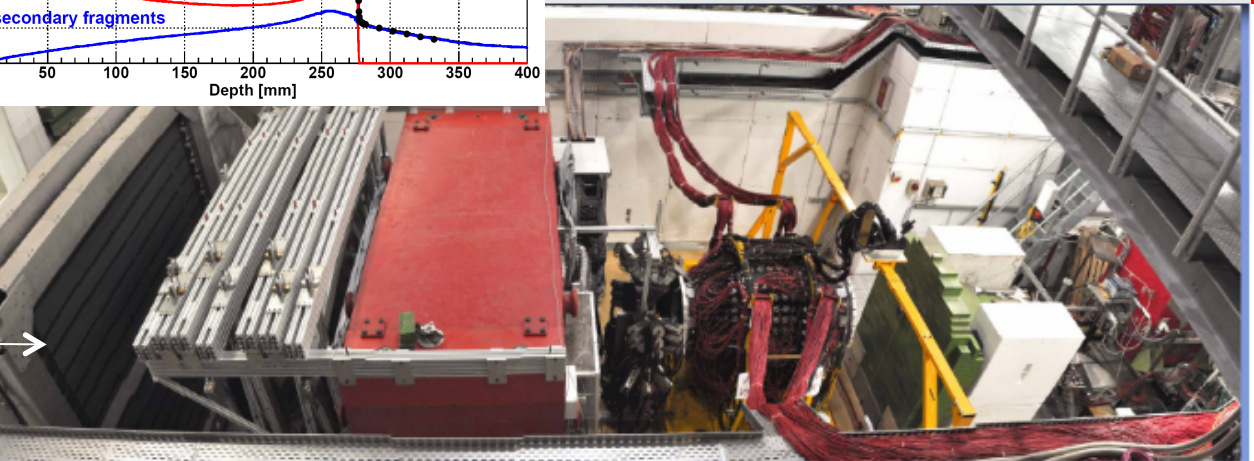
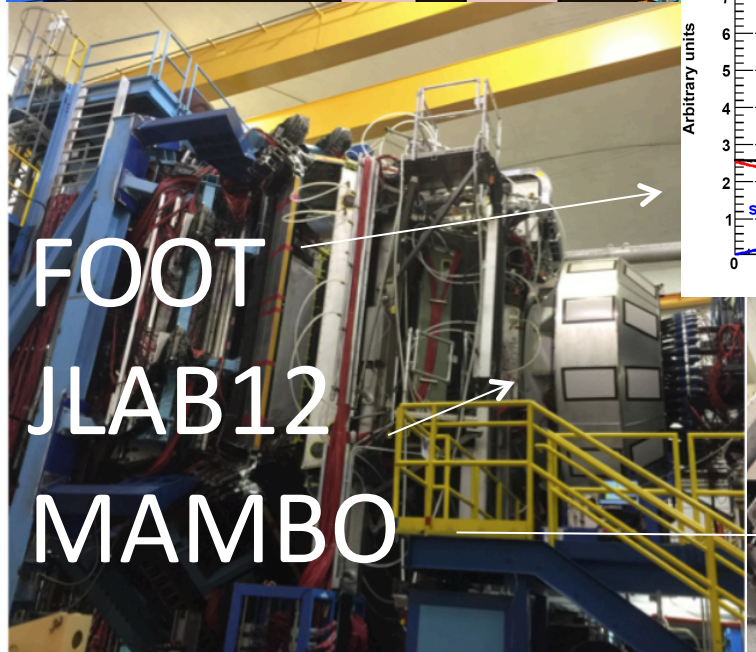
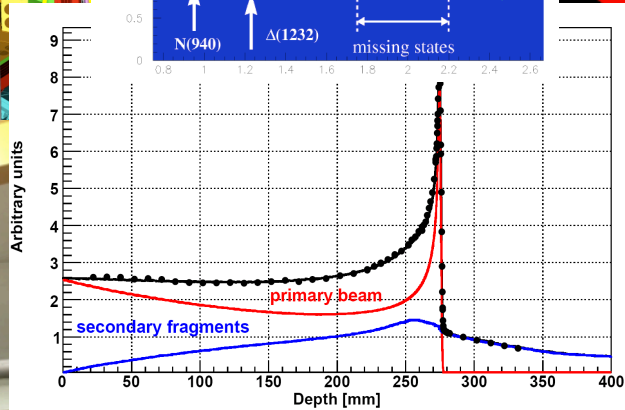
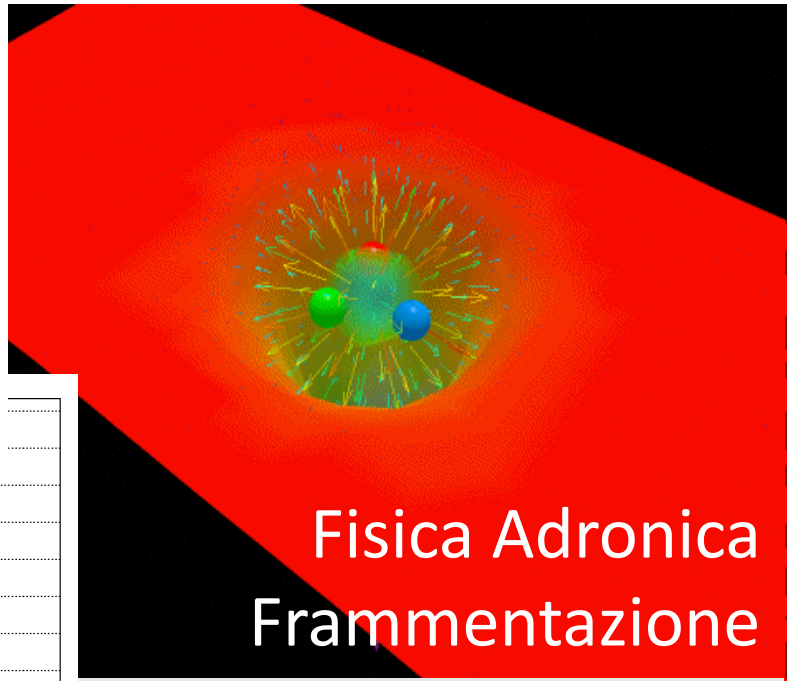
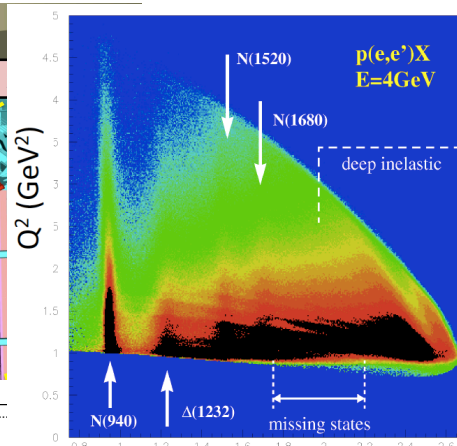
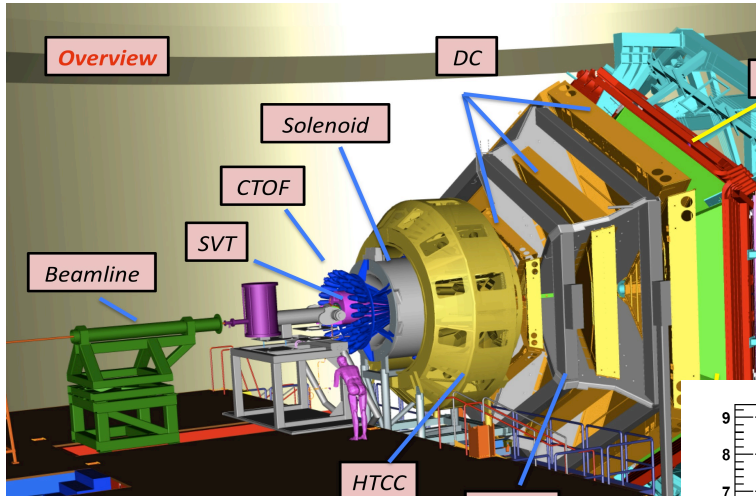


Gruppo III Roma Tor Vergata



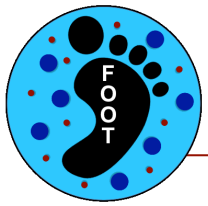
Anagrafica GII Roma Tor Vergata - Ricercatori

Nome	Età	Posizione	Qualifica	Afferenza	FOOT	JLAB12	MAMBO	DOT3	CSN I	CSN II	CSN IV	CSN V	P.S.	CCR	Servizi	Tot.	Note
1 D'Angelo Annalisa		Inc. Ric.	Prof. Associato	CSN III		90							10			100	
2 Di Salvo Rachele Anna		Dipendente	Ricercatore	CSN III			100									100	
3 Fantini Alessia		Inc. Ric.	Ricercatore	CSN III			70		30							100	
4 Lanza Lucilla		Assegn./Bors.	Assegnista	CSN III		100										100	
5 Messi Roberto		Inc. Ric.	Prof. Associato	CSN I			30		50		20					100	
6 Morone Maria Cristina		Associato	Ricercatore	CSN III	70						30					100	
7 Narici Livio		Inc. Ric.	Prof. Associato	CSN II	30					70						100	
8 Rizzo Alessandro		Assegn./Bors.	Assegnista	CSN III		100										100	
FTE Totali					1	2.9	2		Totale: 5.9 FTE								

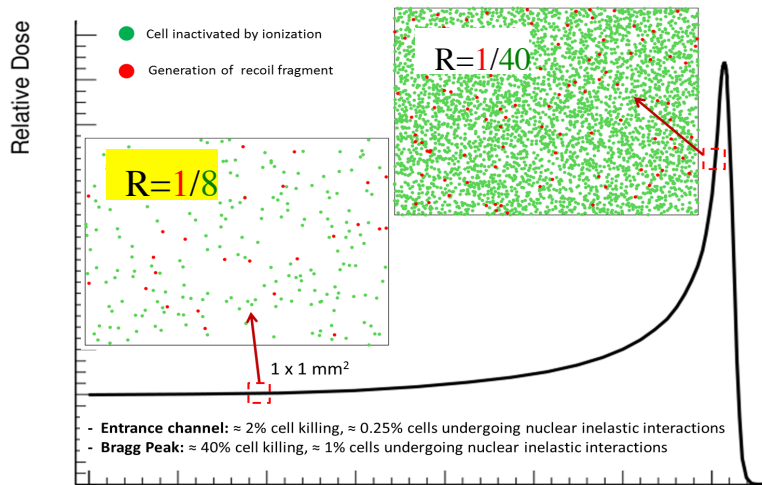
Percentuale di partecipazione $5.9 \text{ FTE} / 8 \text{ RIC} = 74 \%$

Anagrafica GIII Roma Tor Vergata - Tecnici

Nome	Età	Posizione	Qualifica	Afferenza	FOOT	JLAB12	HAMBO	DOT3	CSN I	CSN II	CSN IV	CSN V	P.S.	CCR	Servizi	Tot.	Note	
1 Iannilli Maurizio		Associato	Tecnico Categoria B	CSN III		20	30		20	30						100		
2 Nobili Giovanni		Dipendente	C.T.E.R.	CSN III		50	50									100		
3 Pecchi Daniele		Associato	Tecn.Cat.C	CSN III		30	40		30							100		
4 Reali Enzo		Associato	Tecnico Categoria B	CSN II		30				70						100		
5 Tusi Enrico Maria		Associato	Tecnico Categoria B	CSN III		30			55							85		
6 Vitali Gianni		Associato	Tecn.Cat.C	CSN III			60		20	20						100		
FTE Totali						1.6	1.8		Totale: 3.4 FTE									

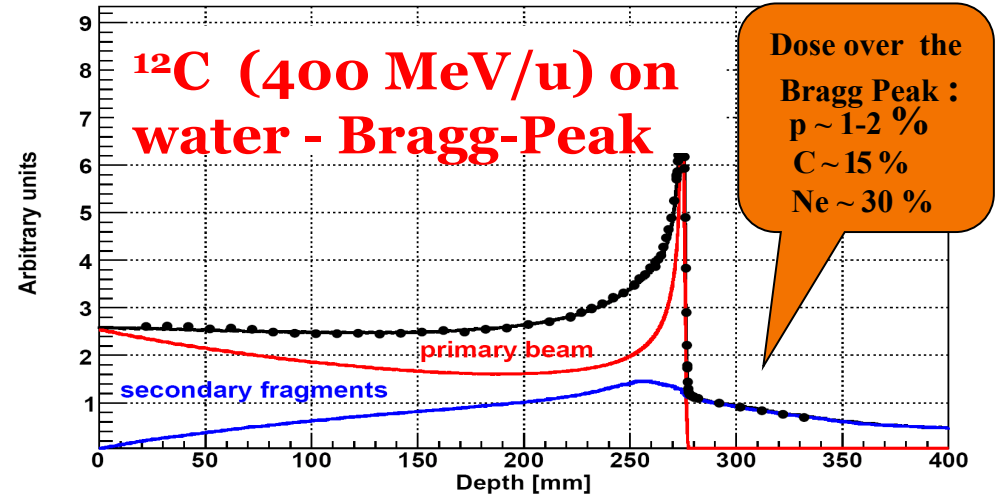


Esperimento FOOT



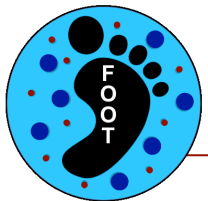
Target fragmentation in proton therapy: Depth gives contribution also outside the tumor region!

Experimental Program



FRAGMENTATION OF ^{12}C & ^{16}O in bio tissue

1. Projectile fragmentation in particle therapy with ^{12}C , ^{16}O and ^4He beams @ 300-350 MeV/nucl on C, C_2H_4 target. **Direct kinematic**
2. Target fragmentation in proton therapy: fragmentation of ^{12}C , ^{16}O beam @ 150-200 MeV/nucl on C, C_2H_4 and PMMA target. **Inverse kinematic approach**
3. Fragmentation study for radioprotection in space, in particular on spacecraft shield. He, C, O, (Si?) beams @ 400-800 MeV/u on different target (shield) materials, in particular on C_2H_4 (maybe up to 1GeV/nucl? MC studies ongoing)
4. Measurement for PT monitoring: β^+ emitters production (^8B production) from C,O on C @200-400 MeV/u; large angle fragment emission in C-C, C-O interaction @300MeV/nucl



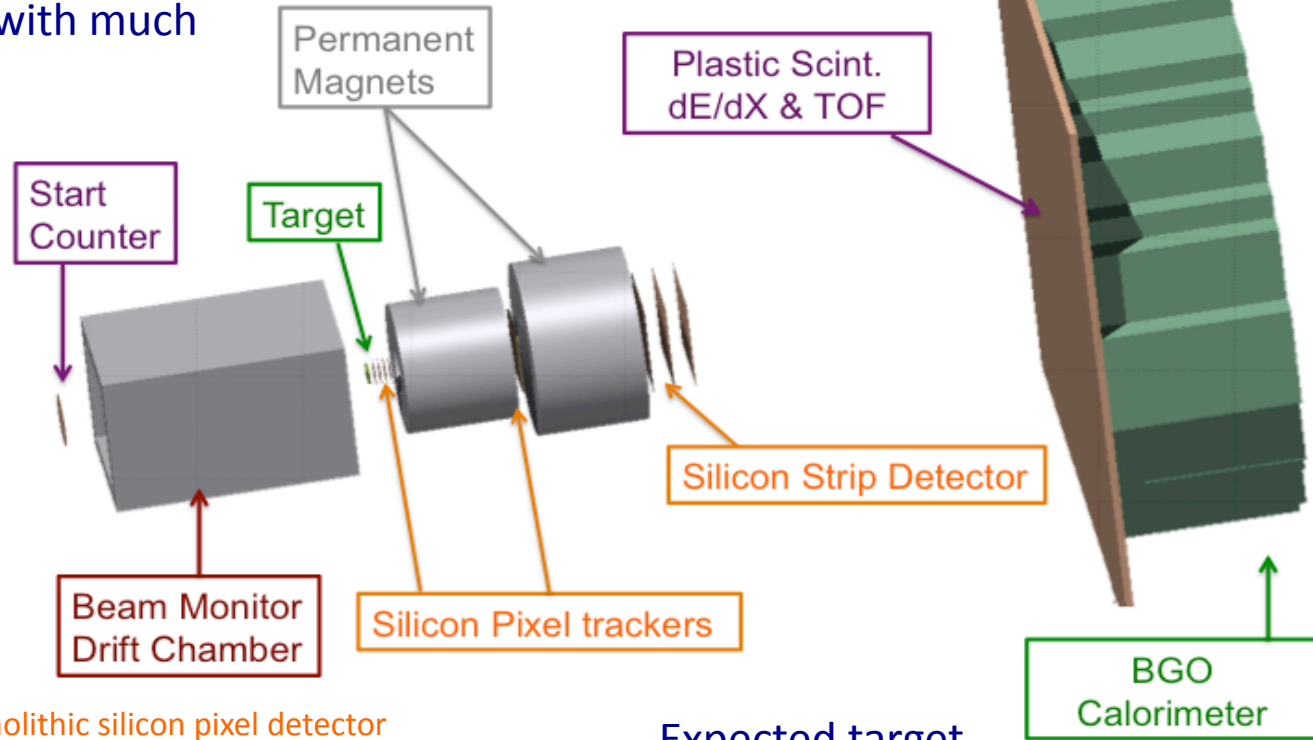
Esperimento FOOT

Detector

Heavy frag forward peaked and $E_{kin} \sim 200 \text{ MeV/nuc}$
 Light fragment spread out in energy with much larger angle distribution

For the fragment with $Z > 2$
 measurements of TOF, P, E_{kin} , ΔE

Maximum 2 meters length

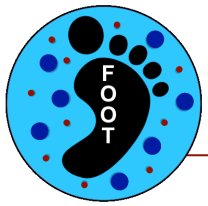


- ✓ Start Counter = thin plastic scintillator (RM1)
- ✓ Beam Monitor = drift chamber (LNF, MI)
- ✓ Vertex detector & Intermediate Tracker = monolithic silicon pixel detector (LNF)
- ✓ Large tracker = silicon strip detector (RM1, LNF, PG)
- ✓ DE/TOF Detector = plastic scintillator (PI)
- ✓ Calorimeter = BGO crystal calorimeter (TO)

Expected target fragmentation performances:

- $\sigma_p/p \sim 4-5\%$
- $\sigma_{TOF} \sim 100 \text{ ps}$
- $\sigma_{E_{kin}}/E_{kin} \sim 1-2\%$
- $\sigma_{DE} \sim 2\%$

Possible Beam time @ CNAO, HIT, GSI
 Calibration @ Trento, LNF

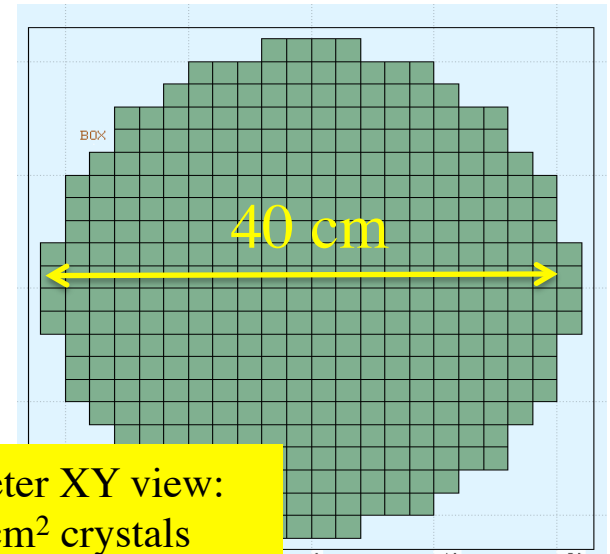


ToV is involved **in the simulation** and design optimization of the BGO Calorimeter

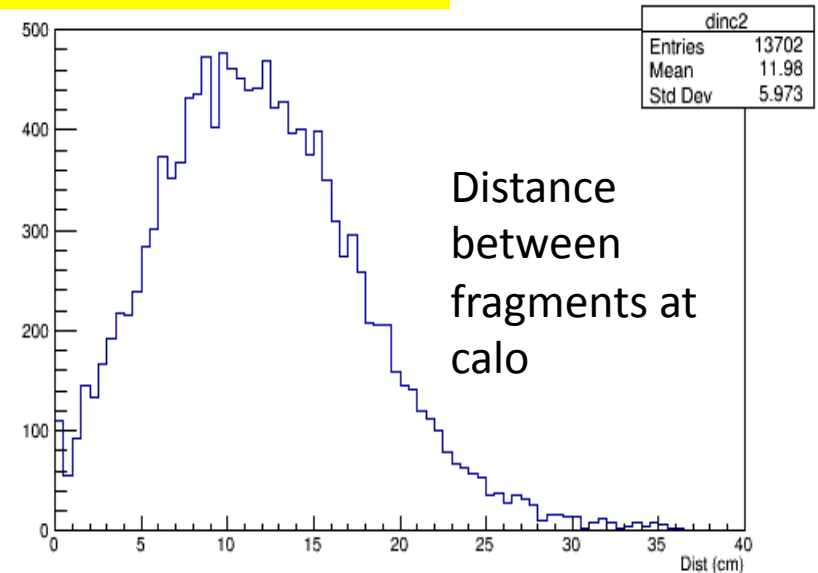
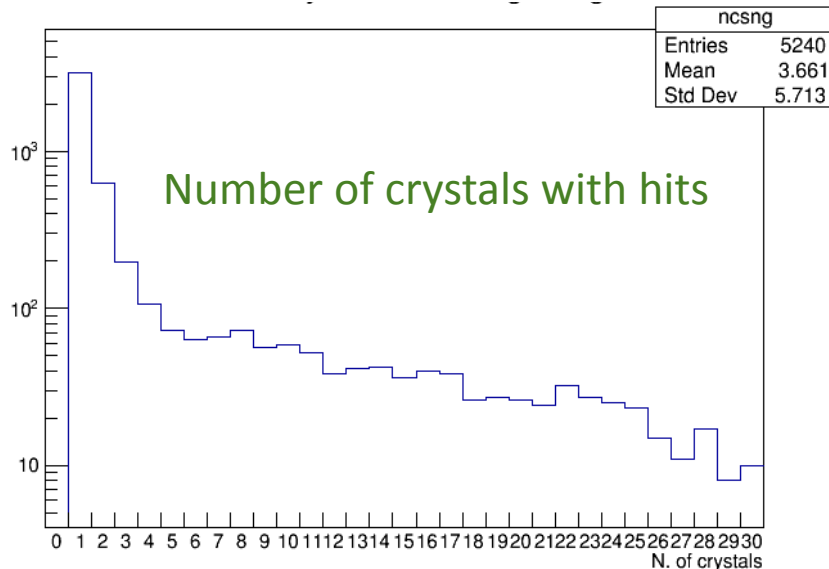
Crystals will be recovered from the L3 experiment

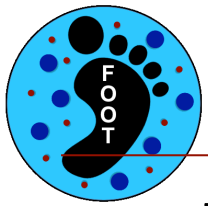
The cluster size is very limited and the distance between multiple fragments seems large->clustering seems an easy task (also due to BGO density)

Neutron leakage is an issue



Calorimeter XY view:
360 2x2cm² crystals



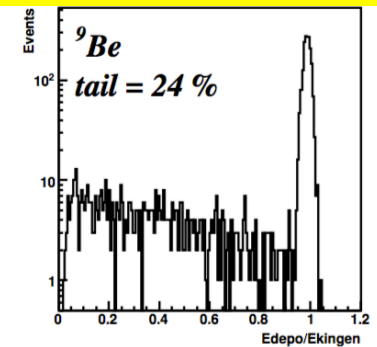
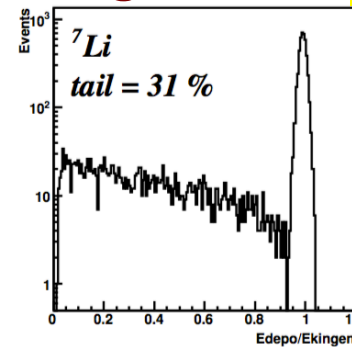
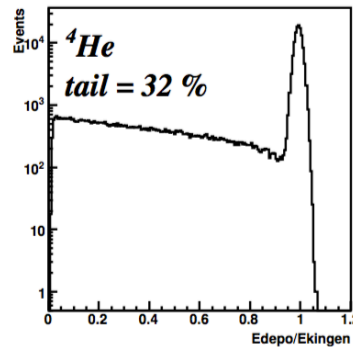
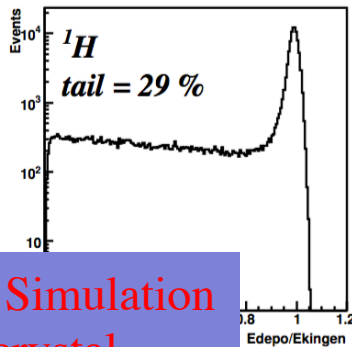


The neutron leakage in BGO seems to be more and more important for energy higher than 200 MeV/nucl and for light fragments (!)

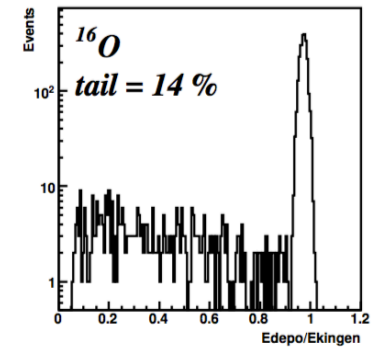
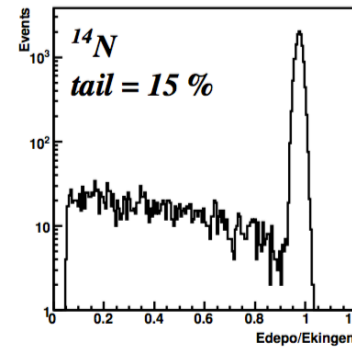
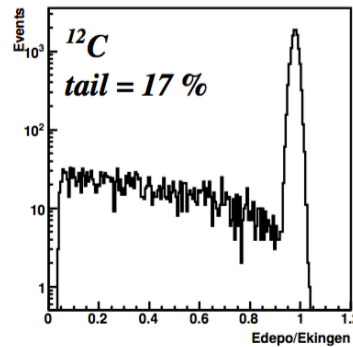
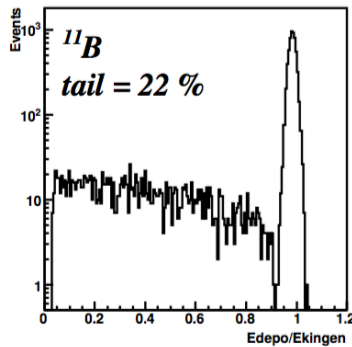
Even if the fit constrained can tag such events, these must be minimized to keep the systematic under control.

BGO calo length VS neutron leakage

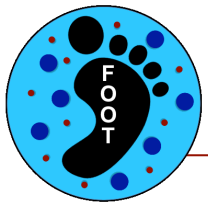
200 MeV/nucl



FLUKA 2017 Simulation
14 cm length crystal



Ecalo/Ekin



- ✓ E' stato redatto il CDR per l'approvazione dell'esperimento
- ✓ L'intero esperimento FOOT è stimato costare circa 1.4M Euro fino al 2021.

Richieste finanziarie Roma TV:
Missioni 3.5 kEuro

FOOT Conceptual Design Report

A. Alexandrov^a, G. Ambrosi^j, S. Argiro^{b,m}, G. Battistoni^c, N. Belcari^{d,t}, S. Biondi^{e,u}, M. G. Bisogni^{d,t}, G. Bruni^e, S. Brambilla^c, N. Camarlinghi^{d,t}, P. Cerello^b, E. Ciarrocchi^{d,t}, A. Clozza^f, G. De Lellis^{a,s}, A. Di Crescenzo^{a,s}, M. Durante^g, M. Emde[†], R. Faccini^{h,o}, V. Ferrero^b, F. Ferroni^{h,o}, C. Finck^x, M. Francesconi^{d,t}, M. Franchini^{e,u}, L. Galli^d, M. Garbini^{l,e,u}, G. Giraudob, R. Hetzel[†], E. Iarocci^{h,o}, M. Ionica^j, K. Kanxheri^{j,w}, A. Lauria^{a,s}, C. La Tessa^{g,q}, M. Marafini^{l,h}, I. Mattei^c, R. Mirabelli^{h,o}, M. C. Montesi^{a,s}, M. C. Morone^{i,r}, M. Morrocchi^{d,t}, S. Muraro^d, L. Narici^{i,r}, R. Paramatti^h, A. Pastore^k, N. Pastrone^b, V. Patera^{h,o,l}, C. Peroni^{b,m}, M. Pulliaz, L. Ramello^{b,n}, V. Rosso^{d,t}, M. Rovituso^g, C. Sanelli^f, A. Sarti^{o,f,l}, G. Sartorelli^{e,u}, O. Sato^p, A. Schiavi^{h,q}, C. Schuy^y, E. Scifoni^g, A. Sciubba^{o,h,l}, M. Selvi^e, L. Servoli^j, M. Sitta^{b,n}, R. Spighi^e, E. Spiriti^f, G. Sportelli^{d,t}, A. Stahl[†], M. Testa^f, V. Tioukov^a, F. Tommasino^{g,q}, G. Traini^{o,h}, S. M. Valle^{c,v}, M. Vanstalle^x, M. Villa^{e,u}, U. Weber^y, A. Zoccoli^{e,u}

^a INFN, Sezione di Napoli, Italy

^b INFN, Sezione di Torino, Italy

^c INFN, Sezione di Milano, Italy

^d INFN, Sezione di Pisa, Italy

^e INFN, Sezione di Bologna, Italy

^f INFN, Laboratori Nazionali di Frascati, Italy

^g INFN, Trento Institute for Physics Applications, Italy

^h INFN, Sezione di Roma 1, Italy

ⁱ INFN, Sezione di Roma 2, Italy

^j INFN, Sezione di Perugia, Italy

^k INFN, Sezione di Bari, Italy

^l Museo Storico della Fisica e Centro Studi e Ricerche Enrico Fermi, Italy

^m Università di Torino, Italy

ⁿ Università del Piemonte Orientale, Italy

^o Università di Roma "La Sapienza", Italy

^p Nagoya University, Japan

^q Università di Trento, Italy

^r Università di Roma "Tor Vergata", Italy

^s Università di Napoli "Federico II", Italy

^t Università di Pisa, Italy

^u Università di Bologna, Italy

^v Università di Milano, Italy

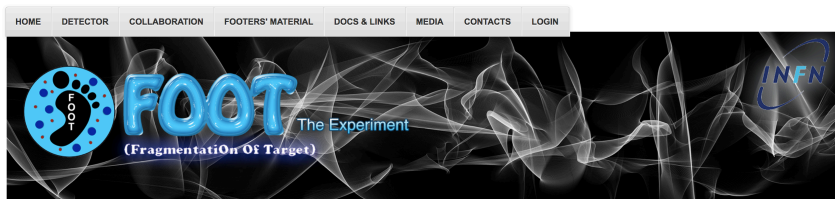
^w Università di Perugia, Italy

^x Institut Pluridisciplinaire Hubert Curien (IPHC), Strasbourg, France

^y GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany

^z CNAO, Italy

[†] RWTH University, Aachen, Germany



News

- 24 May 2017 - Collaboration Meeting - Napoli
- 19 January - First Software meeting
- 30 November 2016 - Collaboration Meeting - Milano
- 2021 Ottobre 2016 - Code Meeting
- 12 July 2016 - FOOT collaboration meeting - Bologna

Introduction

The FOOT (FragmentatiOn Of Target) experiment aims to perform this investigation using an inverse kinematic strategy. This means that instead of using a beam of protons as a projectile, a beam of heavy tissue-like ions (O and C) with the same energy per nucleon would be used against a proton target. This approach is necessary since products emerging from target fragmentation have very low energy and it would be extremely difficult to measure, while using inverse kinematics secondary fragments have boosted energy and longer range, making detection easier.

The final goal of the detector is to measure the heavy fragment (Z>3) cross section with maximum uncertainty of 5% and the fragment energy spectrum with an energy resolution of the order of 1-2 MeV/u.

Understan...

MAACA

Esperimento MAMBO

MAMBO MAMi - Bonn

Motivation. Study of Baryonic Resonances from meson photoproduction with polarized beams and targets.

✓ **BGO-OD at ELSA (Bonn)**

Photon Beam energies 0.3-3.2 GeV

Linear and Circular Beam Polarization

PI: P. Levi Sandri and H. Schmieden spokespersons

✓ **A2@MAMI (Mainz)**

Photon Beam energies 0.1-1.6 GeV

Linear and Circular Beam Polarization

Polarized Buthanol Target

P. Pedroni and A. Thomas spokespersons

Frascati (LNF), Pavia, Roma-ISS, Roma Tor Vergata, Torino

People: ~17 researchers, ~9 FTE

Data taking 2017-2020@ Bonn, Mainz

- **Analisi dati alla soglia (1448 MeV) del canale**

$\gamma p \rightarrow \eta' p$ (v. dopo, resp. Tor Vergata)

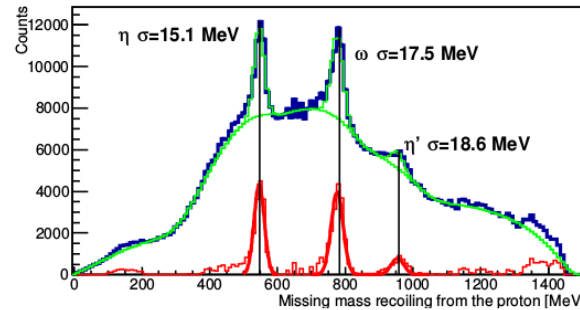
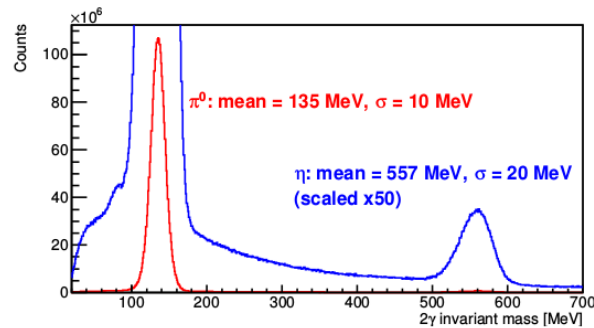
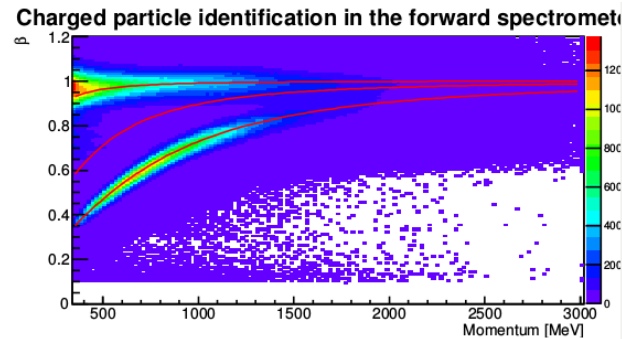
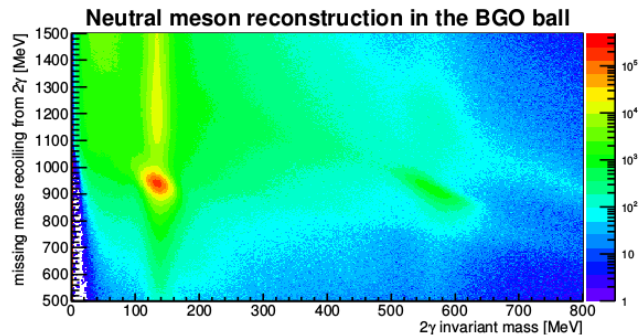
- **Analisi dati del canale**

$\gamma p \rightarrow K^0 \Sigma^+$ ($K^0 \rightarrow 2\pi^0 \rightarrow 4\gamma$, Σ^+ from miss. Mass)

- **Analisi dati del canale**

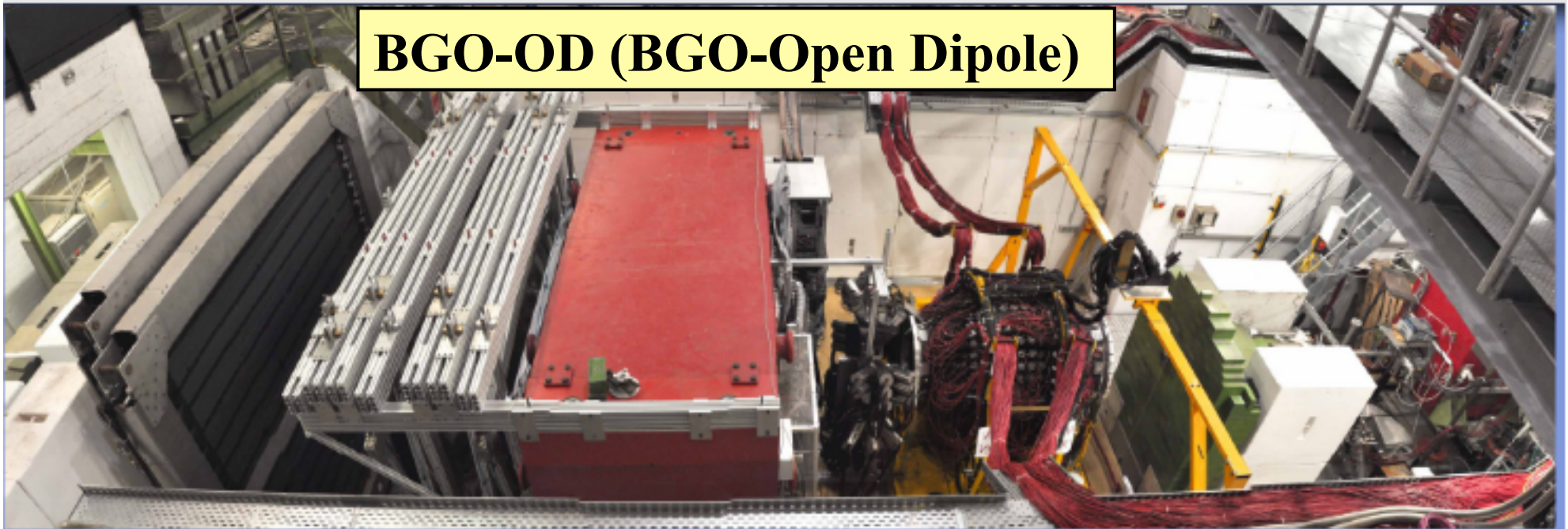
$\gamma p \rightarrow K^+ \Lambda^0$ e $K^+ \Sigma^0$

($K^+ \rightarrow \mu^+ \nu_m$ in BGO 1 cluster+1 subcl. con $\Delta t < 20$ ns e ricostruzione decay time del K^+)



Tom Jude –
GM 19/02/17

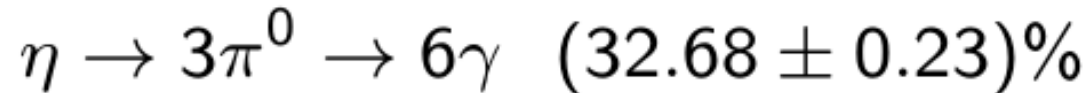
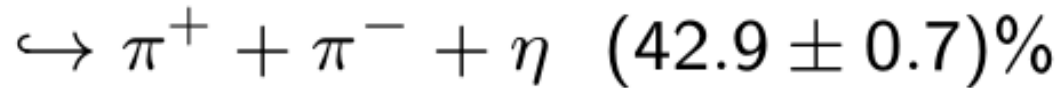
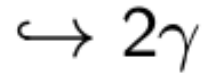
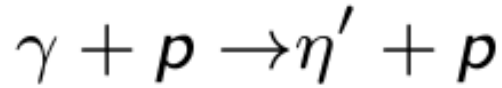
BGO-OD (BGO-Open Dipole)



- BERSAGLIO DI H₂/D₂ LIQUIDO (ME → Tor Vergata) **SUCCESSFUL COMMISSIONING IN FEB. 2012**
- RIVELATORE CILINDRICO di SCINTILL. PLASTICI (ISS, Tor Vergata) **SUCCESSFUL COMMISSIONING IN JUNE 2012**
- DUE MWPC COASSIALI (PV) **▶ SUCCESSFUL COMMISSIONING IN SETT. 2016-FEB. 2017**
- CALORIMETRO E.M. DI BGO, 480 cristalli (Tor Vergata) **▶ SUCCESSFUL COMMISSIONING IN FEB. 2012**
- Rivelatore MRPC: per coprire la regione polare compresa tra 8° e 25° (Tor Vergata) ⇒ **costruito, installato, testato su fascio, necessita ancora test per il rumore elettronico**

ACQUISIZIONE E CALIBRAZIONE BGO E BARREL (RM2, ISS-RM) SIMULAZIONE per BGO, Barrel, MWPC's (LNF, PV)

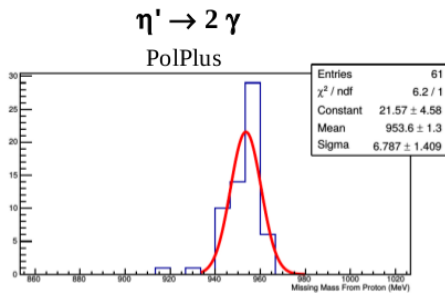
Analisi dati alla soglia (1448 MeV) del canale:



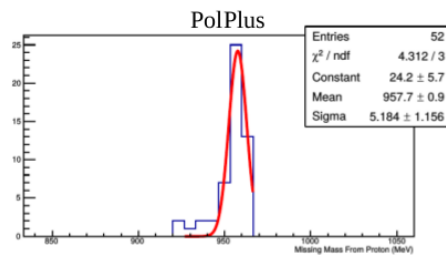
Lorenzo Magnisi – Maggio 2017

$(2.20 \pm 0.08)\%$

Proton Missing Mass – η' neutral decays

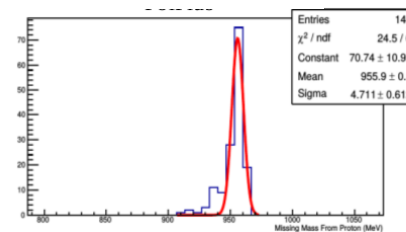


$\eta' \rightarrow 6\gamma$

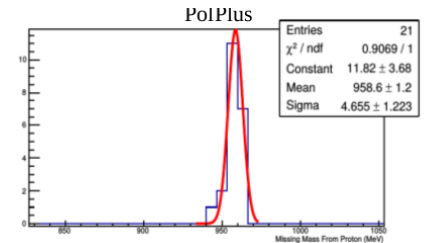


Proton Missing Mass – η' charged decays

$\eta' \rightarrow \pi^+ \pi^- \eta \rightarrow \pi^+ \pi^- 2\gamma$



$\eta' \rightarrow \pi^+ \pi^- \eta \rightarrow \pi^+ \pi^- 6\gamma$



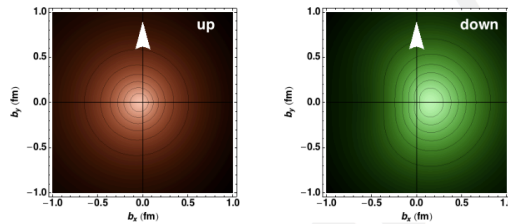
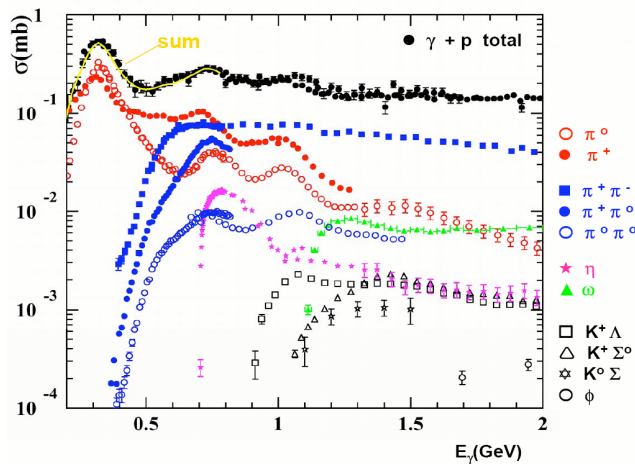
CONSUMO	→ 10. k€	Manutenzione del bersaglio
ALTRI CONSUMI	→ 1.5 k€	Gas MRPC
INVENTARIO	→ 6.5 k€ s.j.	Scheda HV “Spare” per MRPC (s.j. se non viene finanziata quest'anno)
MISSIONI	→ 23.5 k€	
1) 1.5 kE		2 Riunioni di collaborazione in germania per 1 ricercatore
2) 22 kE		Presi dati : 2 MU x 2 FTE considerando 5.5 kE/MU (1MU=30ggx155 E/gg+2viaggi x0.45kE)
MANUTENZIONE	→ 2 k€	Riparazioni Mixer/ Schede elettronica
TRASPORTI	→ 1. k€	Trasporti materiale meccanico ed elettrico da Roma a Bonn e viceversa
TOT Richieste MAMBO(Roma Tor Vergata) → 38kE + 6.5 s.j. ~ 19 kE/FTE + 3.2 s.j.		

Esperimento JLAB12

JLAB12 Jefferson Laboratory at 12 GeV

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

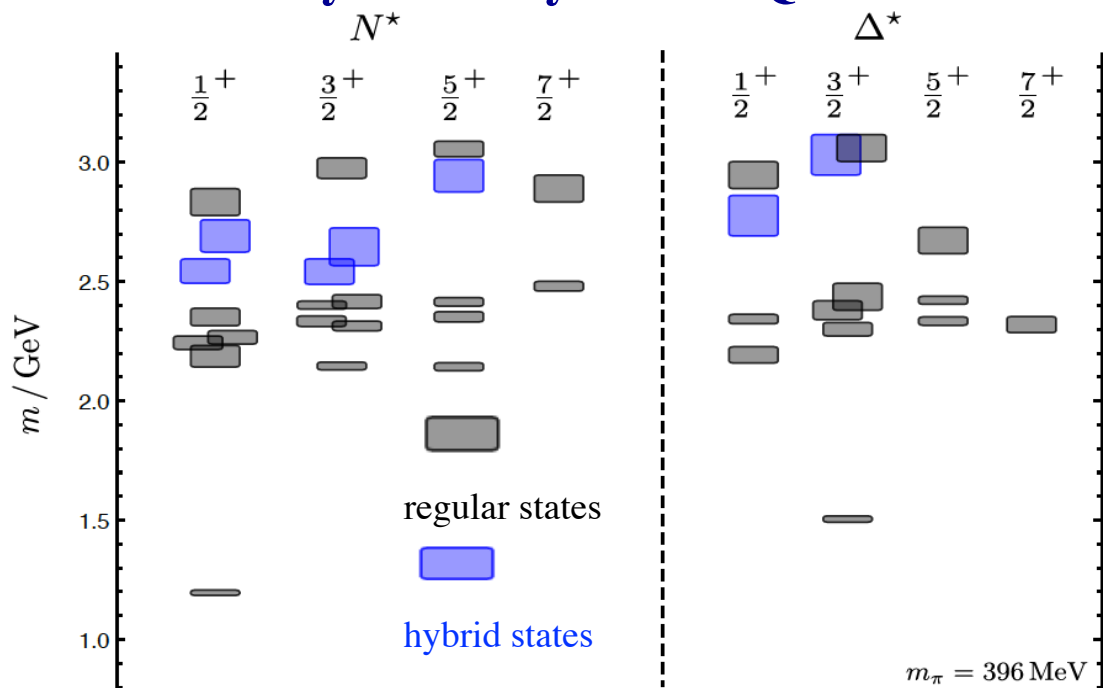
- ✓ Hadron spectroscopy
- ✓ Nucleon Structure
- ✓ HPS – Heavy Photon Search



Bari, Catania, Ferrara, Genova, LNF, LNS, Roma1, ISS, Roma Tor Vergata, Torino, Padova
 Thomas Jefferson National Accelerator Facility – Virginia, US People: 67 researchers, 42 FTE
 Data taking 2017-2027@ 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. Obukhovskiy[†]
 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

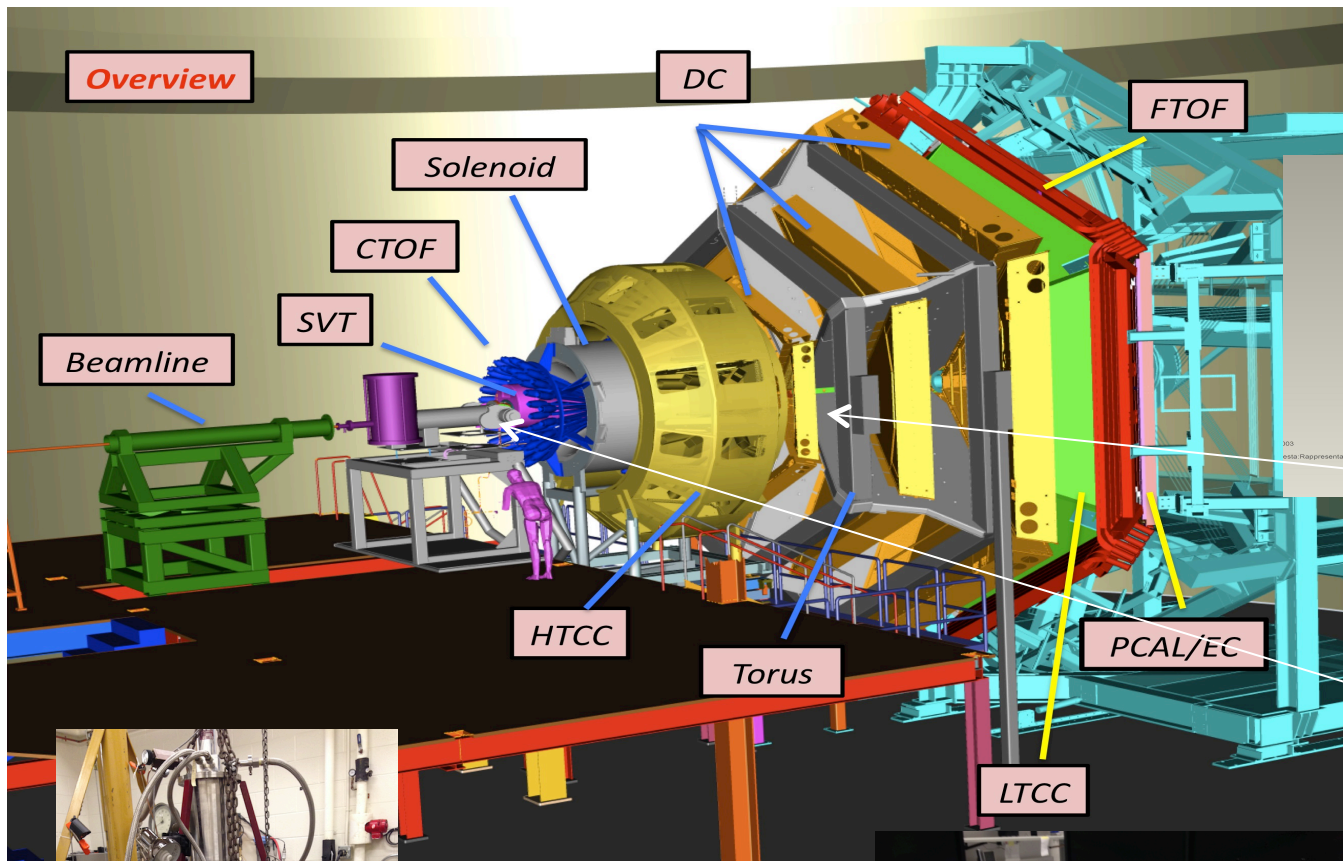
Approved experiment:

A⁻ rating + 100 PAC days beam time

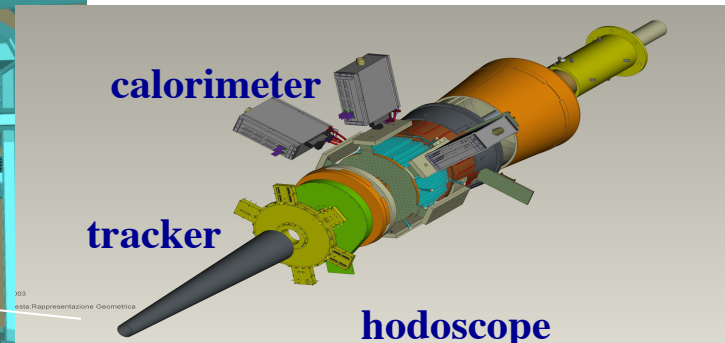
Hybrid states have same J^P values as qqq baryons. How to identify them?

- 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?

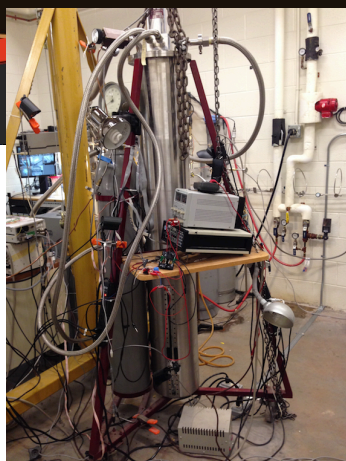
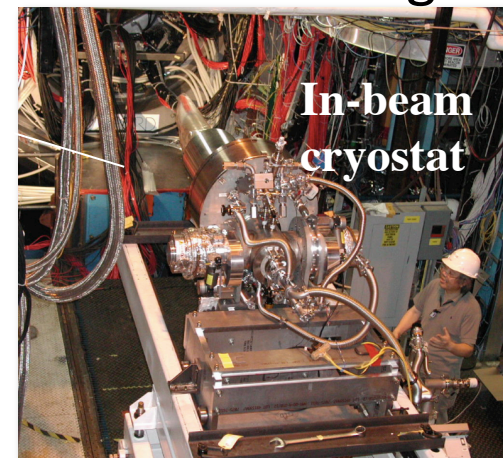
Study of Q^2 evolution of resonances electro-couplings from $K^+\Lambda$ electro production from the proton



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

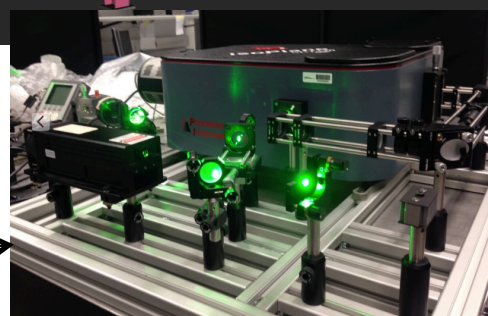


Polarized target



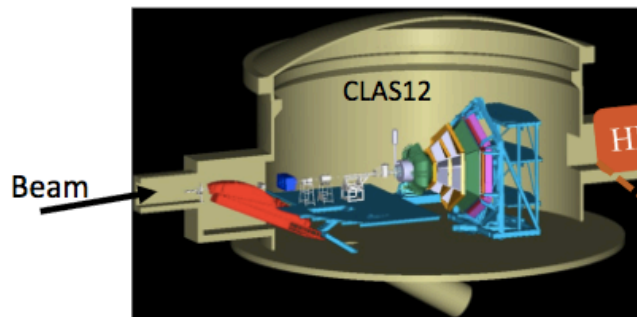
HD gas distiller

Portable Raman



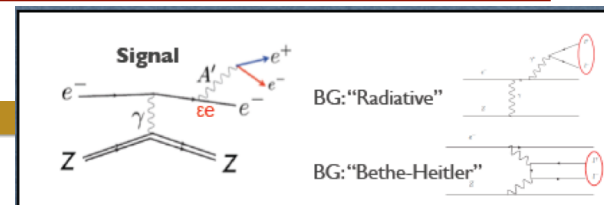


Hall B



HPS

- 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
- Future running planned for 2018 and beyond

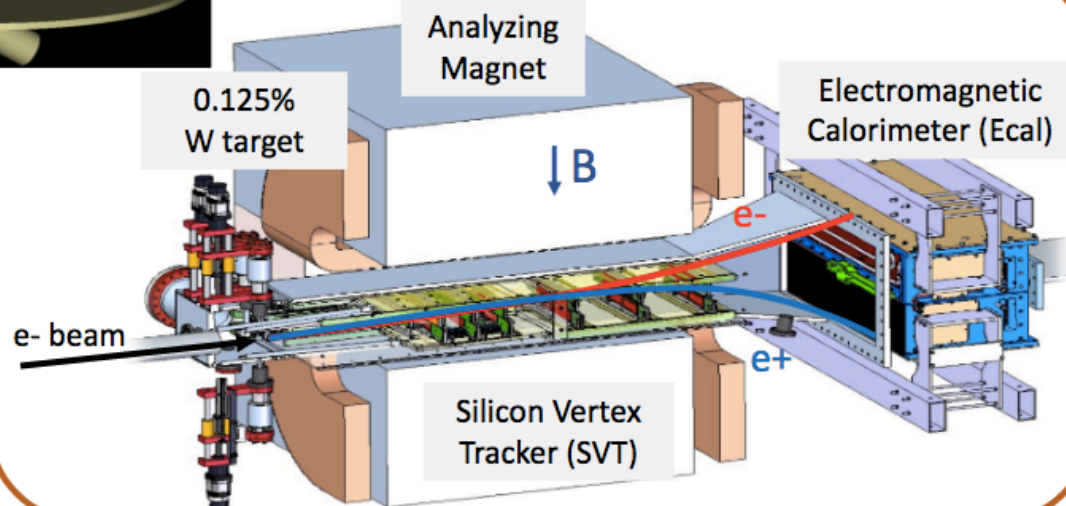


Silicon Vertex Tracker:

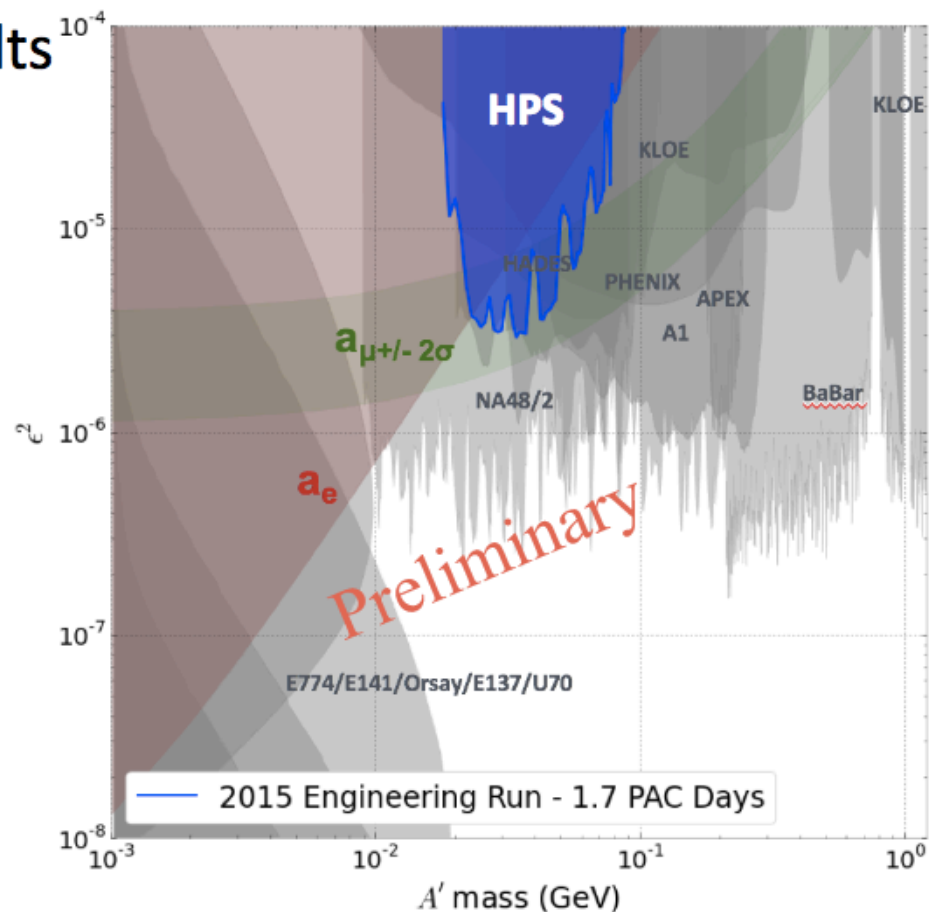
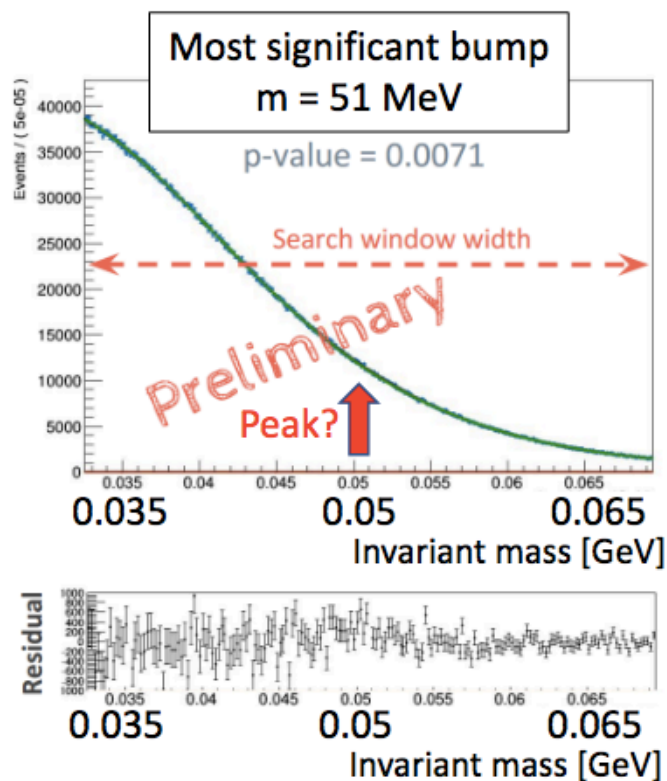
- Tracks particles
- Momentum and vertex reconstruction

EM Calorimeter:

- Triggers events
- Energy and timing



2015 Engineering Run results



No vertexing reach attained → needed to run much longer!

- Projected reach did not fully account for acceptance and efficiency

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)

CLAS12 Partecipazione a run di commissioning e presa dati:

- per Run Group A (12 GeV) Hybrid Meson
- Run Group K (6,6 GeV e 8,8 GeV) Hybrid Baryons

Le richieste maggiori sono relative al progetto PolTarg:

- manutenzione ed al funzionamento del sistema Raman
- installazione e commissioning del sistema di distillazione del gas di HD a Roma

In particolare nel 2018 prevediamo di acquisire 12 nuove bombole per il contenimento del gas distillato con raccorderia e valvola ad ottima tenuta ed il controller di temperatura con sensori calibrati.

Missioni	
Turni di Misura CLAS12, Test Test e-HD, missioni Ge per collaborazione FT e analisi	35 K€
Consumo	
Ottica di ricambio sistema Raman e raccorderia da vuoto	6 K€
Altro Consumo	
Liquidi criogenici: LHe + LN	8 K€
Trasporti	
Spese di Trasporto e sdoganamento gas HD	2 K€
Manutenzione	
Manutenzione Laser e set-up Laser	2 K€
Apparati	
12 nuove bombole di Al elettropulito con valvole a tenuta e carrelli, nuova raccorderia con Swagelock per 14 bombole esistenti e controller di temperatura Lake Shore con 4 sensori Cernox calibrati a 4 k	37 K€
Totale Richieste	90 K€

Totale Richieste GIII Roma Tor Vergata

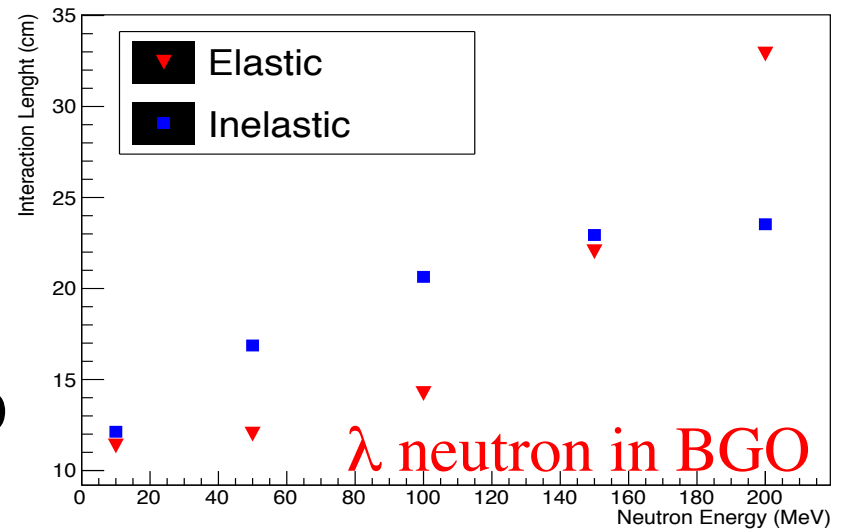
Sigla	A carico dell'I.N.F.N.												
	missioni	inviti	consumo	altri_cons	seminari	trasporti	pubblicazioni	manutenzione	inventario	apparati	licenze-SW	spservizi	TOTALI
FOOT	3.50												3.50
JLAB12	35.00		6.00	8.00		2.00		2.00		37.00			90.00
MAMBO	23.50		10.00	1.50		1.00		2.00	6.50				44.50
Tot.Sigle	62.00		16.00	9.50		3.00		4.00	6.50	37.00			138.00
Dotazioni di CSN III	5.00		2.50		0.50		1.00		8.00				17.00
Totale CSN III Roma II	67.00		18.50	9.50	0.50	3.00	1.00	4.00	14.50	37.00			155.00

Backup

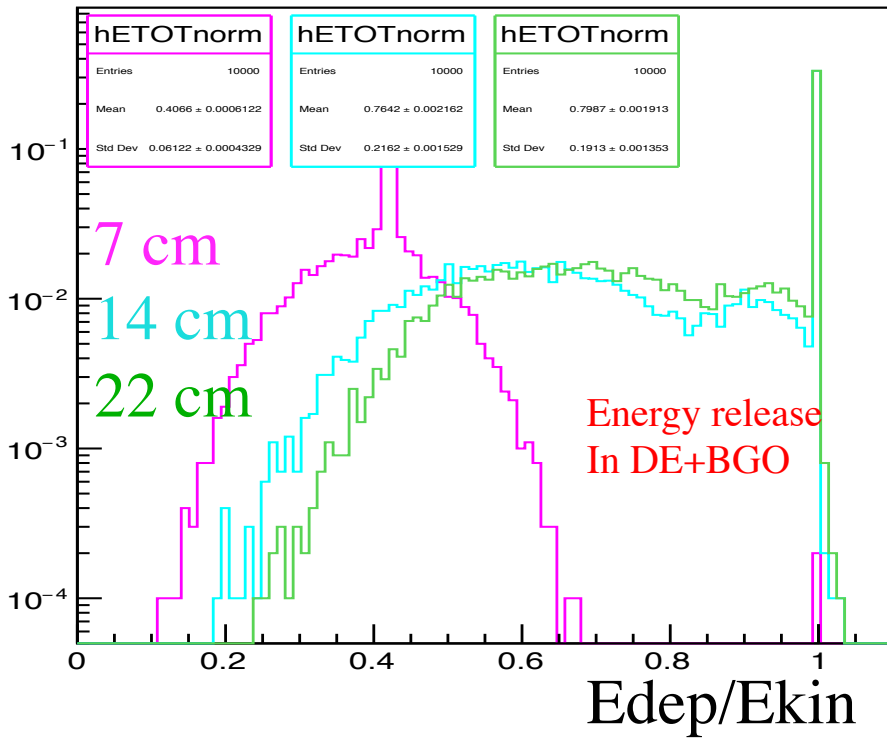


BGO calo length VS neutron leakage

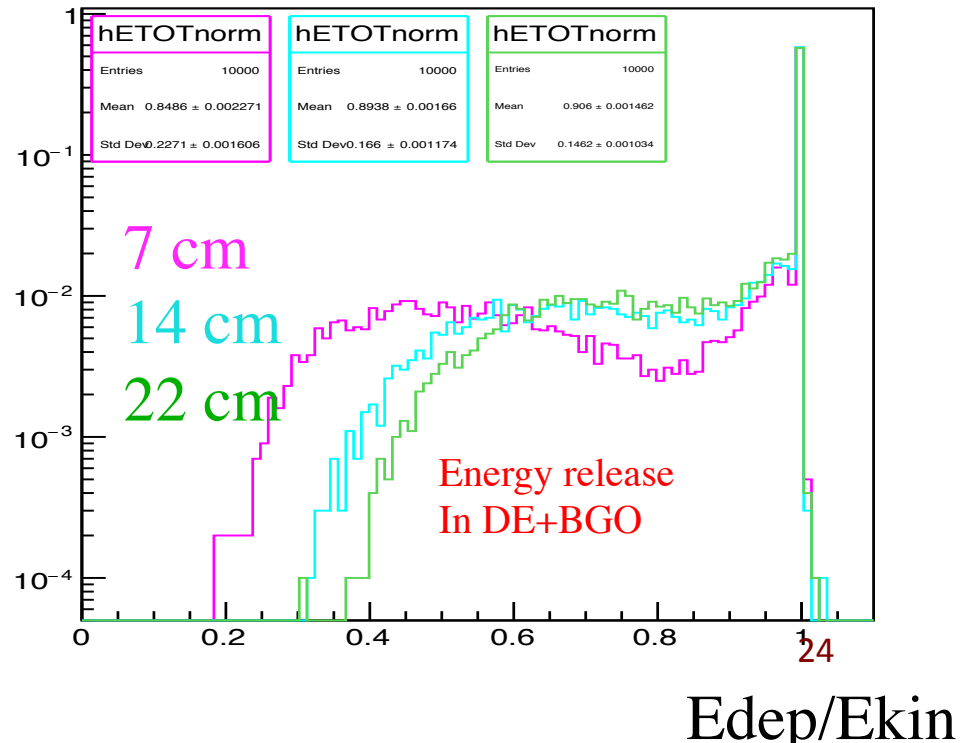
The neutron leakage is difficult to eliminate. The crystal length must be > 10 cm to contain Li, Be fragments at 350 MeV/u. With 7 cm crystals at 300 MeV/nucl also the Li frag escapes



Li @350 MeV /nucl $E_{kin}=2450$ MeV



C @ 350 MeV /nucl $E_{kin} = 4.200$ MeV



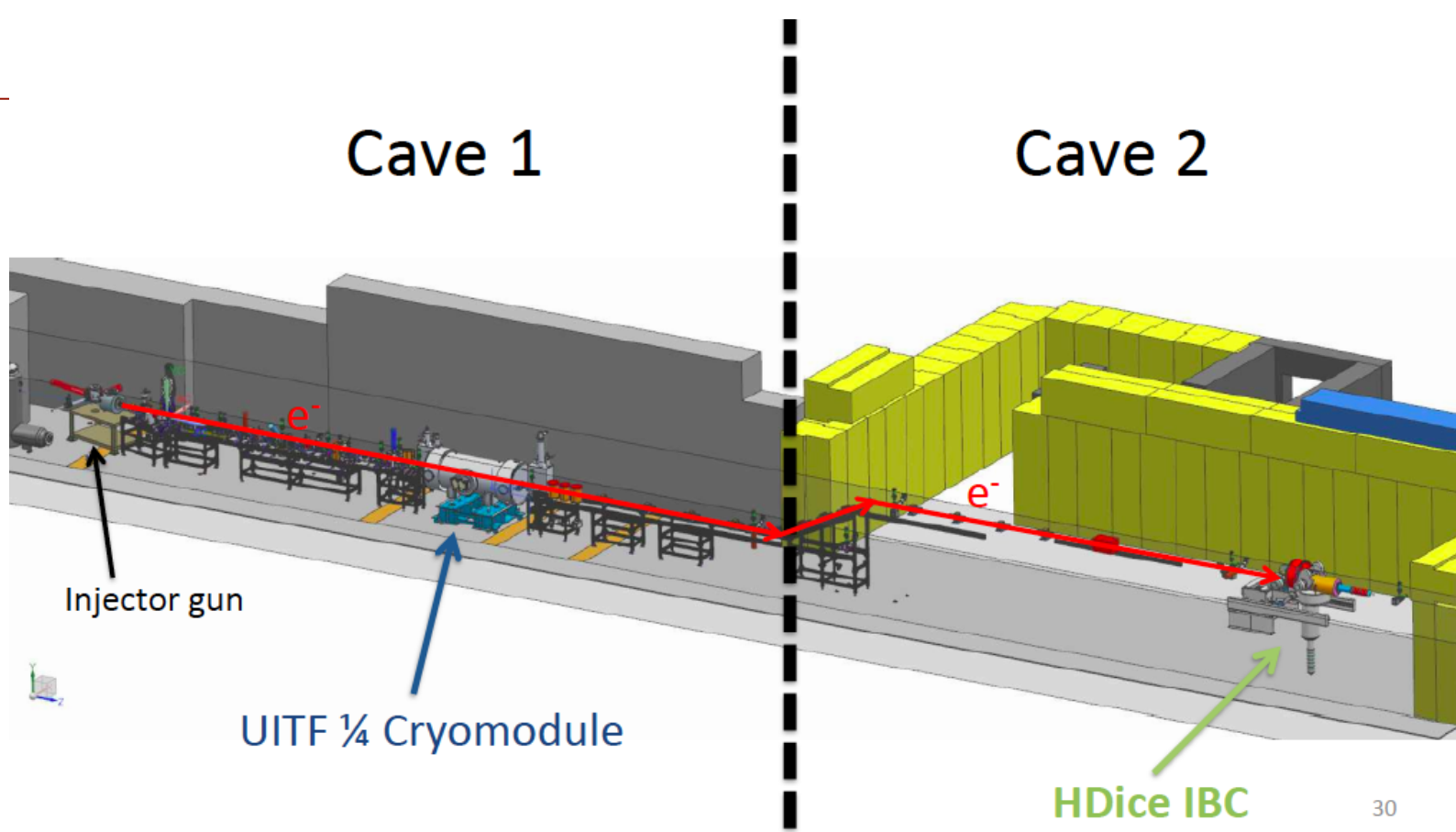
ORIZZONTE TEMPORALE

BGO-OD (Bonn)

- Finanziamento SFB (programma pluriennale per più università) 2008-2016 (terminato in giugno dell'anno scorso)
- Chiesto nuovo finanziamento DFG (programma pluriennale per singole università) per altri 4 anni (si attende risposta)
- Funzionamento di ELSA è garantito per gli esperimenti di fisica adronica (BGO-OD e CB-ELSA) almeno fino al 2020
- In CSN3 la sigla era in scadenza a Dicembre 2016 ed è stata rinnovata per altri 4 anni

A2 (Mainz)

- Approvata la proroga del finanziamento SFB fino al 2023



Il 1/4 cryomodule è pronto per il test a RF.

IBC pronto per i test.

- ✓ Installazione del supporto dell'IBC nella zona del test beam
- ✓ Inizio polarizzazione di nuovi bersagli da utilizzare per il test.