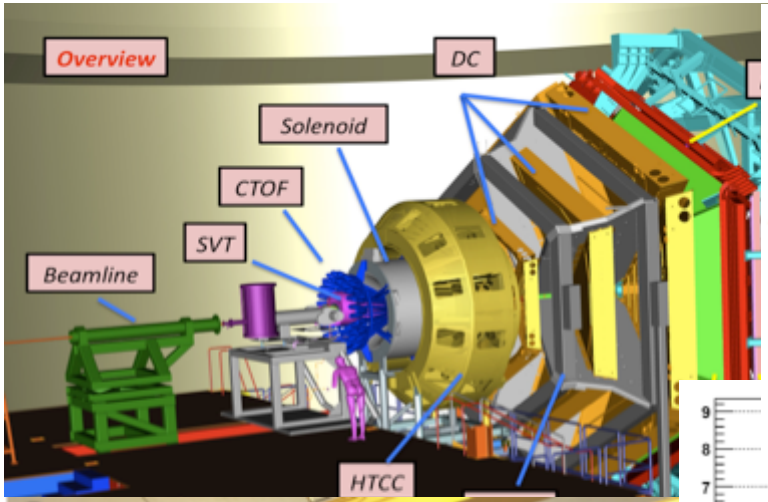
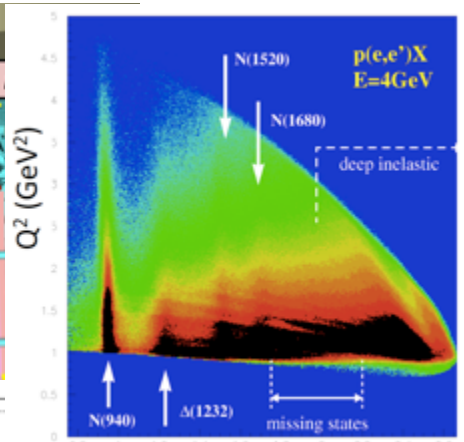
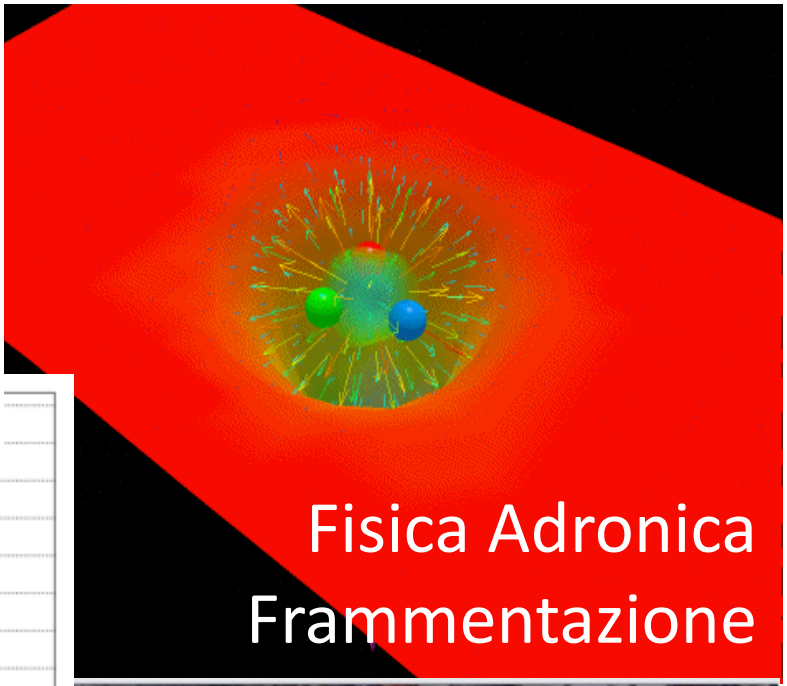
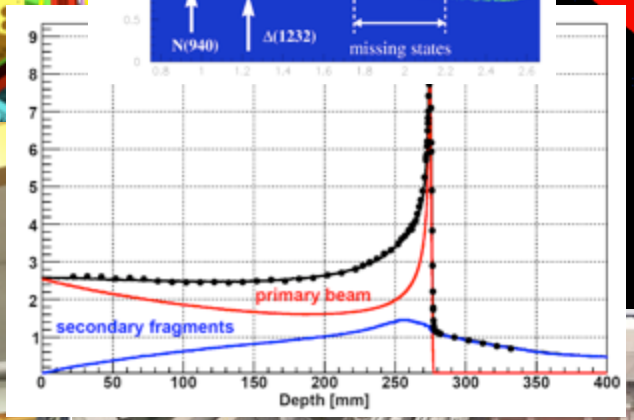
Gruppo III Roma Tor Vergata



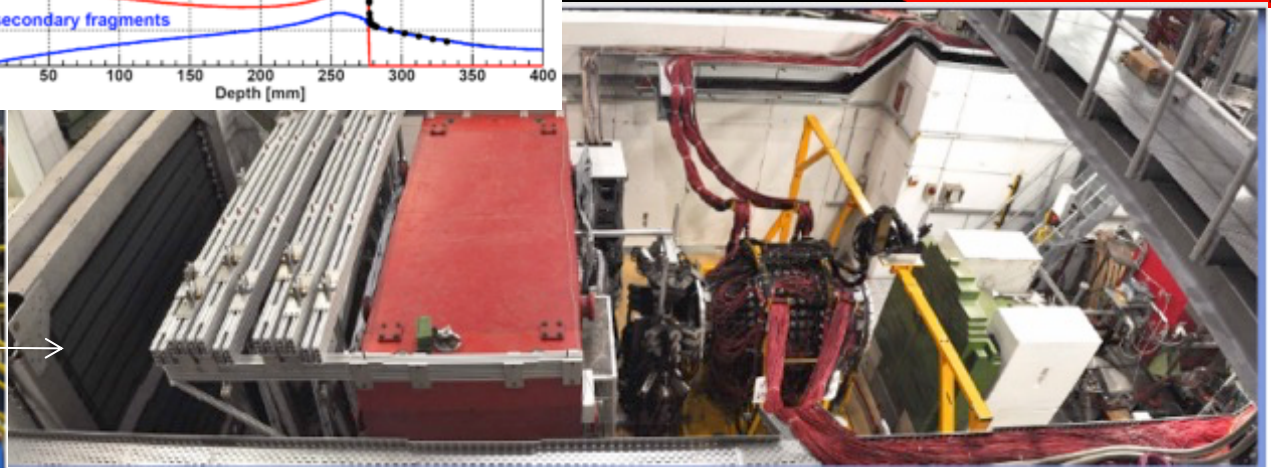




Fisica Adronica
Frammentazione



FOOT
JLAB12
MAMBO
EIC-NET



Anagrafica GIII Roma Tor Vergata - Ricercatori

	Nome	Età	Posizione	Qualifica	Afferenza	EIC_NET_DTZ	FOOT	JLAB12	MAMBO	UE-STRONG_2020	DOT3	CSN I	CSN II	CSN IV	CSN V	P.S.	CCR	Servizi	UE	PON	POR	FIRB	PRIN	ALTRO	PP	TT	C3M	Tot.
1	D'Angelo Annalisa		Inc. Ric.	Prof. Associato		10		80																				90
2	Di Salvo Rachele Anna		Dipendente	Ricercatore		10			90																			100
3	Fantini Alessia		Inc. Ric.	Ricercatore Universitario		20			80																			100
4	Morone Maria Cristina		Inc. Ric.	Prof. Associato			70								30													100
5	Narici Livio		Inc. Ric.	Prof. Associato	CSN II		30						70															100
6	Rizzo Alessandro		Associato	Ricercatore Confermato (Ricercatore)	CSN III			100																				100
7	Romaniuk Marila		Associato	Ricercatore straniero					100																			100
8	Lanza Lucilla		Assegn./Bors.	Assegnista	CSN III	10		90																				100
					FTE Totali	0.5	1	2.7	2.7			Totale: 6.9 FTE																

Percentuale di partecipazione 6.9 FTE / 8 RIC = 86%

Anagrafica GIII Roma Tor Vergata - Tecnici

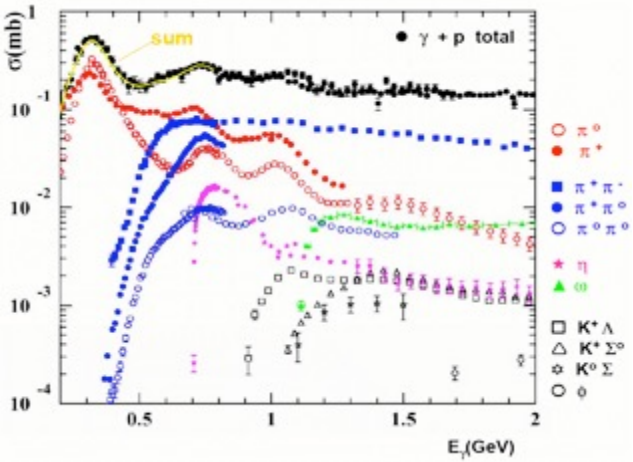
	Nome	Età	Posizione	Qualifica	EIC_NET_DTZ	FOOT	JLAB12	MAMBO	UE-STRONG_2020	DOT3	CSN I	CSN II	CSN IV	CSN V	P.S.	CCR	Servizi	UE	PON	POR	FIRB	PRIN	ALTRO	PP	TT	C3M	Tot.
1	**Iannilli Maurizio**		Associato	**Tecnico Categoria B**			**20**	**30**				30															80
2	**Nobili Giovanni**		Dipendente	**C.T.E.R.**			**50**	**40**			10																100
3	**Pecchi Daniele**		Associato	**Tecn.Cat.C**			**30**	**40**																			70
4	**Reali Enzo**		Associato	**Tecnico Categoria B**			**30**					70															100
5	**Tusi Enrico Maria**		Associato	**Tecnico Categoria B**			**30**				70																100
6	**Vitali Gianni**		Associato	**Tecn.Cat.C**				**60**			20	20															100
				FTE Totali				1.6	1.7			Totale: 3.3 FTE															

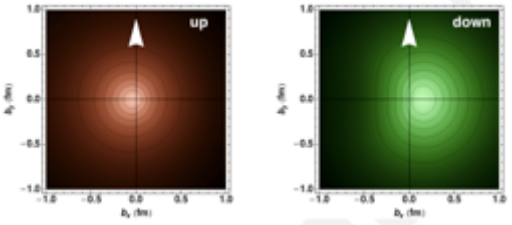
Esperimento JLAB12

JLAB12 Jefferson Laboratory at 12 GeV

Motivation. Photo- and electro-production reactions on nucleons and nuclei with polarized beams and targets for:

- ✓ Hadron spectroscopy
- ✓ Nucleon Structure
- ✓ HPS – Heavy Photon Search





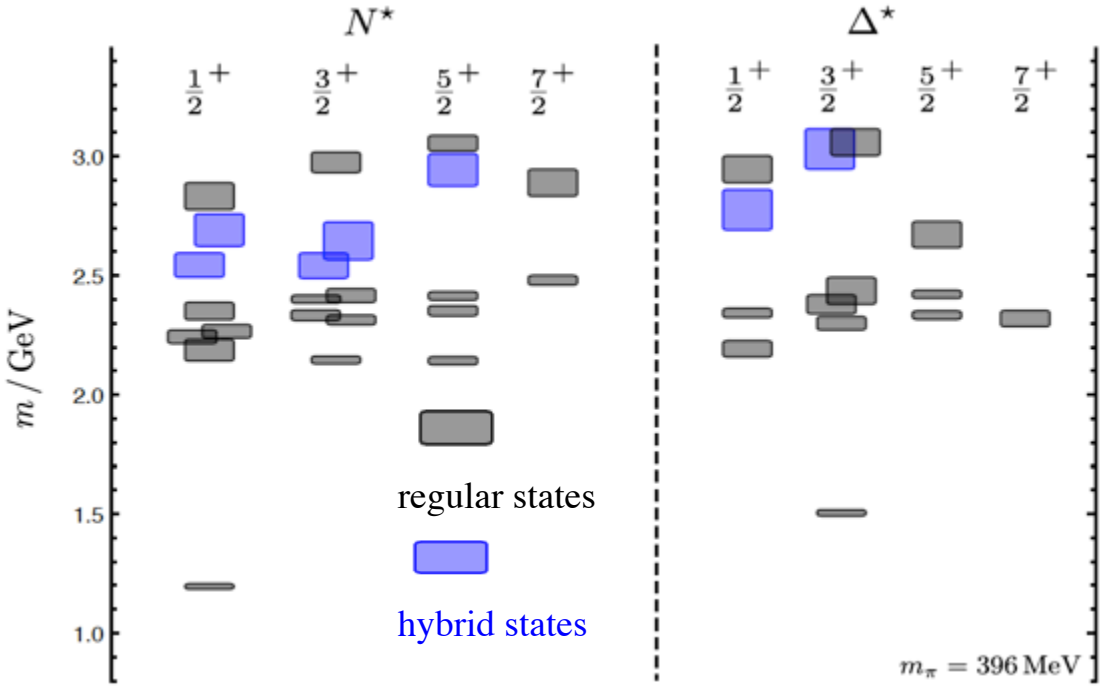
Bari, Brescia, Catania, Ferrara, Genova, LNF, LNS, Roma1, ISS, Roma Tor Vergata, Sassari, Torino, Padova, Pavia

Thomas Jefferson National Accelerator Facility – Virginia, USA People: 72 researchers, 46 FTE

Data taking 2018-2027@ JLAB, Virginia

Hadron Spectroscopy: search for hybrid baryons at CLAS12

Hybrid Baryons in LQCD



A Search for Hybrid Baryons in Hall B with CLAS12

Volker Burkert *(Spokesperson)*, Daniel S. Carman *(Spokesperson)*, Valery Kubarovsky, Victor Mokeev *(Spokesperson)*, Maurizio Ungaro, Veronique Ziegler
Thomas Jefferson National Accelerator Facility, Newport News, Virginia 23606, USA

Annalisa D'Angelo *(Contact Person, Spokesperson)*, Lucilla Lanza, Alessandro Rizzo
Università di Roma Tor Vergata and INFN Roma Tor Vergata, 00133 Rome, Italy

Gleb Fedotov, Evgeny Golovach *(Spokesperson)*, Boris Ishkhanov, Evgeny Isupov, Igor T. Obukhovsky‡
Skobeltsyn Institute of Nuclear Physics, Lomonosov Moscow State University, 119991 Moscow, Russia

Ralf W. Gothe *(Spokesperson)*, Iuliia Skorodumina
University of South Carolina, Columbia, South Carolina 29208, USA

Vincent Mathieu†, Vladyslav Pauk, Alessandro Pilloni, Adam Szczepaniak†
Theory Center, Jefferson Laboratory, Newport News, Virginia 23606, USA
(†*Joint with Indiana University, Bloomington, Indiana 47405, USA*)

Simon Capstick‡, Volker Crede, Johnathan Gross‡
Florida State University, Tallahassee, Florida 32306, USA

Approved experiment:
A⁻ rating + 100 PAC days beam time

Hybrid states have same J^P values as qqq baryons. How to identify them?

- Overpopulation of N $1/2^+$ and N $3/2^+$ states compared to QM projections.
- **$A_{1/2}$ ($A_{3/2}$) and $S_{1/2}$ show different Q^2 evolution. Can we do it?**

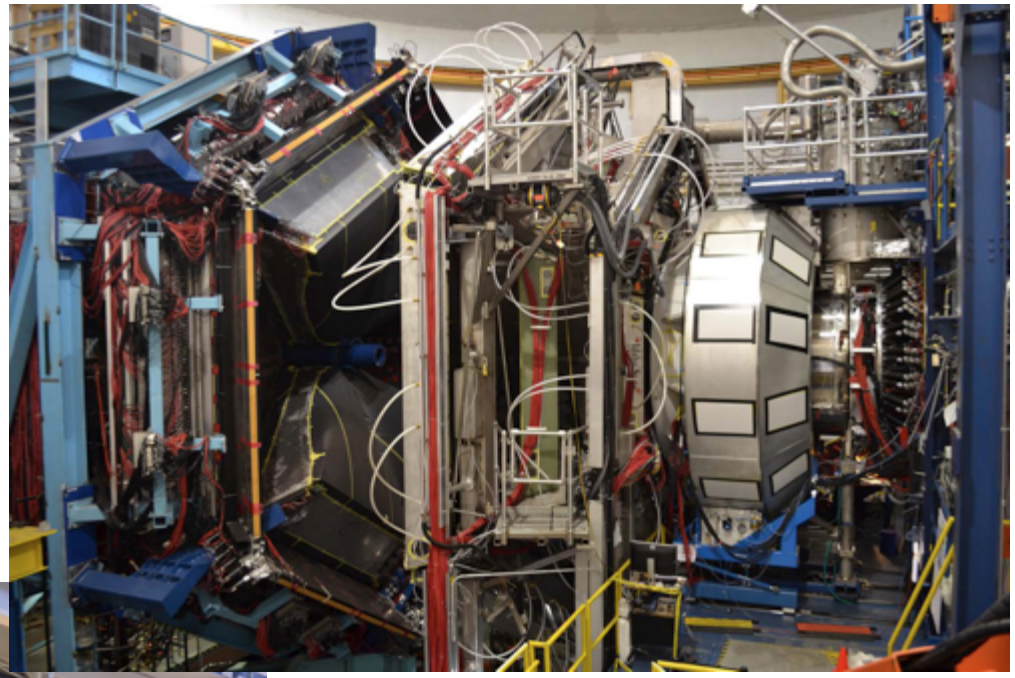
Study of Q^2 evolution of resonances electro-couplings from $K^+\Lambda$ electro production from the proton

20 days of data taking have been collected by the experiment in 2018

Esperimento JLAB12

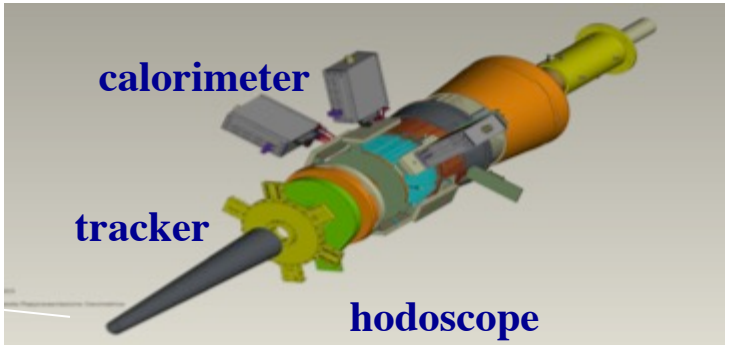
Detector

CLAS12

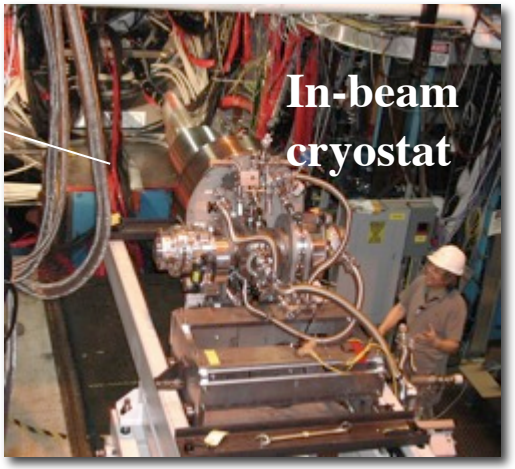


$\theta = 2.5^\circ \rightarrow 4.5^\circ$

Forwar Tagger

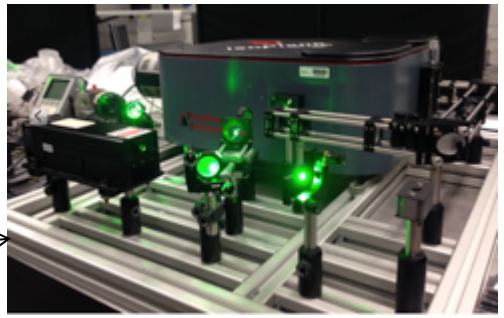


Polarized target

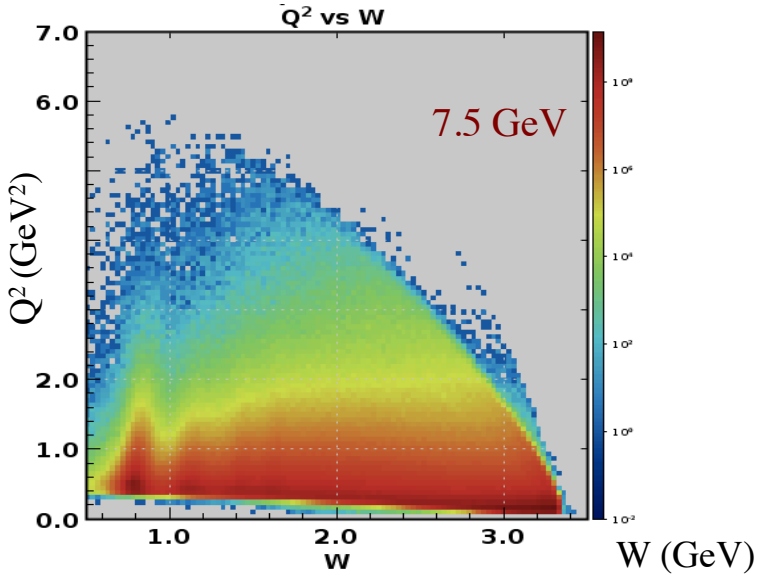


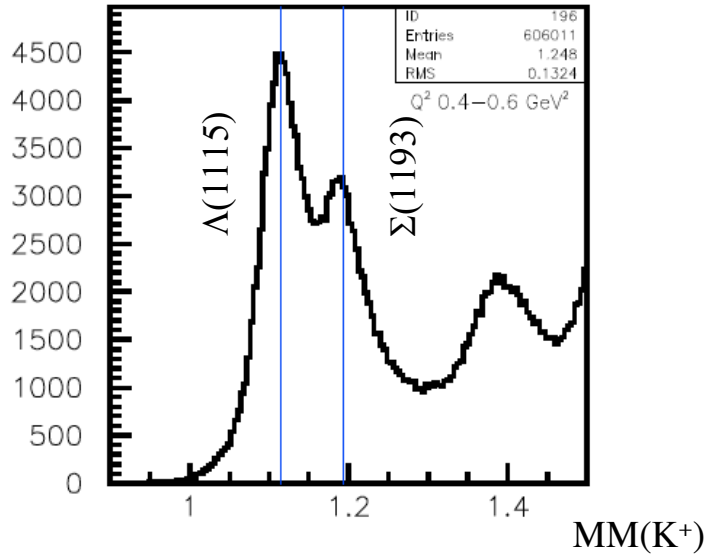
HD gas distiller

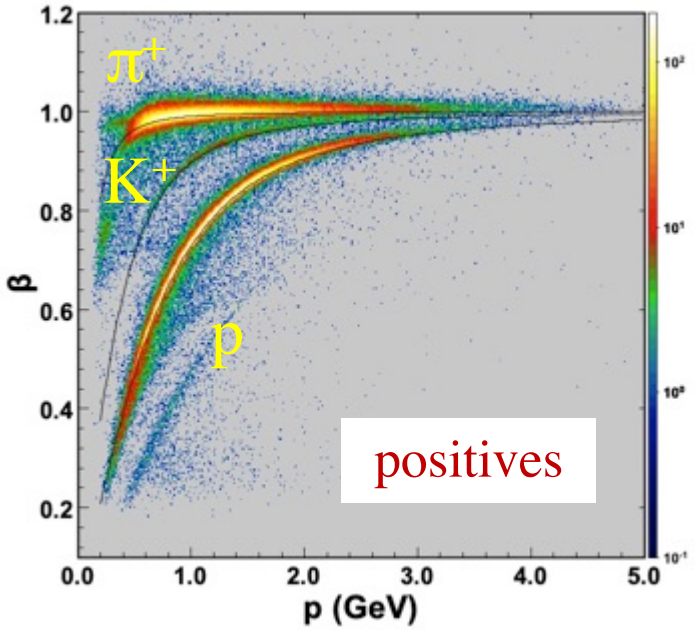
Portable Raman



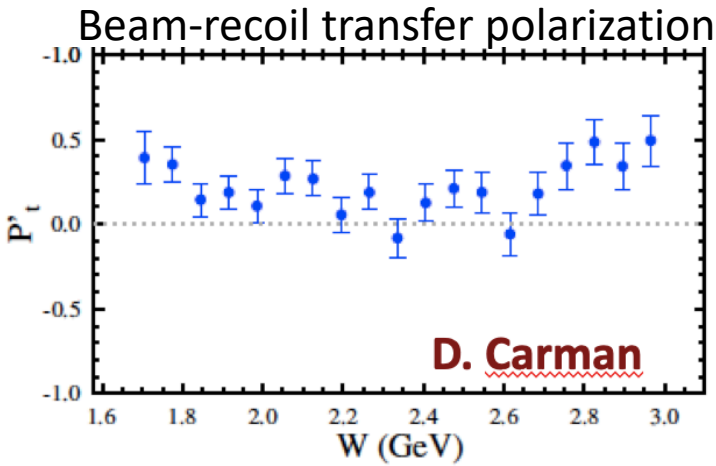
First results on KY electroproduction





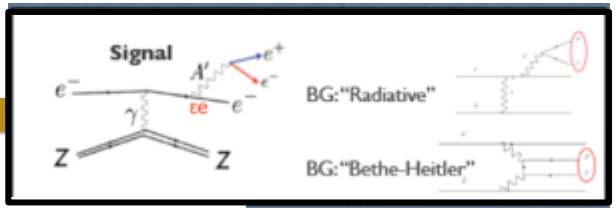


identificazione



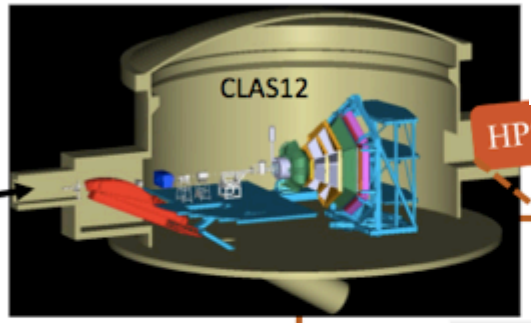
Esperimento HPS

Detector



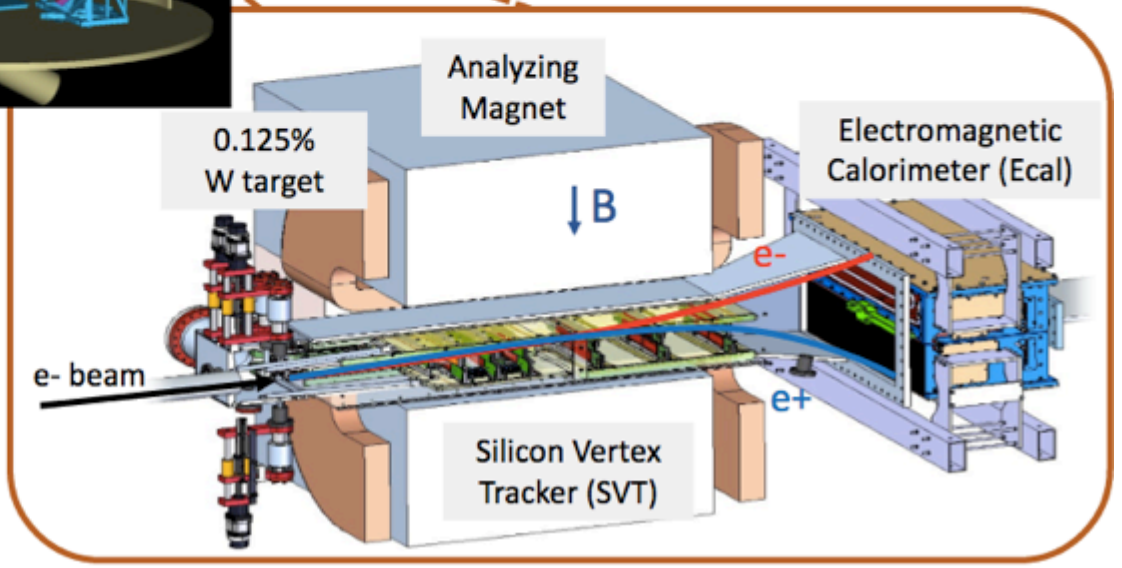
- Searches for A' with **prompt** and **displaced** vertices
- Downstream Hall B alcove
- 2015 Engineering Run, 1 GeV beam at 50 nA
- 2016 Physics Run, 2,3 GeV beam at 200 nA
- 2019 Physics Run **completed.**

Hall B



Silicon Vertex Tracker:
- Tracks particles
- Momentum and vertex reconstruction

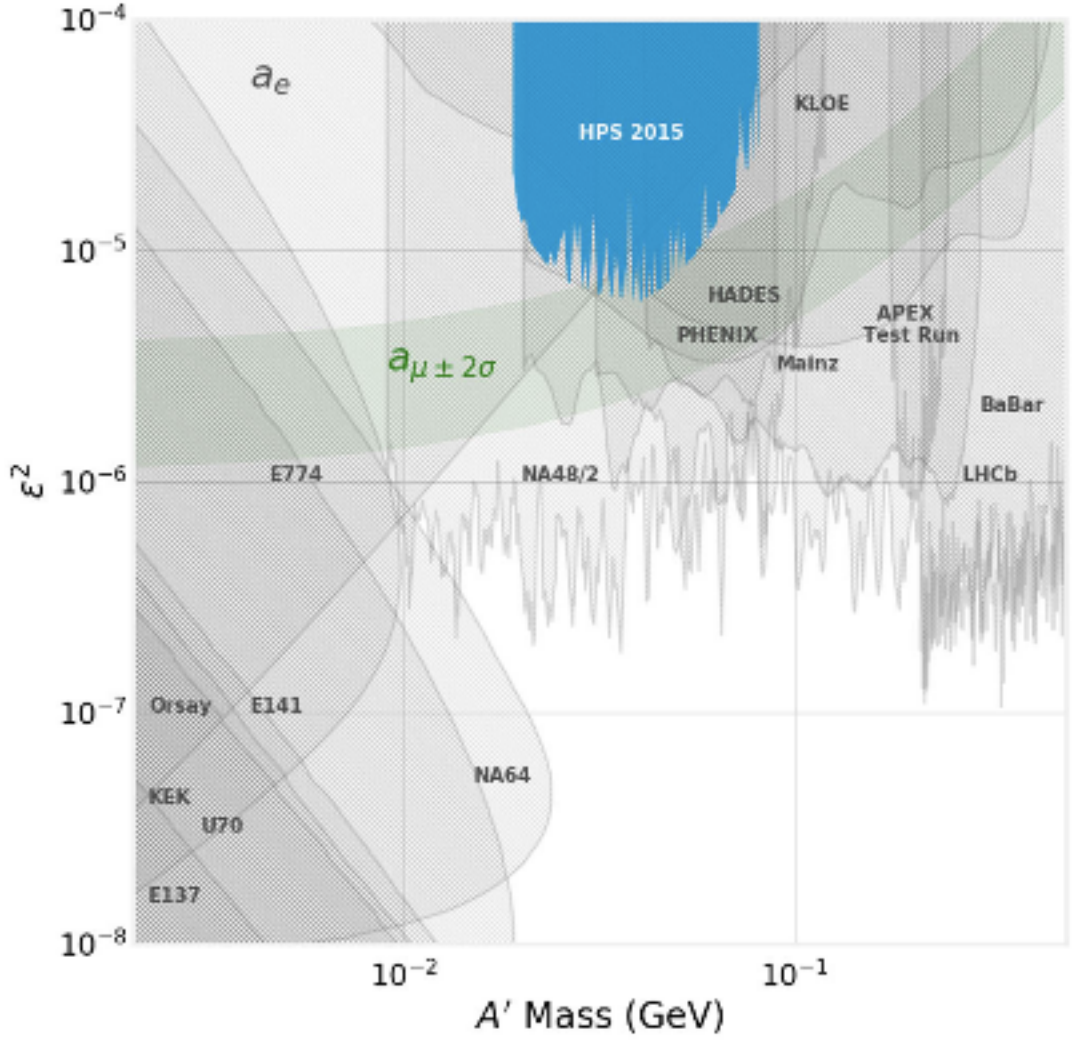
EM Calorimeter:
- Triggers events
- Energy and timing



Esperimento HPS

- **2015 data published**
  Phys Rev D98, 091101(R) 2018
  First Publication on PRD
  Editor's suggestion

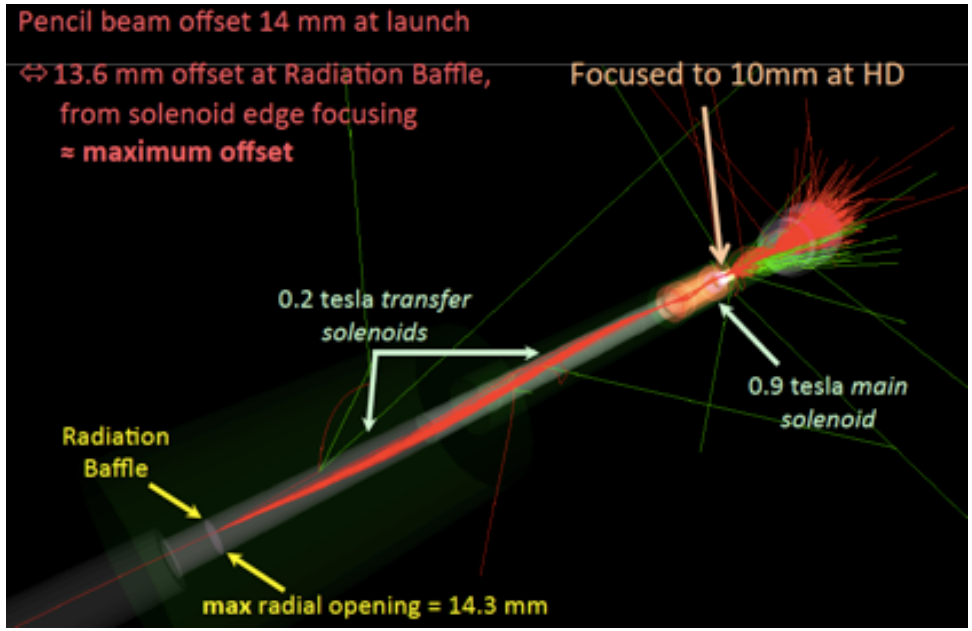
- 2016 data analysis has been approved by the collaboration for publication

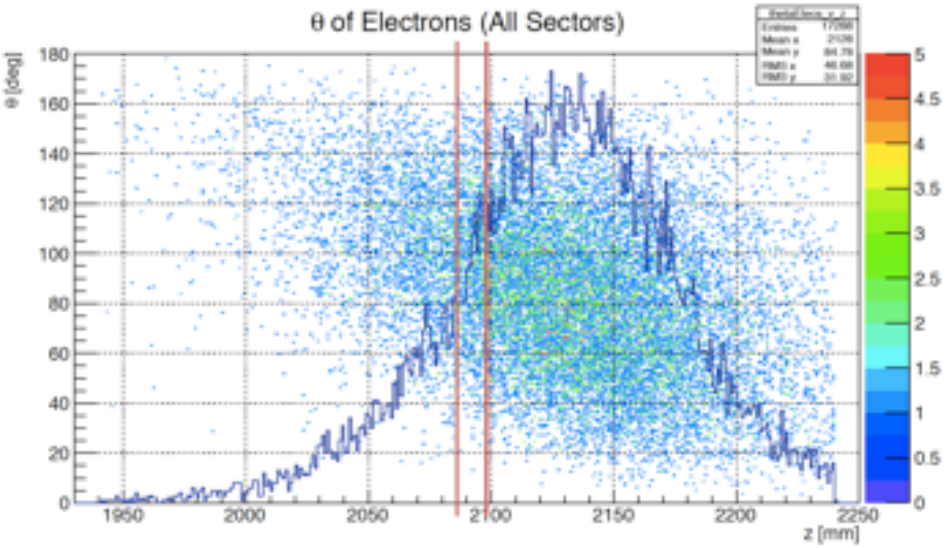


HD-ice: Test Run

- **Test run per verificare la resistenza della polarizzazione al fascio di elettroni**
- **Simulazione dell'interazione del fascio di elettroni da 10 MeV con l'IBC**
- **Realizzazione di un rivelatore "Halo-counter"** per monitorare il centraggio del fascio e validare le simulazioni 16 scintillatori con PM resistenti al campo magnetico e relativa elettronica

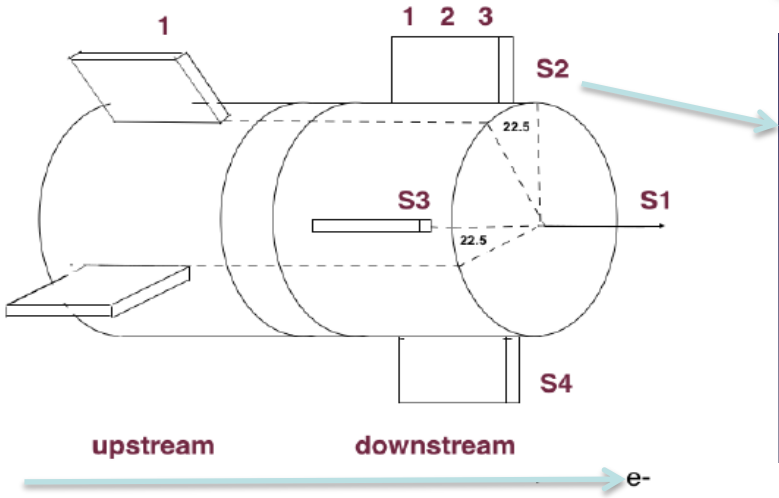
Il test, originariamente previsto a giugno – luglio 2020 è stato posticipato ad Agosto – Settembre 2020.

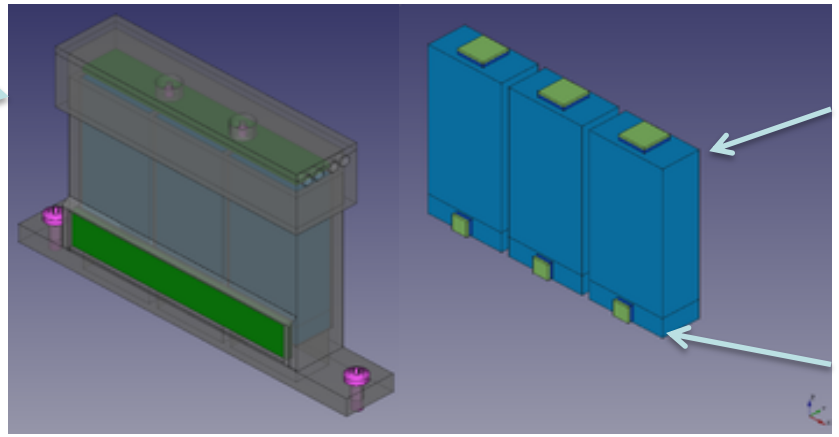




HALO Counter Detectors

- Electron Beam Monitor: → downstream - Moeller scattering
  → upstream - elastic backscattering





BC408
E: 20x10x38 mm coupled to 6x6 mm SensL SiPm

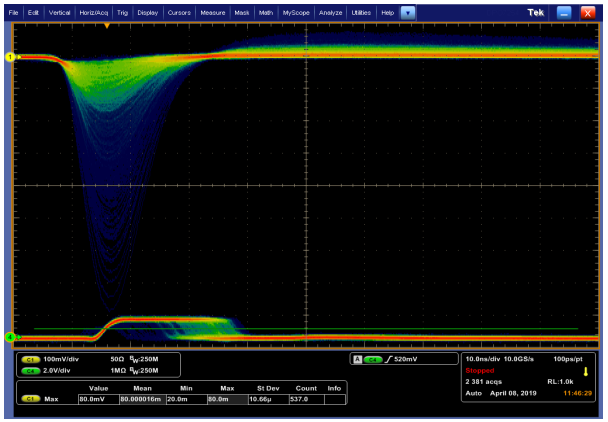
dE: 20x10x5 mm coupled to 3x3 mm SensL SiPm

Each detector is composed of 4 Sectors

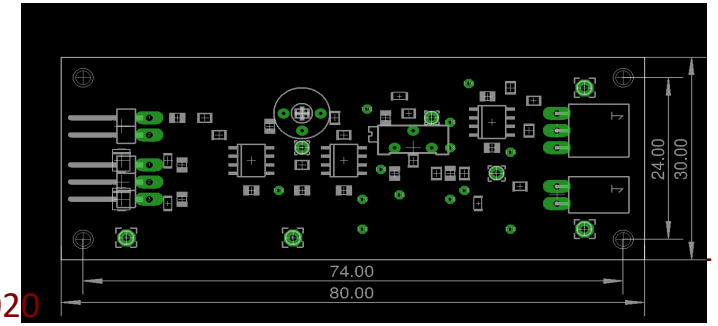
✓ each **Downstream Sector** is composed of **3 sets** of dE-E plastic detectors, read by **Si PM**.

✓ each **Upstream Sector** on contains **1 set** of dE-E plastic detectors.

32 detector channels



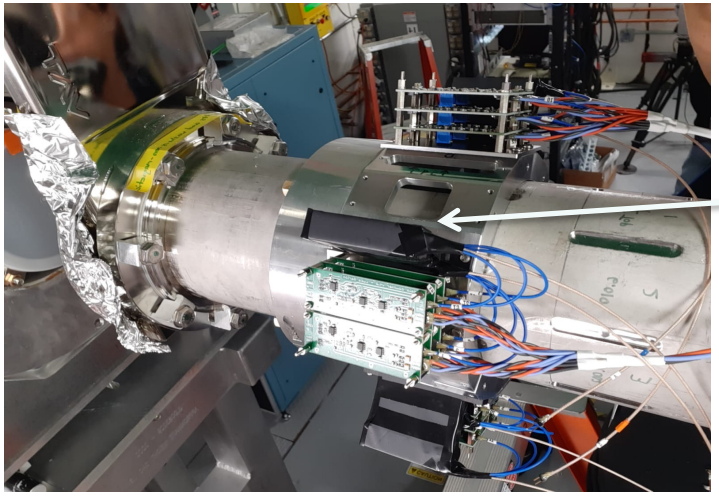
SiPm Power Supply and readout circuit: analog and digital outputs.

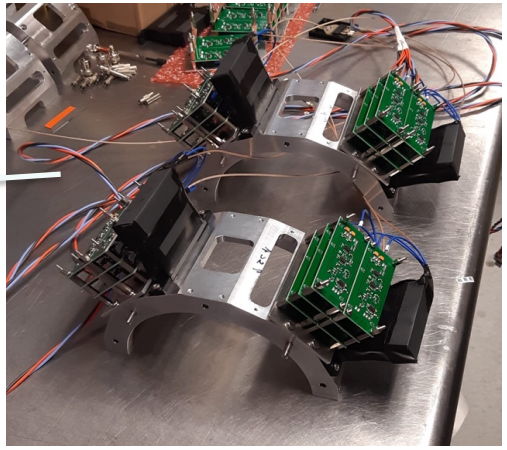


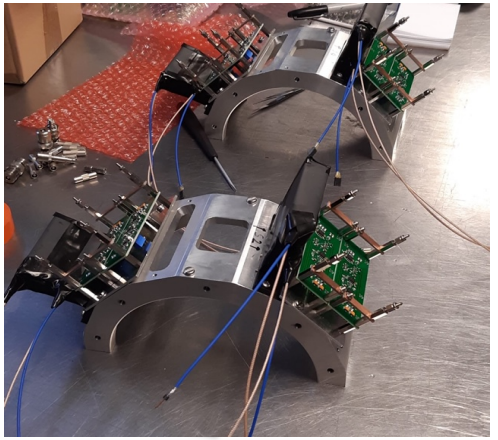
HALO Counter Detectors

- Electron Beam Monitor Downstream Upstream

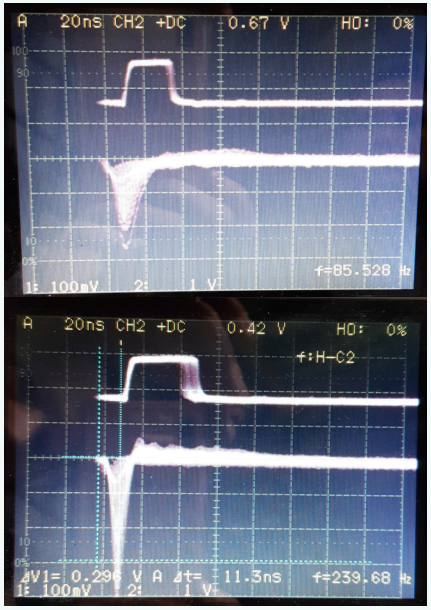
e







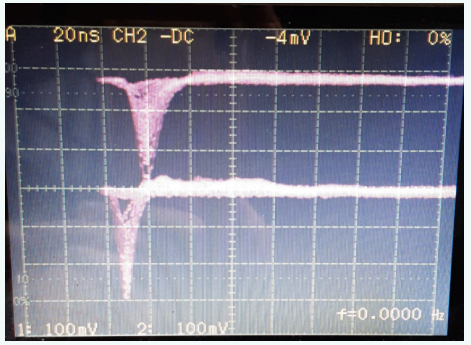
Detectors response to Sr^{90}



E detector
10 ns rise time

dE detector

8 ns rise time



E – dE
coincidence signals

Attività previste

HD-ice -> HD-e

- Test delle prestazioni eHD con fasci di elettroni (al JLAB)
- Distillazione del gas di HD ed analisi on-line del gas distillato con il nuovo sistema Raman (Roma - PP1)

Partecipazione a run di presa dati:

- CLAS (12 GeV)

Le richieste maggiori sono relative al progetto PolTarg - Bersaglio polarizzato HD:

- manutenzione e funzionamento del sistema Raman
- funzionamento del sistema di distillazione del gas di HD a Roma
- test run

Esperimento JLAB12 Richieste Roma Tor Vergata

Missioni	
Turni di Misura CLAS12, missioni Ge per collaborazione FT e analisi	20 K€
Consumo	
Ottica di ricambio sistema Raman, raccorderia da vuoto, manutenzione	15 K€
Altro Consumo	
Liquidi criogenici: LHe + LN	8 K€
Trasporti	
Spese di Trasporto e sdoganamento gas HD	5 K€
Apparati	
Componenti per la manutenzione ed il funzionamento HD Distiller	12 K€
Totale Richieste	60 K€

MAMBO (MAMi-BOnn)

La sigla MAMBO si articola su due attività:

BGO-OD a ELSA (Bonn) Coinvolgimento della sezione TOV

- Fascio di fotoni di energia 0.3-3.2 GeV
- Polarizzazione lineare e circolare del fascio
- **Spokespersons: P. Levi Sandri** e H. Schmieden

A2@MAMI (Mainz)

- Fascio di fotoni polarizzati di energia fino a 1.6 GeV
- Polarizzazione lineare e circolare del fascio
- Bersaglio polarizzato
- **Spokespersons: P. Pedroni** e A. Thomas

Obiettivi di fisica:

- Studio delle proprietà delle risonanze nucleoniche attraverso la fotoproduzione di mesoni con e senza stranezza, pseudoscalari e vettoriali con fasci e/o bersagli polarizzati

Attività BGO-OD

- **Periodo 2017-2020:**
  Finanziamento DFG (programma pluriennale per singole università) che vincola l'acceleratore ELSA a fornire all'esperimento BGO-OD un minimo di 1000 h fascio/anno (pari a circa 42 gg).
- **Richiesta nuovo finanziamento Triennale DFG a Luglio2020**

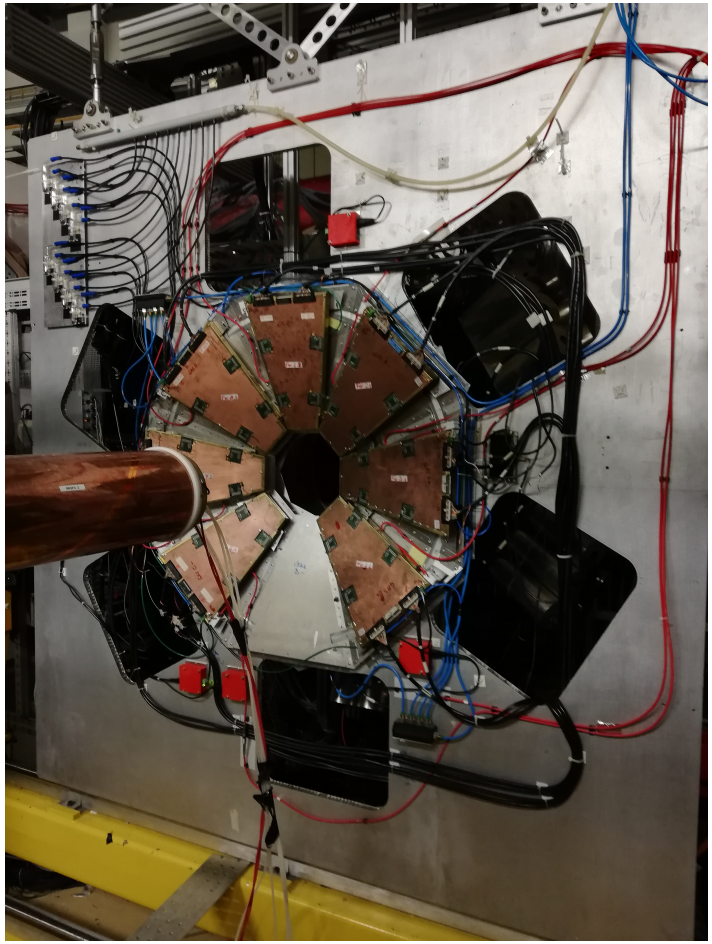
- **Prese dati 2019-giugno 2020**:
  - 2019- Non ci sono state prese dati a causa della rottura (e successiva sostituzione) del Klystron di ELSA
  - Inizio 2020 : Sostituzione del Klystron
  - Marzo-Maggio stop per Lockdown COVID-19
  - Giugno 2020 riapertura graduale delle attività presso l'acceleratore e completamento entro fine luglio dei test dopo riparazione acceleratore

- Rivelatore DAISY (**MRPC): vedi prossima slide**

- **Aprile 2020: Pubblicazione Technical paper su EPJA:**
  "The BGOOD Experimantal setup at ELSA"

Inclusi i risultati di banchmark di asimmetria per fotoproduzione di π^0 ed η su protone

DAISY TOF status



Attivita' 2019- giugno2020

Interventi sulla meccanica ed elettronica mirati alla riduzione del rumore indotto dal sistema di acquisizione e RF macchina

- -Ottobre 2019 (Bonn)

-Test di acquisizione senza fascio delle MRPC per monitorare il fondo elettronico residuo

–OK fondo rimosso

- Febbraio 2020 (PP1 Tor Vergata)

-Passaggio di consegne da Roberto Messi (in quiescienza da novembre 2019) a Mariia Romaniuk (ricercatore straniero associato INFN) ed Alessia Fantini

-test con cosmici di 4 petali (2 spare e 2 inviati da Bonn per manutenzione)

Analisi dati

- **Conclusi e sottomessi due articoli :**

1. ***K+Λ photoproduction at forward angles and low momentum transfer***

   $\gamma + p \rightarrow K^+ \Lambda$ → Sez. Urto diff. Ad angoli extr. Forw. ed asimmetrie di polarizzazione di rinculo

   Risolti conflitti da datasets precedentemente pubblicati

   Pubblicazione su archive http://arxiv.org/abs/2006.12350 e sottomissione a EPJA

2. **Cusp-like structure in the γp→K+Σ0 cross section at low momentum transfer**

   $\gamma + p \rightarrow K^+ \Sigma^0$ → Sez. Urto diff. Ad angoli extr. Forw. Evidenza di una struttura stretta a W=1900 MeV

   Pubblicazione su archive http://arxiv.org/abs/2006.12437 e sottomissione PRL

Analisi dati(continua)

Continua l'analisi dati dei canali:

$\gamma + p \rightarrow K^+ \Lambda(1405) \quad \rightarrow K^+ \pi^0 \Sigma^0$ Identif. Segnale e separazione dalla $\Lambda(1520)$

$\gamma + p \rightarrow \eta + p \; (\eta \rightarrow 2\gamma \;\; \eta \rightarrow 6\gamma)$ → Asimmetrie, recupero eventi con rumore elettronico

$\gamma + p \rightarrow \eta' + p$ → Asimmetrie e sezioni d'urto

$\gamma + n \rightarrow K^0 \Sigma^0$ → Sezioni d'urto differenziali

Attività 2020-2021

- Esperimento BGO-OD in corso:
- Settembre 2020 fascio in macchina
- Ottobre-Novembre 2020 riapertura prese dati con verifica delle regole di distanziamento sociale per Covid-19 e delle regole di viaggio tra stati europei.
- Attività della sezione per il 2020-2021:

  → Finalizzazione analisi dati per asimmetrie nella fotoproduzione di η su bersaglio di idrogeno e deuterio

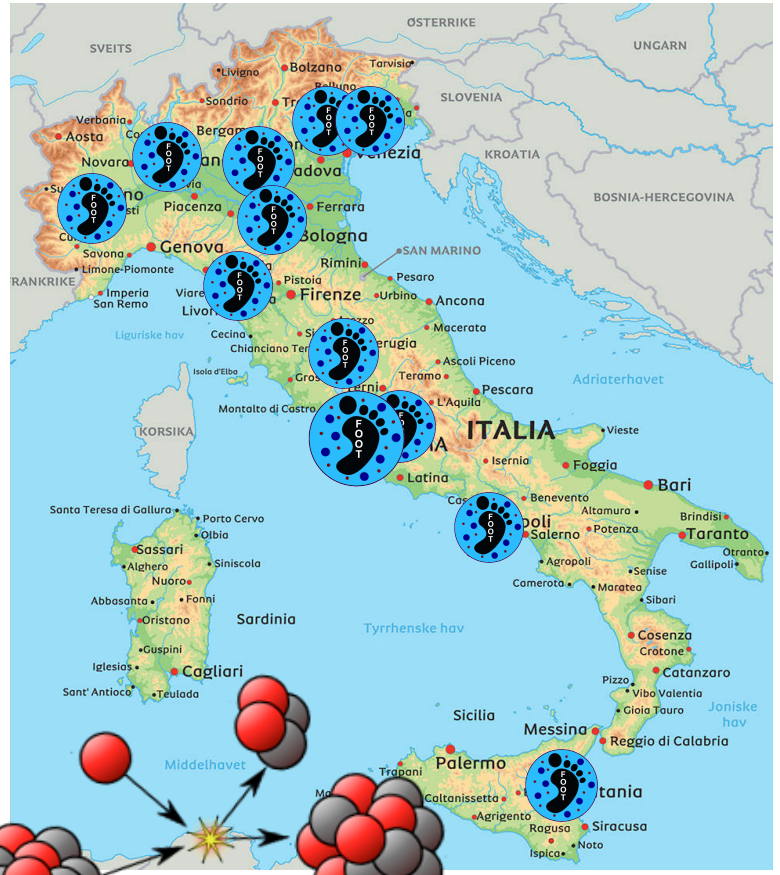
  → Continuazione analisi dati per asimmetrie nella fotoproduzione di η' su bersaglio di idrogeno

Esperimento MAMBO Richieste Roma Tor Vergata

Missioni	
Turni di Misura BGO-OD, manutenzione rivelatori e riunioni di collaborazione	22 K€
Altro Consumo	
Gas per MRPC	1.5 K€
Trasporti	
3 Trasporti Materiale da Roma a Bonn e viceversa (circa 0.5kE a trasporto)	1.5 K€
Manutenzione	
Riparazione schede	2 K€
Materiale inventariabile	
1 scheda HV spare	4.0 K€
Consumo	
1 Minuteria per manutensione MRPC Ritaratura 3 flussimetri	0.5 K€ 3.0K€
Totale Richieste	**34.5 k€**

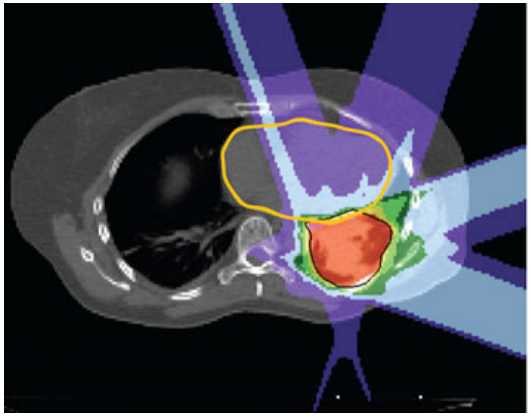
FOOT FragmentatiOn Of Target

An experiment for the measurement of the nuclear fragmentation for Particle Therapy
& Radioprotection in space

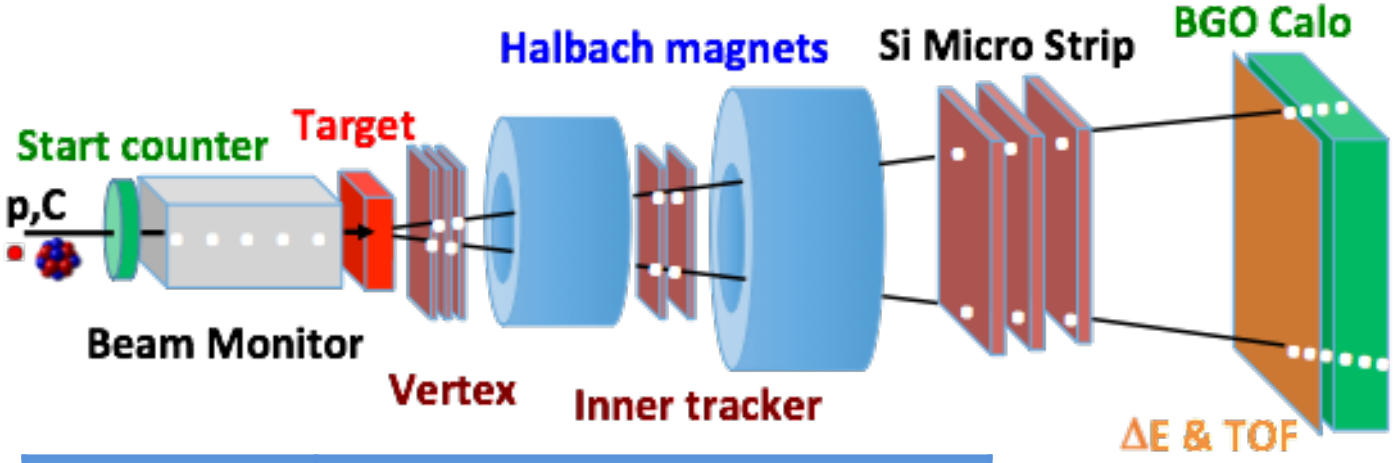


Bologna, Frascati, Milano, Napoli, Perugia, (Pavia), Pisa, Roma1, Roma2, Torino, Trento

Strasbourg, GSI, Aachen, Nagoya



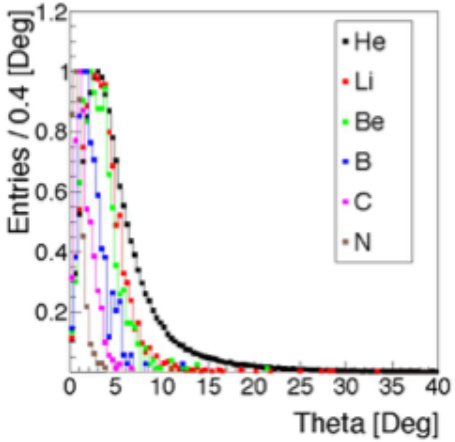
FOOT setup



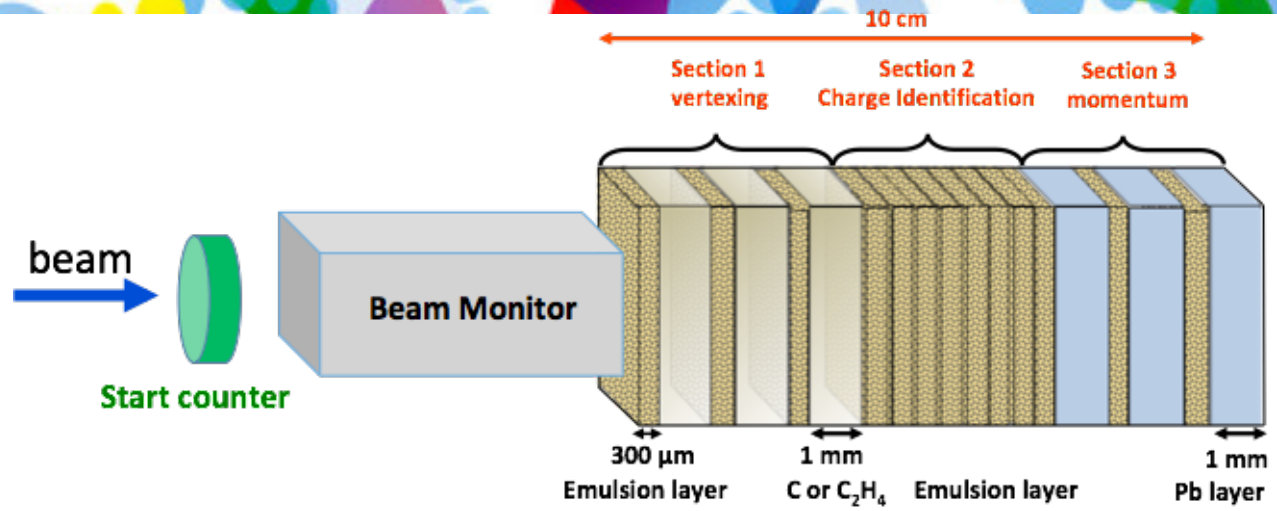
Needed detector performances
Δp/p ~5%
TOF resolution ~100ps
ΔEkin/Ekin ~2%
Δ(dE)/dE ~2%

Sub-detector	Main characteristics
Start counter	plastic scintillator 250 μm
Beam monitor	drift chamber (12 layers of wires)
Target	C+C2H4 (2 mm)
Vertex	4 layers silicon pixel (20x20 μm)
Magnet	2 permanent dipoles (0.8 T)
Inner tracker	2 layers silicon pixel (20x20 μm)
Outer tracker	3 layers silicon strip (125 μm pitch)
Scintillator	2 layers of 20 bars (2x40x0.3 μm)
Calorimeter	360 BGO crystals (2x2x14 μm)

- optimised for heavy (Z≥3) fragments
- less than 2m: can be easily movable to fit the space limitations from experimental and treatment rooms
- angle setup: ±10°



FOOT emulsion setup



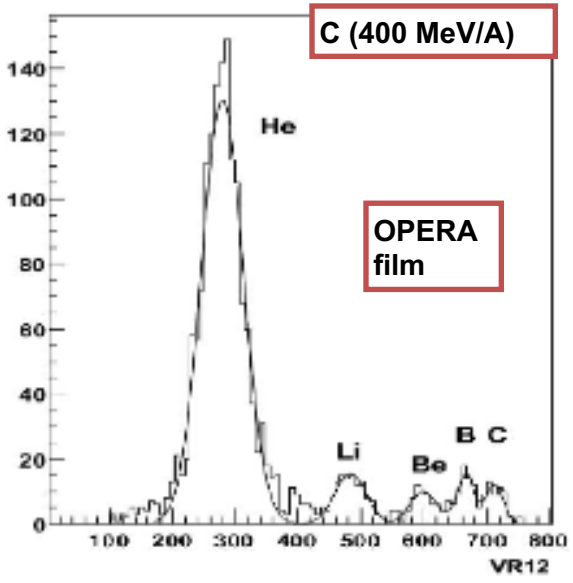
- optimised for light (Z≤3) fragments
- less than 1m: can be easily movable to fit the space limitations from experimental and treatment rooms
- angle setup: ±75°

Two complementary setups

- main reason: required angular precision of few mrad hard to achieve with an apparatus of limited size
- lower mass fragments (Z<3) can be emitted within a wider angular aperture wrt heavier nuclei

Main characteristics

- both target and detector integrated in a very compact setup
- accurate reconstruction of the interactions inside the target (sub-micrometric resolution)
- fragment charge assessed with an efficiency > 99%
- automated scanning system technique: very fast and with wide angular acceptances



News about the detector construction...

The emulsion part of our detector has been successfully built, exposed and now is in analysis phase.

Electronic detector:

- The MSD detector should be early in the testing phase. Could it be ready for a test @CNAO?
- Calorimeter saga should now have an acceleration. A reduced size, but otherwise final, prototype with all the DAQ chain is expected by CSN3 at late 2020.
- The IT is heavily delayed. We should understand if the delay is getting a real showstopper for the magnetic region
- The magnet bid is out.. We have to cross our fingers!!!!!

About the data taking...

- Completed the ESA data taking in February with emulsions. Analysis is improving, hoping for quick result publication
- Several beam times are in front of us: CNAO, GSI, HIT. The season of the test beam is almost over, we are going to deal with our main data takings...

- The beam time request to ESA is out: high energy beams for radioprotection in space at GSI: the beam could arrive at ney time 2021-2022 (likely in late spring)
- Beam time request to BIO-PAC: PT focused data taking assigned by BIO-PAC for 2021-2022
- CNAO data taking: our first target is late 2020, further data taking must be submitted to the future CNAO PAC
- Calorimeter crew is preparing a beam request for HIT-> unknown outcome, but could be a test beam extended to large part of FOOT-> physics results?

FOOT@RM2: anagrafica & richieste finanziarie 2020

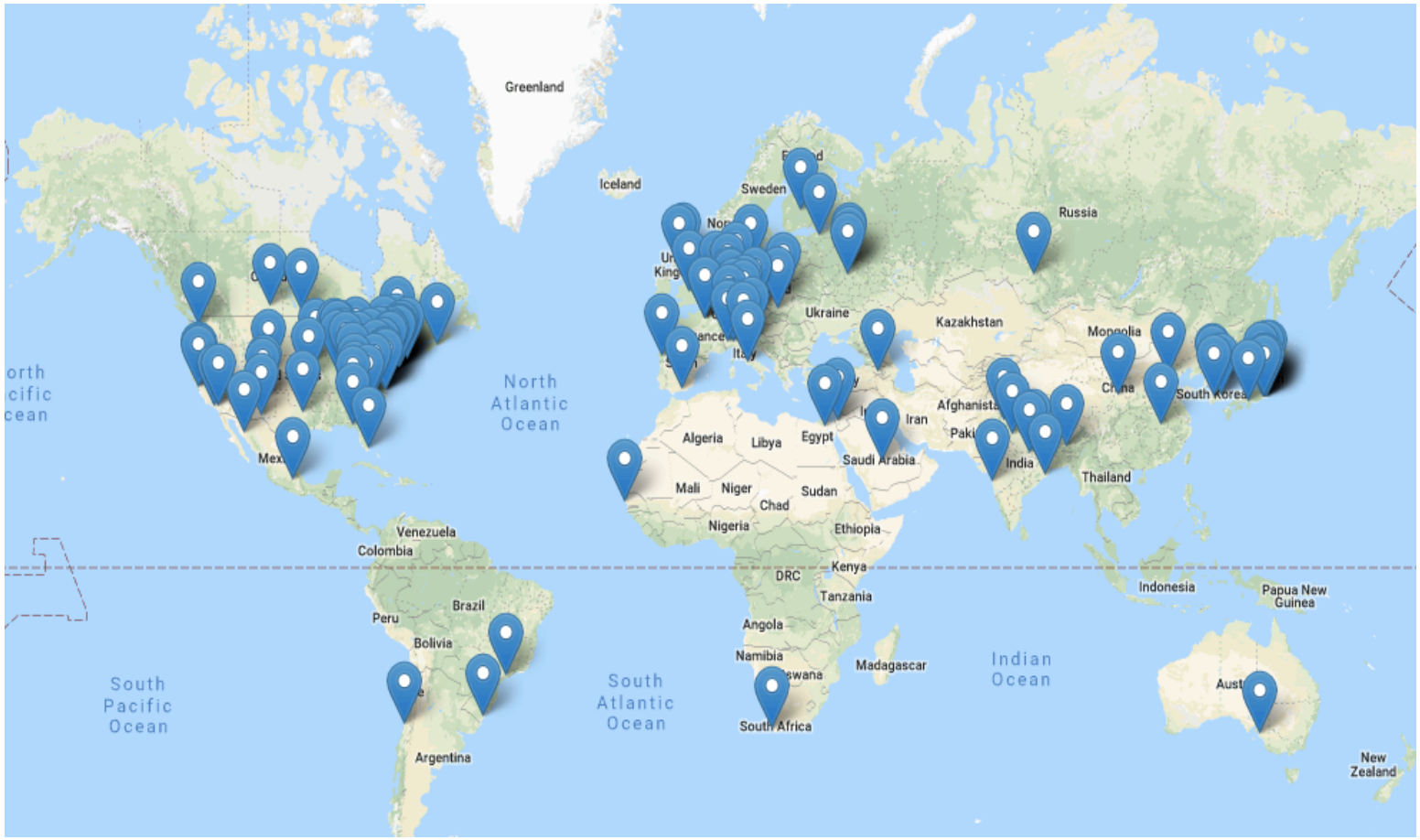
	Posizione	Percentuale (%)
M.C.Morone	PA	70
L.Narici	PA	30

Richieste finanziarie:

Missioni per 2 General meetings + presa dati CNAO 4.5kEuro

+ 3.0kE SJ (causa covid) per altre 2 turni di misura a HIT e GSI

EIC - NET



EIC-NET Roma Tor Vergata

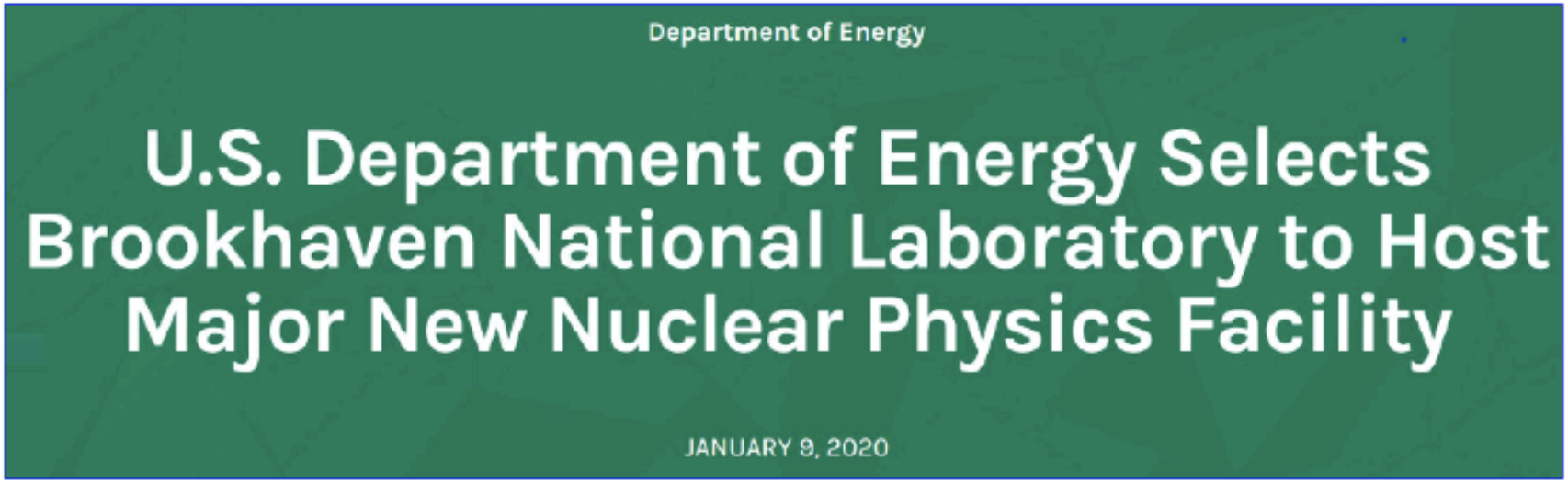
Annalisa D'Angelo
Rachele Di Salvo
Alessia Fantini
Lucilla Lanza

I. EIC User Group:

- **795** members
- **170** institutions
- **29** countries (7 world regions)

Experiment Scientists: **453**, Theory Scientists: **158**, Accelerator Scientists: **142**, Support: **3**, Other: **39**

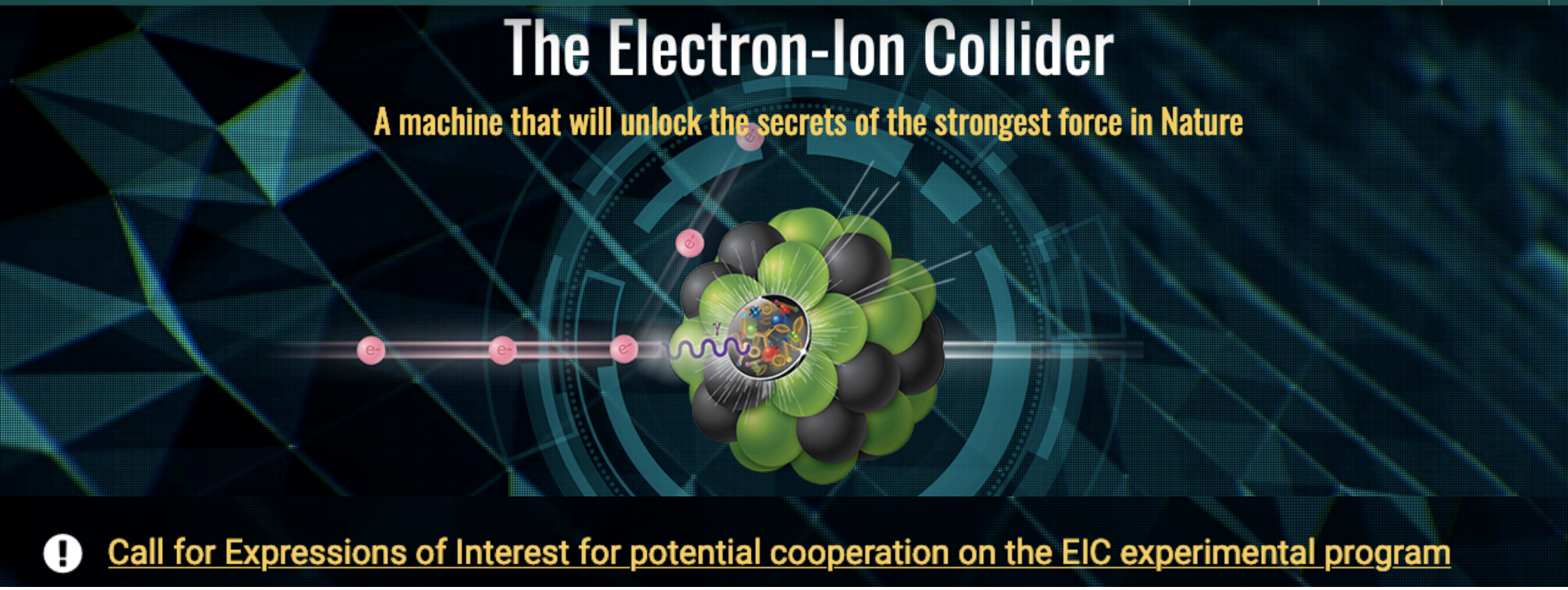
BREAKING NEWS, January 2020



The Electron Ion Collider (EIC), to be designed and constructed over ten years at an estimated cost between $1.6 and $2.6 billion, will smash electrons into protons and heavier atomic nuclei in an effort to penetrate the mysteries of the "strong force" that binds the atomic nucleus together.

Secretary Brouillette approved Critical Decision-0, "Approve Mission Need," for the EIC on December 19, 2019.

https://www.energy.gov/articles/us-department-energy-selects-brookhaven-national-laboratory-host-major-new-nuclear-physics



Call per *Expression of Interest* degli istituti partecipanti.
Decisioni da prendere:

- Energia di lavoro
- Numero di punti di interazione

(Yellow report in fase di relazione sia per la fisica che per R&D)

L'INFN parteciperà su 3 temi di RD: **Vertexing, PID, Triggerless DAQ**

EIC-NET - Roma Tor Vergata

Attività prevista:

- sviluppo di scintillatori per calorimetro EM
  - PbWO
  - vetri ceramici
- triggerless DAQ

in collaborazione con INFN – Genova

Partecipanti: Annalisa D'Angelo 10% Rachele Di Salvo 10%
Alessia Fantini 20% Lucilla Lanza 10%

Richieste di Finaziamento: 5 K€ Missioni
Networking per calorimetria e triggerless DAQ

Dotazioni gruppo III: richieste finanziarie 2021

Metabolismo del gruppo come da algoritmo di commissione in base al numero di FTE

Missioni	**6 K€**
Consumo	**3,5 K€**
Seminari	**0.5K€**
Pubblicazioni	**1,5 K€**
Materiale inventariabile	**9,5 K€**
Totale Richieste	**21 K€**

Totale Richieste GIII Roma Tor Vergata

SIGLA	CONS (k€)	ALTRO CONS (k€)	TRASP (k€)	MAN (k€)	INV (k€)	APP (k€)	SEM (k€)	PUB (k€)	TOT Altro (k€)	MISSIONI (k€)	TOT (k€)
EIC_NET DTZ									0	5	5
FOOT									0	7.5	7.5
JLAB	15	8	5			12			40	20	60
MAMBO	3.5	1.5	1.5	2	4				12.5	22	34.5
TOT SIGLE	18.5	9.5	6.5	2	4	12			52.5	54.5	107
DOTZ.	3.5				9.5		0.5	1.5	15	6	21
RM2	22	9.5	6.5	2	13.5	12	0.5	1.5	67.5	60.5	128