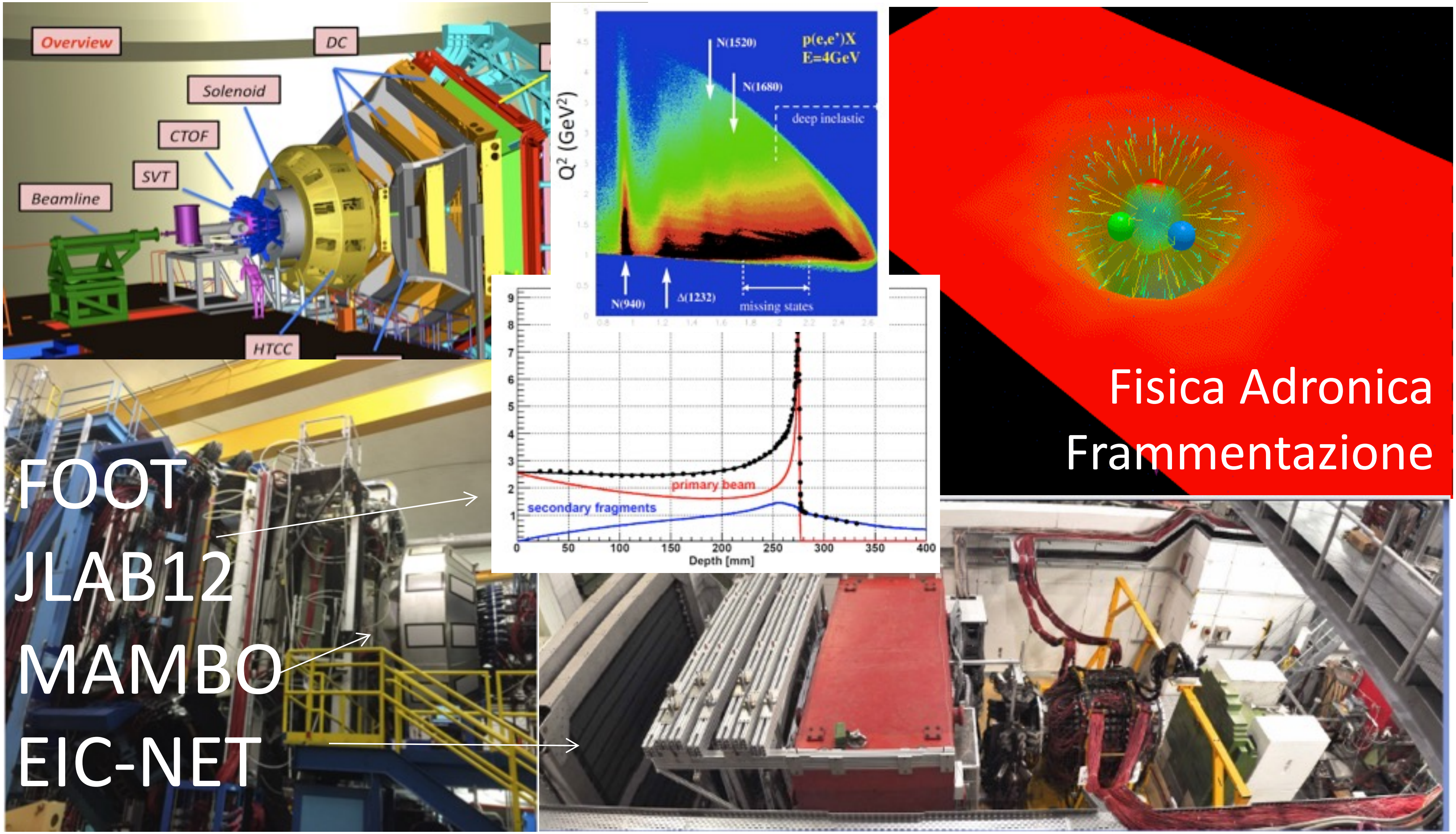
Gruppo III Roma Tor Vergata



MAMBO (MAMi-BOnn)

Cognome	Nome	Struttura	Modulo	Contratto	Profilo	Stato	Aff.	%
Di Salvo	Rachele Anna	ROMA2	G1	Dipendente	Ricercatore	Attivo	CSN3	90%
Fantini	Alessia	ROMA2	G1	Associato	Incarico di Ricerca scientifica	Attivo	CSN3	80%
Iannilli	Maurizio	ROMA2	G3	Contratto non Trovato			CSN3	30%
Nobili	Giovanni	ROMA2	G3	Dipendente	Collaboratore Tecnico E.R.	Attivo	CSN3	40%
Pecchi	Daniele	ROMA2	G3	Associato	Associazione Tecnica	Attivo		40%
Romaniuk	Mariia	ROMA2	G1	Associato	Scientifica Enti stranieri	Attivo	CSN3	100%
Vitali	Gianni	ROMA2	G3	Associato	Associazione Tecnica	Attivo	CSN3	60%

MAMBO (MAMi-BOnn)

La sigla MAMBO si articola su due attività:

BGOOD 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 (INFN-LNF)** 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 (INFN-PV)** 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

BGOOD Status

Apparato completamente funzionante.

Il persistere delle restrizioni e lo scoppio della guerra in Ucraina hanno causato un ritardo di alcuni mesi

Elsa perfettamente funzionante e fascio in sala migliorato con spill passato da ~10s a ~18s.
Riduzione del tempo morto di DAQ

	June 2018	November 2018	September 2021
Target	Deuterium	Hydrogen	Deuterium
Flux integral (no PGamma)	2,217E+13	1,705E+13	1,584E+13
Events per run	1M	1M	1M
Time per run	10m	10m	6m 30s
Number of runs analysed	3523	1954	2879
Nominal beam current [pA]	840	840	360
Total time	24d 11h	13d 14h	13d 0h
Flux rate [MHz]	10,5	14,5	14,1

Attività BGOOD

- **Periodo giugno 2021-giugno 2022**:

- **Sett-Ott. 2021: 3 settimane** presa dati con bersaglio di deuterio (11cm)

- **Dic. 2021:** Intervento di manutenzione sulla BGO (fototubi, HV)

- **Marzo 2022**: prevista presa dati con bersaglio di idrogeno (11cm) annullata a causa dello scoppio della guerra in Ucraina. La collega ucraina Mariia Romaniuk associata a Roma Tor Vergata e numerosi colleghi russi impossibilitati a partecipare

  - **Luglio 2022:** secondo intervento di manutenzione sulla BGO (elettronica, acquisizione, fototubi)

  - **Sett.-Ott. 2022:** prevista presa dati con bersaglio di idrogeno (11cm)

Pubblicazioni

1) “$K^+\Lambda$ photoproduction at forward angles and low momentum transfer ”
EPJA (2021), 57:80

2) “Observed cusp in the cross section at forward angles and low momentum transfer“
PLB 821 (2021), 136559

3) Contributo all’articolo congiunto di CSN3:
“Trends in particle and nuclei identification techniques in nuclear physics experiments”
Riv.Nuovo Cim. 45 (2022) 3, 189-277

4) “Evidence of a dibaryon spectrum in coherent $\pi^0\pi^0$ d photoproduction at forward deuteron angles”
Accettato da PLB e disponibile online

5-6) Due articoli su arXive:
- fotoproduzione di $K^0\Sigma^0$ su neutrone

sottomesso a EPJ
- fotoproduzione di $K^+\Lambda(1405)$ su protone

sottomesso a PLB

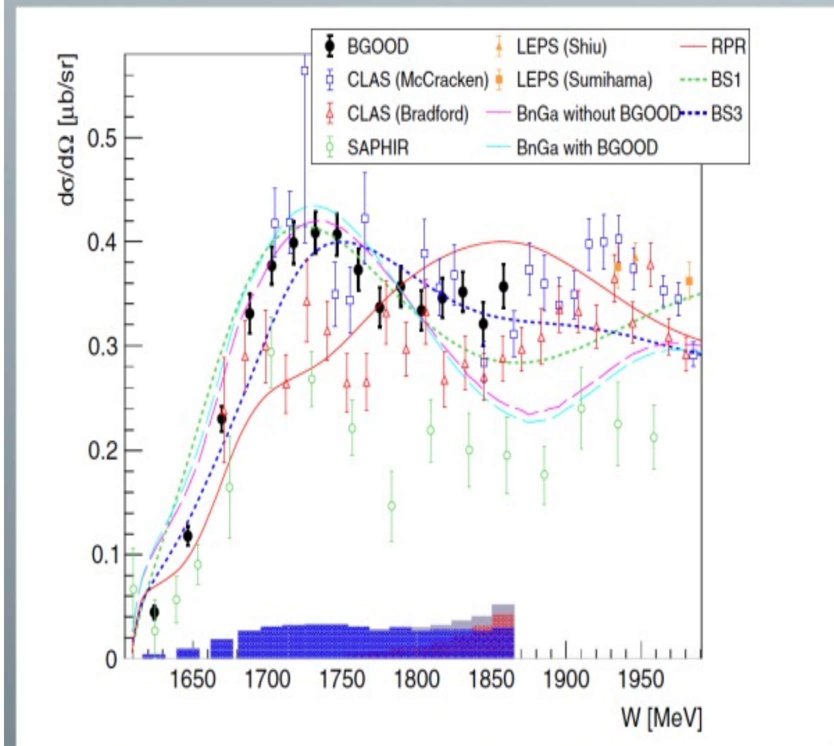
NB: Queste analisi si avvalgono della proprietà di «hermetic coverage» dell’apparato e dell’elevata risoluzione energetica per fotoni e dell’elevata efficienza di rivelazione dei neutroni (30-40%) del calorimetro di BGO

Eur. Phys. J. A (2021) 57:80
https://doi.org/10.1140/epja/s10050-021-00392-0

THE EUROPEAN PHYSICAL JOURNAL A

Regular Article - Experimental Physics

$K^+\Lambda$ photoproduction at forward angles and low momentum transfer



Physics Letters B 820 (2021) 136559

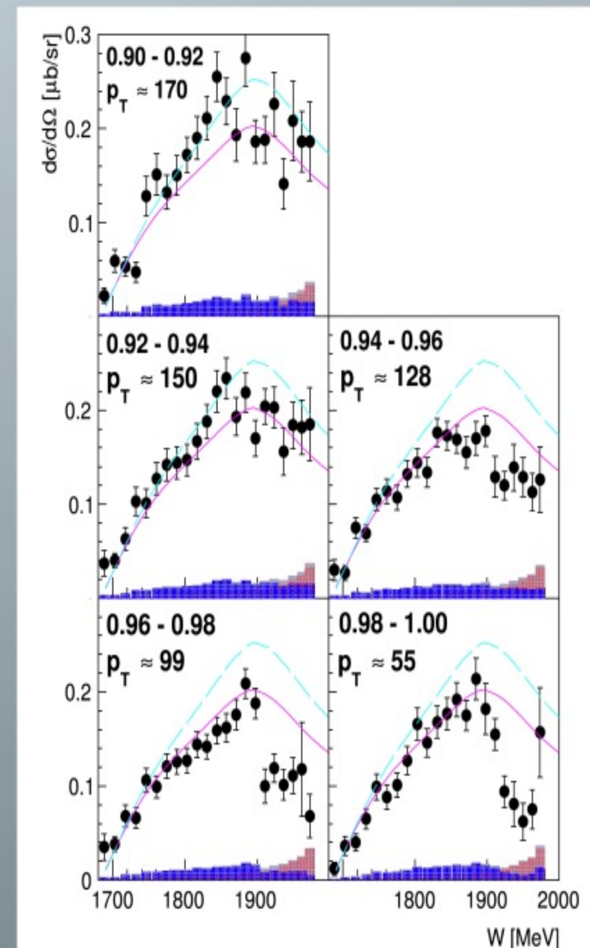
Contents lists available at ScienceDirect

Physics Letters B

www.elsevier.com/locate/physletb

ELSEVIER

Observation of a cusp-like structure in the $\gamma p \to K^+\Sigma^0$ cross section at forward angles and low momentum transfer



Evidence of a dibaryon spectrum in coherent $\pi^0\pi^0$ d photoproduction at forward deuteron angles

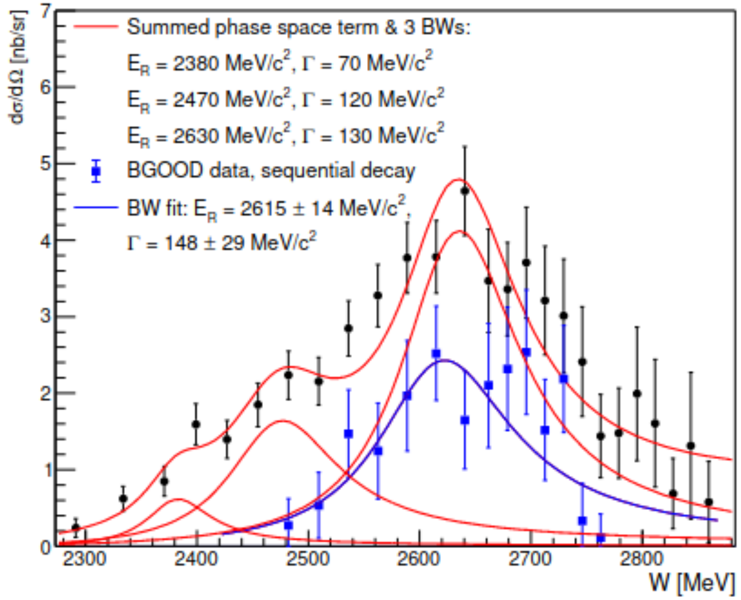


Figure 7: $\gamma d \rightarrow \pi^0\pi^0 d$ differential cross section for $\cos\theta^d_{CM} > 0.8$ (the same as in fig. 5). A fit including three Breit-Wigner functions (BW) are shown as the red lines, with the fixed masses and widths labelled inset. The additional small centre-of-mass momentum term described in the text is not shown. The blue square data points are the differential cross section for the first of the sequential dibaryon candidate determined from the $\pi^0 d$ invariant mass distributions shown in fig. 9 with a Breit-Wigner function fitted and the mass and width labelled inset. Only the statistical uncertainties are shown.

ePrint: 2202.08594 [nucl-ex]
Accettato da PLB e disponibile online

La Rivista del Nuovo Cimento (2022) 45:189–276
https://doi.org/10.1007/s40766-021-00028-5

REVIEW PAPER

Check for updates

Trends in particle and nuclei identification techniques in nuclear physics experiments

7.3 BGOOD (MAMBO): neutral particles discrimination with BGO

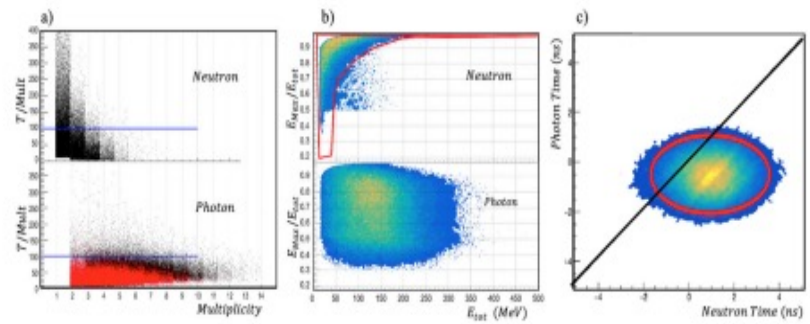
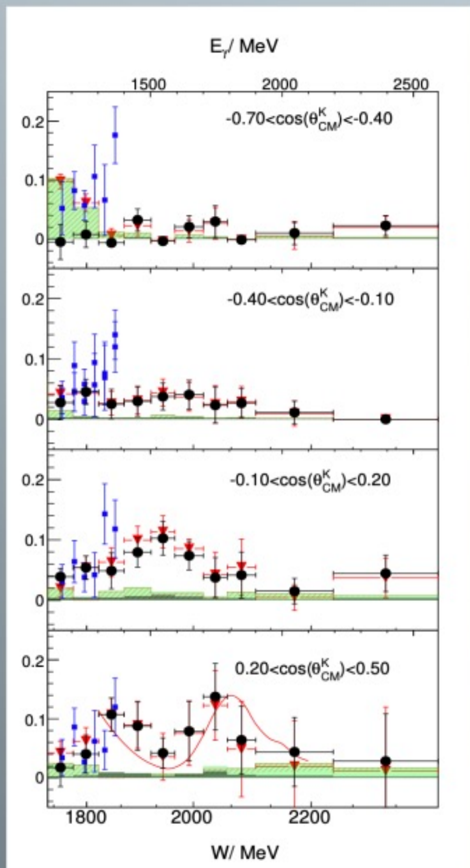


Fig. 35 MAMBO. **a** Ratio between the total cluster energy and the cluster multiplicity for neutrons and photons (in black and red the more and less energetic π^0 decay photons, respectively). **b** Ratio between the maximum energy released in a crystal and the total cluster energy for neutrons with multiplicity > 2 and photons (sum of red and black distributions from **a**).The applied graphical cut is the red contour. **c** photon TOF versus neutron TOF distribution for selected events, the applied cut is presented in red. Ambiguity between two neutral signals with the same multiplicity is solved assigning the neutron tag to the signal with larger TOF (see 45° black line in the picture)

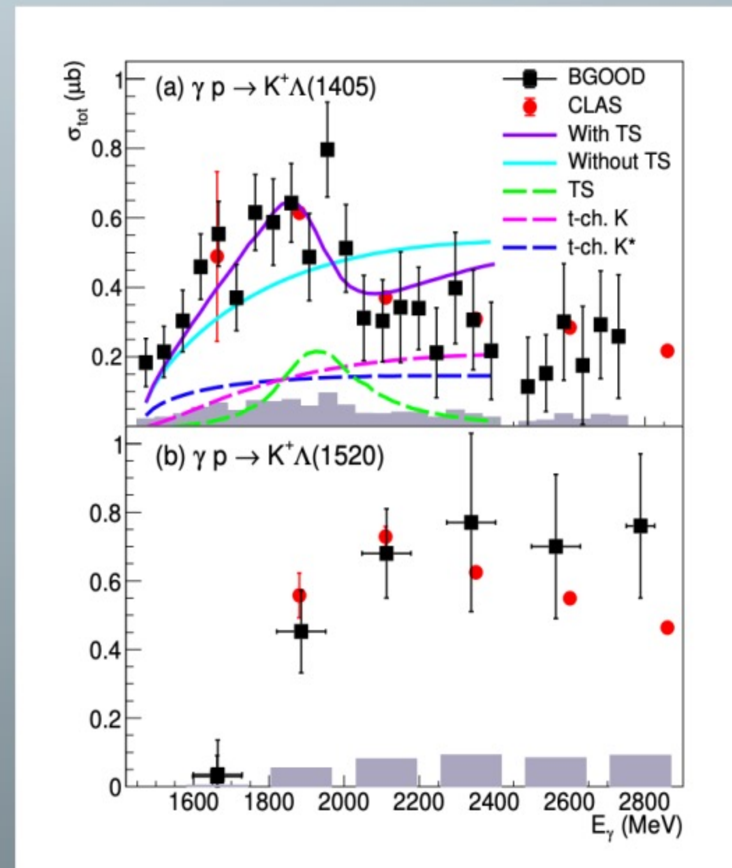
La Rivista del Nuovo Cimento , Volume 45, pp 189-276; https://doi.org/10.1007/s40766-021-00028-5

Measurement of the $\gamma n \rightarrow K^0 \Sigma^0$ differential cross section over the K^* threshold (➛EPJ)

Photoproduction of $K^+\Lambda(1405) \rightarrow K^+\pi^0\Sigma^0$ extending to forward angles and low momentum transfer(➛PLB)



2 lavori su arXiv



ePrint: 2108.13319 [nucl-ex]

ePrint: 2108.12235 [nucl-ex]

Analisi dati

Estrazione delle asimmetrie di fascio nella fotoproduzione dei mesoni pseudoscalari su protone e su neutrone quasi libero

Confronto con dati esistenti in letteratura (GRAAL)

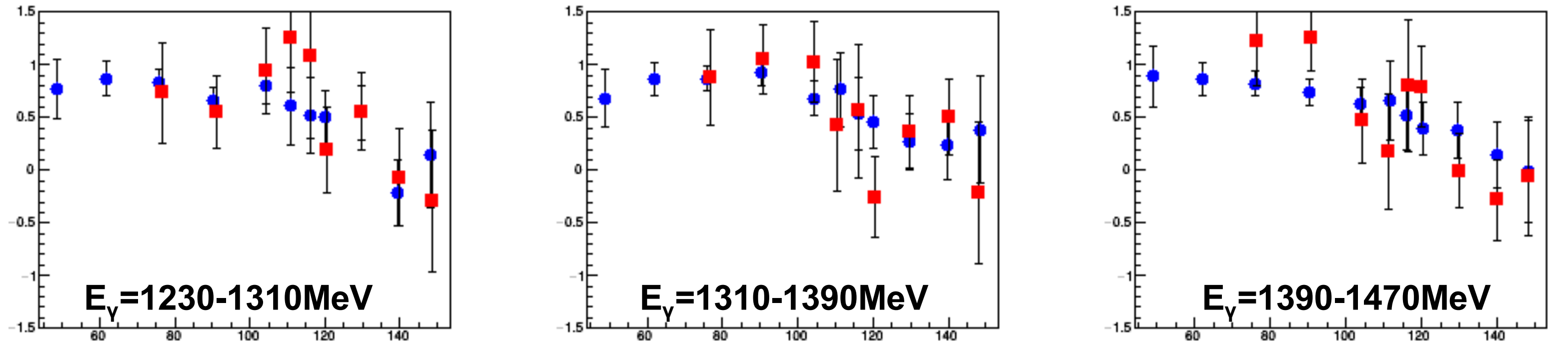
In attesa di ulteriore statistica studio di tutti i decadimenti dell' η

$\eta \rightarrow 2\gamma$ $\eta \rightarrow 3\pi^0 \rightarrow 6\gamma$ $\eta \rightarrow \pi^+\pi^-\pi^0$

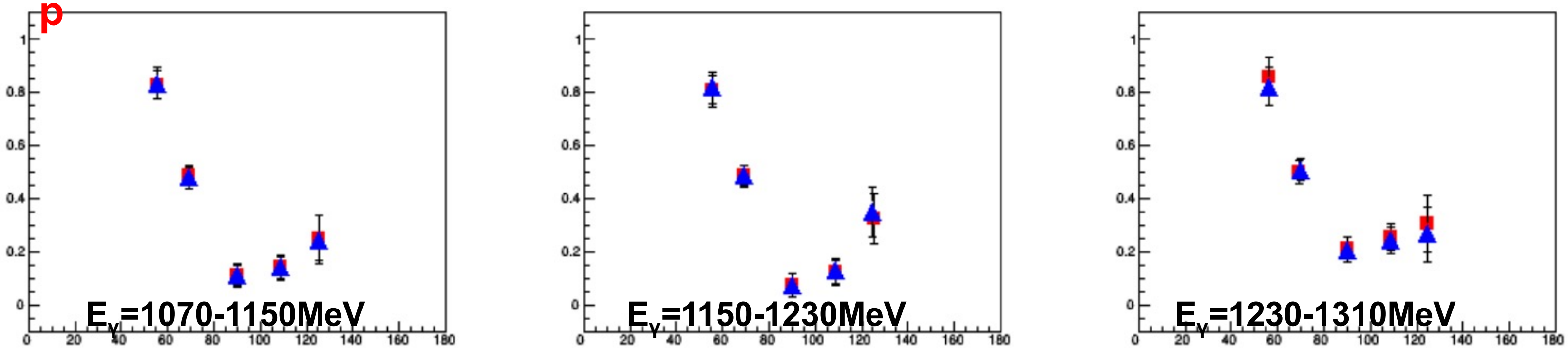
e con protone in avanti (spettrometro) o al centro (BGO+barrel), neutron al centro (BGO)

Ricerca del segnale di η' in 2γ e in 6γ

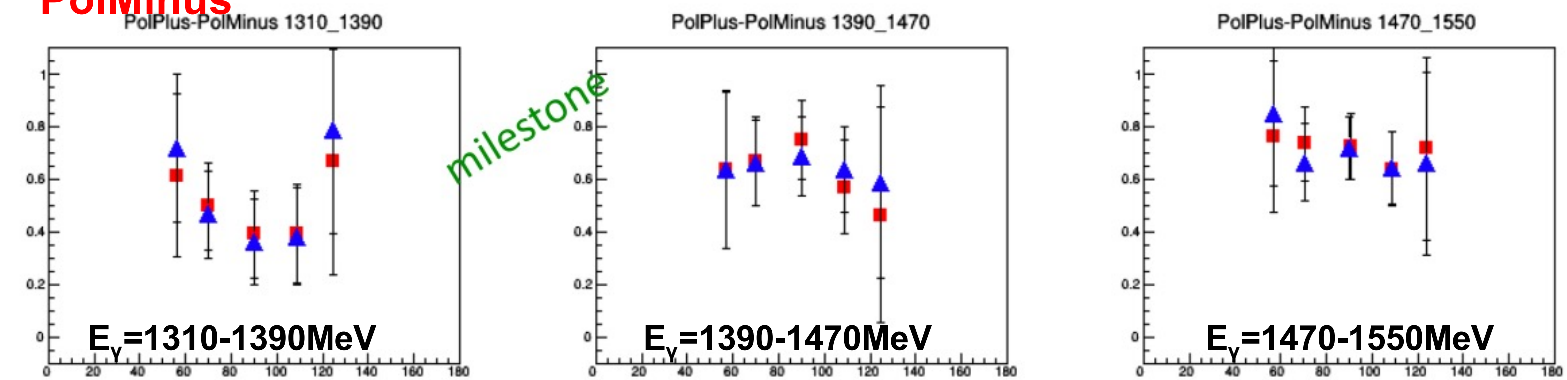
Risultati preliminari – Asimmetrie vs Theta$_{CM}$



Blue: $\gamma p \rightarrow \eta\ p \rightarrow 2\gamma\ p$ **Red**: $\gamma\ p \rightarrow \eta\ p \rightarrow 3\ \pi^0\ p \rightarrow 6\ \gamma$
p



Blue: $\gamma n \rightarrow \pi^0\ n \rightarrow 2\gamma\ n$ PolPlus **Red**: $\pi^0\ n \rightarrow \pi^0\ n \rightarrow 2\ \gamma\ n$
PolMinus



Blue: $\gamma n \rightarrow \eta\ n \rightarrow 2\gamma\ n$ PolPlus **Red**: $\gamma\ n \rightarrow \eta\ n \rightarrow 2\ \gamma\ n$
PolMinus

Attività prevista 2022-2023

- Esperimento BGOOD in corso:

- Sett-Ott 2022: Presa dati di 2-3 settimane su idrogeno (bersaglio 11cm) per incrementare la statistica di fotoproduzione di η ed η’

- Sostituzione della cella del bersaglio (passaggio da 11cm a 6cm) e manutenzione del sistema criogenico con sostituzione eventuali componentistiche obsolete o deteriorate → vedi preventivi

- Dic. 2022: possibile presa dati di 2-3 settimane (in funzione della disponibilità di fascio)

- 2023: prese dati su bersaglio di deuterio (bersaglio 6cm) per migliorare la risoluzione nella misura di canali completamente neutri

- Attività della sezione per il 2023:

- Partecipazione ai lavori per la ripartenza dell’apparato e alle prese dati

- Analisi dei nuovi dati per l’estrazione delle asimmetrie di fascio di η ed η’ su neutrone

PREVENTIVI MAMBO 2023	
Missioni	
Presa Dati+Manutenzione Calorimetro-Bersaglio- MRPC su BGOOD a Bonn: 1.5 MU x 2 FTE	14 K€
Trasporti	
Trasporto Materiale da Roma a Bonn e viceversa	1.5 K€
Manutenzione	
Manutenzione del sistema criogenico installato su BGOOD con sostituzione componentistica obsoleta o deteriorata + sostituzione della cella del bersaglio (passaggio da 11cm a 6cm) Riparazione ADC Wiener da parte della CAEN (modello in obsolescenza)+riparazione schede HV CAEN	14.0 K€ 10.0 K€
Assorbitore sistema criogenico per bersaglio	2.5 kE
Totale Richieste	**38 k€**

Anagrafica – JLAB12 Roma Tor Vergata

cognome	nome	contratto	profilo	aff	perc	
Bondi'	Mariangela	Associato	Scientifica Ricercatori/Professori universita'		3	50%
D'Angelo	Annalisa	Associato	Incarico di Ricerca scientifica		3	80%
Lanza	Lucilla	Dipendente	Assegno di Ricerca		3	90%
Rizzo	Alessandro	Associato	Scientifica Dipendenti altri enti		3	100%
				Totale	3.2 FTE	
			Personale Tecnico			
Nobili	Giovanni	Dipendente	Collaboratore Tecnico E.R.		3	50%
Pecchi	Daniele	Associato	Associazione Tecnica			30%
Reali	Enzo	Associato	Incarico di Collaborazione Tecnica		2	30%
Tusi	Enrico Maria	Associato	Incarico di Collaborazione Tecnica			30%
				Totale	1.4 FTE	

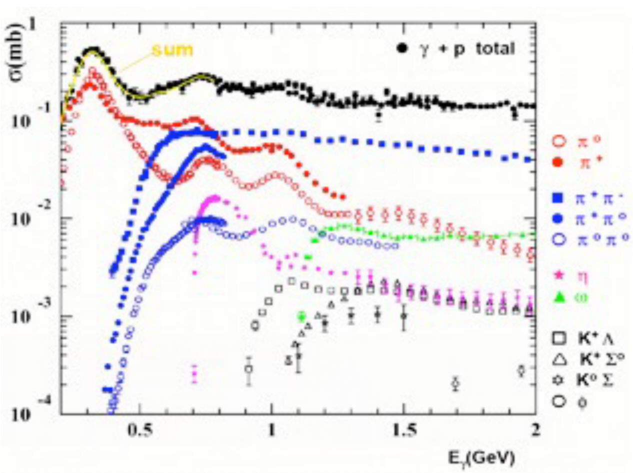
Percentuale di partecipazione 3.2 FTE / 4 RIC = 80%

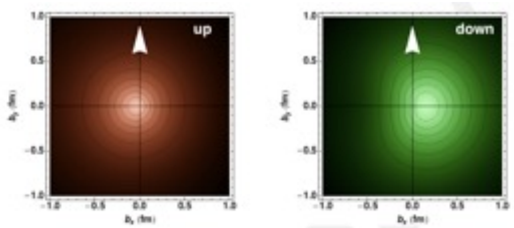
Esperimento JLAB12

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 & BDX (Beam Dump Experiment)





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

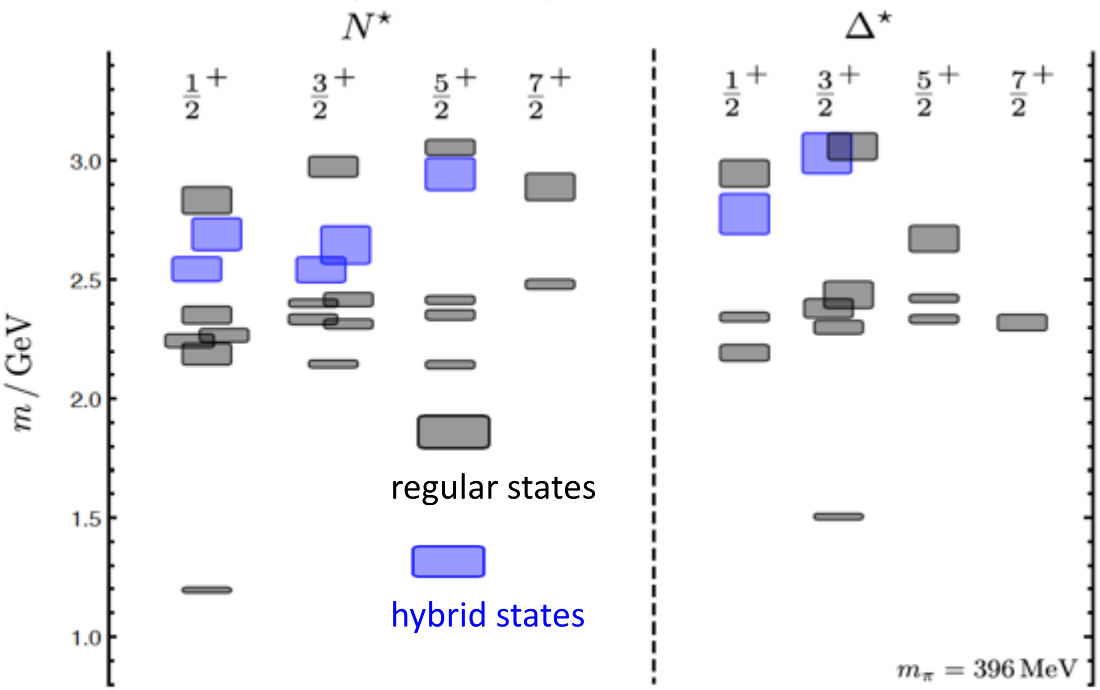
Thomas Jefferson National Accelerator Facility – Virginia, USA People: 46 researchers, 25 FTE

Data taking 2022-2027@ JLAB, Virginia

Experimental Program

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?

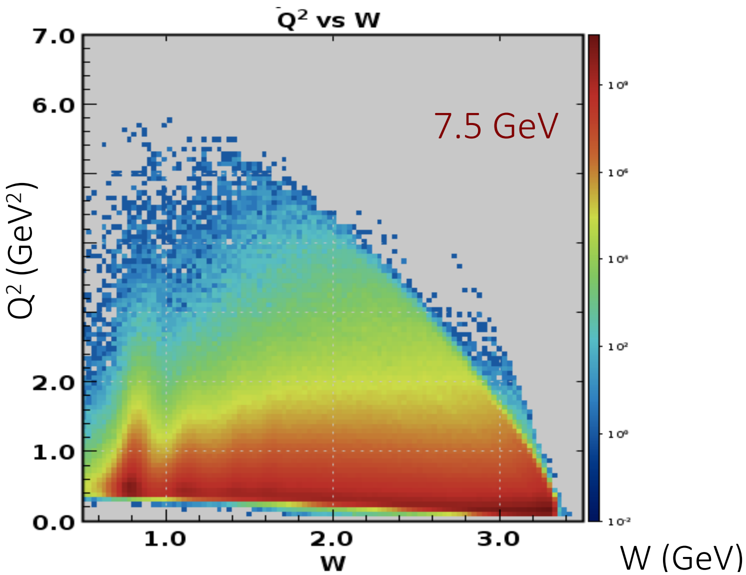
- Overpopulation of N $1/2^+$ and N $3/2^+$ states compared to QM projections.
- **$A_{1/2}$ ($A_{3/2}$) and $S_{1/2}$ show different Q^2 evolution. Can we do it?**

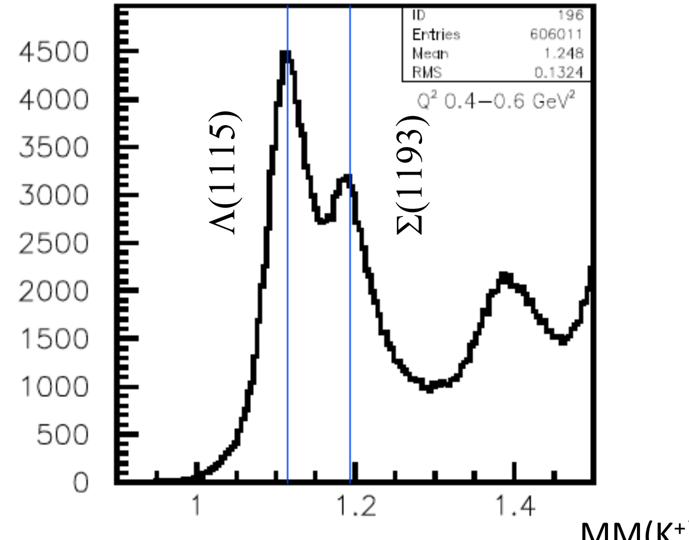
Study of Q^2 evolution of resonances electro-couplings from $K^+\Lambda$ electro production from the proton

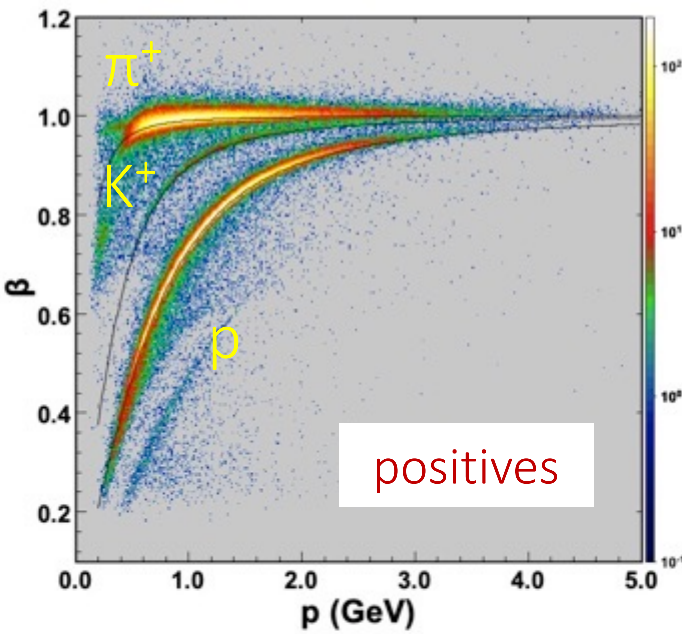
20 days of data taking have been collected by the experiment in 2018

→ additional 86 days have been allocated from September 23rd to December 18th 2023

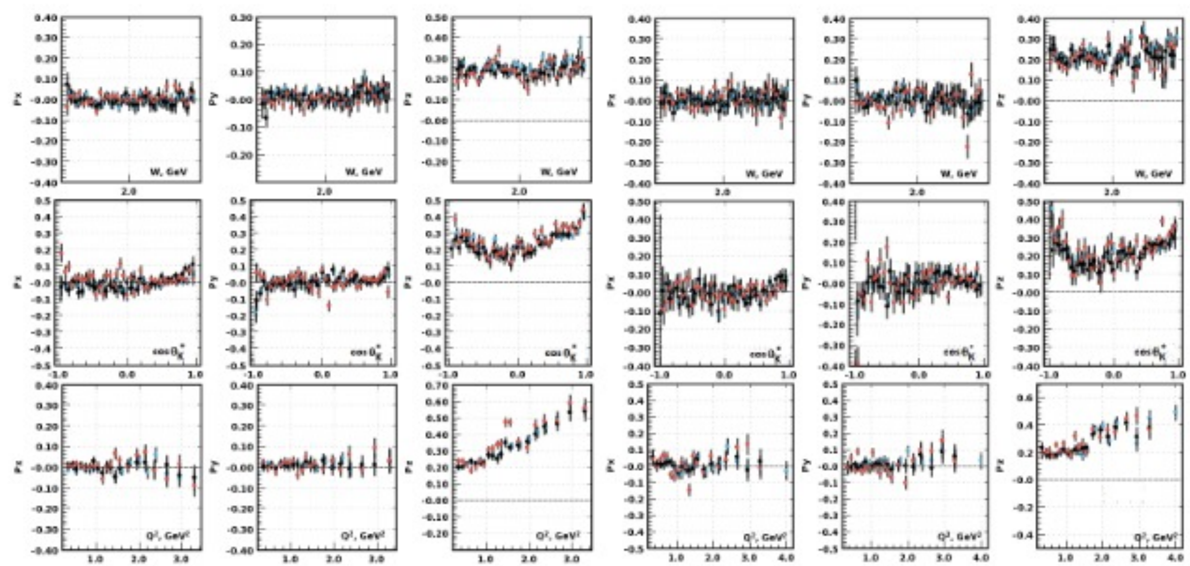
First results on KY electroproduction







Polarization Transfer asymmetries



CLAS12 Collaboration

On-going data analysis

RG_K
Data set

Paper

Phys. Rev. C

Beam-Recoil Transferred Polarization in K^+Y Electroproduction in the Nucleon Resonance Region with CLAS12

D.S. Carman,[†40] A. D'Angelo,[19,34] L. Lanza,[19] V.I. Mokeev,[40] K.P. Adhikari,[14] M.J. Amaryan,[31] W.R. Armstrong,[1] H. Atac,[38] H. Avakian,[40] C. Ayerbe Gayoso,[26,42] N.A. Baltzell,[40] L. Barion,[15] M. Battaglieri,[17,40] I. Bedlinskiy,[21] B. Benkel,[39] A. Bianconi,[2,18] A.S. Biselli,[7] M. Bondi,[17] S. Boiarinov,[40] F. Bossù,[35] W.J. Briscoe,[12] S. Bueltmann,[31] D. Bulumulla,[31] V.D. Burkert,[40] R. Capobianco,[6] J.C. Carvajal,[9] A. Celentano,[17] P. Chatagnon,[32] V. Chesnokov,[36] T. Chetry,[26,30] G. Ciullo,[8,15] L. Clark,[13] P.L. Cole,[24] M. Contalbrigo,[15] G. Costantini,[2,18] V. Crede,[10] N. Dashyan,[43] R. De Vita,[17] M. Defurne,[35] A. Deur,[40] S. Diehl,[6,11] C. Djalali,[30] R. Dupre,[32] M. Ehrhart,[1,32] A. El Alaoui,[39] L. El Fassi,[26] L. Elouadrhiri,[40] S. Fegan,[44] A. Filippi,[20] G. Gavalian,[40] Y. Ghandilyan,[43] G.P. Gilfoyle,[33] F.X. Girod,[40] D.I. Glazier,[13] A.A. Golubenko,[36] R.W. Gothe,[37] Y. Gotra,[40] K.A. Griffioen,[42] K. Hafidi,[1] H. Hakobyan,[39,43] M. Hattawy,[31] F. Hauenstein,[40] T.B. Hayward,[6,42] A. Hobart,[32] M. Holtrop,[27] Y. Ilieva,[37] D.G. Ireland,[13] E.L. Isupov,[36] H.S. Jo,[23] K. Joo,[6] D. Keller,[41] A. Khanal,[9] A. Kim,[6] W. Kim,[23] V. Klimenko,[6] A. Kripko,[11] V. Kubarovsky,[40] M. Leali,[2,18] S. Lee,[25] P. Lenisa,[8,15] K. Livingston,[13] I.J.D. MacGregor,[13] D. Marchand,[32] L. Marsicano,[17] V. Mascagna,[2,18] M. Mayer,[31] B. McKinnon,[13] S. Migliorati,[2,18] T. Mineeva,[39] M. Mirazita,[16] R.A. Montgomery,[13] C. Munoz Camacho,[32] P. Nadel-Turonski,[40] K. Neupane,[37] J. Newton,[31,40] S. Niccolai,[32] M. Osipenko,[17] P. Pandey,[31] M. Paolone,[28,38] L.L. Pappalardo,[8,15] R. Paremuzyan,[27,40] E. Pasyuk,[40] S.J. Paul,[3] N. Pilleux,[32] O. Pogorelko,[21] J.W. Price,[4] Y. Prok,[31] B.A. Raue,[9] T. Reed,[9] M. Ripani,[17] J. Ritman,[22] A. Rizzo,[19,34] P. Rossi,[40] F. Sabatié,[35] C. Salgado,[29] A. Schmidt,[12,25] Y.G. Sharabian,[40] E.V. Shirokov,[36] U. Shrestha,[6,30] P. Simmerling,[6] D. Sokhan,[13,35] N. Sparveris,[38] S. Stepanyan,[40] I.I. Strakovsky,[12] S. Strauch,[37] N. Tyler,[37] R. Tyson,[13] M. Ungaro,[40] S. Vallarino,[15] L. Venturelli,[2,18] H. Voskanyan,[43] E. Voutier,[32] D.P. Watts,[44] K. Wei,[6] X. Wei,[40] R. Wishart,[13] M.H. Wood,[5] B. Yale,[42] N. Zachariou,[44] J. Zhang,[41] V. Ziegler[40]
(CLAS Collaboration)
[1] *Argonne National Laboratory, Argonne, Illinois 60439*

PHYSICAL REVIEW C
covering nuclear physics

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Beam-recoil transferred polarization in K^+Y electroproduction in the nucleon resonance region with CLAS12

D. S. Carman *et al.* (CLAS Collaboration)
Phys. Rev. C **105**, 065201 – Published 1 June 2022

[17] *INFN, Sezione di Genova, 16146 Genova, Italy*
[18] *INFN, Sezione di Pavia, 27100 Pavia, Italy*
[19] *INFN, Sezione di Roma Tor Vergata, 00133 Rome, Italy*
[20] *INFN, Sezione di Torino, 10125 Torino, Italy*
[21] *National Research Center Kurchatov Institute,*

G14
Data set

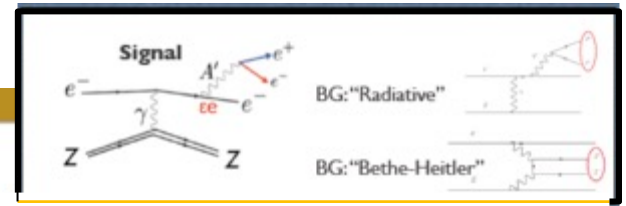
Analysis Notes

Study of polarization asymmetries in the $\vec{\gamma}\vec{N} \rightarrow \pi^+\pi^- N$ reaction with circularly polarized photons and a polarized target at CLAS

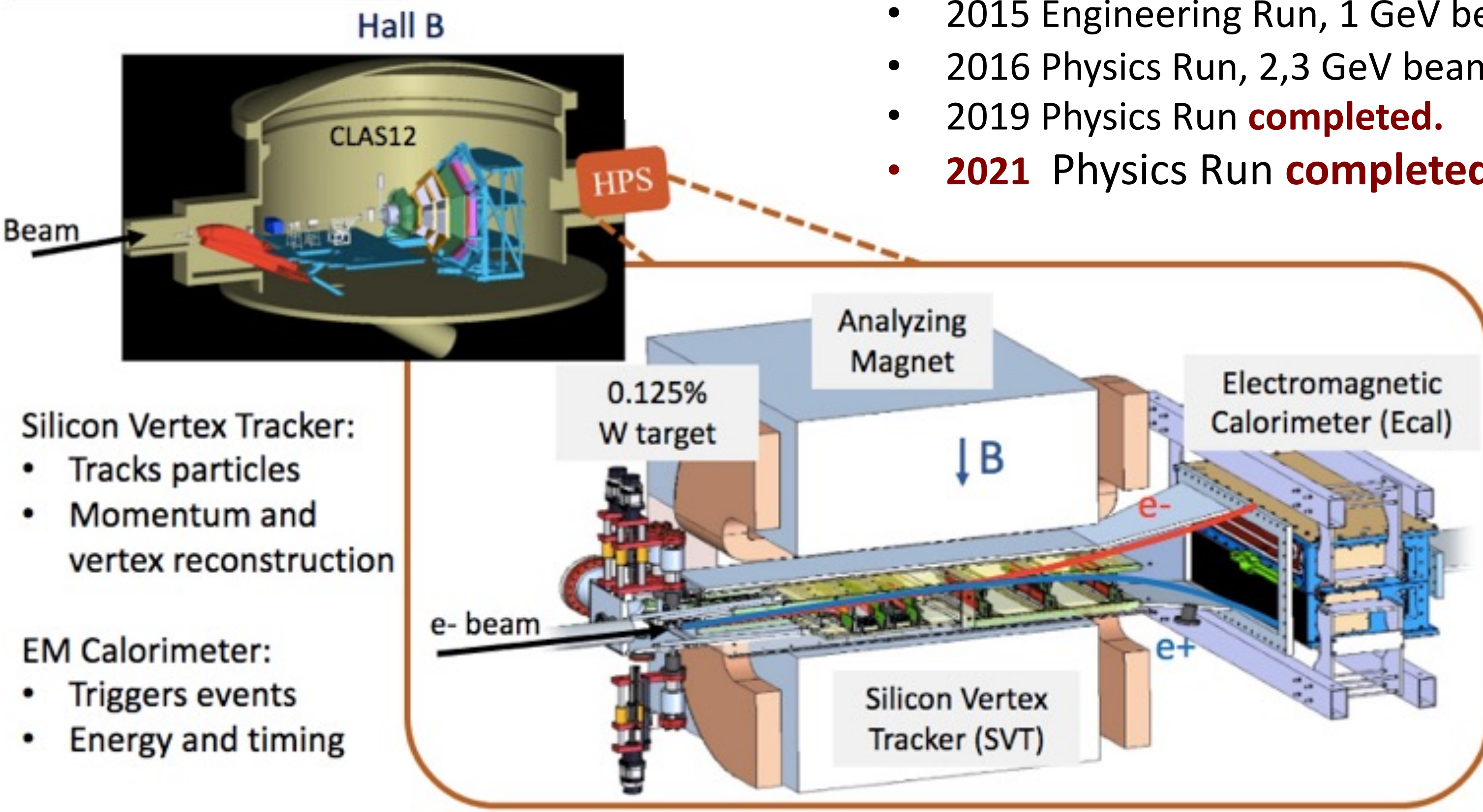
Annalisa D'Angelo
Alessandra Filippi
Lucilla Lanza

July 13, 2021

HPS Experiment   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.**
- **2021** Physics Run **completed.**



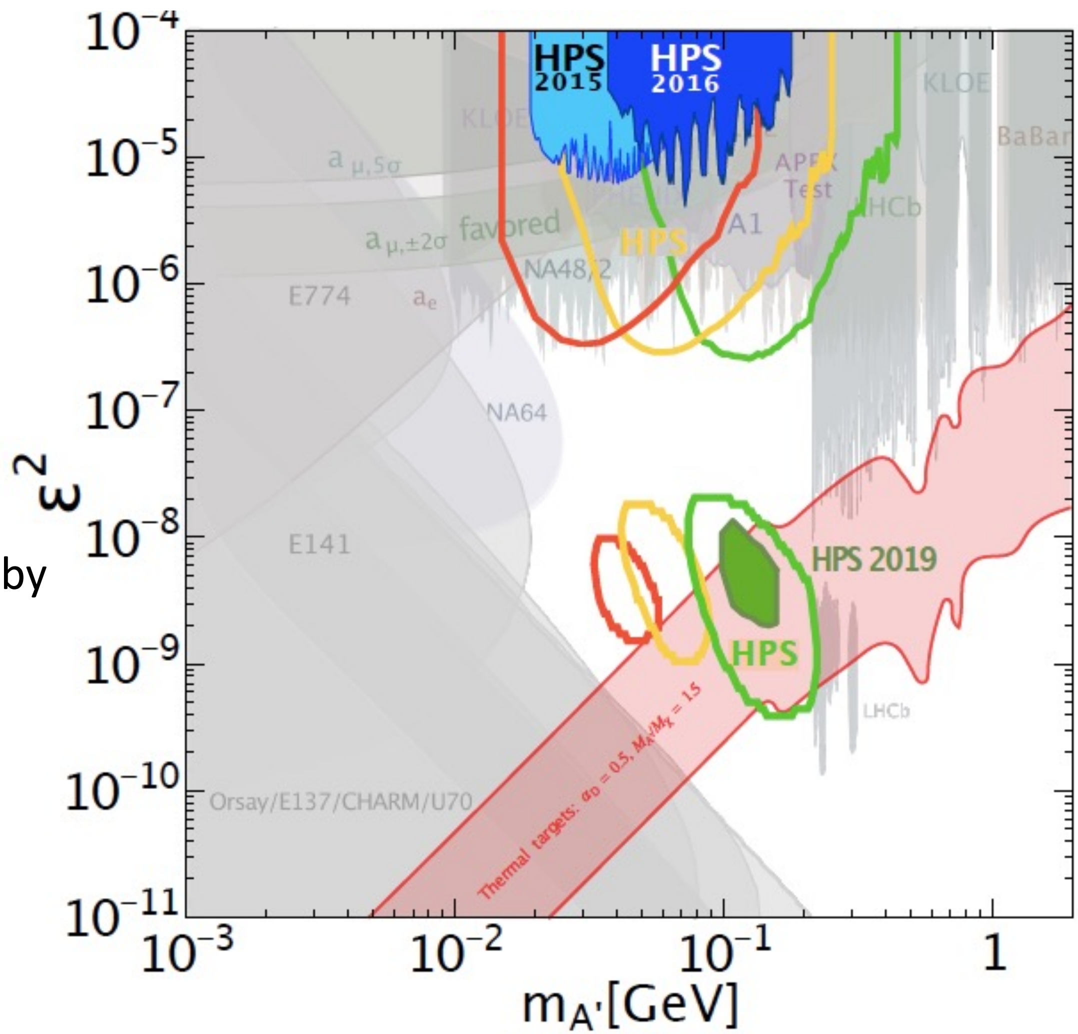
Silicon Vertex Tracker:
- Tracks particles
- Momentum and vertex reconstruction

EM Calorimeter:
- Triggers events
- Energy and timing

HPS Experiment

HPS Projected Reach with upgraded detector.

- **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
- 2019 – data taken
- 2021 – data taken



The Heavy Photon Search Experiment

Nathan Baltzell,[1] Marco Battaglieri,[1] Mariangela Bondi,[2] Sergei Boyarinov,[1] Cameron Bravo,[3] Stephen Bueltmann,[4] Volker Burkert,[1] Pierfrancesco Butti,[3] Tongtong Cao,[5] Massimo Carpinelli,[6] Andrea Celentano,[2] Gabriel Charles,[7] Chris Cuevas,[1] Annalisa D'Angelo,[8] Domenico D'Urso,[6] Natalia Dashyan,[9] Marzio De Napoli,[10] Raffaella De Vita,[2] Alexandre Deur,[1] Miriam Diamond,[11] Raphael Dupre,[7] Rouven Essig,[12] Vitaliy Fadeyev,[13] R. Clive Field,[3] Alessandra Filippi,[14] Sarah Gaiser,[15] Nerses Gevorgyan,[9] Norman Graf,[3] Mathew Graham,[3] Michel Guidal,[7] Ryan Herbst,[3] Maurik Holtrop,[5] John Jaros,[3] Robert Johnson,[13] Valery Kubarovsky,[1] Dominique Marchand,[7] Luca Marsicano,[2] Takashi Maruyama,[3] Samantha McCarty,[5] Jeremy McCormick,[3] Bryan McKinnon,[16] Omar Moreno,[3] Carlos Munoz-Camacho,[7] Timothy Nelson,[3] Silvia Niccolai,[7] Rory O'Dwyer,[15] Rafayel Paremuzyan,[1] Emrys Peets,[15] Nunzio Randazzo,[10] Benjamin Raydo,[1] Benjamin Reese,[3] Philip Schuster,[3] Gabriele Simi,[17] Valeria Sipala,[6] Matthew Solt,[3] Alic Spellman,[13] Stepan Stepanyan,[1] Holly Szumila-Vance,[1] Lauren Tompkins,[15] Natalia Toro,[3] Maurizio Ungaro,[1] and Hakop Voskanyan[9]

[1]*Thomas Jefferson National Accelerator Facility, Newport News, Virginia 23606*

[2]*Istituto Nazionale di Fisica Nucleare, Sezione di Genova e Dipartimento di Fisica dell'Università, 16146 Genova, Italy*

[3]*SLAC National Accelerator Laboratory, Menlo Park, CA 94025, USA*

[4]*Old Dominion University, Norfolk, Virginia 23529*

[5]*University of New Hampshire, Department of Physics, Durham, NH 03824*

[6]*Università di Sassari e Istituto Nazionale di Fisica Nucleare, 07100 Sassari, Italy*

[7]*Institut de Physique Nucleaire d'Orsay, IN2P3, BP 1, 91406 Orsay, France*

[8]*Istituto Nazionale di Fisica Nucleare, Sezione di Roma-TorVergata*

arXiv:2203.08324v1 [hep-ex] 16 Mar 2022

Submitted to the Proceedings of the US Community Study
on the Future of Particle Physics (Snowmass 2021)

University of California at Santa Cruz, Santa Cruz, CA 95064, USA

[14]*Istituto Nazionale di Fisica Nucleare, Sezione di Torino, Torino, Italy*

$\mu - Rwell$ for HI-LUMI

Future Activities

- A Luminosity upgrade has been foreseen by JLAB
  I. increase the luminosity by x2 with high reconstruction efficiency
  II. proceed with >x10 increase

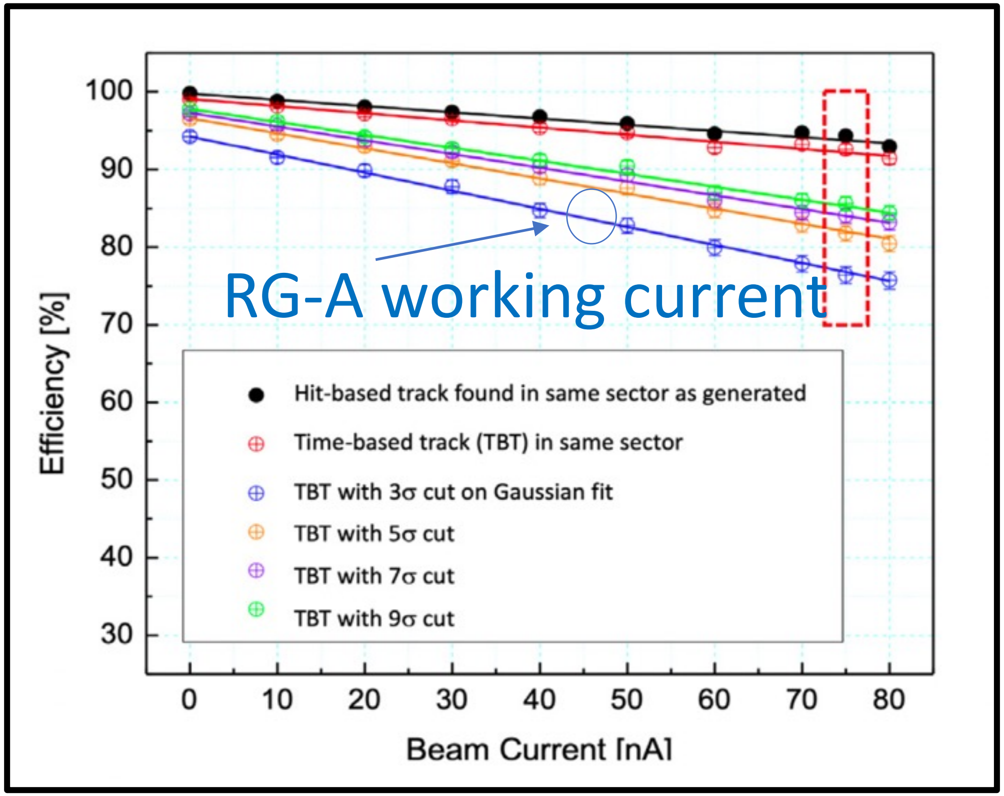
- **Phase 1** - DC R1 should be backed or substituted by a faster MPGS
  - µ-Rwell detectors have been identified as the most suited MPGS
  - R&D activity is on-going –both at JLAB and INFN - to identify the best 2D – large scale configuration of µ-Rwell detect to cover R1 region
  (2 years study + final production)

- **Phase 2 and** - µCLAS12 / open acceptance configurations require major changes streaming read-out DAQ electronics

$\mu - Rwell$ for HI-LUMI

CLAS12 Luminosity - Detectors Limitations

Nominal CLAS12 luminosity $\mathcal{L} = 10^{35}$ cm^{-2} sec^{-1} is achieved on a 5 cm LH2 target at $I_e = 75$ nA



Most Data Taking currently limited the current on target to $I_e = 45$ nA to maximize the figure of merit $\mathcal{L} \times \eta$ for three-prongs events.

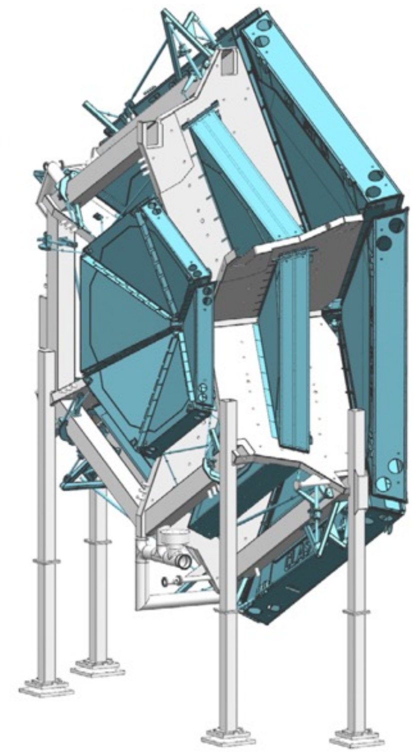
$\mathcal{L} = 0.7\ 10^{35}$ cm^{-2}s^{-1}

$\eta_{3p} = 0.85^3 = 0.55$

$\mu - Rwell$ for HI-LUMI

CLAS12 Luminosity Upgrade

- replace tracking planes to DC Region 1 (with MPGD tracker) – **major project**, R&D started
- DC chambers in Region 1 are made of 2 superlayers, of 6 layers each, and should be replaced with 6 layers of 2D $\mu - Rwell$.
- Requirements:
  - ✓ Tracking resolution: 100 μm
  - ✓ Timing resolution: 10 ns
  - ✓ Rate: 100 KHz/cm^2
  - ✓ Low material budget

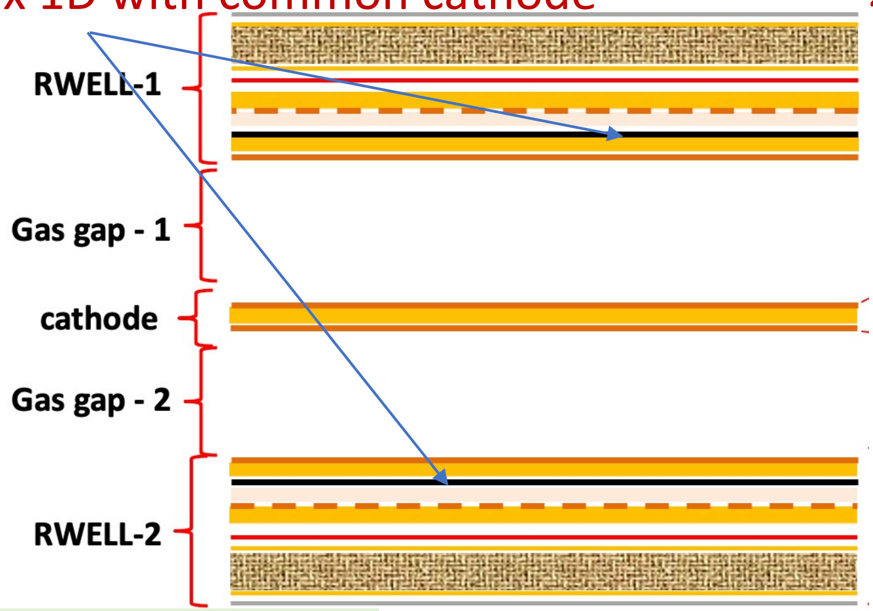


$\mu - Rwell$ for HI-LUMI

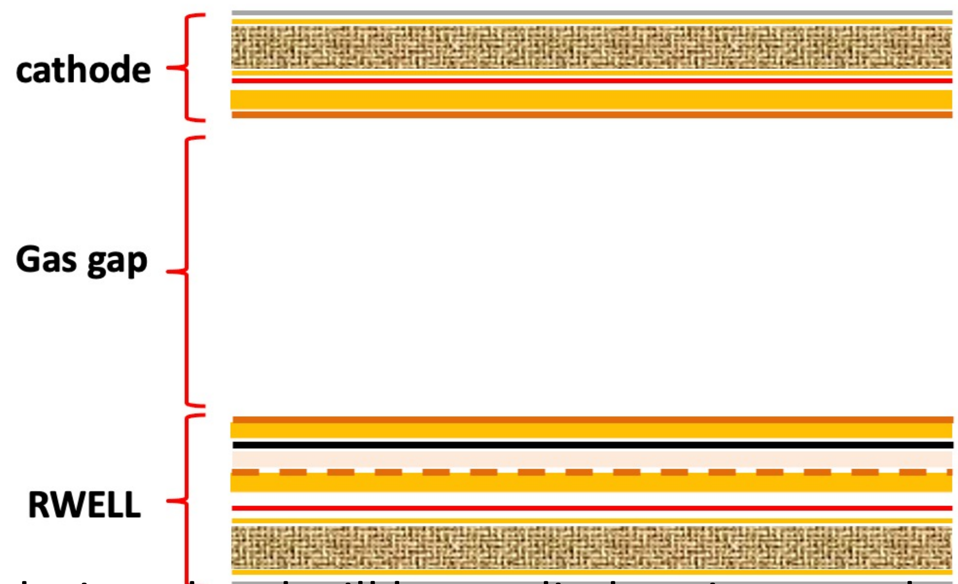
μ-RWELL Prototyping: step 1 - 10 cm x10 cm 2D readout

2D – readout schemes are being studied in LNF/Rome

2 x 1D with common cathode



2D readout: standard X strips on the bottom layer
Y strips on the top layer



G. Bencivenni

The prototype is being designed and will be studied against couples of 1D detector in X-Y configuration.

Detectors prototypes will be tested @ CERN test beam run in fall 2022

Attività sperimentali previste

Hi-Lumi

Il laboratorio PP1 attrezzato per test rivelatori micro-R well.

Sviluppo di prototipi in collaborazione con LNF (G. Bencivenni)

Partecipazione a run di presa dati:

- CLAS (12 GeV) – 86 giorni assegnato a RG-K

Le richieste maggiori sono relative al progetto Hi-luminosity:

- Attrezzature di laboratorio per test rivelatori μ-R well
- Sviluppo rivelatori a ridotta densita' di materiali (low material budget)
- Forno per condizionare rivelatori a grande area

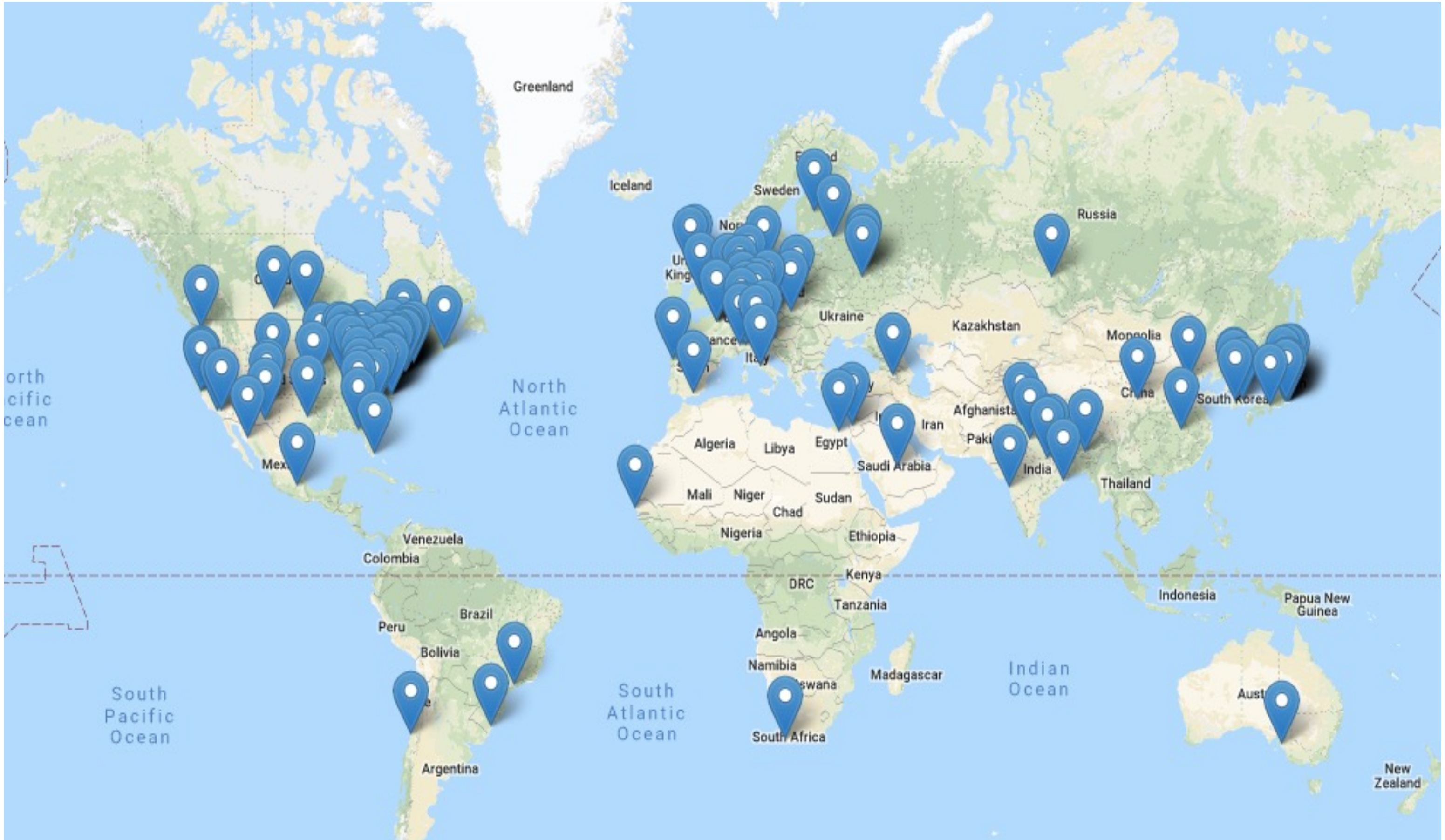
HI-LUMI

Roma Tor Vergata – Lab startup		
Item	**Costo Unitario €**	**Costo Totale IVA inclusa€**
2 rivelatori *50x50* + 1 grande area	3500	12000
Sistema di distribuzione del gas	5000	6100
HV Caen DT 552	3500	4250
Forno per rivelatori grande superficie	20000	24000
2 Bombol3 gas pre-miscelato Ar:CO2:CF4 (45:15:40)	1000	1200
Regolatori di flusso digitali	10000	12000
Materiale di Consumo	5000	6100
Totale		**65 650**
In Collaborazione con le Sezioni di Genova e Ferrara		

Esperimento JLAB12 Richieste Roma Tor Vergata

Missioni	
Turni di Misura CLAS12, missioni Ge per collaborazione FT e analisi	20 K€
Consumo	
Materiali per realizzazione Micro-R well test detectors	18.1 K€
Altro Consumo	
Gas Ar:CO2:CF4 (45:15:40)	1,5 K€
Inventariabile	
HV+Forno+regolatori di flusso	42 K€
Apparati	
Sistema distribuzione gas	6.1 K€
Totale Richieste	85,6 K€

EIC - NET



EIC-NET Roma Tor Vergata

Annalisa D'Angelo
Rachele Di Salvo
Alessia Fantini
Lucilla Lanza

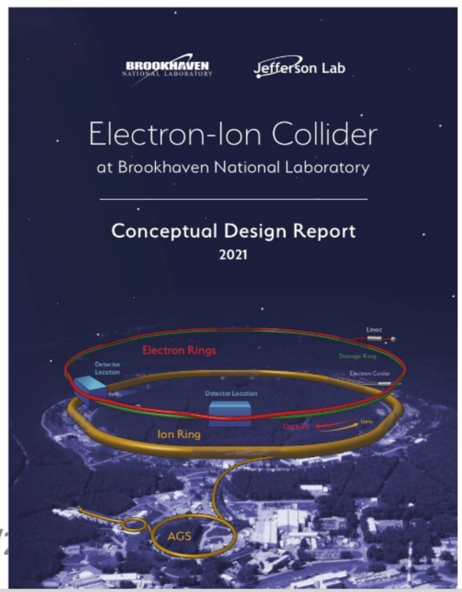
I. EIC User Group:

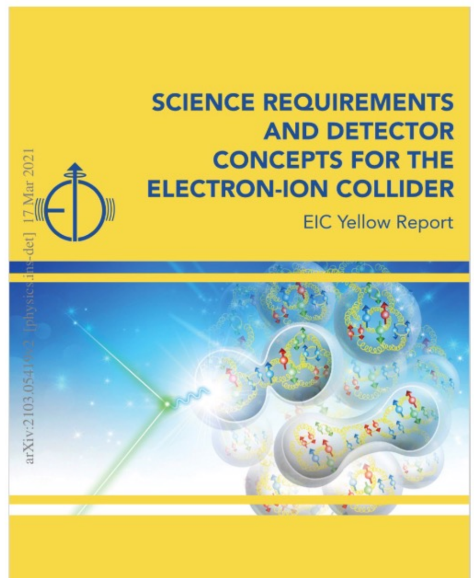
- 795 members
- 170 institutions
- 29 countries (7 world regions)

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

EIC - NET

CD-0 approved + BNL site selected (Dec2019/Jan2020)
All 2020: 4 online workshops to prepare Yellow Report + 1 EICUG meeting online
February 2021: EIC Conceptual Design Report: https://doi.org/10.2172/1765663
8 March 2021 Yellow Report released: https://arxiv.org/abs/2103.05419
March 2021: Call for detector proposals: https://www.bnl.gov/eic/CFC.php
March: First meetings of protocollaborations
28 June 2021: CD-1 passed "completion of the project Definition Phase and the conceptual design."
2-7 August 2021 EICUG (online) meeting: https://indico.bnl.gov/event/11463/
10 August 2021 call EIC Detector R&D FY22: https://indico.bnl.gov/event/10974/contributions/53172/attachments/36485/59965/Detector_RD_Plan_Aug10.2021.pdf
1st December 2021: **experiment proposals sent to DoE (ATHENA, ECCE, CORE)**
13-15 December 2021: first meeting of Detector Proposal Advisory Panel vis à vis proto-collaborations
https://indico.bnl.gov/event/13614/



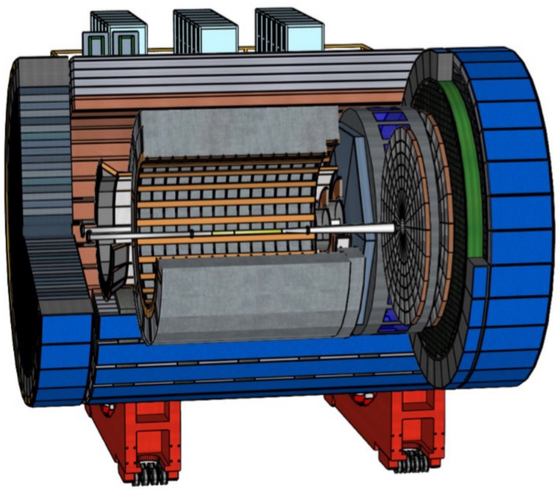


EIC - NET

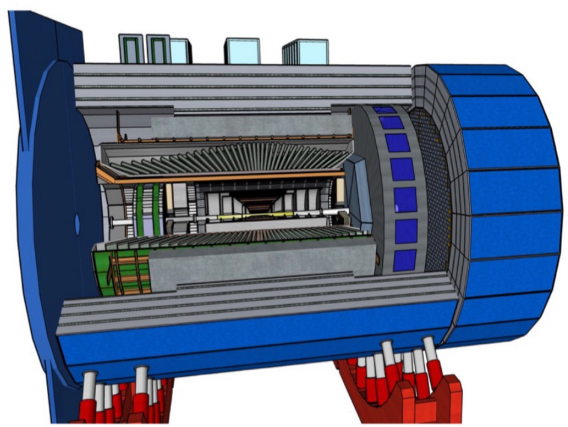
Detector proposals

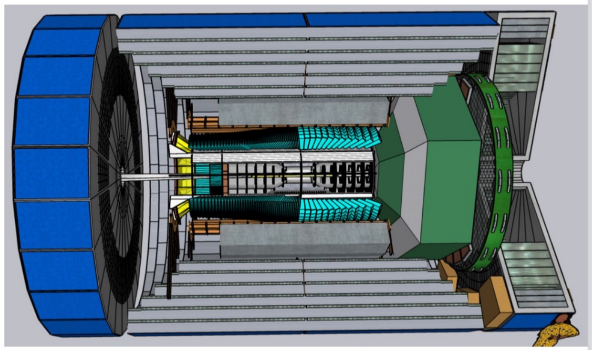
- ATHENA is general purpose (full EIC science) for IP6 with new 3T solenoidal magnet (and large bore diameter)
- ECCE is general purpose detector for IP6 re-using 1.4 T Babar magnet (bore diameter 2.8)
- CORE is a more "compact" proposal, potentially for IP8 (3T solenoid as well)

Design of all proposal driven by YR requirements, obviously with differences...



ATHENA





EIC-NET - Roma Tor Vergata

Attività prevista:

- triggerless DAQ – implementazione di codici basati su reti neurali su FPGA
  in collaborazione con INFN – Genova

Partecipanti: Annalisa D'Angelo 10% Rachele Di Salvo 10%
Alessia Fantini 20% Lucilla Lanza 10%
Mariangela Bondi' 30% Gaetano Salina 10%
Roberto Ammendola 10%

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

5 K€ Inventariabile per scheda di test FPGA

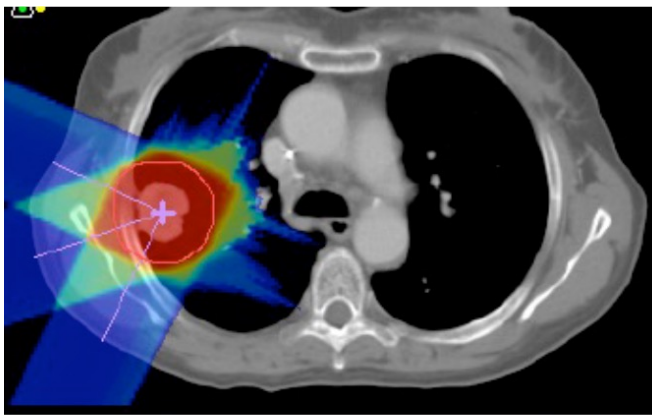
FOOT

Purposes:

a) Particle therapy improvements

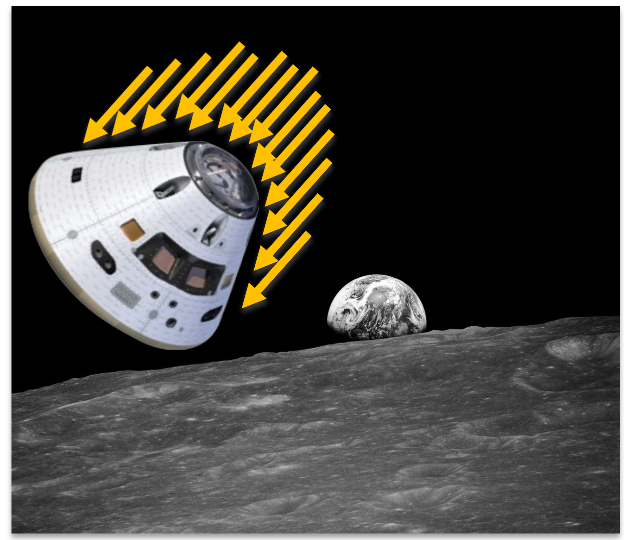
b) Deep space radioprotection

Hadrontherapy 150-400 MeV/u



Better knowledge of the nuclear fragmentation processes
→ better TPS, more patients and/or lower costs

0.4-2 GeV/u



Solar particle events or Galactic cosmic rays

The FOOT Physics Program

Specific measurements related with Particle Therapy & Radioprotection in Space

- Using C, C_2H_4 → cross sections on C and H
- Using C, C_2H_4, PMMA → cross sections on C, O and H

PMMA is a combination of C,O,H.

Phys	Beam	Target	Energy (MeV/u)	Inverse or direct
Target Frag. PT	^{12}C	C, C_2H_4	200	inv
Target Frag. PT	^{16}O	C, C_2H_4	200	inv
Beam Frag. PT	^{12}C	C, C_2H_4, PMMA	350	dir
Beam Frag. PT	^{16}O	C, C_2H_4, PMMA	400	dir
Beam Frag. PT	^{4}He	C, C_2H_4, PMMA	250	dir
Rad. Prot.space	^{4}He	C, C_2H_4, PMMA	700	dir
Rad. Prot.space	^{12}C	C, C_2H_4, PMMA	700	dir
Rad. Prot.space	^{16}O	C, C_2H_4, PMMA	700	dir

open to other possible physics programs

e.g. $^{12}C+C \rightarrow 3\alpha+X$ (clustering)

Fe+(Al, Si) → fragments (deep space radioprotection)

e.g. $^{12}O+O$ fragmentation

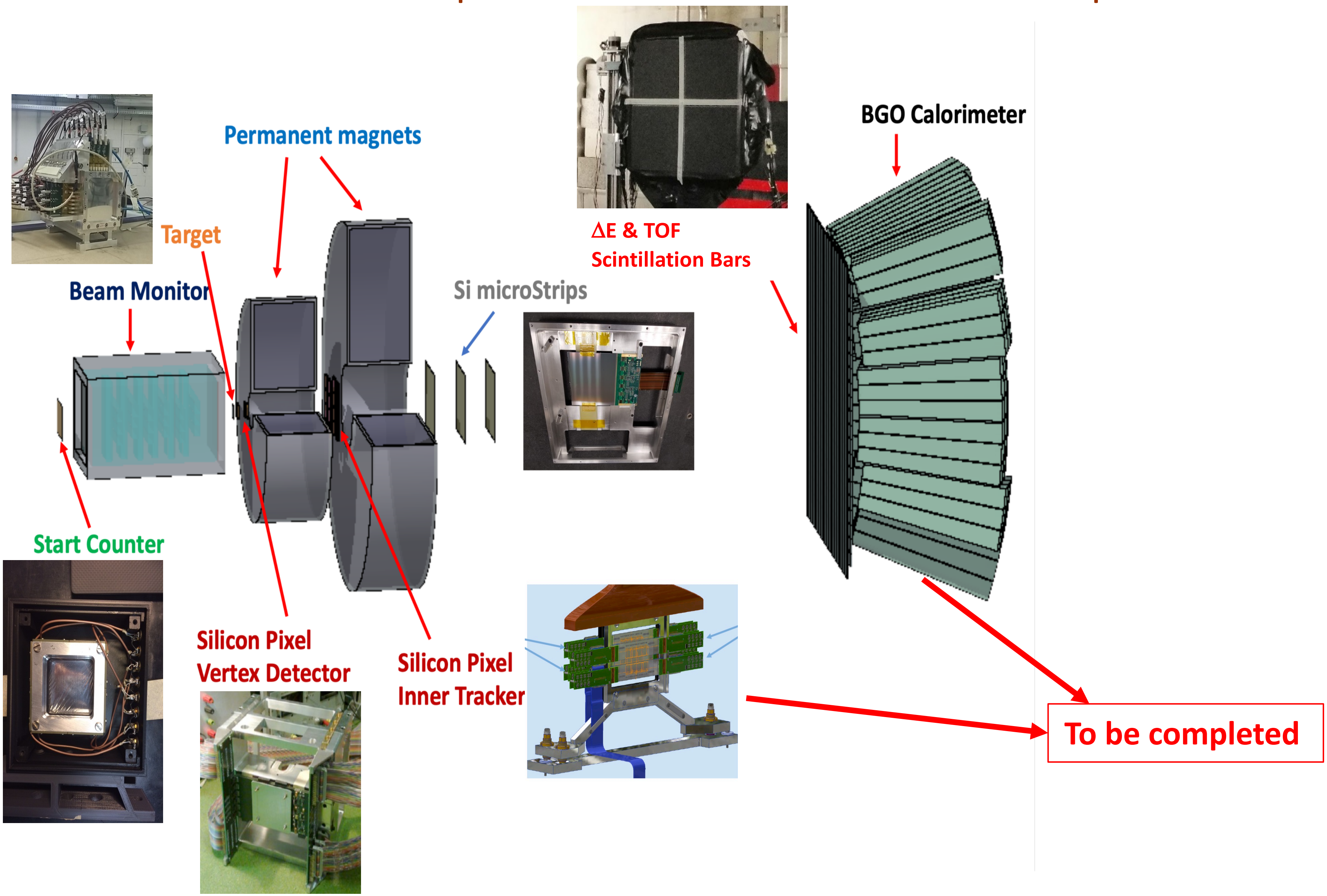
Collaboration

10 units (Bo, LNF, Mi, Na, Pg, Pi, Rm1, Rm2, TIFPA, To)
73 researchers & 11 technologists

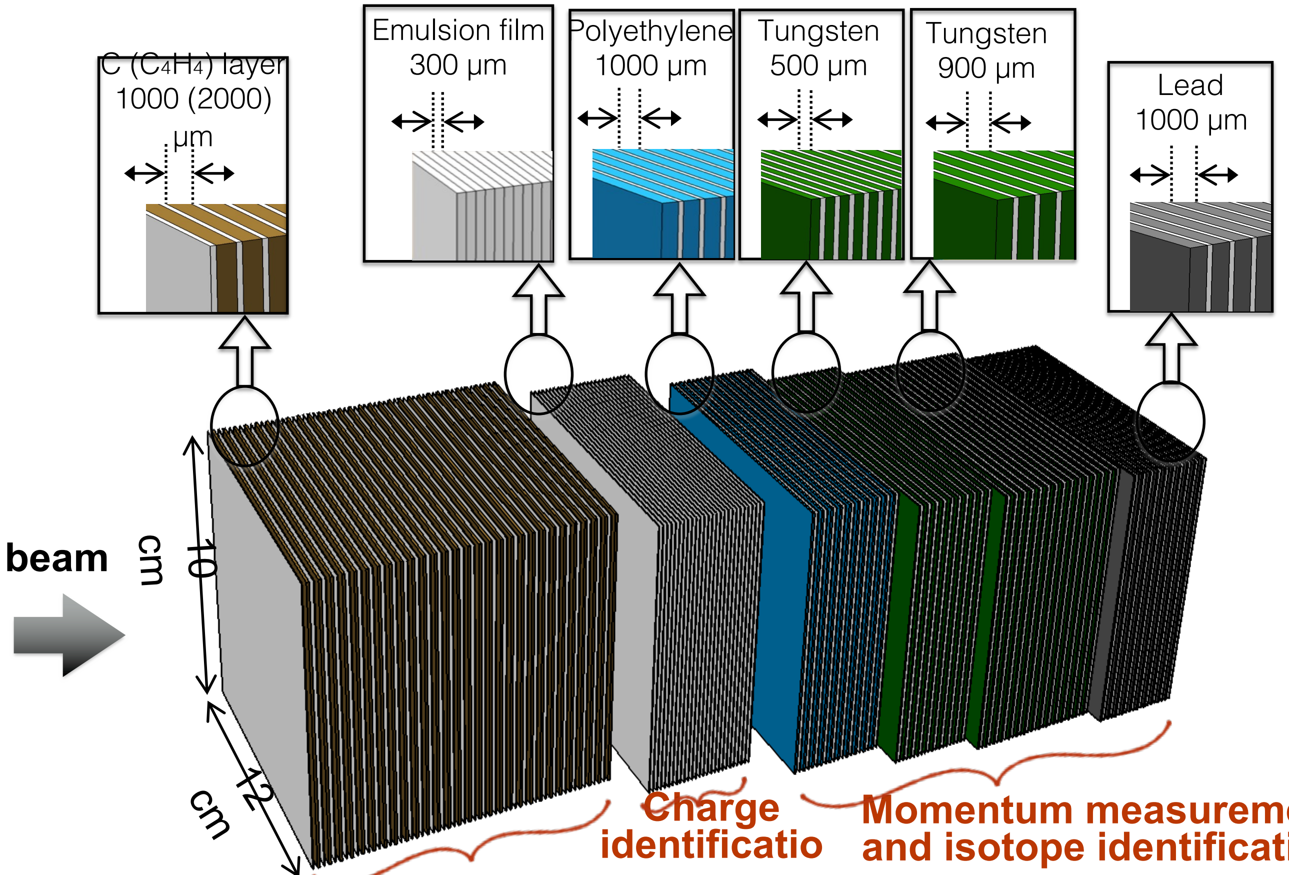
99 Authors, 34 Institutions
Italy, France, Germany, **Japan**, Russia, **Cuba**
3 Continents (Europe, **Asia, America**)

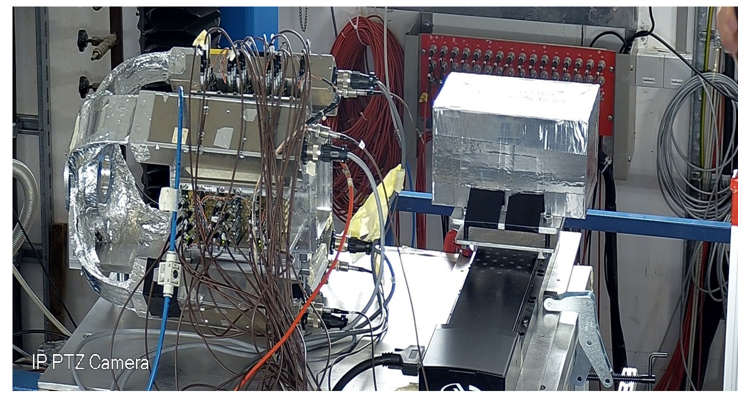
Cognome	Nome	Note	Struttura	Modulo	Contratto	Profilo	Stato	Aff.	%
Minniti	Triestino		ROMA2	G1	Associato	Scientifica Ricercatori/Professori università	Attivo	CSN3	**100%**
Morone	Maria Cristina		ROMA2	G1	Associato	Incarico di Ricerca scientifica	Attivo	CSN3	**70%**
Narici	Livio		ROMA2	G1	Associato	Incarico di Ricerca scientifica	Attivo	CSN2	**30%**

The FOOT experiment: the electronic spectrometer



The FOOT experiment: the emulsion spectrometer





Vertexing

alternated layers of emulsions and target (C or C_2H_4)

Charge identificatio n

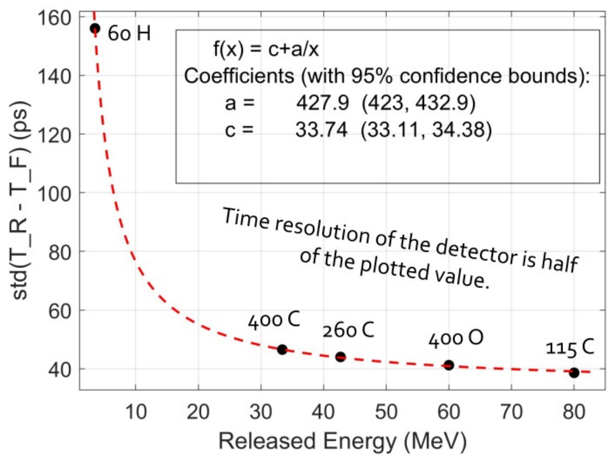
only emulsion layers

Momentum measurement and isotope identification

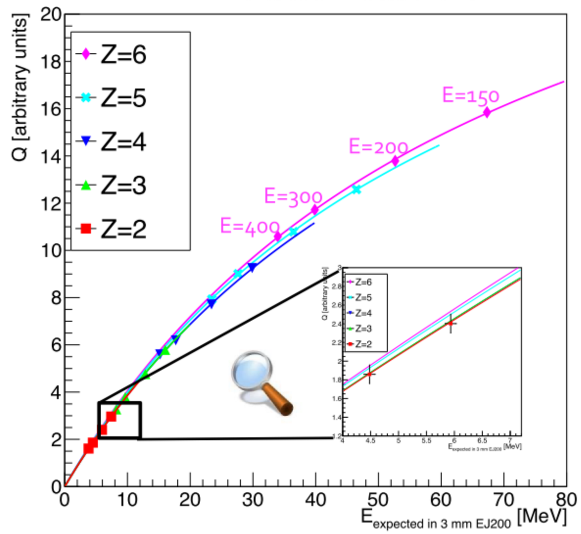
alternated layers of emulsions and passive material (plastic, tungsten and lead)

Start counter & TOF Wall

Time resolution

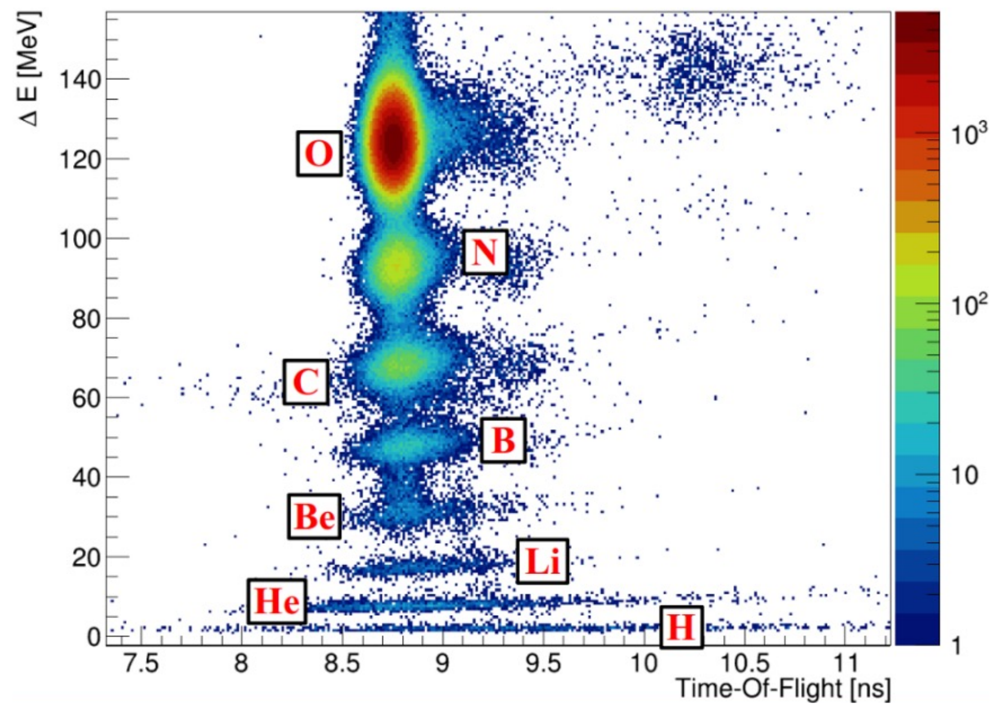


Delta E calibration



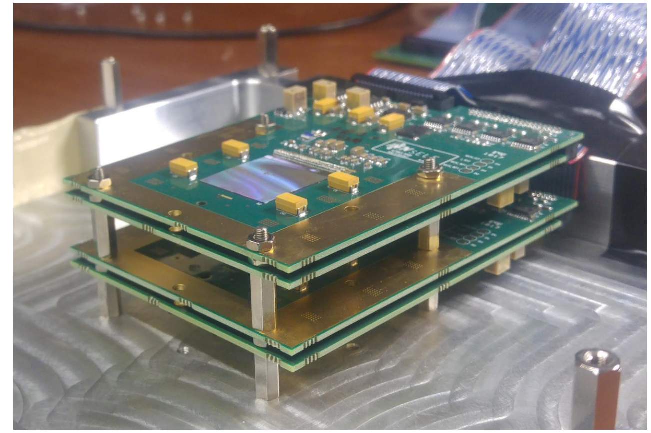
GSI 2021 data

400 MeV/u ^{16}O on 5mm carbon

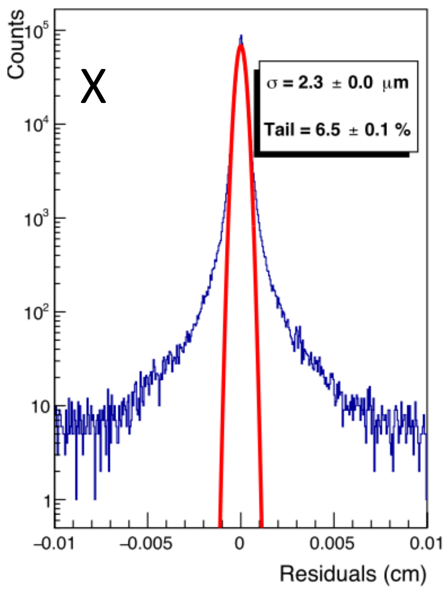


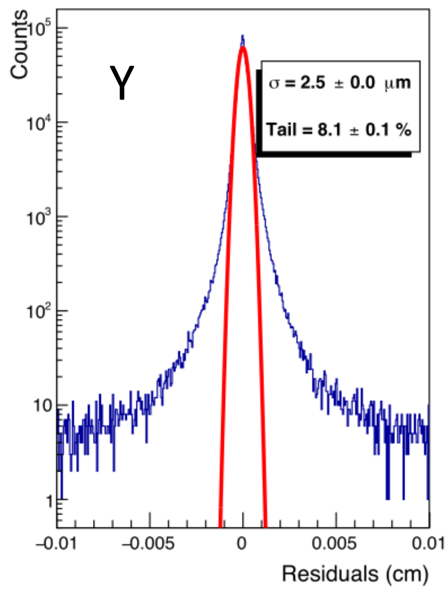
Working on: beam rate effects, pile-up

Vertex



Track residuals (mostly ^{16}O)





Working almost correctly

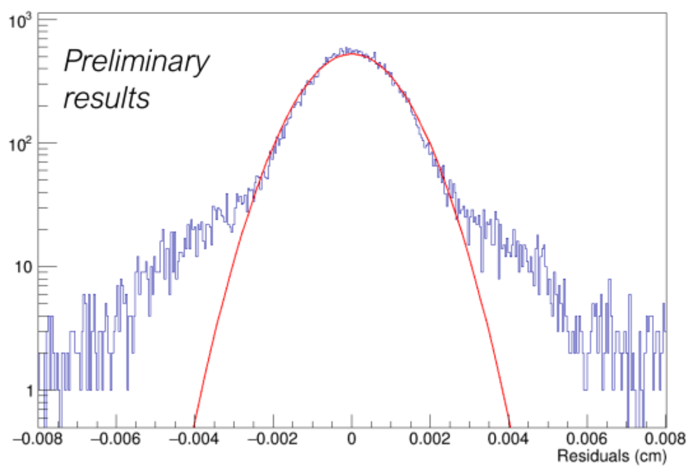
- Randomly a trigger is lost→ resync needed
- (corrected/addressed in firmware now)
- Good internal alignment
- Max 1 kHz DAQ rate … or pile-up!

→ Shortage of manpower

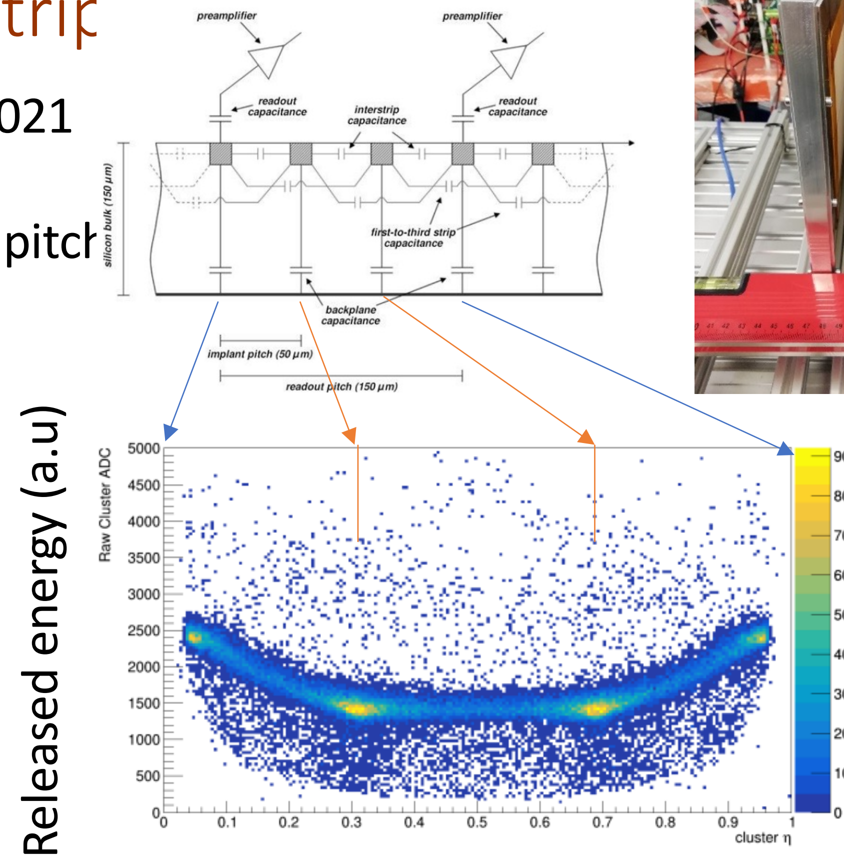
MicroStrip

3 x-y planes used extensively since jun 2021
(3 more xy planes available)
50 um microstrip pitch, 150 um readout pitch

Track residuals



Resolution ≈ 12 µm

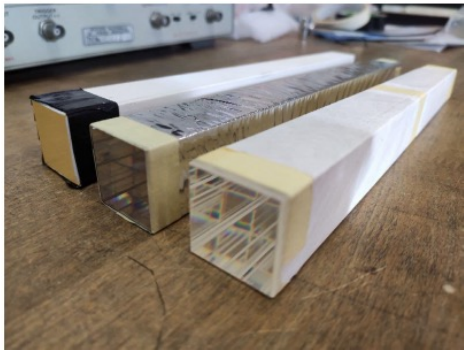


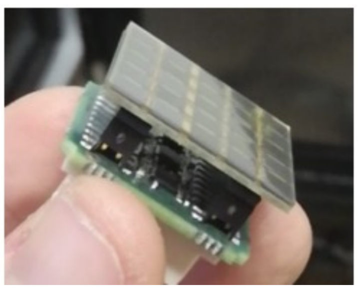
Before correction

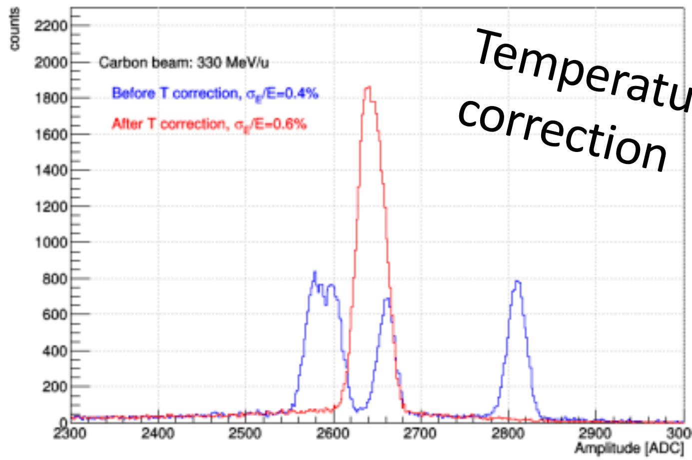
Studies ongoing to improve spatial end energy resolutions

Calorimeter

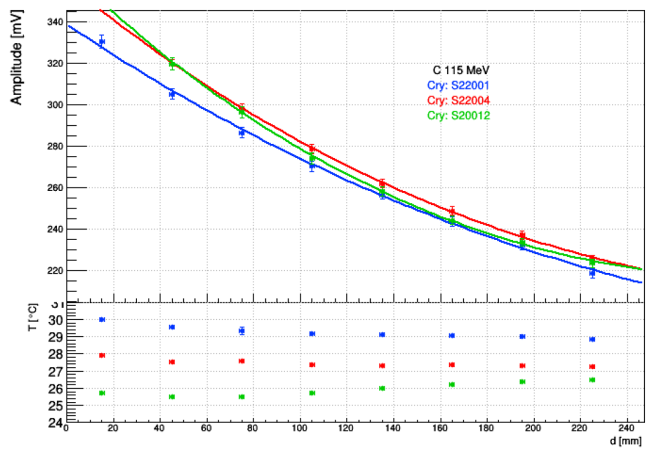
320 BGO crystals

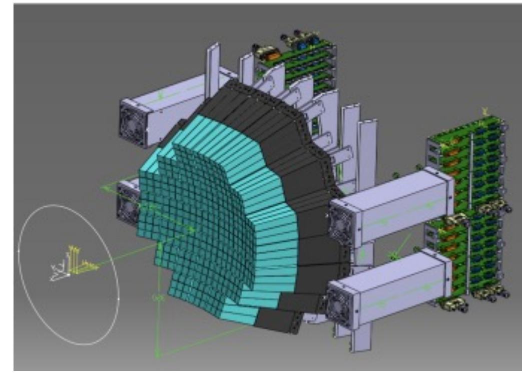


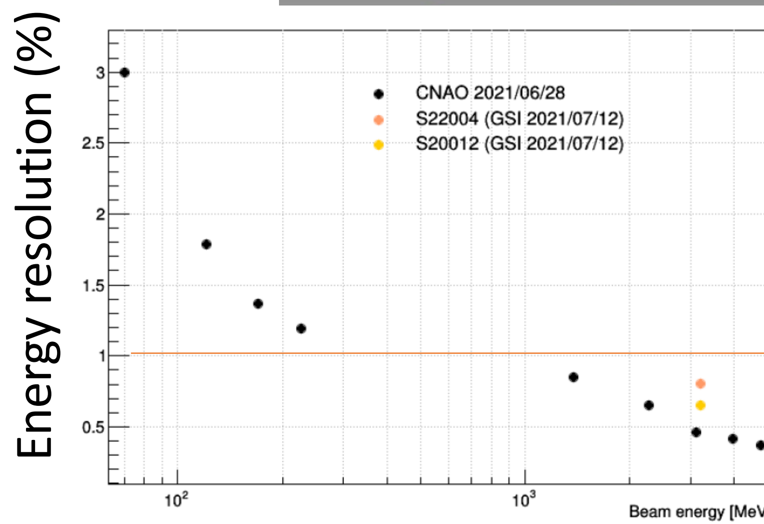




Temperature correction





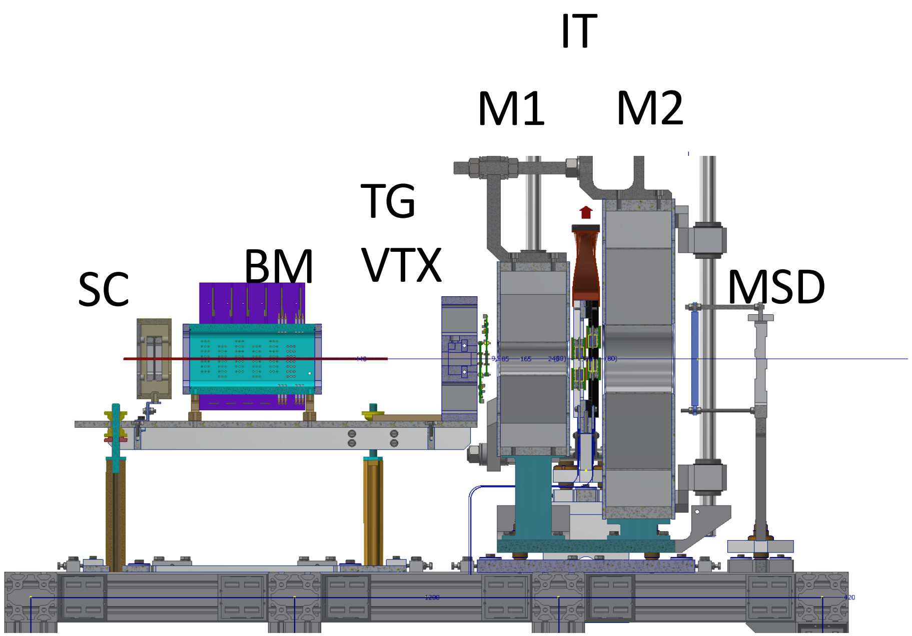


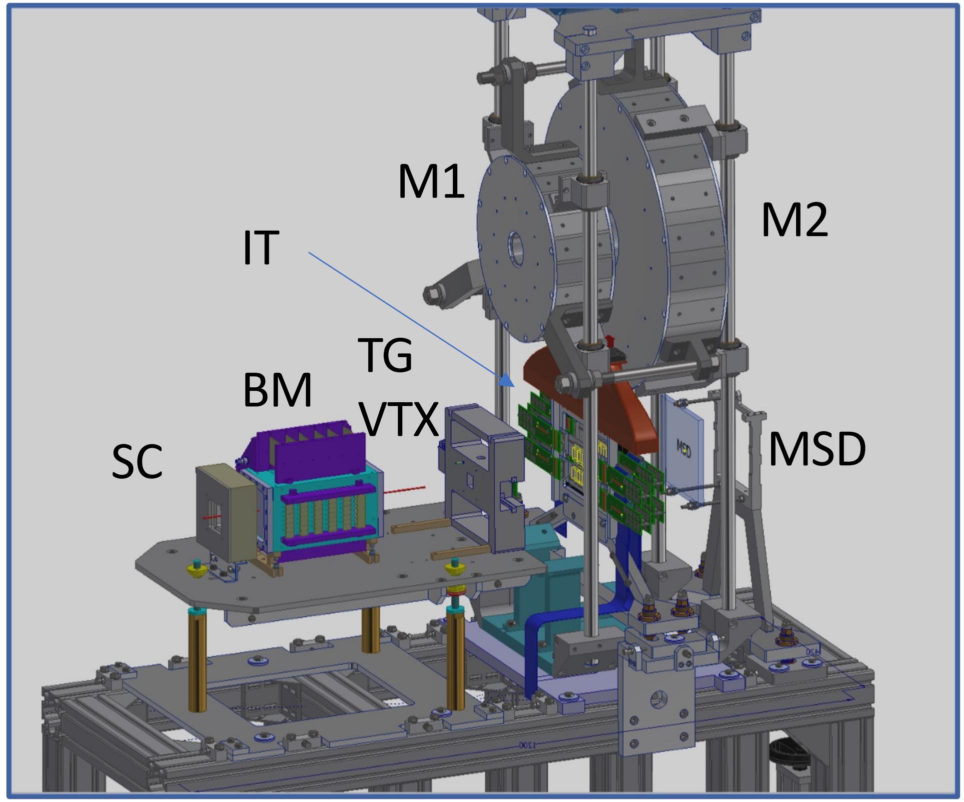
One module (9 crystals) tested at GSI 2021

5-7 modules available for Heidelberg

Tracker's Mechanics

Fully designed; tender assigned;
Realization on hold!





Magnet status

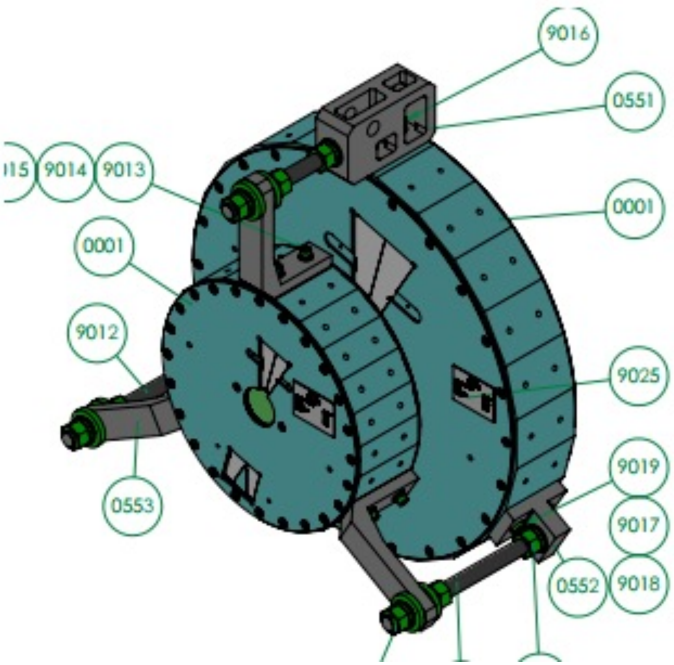
The long story short:

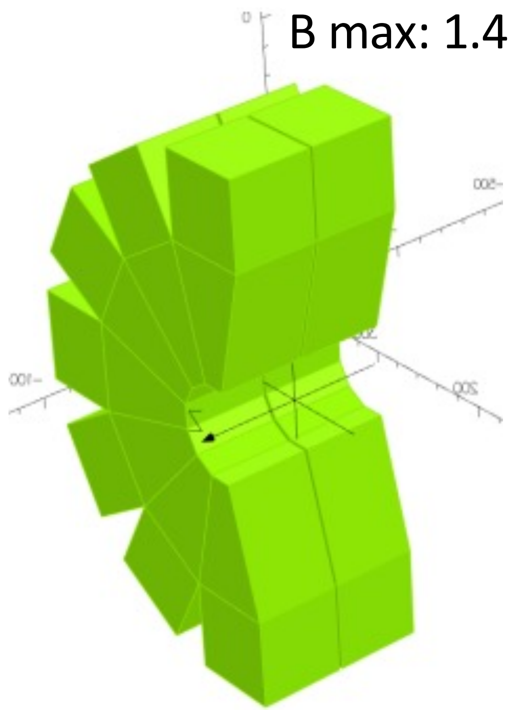
3 firms invited to the bid; one responded: Sigma Phi

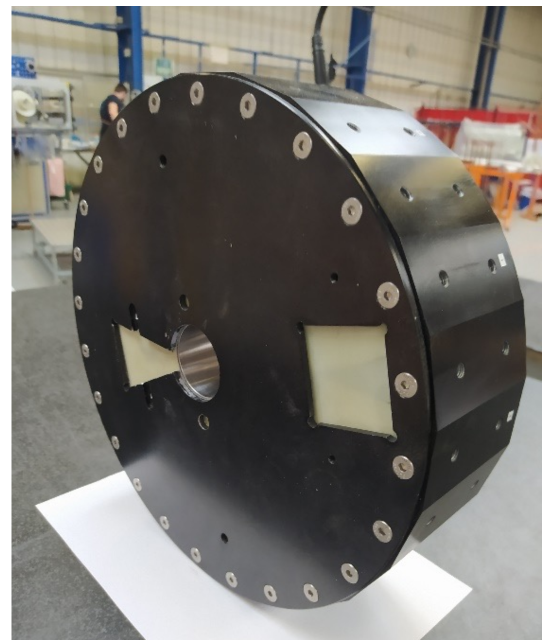
Decided for NbSm magnetic elements

M1: 96 elements on 2 disks, 2 rings

B max: 1.4 T → strong magnetic forces







Magnet status

During assembly many magnetic elements broke. Front flanges do not look safe!

The firm made also M2 with the same problems. Even more magnetic elements broke. No picture given.

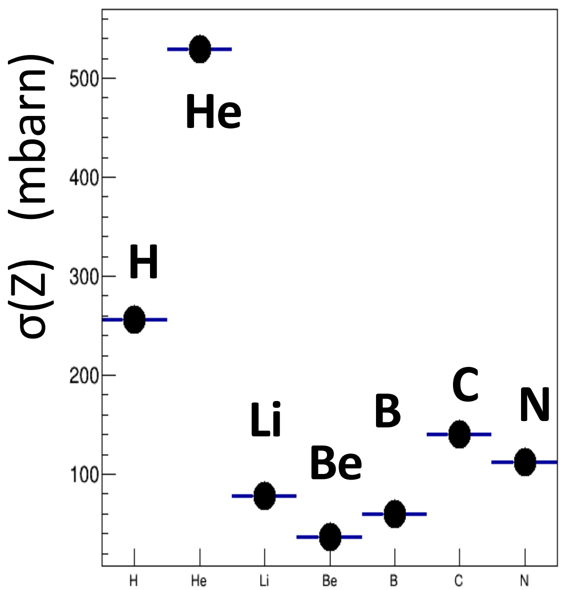
The firm decided to restart the design from scratch using Neodymium-Iron-Boron magnetic elements (harder) and avoiding The longitudinal segmentation of magnets.

We decided to follow the process more closely and demanded weekly updates.

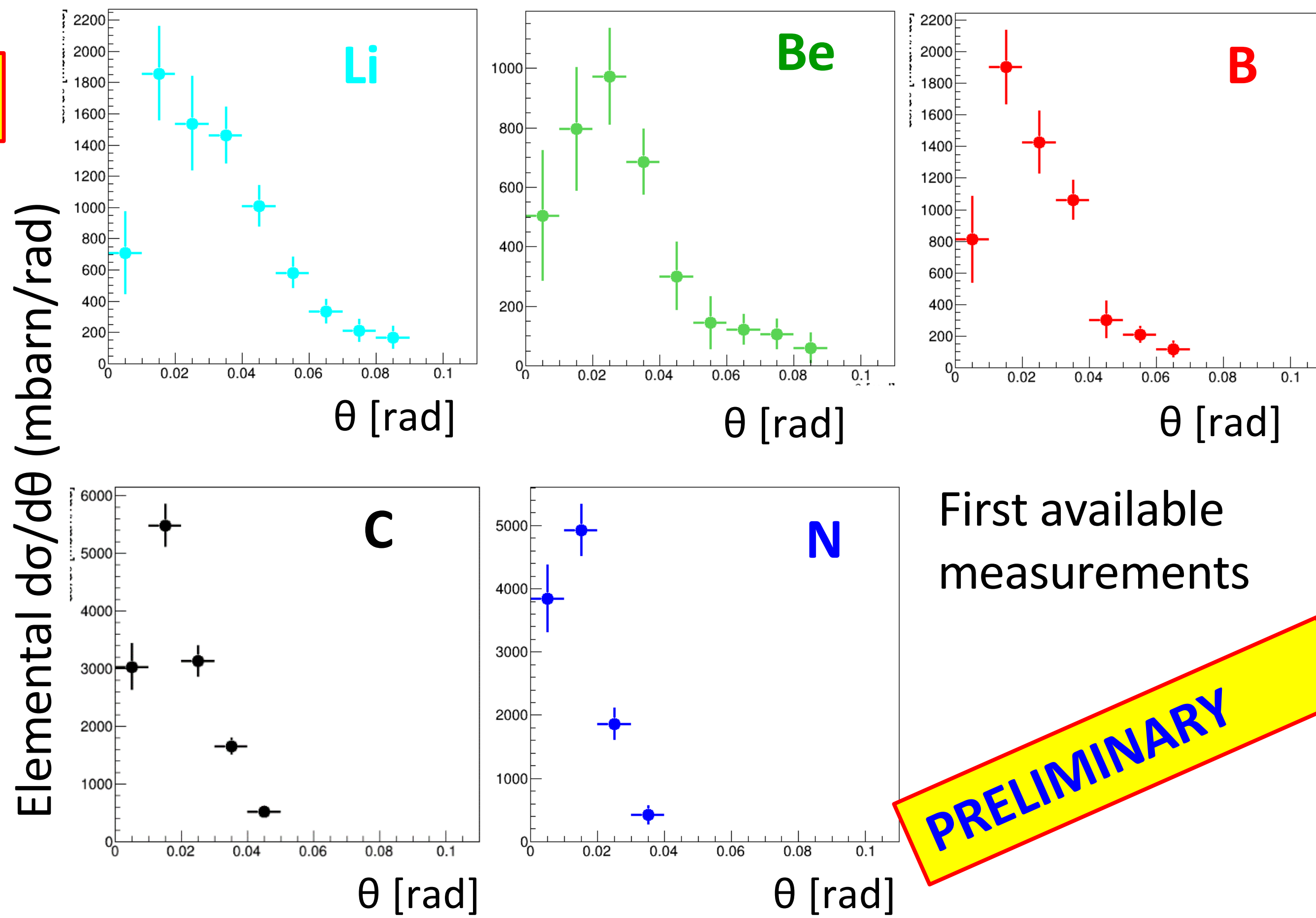
First results from GSI 2021

^{16}O (400 MeV/u) + C

Elemental Cross Sections



Elemental dσ/dθ (mbarn/rad)



First available measurements

PRELIMINARY

Publications

1. Y. Dong et al, *The Drift Chamber detector of the FOOT experiment: Performance analysis and external calibration*, NIM A **986 (2021) 164786**
2. M. Morrocchi et al, *Performance Evaluation of the TOF-Wall Detector of the FOOT Experiment*, IEEE Trans. Nucl. Sci. (doi:10.1109/TNS.2020.3041433)
3. G. Battistoni et al, *Measuring the impact of Nuclear Interaction in Particle Therapy and in Radio Protection in Space: the FOOT experiment*, Front. Phys. **8 (2021) 568242**
4. A. C. Kraan et al, *Charge identification of nuclear fragments with the FOOT Time-Of-Flight system*, NIM **A 1001 (2021) 165206**
5. G. Galati et al, *Charge identification of fragments with the emulsion spectrometer of the FOOT experiment*, Open Physics **(2021),** vol. 19, no. 1, pp 383-394.

Procs

1. K. Kanxheri et al, The Microstrip Silicon Detector data acquisition system architecture …, JINST 2022
2. A. De Gregorio et al, Measurements of 16° cross section on C targer with the FOOT Apparatus, Il nuovo Cimento (2022)
3. S. Colombi et al, Enhancing the understanding of fragmentation processes in hadrontherapy …, Phys, Scripta, **96** (2022)
4. R. Zarrella, Calibration and performances of the full-scale Delta E-TOF prototype …, Il Nuovo Cimento (2022)
5. S. Biondi et al, The FragmentatiOn Of Target (FOOT) Experiment and Its DAQ System, IEEE TNS (2022)
6. Y. Dong et al, The FOOT drift chamber performance, Il nuovo cimento (2022)
7. R. Ridolfi et al, The magnetic spectrometer of the FOOT experiment, Il nuovo cimento (2022)

Future programs: Year 2022

- March/April/May – 30-40 h, ^{12}C @ 110 – 400 MeV/n

- Current apparatus; high statistics, max accuracy measurements:
  - Measurements of **p-C Fragmentation**

- Heidelberg - july – 45 h, p, ^{4}He, ^{12}C, ^{16}O @ 50 – 400 MeV/n

- Current apparatus (-VTX); beam test goals:
  - Caracterisation BGO with different beams and energies; MSD calibration
  - Fully physics: production cross sections with a **^{4}He** beam for «heavy» fragments

- November (?) – 30-40 h, p & ^{12}C @ 110 – 400 MeV/n

- Final apparatus (-magnet); high statistics, max accuracy measurements:
  - Measurements of **p-C Fragmentation with electronic and emulsion set-ups**

Future programs: Year 2023

CNAO - **FOOT continuosly in experimental room**

- Final apparatus; high statistics, max accuracy measurements:
  - Measurements of **p-C Fragmentation using full calo and magnet (2 weeks of beam)**
  - **Test and calibration facility (60 h of beam)**
  - **Measurements with NIT emulsions**

GSI - Darmstadt - summer 23/24

- Final apparatus:
  - Measurements of **p-O and O-O Fragmentation using full calo and magnet (2 weeks of beam)**
  - **Measurements with NIT emulsions**

Richieste finanziarie per il 2023

- Missioni (meeting di collaborazione e prese dati) 5 k€
- Inventario 1k€

Totale Afferenti al gruppo 3 ed FTE

cognome	nome	note	modulo	contratto	profilo	stato	aff	DOTAZIONI (	EIC_NET	FOOT	J_LAB12	MAMBO	perc	tot
Totale(FTE)								0	1.00	2.00	4.80	4.40		12.2
Ammendola	Roberto	Partecipazioı	G2	Dip	Tecnologo	Attivo	5		10				EIC_NET - 10	10
Bondv¨	Mariangela		G1	Ass	Scientifica R	Scaduto	3		30		50		EIC_NET - 30	80
D'Angelo	Annalisa		G1	Ass	Incarico di Ri	Scaduto	3		10		80		EIC_NET - 10	90
Di Salvo	Rachele Anna		G1	Dip	Ricercatore	Attivo	3		10			90	EIC_NET - 10	100
Fantini	Alessia		G1	Ass	Incarico di Ri	Scaduto	3		20			80	EIC_NET - 20	100
Iannilli	Maurizio		G3			Contratto no	3				20	30	JLAB12 - 20%	50
Lanza	Lucilla	assegno pror	G1	Dip	Assegno di R	Scaduto	3		10		90		EIC_NET - 10	100
Minniti	Triestino		G1	Ass	Scientifica R	Scaduto	3			100			FOOT - 100%	100
Morone	Maria Cristina		G1	Ass	Incarico di Ri	Scaduto	3			70			FOOT - 70%	70
Narici	Livio		G1	Ass	Incarico di Ri	Scaduto	2			30			FOOT - 30%	30
Nobili	Giovanni		G3	Dip	Collaborator	Attivo	3				50	40	JLAB12 - 50%	90
Pecchi	Daniele		G3	Ass	Associazione	Scaduto					30	40	JLAB12 - 30%	70
Reali	Enzo		G3	Ass	Incarico di Co	Scaduto	2				30		JLAB12 - 30%	30
Rizzo	Alessandro		G1	Ass	Scientifica D	Scaduto	3				100		JLAB12 - 100	100
Romaniuk	Mariia		G1	Ass	Scientifica Eı	Scaduto	3					100	MAMBO - 10	100
Salina	Gaetano		G1	Dip	Primo Ricerc	Attivo	5		10				EIC_NET - 10	10
Tusi	Enrico Maria		G3	Ass	Incarico di Co	Scaduto	1				30		JLAB12 - 30%	30
Vitali	Gianni		G3	Ass	Associazione	Scaduto	3					60	MAMBO - 60	60

Ricercatori: 11 (8.8 FTE) - **Tecnologi:** 1 (0.1 FTE) - **Tecnici:** 6

(Nel 2022 tot FTE: 4,9)

Richieste metabolismo Gr3

Sez./Lab	nFTE	coordinatore	Interno	Estere	Missioni met.	Consumo	Seminari	Pubblicazioni	Inventario	Totole NON missioni	TOTALE
Roma Tor Vergata	8,9	1	4,50	2,50	7,00	4,50	1,00	2,00	11,50	19,00	26,00