Attività di Gruppo III e preventivi 2024

Luciano L. Pappalardo
Consiglio di Sezione INFN
Ferrara, 05/07/2023

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:
- Studio della struttura degli adroni e dell'interazione forte nel regime non perturbativo
- Misure di simmetrie fondamentali (P, T, CP)
- Ricerca di DM

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

Principali Laboratori di riferimento
- JEDI → FZ, Juelich, GE
- JLAB12 → Jlab, USA
- EIC-Net → (CERN) + BNL, USA

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

- EDM
- Test of fundamental symmetries (P, T, CP)
- Search for DM (axions)

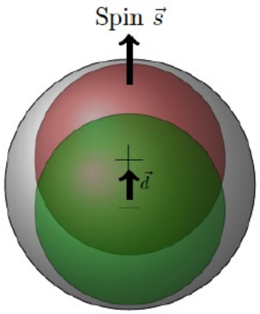
Problems

- 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

Direct EDM measurements missing

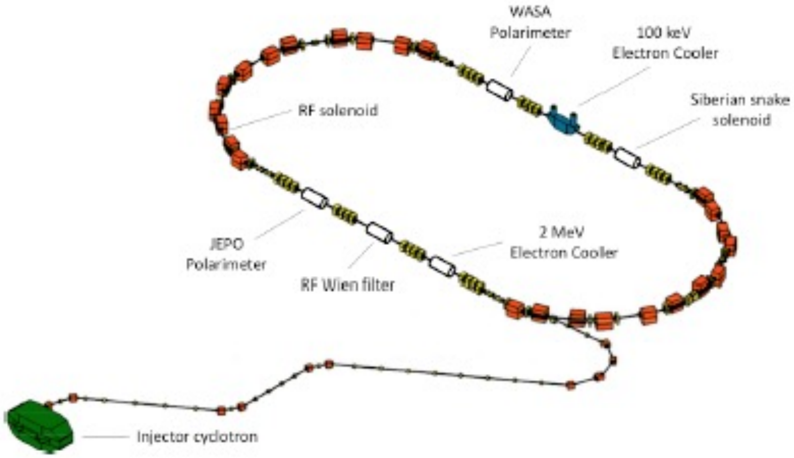
- No direct measurements of electron: limit obtained from (ThO molecule).
- No direct measurements of proton: limit obtained from $^{199}_{80}Hg$.
- No measurement yet of deuteron EDM.

Main goals: first measurements of static and oscillating deuteron EDM at a Storage Ring

EDM search at COSY

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



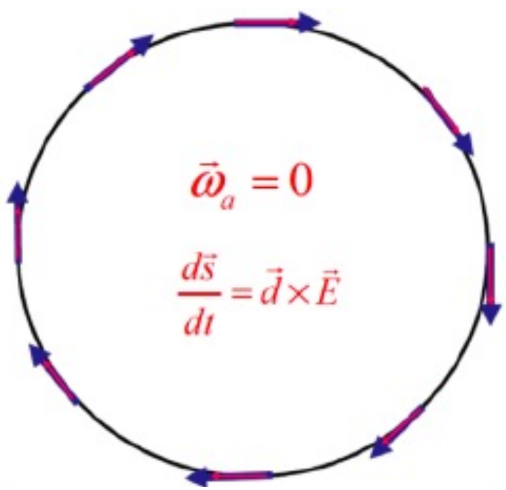
Previously used as spin-physics machine for hadron physics:

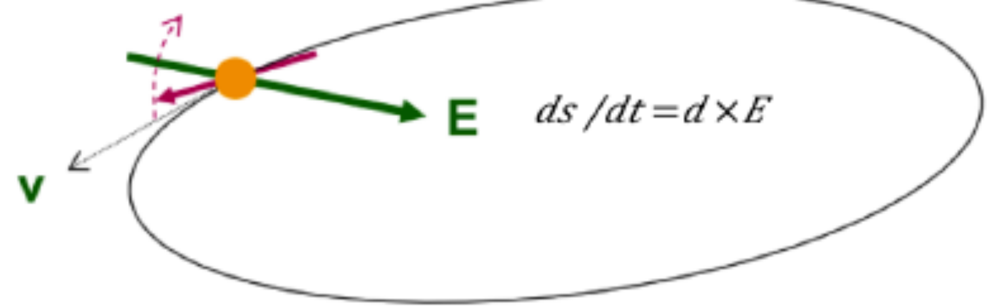
- Ideal starting point for srEDM related R&D
- Dedicated and unique experimental effort worldwide

EDM search at Storage Rings

Procedure:

1. Inject polarized particles (e.g. deuterons) in storage ring
2. Align spin along momentum (freeze orizontal spin precession)
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)



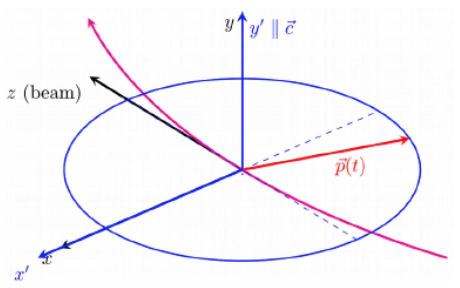


$$\varepsilon_V = \frac{L-R}{L+R} \propto p_V A_y$$

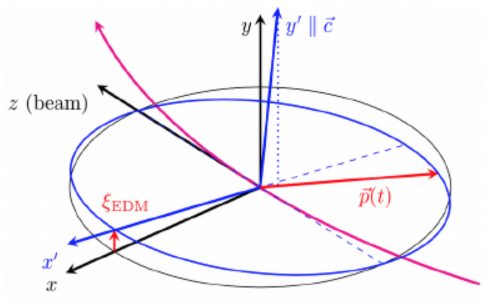
sensitive to EDM

VERTICAL polarization — Analyzing power

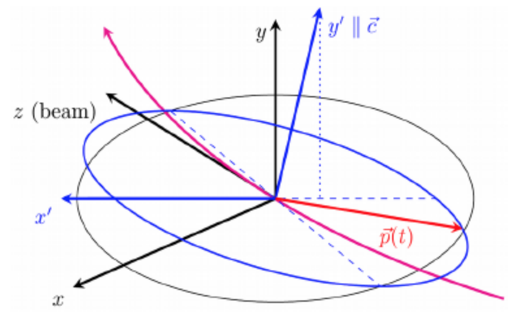
Deuteron EDM measurement at COSY



EDM absence



EDM effect



Magnetic misalignm.

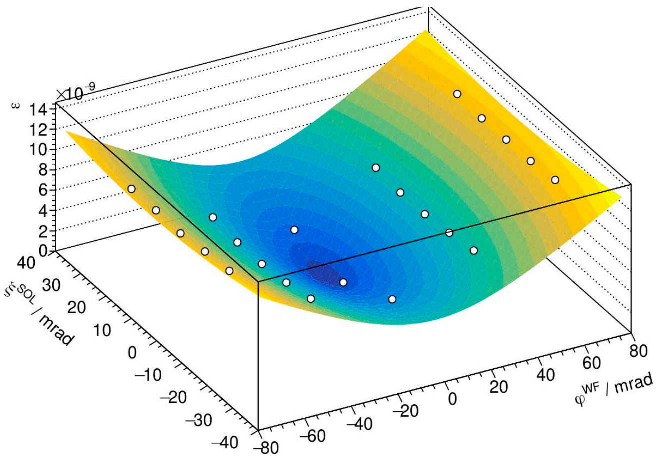
EDM tilts the invariant spin axis

- Presence of EDM $\rightarrow \xi_{EDM} > 0$
  - $\rightarrow$ spin precess around the $\vec{c}$ axis
  - $\rightarrow$ oscill. vert. polarization $p_y(t)$

Deuteron EDM measurement at COSY

EDM resonance strength map for ϵ^{EDM}

- Includes tilts of invariant spin axis due to EDM and magnetic ring imperfections.



Preliminary result on static EDM

- Determination of minimum via fit with theoretical surface function yields:
  - ϕ_0^{WF} (mrad) = - 2.05 $\pm$0.02
  - ψ_0^{sol} (mrad) = + 4.32 $\pm$0.06

Extraction of EDM

1. Minimum determines spin rotation axis (3-vector) at RF WF, including EDM
2. Spin tracking in COSY lattice $\rightarrow$ orientation of stable spin axis w/o EDM
3. EDM is obtained from the difference of 1. and 2.

- Data analysis now focused on systematics and close to be finalized
- Results compatible with $d_{EDM} < 10^{-19}\ e \cdot cm$

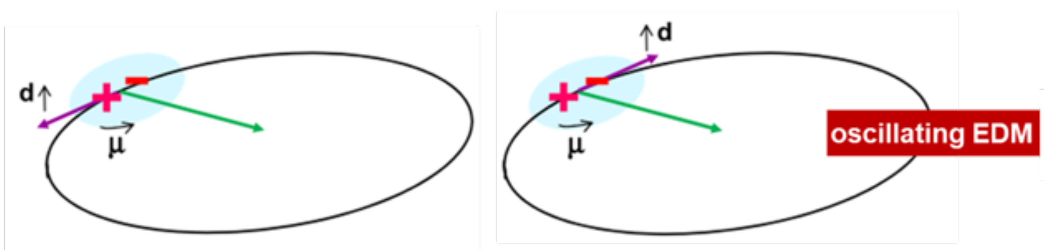
Oscillating EDM and sensitivity to axions

Axions and oscillating EDM

- Axion: candidates for light dark matter ($m_a < 10^{-6}$ eV)
- Axion interaction with ordinary matter: $\frac{a}{f_0} F_{\mu\nu}\tilde{F}_{\mu\nu}$, $\frac{a}{f_0} G_{\mu\nu}\tilde{G}_{\mu\nu}$, $\frac{\partial_\mu a}{f_a}\bar{\Psi}\gamma^\mu\gamma_5\Psi$
- $\frac{a}{f_0} G_{\mu\nu}\tilde{G}_{\mu\nu} \rightarrow$ coupling to gluons with same structure as QCD-θ term
- Generation of an oscillating EDM with freq. related to mass: $\hbar\omega_a = m_a c^2$

Experimental approach

- Mag. dipole moment (MDM) $\rightarrow$ spin prec. in B field $\rightarrow$ nullifies static EDM effect
- Osc. EDM resonant condition ($\omega_a = \omega_s$) $\rightarrow$ buildup of out-of-plane spin rotation

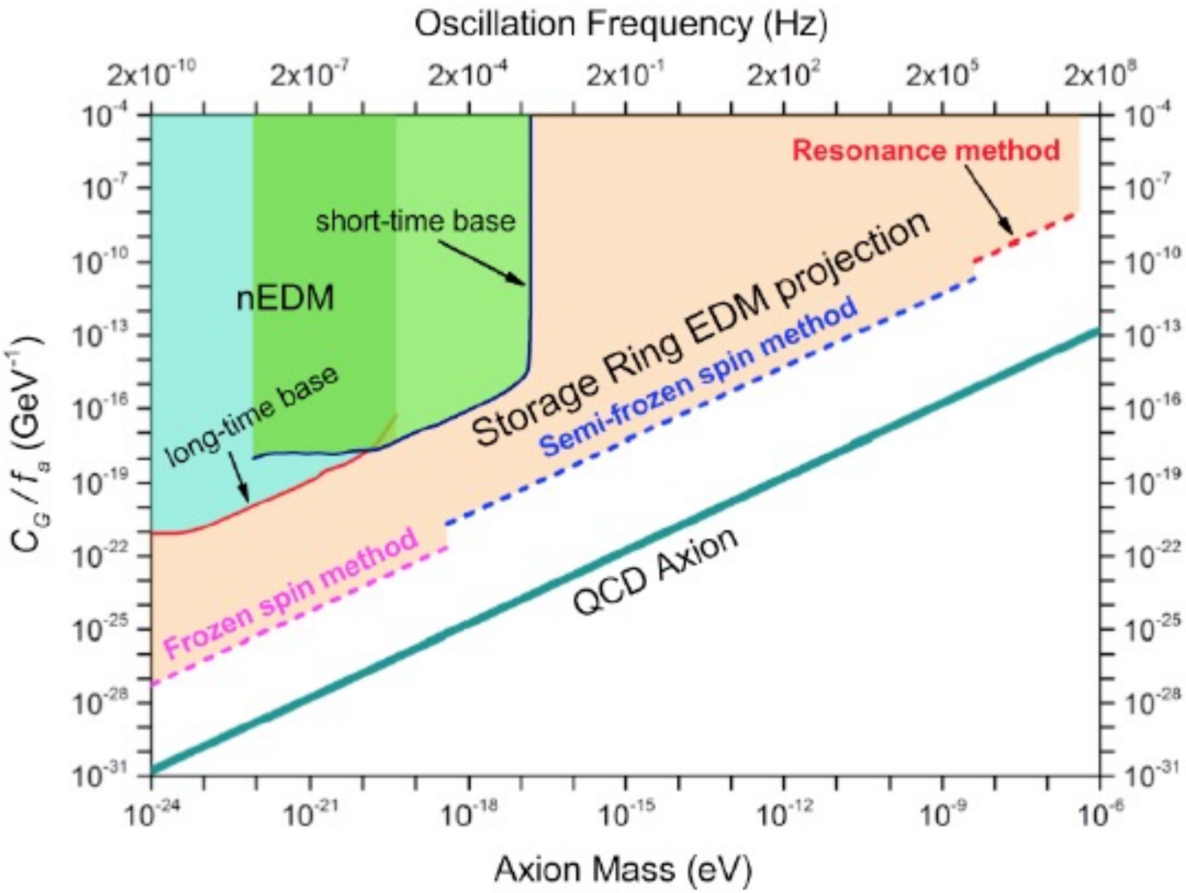


$$\vec{d} = \eta \frac{q\hbar}{2mc}\vec{S}$$

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

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

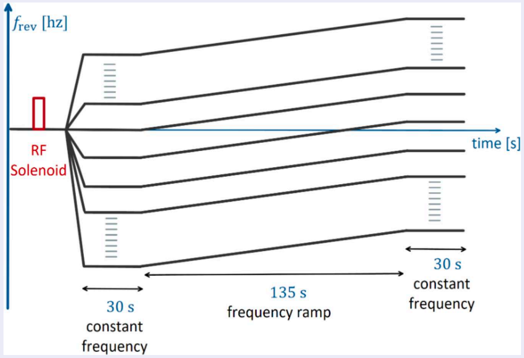
Oscillating EDM and sensitivity to axions

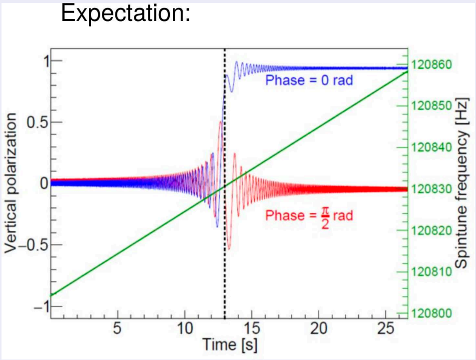


[S. P. Chang et al. Phys. Rev. D 99, 083002]

Oscillating EDM and sensitivity to axions

Momentum ramps (f_{rev}) searching for polarization changes



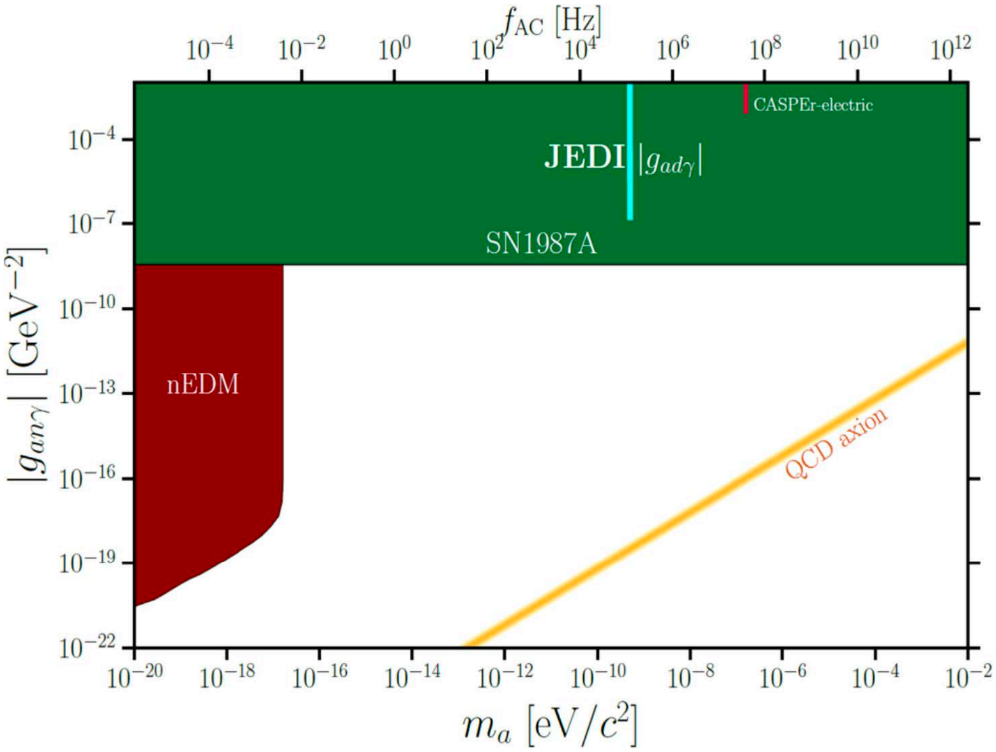


- Organization of frequency ramps.
- Jump of vertical polarization when resonance is crossed, for $\omega_a = \omega_s$

Observed oscillation amplitudes from 4 bunches

- 90 % CL upper limit on the ALPs induced oscillating EDM
- Average of individual measured points $d_{AC} < 6.4 \times 10^{-23}$ e cm

Oscillating EDM and sensitivity to axions



Coupling of ALP to deuteron EDM

- Obtained limit of $g_{ad} < 1.7 \times 10^{-7}$ GeV^2 during few days of data taking
- Accepted for publication on Phys. Rev. X

The long-term plan

On the basis of the preparedness of the required technological developments

Stage 1

precursor experiment

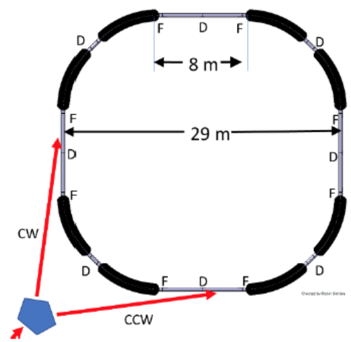
at COSY (FZ Jülich)

- magnetic storage ring

now

Stage 2

prototype ring

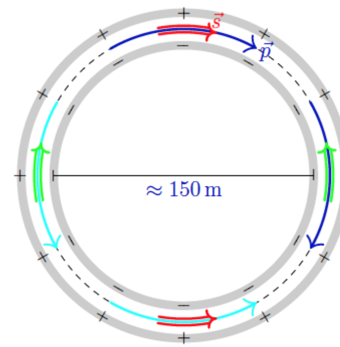


- electrostatic storage ring
- simultaneous ↻ and ↺ beams

5 years

Stage 3

dedicated storage ring



- magic momentum

(701 MeV/c)

10 years

$\sigma_{EDM}/(e \cdot \mathrm{cm})$

10^{-17} 10^{-18} 10^{-19} 10^{-20} 10^{-21} 10^{-22} 10^{-23} 10^{-24} 10^{-25} 10^{-26} 10^{-27} 10^{-28} 10^{-29}

Project stages and time frame

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

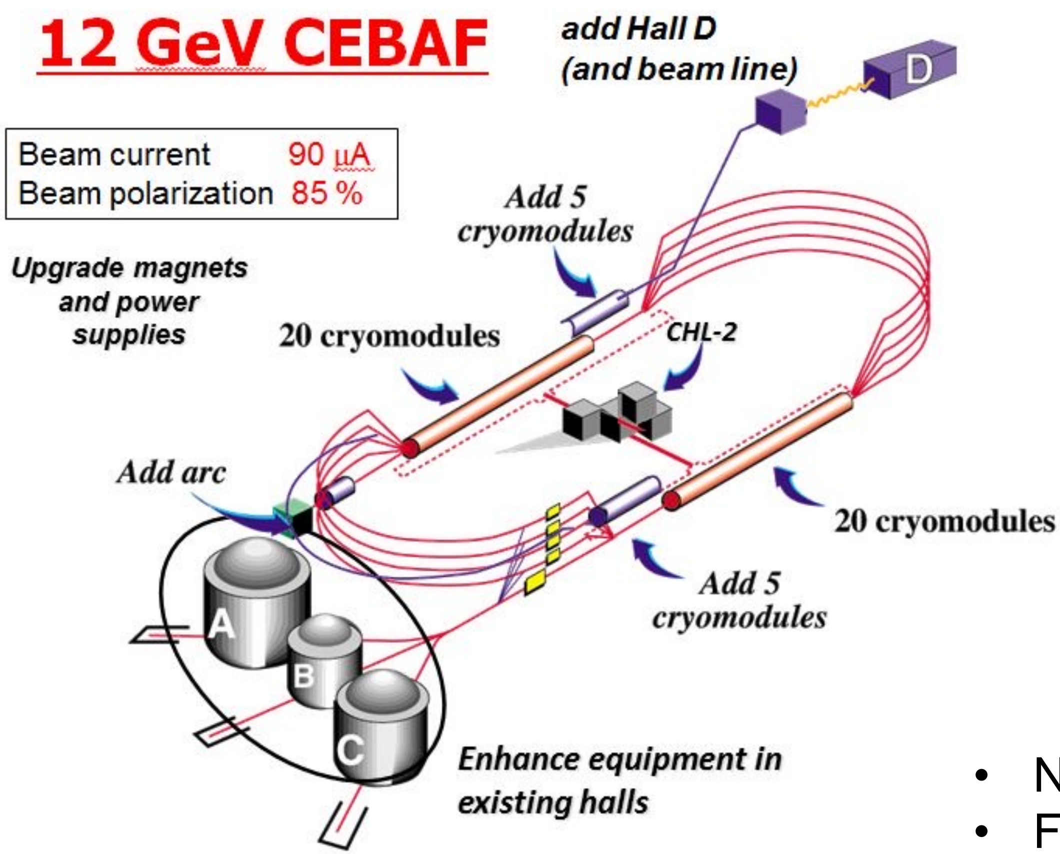
- Nucleon structure and spin physics
- Transverse momentum phenomena (TMDs) & 3D imaging
- GPDs & EM Form Factors of the nucleon

M. Contalbrigo elected Chair of the JLab User Organization (1600 users from US and all over the World)

M. Contalbrigo PI of the CLAS12 RICH detector

M. Contalbrigo contact person for RGH group of experiment with transversely polarized target

The Jlab accelerator facility

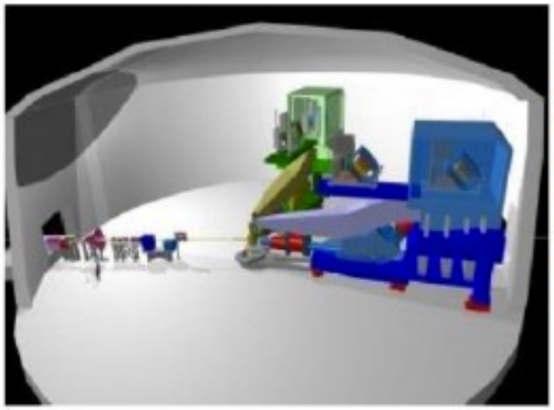


- **Up to 12 GeV highly polarized electron beam**
- **4 experimental halls** with complementary physics programs

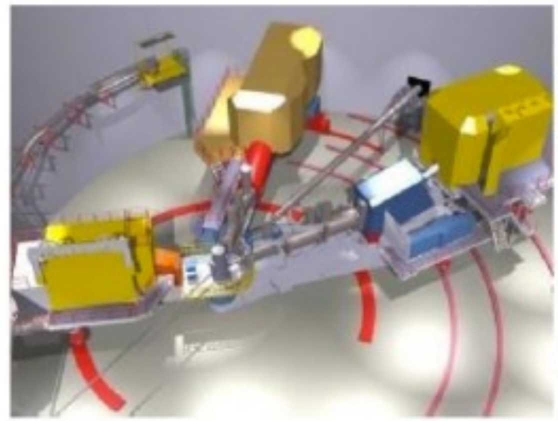
- Nucleon structure and spin physics
- Form Factors of the nucleon
- Hadron spectroscopy
- Dark matter searches
- …

The four Jlab experimetal halls

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



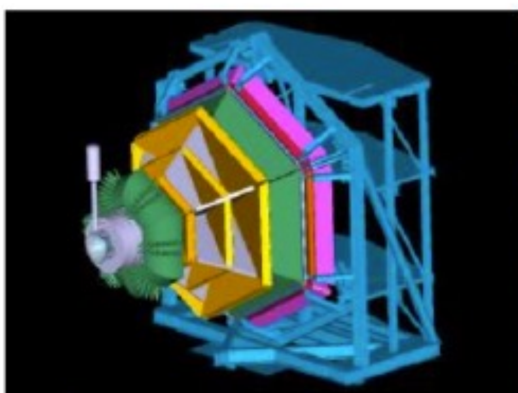
short range correlations, fattori di forma e nuovi esperimenti : SOLID, MOELLER, SBS



Hall C – Super High Momentum Spectrometer (SHMS)

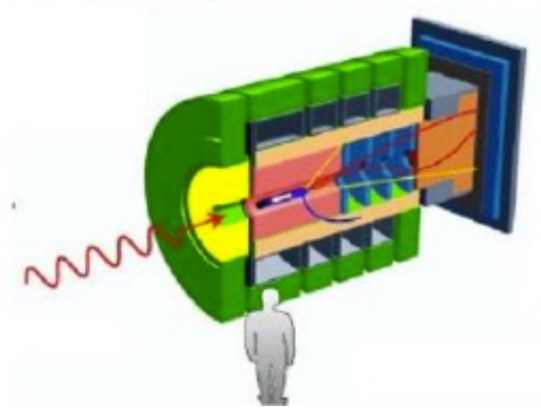
Determinazione precisa delle proprietà dei q di valenza nei nucleoni e nei nuclei

Hall D – Rivelatore GLUEx per esperimenti di fotoproduzione



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

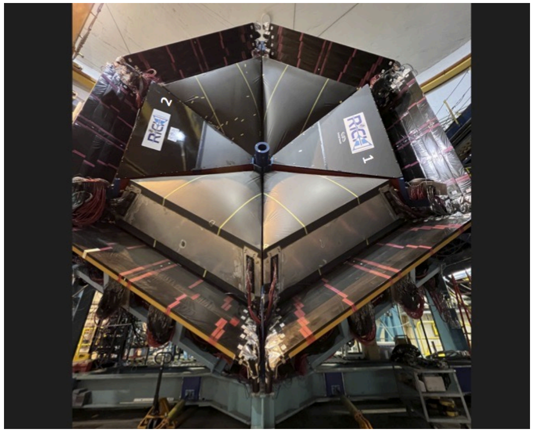
Comprensione della struttura del nucleone via GPDs and TMDs e spettroscopia adronica



Le origini del confinamento attraverso lo studio dei mesoni ibridi

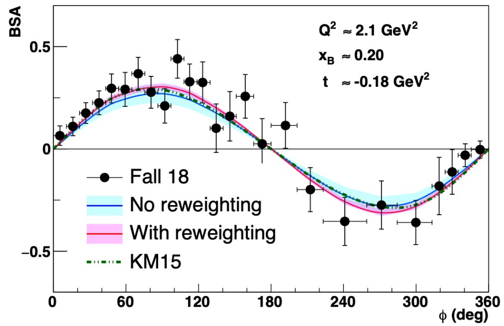
Some selected highlights

Hall-B: RICH installation completed
First run with a polarized target
Hall-A: Fully operational SBS spectrometer



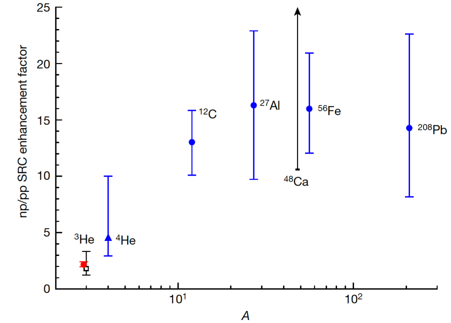
CLAS12: PRL 130 (2023) 21, 211902
First CLAS12 Measurement of DVCS Beam-Spin Asymmetries in the Extended Valence Region

The first CLAS12 measurement of the DVCS beam-spin asymmetry off unpolarized proton targets, greatly extends the x and Q^2 phase space beyond the existing data in the valence region with unprecedented statistical precision.



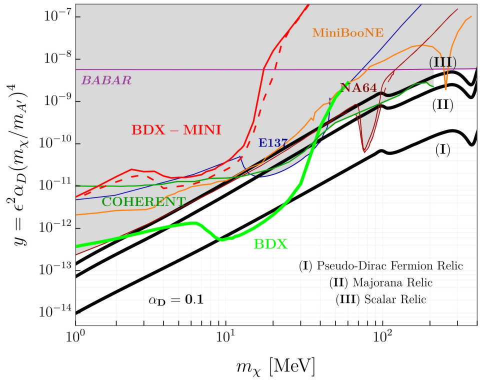
Hall-A: Nature 609 (2022) 41-46
Revealing short-range structure of the mirror nuclei ^3H and ^3He

Hall-A measurement of np/pp short-range corelation ratio in mirror nuclei ^3H and ^3He is an order of magnitude more precise than previous experiments, and finds a marked deviation from the near-total np dominance observed in heavy nuclei.



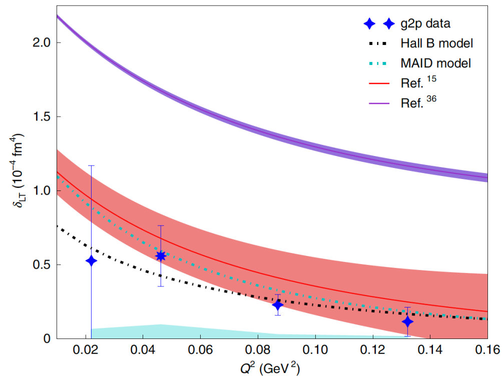
Dark matter: PRD 106 (2022) 072011
Dark matter search with DBX-mini experiment

The BDX-mini pilot experiment probed to be sensitive to the parameter space covered by some of the most sensitive experiments to date, and demonstrates the discovery potential of the next generation beam dump experiment planned at intense electron beam facilities.



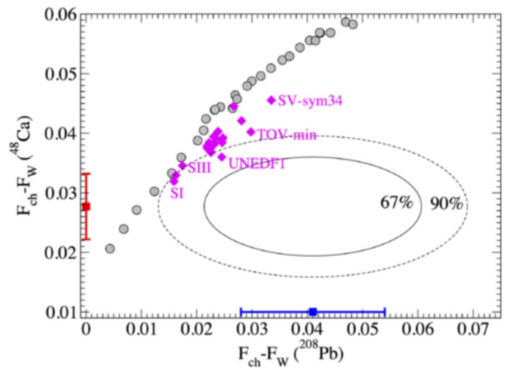
Hall-A: Nature Phys. 18 (2022) 1441-1446
Proton spin structure and generalized polarizabilities in the strong QCD regime

Hall-A measurement of the spin structure function g2 accesses generalized polarizabilities that are fundamental quantities describing the nucleon's response to an external field, and benchmarks the Chiral perturbation theory predictions.



CREX: PRL 129 (2022) 042501
Precise determination of the neutral weak form factor of ^{48}Ca.

CREX has performed a precise determination of the neutron skin thickness of the ^{48}Ca nucleus. Together with the PREX measurement on ^{208}Pb, it provides constraints on the density dependence of the symmetry energy of nuclear matter.



The CLAS12 RICH detector

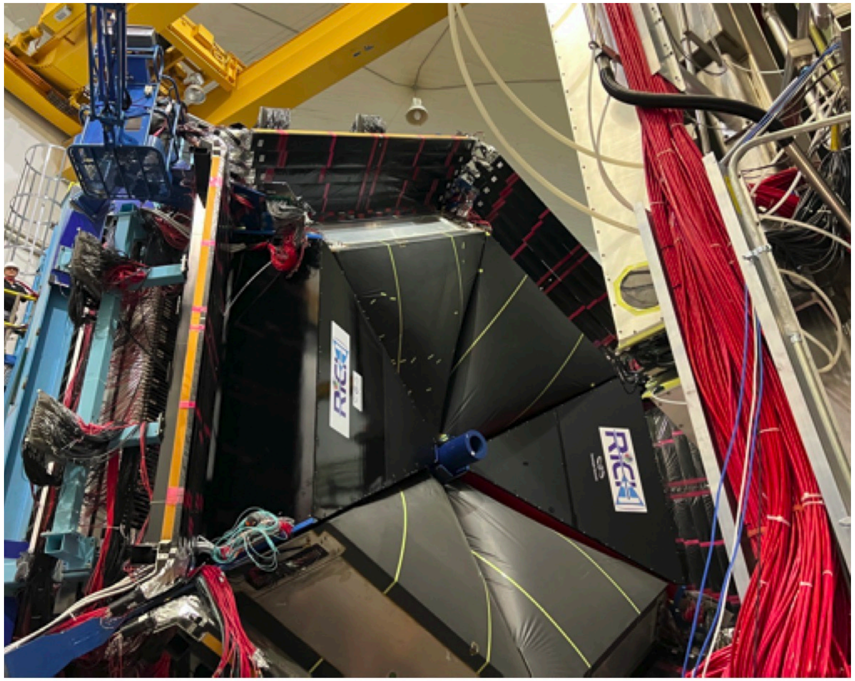
Physics Program	Particle Identification Requirement
Internal nucleon dynamics	Flavour tagging
Quark hadronisation in nuclear medium	Constraining models
Spectroscopy	Rare processes

RICH goal:

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

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

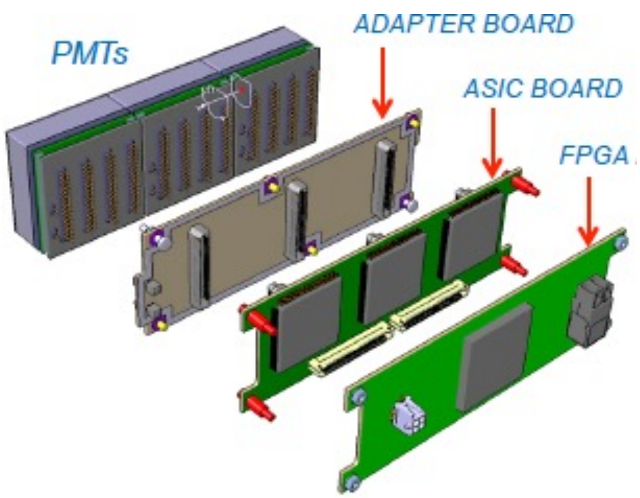
Completed with 2nd module in June 2022



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)

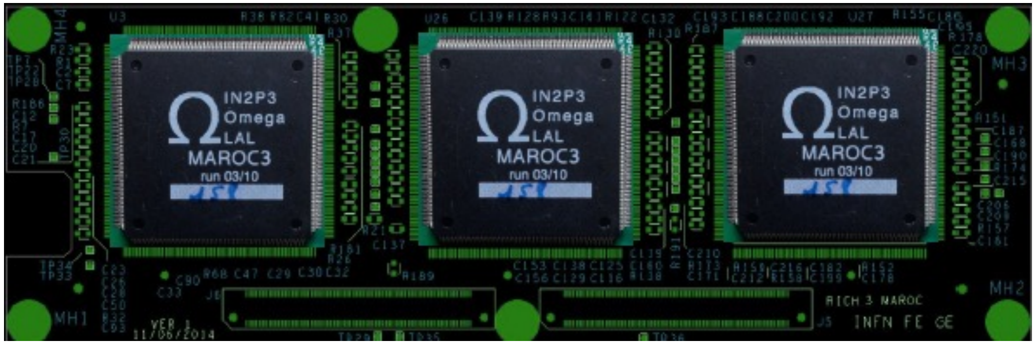
The RICH Front-End electronics

Compact and modular electronics to readout multi-anode PMTs



FPGA Board (JLab)

ASIC Board (Ferrara)



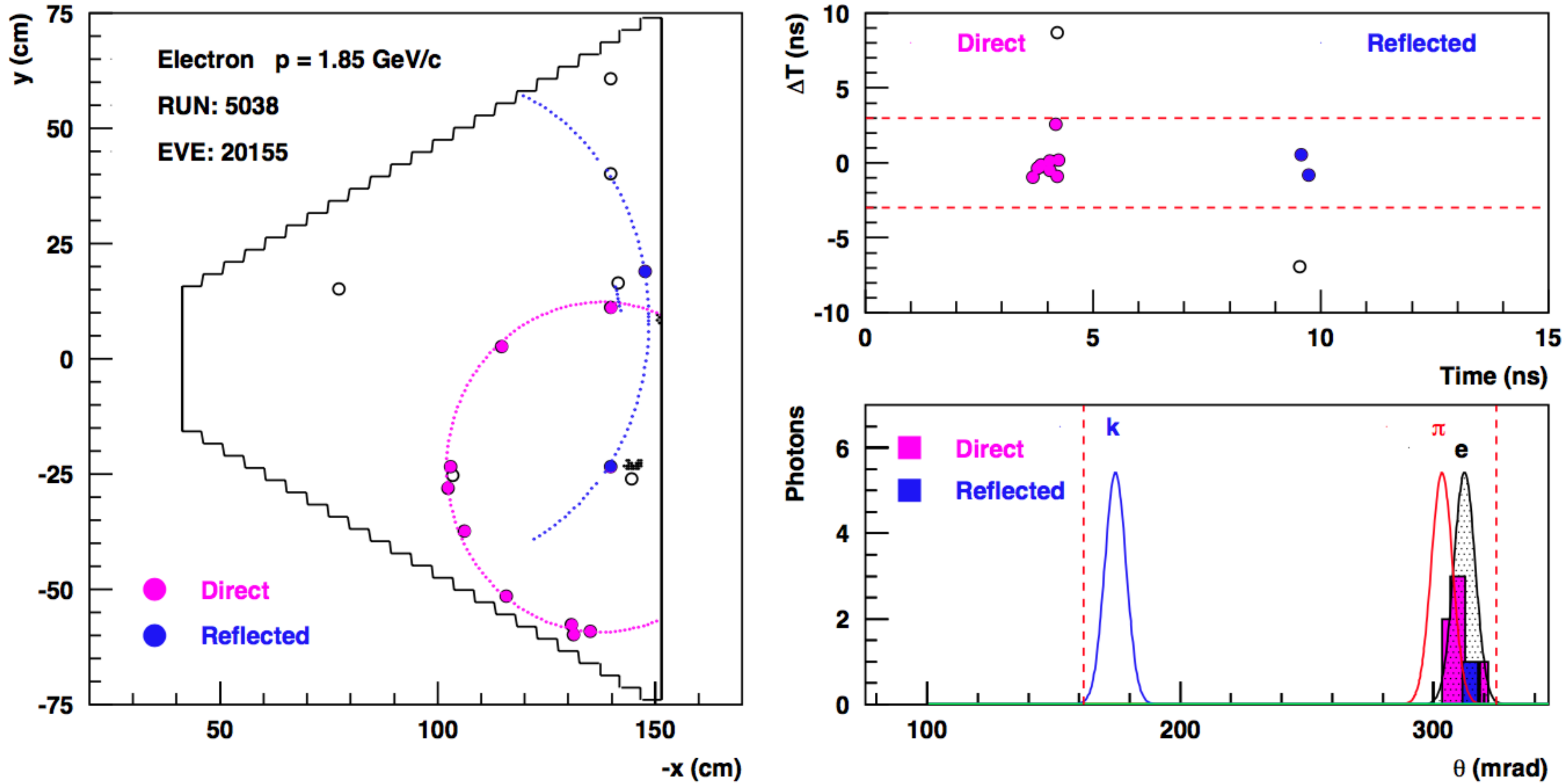
Developed for RICH1 & RICH2 (Roberto M., L Barion)

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

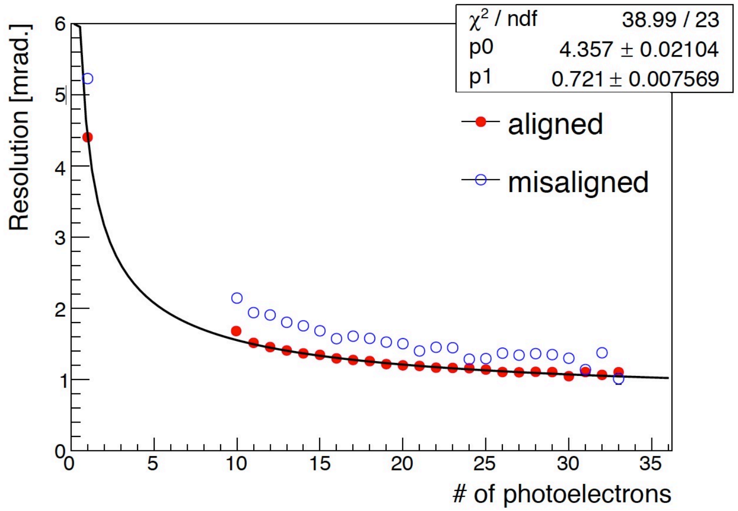
Adapted to different sensors:
Multi-anode PMT H12700, H13700
SiPM array S12642, H13361

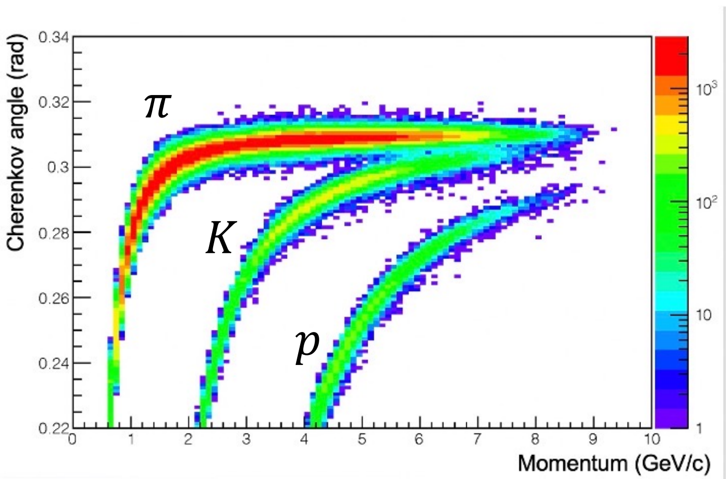
RICH reconstruction

Completed for the CLAS pass-2 data reprocessing (started in spring 2023)
Single-photon pattern recognition based on space and time

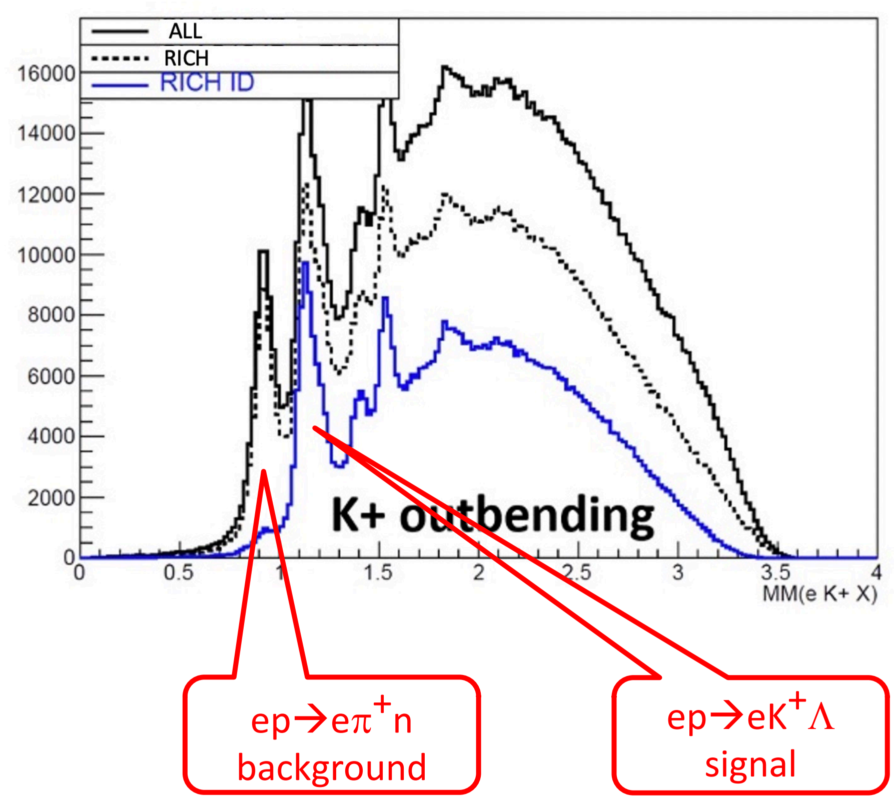


RICH performance





Check with semi-inclusive physics channel ep→eh⁺X



The Transverse target

Internal Target

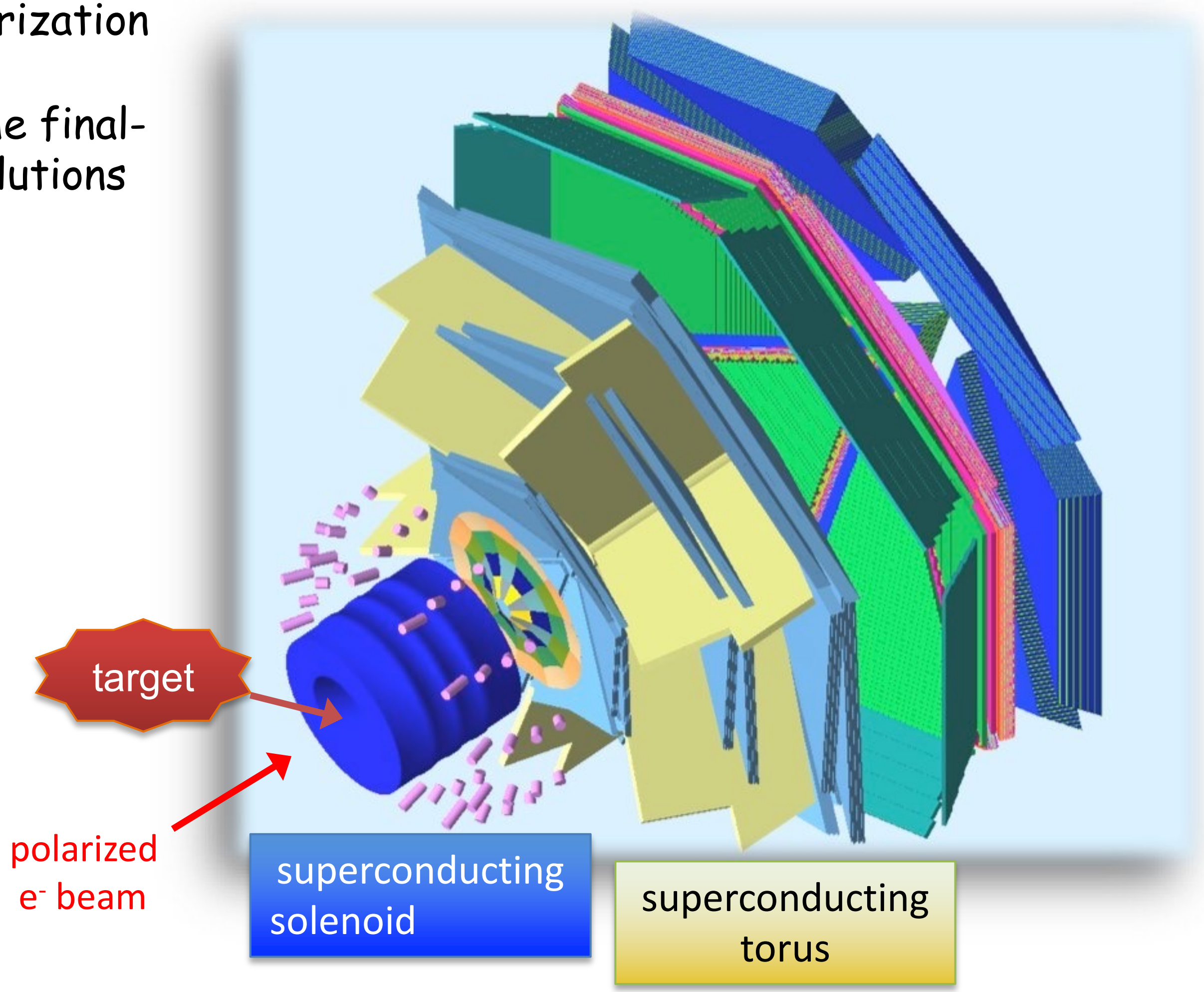
To maintain transverse spin polarization within the CLAS12 solenoid and preserve wide acceptance for the final-state particles, new magnetic solutions are required.

Tracking solenoid

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

Transverse Target:

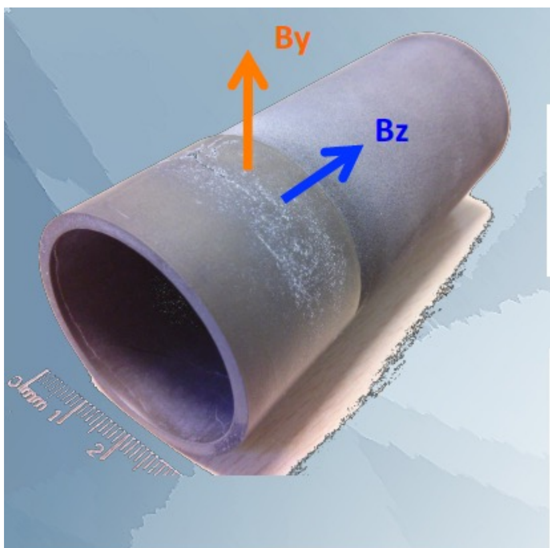
- high polarization
- d 25 mm – Length 25 mm
- transverse field up to 2 T



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!

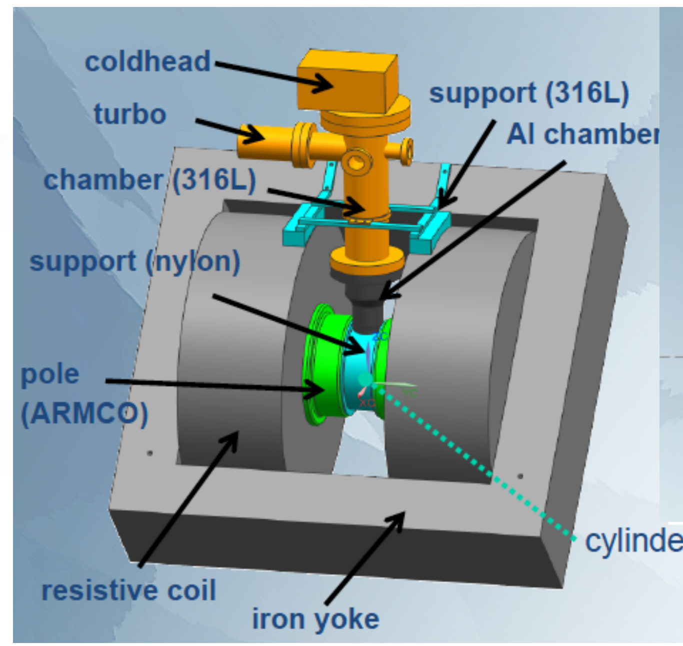
Alternative to the use of a massive 5 T magnet to increase acceptance (for recoil)



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

Bulk cylinder (MgB_2)
- longitudinal shield
- transverse magnetization

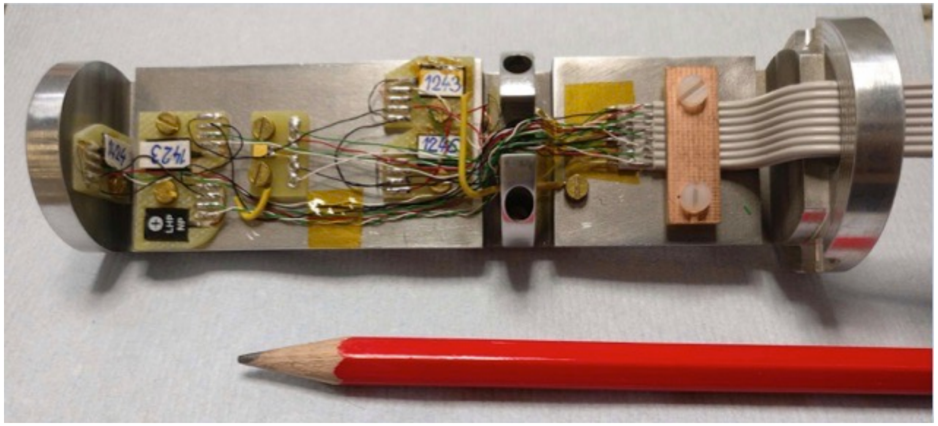
Features
- no current leads
- Cu free
- self tuning
- few mm thickness
- external magnet for magnetization

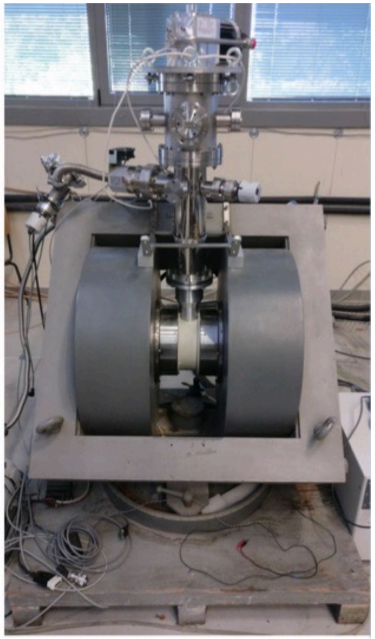


Transverse target: the new cryostat

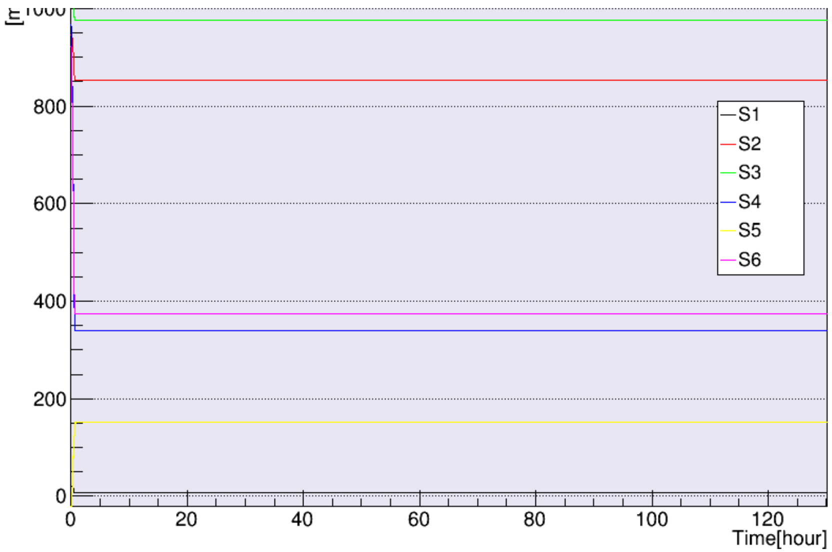
New concept:
pre-conditioned bulk superconductor

- new cryostat
- new holder probe (6x)
- smart MgB2 sample exchange





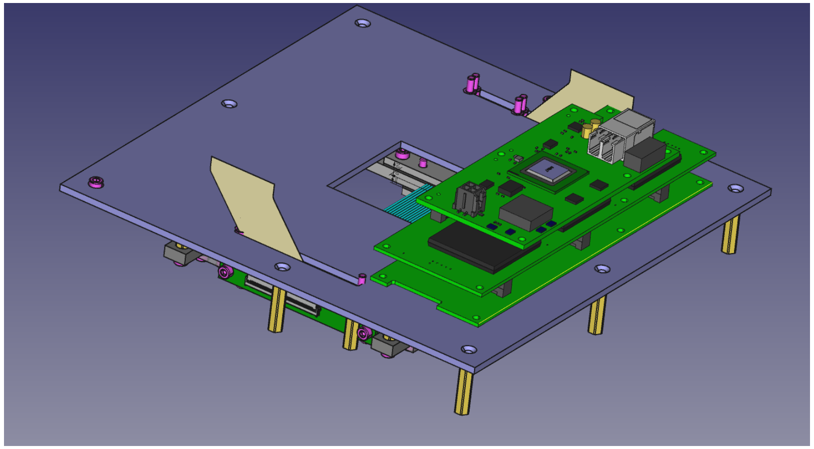
Magnetization @ 1 T

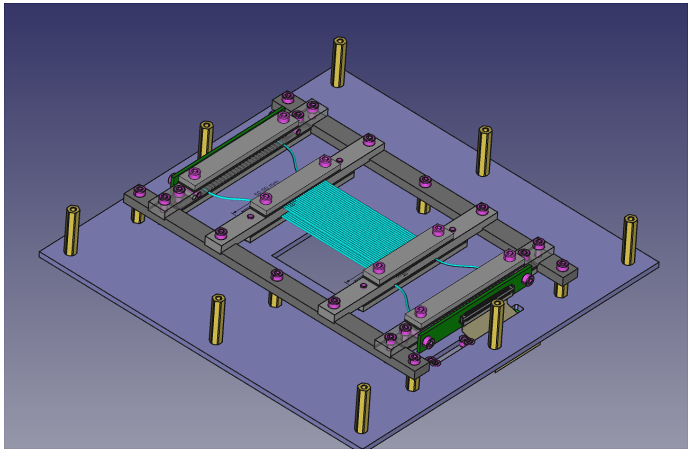


Developed thanks to L. Barion, M. Cavallina

Sintillating Fiber Detector

New potential application of the CLAS12 RICH Electronics reading SiPM





To be used as fast beam particle tracking with RICH prototypes

Potential use as recoil detector for CLAS12 – RGH (transversely polarized targets)

Developed thanks to L. Barion, M. Roberto, M. Cavallina

μ-Rwell @ CLAS12

Substitute first tracking chamber layer to increase the luminosity (x 2)
Develop a recoil detector for RGH- experiments with transversely polarized target

μ-Rwell technology features compactness, easy assembling, easy powering, instrinsic spark quenching
is new, only small prototypes have been tested → require extensive R&D

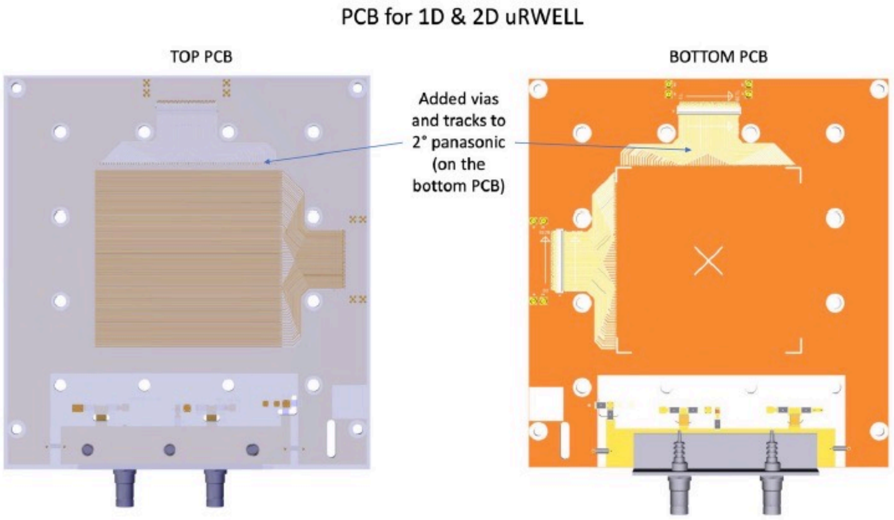
@INFN: RM2 and G. Bencivenni
with support from other groups

2022: 10x10 cm^2 prototype readout
Compare 780 μm vs 300 μm pitch

2023: 50x50 cm^2 prototype

Study charge collection, time and spatial resolution

Requirements: $\sigma_s \sim 100\ \mu m$
$\Delta t \sim 10$ ns
Eff > 95%



Mechanical stability study thanks to M. Melchiorri

Il gruppo di Ferrara @ JLab

Responsabilita':

- M. C.: responsabile locale e nazionale di JLab12
- M. C. : chair of the Jlab User Organization
- M. C.: contact person for the RGH experiments with transversely polarized target
- M. C. responsabile progetto RICH
- M. C. & L.P. Co-spokesperson di diverse proposte di esperimento (PAC34,37,38,39)

Contributi principali del gruppo:

- Data analysis
  - Data analysis on kaon SIDIS
- RICH detector
  - Reconstruction and alignment algorithms
- Magneti superconduttori
  - Configurazione magnetica per transverse target
  - Frozen field con magneti a bulk di superconduttore
  - Recoil detector design
- High-luminosity
  - Study micro-Rwell mechanical stability with light structure

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

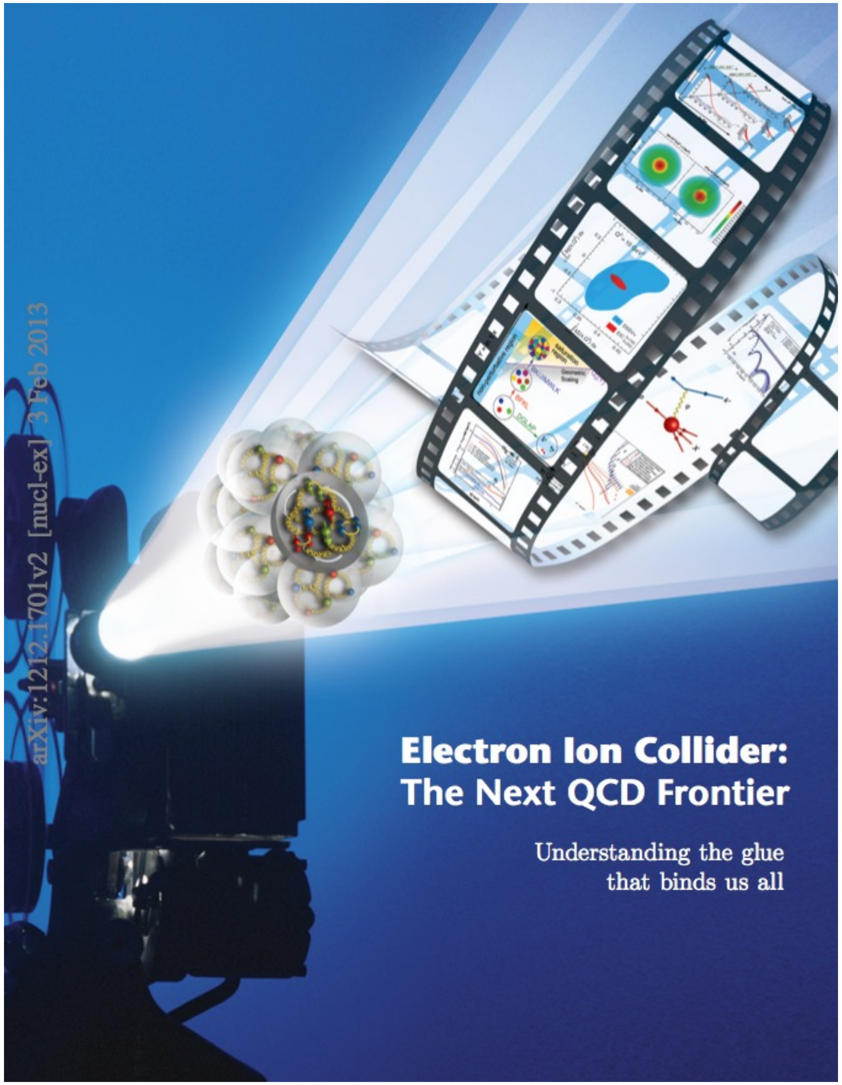
- INFN Network for preliminary studies on the EIC project

dRICH: Dual-radiator RICH for the EIC hadron end-cap (project led by INFN)

M. Contalbrigo is dRICH detector subsystem lead
co-coordinator of the dRICH R&D EIC Program (eRD102)

A. Saputi is Contact Person for dRICH mechanics

EIC_NET



Electron Ion Collider:

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

CD1 approval in June 2021

EPIC Coll. for 1st detector start in fall 2022

Detector subsystems defined in spring 2023

TDR expected at the end of 2024

CD2 & 3 expected in spring 2025
(start of construction)

INFN Ferrara leading the dRICH subsystem

EIC_NET: The dual RICH

Compact cost-effective solution for particle identification in the high-energy endcap at EIC

dRICH

INFN

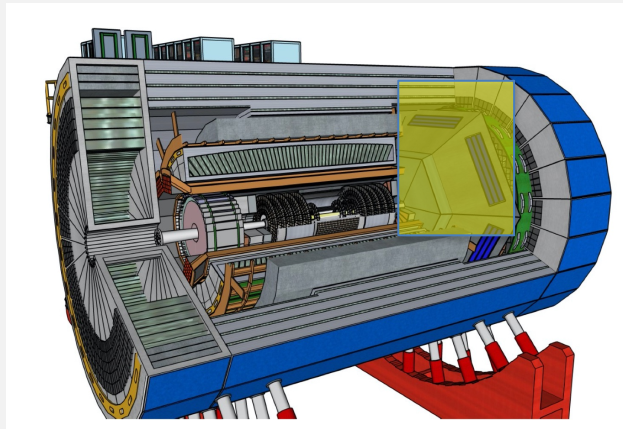
BA, BO, CS, CT, FE , GE, LNF, LNS, RM2, SA, TO, TS

Duke University

NISER

Jefferson Lab

EPIC



EIC RICH Consortium

Brookhaven National Laboratory

Stony Brook University

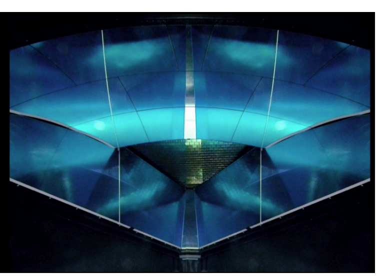
Univerza v Ljubljani

.....

p: 41 GeV, 100 to 275 GeV	p/A beam →	← e beam	**e: 5 GeV to 18 GeV**

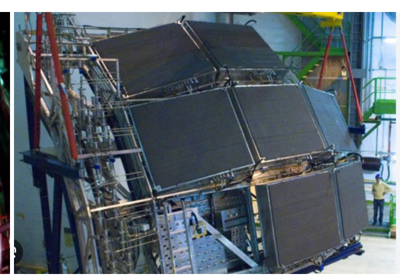
Background Expertise:

CLAS12 RICH

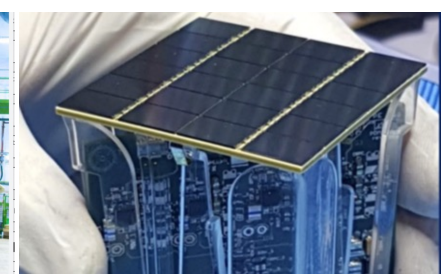


COMPASS RICH

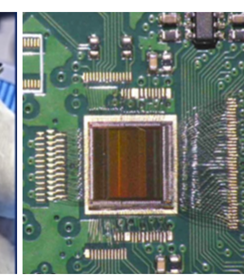
ALICE HMPID



DARKSIDE



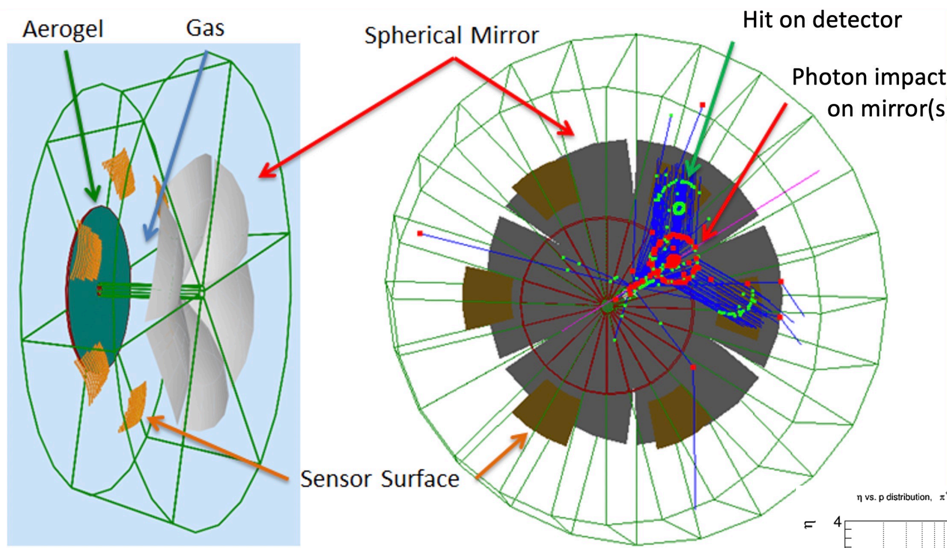
ALCOR

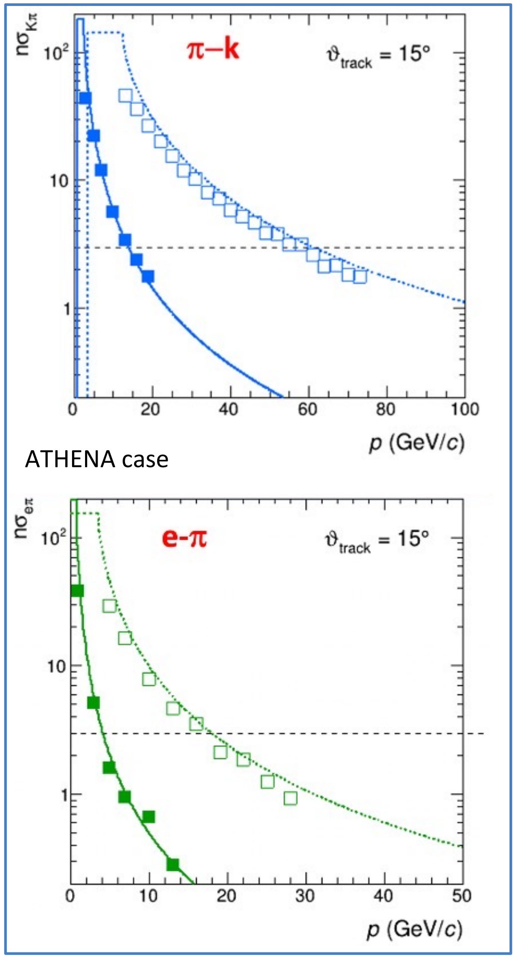


EIC_NET: Baseline Design

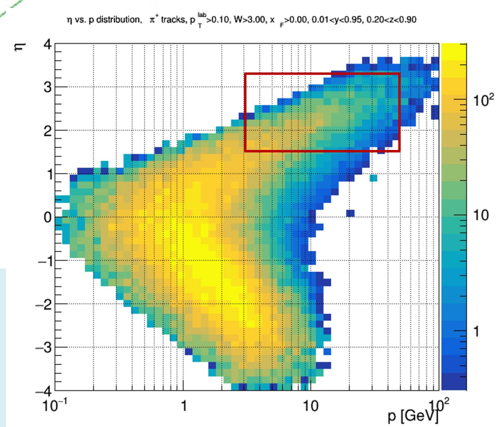
Main features

- **cover wide momentum range 3 - 50 GeV/c**
- **work in high (~ 1T) magnetic field**
- **fit in a quite limited (for a gas RICH) space**





Essential for semi-inclusive physics
due to absence of kinematics constraints at event-level



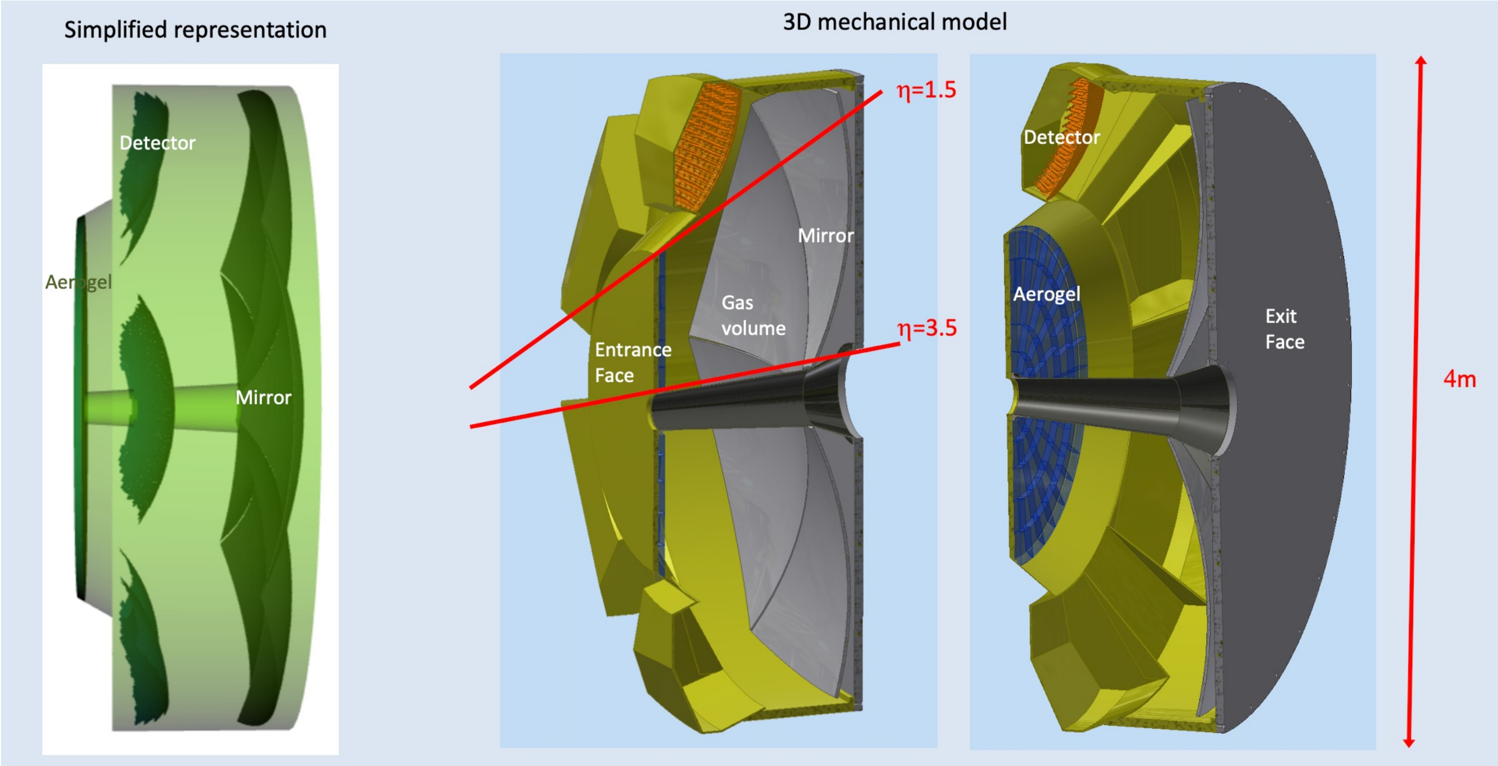
dRICH: cost-effective compact solution

Radiators: Aerogel (n_{AERO}~1.02) + Gas (n_{C2F6} ~ 1.0008)

Detector: 0.5 m^2/sector, 3x3 mm^2 pixel → SiPM option

EIC_NET: Mechanics

Design thanks to A. Saputi, L. Barion

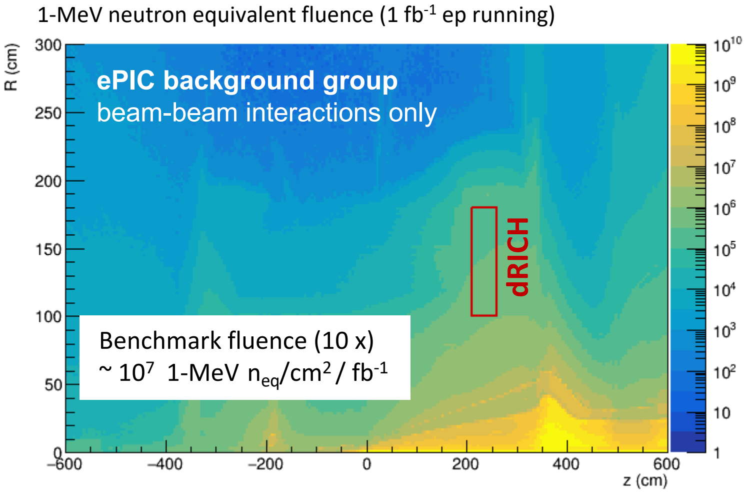


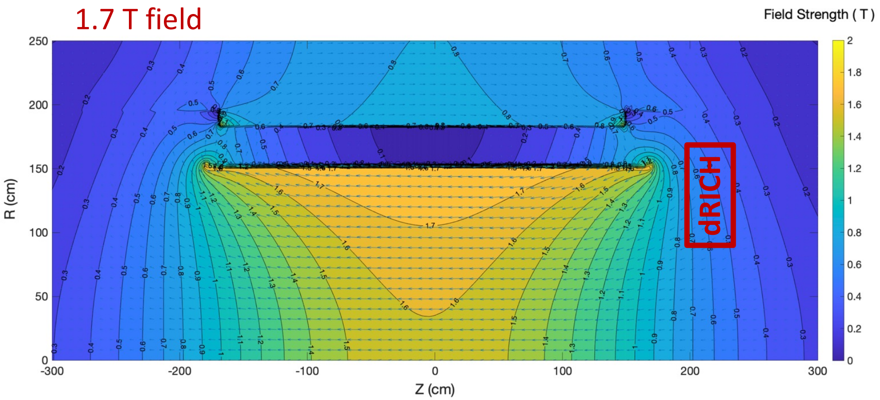
Windows: sandwich panel made of two ~1 mm carbon fiber reinforced epoxy skins separated by 30 mm PMI foam or Al honeycomb (~ 1% X_0)

Shells: 3 mm (inner tube) to 8 mm (outer tube) thick carbon fiber epoxy composite (~ 4% X_0)

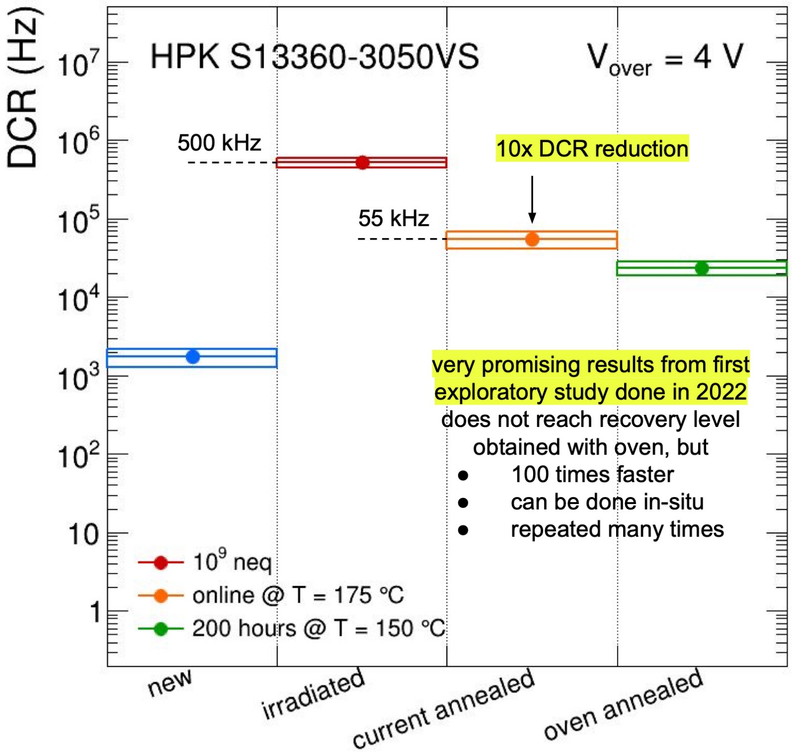
Skins formed with two layers of balanced weave laminate with fibers at 0°/90° and +/- 45° for uniform stiffness

EIC_NET: SiPM





R. Preghenella, NIIMA 1046 (2023) 167661



Strong and not-uniform magnetic field

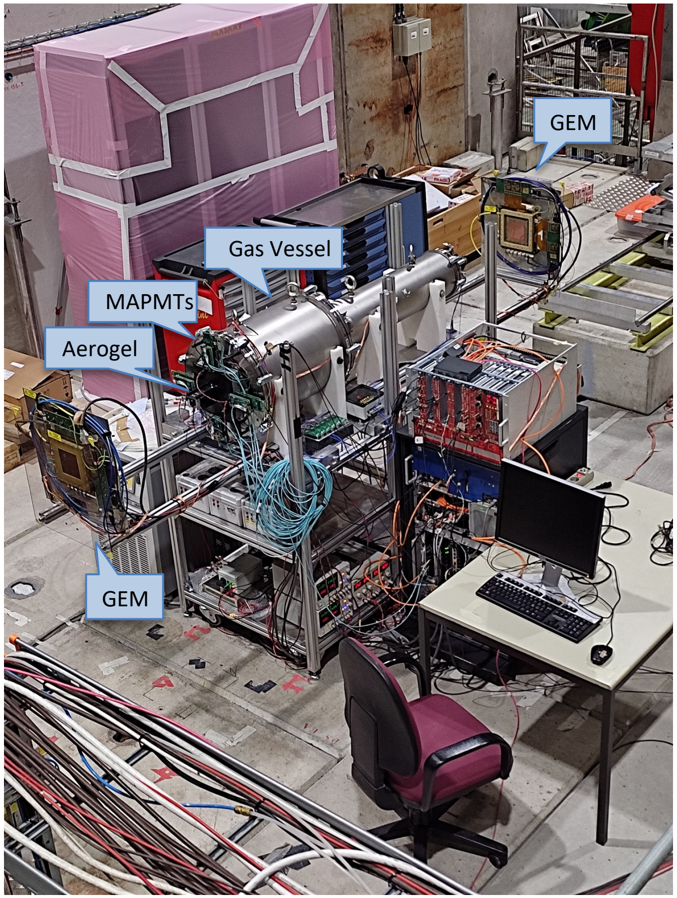
Moderate radiation levels (up tp 10^{11} n_{eq}/cm^2)

Usage of SiPM with

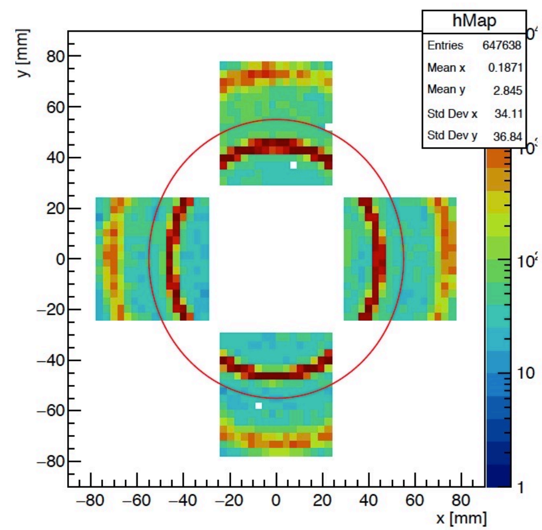
- low temperature working point
- periodic annealing at high temperature (in-site by Joule effect)

EIC_NET: dRICH Prototype

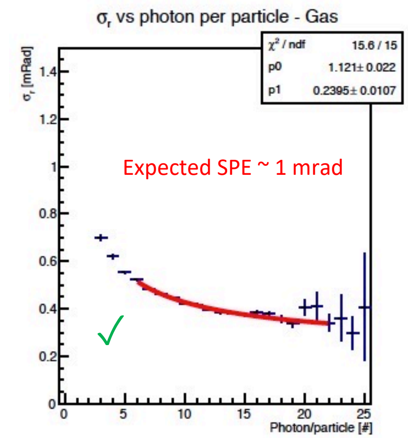
Operative prototype commissioned. Double ring imaging achieved. Performance in line with expectations except for aerogel single-photon angular resolution (worse by a factor ~ 1.5)

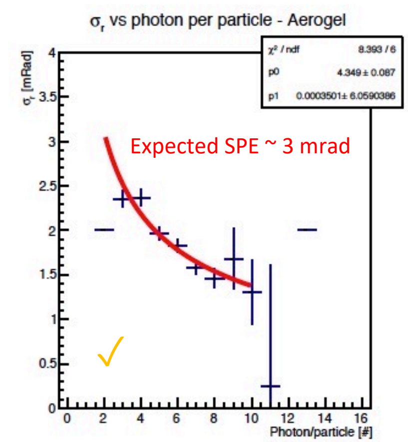


Reference readout from CLAS12 RICH:
H13700 MA-PMTs + ALCOR3 ToT chip



Gas ring coverage: 60%
Aerogel ring coverage: 40 %





Optics at variance with respect EIC

Realization thanks to L. Barion, M. Cavallina, R. Malaguti

EIC_NET: dRICH Prototype

EIC_NET: dRICH Prototype Highlight

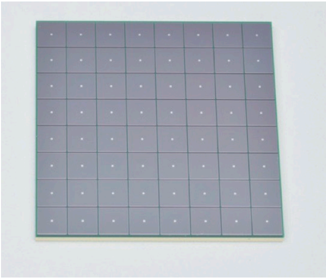
Realization of a suitable detector plane for the dRICH prototype (23/10): Design ready, procurement aligned to 2023 test-beam campaign.

Hamamatsu S13361-3050

✓

8x8 array
50 μm cell
Excellent fill factor
Best DCR

S14160 alternative

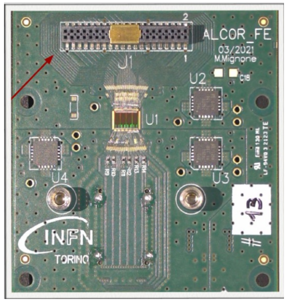


MPPC arrays selected with irradiation campaign

Front-end re-design completed

ALCOR v2 (bwetter dynamic range and rate)
ToT architecture, streaming mode ready
- 50 ps time bin
- 500 kHz rate per channel
- cryogenic compatible

ALCOR chip



✓

Multi-wafer run done

Version2:
32 channels
Extended dynamic range
Improved digital time

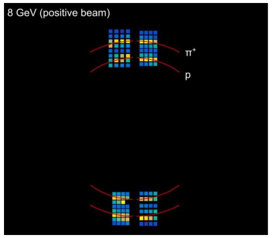
Integrated Cooling/ In-situ annealing

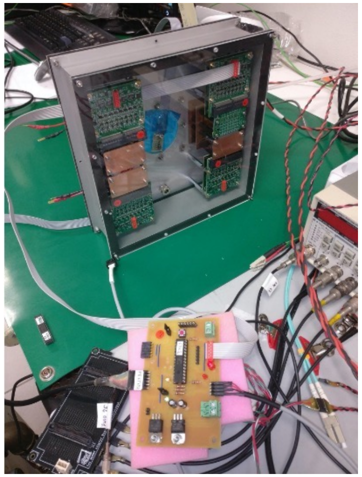
✓

Cooling plate

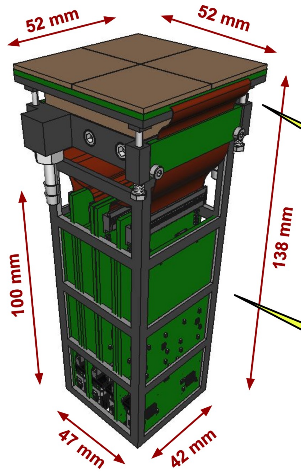
Peltier cells

Annealing circuitry

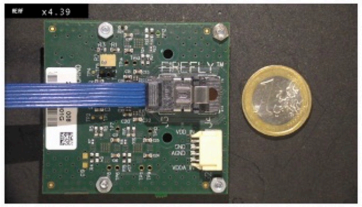




New EIC-driven readout unit



Streaming readout



✓

2023:
1 RDO per chip

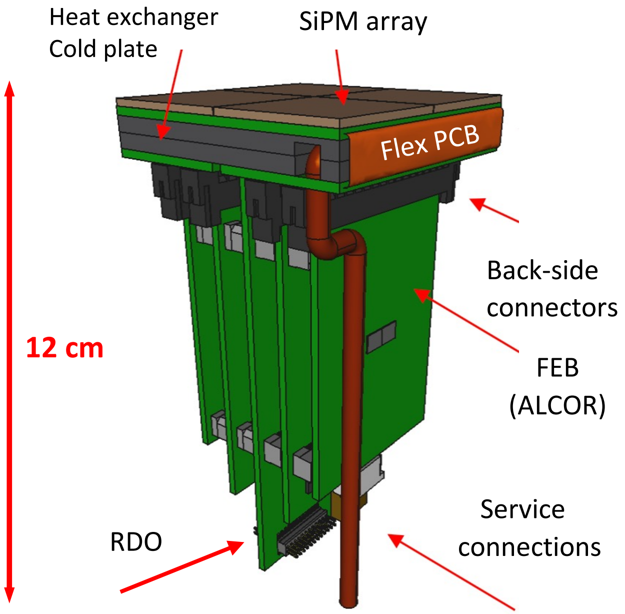
2024:
1 RDO per PDU

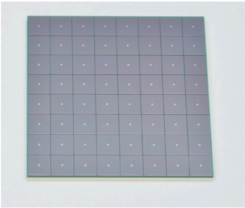
Development
Kit KC705

Realization thanks to L. Barion, M. Cavallina, R. Malaguti

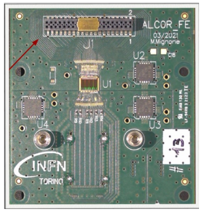
EIC_NET: Photo-Detector

Active area is shaped to resemble the focal surface and best exploits the focalization.
Electronics is minimized to fit the limited available space.





SiPM array



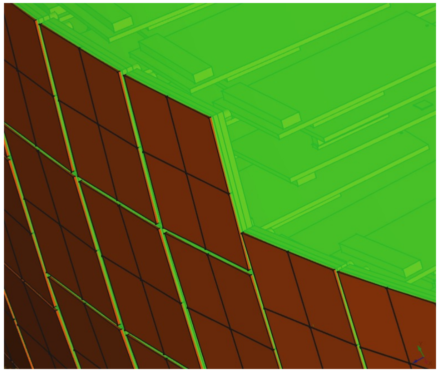
ALCOR chip

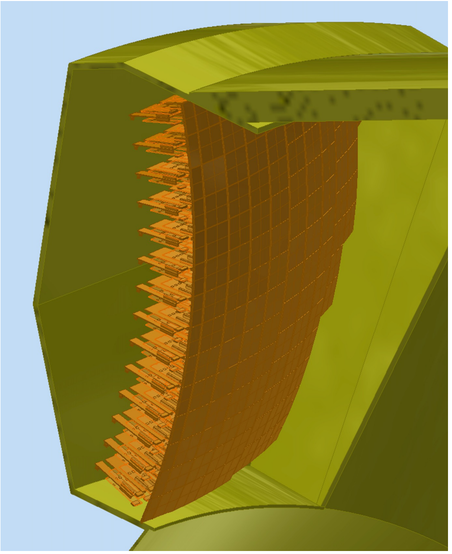
Photon Detector Unit (PDU):

- Compact to minimize space
- 4x Hamamatsu S13361-3050HS SiPM arrays
- 4x Front-End Boards (FEB)
- 4x ALCOR chip (ToT discrimination)
- 1x Read-Out Board (RDO)
- 1x Cooling plate (< -30 C)

Detector box:

- Shaped to fit the space
- Quartz window
- Cooling for sensors and electronics
- Power distributing patch panel
- Heat insulation





Design thanks to L. Barion, A. Saputi

EIC_NET: dRICH Prototype Milestones

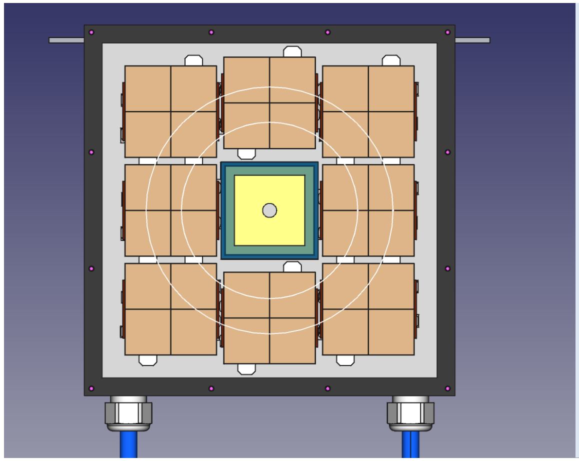
2023: EIC-driven detector plane

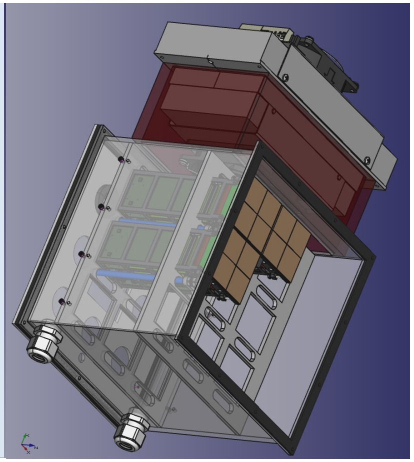
✓ Initial characterization of realistic aerogel and mirror components (23/04);

✓ Projected performance of the baseline detector as integrated into EPIC (23/06);

✓ Assessment of the dRICH prototype performance with the EIC-driven detection plane (23/10).

Test beam planned in August and October 2023





2024: Real-scale prototype for TDR (1 sector)

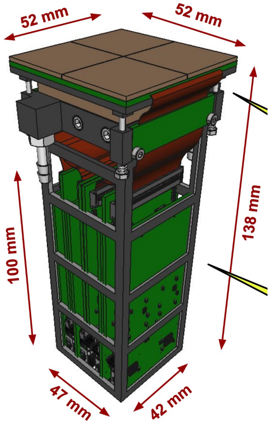
Mechanical structure

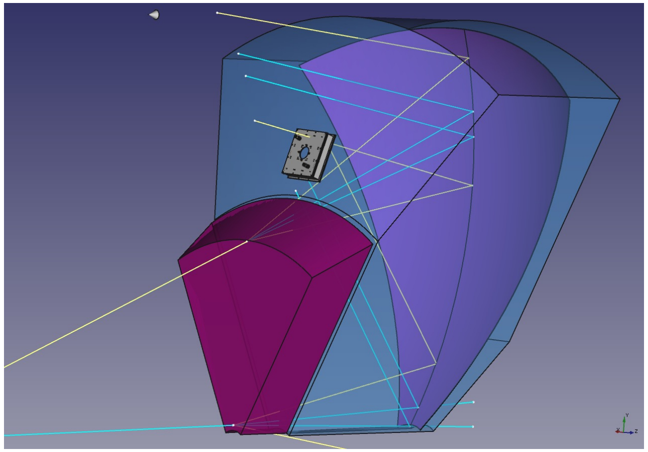
Realistic optics (off-axis)

ALCOR64 FEB + RDO

Aerogel and mirror demonstrator

New EIC-driven readout unit



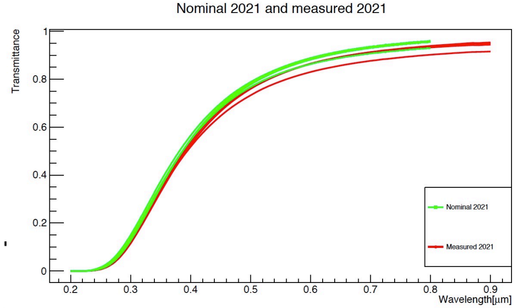


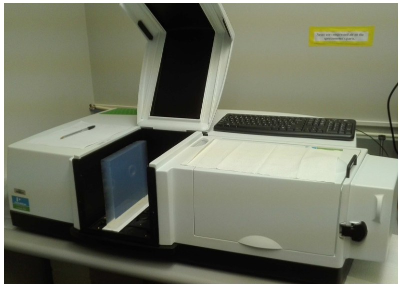
Realization thanks to L. Barion, M. Cavallina, R. Malaguti

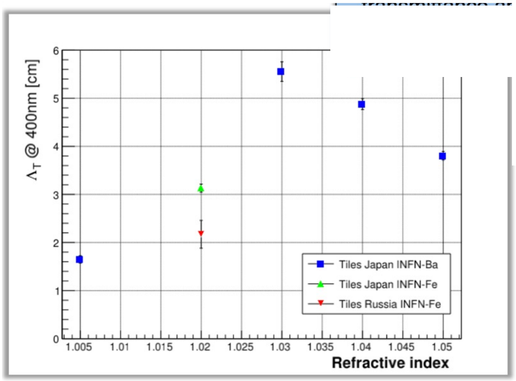
EIC_NET: dRICH Aerogel

Aerogel Factory (BELLE-II)
Initial evaluation & Reproducibility
on small samples in sinergy with ALICE

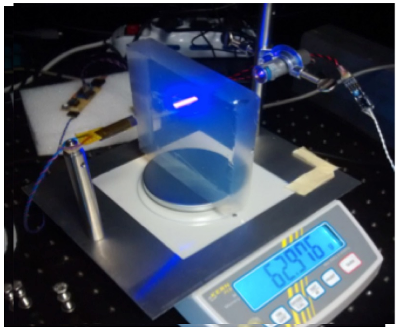
Transmittance & Transflectance



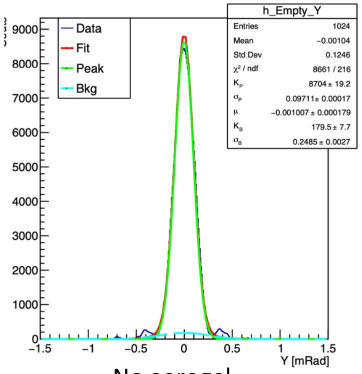




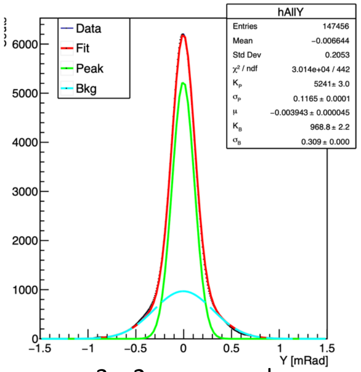
Density & refractive index



Laser spot bradening: Y profile



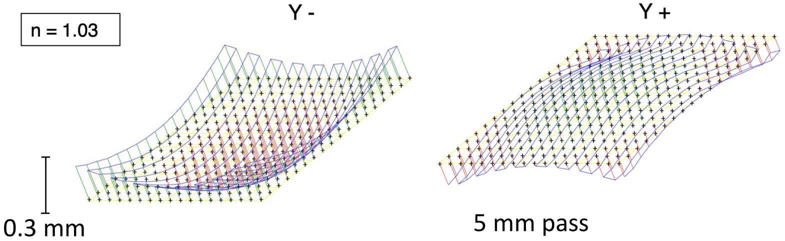
No aerogel



3 x 2 cm aerogel

Touch Probe: planarity and thickness

10x10x2 cm³ tile
(from ALICE)



CLAS12 RICH quality assurance laboratory @ INFN-FE being refurnished

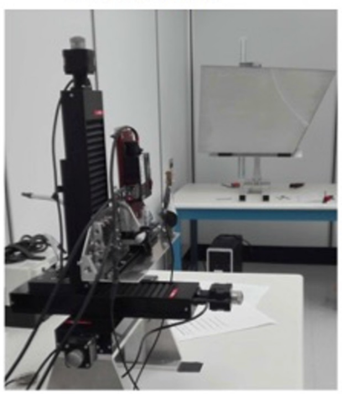
EIC_NET: dRICH Mirror

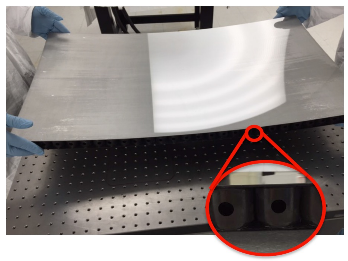
CMA Carbon fiber mirrors (HERMES, AMS, LHCb, CLAS12)

cost-effective light & stiff solution:

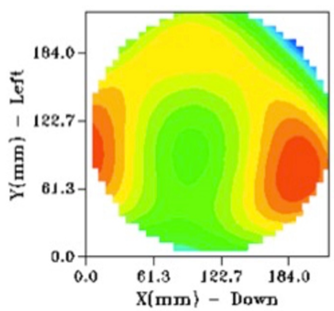
- roughness driven by mandrel 1-2 nm rms
- surface accuracy better than 0.2 mrad
- radius reproducibility better than 1 %

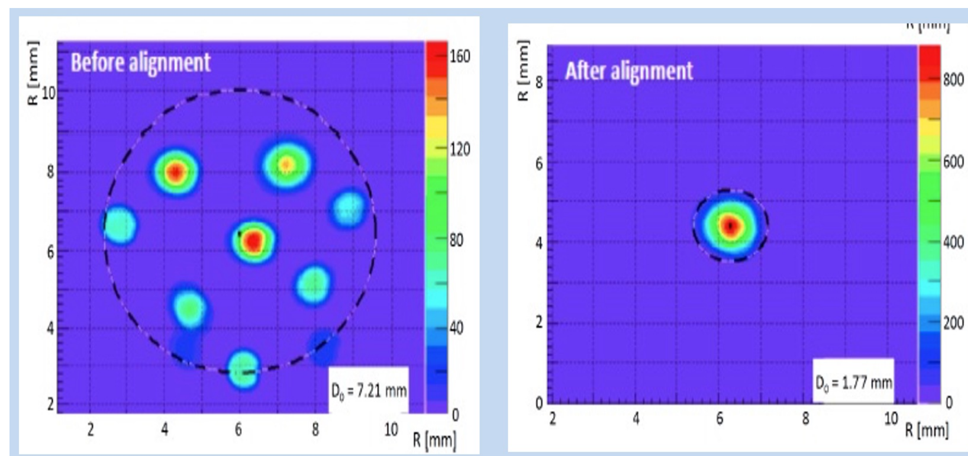
Surface Quality





Shack-Hartmann sensor
Mirror aberrations





CLAS12 RICH quality assurance laboratory @ JLab being refurnished in collaboration with DUKE

EIC_NET: responsabilità

Responsabilita':

- M. C.: responsabile locale EIC_NET
- M. C.: responsabile dRICH
- A. S.: Contact for dRICH mechanics
- M. C.: co-coordinator eRD102
- M. C.: IAC POETIC (Physics Opportunities at EIC) Conference

Contributi principali:

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

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

Anagrafica 2024

Anagrafica e afferenze (Ric. + Tecnol.)

Name	JEDI	JLab12	EIC_NET
G. Ciullo (staff)	50	20	
M. Contalbrigo (staff)		50	50
L. Del Bianco (staff)		90	
P. Lenisa (staff)	70	30	
A. Maragno (dottoranda)	100		
L. Pappalardo (staff)		30	
R. Shankar (assegnista)	100		
F. Spizzo (staff)		80	20
S. Vallarino (dottorando)		100	
Totale/100	**3.2**	**4.0**	**0.7**
Gran Totale	**7.9**		

Servizio meccanico ed elettronico

Name	JEDI	JLab12	EIC_NET
L. Barion		25	75
R. Malaguti		15	30
M. Cavallina			10
F. Evangelisti			40
S. Squerzanti			10
N. Menegatti			20
A. Magnani			10
Totale/100		**0.4**	**1.95**
Gran Totale	**2.05**		

Richieste finanziarie per 2024

Richieste finanziarie (k€) (provvisorie)

Name	JEDI	JLab12	EIC_NET	Dot.3
Missioni	57	45	15	8
Trasp.		5		
Inv.	9			15
Consumi	34.5	15	20	6
Apparati		20		
Altro				3
TOTALE	100.5	85	35	32

Backup

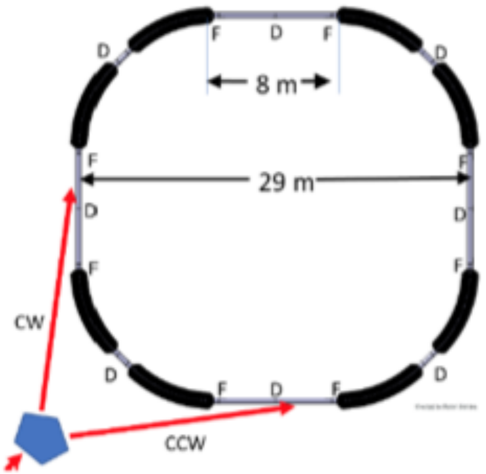
The long-term plan

Build demonstrator for charged particle EDM

- Project prepared by CPEDM working group (CERN+JEDI)
- P.B.C. process (CERN) & European Strategy for Particle Physics Update

100 m circumference

- p at 30 MeV all-electric CW-CCW beams operation
- Frozen spin including additional vertical magnetic fields



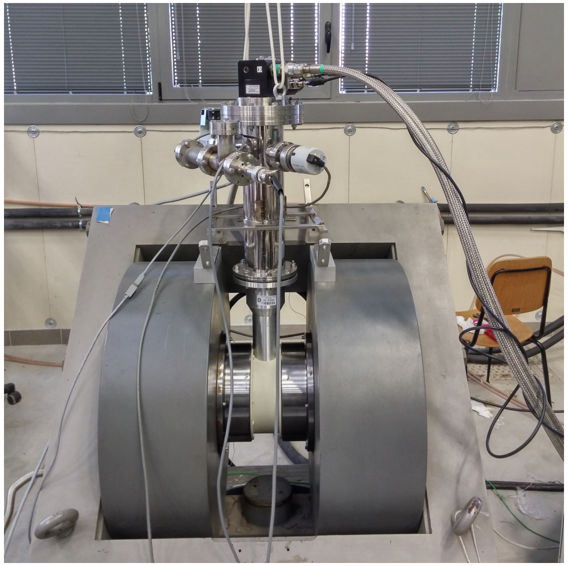
Challenges - open issues

- All electric & E-B combined deflection
- Storage and spin-coher. time in elec. machine
- CW-CCW operation
- Orbit control
- Polarimetry
- Magnetic moment effects
- Stochastic cooling

Primary purpose of PSR

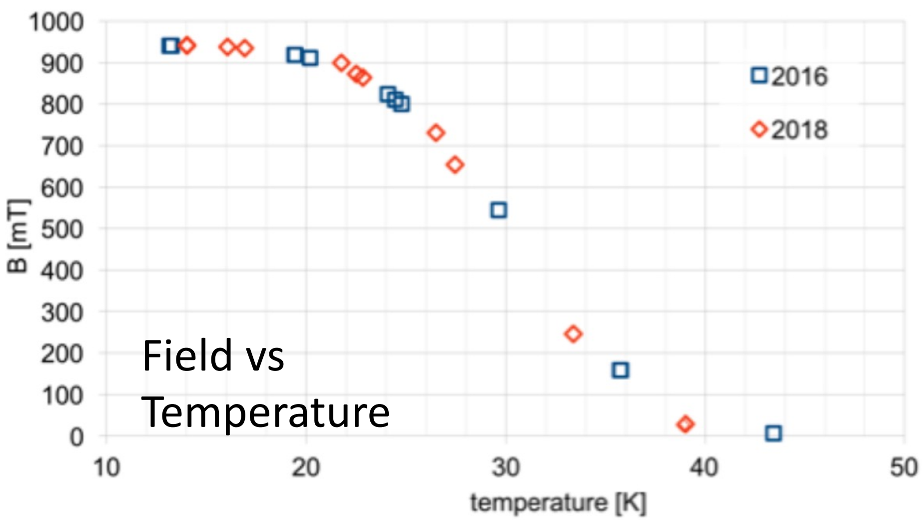
- Study open issues and perform first direct proton EDM measurement.

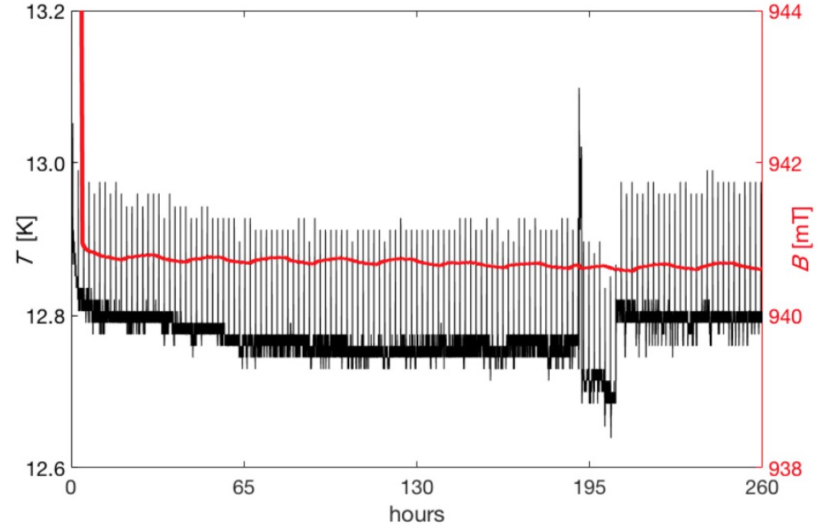
Transverse target: the Ferrara setup



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





Richieste ai Servizi

Servizio Meccanico
FE laboratory: supporto per misure e stazioni di test, preparazione test-beam
JLAB12
TTarget: supporto per test con doppio campo magnetico al LASA di Milano
High-Lumi: simulazioni stabilità meccanica μ-rwell
Recoil: contributo meccanica tracciatore recoil
EIC_NET
dRICH: progettazione meccanica del rivelatore dRICH
dRICH: meccanica del prototipo dRICH

Servizio Elettronico
FE laboratory: supporto per misure e stazioni di test, preparazione test-beam
JLAB12
TTarget: piccoli contributi alle misure con magneti superconduttori
TTarget: contributo per recoil detector (μ-rwell e/o fibre scintillanti)
EIC_NET
dRICH: contributo piano di rivelazione curvo basato su SiPM + ALCOR