Attività di Gruppo III e preventivi 2023

Luciano L. Pappalardo

Consiglio di Sezione INFN

Ferrara, 01/07/2022

Il Gruppo III a Ferrara

Esperimenti:

- **JEDI (R.N. & R.L.: Paolo Lenisa)**
- **JLab12 (R.N. & R.L.: Marco Contalbrigo)**
- **EIC-Net (R.L.: Marco Contalbrigo)**

Fisica:

- Misure di simmetrie fondamentali (P, T, CP) mediante ricerca di EDM in Storage Rings
- Studio della struttura interna degli adroni mediante misure di DIS
- Studio sperimentale dell'interazione forte nel regime non perturbativo
- Ricerca di DM: Assioni con Storage Ring e Dark Photon in Beam-dump experiments

Tecnologie

- Tecnologie di polarizzazione (ABS, polarimetria, celle di accumulazione, etc)
- Sviluppo di rivelatori (tracciatori, RICH, SiPM, etc)
- Magneti superconduttori

Principali Laboratori di riferimento

- FZ, Juelich, GE
- Jlab, USA
- BNL, USA

JEDI (R.N. & R.L.: Paolo Lenisa)

- EDM
- Test of fundamental symmetries (P, T, CP)

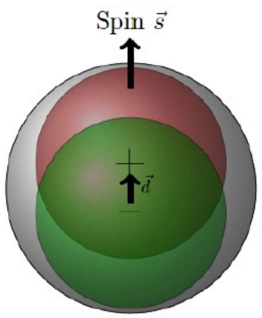
Problems

- Dominance of matter over antimatter in the Universe
- Nature of Dark Matter (DM)

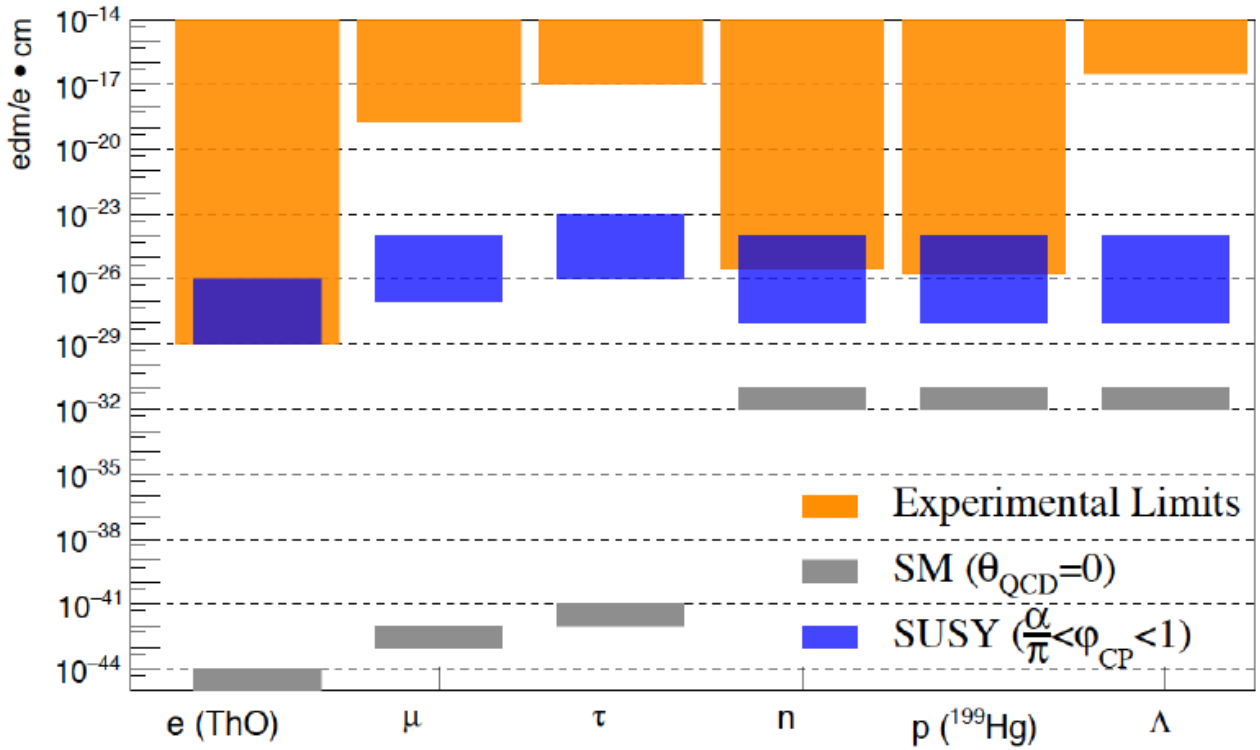
Approach

- Measurements of static Electric Dipole Moments (EDM) of fundamental particles.
- Searches for axion-like particles as DM candidates through oscillating EDM

JEDI: Julich Electric Dipole moment Investigations



- **EDM**: Permanent separation of + and – electric charge in a fundamental particle (including hadrons)
- Permanent EDMs violate P and T (and CP) symmetries
- Could provide a new source of CP violation, relevant for understanding matter-antimatter asymmetry in the Universe

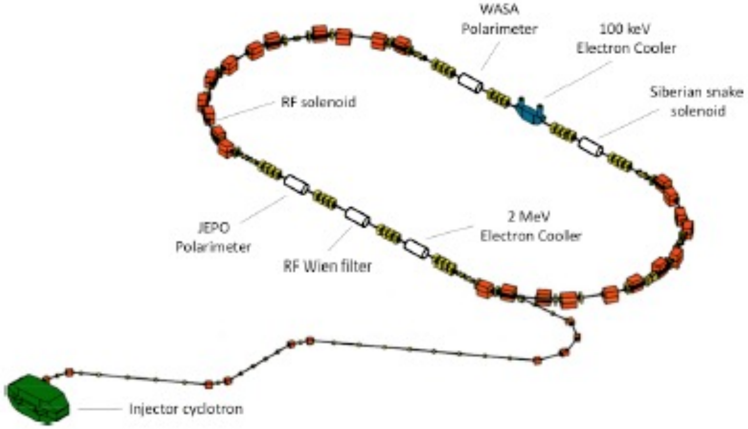


EDM search at COSY

Goal: first measurement of EDM of deuterons at the COSY Storage Ring (Juelich)

COoler SYnchrotron COSY

- Cooler and storage ring for (pol.) protons and deuterons.
- Momenta p= 0.3-3.7 GeV/c
- Phase-space cooled internal and extracted beams



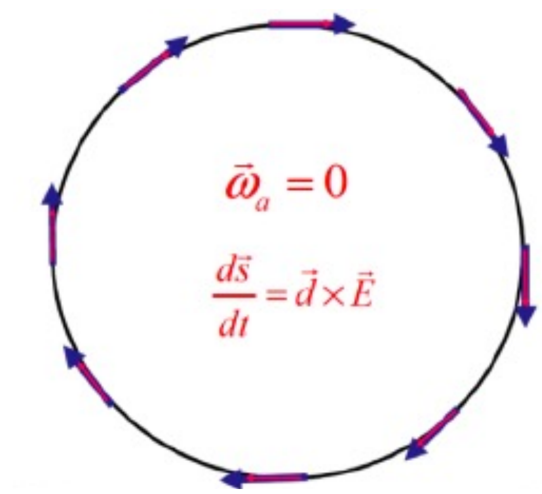
Previously used as spin-physics machine for hadron physics:

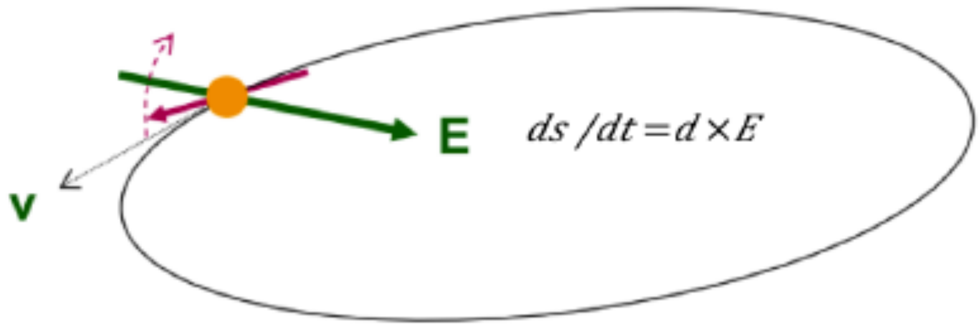
- Ideal starting point for srEDM related R&D
- Dedicated and unique experimental effort worldwide

EDM search at Storage Rings

Procedure:

1. Inject particles (e.g. deuterons) in storage ring
2. Align spin along momentum
3. Search for time development of a vertical polarization
4. Exploit **spin-asymmetry** measurements in elastic scattering (e.g. deuteron-carbon scattering) to determine the spin precession (polarimeter)





$$\varepsilon_V = \frac{L-R}{L+R} \propto p_V A_y$$

sensitive to EDM

VERTICAL polarization

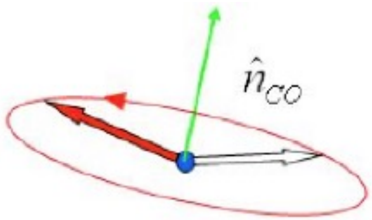
Analyzing power

EDM search at Storage Rings

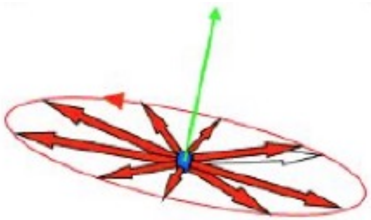
High precision, primarily electric storage ring

- Crucial role of alignment, stability, field homogeneity and shielding from *unwanted* magnetic fields.
- High beam intensity: $N=4 \cdot 10^{10}$ per fill
- Polarized hadron beams: $P=0.8$
- Long spin coherence time: $\tau = 1000$ s
- Large electric fields: $E \sim 10$ MV/m
- Efficient polarimetry with:
  - large analyzing power: $A = 0.6$
  - high efficiency detection: eff. $= 0.005$

EDM search at COSY: Spin-Coherence Time (SCT)

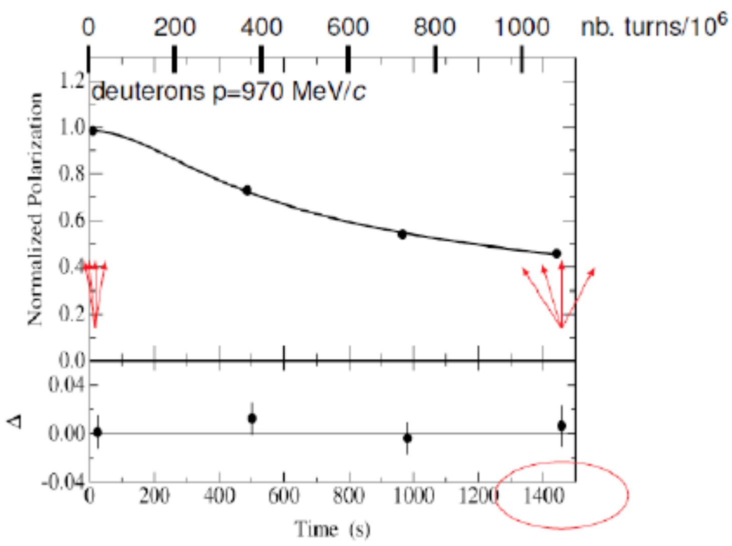


At injection all spin vectors aligned



After some time, the spin vectors are all out of phase and in the horizontal plane

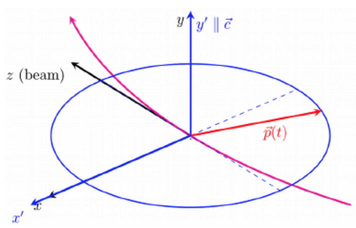
- **Critical requirement: long Spin-Coherence Time (τ_{SCT}):** spin of all particles preceding with the same frequency
- Large value of SCT of crucial importance since: $\sigma_{Stat} \propto \frac{1}{\tau_{SCT}}$



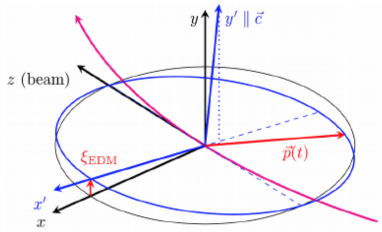
Major achievement

- τ_{SCT} = (782 ± 117)s
- Previously: τ_{SCT}(VEPP) ≈ 0.5 s (≈ 10^7 spin revolutions)

EDM search at COSY: first results



EDM absence



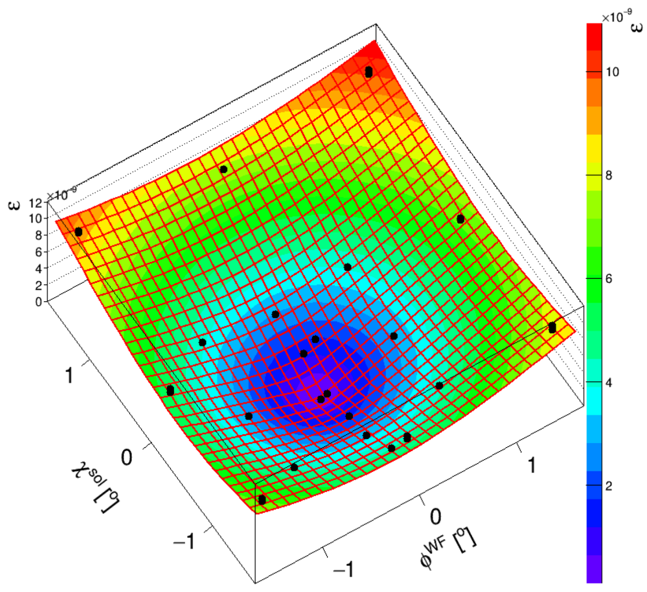
EDM effect

EDM tilts the stable spin-axis

- Presence of EDM $\rightarrow \varepsilon_{EDM} > 0$

First run: Nov. 18 - Second run: April 21)

- 31 points measured
- 2 weeks of measurement
- Parametric resonance strength based on initial slope
- Precession axis RF WF determined from the minimum of the surface:
  ϕ_0^{wf} = - 3.80 $\pm$ 0.05 mrad
  χ_0^{sol} = - 5.51 $\pm$ 0.05 mrad
- Spin tracking to provide orientation of precession axis without EDM



Compatible with $d_{EDM} < 10^{-19}$ e·cm

Short-term plan: study of proton SCT at COSY

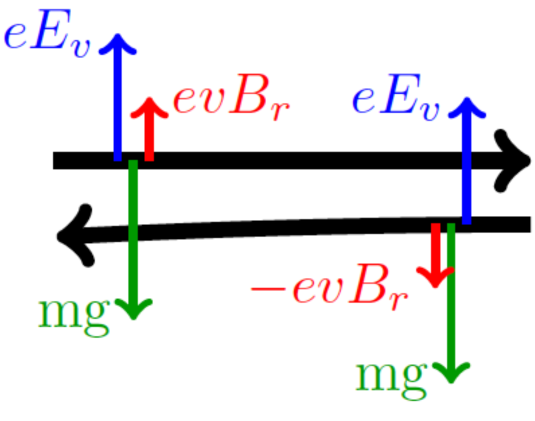
Motivation: systematics

Example: radial B field (B_r)

- B_r can mimic EDM (if $dE_r \approx \mu\, B_r$)
- E.g. $d = 10^{-29}$ e · cm, $E_r = 10$ MV/m
  - Corresponds to $B_r = \frac{dE_r}{\mu} \approx 10^{-17}\,T$

Solution

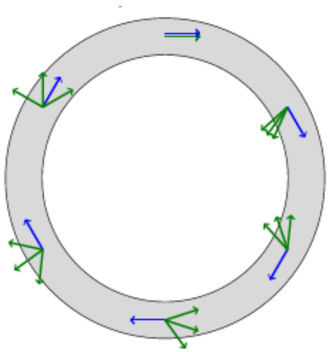
- Use of two beams running clockwise and counterclockwise
- Separation of the two beams sensitive to B_r

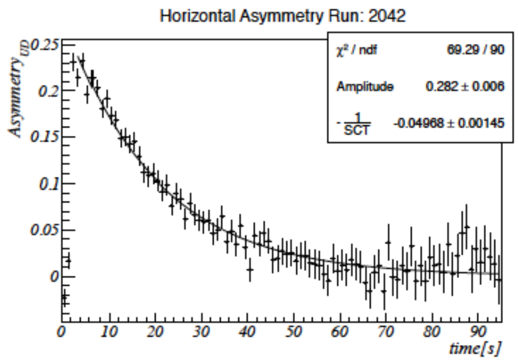


- Not possible with deuterons → protons required

Short-term plan: study of proton SCT at COSY

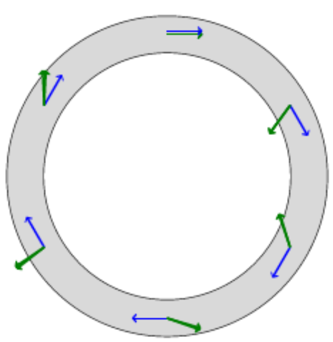
Optimization of spin-coherence time for protons

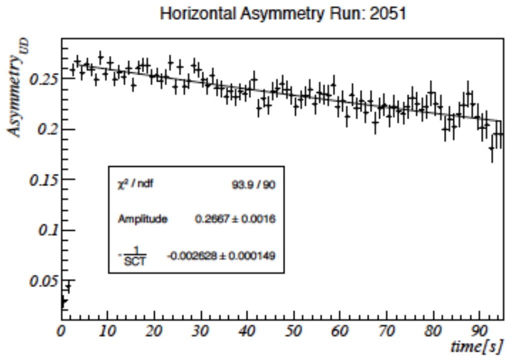




Short SCT

- Unbunched beam:
  - $\Delta p/p = 10^{-5}$
  - $\Rightarrow$ decoherence after < 1s
- Bunched beam:
  - No 1^{st} order effects in $\Delta p/p$
  - $\Rightarrow$ SCT = 20 s





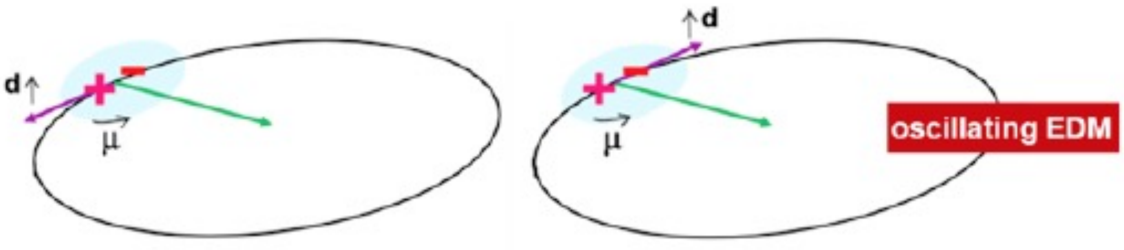
Long SCT

- Use of of 6-poles
  - Compensate for β oscillations

(Note: figures refer to measurements with deuterons)

Oscillating EDM and sensitivity to axions

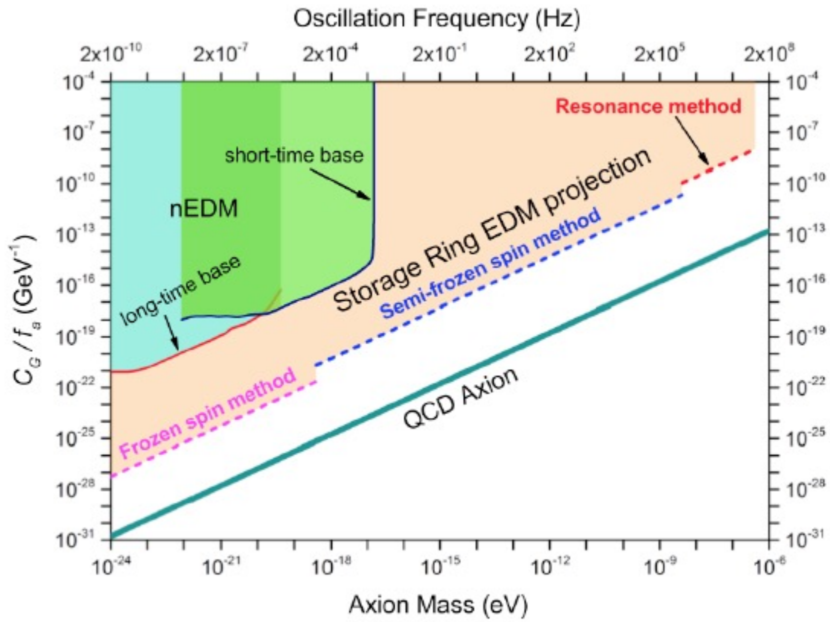
Interaction of Axions with ordinary matter (axion-gluon coupling $\frac{a}{f_0} G_{\mu\nu}\widetilde{G}^{\mu\nu}$) can produce a measurable oscillating EDM!



$$\vec{d} = \eta \frac{q\hbar}{2mc} \vec{S}$$

$$\eta = \eta_0 + \eta_1 \sin(\omega_{\text{axion}} t + \varphi_a)$$

$$\omega_{\text{axion}} = \frac{m_a c^2}{\hbar}$$

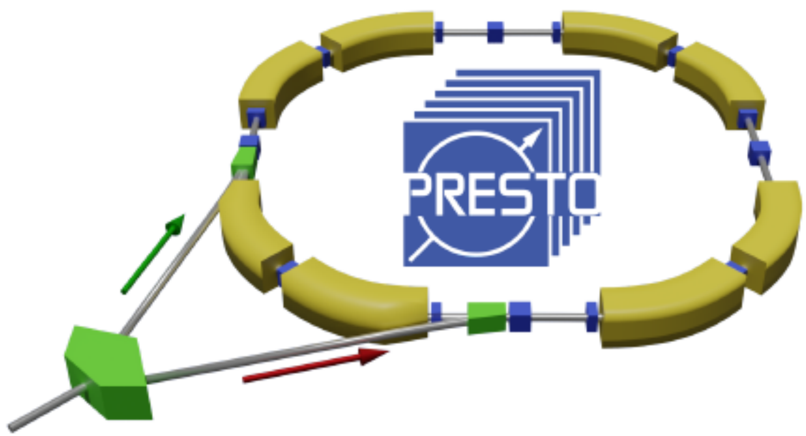


[S. P. Chang et al. Phys. Rev. D 99, 083002]

Long-term plan: design study for electrostatic prototype storage ring

Pathfinder Facility for a new Class of Precision Physics Storage Rings

PRESTO



List of participants:

Part. No.	Part. Short Name	Participant Organisation Name	Country
1	INFN	Istituto Nazionale di Fisica Nucleare	Italy
2	GSI	GSI Helmholtzzentrum für Schwerionenforschung	Germany
3	CERN	Organisation Européen pour la Recherche Nucléaire	Switzerland
4	MPG	Max-Planck-Gesellschaft zur Förderung der Wissenschaften EV	Germany
5	RWTH	Rheinisch-Westfälische Technische Hochschule Aachen	Germany
6	LIV	The University of Liverpool	United Kingdom
7	JAG	Uniwersitatet Jagiellonsky	Poland
8	TSU	Ivane Javakhishvili Tbilisi State University	Georgia

Submitted to: **HORIZON-EUROPE**

INFRADEV-01-01-2022 - Concept Development

- Submission: 20.04.22
- Duration: 4 years
  - Possible project development: 2023-2026
- Budget: total 3 M euro
- Coordinator + 7 beneficiaries
  1. INFN (Coord.)
  2. CERN
  3. RWTH-Aachen
  4. IKP/GSI
  5. MPI-HD
  6. Univ. Liverpool
  7. Univ. Cracow
  8. Tbilisi State University

Expected response

- > 4 months after submission

Long-term plan: design study for electrostatic prototype storage ring

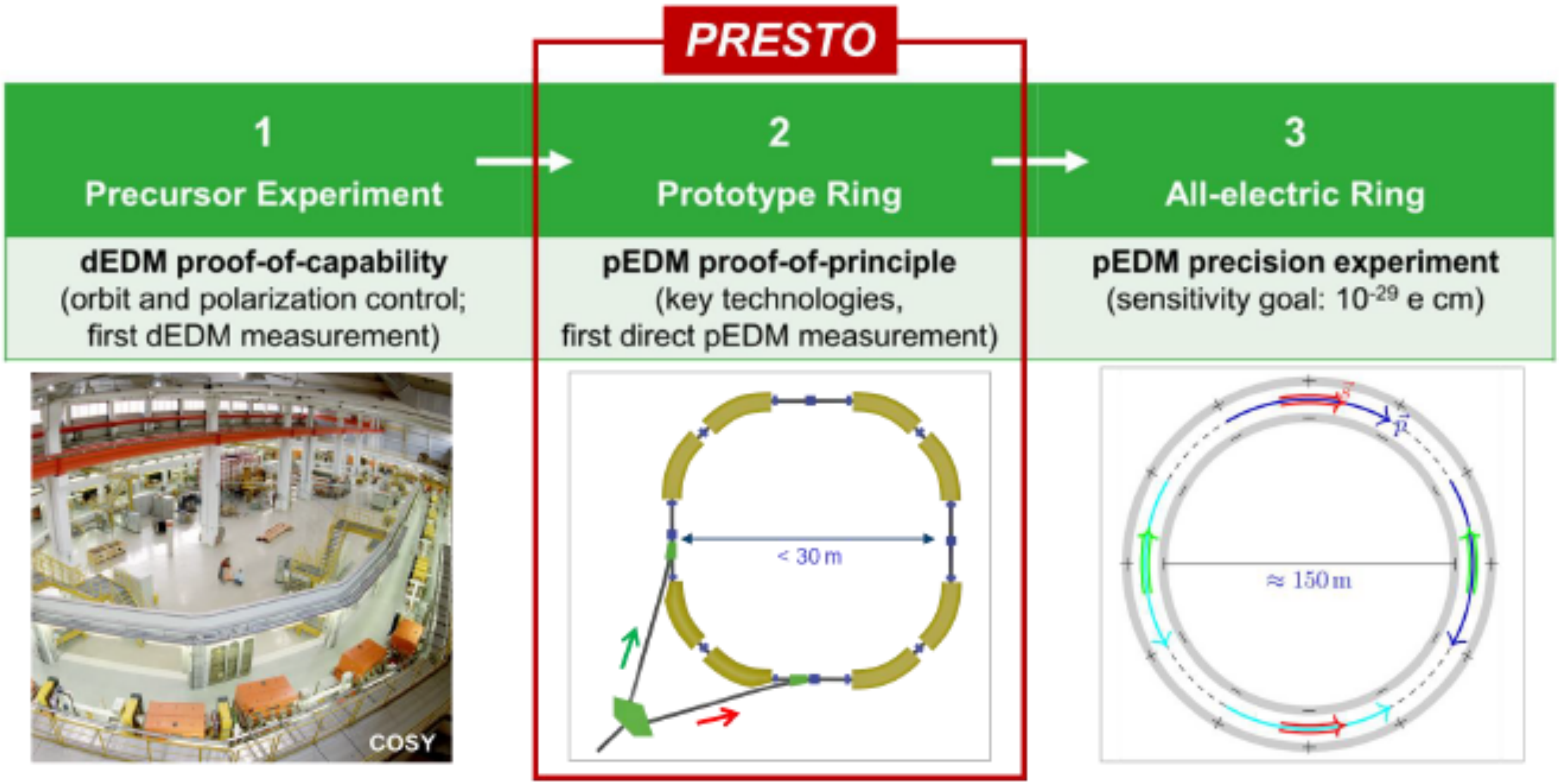
PSR purposes

1. Simultaneous storage of CW-CCW beams
2. (vertical B field) frozen-spin condition and first direct proton EDM measurement

Challenges

1. Ring design
2. Beam storage time
3. Spin-coherence time
4. Understanding and mitigation of systematic effects
5. Stochastic cooling
6. Electric bends and high-electric fields
7. Storage ring vacuum
8. Beam diagnostic and instrumentation
9. Polarimetry
10. Beam injection and spin-manipulation techniques
11. Site of the PSR

Long-term plan: design study for electrostatic prototype storage ring



Responsibilities

INFN responsibilities in JEDI Collaboration

- Co-Spokesperson: P.L.
- Data analysis: S. Dymov, A. Saleev, V. Shmakova
- Polarimeter: N. Canale, L. Barion, V. Carassiti, A. Pesce, R. Shankar, P.L.
- Spin-tracking simulations: R. Shankar
- Control system of RF-Wien filter: G. Tagliente

Requests

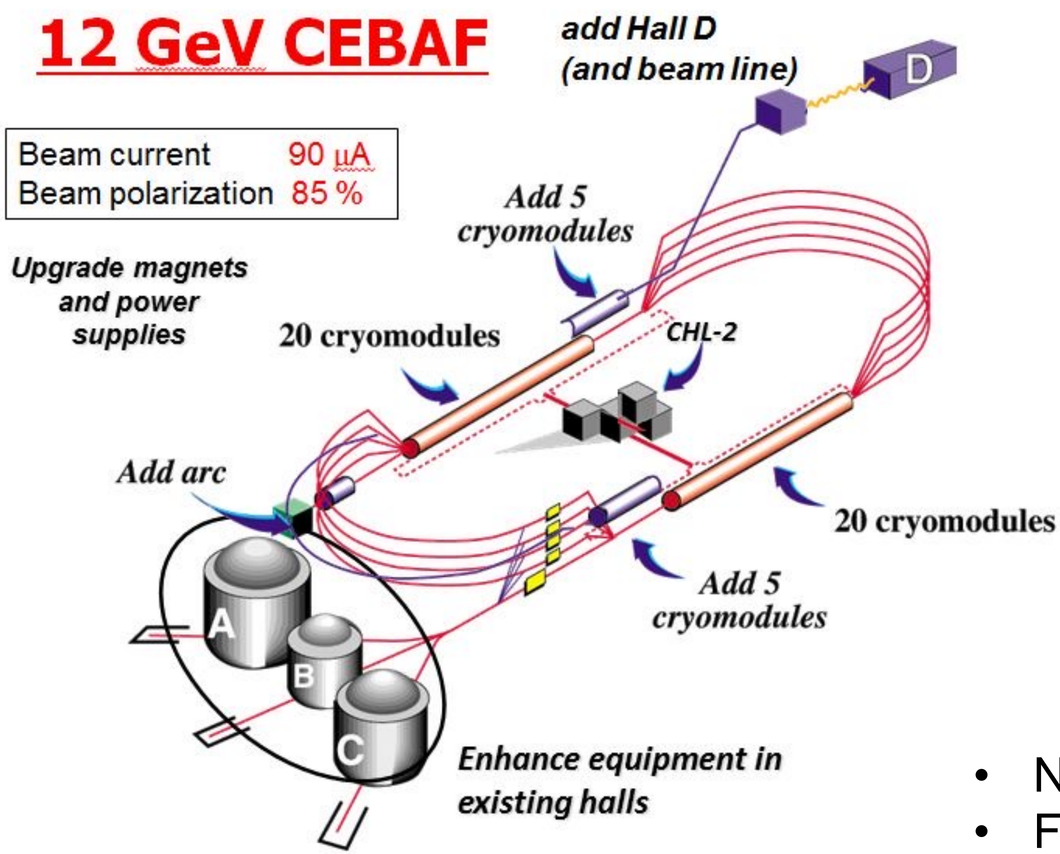
- Short range

  Two year extension for JEDI to complete the studies at COSY
- Long range
  - New experiment for the Design Study of a precision storage ring
  - Dedicated submitted to HORIZON-EUROPE

JLab12 (R.N. & R.L.: Marco Contalbrigo)

- Nucleon structure and spin physics
- Transverse momentum phenomena (TMDs) & 3D imaging
- GPDs & EM Form Factors of the nucleon

e-JLab12 (R.N. & R.L. M. Contalbrigo)

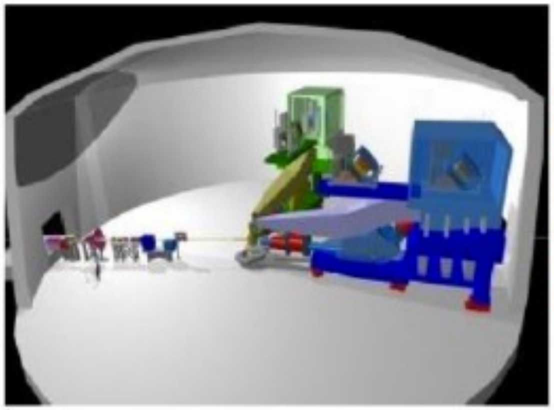


- **Up to 12 GeV highly polarized electron beam**
- **4 experimental halls** with complementary physics programs

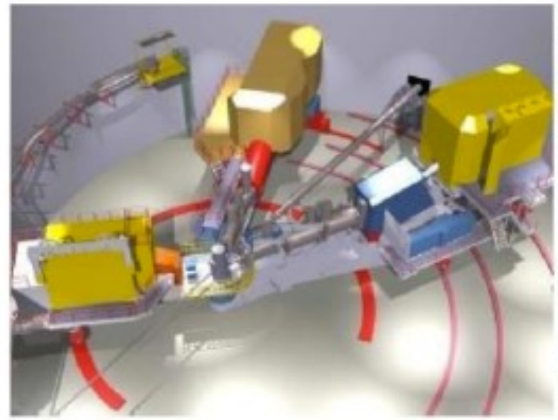
- Nucleon structure and spin physics
- Form Factors of the nucleon
- Hadron spectroscopy
- Dark matter searches
- …

Jlab12 Italia (R.N. & R.L. M. Contalbrigo)

Hall A – Spettrometri ad alta risoluzione e un nuovo rivelatore multipurpose a grande accettanza

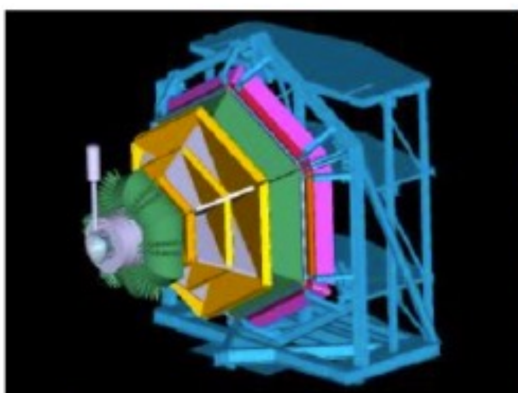


short range correlations, fattori di forma e nuovi esperimenti : SOLID, MOELLER, SBS



Hall C – Super High Momentum Spectrometer (SHMS)

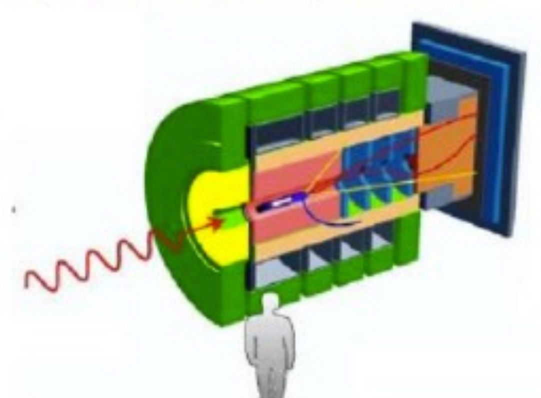
Determinazione precisa delle proprietà dei q di valenza nei nucleoni e nei nuclei



Hall B – Rivelatore a grande accettanza CLAS12 for misure a grande luminosità ($10^{35}cm^{-2}s^{-1}$)

Comprensione della struttura del nucleone via GPDs and TMDs e spettroscopia adronica

Hall D – Rivelatore GLUEx per esperimenti di fotoproduzione

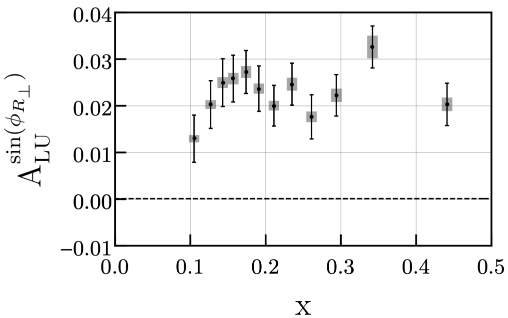


Le origini del confinamento attraverso lo studio dei mesoni ibridi

CLAS12: PRL 126 (2021) 152501

Observation of beam spin asymmetries in the process $ep \rightarrow e'\pi^+\pi^- X$ with CLAS12

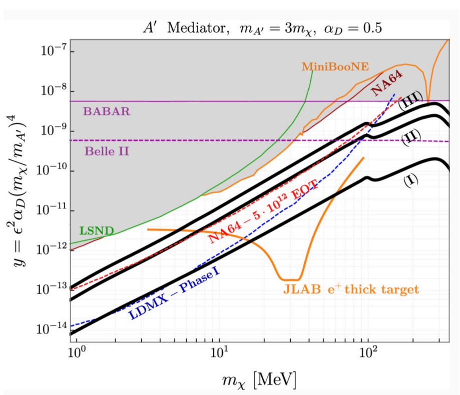
First CLAS12 publication on the nucleon 3D structure: access quark-gluon correlations in the target or during fragmentation, using as probe the beam spin asymmetry in electron scattering of a proton target.



Dark matter: EPJA 57 (2021) 253

Light dark matter searches with positrons

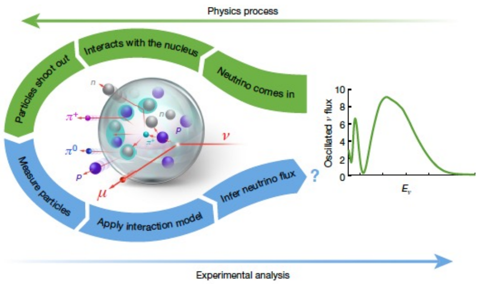
Complementary strategies to search for light-dark matter exploiting high-luminosity positron beams, as possibly available in future at JLab.



CLAS: Nature 599 (2021) 565-570

Electron-beam energy reconstruction for neutrino oscillation measurements

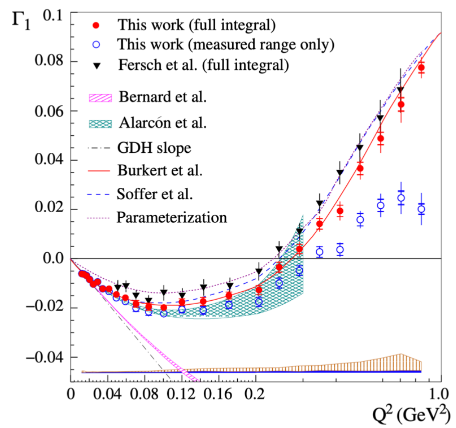
CLAS has studied the capability of phenomenological models to infer the initial neutrino (lepton) energy from the observed scattering products .



CLAS: Nature Phys. 17 (2021) 736-741

Measurement of proton spin structure at long distances

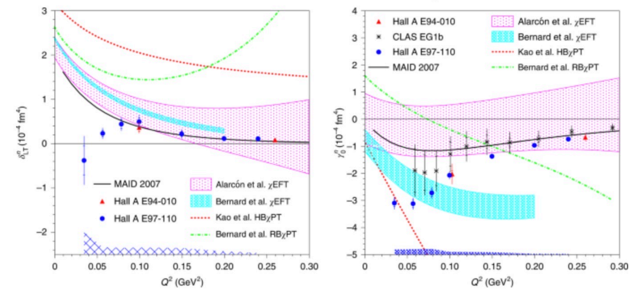
CLAS has measured spin-dependent properties of the proton at the scale of the nucleon dimensions, using as probe electrons at medium energies scattering off a longitudinally polarized proton target at exceptionally low transfer momenta.



Hall-A: Nature Phys. 17 (2021) 687-692

Measurement of the generalized spin polarizabilities of the neutron in the low-Q^2 region

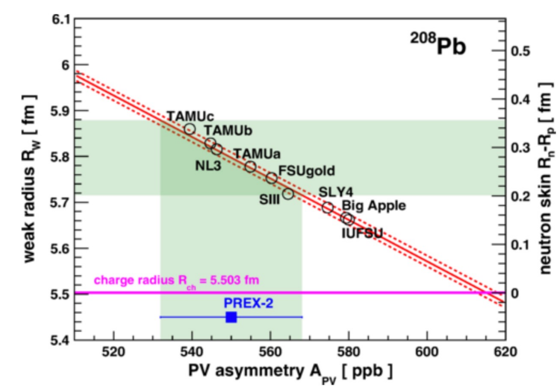
Hall-A measurement quantifies the neutron's spin precession under electromagnetic fields at very low energy-momentum transfer, when the strong interaction of partons inside the nucleon makes them highly correlated.



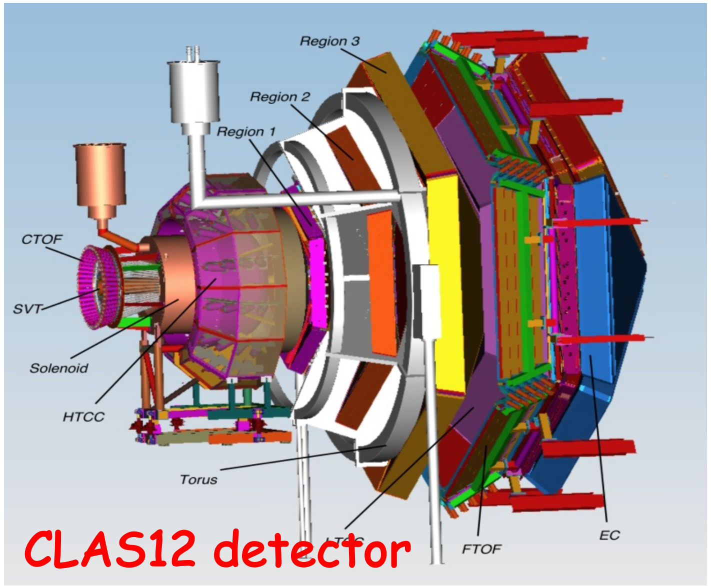
PREX-II: PRL 126 (2021) 17, 172502

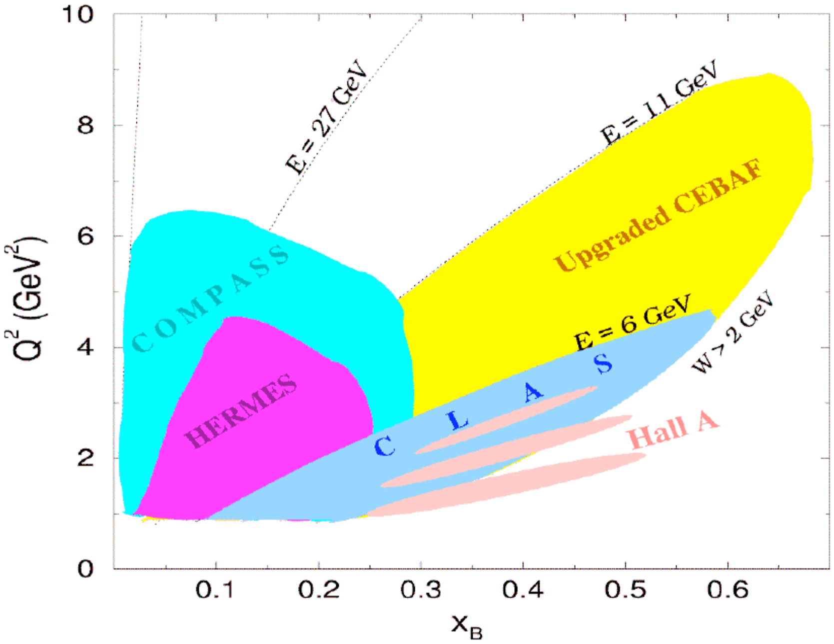
Accurate Determination of the Neutron Skin Thickness of ^{208}Pb through Parity-Violation in Electron Scattering

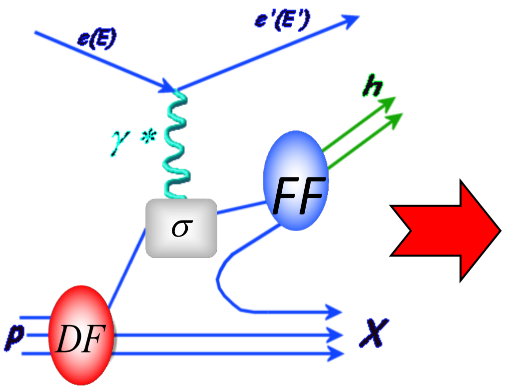
PREX has performed an improved measurement of the neutron skin in lead. This has implications for the equation of state of neutron rich matter, up to the extreme conditions of neutron stars, where the derived shape constraints are complementary to the gravitational interferometers.

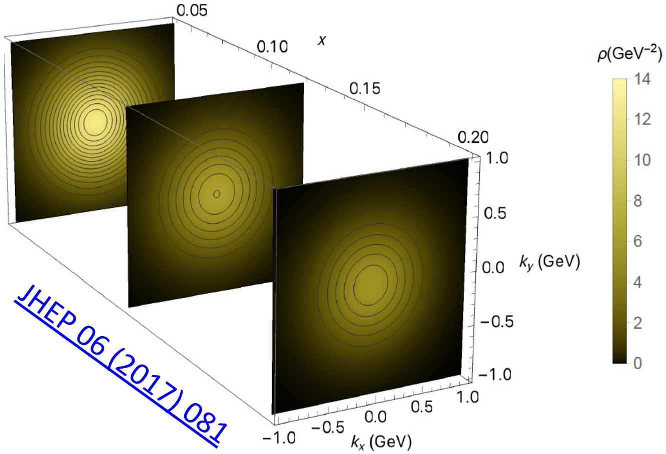


CLAS12 Experiment in Hall-B









JHEP 06 (2017) 081

3-dim picture of the nucleon in momentum space (**nucleon tomography**)

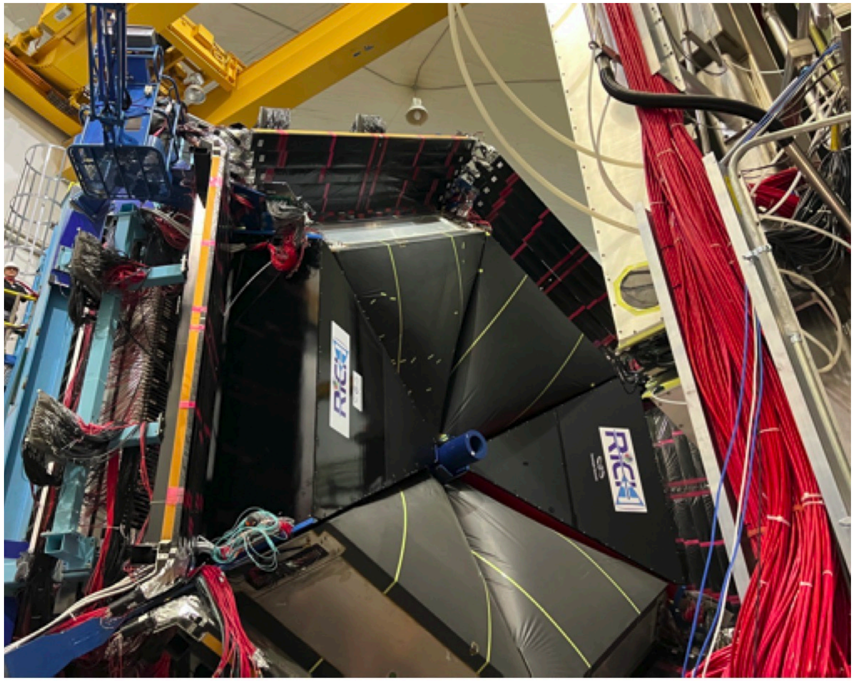
The RICH detector project (INFN)

Physics Program	Particle Identification Requirement
Internal nucleon dynamics	Flavour tagging
Quark hadronisation in nuclear medium	Constraining models
Spectroscopy	Rare processes

RICH goal:

π/K/p separation of ~4 σ up to 8 GeV/c

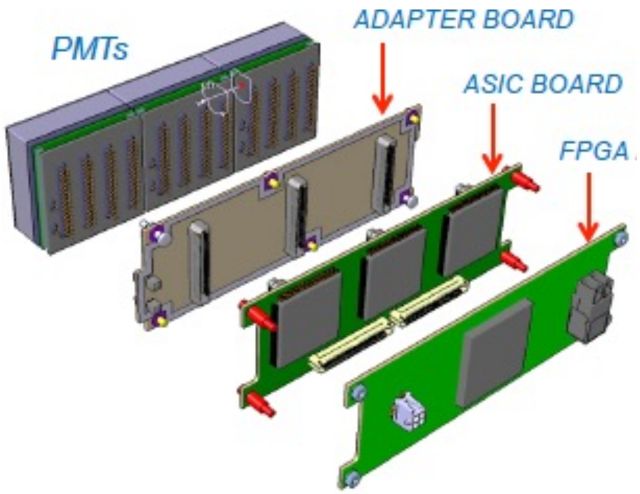
for a pion rejection factor ~ **1:500**



INSTITUTIONS
INFN (Italy) Bari, Ferrara, Genova, L.Frascati, Roma/ISS
Jefferson Lab (Newport News, USA)
Argonne National Lab (Argonne, USA)
Duquesne University (Pittsburgh, USA)
George Washington University (USA)
Glasgow University (Glasgow, UK)
J. Gutenberg Universitat Mainz (Mainz, Germany)
Kyungpook National University, (Daegu, Korea)
University of Connecticut (Storrs, USA)
UTFSM (Valparaiso, Chile)

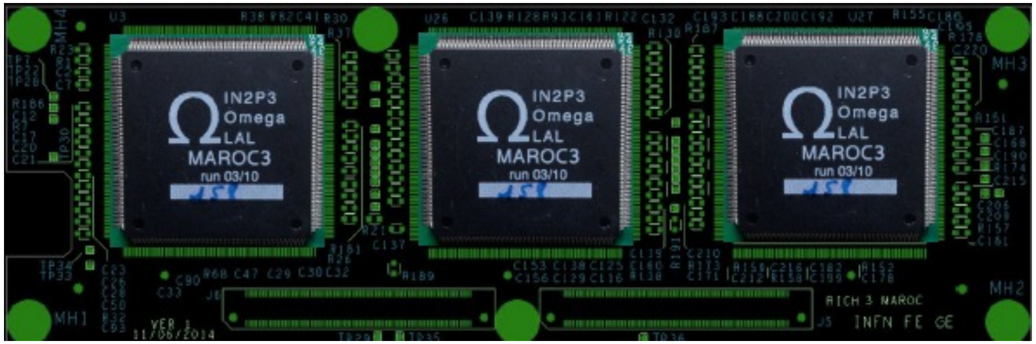
The RICH Front-End electronics

Compact and modular electronics to readout multi-anode PMTs



FPGA Board (JLab)

ASIC Board (Ferrara)



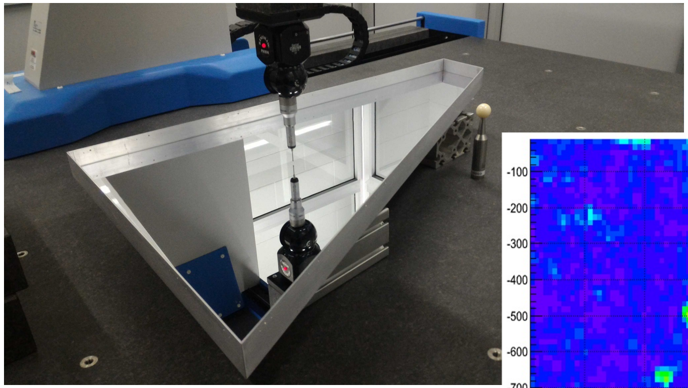
Developed (Roberto M.) for RICH1 & RICH2

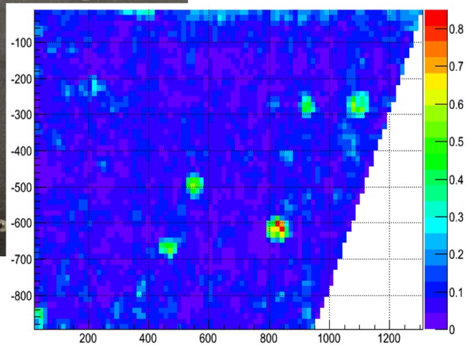
Also adopted by other experiments (Gluex, SOLID, EIC R&D...)

Ferrara Lab

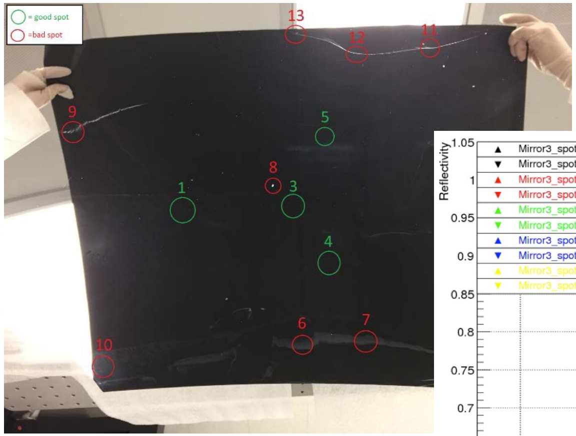
Existing facility to study detailed **mirror optical properties** (surface map, radius of curvature, reflectivity)

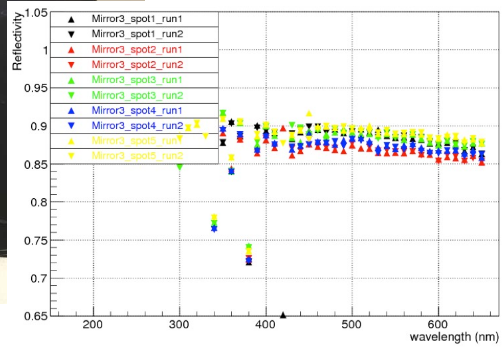
Planarity



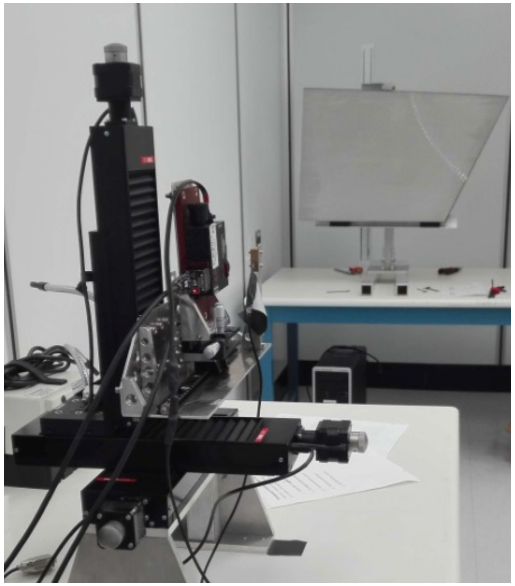


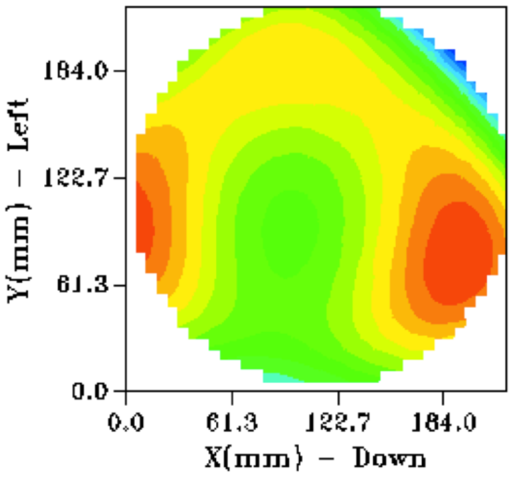
Reflectivity

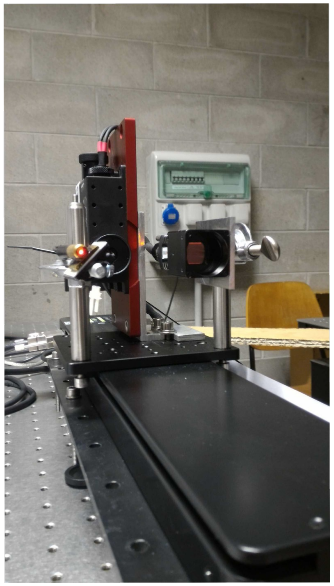




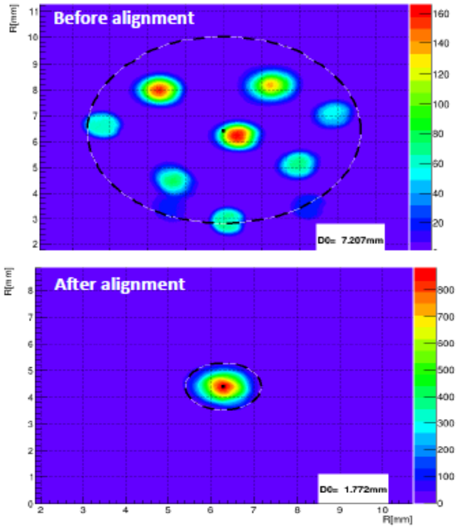
Shack-Hartmann: Aberrations







Point Image: Alignment

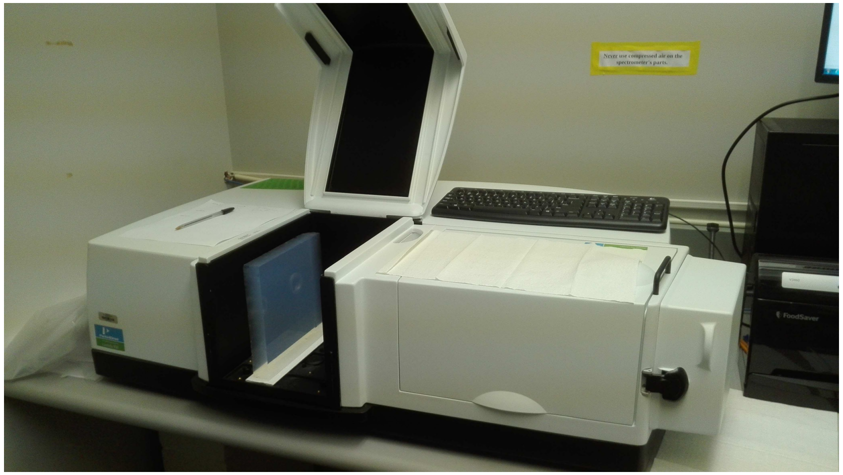


Ferrara Lab

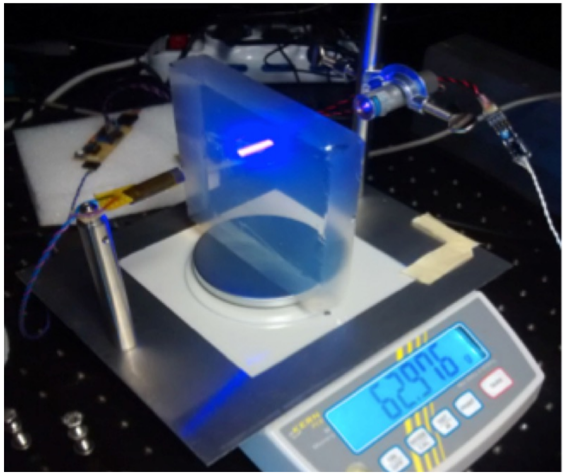
Existing facility to study detailed **aerogel optical properties**
(refractive index, surface planarity, forward scattering)
safe handling and Interplay with gas radiator

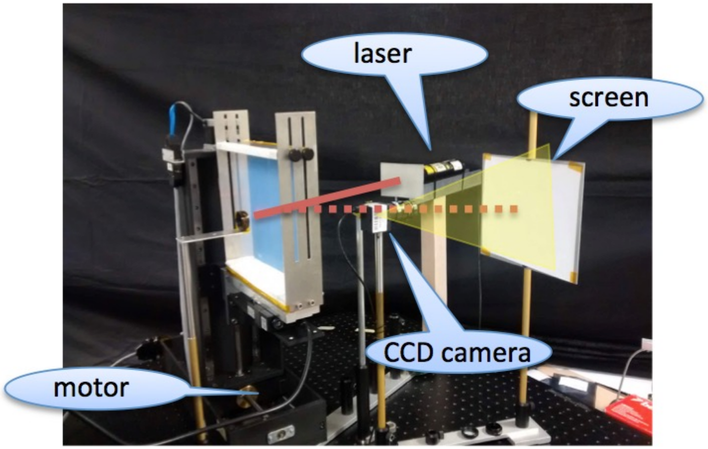
Controlled storage

Spectrophotometer

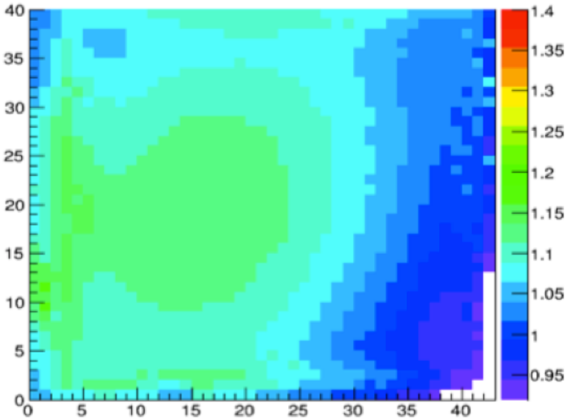


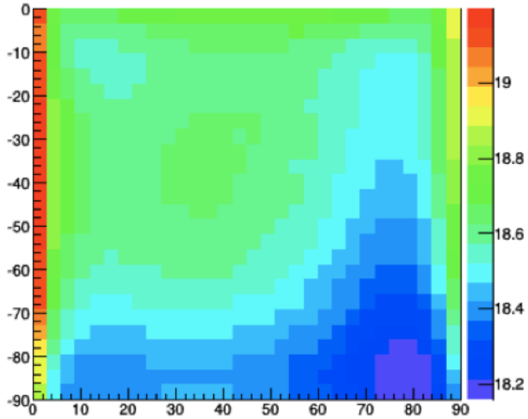
Characterization station



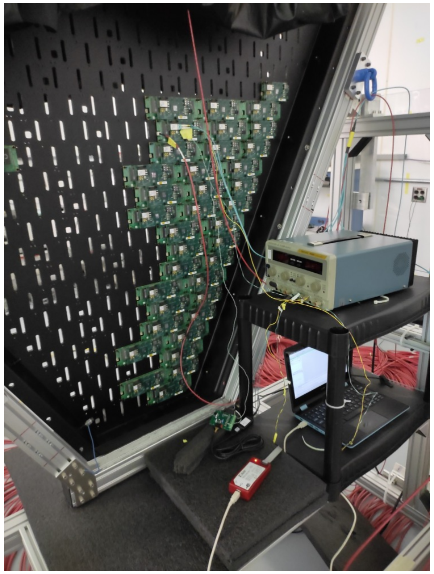


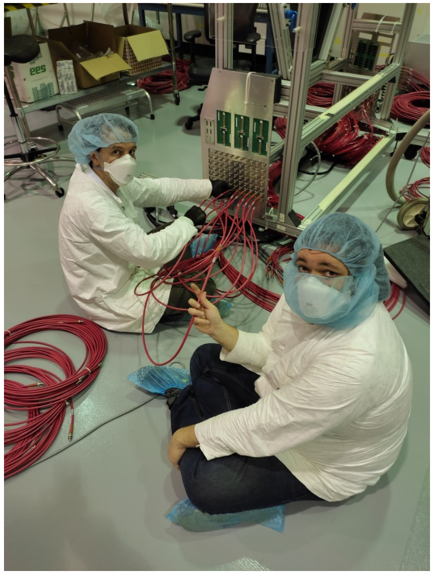
Surface map by laser setup vs touch machine

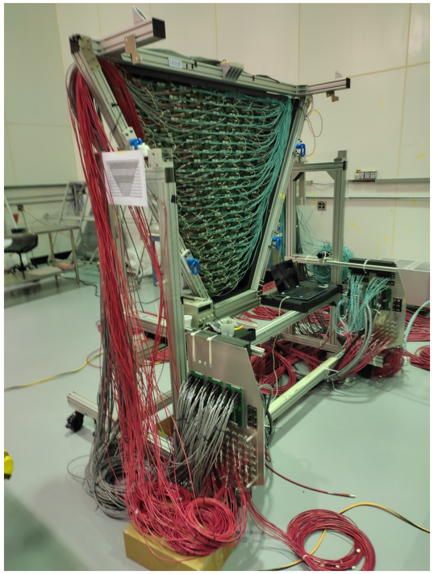


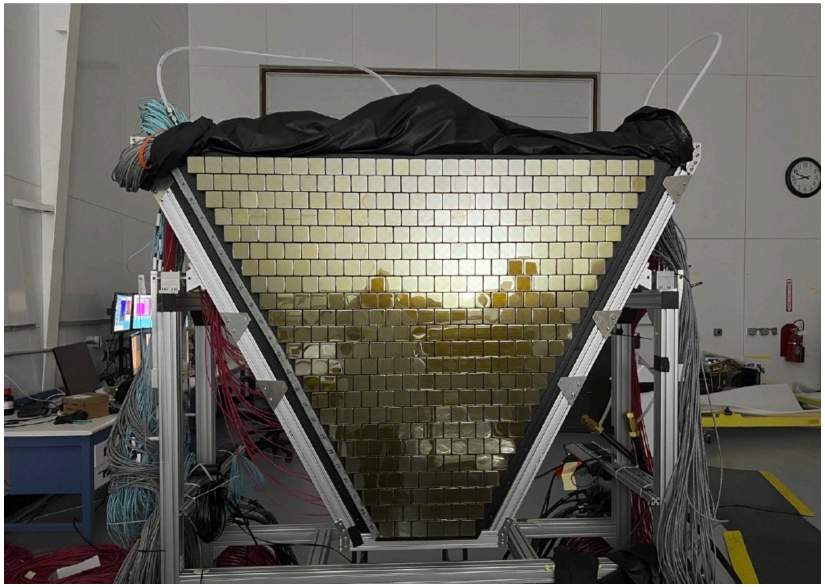


The RICH2 Detector Plane

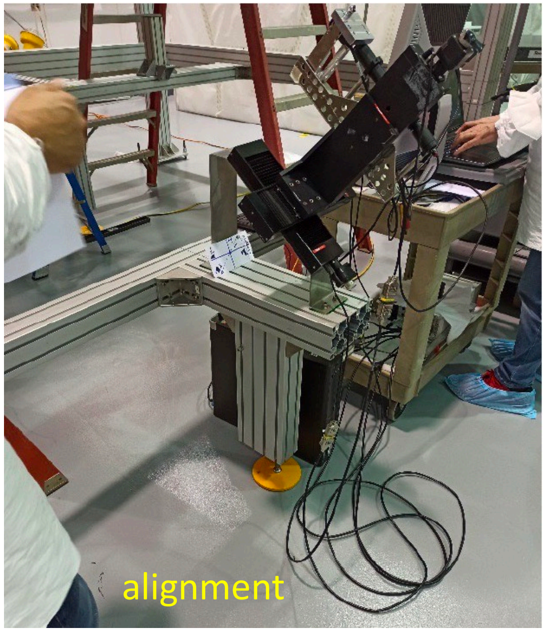


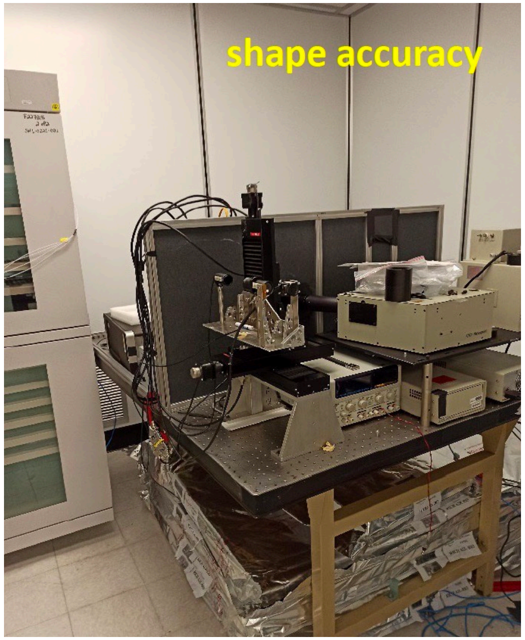


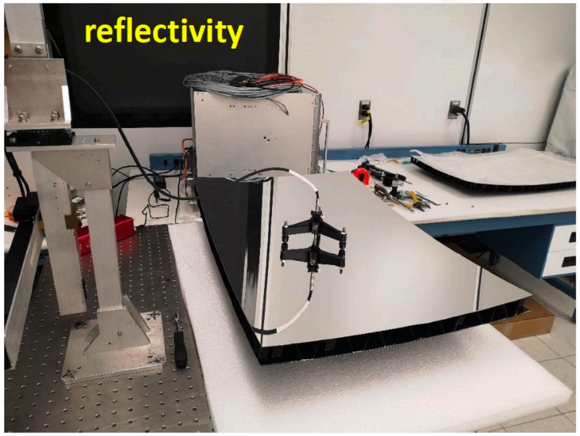


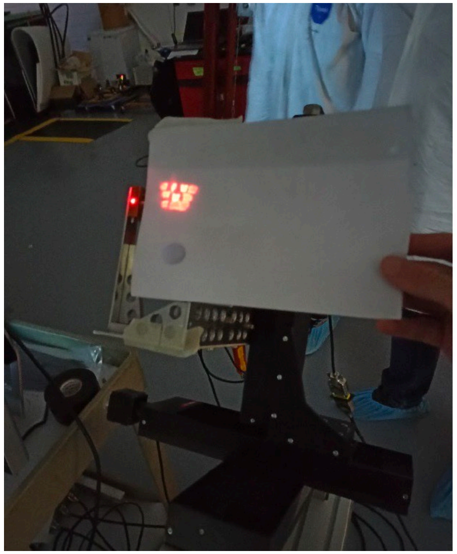


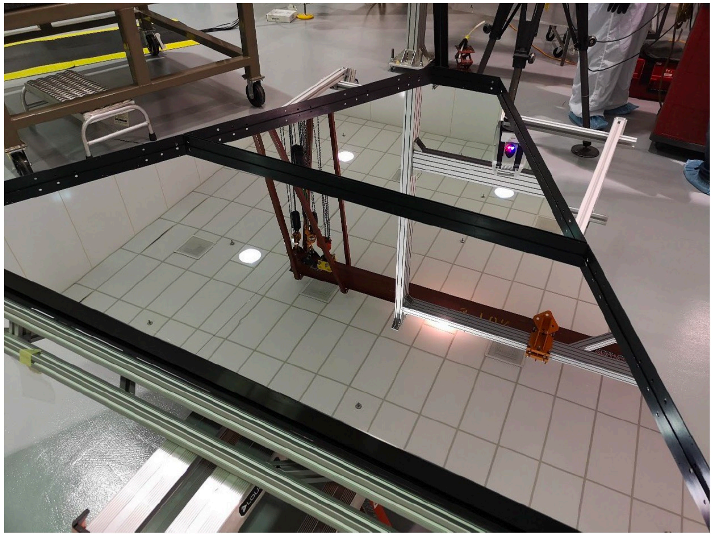
The RICH2 Mirror System



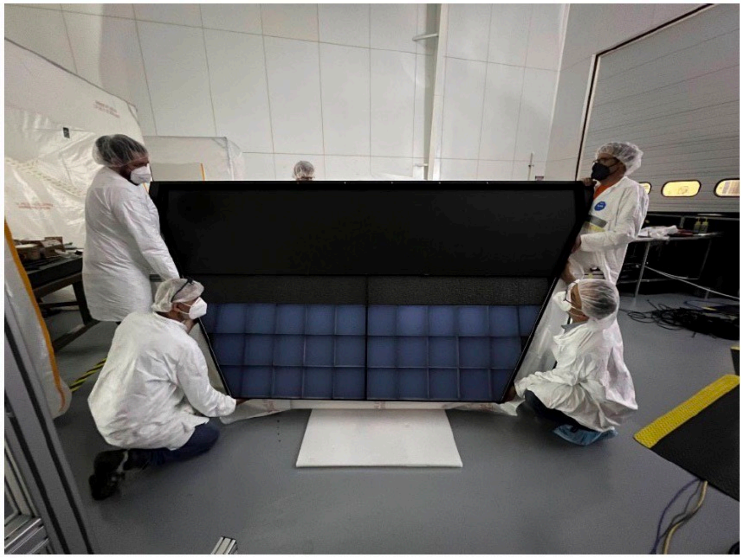


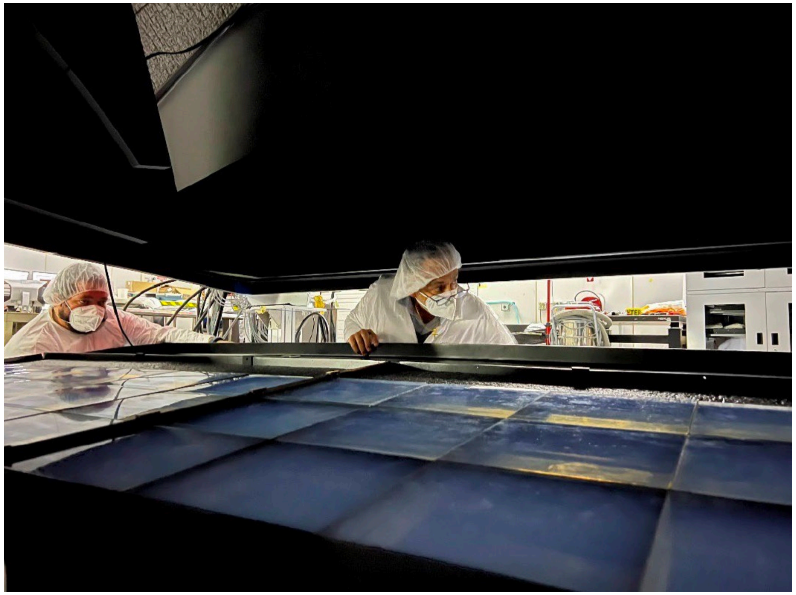


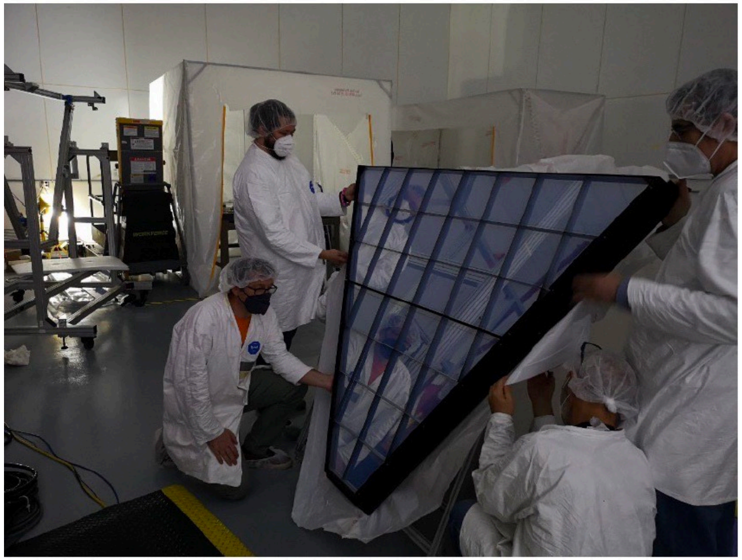




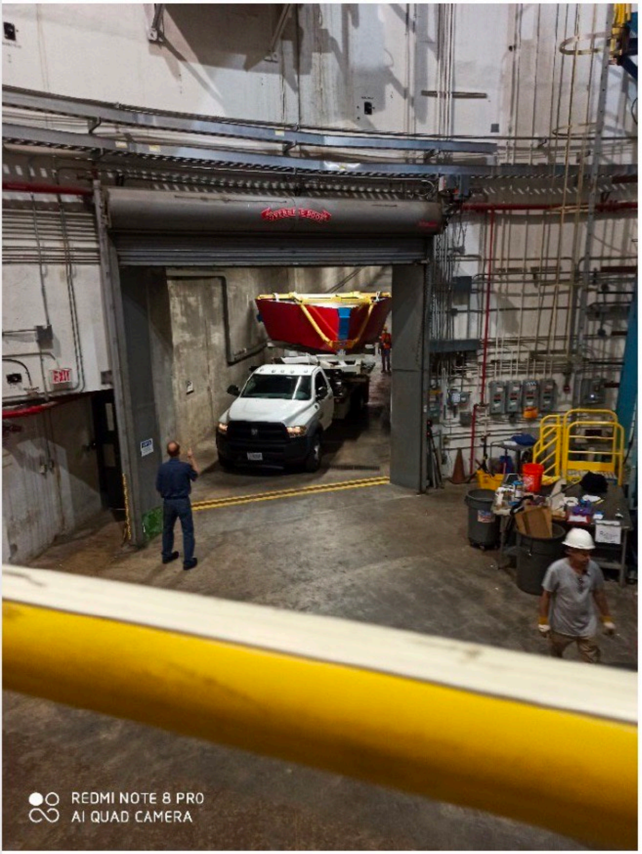
The RICH2 Aerogel

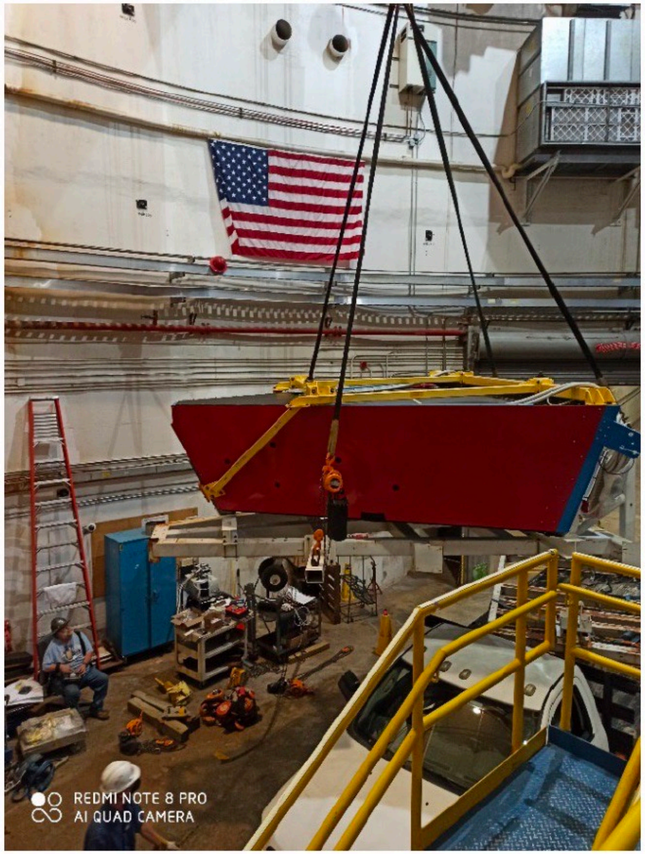


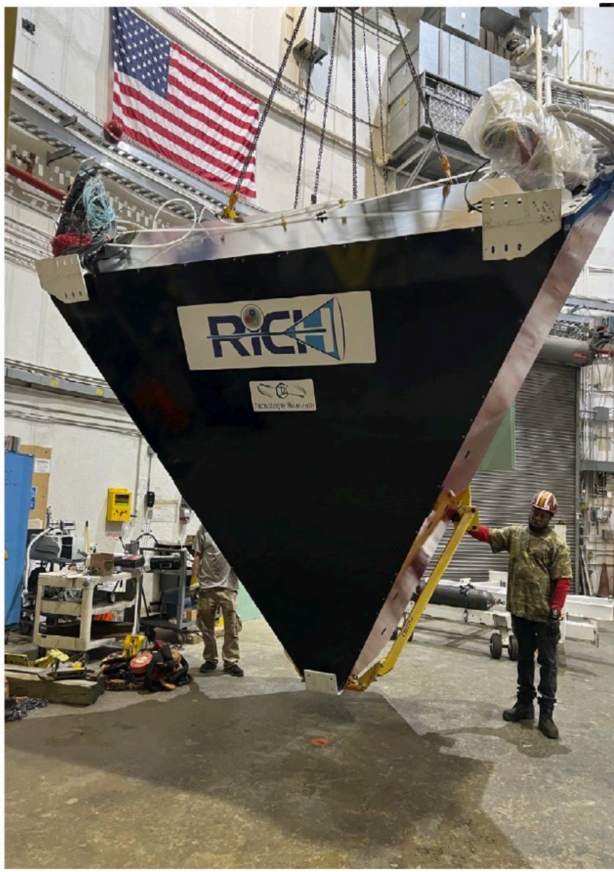




The RICH2 Installation (June 2022)







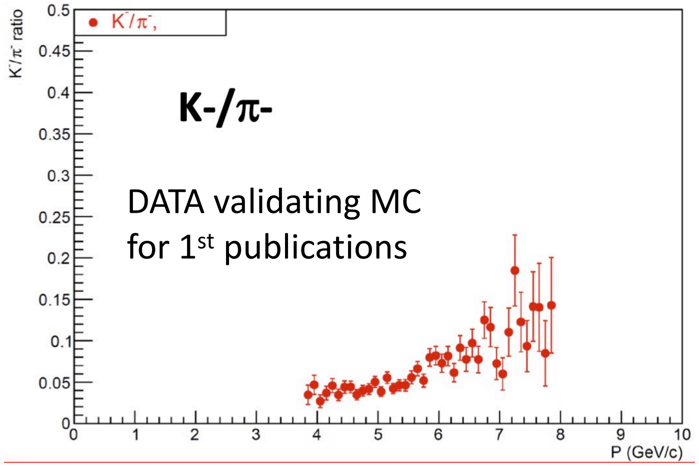
- **Major achievement: RICH2 ready in time for the start of polarized target experiments despite COVID restrictions**

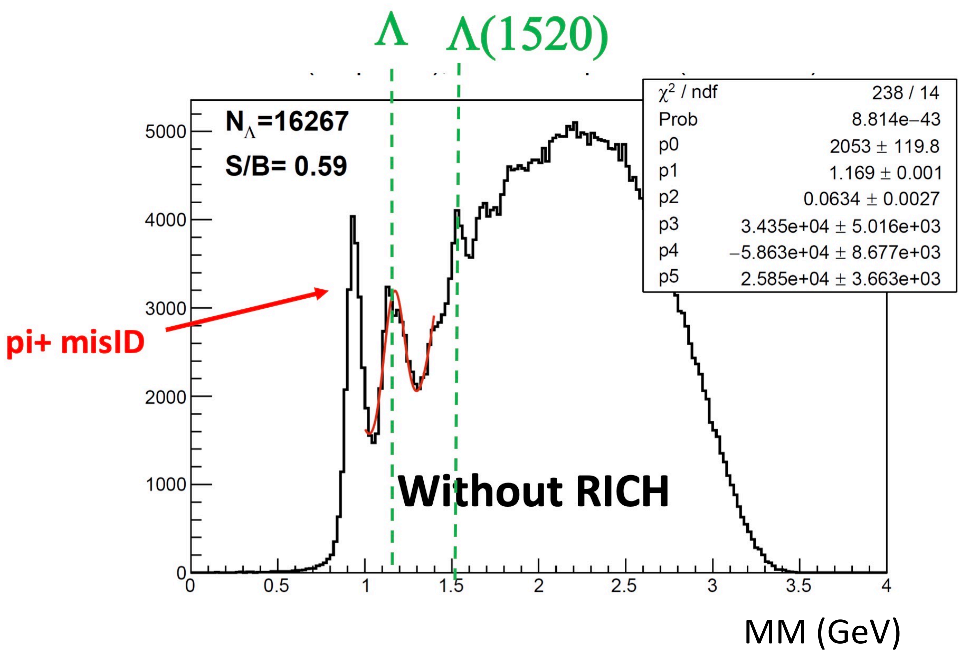
RICH Preformance

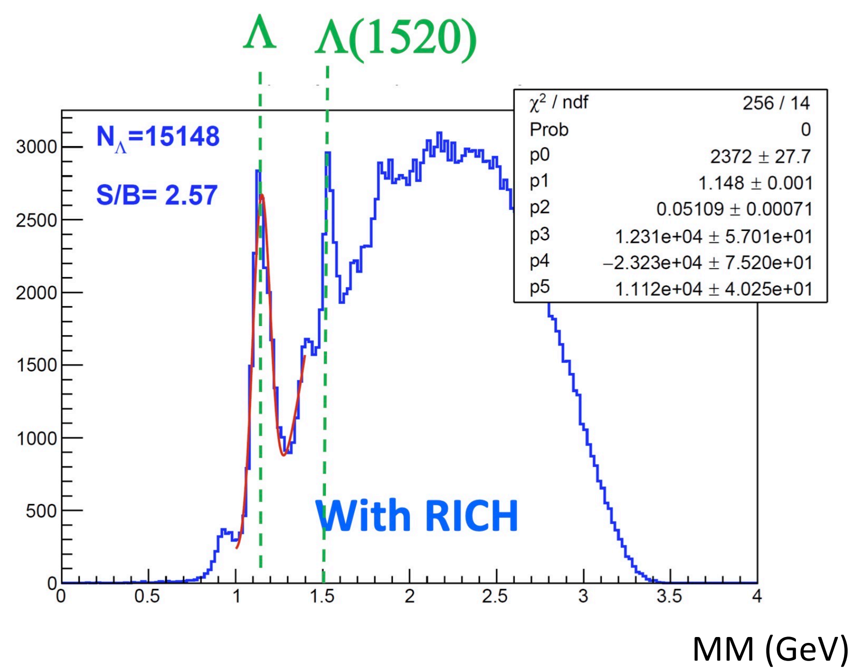
RICH PID used to benchmark simulations for 1st CLAS12 publications

Performance being studied with physics channels
Missing mass in ep → e' K^+ X
with electron and kaon identified by CLAS12

Phase space and performance being improved with new alignment and calibrations + RICH2.



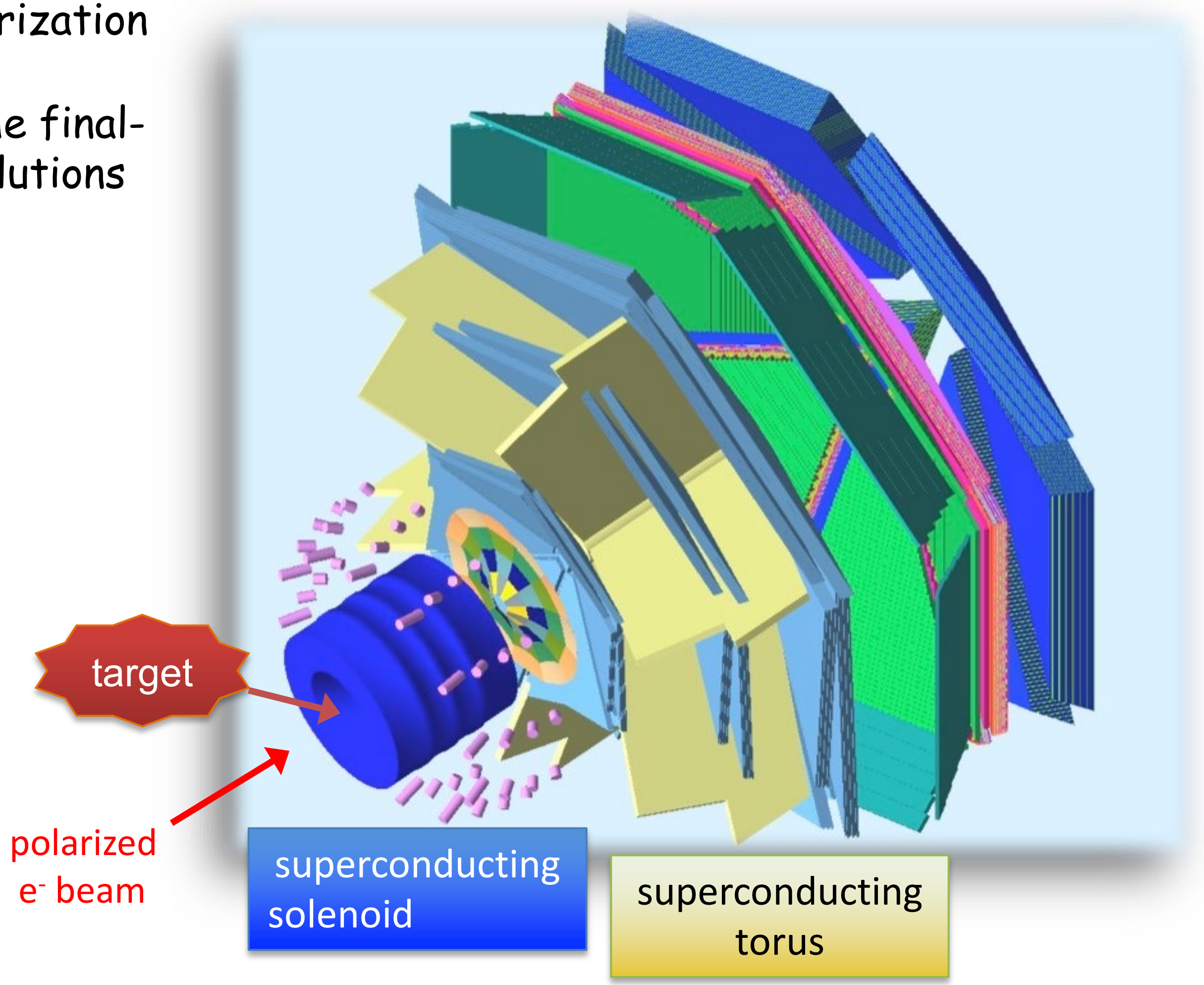




The Transverse target

Internal Target

To maintain transverse spin polarization within the CLAS12 solenoid and preserve wide acceptance for the final-state particles, new magnetic solutions are required.

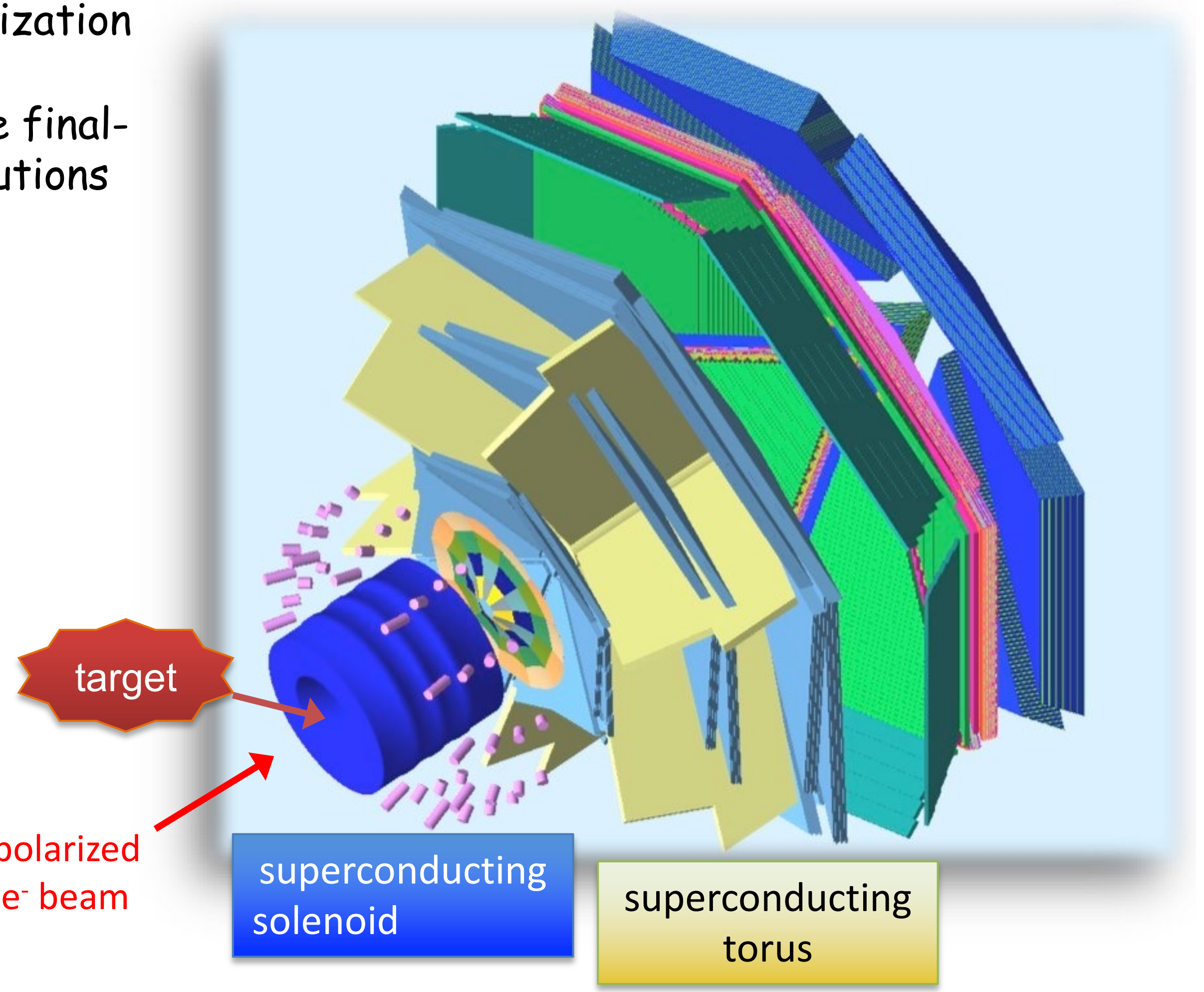


The Transverse target

Internal Target
To maintain transverse spin polarization within the CLAS12 solenoid and preserve wide acceptance for the final-state particles, new magnetic solutions are required.

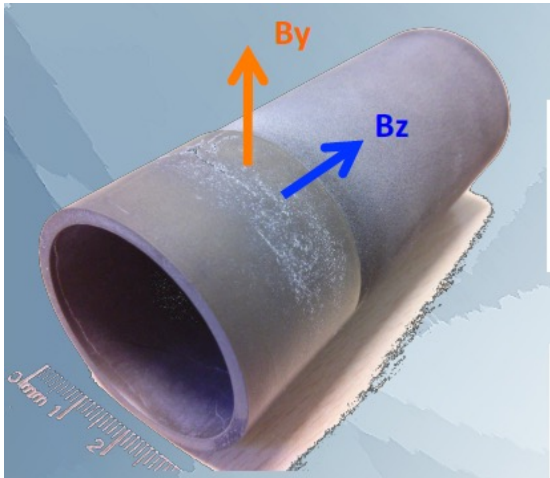
Tracking solenoid
- design up to 5 T longitudinal
- 4K L-He cryostat
- length 1500 mm

Transverse Target:
- high polarization
- d 25 mm – Length 25 mm
- transverse field up to 2 T



Transverse target: bulk transverse magnet

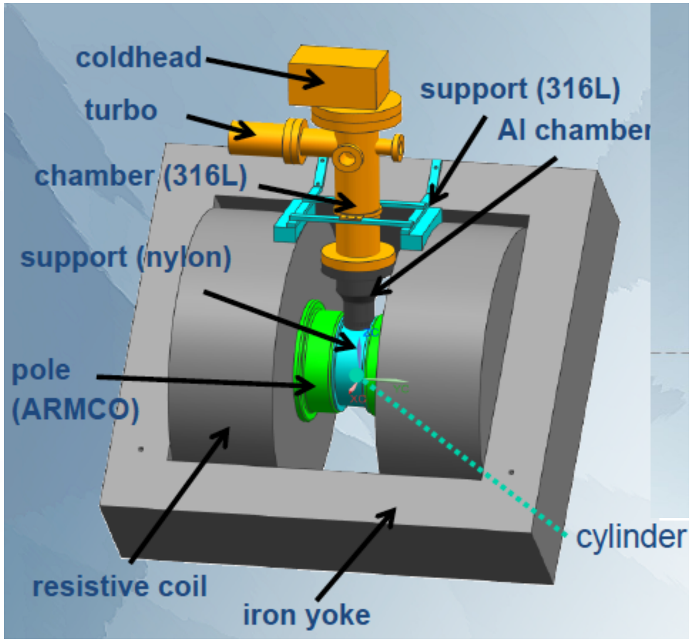
A hollow bulk superconductor is able to provide a transverse holding field inside, while adjusting its internal currents to shield any outside field, without the need of a current supply!



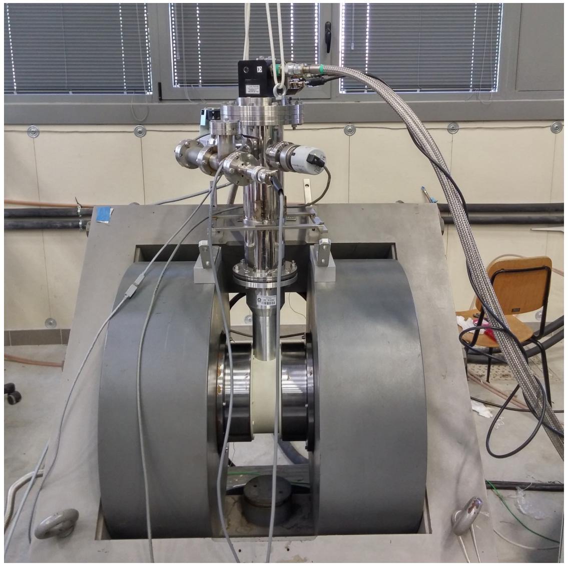
existing sample (courtesy of G. Giunchi)
diameter 39 mm
length 90 mm
thickness ~1 mm

Bulk cylinder (MgB_2)
- longitudinal shield
- transverse magnetization

Features
- no current leads
- Cu free
- self tuning
- few mm thickness
- external magnet for magnetization

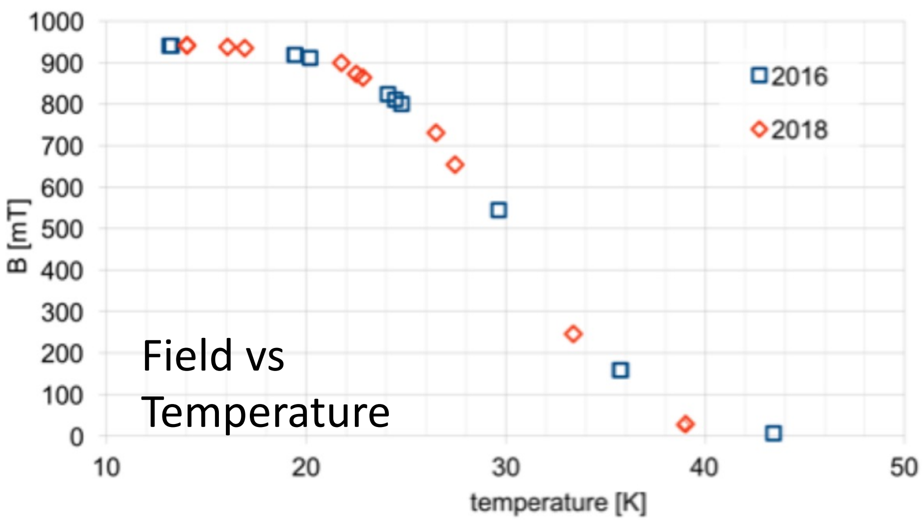


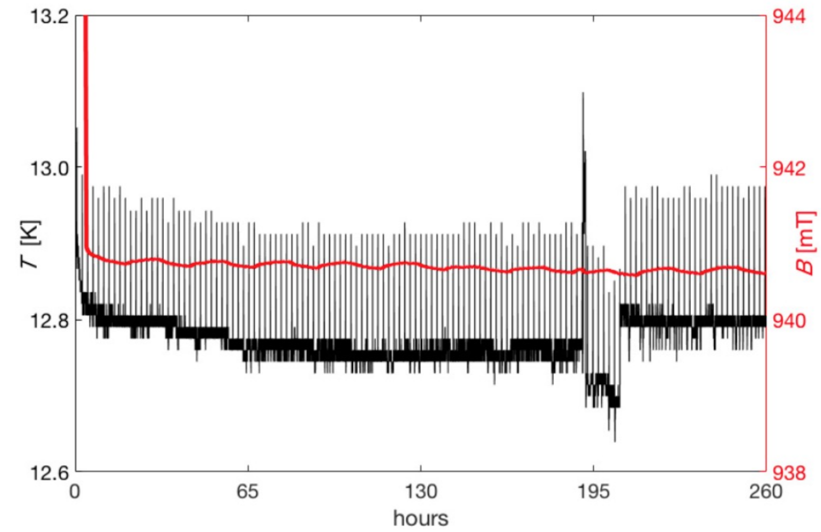
Transverse target: the Ferrara setup



Dipole field frozen for days inside a MgB_2 cylinder:

- After cooling down the MgB2 cylinder inside a dipole field of about 1T, the external field is zeroed and the dipole field at the center of the cylinder measured.
- With the decrease of the temperature below the transition point, an increasing fraction of the original field is trapped.
- At the minimum temperature of 12.8 K reachable by the setup, a field of about 940 mT is preserved for days, without any significant degradation



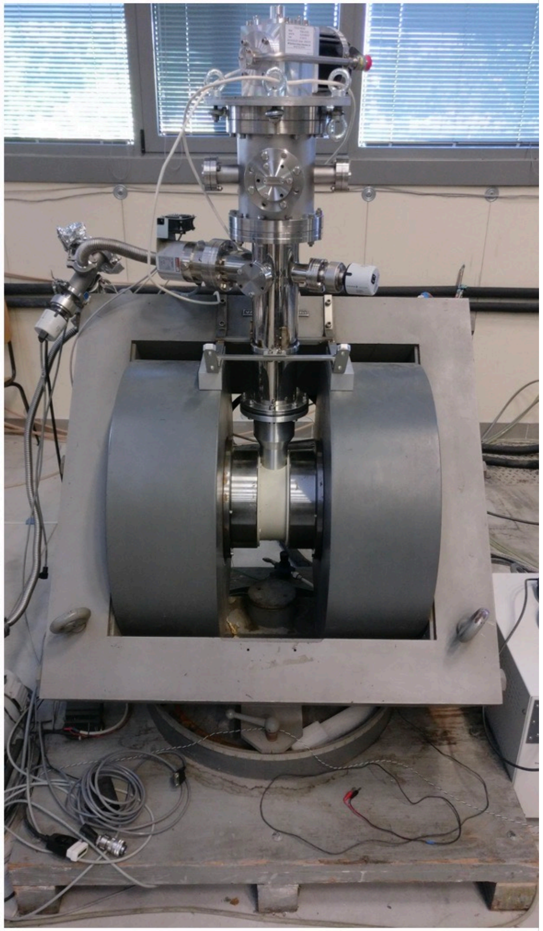


Transverse target: the new cryostat

New support **(M. Cavallina)**

New cold head:
- lower and more stable temperature working point

New cold stage:
- reduced mass
- space for cabling

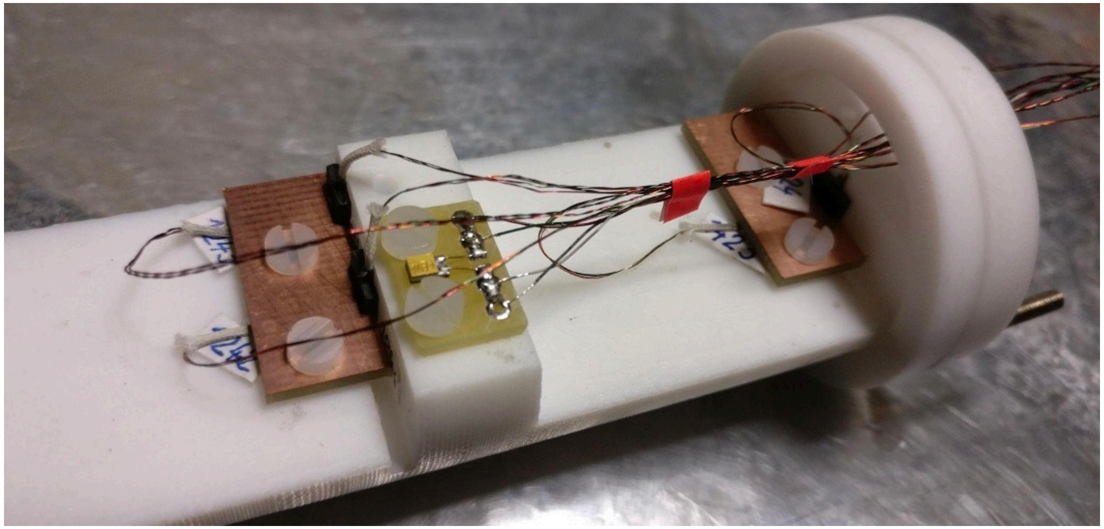


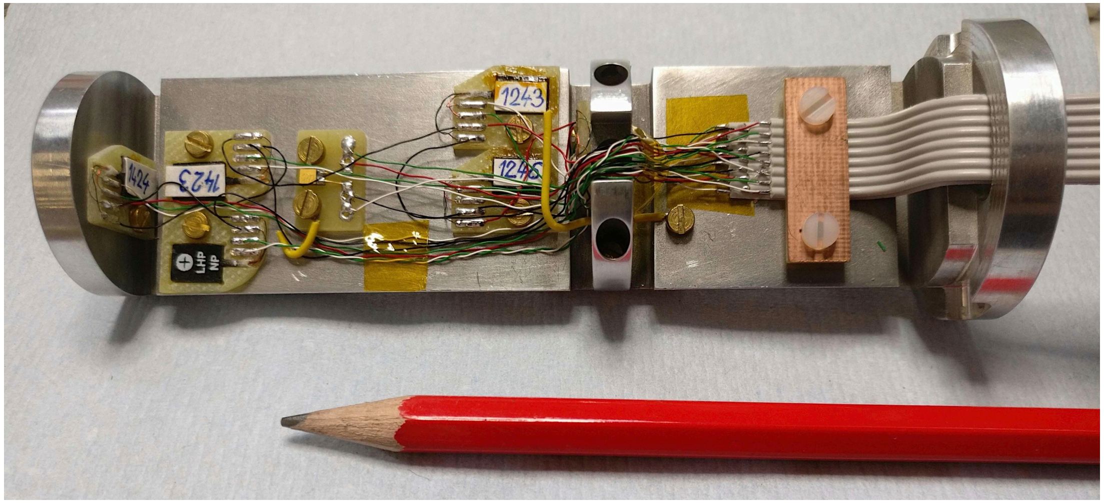
Transverse target: the new sensor holder

New sensor holder: (**M. Cavallina**)
  3 points x 2 orientation
    center
    off axis
    downstream

From Teflon to Al for heat sink

New fast access
  for MgB_2 sample exchange



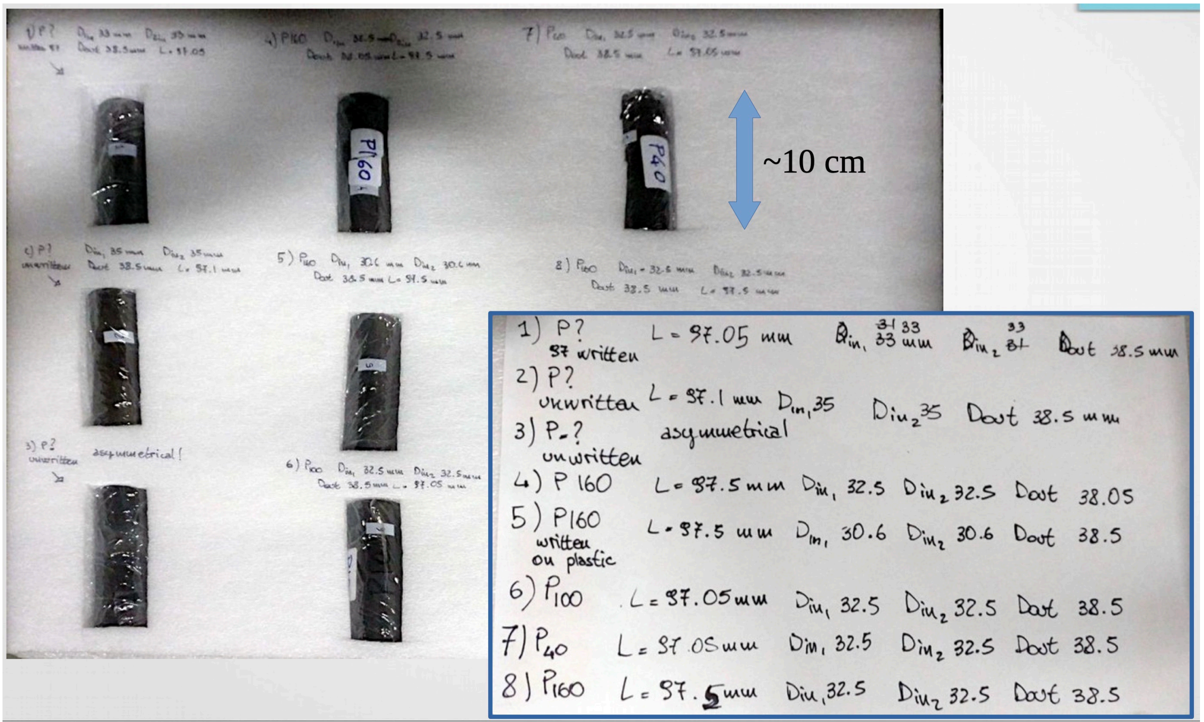


Transverse target: the new steps

Field mapping and temperature vs field scan

Study MgB2 performance vs thickness and granularity

Organize a 2x field (transverse holding, longitudinal screen) test in collaboration with INFN – LASA (MI)

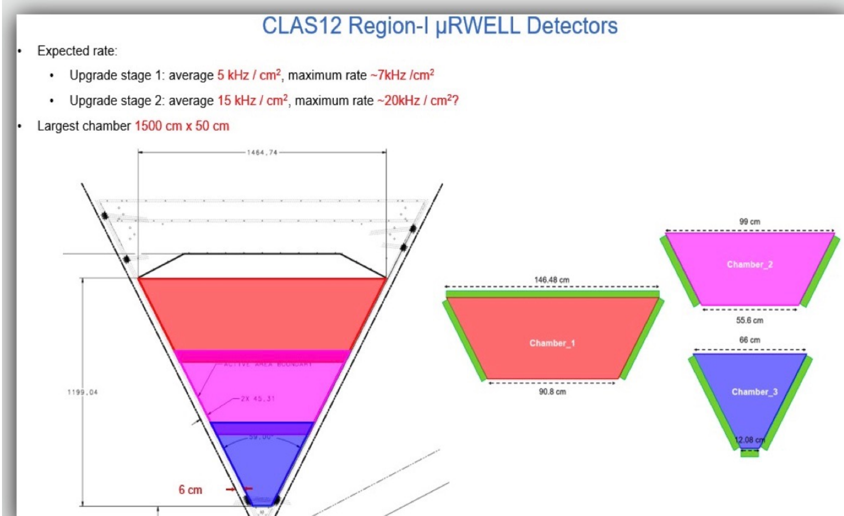


CLAS12 @ High-Luminosity

Stage -1:
- Achieve luminosity of **$2x10^{35}cm^{-2}\,s^{-1}$** for normal CLAS12 running with charged particle reconstruction efficiency of >85%
- Can be achieved within 3 years

Stage -2:
- Define a configuration of CLAs12 operations for two order of magnitude higher luminosity , > **$10^{37}cm^{-2}\,s^{-1}$**
- Can be achieved in 7-10 years

1. **Hardware upgrade:** Region 1 DC replacements with GEM-type detectors (stage-I), new tracker and new calorimeter (stage-II)
2. **Software developments:** Optimization of track-finding making use of ML/AI
3. **L3 capabilities enhancement:** trigger-less DAQ, streamed readout)



Rate requirements:
- Upgrade stage 1:
  average 5 kHz / cm², max rate ~7kHz /cm²
- Upgrade stage 2:
  average 15 kHz / cm², max rate ~20kHz / cm²

Dimensions
- Largest chamber 150 cm x 50 cm

μ-RWELL prototyping
- UVa (INFN support)

Work Started

μ-RWELL redout
- Two leading options under investigation: SAMPA (ALICE) and VMM3 (ATLAS)
- INFN involvement in MPD

Jefferson Lab

Ferrara: study mechanical stability for minimal material budget (**M. Melchiorri**)

Il gruppo di Ferrara @ JLab

Responsabilita':

- M. C.: responsabile locale e nazionale di JLab12
- M. C. : chair-elect of the Jlab User Organization (1600 users from US and all over the World)
- M. C.: membro CLAS Coordination Committee
- M. C. responsabile progetto RICH
- M.C. Deep-Process WG coordinator
- M. C. & L.P. Co-spokesperson di diverse proposte di esperimento (PAC34,37,38,39)

Contributi principali

- **Data analysis**
  - Data processing
- **RICH detector**
  - Reconstruction algorithms
  - Second RICH module construction
- **Magneti superconduttori**
  - Configurazione magnetica per transverse target
  - Frozen field con magneti a bulk di superconduttore
- **High-luminosity**
  - Study micro-Rwell mechanical stability with light structure
  - Laboratory test

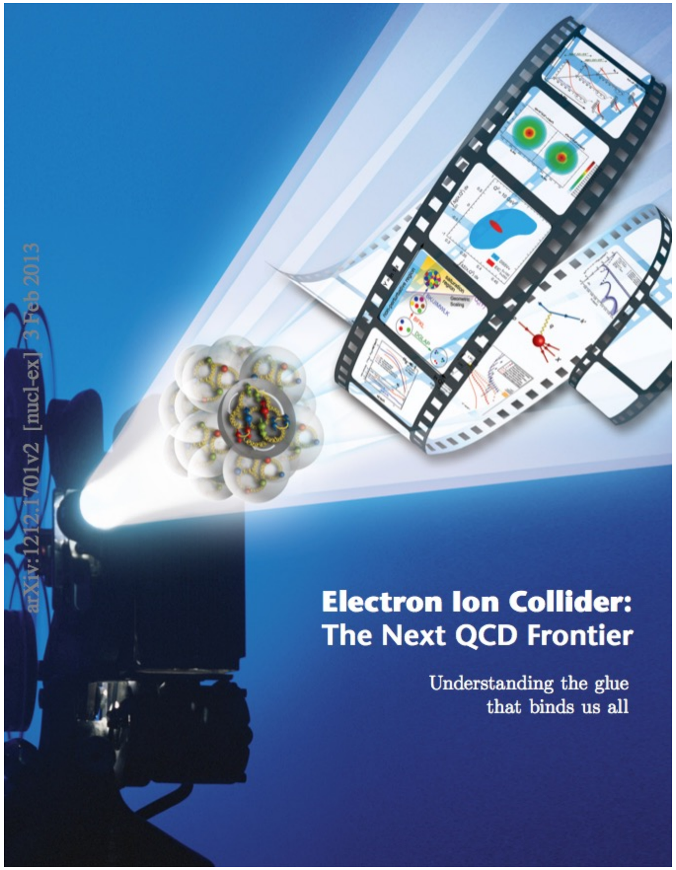
EIC-NET (R.L.: Marco Contalbrigo)

- INFN Network for preliminary studies on the EIC project

EIC_NET

EIC-NET (R.L.: Marco Contalbrigo)

- INFN Network for R&D studies for the EIC project



Electron Ion Collider:

CD0 Announced in January 2020

“Yellow Report” published

“Expression of Interest” survey done

“Call for Detectors” ongoing

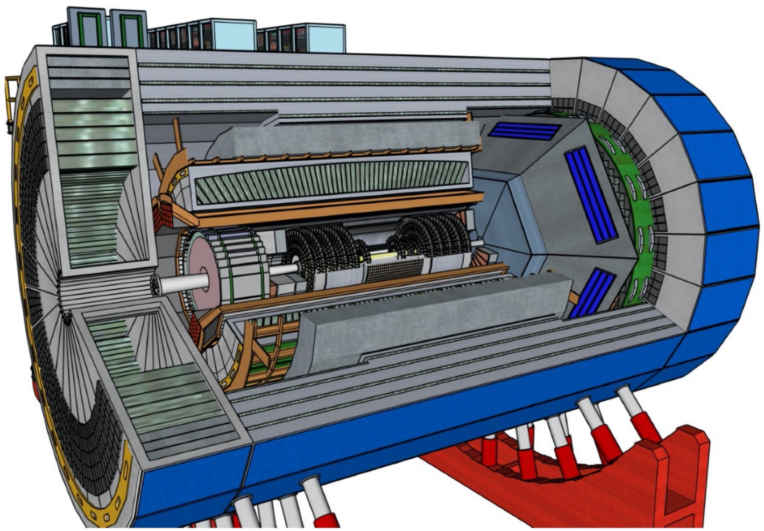
Strong interest in Italian nuclear physics community (theory and experiment)

Increasing R&D effort

INFN Ferrara working with the PID R&D

EIC_NET: The dual RICH

dRICH has been a common reference in the forward region since EIC Yellow Report



p: 41 GeV, 100 to 275 GeV

p/A beam →

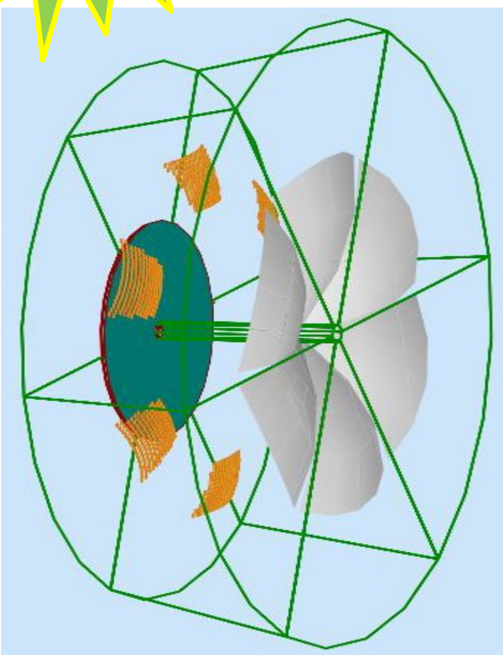
← e beam

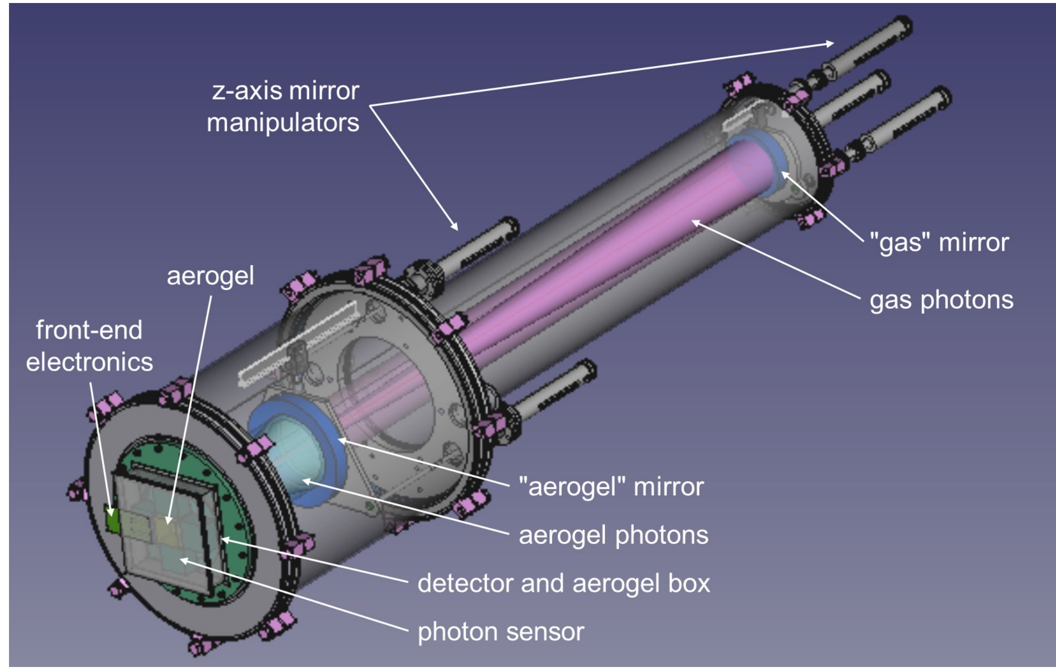
e: 5 GeV to 18 GeV

INFN   Duke University   NISER

EIC_NET: The dual RICH

$\geq 3\sigma$ π/k separation
$\sim 2 \div 50$ GeV/c





Extended 3-60 GeV momentum range

Prototype under construction:

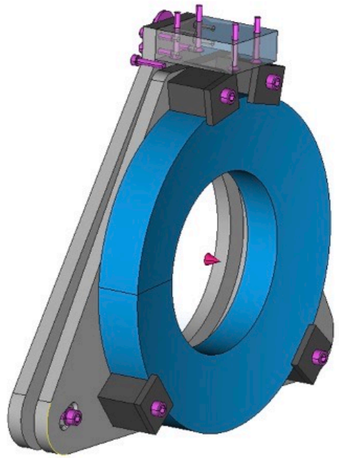
INFN **FE**, BO, CT, LNF, LNS,RM1, TO, TS

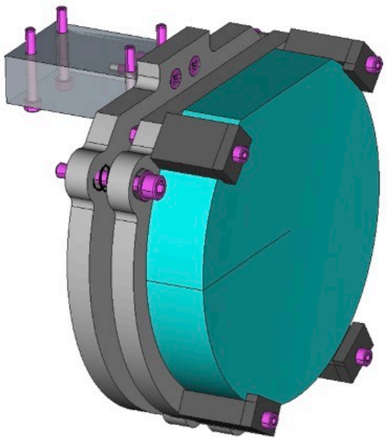
Two test-beam apporved at CERN in 2022:

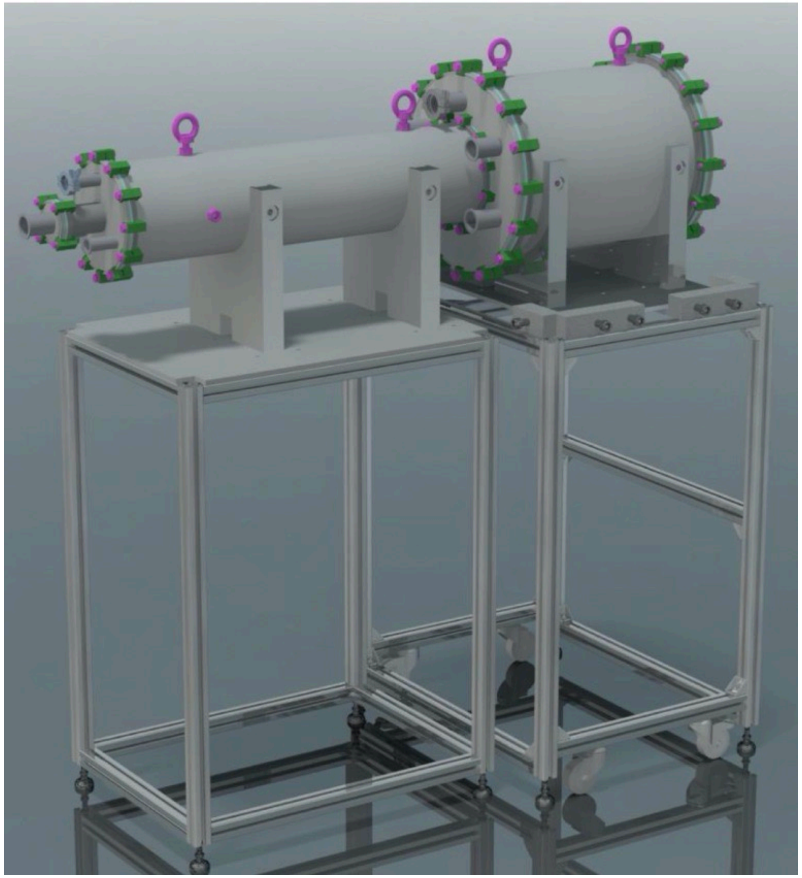
Sep. SPS T4-H8: high-momentum > 20 GeV/c

Oct. PS T10: low-momentum < 15 GeV/c
in conjunction with ALICE PID

EIC_NET:
The dual RICH Prototype

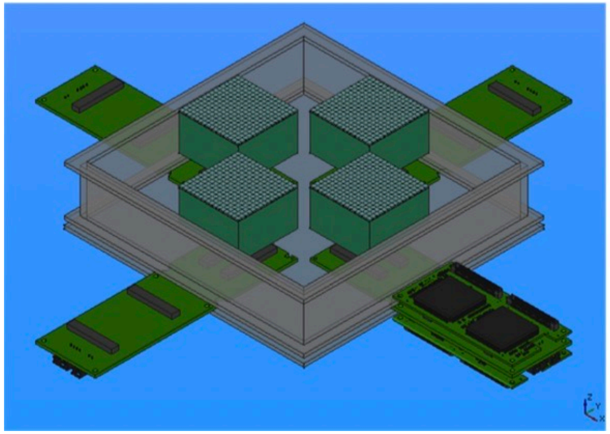


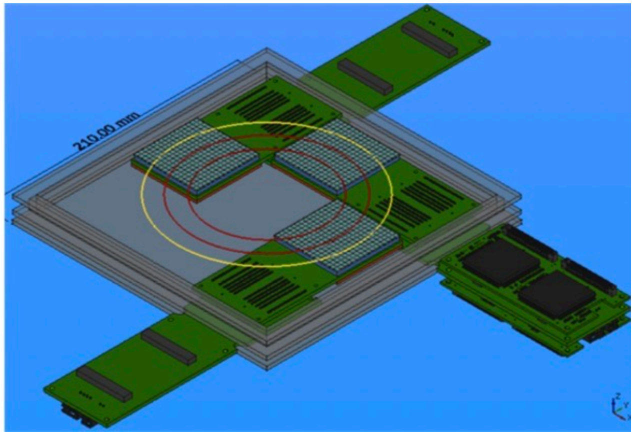




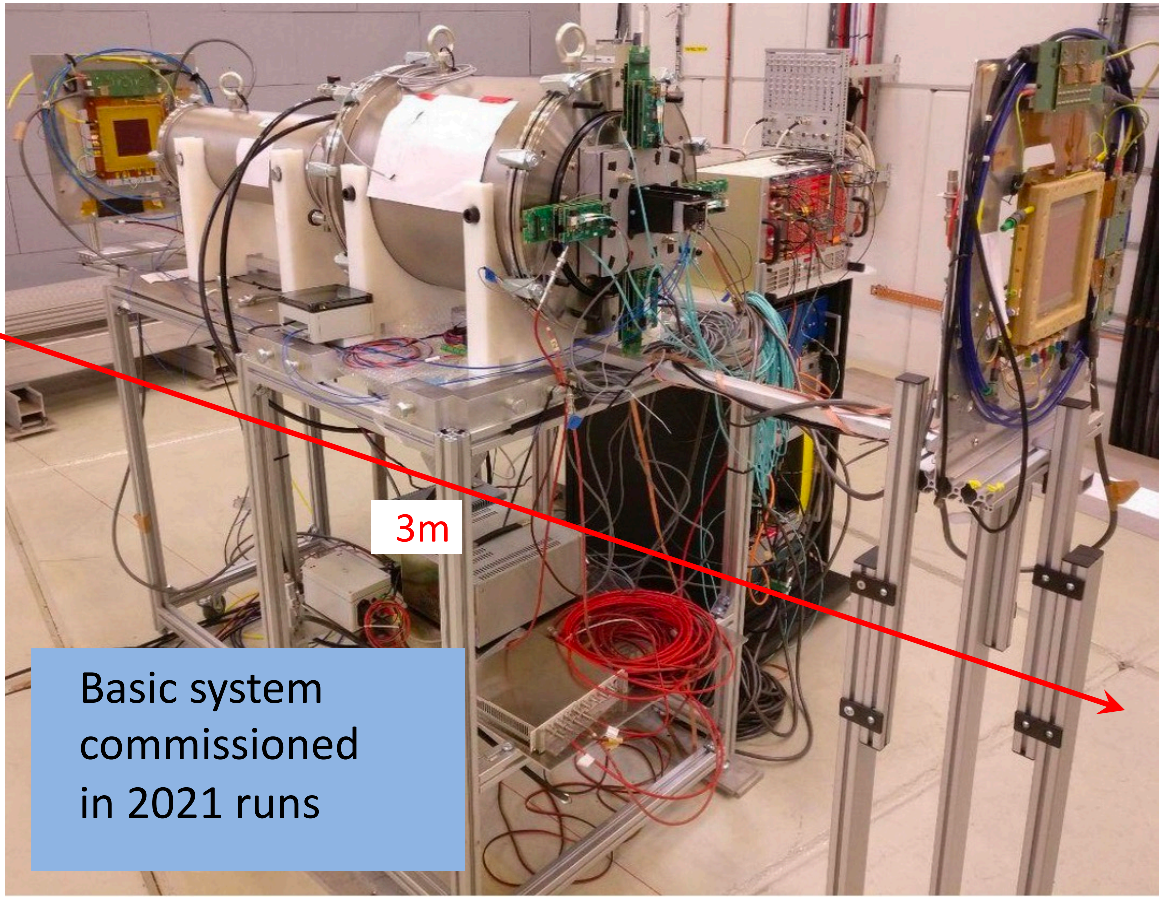
Mirror alignment system
Detector box
(**M. Cavallina**)

Detector support cart
(**off. Meccanica**)





dRICH Prototype



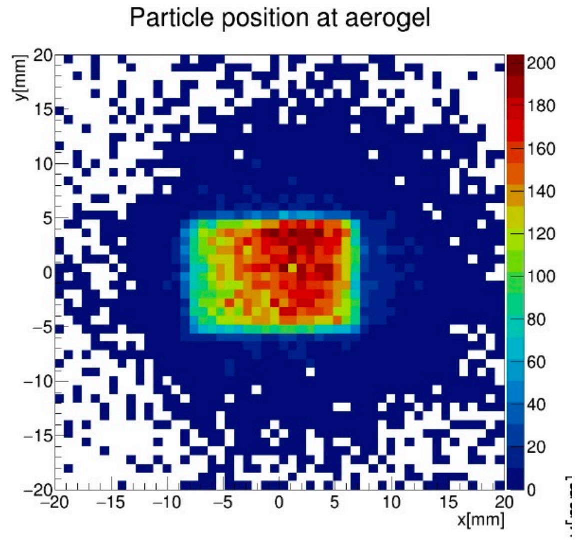
Goals:

- Study dual radiator performance and interplay
- Study specifications and alternatives for optical components
- Test alternate single-photon detection systems
- Design parameters and optimization

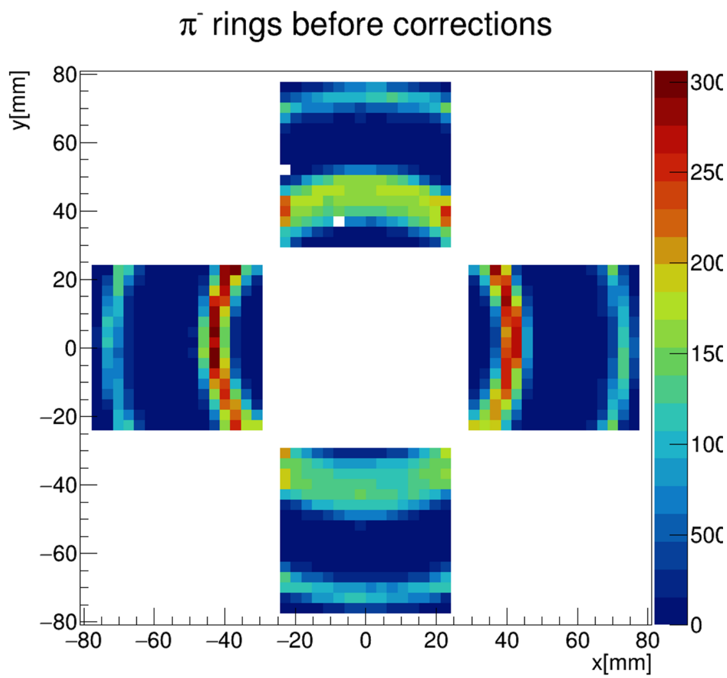
dRICH Prototype Imaging

A tracking system based on two GEM detectors was used during the test beam to track the beam particles for measuring alignment and beam divergence.

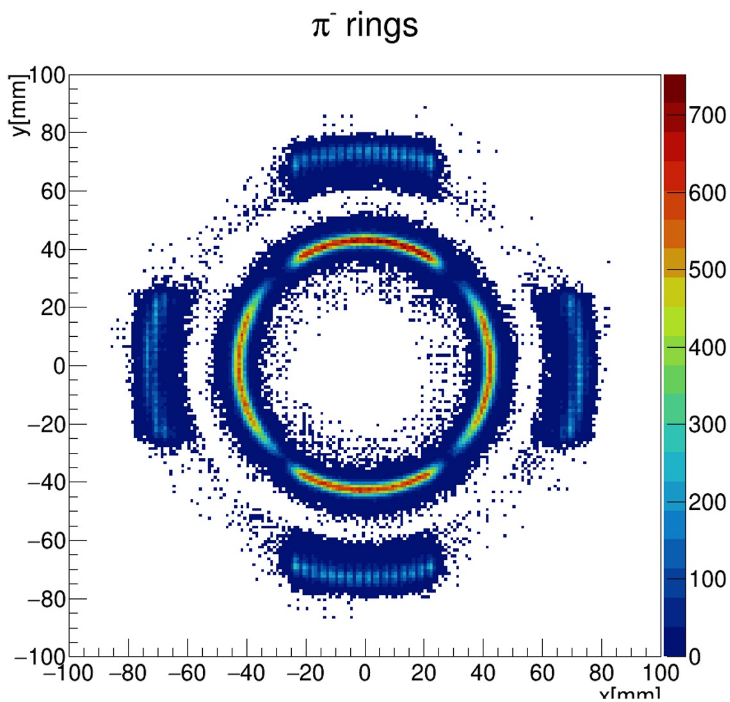
The combination of the dRICH optical information and GEM track information allows to correct data on an event by event analysis.



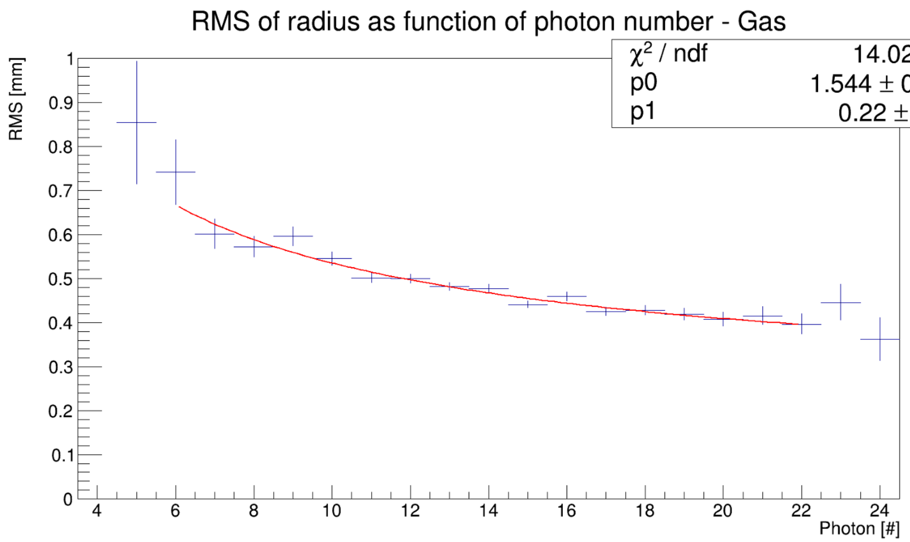
Without GEM

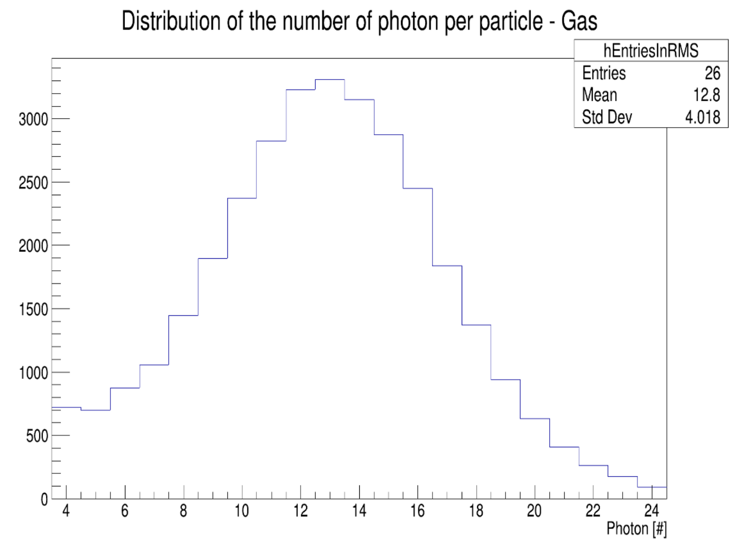


With GEM



dRICH-gas Performance





Fitting function: $$y = \sqrt{\frac{{p_0}^2}{x} + {p_1}^2}$$

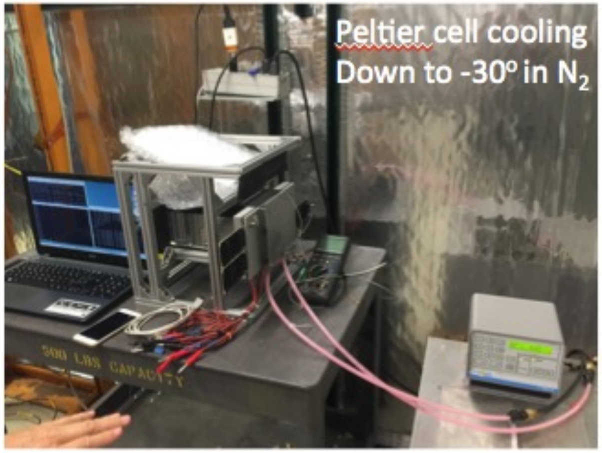
p_0 = single photon resolution

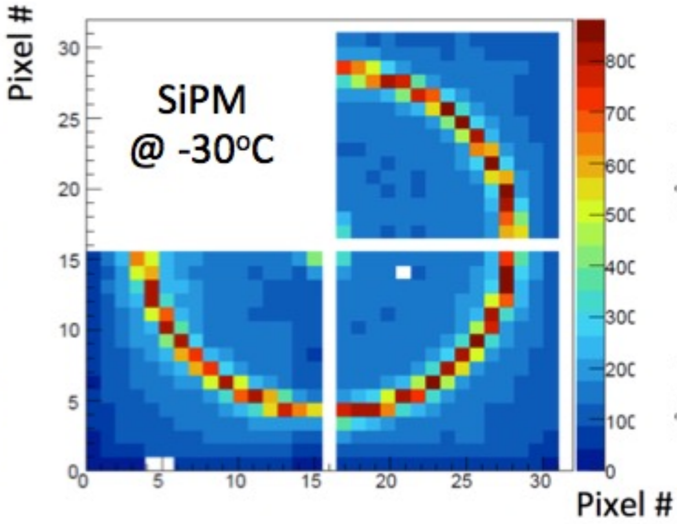
p_1 = single particle resolution constant term

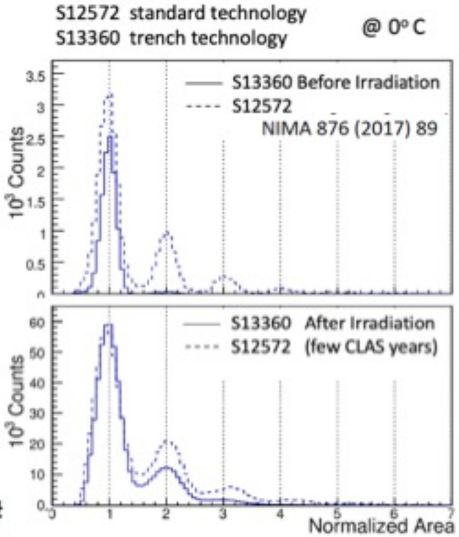
Gas	Data	Simulation
p_0 [mm]	1.5	1.1
p_1 [mm]	0.22	0.07
Avg photon	12.8	11.3

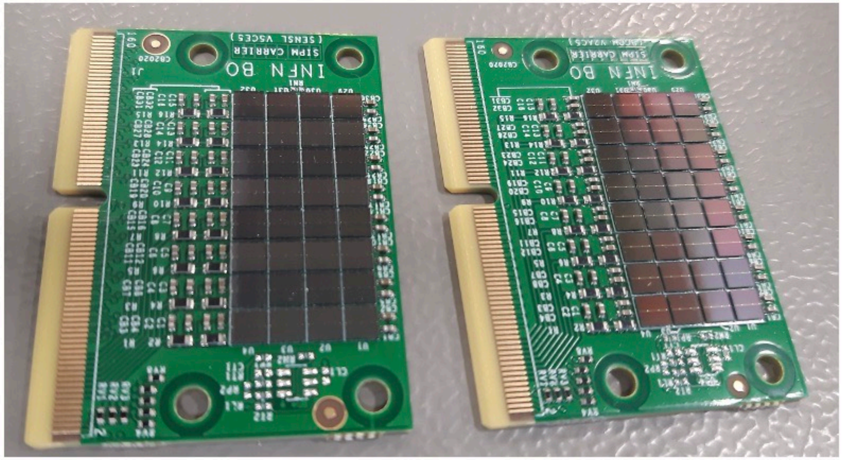
EIC_NET: The SiPM program

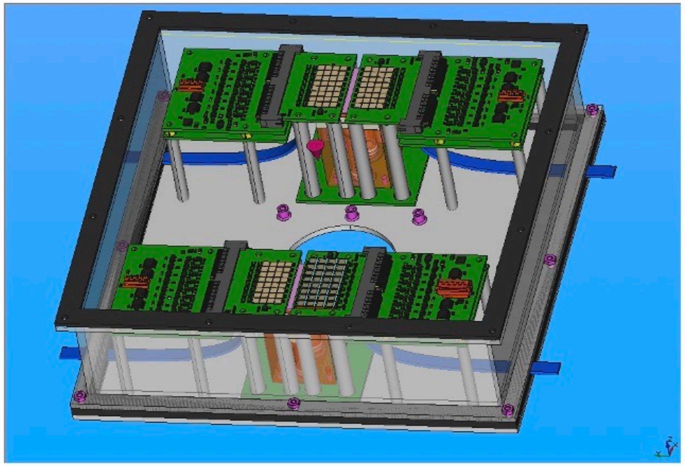
Cherenkov imaging with commercial MPPC and MAROC readout



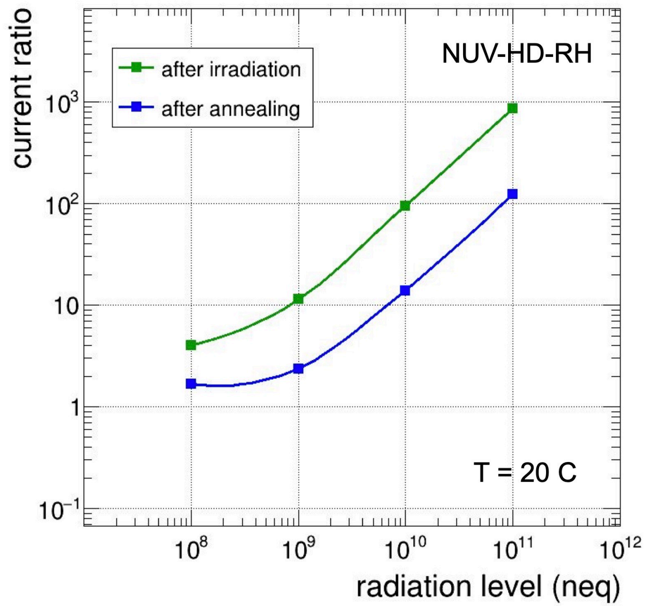




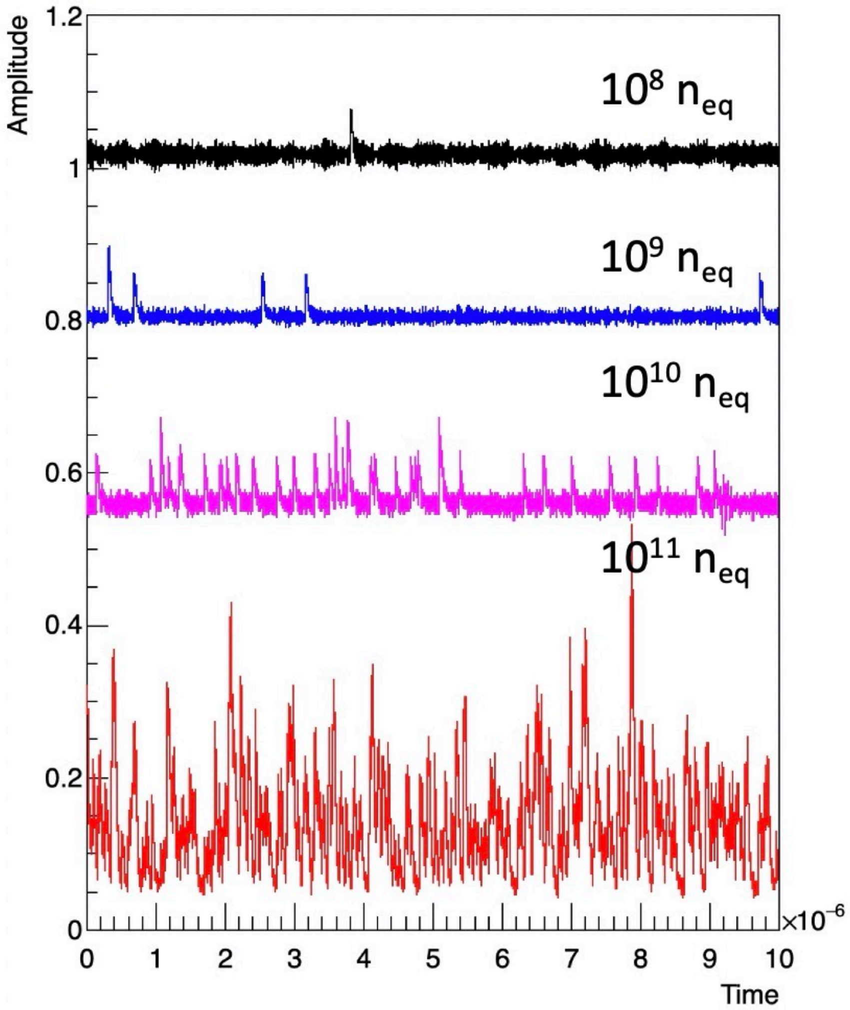


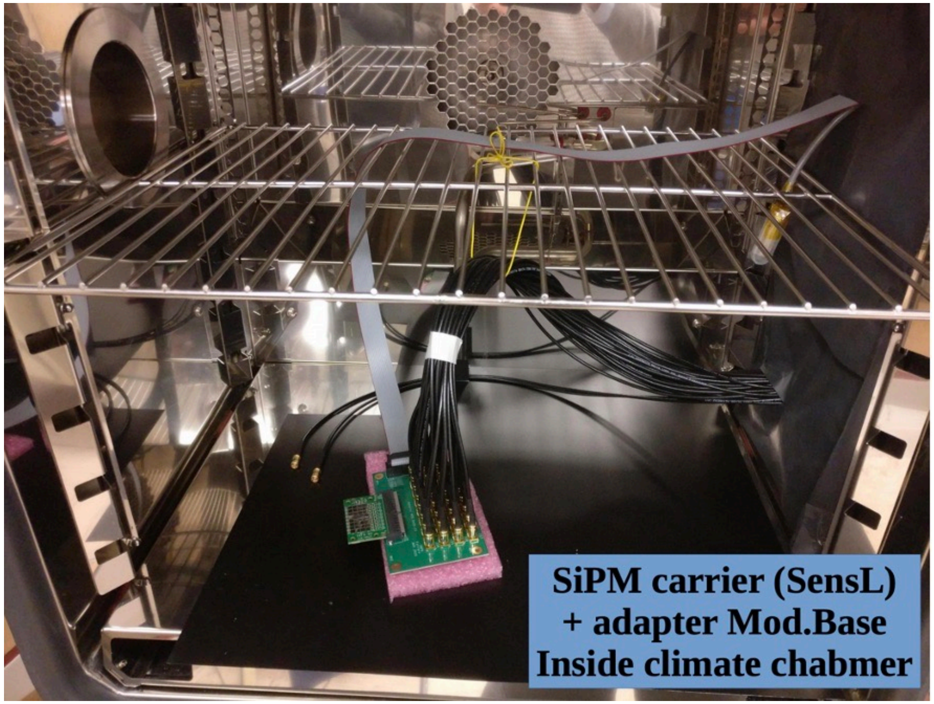


EIC_NET: The SiPM program



Dark counts @ -30º (before annealing)





EIC_NET: responsabilità

Responsabilita':

- M. C.: responsabile locale EIC_NET
- M.C.: co-coordinator eRD102
- M. C.: IAC POETIC (Physics Opportunities at EIC) Conference

Contributi principali:

- dRICH detector
  - Prototyping
  - Optical component characterization
  - SiPM irradiation program

- Electronics
  - MAROC (reference) + ALCOR (INFN development)

Richieste ai Servizi

Servizio Meccanico
JLAB12
TTarget: traliccio di supporto per test con doppio campo magnetico disegno e realizzazione esterna
High-Lumi: supporto per stazione di test con μ-rwell
FE laboratory: supporto per misure e stazioni di test
EIC_NET
dRICH: meccanica del prototipo
SiPM: meccanica per il raffreddamento dei sensori
EIC: contributo piano di rivelazione basato su SiPM+ALCOR

Servizio Elettronico
JLAB12
Ttarget: piccoli contributi alle misure con magneti superconduttori
High-Lumi: supporto per stazione di test con μ-rwell
FE laboratory: supporto per misure e stazioni di test
EIC_NET
dRICH: supporto in preparazione ai test-beam e misure di laboratorio
SiPM: contributo piano di rivelazione basato su SiPM + ALCOR

Manpower e richieste finanziarie per 2023

Anagrafica e afferenze (Ric. + Tecnol.): 13.7 FTE

Name	JEDI	JLab12	EIC_NET
G. Ciullo (staff)	70	20	
M. Contalbrigo (staff)		70	25
L. Del Bianco (staff)		100	
S. Dymov (assegnista)	100		
A. Kononov (assegnista)	100		
P. Lenisa (staff)	75	20	
A. Maragno (dottoranda)	100		
L. Pappalardo (staff)		30	
A. Pesce (post-doc)	100		
A. Seleev (assegnista)	100		
R. Shankar (dottorando)	100		
V. Shmakova (assegnista)	100		
F. Spizzo (staff)		80	20
S. Vallarino (dottorando)		100	
V. Carassiti	50		
A. Saputi	10		
TOTALE/100	**9.05**	**4.20**	**0.45**

Servizio meccanico ed elettronico: 2.2 FTE

Name	JEDI	JLab12	EIC_NET
L. Barion		25	75
M. Cavallina		5	
F. Evangelisti	20	10	
M. Gambetti	10		
A. Magnani		10	
R. Malaguti		15	20
M. Melchiorri		15	
S. Squerzanti		15	
TOTALE/100	**0.30**	**0.95**	**0.95**

Manpower e richieste finanziarie per 2023

Richieste finanziarie (k€)

Name	JEDI	JLab12	EIC_NET	Dot.3
Missioni	50	45	15	9.5
Trasp.		5		
Inv.				15
Consumi	15	15	17	6.5
Apparati		20		
Altro				4
TOTALE	65	85	32	35