass gas mixtures; new materials for wires and for mechanical supports; new assembly techniques for high granularity layouts; new reconstruction techniques to improve particle identification capability by more than a factor of two w.r.t. the traditional method of charge integration; cluster timing, to improve the spatial resolution by correcting the bias in the impact parameter definition. The FEE must evolve to match the specific requirements of these innovations; task T3.4 is coping with such requirements in WP3.

✓ Project duration: 4 years, 01.01.2020-31.12.2023

Task 2.1 Drift Chamber [M1-48] [HM 12/18,0/0] [INFN,IHEP] New solutions involving polymeric fibers or Carbon monofilaments, coated with easy to solder light metals, like tin, zinc, copper or their common alloys, will represent a breakthrough in the drift chamber technology and must be pursued with feasibility studies. Moreover, the adoption of new composite materials for the drift chamber gas containment and for the electrostatic and radiofrequency shielding of the active chamber volume, suitably shaped to minimize stresses and deformations, will contribute to further lowering the overall tracking system material budget in front of the remaining sub-detectors. Prototypes will be developed to test both new wires and smart enclosure/shielding technologies. This task will lead to D2.1.

Task 3.4 Develop specific Front-End and Post-Processing Electronics [M28-40] [HM 18/18,0/0] [INFN,IHEP] Front-end electronics for high density drift chambers will be designed for a gain which must produce a suitable read-out signal for further processing, low power consumption, a bandwidth adequate to the expected signal spectral density and a fast pulse rise time response, to exploit the cluster counting/timing technique. Identifying both the amplitude and the arrival time of each peak associated with each individual ionization cluster is the minimum requirement on the data transfer for storage. The possibility of being programmed to perform “ad hoc” functions, optimizing its performance in relation to the task to be performed, suggests the possibility of using FPGAs for the real-time analysis of the data generated by a drift chamber and successively converted by an ADC. This task will lead to D3.4.

Description of Deliverables:

2.1 Report on the technical characteristics of a full scale prototype [M48] [T2.1]

D3.4 Report with the definition of a suitable FPGA and implementation of the peaks finding algorithm on the FPGA through the related evaluation board [M36] [T3.4]

M2.2	DCH: choice of materials for wires and gas containment	WP2	INFN	M36	Results of mechanical tests
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SCT: Lepton Collider „Super Charm-Tau Factory“; Novosibirsk

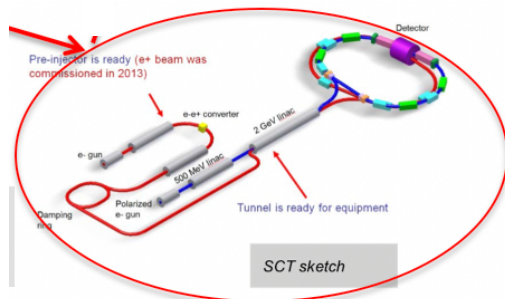
✓ Project duration: 4 years, 01.02.2020-31.01.2024

CREMLIN PLUS
Connecting Russian and European Measures for Large-scale Research Infrastructures

Task 5.3: Development of software for the design of an SCT detector

Task 5.5: Development and design of Central Tracker for the SCT detector

- An ultra-low mass Tracking Chamber with Particle Identification capabilities (TraPIId) concept (INFN Lecce and Bari)
- Low material, Improved identification with cluster counting
- Synergy with MEG2 DC and the IDEA DC project for FCC-ee and CEPC
- New drift chamber for the CMD3 experiment as a prototype for the SCT central tracker



Attività svolta da INFN Bari nel 2019 e 2020

Strategia delle attività

La partecipazione alle attività relative alla progettazione, simulazione e costruzione della camera a deriva per IDEA (FCC-ee/CepC/SCT) richiede numerosi passi :

- Test e caratterizzazione di un prototipo di camera a deriva
 - **analisi dati del Test Beam 2018** (in backup)
- Test e caratterizzazione di una camera di monitoraggio della velocità di deriva
 - **simulazione della camera**
- **Simulazione** della camera a drift con Geant4 ed integrazione in IDEA (in backup)
- Contributo alla **progettazione meccanica** per nuovo prototipo per SCT
→IDEA

Camera di monitoraggio della velocità di deriva

I. Margjeka, N. De Filippis

F. Cuna, G. Tassielli, F. Grancagnolo et al. (Lecce)

Motivazioni:

Variazioni dell'ordine del percento 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' 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
- 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:

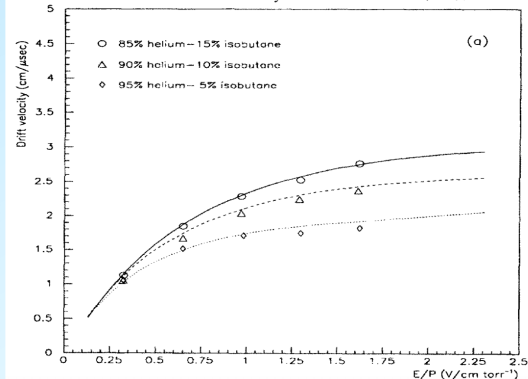
- variazioni di campo elettrico di 2V/cm;
- variazioni relative di contenuto di isobutano del 4.3×10^{-3} ;
- variazioni della pressione della miscela di 0.8 mbar;
- **variazioni nel contenuto di vapore acqueo del 150 ppm .**

Precise measurements of drift velocities in helium gas mixtures

P. Bernardini, G. Fiore, R. Gerardi, F. Grancagnolo, U. von Hagel¹, F. Monitola, V. Nassisi, C. Pinto, L. Pastore, M. Primavera²

¹Università di Lecce, Dipartimento di Fisica and INFN, Sezione di Lecce, via Arnesano, 73100 Lecce, Italy

Nuclear Instruments and Methods in Physics Research A 355 (1995) 428–433



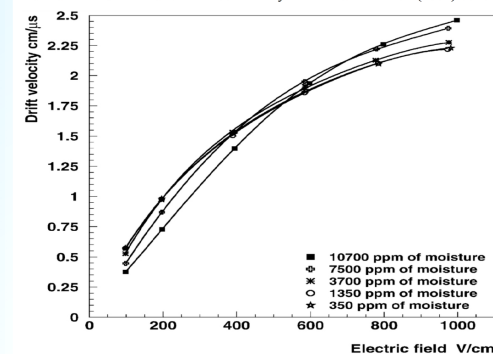
For a 90/10 mixture, at normal pressure, variations of the electric field, around the operating value of 1 V/cm/torr, of about 2 V/cm induce drift velocity variations of 1×10^{-3} .

Influence of oxygen and moisture content on electron life time in helium–isobutane gas mixtures

V. Golovatyuk*, F. Grancagnolo, R. Perrino

^{*}Dipartimento di Fisica dell'Università, INFN Sezione di Lecce, via Arnesano, 73100 Lecce, Italy

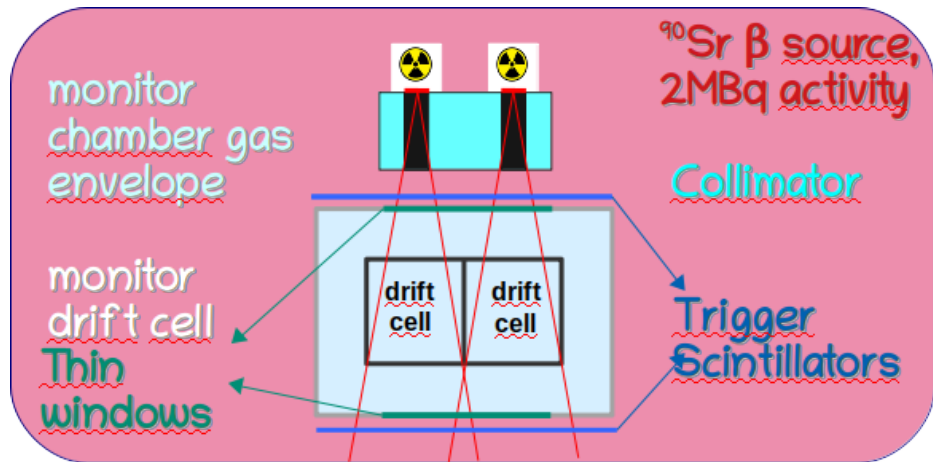
Nuclear Instruments and Methods in Physics Research A 461 (2001) 77–79



To mitigate the ageing effect, sometimes it is useful to introduce small quantities of water vapors in the gas mixtures, but it is important to control the consequent variations of drift velocity.

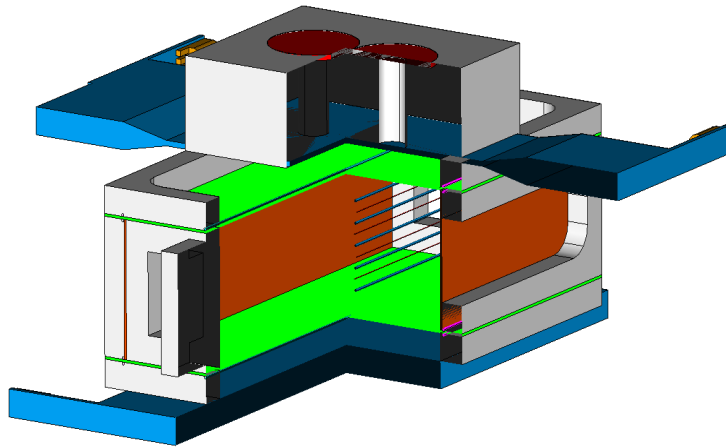
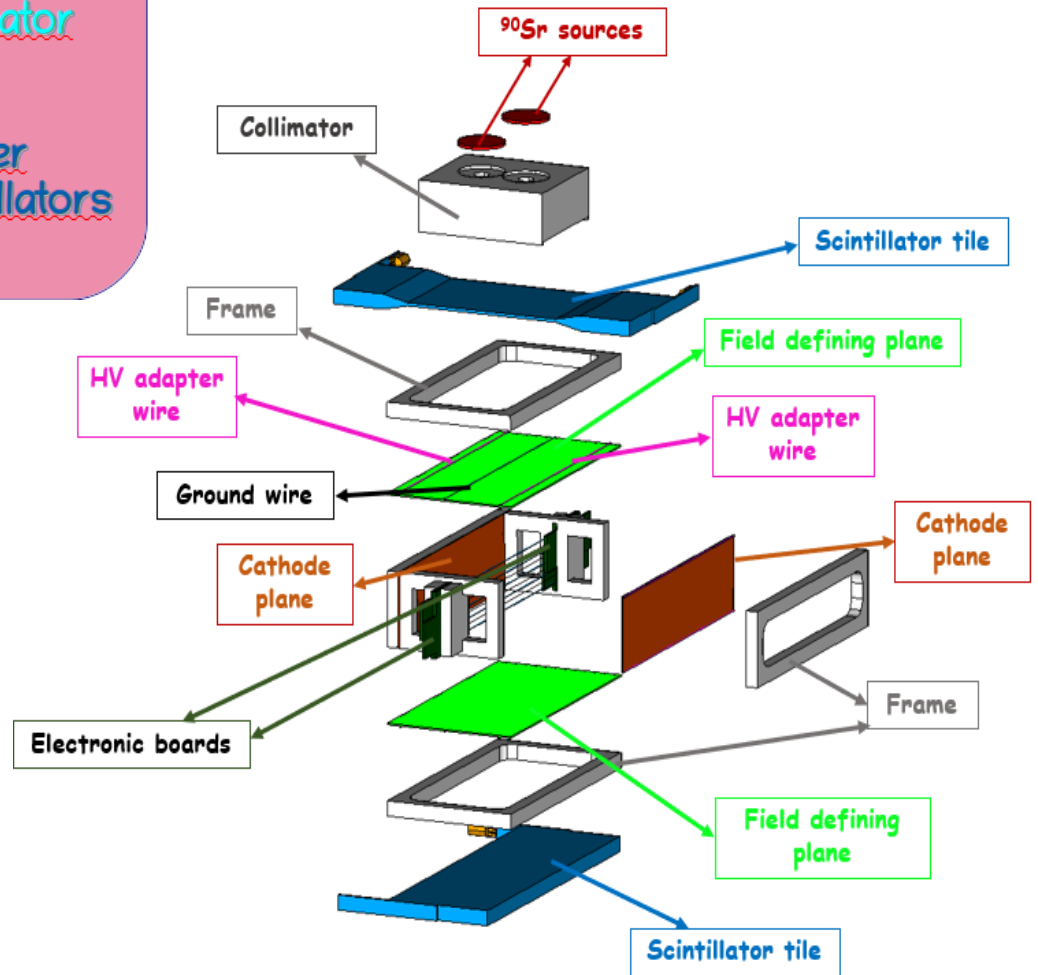
E.g. at the operating value of the electric field of about 1 V/cm/torr, variations of ≈ 150 ppm leads to an increase of 10^{-3} in drift velocity.

Camera di monitoraggio della velocità di deriva



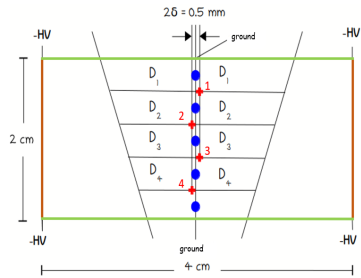
Struttura della camera

I. Margjeka, N. De Filippis, F. Cuna, A. Miccoli (Lecce)



Camera di monitoraggio della velocità di deriva

Principio della misura (F. Cuna, I. Margjeka, N. De Filippis)



Cathode walls will define higher uniform electric field.

Sense wires are staggered in the planes $x = \pm \delta$ to allow drift velocity measurements.

Drift velocity can be measured using the shift on wire positions, starting by time relations:

$$t_2 = \frac{t_1 + t_3}{2} \mp \frac{2\delta}{v_d} \quad \text{Subtracting } t_3 - t_2$$

$$t_3 = \frac{t_2 + t_4}{2} \pm \frac{2\delta}{v_d}$$

$$\Theta = (t_1 + t_3 - 2t_2) - (t_2 + t_4 - 2t_3)$$

For tracks on left side

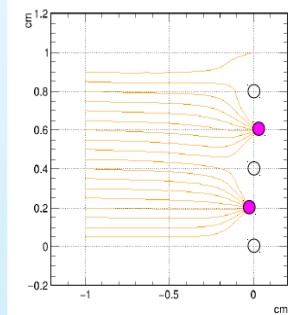
$$\Theta_+ = +8\delta/v_d$$

For tracks on right side

$$\Theta_- = -8\delta/v_d$$

$$v_d = \frac{16\delta}{\Delta\Theta} \quad \sigma_{v_d} = \sqrt{\left(\frac{16\delta}{\Delta\Theta}\right)^2 \sigma_\delta^2 + \left(\frac{-16\delta}{\Delta\Theta^2}\right)^2 \sigma_{\Delta\Theta}^2}$$

- Θ will have **double gaussian** distribution.
- The distance between the two peaks is related to drift velocity



Simulation results for electric field

We made simulations using Garfield++. First step was the optimization of electric field inside the two drift cells. We fixed the voltage on cathode plane at -2000V and varied the voltage on field wires from 0V to -800 V and on the sense wires from 0 V to 1200 V.

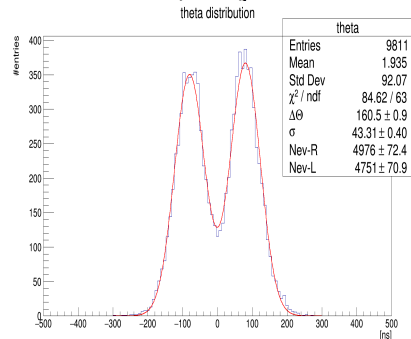
The optimized values are:

- 925 V for sense wires
- -350 V for field wires

Simulation results for electron tracks

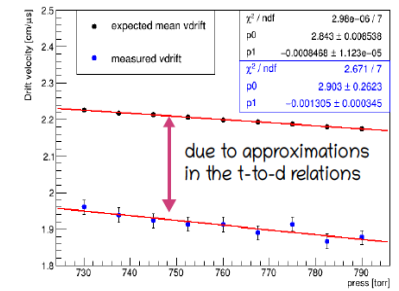
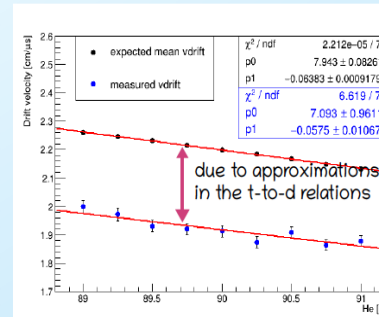
We simulated 2000 tracks on left side and 2000 on the right side.

After ionization, every electron from cluster drifted to the sense wire. Saving drift times and total charges produced, we obtained the double peak distribution.



$$\Delta\Theta = (209.1 \pm 2.2) \text{ ns} \quad v_d = (1.91 \pm 0.02) \text{ cm}/\mu\text{s}$$

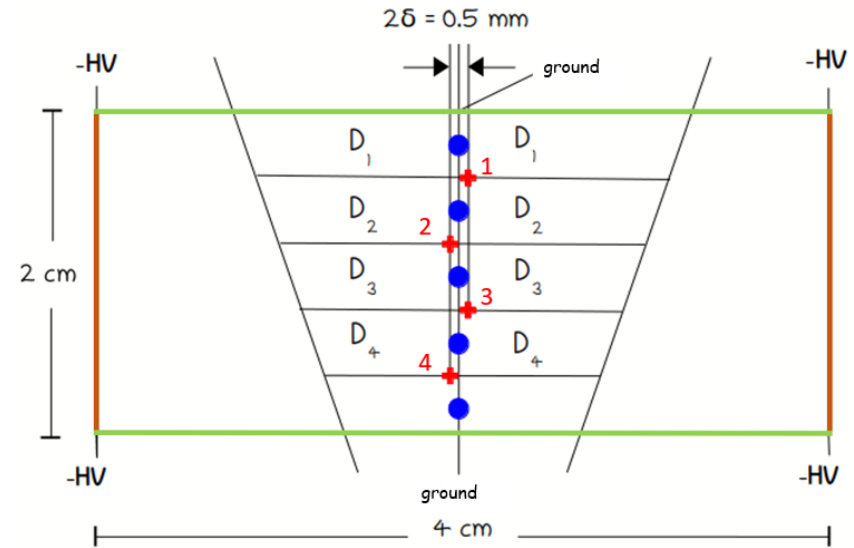
An increment in the number of event of a factor of 100 increases the sensibility at 10^{-3} level. The number of tracks necessary to obtain this sensibility is 4×10^5 and it will be obtained with the radioactive source and the experimental set-up chosen.



Camera di monitoraggio della velocità di deriva

Simulazione della camera:
F.Cuna, G. Tassielli (Lecce)
I.Margjeka, N. De Filippis

- Simulation program Garfield++ (v. 2017)
- Simulation different gas-mixtures
- Simulation of electric field configuration and
- Tracks through the chamber
- Simulation of the measurement
- Scope: to determine the optimized value for V_s and V_g to ensure a high and uniform electric field in the two drift cells.



Electric field configuration with $V_g = -350$ V, $V_s = 925$ V

PREPARED FOR SUBMISSION TO JINST

INTERNATIONAL CONFERENCE ON INSTRUMENTATION FOR COLLIDING BEAM PHYSICS
 24 - 28 FEBRUARY, 2020
 BUDKER INSTITUTE OF NUCLEAR PHYSICS, NOVOSIBIRSK, RUSSIA

A 10^{-3} drift velocity monitoring chamber

F. Cuna^{a,b,1}, G. Chiarello^d, A. Corvaglia^a, N. De Filippis^{c,f}, F. Grancagnolo^a, M. Manta^b,
 I. Margjeka^{c,e}, A. Miccoli^a, M. Panareo^{a,b}, G. F. Tassielli^{a,1}

^aIstituto Nazionale di Fisica Nucleare, Lecce, Italy

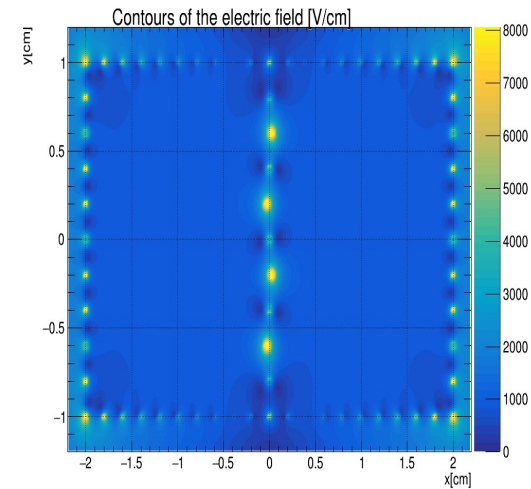
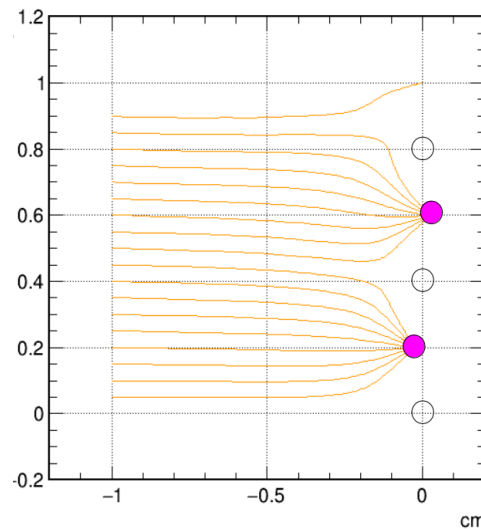
^bUniversità del Salento, Italy

^cUniversità degli Studi di Bari, "Aldo Moro", Italy

^dIstituto Nazionale di Fisica Nucleare, Roma, Italy

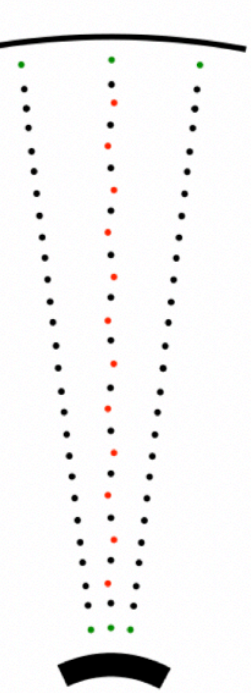
^eIstituto Nazionale di Fisica Nucleare, Bari, Italy

^fPolitecnico di Bari



Progettazione meccanica camera a deriva per SCT

15° sector A



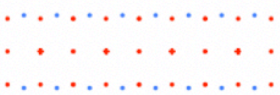
$R_{cyl} = 120 \text{ mm}$
 $\Delta R = x \text{ mm}$
 $h_{cell} = 7 \text{ mm}$
 $w_{cell} = 28.4 \text{ mm}$

- sense wire 20 μm
- field wire 80 μm
- guard wire 120 μm

$h_{cell} = 7 \text{ mm}$
 $w_{cell} = 8.25 \text{ mm}$

$R_{in} = 20 \text{ mm}$
 $\Delta R = 5 \text{ mm}$

15° sector B
4 cells



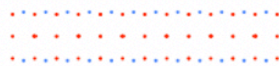
4 layers
 $w_{cell} = 8.66 \div 10.54 \text{ mm}$

15° sector C
5 cells



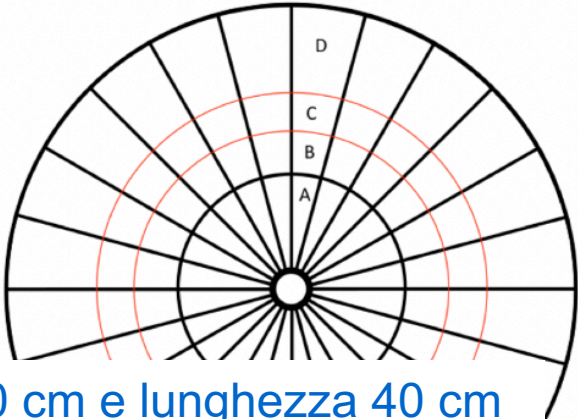
4 layers
 $w_{cell} = 8.94 \div 10.46 \text{ mm}$

15° sector D
6 cells



8 layers
 $w_{cell} = 9.15 \div 12.42 \text{ mm}$

Details about the cell structure in chamber sectors.



- SPIDER WEB STRUCTURE**
- A:
jet cell axial-layer
12 sense per cell
1 cell per sector
 - B:
4 single wire cell
 \pm stereo-layers
4 cells per sector
 - C:
4 single wire cell
 \pm stereo-layers
5 cells per sector
 - D:
8 single wire cell
 \pm stereo-layers
6 cells per sector

CMD3 camera (prototipo di SCT) —> diametro di 60 cm e lunghezza 40 cm
camera di SCT—> diametro 1 m e lunghezza fra 1.5 e 2 m (intermedia)
Ottimizzazione del progetto meccanico (A. Miccoli e F. Cuna (Lecce) in
contatto con C. Pastore, M. Mongelli, V. Valentino)

Anagrafica e richieste 2021

Anagrafica RD_FCC/CREMLIN+/WN_CC3M 2021

INFN- Bari	Sigle sinergiche	RD_FCC	CREMLIN+	WN_CC3M
N. De Filippis (Assoc. Prof.)	30%	25%	--	5%
M. Abbrescia (Assoc. Prof.)	15%	10%	--	5%
R. Aly (PhD)	30%	30%	--	
I. Margjeka (PhD)	20%	20%	--	
W. Elmetenawee (PhD)	30%	30%	--	
M. Maggi (1+ ricerc. INFN)	20%	--	20%	
G. Iaselli (Full prof.)	10%	5%	--	5%
D. Diacono (Tecn. INFN)	10%	10%		
TOT	1.65 FTE	1.3 FTE	0,2 FTE	0,15 FTE
Officina meccanica	1 m.u.			
Servizio Progettisti Meccanici	1 m.u.			

In contatto con:

- C. Pastore (OM)
- M. Mongelli (SPM)
- V. Valentino (SPM)

Richieste finanziarie per RD_FCC 2021

Missioni: meetings/workshops (escludendo missioni su FEST)

INFN- Bari	k€
N. De Filippis	2
M. Abbrescia	1
R. Aly	1
I. Margjeka	1
W. Elmetenawee	1
G. Iaselli	0,5
D. Diacono	0.5
TOT	7k€

Richieste su FEST (le stesse dell'anno scorso)

	Diaria Cina	120	E/day	FEST A	2100	E/month	Risparmio CSN1			
	Viaggi Cina	900	E/viaggio	FEST B	1800	E/month	AdR			
Sezione	MU FEST	Diaria tot	Viaggi	Viaggi tot	Totale	FEST A	FEST B	ASS.	SJ	Cost CSN1
INFN-BA	6	21.600	7	6.300	27.900	12.600	10.800	4.500	23.400	15.300

Richieste finanziarie per consumi RD_FCC 2021

Si richiede supporto per strumentazione di laboratorio per il funzionamento per “ v_{drift} monitoring chamber” in costruzione presso INFN Lecce.

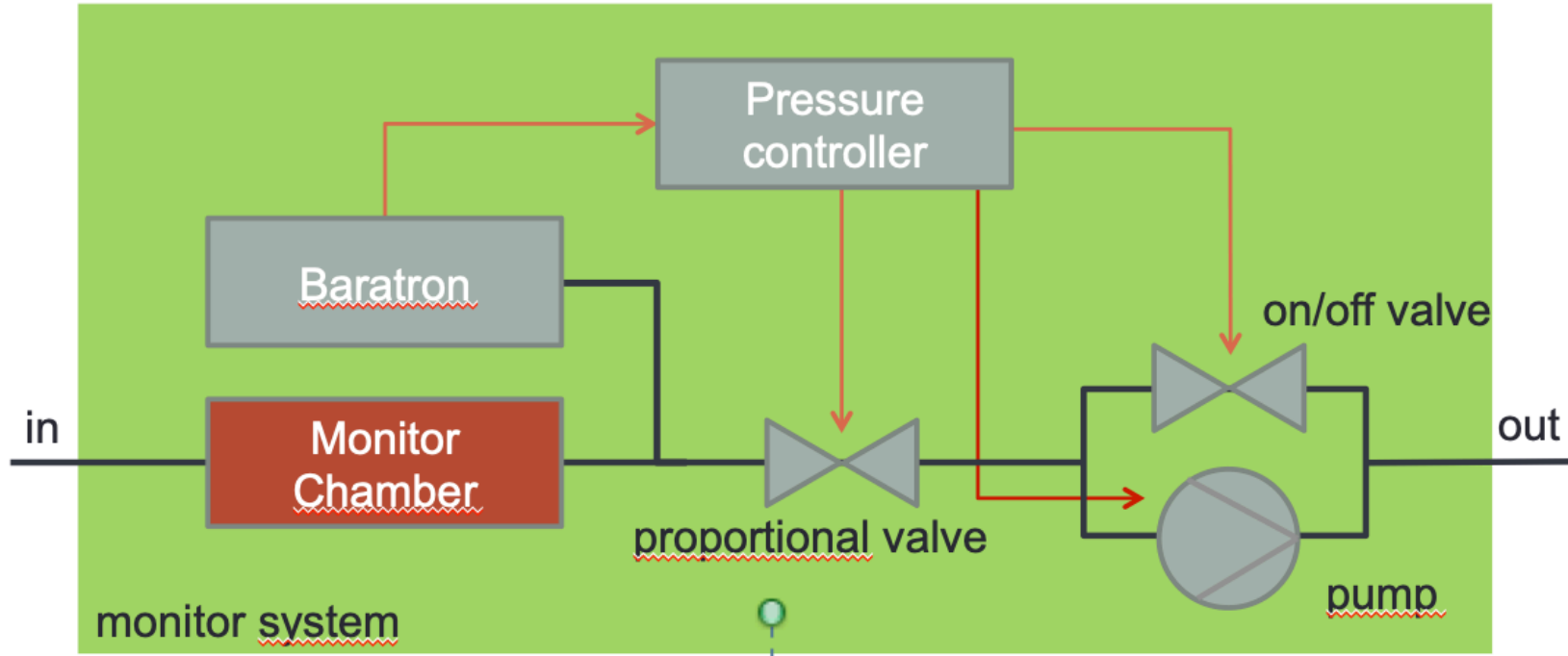
La raccomandazione della CSN1 nel 2019 è stata di continuare la attività formazione del personale con i colleghi di Lecce per poi procedere quest’anno alla valutazione della proposta.

Essa include:

- sorgente
- bombola di gas
- sistema di monitoraggio pressione del gas
- elettronica di lettura
- alimentazione e circuiti di alimentazione

(vedi prossime slide per i dettagli)

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 RD_FCC 2021

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

Conclusioni

- Nell'arco del 2019 e 2020 sono partite molte attività relative al nostro impegno sui futuri acceleratori
- Le attività per FCC/CepC trovano ampio supporto e considerazione nelle decisioni della European Strategy
- Abbiamo due progetti di ricerca ufficialmente approvati ed uno di *outreach*
- L'impegno è destinato a crescere nel breve e lungo termine
- Attività previste per il 2021 ed anni successivi (in backup)

Backup

Calcolo per RD_FCC

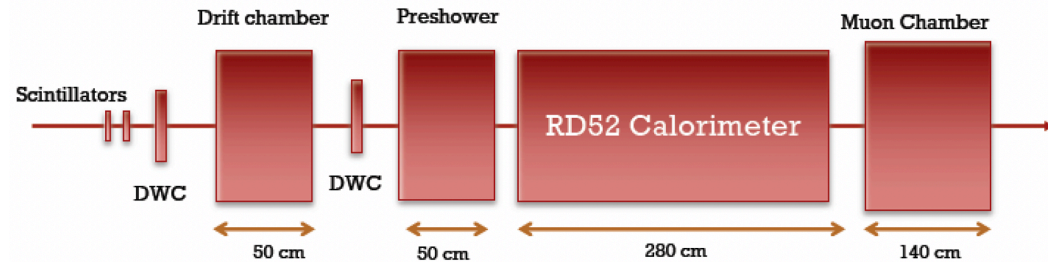
- E' essenziale che il programma di futuri acceleratori sia supportato dall'evoluzione del calcolo scientifico
- E' stata creata una “virtual organization” **rdfa** per attività RD_FA in GRID:
 - una coda del CNAF associato alla VO e 10TB di disco
- Il **centro ReCaS Bari** è il primo Tier2 che supporta la VO **rdfa** quanto:
 - ci sono le risorse per ospitare le simulazioni per RD_FCC
 - 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**
- Simulazione della camera a deriva con programma GARFIELD a Bari
- Partita l'attività di **simulazione** di eventi di fisica, simulazione del rivelatore IDEA ed uso di risorse per il **machine learning**

Analisi dati test beam 2018

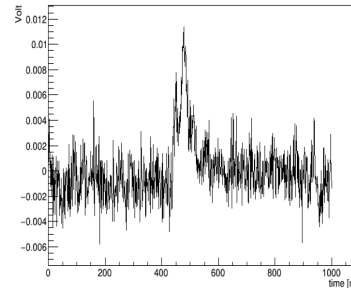
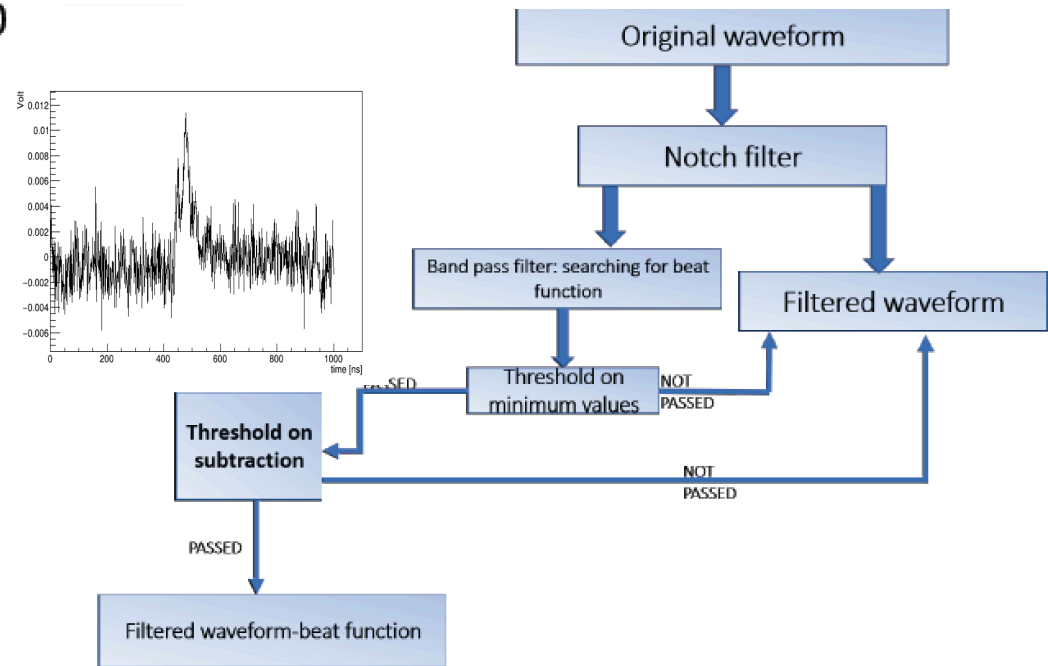
R. Aly, I. Margjeka

F. Cuna, G. Tassielli, F. Grancagnolo. et al. (Lecce)

- 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



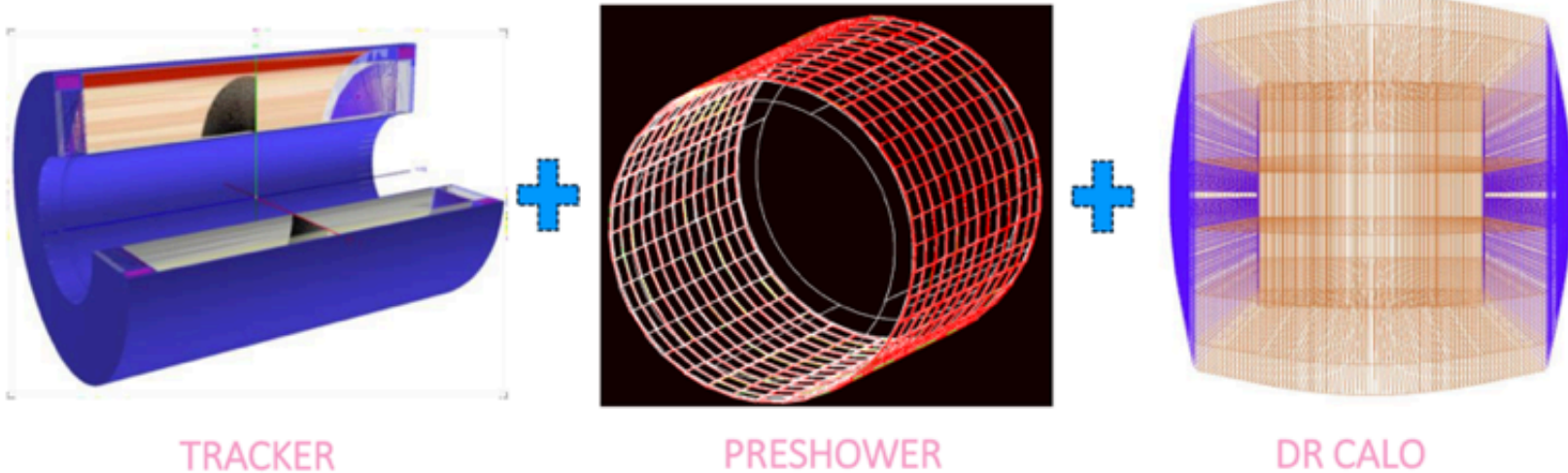
Trattamento del rumore



Publicazione: «*First test-beam results obtained with IDEA, a detector concept designed for future lepton colliders*», Nucl. Instrum. Methods Phys. Res., A 958 (2020) 162088

Simulazione della camera a deriva per IDEA

W. Elmetenawee
G. Tassielli (Lecce)



Plan to provide a standalone Geant4 simulation for IDEA detector

The Status of the work:

The setup of the Tracker detector (Drift chamber + vertex detector) has been done according to the instruction on the github "<https://github.com/elfontan/IDEA>".

The setup of calorimeter simulations has been done.

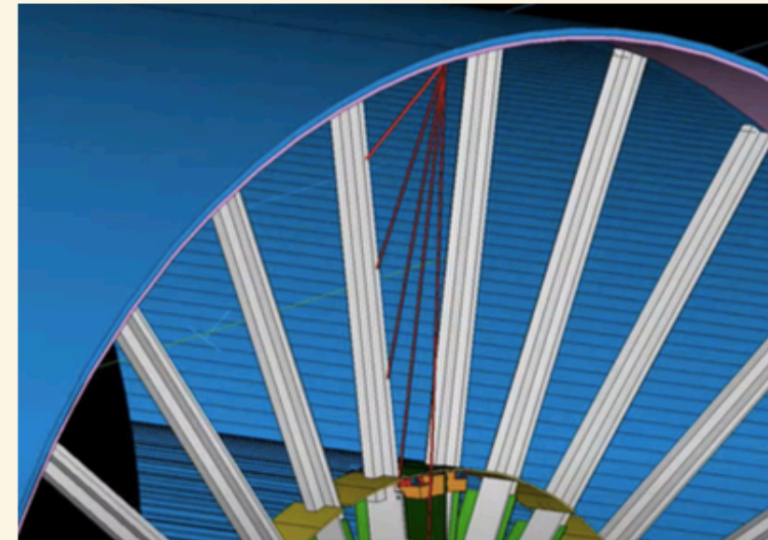
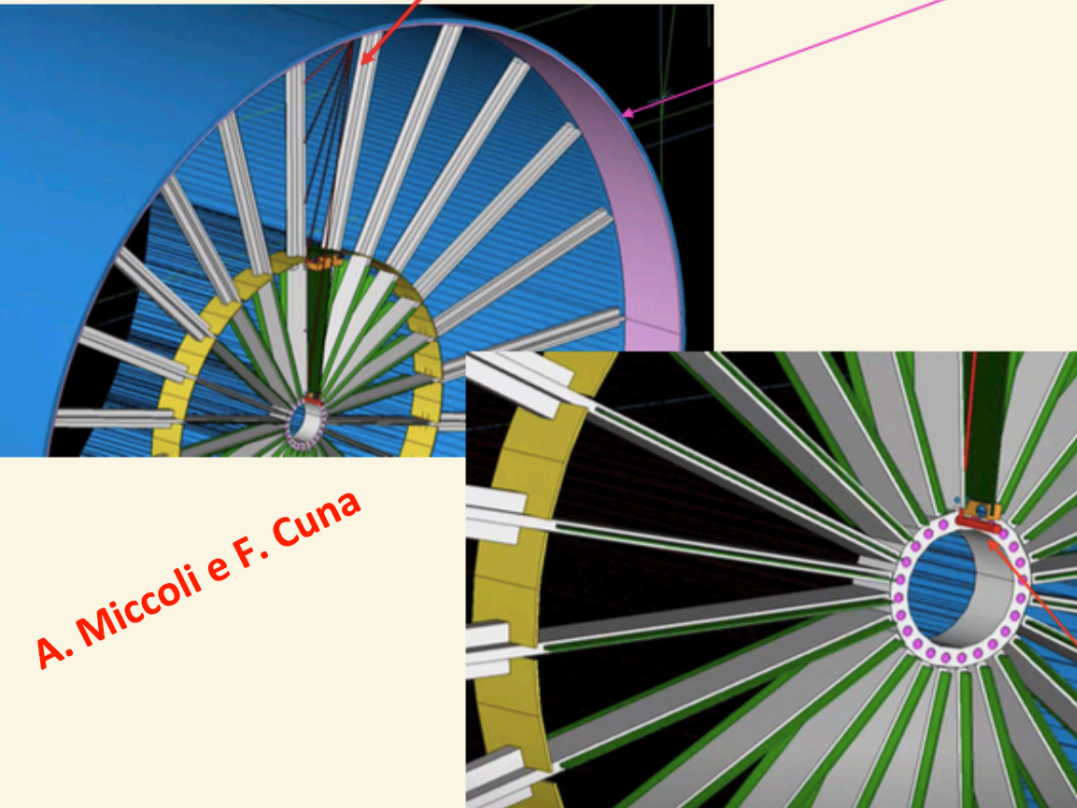
The work is on going to provide the standalone geant4 simulation for IDEA detector.

Progettazione meccanica camera a deriva per SCT

Tie rod to prevent deformations

Due to the wire loads, the end-plates go towards deformations. We intend to install 5 tie rods per spokes.

The tie rods will be fix to the outer cylinder, that probably will have a reinforcement

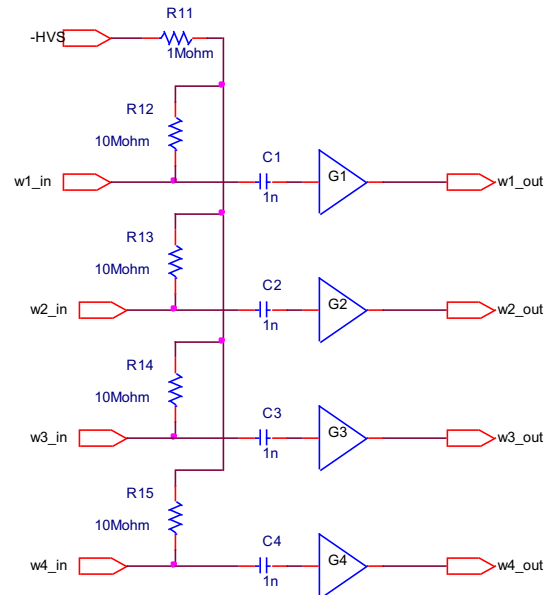
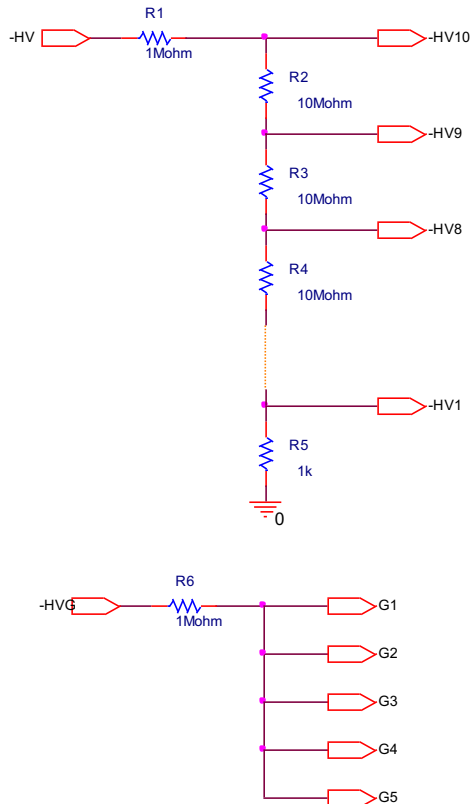


To fix the tie rods at the inner cylinder we will use a pin

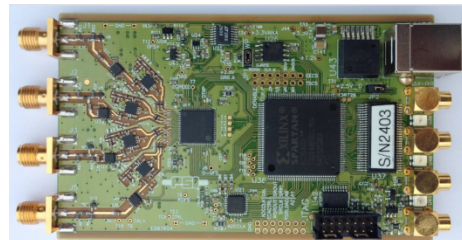
A. Miccoli e F. Cuna

- Contenimento delle deformazioni dei raggi mediante alcuni stralli.
- Soluzione preferita ad una aletta di rinforzo solidale ad ogni raggio.

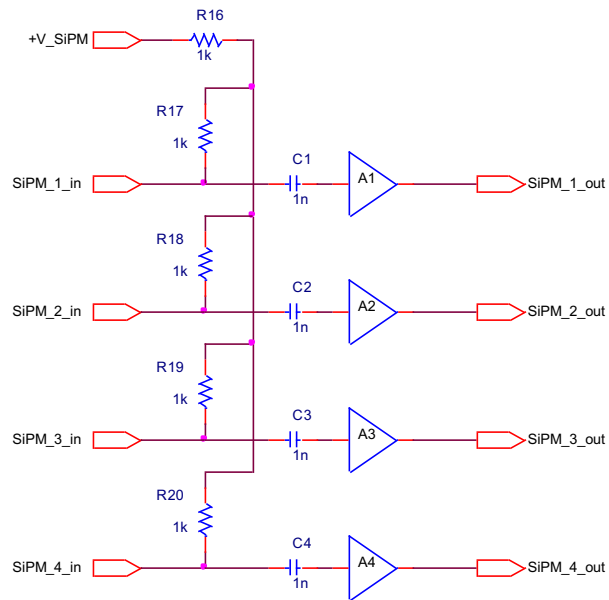
Monitor chamber: biasing/amplifying - DC



- 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

Attività specifiche per il 2021

Oltre al raggiungimento degli obiettivi del 2020, ritardati di almeno tre-quattro mesi (finora) per via del COVID19:

1. la continuazione degli studi sui fili in collaborazione con BINP, Novosibirsk (nell'ambito di CREMLINplus);
2. lo sviluppo del sistema di recupero della tensione dei fili (nell'ambito di CREMLINplus) per la camera di CMD3;
3. lo sviluppo della scheda di acquisizione per il cluster counting, in collaborazione con CAEN (nell'ambito di AIDAinnova);
4. l'installazione di una facility per lo studio di rivelatori a gas presso l'INFN di Bari,
5. la continuazione dello sviluppo del software di simulazione per la clusterizzazione della ionizzazione in gas a base di elio, per lo studio dettagliato delle performance di particle identification;
6. studi su algoritmi di tracciamento sia per IDEA che per CMD3 (task 5.3 di CREMLiNplus).

Attività post-2021

- Studi su algoritmi di tracciamento a basso momento (CMD3), momento intermedio (SCTF) e alto momento (IDEA) con tecniche di ML.
- A partire dal 2022/2023, la costruzione di prototipi di tubi a drift finalizzati all'identificazione di particelle per test su fascio al PSI (per la separazione π/μ a basso momento, fino a 400 MeV/c) e al CERN (per la separazione π/K a momenti intermedi, few-50 GeV/c).
- Entro la fine del 2023, la conclusione del progetto esecutivo della camera a drift per la Super Charm-Tau Factory (SCTF) a BINP e la costruzione della camera a drift di CMD3 come suo prototipo (programma CREMLINplus).
- Se approvata la proposta di AIDAinova, in collaborazione con la CAEN, la costruzione di una scheda a 4 canali di fADC-FPGA, entro il 2024.
- Entro il 2025, l'equivalente di un TDR per la camera a drift di IDEA, sulla base del progetto esecutivo della camera a drift per la SCTF a BINP.