Gruppo III: Fisica Nucleare

Coordinatore: Pasquale Di Nezza

CERN	Fisica: QGP	FTE: ric.+tecnol.	11.5
Jlab	Fisica: adronica	FTE: ric.+tecnol.	10.5
Bonn/Mainz	Fisica: adronica	FTE: ric.+tecnol.	1.6
GSI	Fisica: adr./nucl.	FTE: ric.+tecnol.	2.5
LNF	Fisica: nucleare	FTE: ric.+tecnol.	12.0
LNGS	Fisica: nucleare	FTE: ric.+tecnol.	5.5

Esperimenti terminati , ma con impegno residuo su analisi e pubblicazioni

Gruppo III: Fisica Nucleare

Coordinatore: Pasquale Di Nezza

ALICE	CERN	Fisica: QGP	FTE: ric.+tecnol. 11.5
JLab12	Jlab	Fisica: adronica	FTE: ric.+tecnol. 10.5
MamBo	Bonn/Mainz	Fisica: adronica	FTE: ric.+tecnol. 1.6
panda	GSI	Fisica: adr./nucl.	FTE: ric.+tecnol. 2.5
Kaonnis	LNF	Fisica: nucleare	FT
VIP	LNGS	Fisica: nucleare	FT

FTE Totali

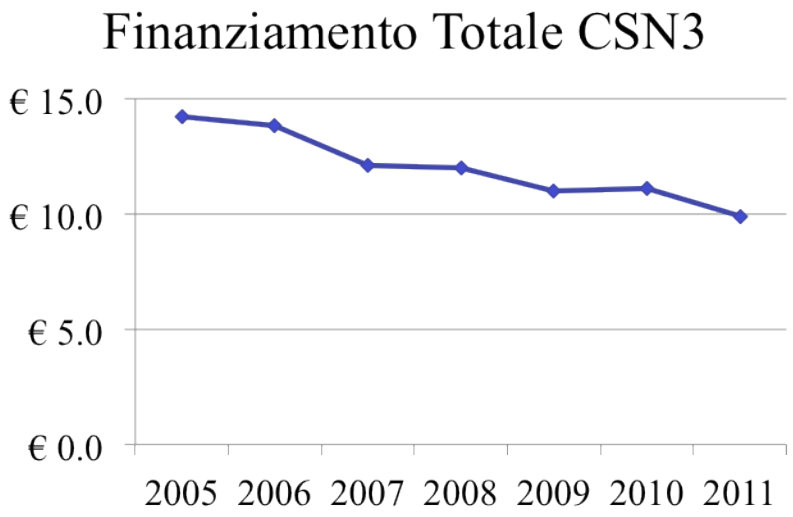
Ric.+Tecnol. 43.6

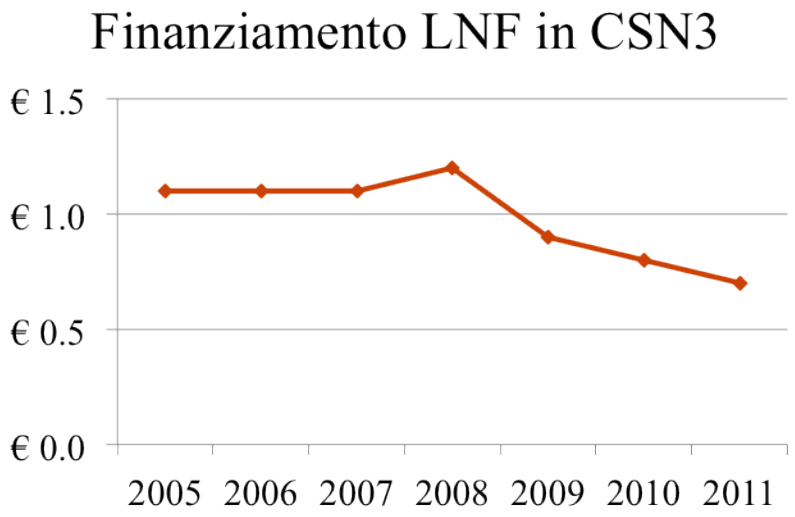
Tecnici 5.7

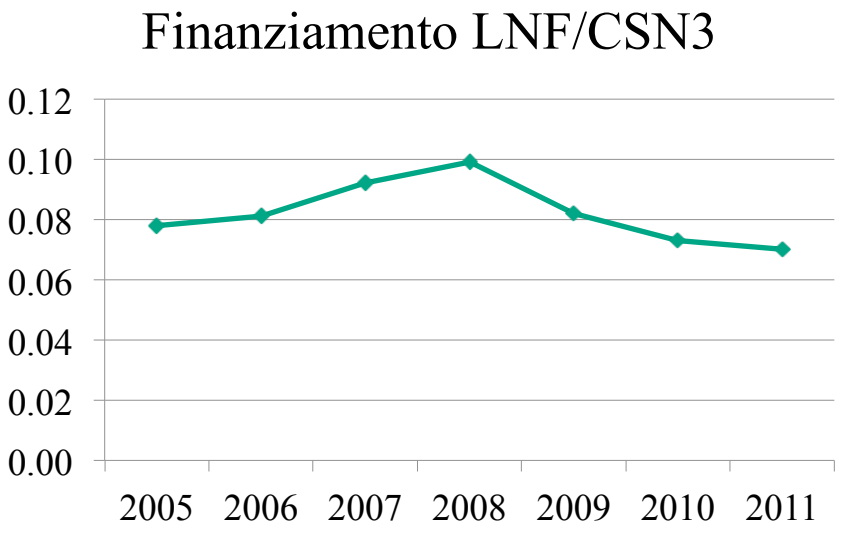
hermes

Esperimenti terminati , ma
su analisi e pubblicazioni

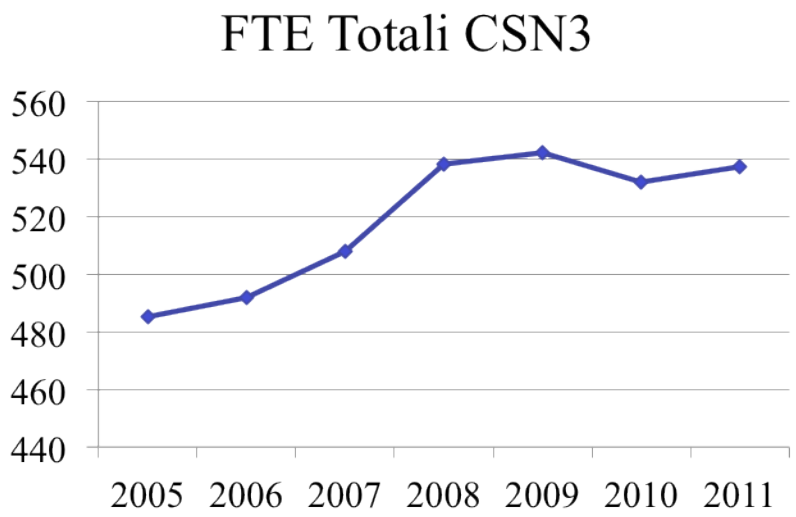
Overview e confronto con CSN3

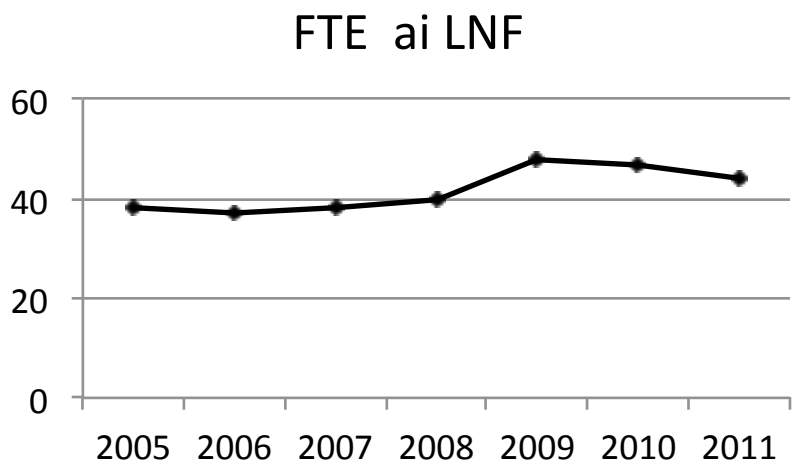






Overview e confronto con CSN3





Integrando dal 2005

- FTE LNF/CSN3 = 8.2%
- Finanziamenti LNF/CSN3=9.3%
- Turnover = 4 pensionamenti, 2 nuovi assunti

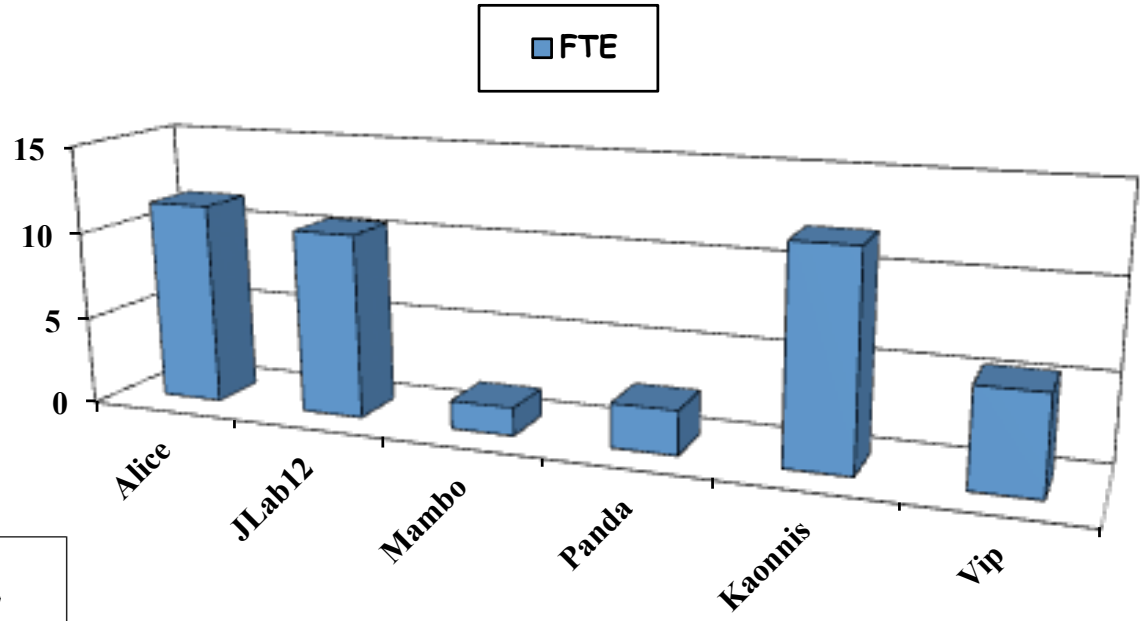
Ricercatori Gr III

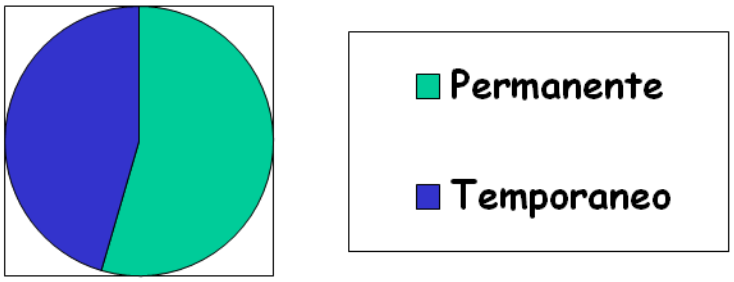
- 5 sigle (su 6) hanno responsabilitá nazionale LNF :

JLab12, MamBo, PANDA, SIDDHARTA e VIP

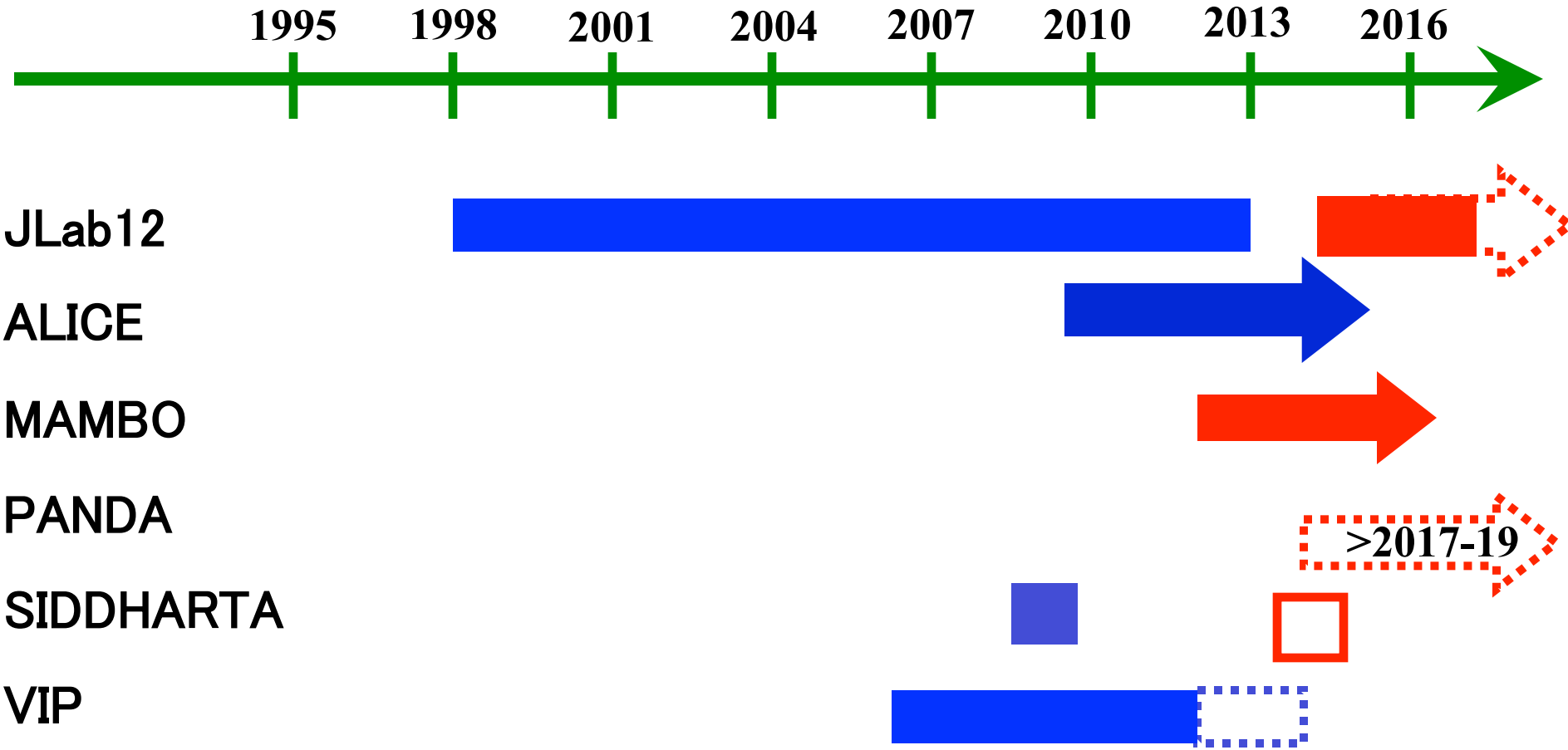
- Numerose importanti responsabilitá nazionali / internazionali :

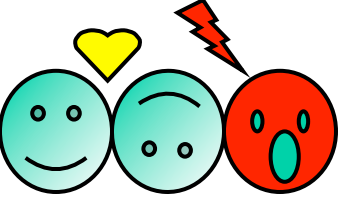
ALICE (Management Board), JLab12 (Scientific Committee), MamBo (Co-Spokeperson), PANDA (Deputy Spokesperson), SIDDHARTA (Spokesperson), VIP (Spokesperson), I3HP (Chair), ……





Time schedule data taking





The VIP Experiment

(VIolation of the Pauli Exclusion Principle)

VIP Collaboration: LNF- INFN, LNGS and INFN, Trieste, Italy

SMI-Vienna,Austria; IFIN–HH, Bucharest, Romania

Univ. Neuchâtel, Switzerland

Goal: ***perform an experimental test of the validity of the Pauli Exclusion Principle for electrons to*** 10^{-29} - 10^{-30}

(region of particular interest: for example - the validity of Pauli principle in a higher-dimensional space-time – small violation in the 3 +1 dimensional space-time; or strings and superstrings etc. – violation of Pauli principle in this range)

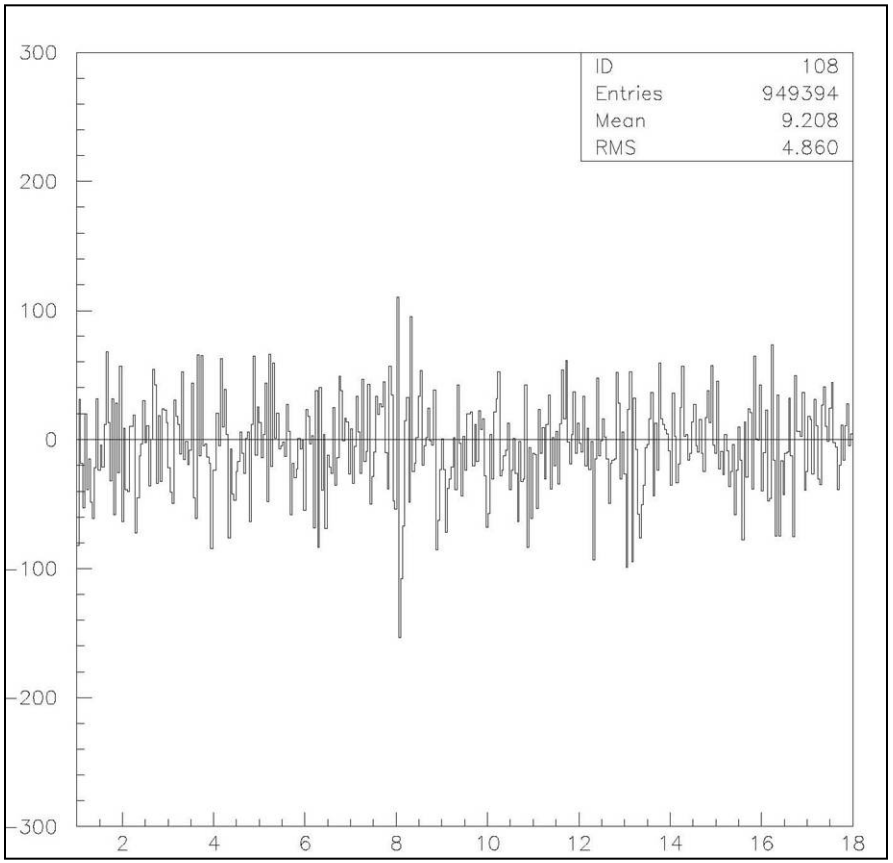
(pre-VIP limit: $\beta^2/2 \le 1.7 \cdot 10^{-26}$ *(Phys. Lett.* ***B238*** *(1990) 438))*

Experimental method: ***search for anomalous X-ray transitions in copper (2p->1s with 1s already occupied by 2 electrons; have the energy displaced with respect to the "normal" one)***

Performed at the LNGS Laboratory ***to reduce the X ray background induced by cosmic rays***

The present best limit on probability

that Pauli Exclusion Principle is violated



Performing the calculation we find for the PEP violation parameter :

$$\beta^2/2 \leq 5\times10^{-29}$$

We have thus improved the limit obtained by Ramberg & Snow by a factor ~ 300 (>2 orders of magnitude)

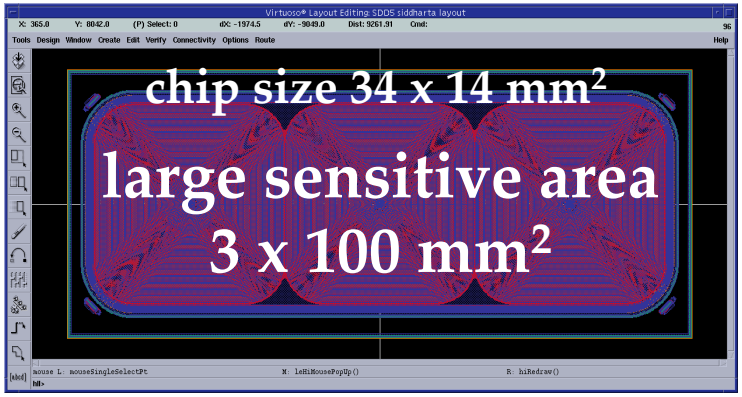
Published in International Journal of Quantum Information, Vol. 9 (2011) 145

Drawbacks of VIP:

-Reused an already done setup (DEAR experiment) – limited selection of materials

- No timing (trigger) capabilities

-Limited energy range (30 microns)



VIP- upgrade:

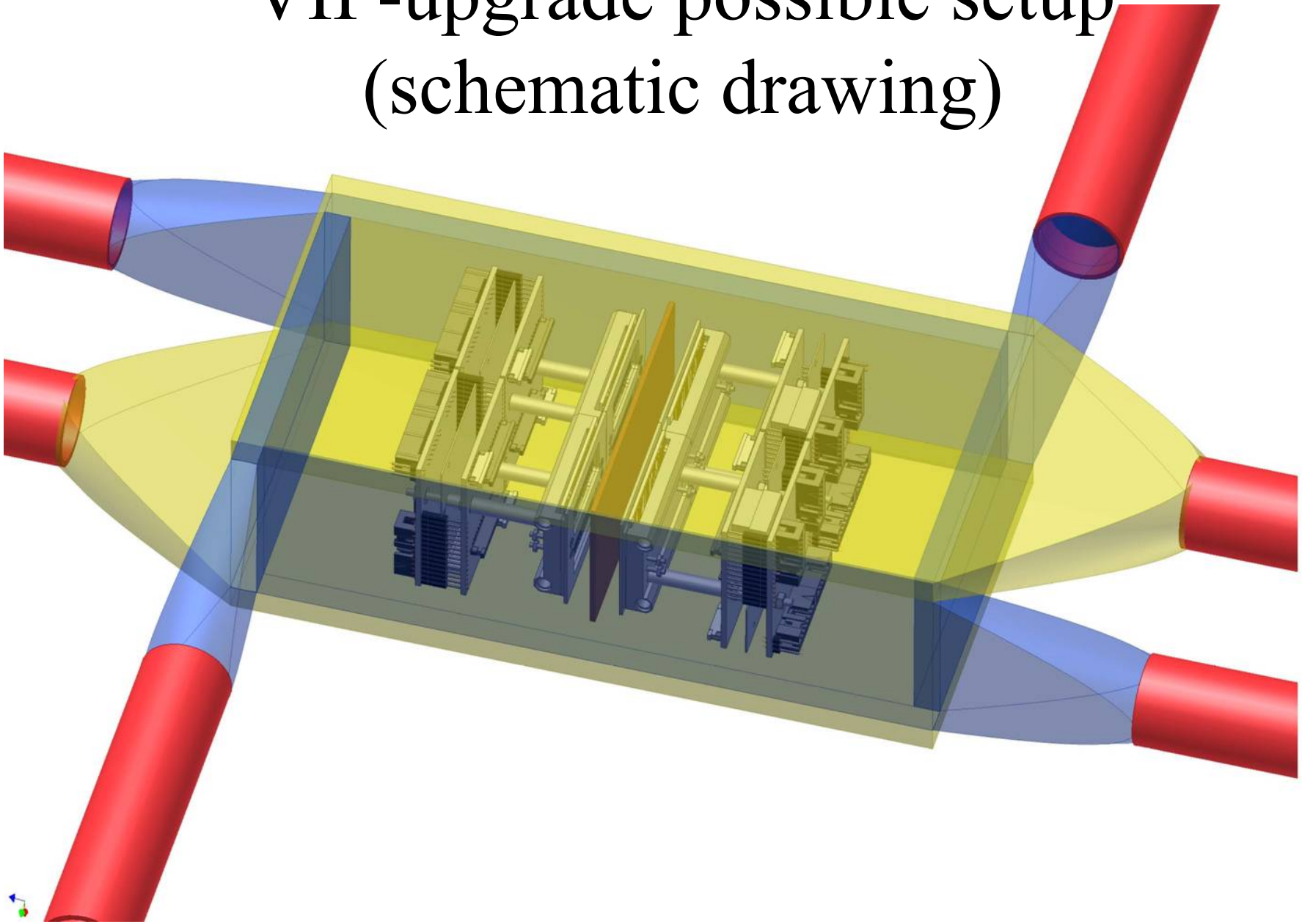
⇒ *Use new detectors – triggerable SDD (as those used in SIDDHARTA proved to have high rejection power) -> implement an active shielding (veto on scintillators surrounding setup) or Si-PIN*

⇒ *300 microns – more efficient in a broader energy range – possibility to study other mterials (Ag?)*

⇒ *Design a new setup – more compact (higher acceptance)*

⇒ *Enrichment of physics case*

VIP-upgrade possible setup (schematic drawing)



VIP plans

- *Finalize data analyses with present data*

- *2012 - built VIP-upgraded setup, test and installation at LNGS*

- *2-3 years of DAQ – to arrive at 10^{-30} – 10^{-31}*

- *In parallel – study feasibility of using same method for study of collapse of wave function (GRW model)*

Castello di Trento ("Trint"). watercolour, 19.8 x 27.7, painted by A. Dürer on his way back from Venice (1495) British Museum, London.

Speakable in quantum mechanics: atomic, nuclear and subnuclear physics tests

Trento, August 29 – September 2, 2011

Main Topics

Foundations of quantum mechanics and open problems
Spin-statistics theorem: the Pauli Exclusion Principle
Bell inequalities
Decoherence in quantum mechanics
CPT and Lorentz symmetry violation
Neutral meson interferometry
Quantum vacuum: present status of understanding and experiments
The measurement problem and possible experimental tests
Present and future experiments, new ideas

Participants include

Angelo Bassi (*Univ. and INFN Trieste, Italy*), Rita Bernabei (*Univ. Tor Vergata, Roma, Italy*), Giacomo Mauro D'Ariano (*Univ. Pavia, Italy*), Francesco de Martini (*La Sapienza, Roma*), Alexis Diaz-Torres (*University of Surrey, UK*), Antonio di Domenico (*Univ. "La Sapienza", Roma, Italy*), Carlo Guaraldo (*LNF-INFN, Italy*), Ryugo Hayano (*Univ. Tokyo, Japan*), Beatrix Hiesmayr (*Univ. Vienna, Austria*), Klaus Jungmann (*Univ. of Groningen, Holland*), Nikolai Kiesel (*Univ. Vienna, Austria*), Nikolaos Mavromatos (*King's College London, Univ. of London, UK*), Fabrizio Piacentini (*INRIM-Torino, Italy*), Helmut Rauch (*Vienna University of Technology, Austria*), Eberhard Widmann (*SMI-Vienna, Austria*), Nino Zanghi (*Univ. Genova, Italy*), Guido Zavattini (*Univ. Ferrara, Italy*)

HadronPhysics2
Study of Strongly Interacting Matter

Organizers

C. Curceanu (*LNF - INFN*) petrascu@lnf.infn.it
J. Marton (*SMI-Vienna*) johann.marton@oeaw.ac.at
E. Milotti (*Università di Trieste and INFN*) edoardo.milotti@ts.infn.it

Director of the ECT*: Professor Achim Richter (*ECT**)

Richieste VIP per 2012 (preliminary)

All'esperimento VIP partecipano 8 fra ricercatori e tecnologi LNF

(per un totale di ~ 5.5 FTE)

LNF: 3 mesi uomo per SPAS, 3 mesi uomo SSRC

3 mesi uomo elettronica

Piano globale di spesa (kE) per 2012 per LNF

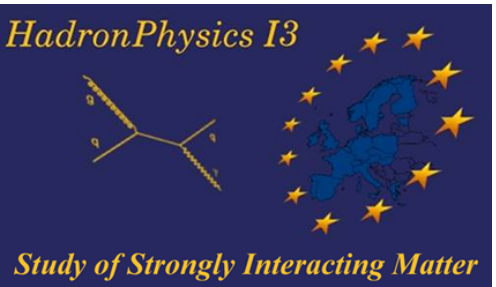
	Miss. interne	Miss. estero	Trasporti e facchinaggio	Inventar.	Costr. apparati	Consumi	**Totale**
2012	16	11	1	48	0	28.5	105.5

KAONNIS initiative

Kaon – Nucleon/Nuclei Interaction Studies

Sigla KAONNIS includes:

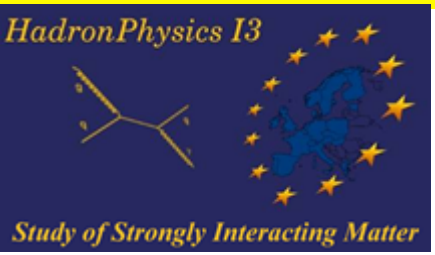
- SIDDHARTA and SIDDHARTA-2
- Participation to the KLOE data taking and analyses for kaon-nuclei interaction studies
- AMADEUS R&D



HadronPhysics3
HP3! New!!!

SIDDHARTA

SIlicon Drift Detector for Hadronic Atom Research by Timing Applications



- LNF- INFN, Frascati, Italy
- SMI- ÖAW, Vienna, Austria
- IFIN – HH, Bucharest, Romania
- Politecnico, Milano, Italy
- MPE, Garching, Germany
- PNSensors, Munich, Germany
- RIKEN, Japan
- Univ. Tokyo, Japan
- Victoria Univ., Canada

EU Fundings: JRA10 – FP6 - I3HP
Network WP9 – LEANNIS – FP7- I3HP2

SIDDHARTA data:

- Kaonic Hydrogen: 400pb^{-1}, most precise measurement, submitted for publication, PLB, arXiv:11053090v1; Ph D

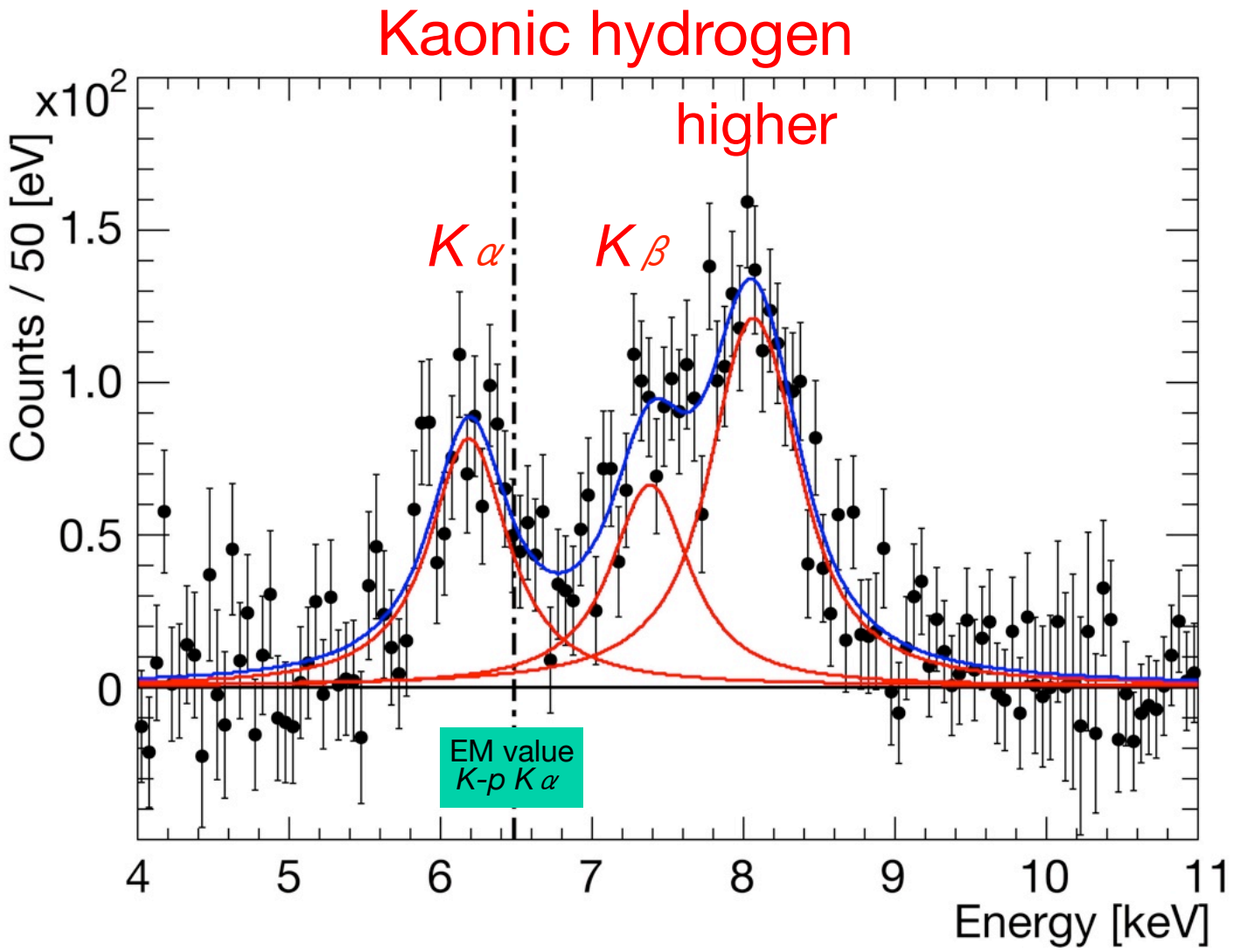
- Kaonic deuterium: 100 pb^{-1}, as an exploratory first measurement ever, advanced analysis; Ph D

- Kaonic helium 4 – first measurement ever in gaseous target; published in Phys. Lett. B 681 (2009) 310; NIM A628 (2011) 264 and Phys. Lett. B 697 (2011) PhD

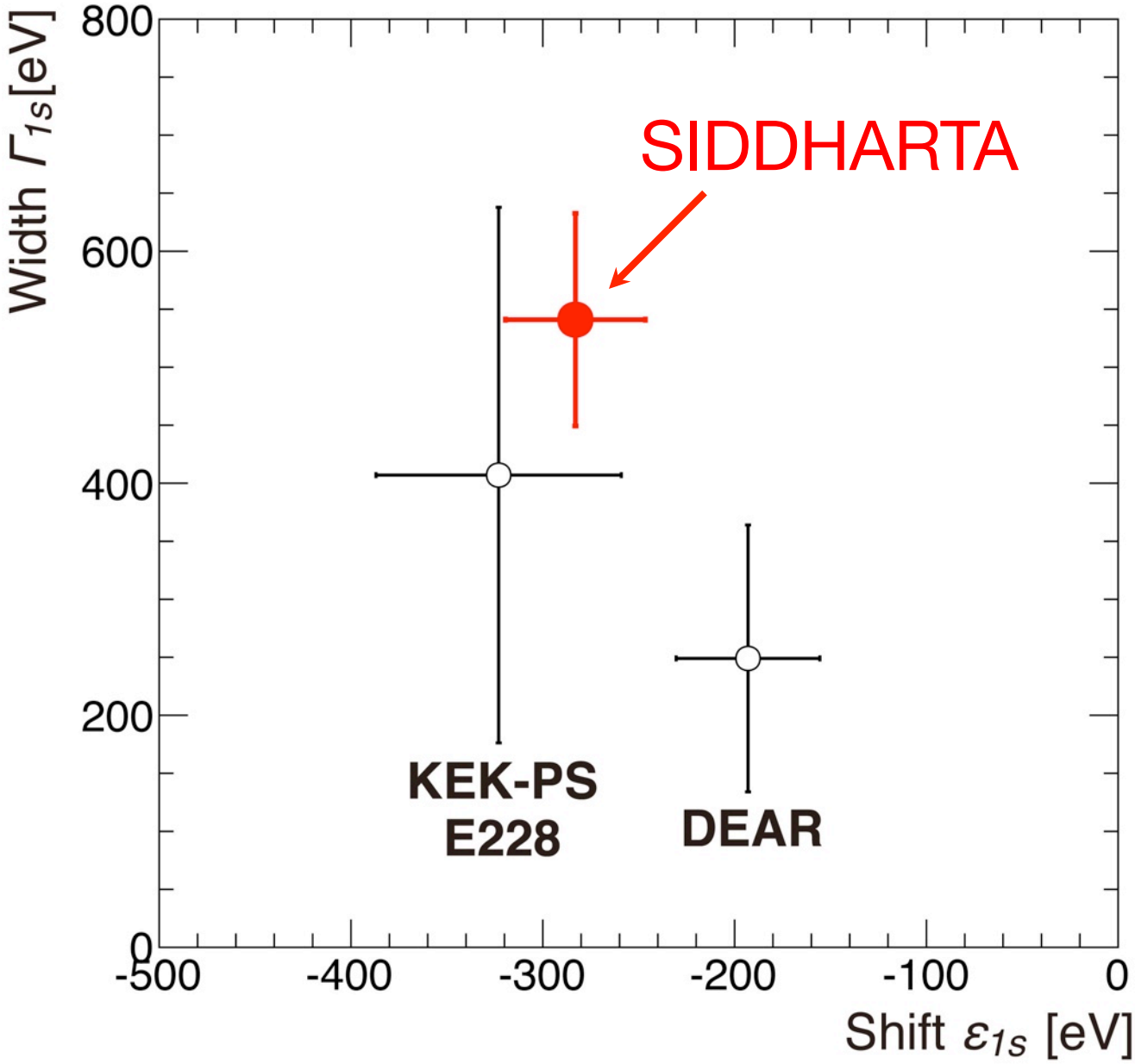
- Kaonic helium 3 – 10 pb^{-1}, first measurement in the world, published in Phys. Lett. B 697 (2011) 199 - Ph D

SIDDHARTA – important academy for young researchers

Kaonic Hydrogen x-ray spectrum after subtraction of fitted background



Kaonic hydrogen result



SIDDHARTA KHe4 result: Phys. Lett. B 681 (2009) 310

$$\Delta E = E_{\mathrm{exp}} - E_{\mathrm{e.m.}}$$
$$= 0 \pm 6\ (\mathrm{stat}) \pm 2\ (\mathrm{syst})\ \mathrm{eV}$$

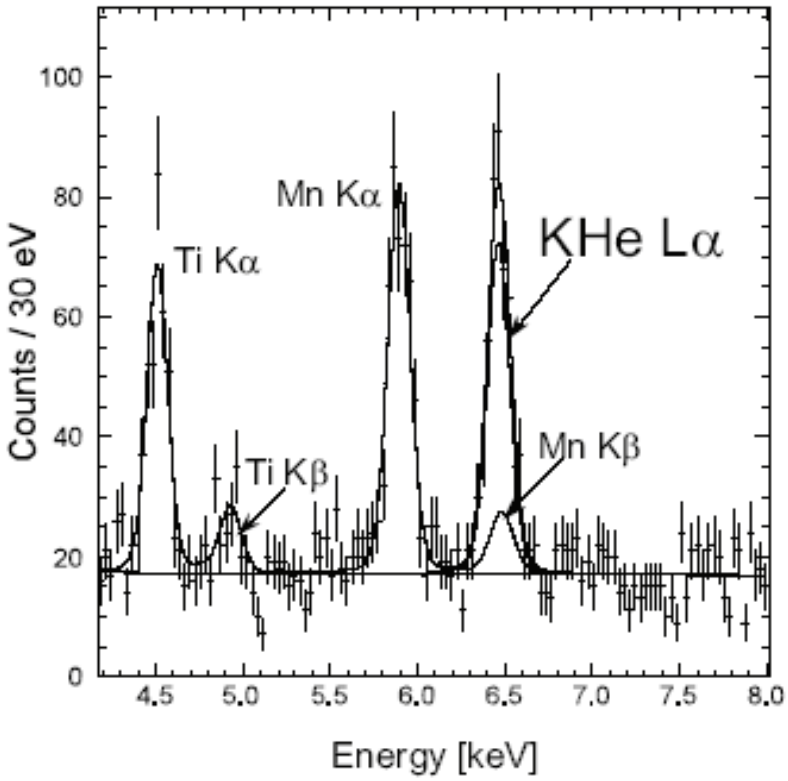
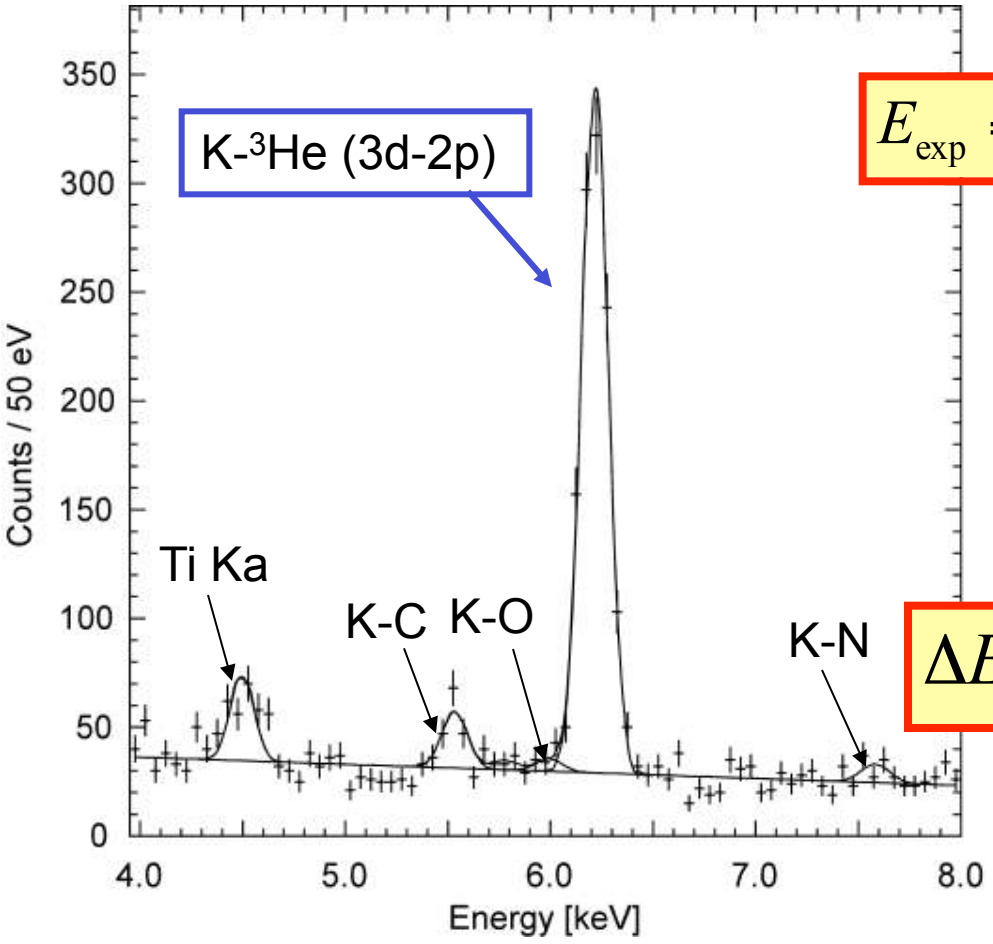


Fig. 5. Energy spectrum of the kaonic ^{4}He X-rays in coincidence with the K^+K^- events. Together with the accidental coincidence events of the Ti and Mn X-rays, the kaonic ^{4}He Lα line is seen at 6.4 keV.

Kaonic Helium-3 energy spectrum



X-ray energy of K-3He 3d-2p

$$E_{\exp} = 6223.0 \pm 2.4(sta) \pm 3.5(sys)\ \text{eV}$$

QED value: $E_{e.m.} = 6224.6\ \text{eV}$

$$\Delta E_{2p} = E_{\exp} - E_{e.m.}$$

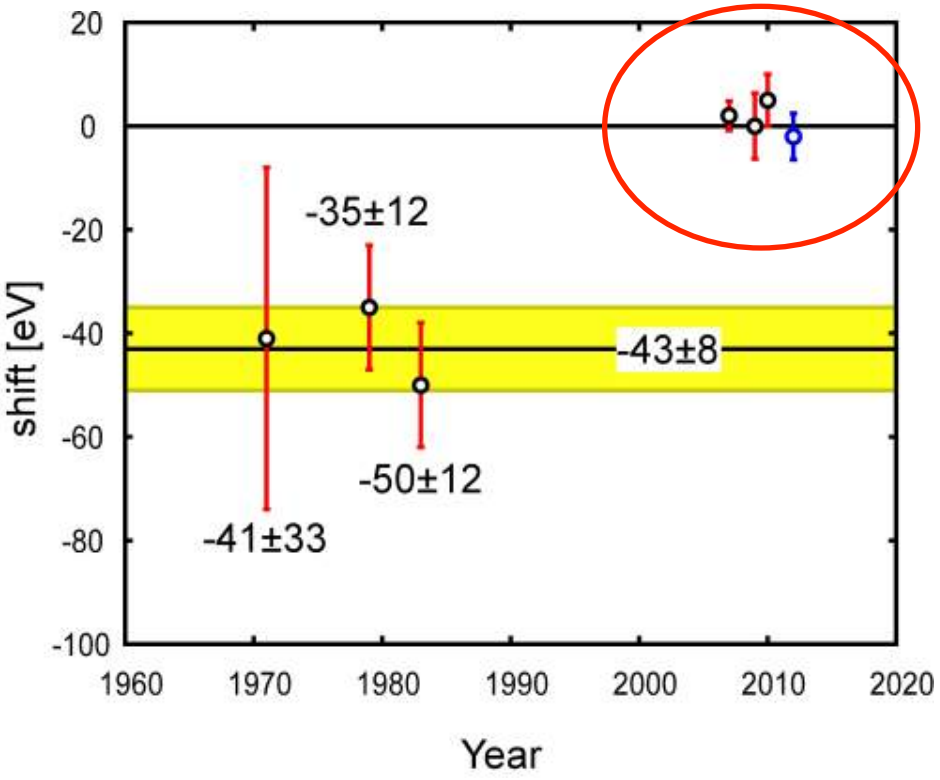
$$\Delta E_{2p} = -2 \pm 2(sta) \pm 4(sys)\ \text{eV}$$

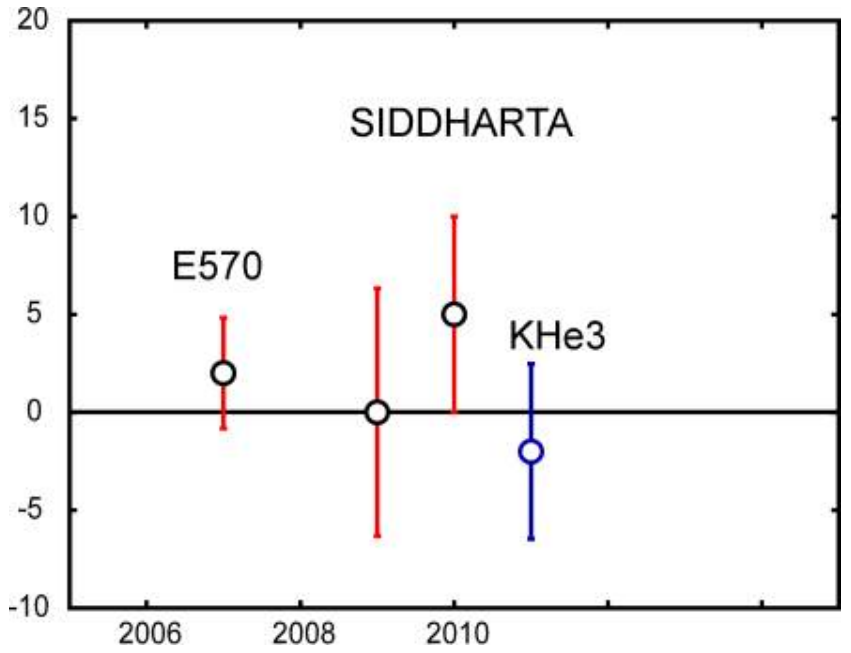
World First !
Observation of K-³He X-rays
Determination of
strong-interaction shift

arXiv:1010.4631v1 [nucl-ex], PLB697(2011)199

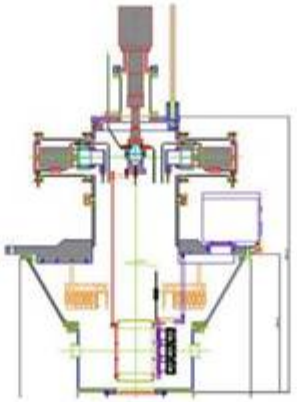
KHe results worldwide:

	Shift [eV]	Reference
KEK E570	+2±2±2	PLB653(07)387
SIDDHARTA (He4 with 55Fe)	+0±6±2	PLB681(2009)310
SIDDHARTA (He4)	+5±3±4	arXiv:1010.4631, PLB697(2011)199
SIDDHARTA (He3)	-2±2±4	





*error bar $= \pm\sqrt{(stat)^2 + (syst)^2}$



SIDDHARTA-2 Proposal

The upgrade of the SIDDHARTA apparatus for

an enriched scientific case

Exploring the (very) low-energy QCD in the strangeness sector by means of exotic atoms

14 June 2010

SIDDHARTA2 physics – enriched case

SIDDHARTA-2:

1) Kaonic deuterium measurement

2) Investigate the possibility of the measurement of other types of hadronic exotic atoms (sigmonic hydrogen ?)

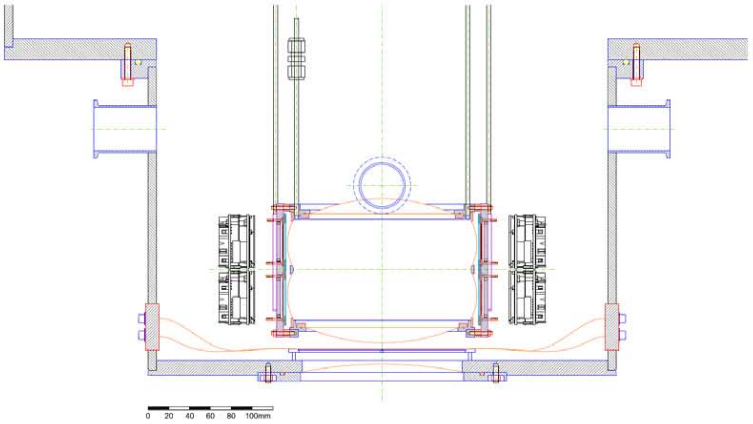
3) Kaonic helium transitions to the 1s level (and more precise measurements to 2p level)

4) Other light kaonic atoms (KO, KC,…)

4) Heavier kaonic atoms measurement (Si, Pb…)

5) Kaon mass precision measurement at the level of <10 keV

6) Kaon capture in hydrogen – L(1405) study



SIDDHARTA-2
the kaonic deuterium case

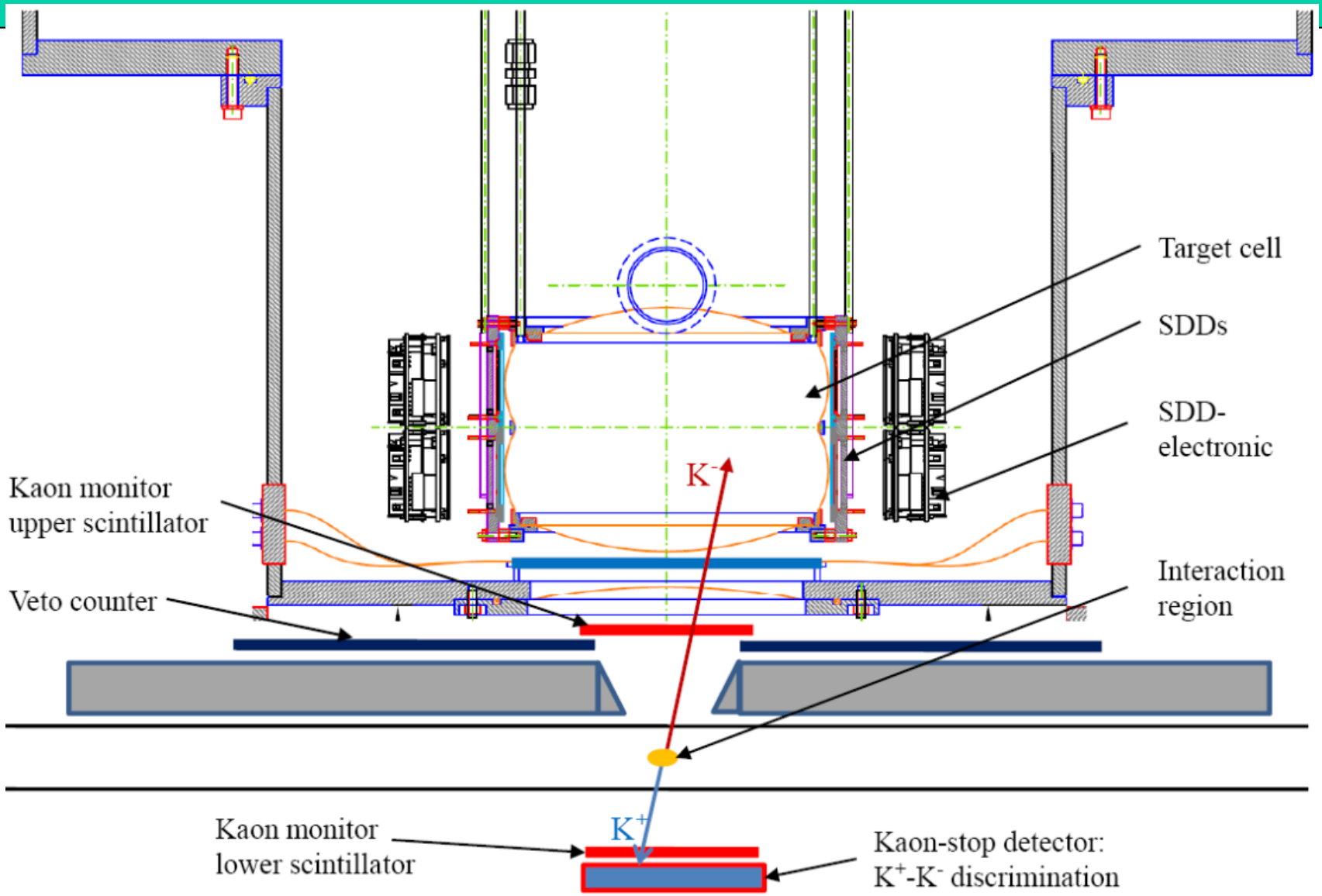
Upgrade of the SIDDHARTA apparatus for

the measurement of kaonic deuterium

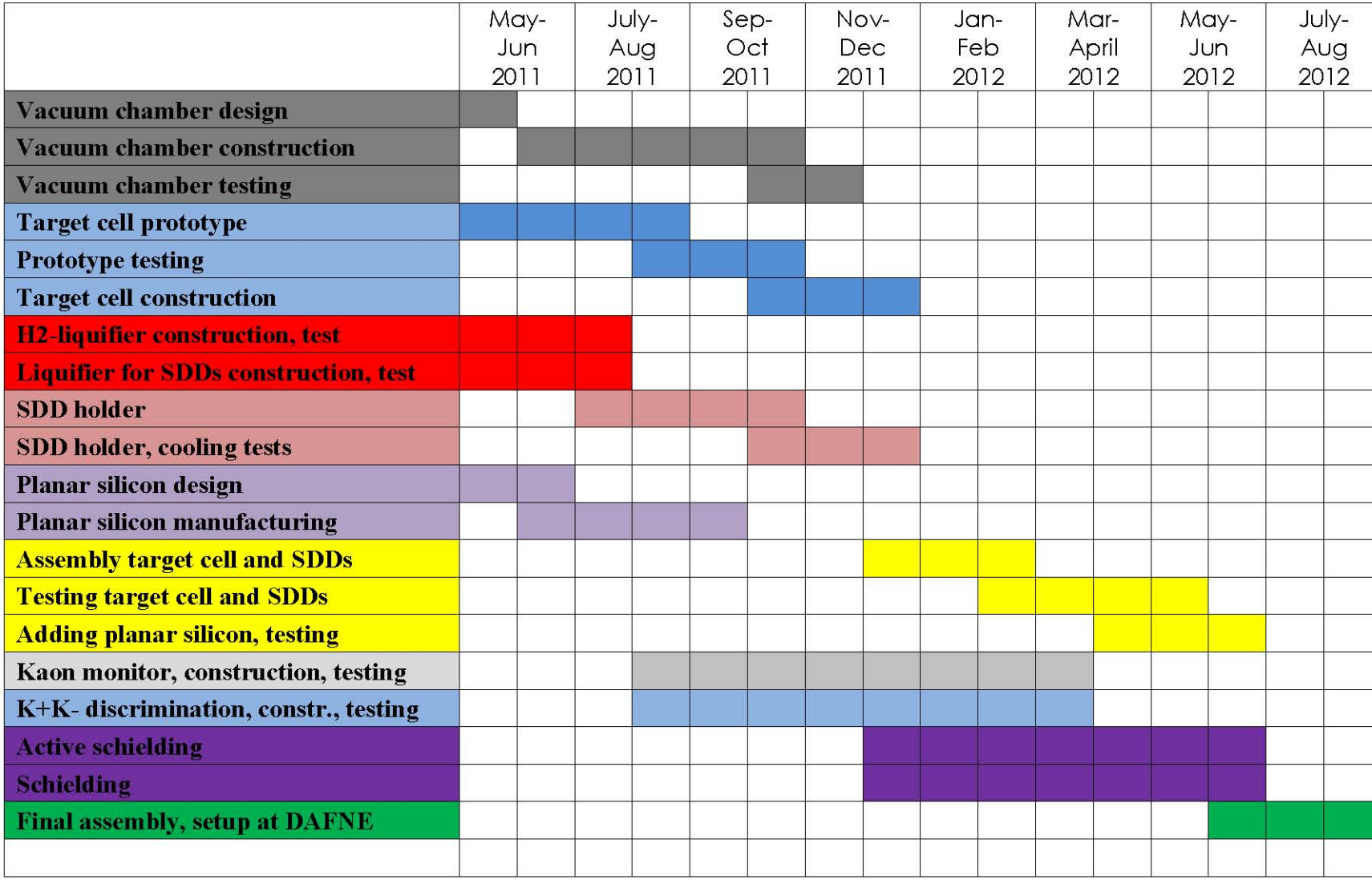
Asked by the LNF-SC

14 April 2011

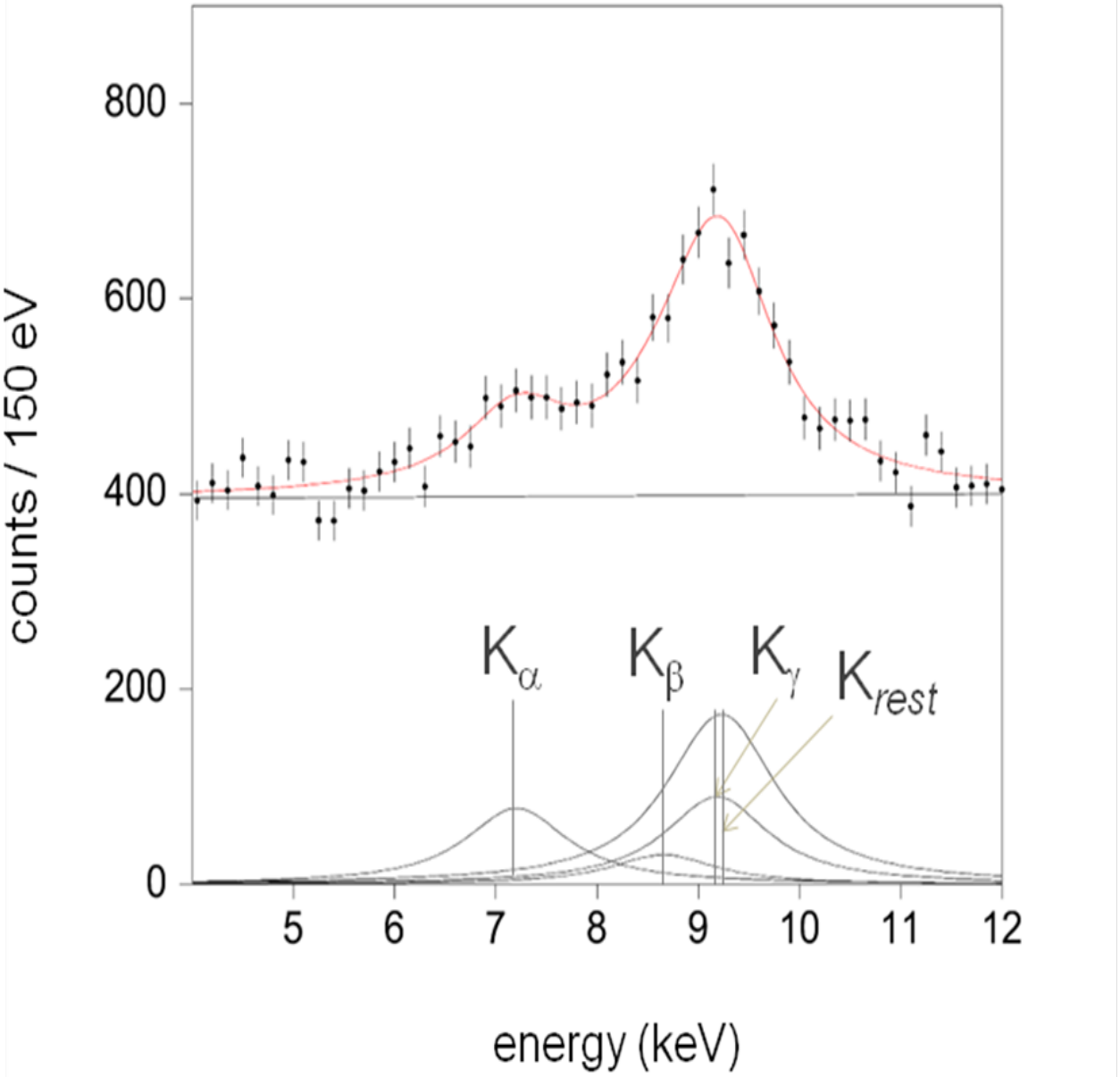
SIDDHARTA-2 setup
(new target cell, cooling, electronics trigger, veto and shielding)



SIDDHARTA-2 time schedule

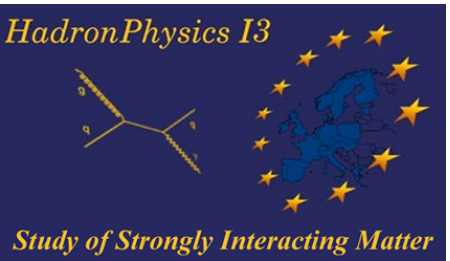


Kaonis deuterium simulated spectrum for an integrated luminosity of 600 pb-1



AMADEUS activities in 2011

- Participate with KLOE at the data taking (shifts) and data analyses
- R&D for AMADEUS (trigger system and inner tracker) - continued



HadronPhysics3
HP3! New!!!

Richieste KAONNIS-LNF per 2012

All'iniziativa KAONNIS partecipano 19 fra ricercatori tecnologi e tecnici LNF (per un totale di ~ 12 FTE).

Elettronica: 6 mesi-uomo; Prog. Meccanica: 4 mesi-uomo ; Officina: 8 mesi-uomo

Piano globale di spesa per 2012 per LNF (kE) (preliminare)

	Miss. interne	Miss. estero	Costr. apparati	Inventar.	Consumi	Totale
2012	10	18	0	25	60	103

MamBo (1.6 FTE)

Studio degli stati eccitati del nucleone attraverso la fotoproduzione di mesoni a MAMIc (Mainz) e ELSA (Bonn)

ELSA(Bonn) beamline S

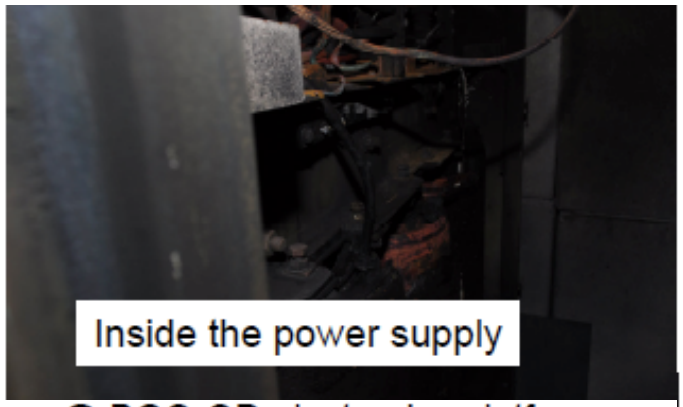
- Completato cablaggio HV, segnale, slow control. (Roma2/Roma1/LNF)
- Nuova elettronica. Prova positiva ma richieste alcune modifiche. Effettuata la gara per l'acquisto di tutti i moduli. Entro settembre dovremmo avere l'elettronica completa. (Roma2/Roma1)
- Power supply: prosegue la sostituzione delle vecchie schede fuori manutenzione. (LNF/Roma2/ Roma1)
- Primi test con fascio (tagging provvisorio). Schermatura per campo magnetico necessaria agli angoli in avanti. In corso le simulazioni. (Roma2/LNF)
- Bersaglio: in corso di installazione. SI attende l'OK dalla sicurezza per i tank di Idrogeno/Deuterio. (Messina)
- Camere cilindriche (Pavia) saranno installate entro l'anno o nei primi mesi 2012.
- MRPC: test di affollamento positivi. si chiederà lo sblocco sj a settembre. (Roma2/LNF)
- DAQ: inseriti nel DAQ generale tutti i rivelatori INFN. Da implementare l'inserimento nello slow-control generale in ambiente Explora.
- MonteCarlo in fase di completamento (LNF/Messina/Roma2)
- Coordinamento del gruppo di simulazione/analisi (LNF)
- co-spokesperson dell'esperimento BGOOD (LNF).
- Interamente svolto il programma previsto per il 2010. Il leggero ritardo dei lavori in sala dovuto al blocco delle diarie di missione è stato recuperato ad inizio 2011 grazie alla disponibilità del personale tecnico (Roma2/Roma1)

21 giugno 2011 ore 6.02
dietro le schermature e il beam dump

- Si sviluppa un incendio in un generatore di tensione che alimenta i magneti di tagging e una linea di estrazione fascio da ELSA. Intervento dei Vigili del Fuoco con CO_2 e poi con acqua.
- danni al TOF (4 elementi).
- nessun danno evidente agli apparati INFN.
- polvere e fuliggine ovunque.

beamline S
28 giugno 2011

@ BGO-OD electronics platform

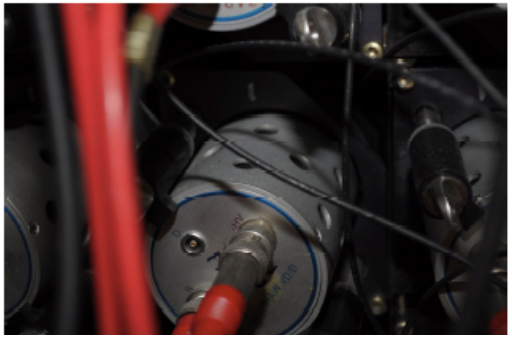


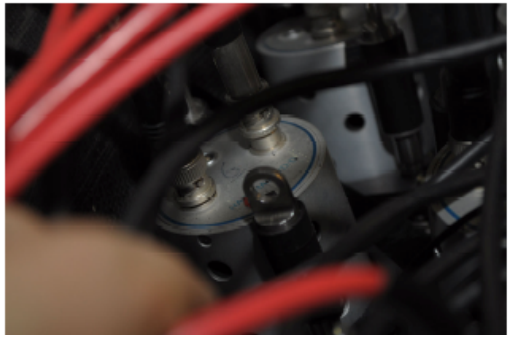
@ BGO-OD electronics platform

ELSA(Bonn) beamline S
28 giugno 2011

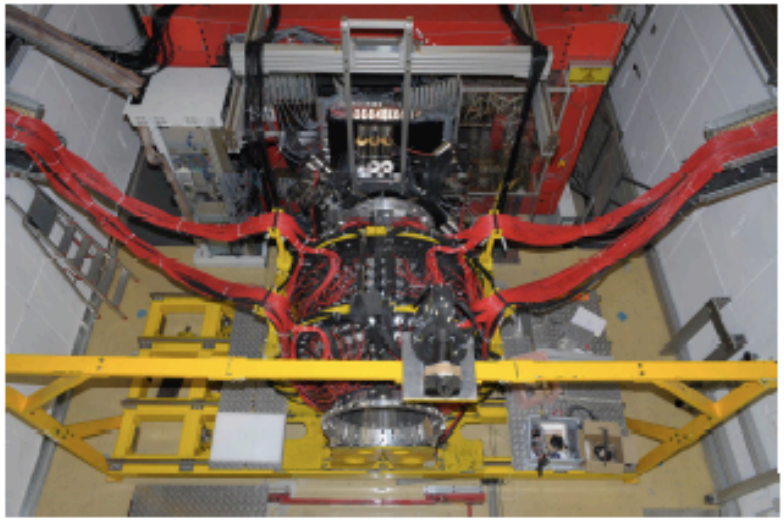
•ToF wall no.4 (top view)
•Black foil melted by hot air
•At least 4 bars have to be reassembled

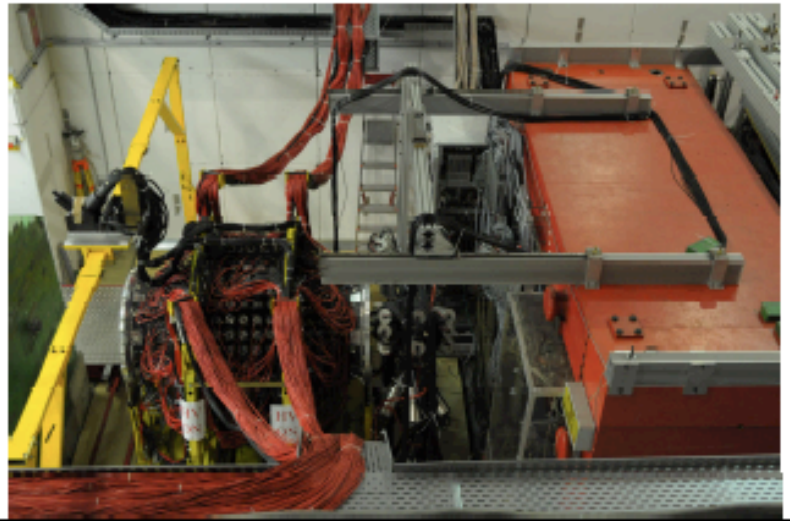
•Underneath ToF wall (left side)
•Cables go to the power supply
•Some fire fighting water run into the pit
•Here the water is evaporated
•Pic. shows the remaining dirt





No major damages visible





beamline S – cose da fare

- pulizia dalla polvere in sala: una ditta specializzata è già al lavoro (~1 mese?)
- pulizia dell'elettronica già installata
- sostituzione muduli TOF danneggiati.
- pulizia dell'apparato:
  - partitori BGO
  - finestre camere a fili
- nuove richieste per la sicurezza?

➔ circa sei mesi di ritardo

Collaborazione

BGOOD: INFN ~14FTE
ISS, LNF, Messina, Pavia, Roma2,Torino)

Università di Bonn Physikalishes Institut
Università di Bonn Helmholtz Institute
ELSA department
Università di Edinburgh
Università di Basel
IHENP Kharkov
PNPI Gatchina
INR Moscow

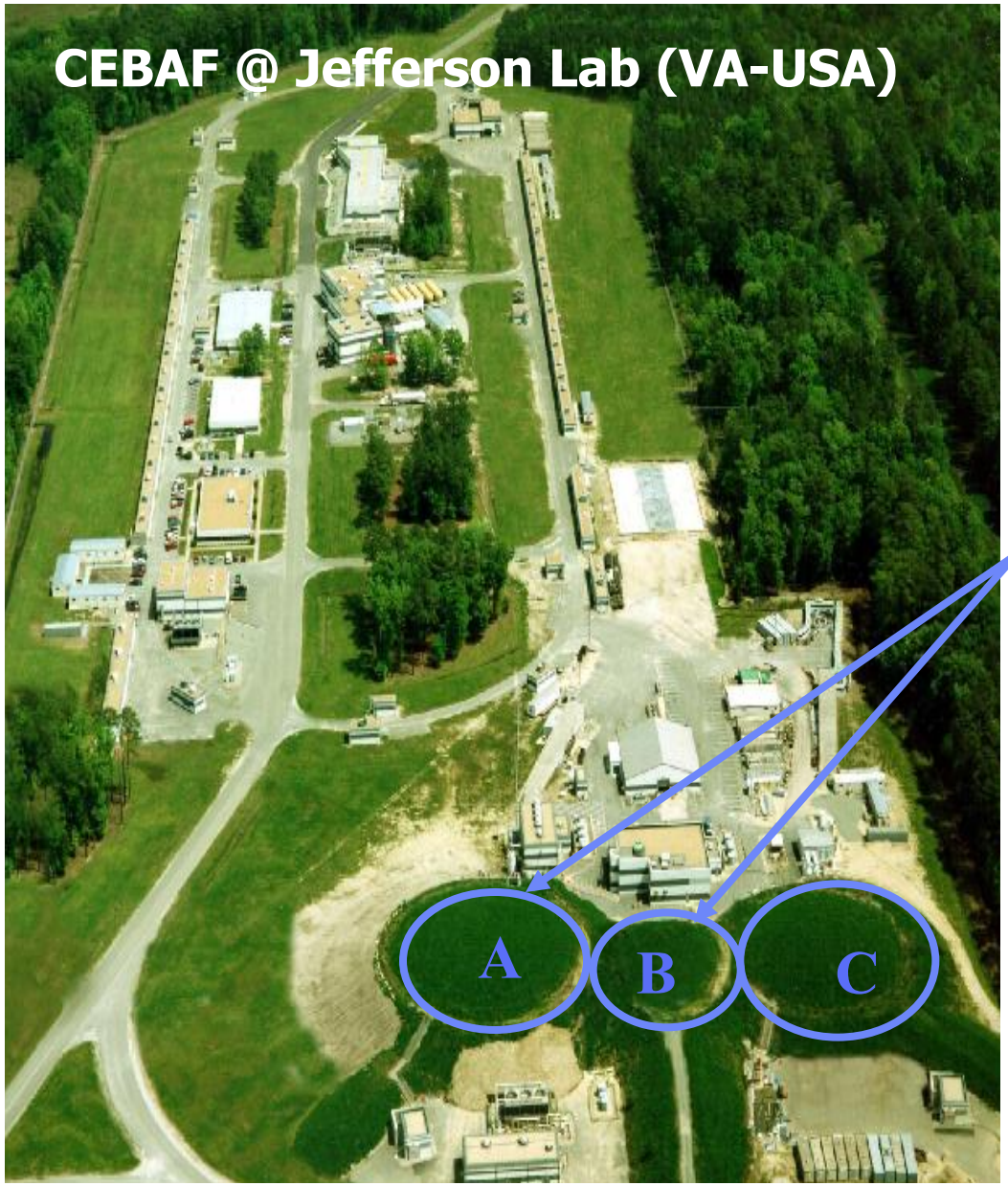
totale ~ 70 ricercatori

Richieste

inventario	*12.0*
Consumo	*6.0*
Missioni estere	*20.0 (8 s.j.)*
Missioni interne	*2.0*
totali	*40.0 (8 s.j.)*

JLAB12

Responsabili Nazionali: E. Cisbani, P. Rossi



CEBAF: Continuous e^- beam

- $Energy_{max}$ **6 GeV** till may **2012**
- $Energy_{max}$ **12 GeV** : may **2013**
- 200 μA, 75-85% polarization
- Beam simultaneously delivered to 3 Halls

Bari, Catania, Ferrara, Genova, ISS, LNF, RMI, RMII

Ricercatori + Tecnologi: **47** (32.9 FTE)

Personale Tecnico: **31** (12.7 FTE)

JLAB12- Gruppo LNF

2011

Ricercatori/Tecnologi: 10.5 FTE

M. Aghasyan (Ass. Ric.)
S. Anefalos Pereira (Art. 23)
E. De Sanctis (Dir.)
D. Hasch (I Ric.)
L. Hovsepyan (Assoc.)
V. Lucherini (Dir.)
M. Mirazita (Ric.)
J. de Oliveira Echeimberg (Assoc.)
S. Pisano (Assoc.)
E. Polli (I Tecn.)
P. Rossi (Resp)

Tecnici: 0.4-0.6 FTE

A. Orlandi,
A. Viticchie'

2012

Ricercatori/Tecnologi: 10.5 FTE

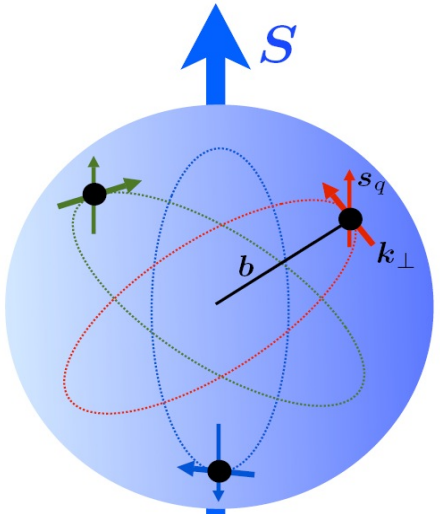
M. Aghasyan (Ass. Ric.)
S. Anefalos Pereira (Art. 23)
E. De Sanctis (Dir.)
D. Hasch (I Ric.)
L. Hovsepyan (Assoc.)
V. Lucherini (Dir.)
M. Mirazita (Ric.)
J. de Oliveira Echeimberg (Assoc.)
S. Pisano (Assoc.)
E. Polli (I Tecn.)
P. Rossi (Resp)

Tecnici: 0.8-1.0 FTE

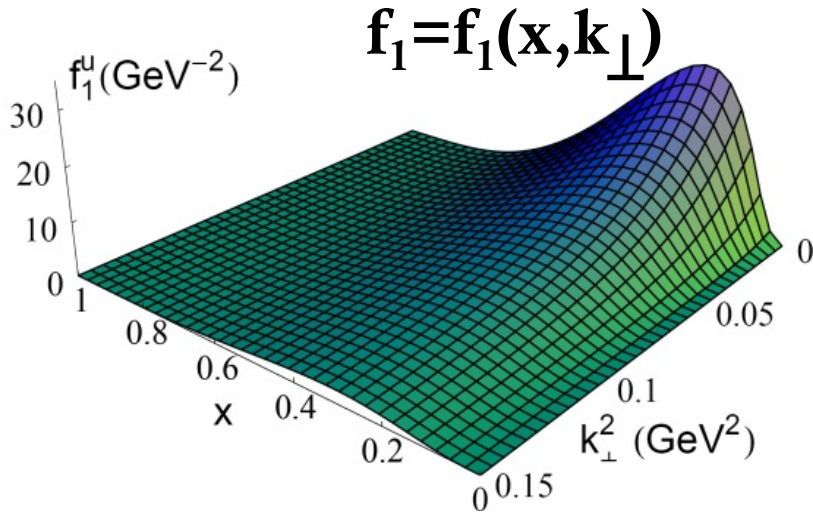
A. Orlandi,
A. Viticchie'

Physics

Our main goals is to study the **internal nucleon dynamics**



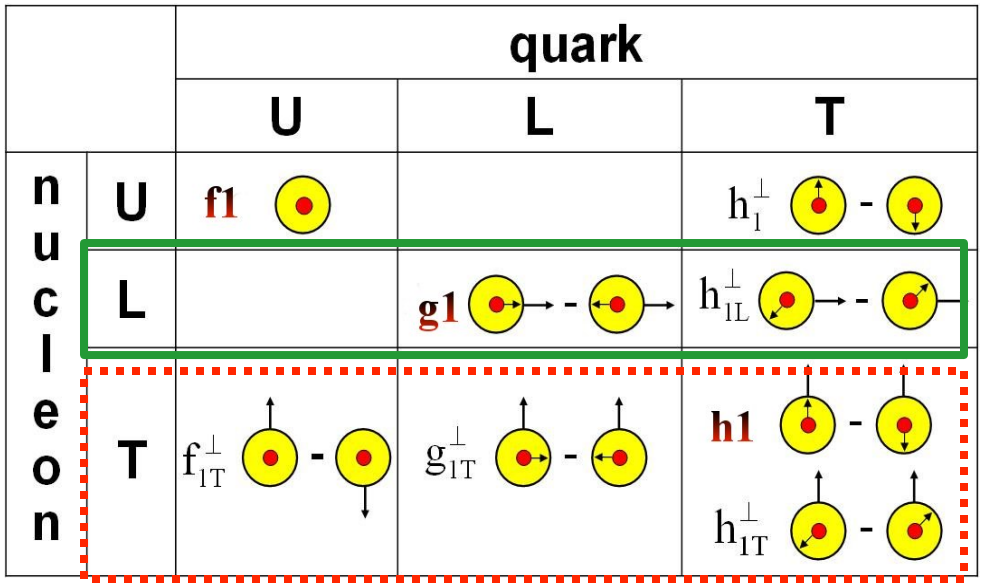
The **orbital motion of quarks** and **gluons** and **spin-orbit correlations** can be described by transverse momentum dependent (**TMD**) distributions



Measurement of final state hadrons in semi-inclusive DIS provide access to partonic TMDs. The program requires identification of pions and kaons over the full kinematical range.

TMDs: Transverse Momentum Dependent Parton Distribution Functions

Leading twist TMDs



- On going analysis:

- Λ polarization study in ep → e' Λ X

- $\pi^{0/+/-}$ and $\rho^{0/+}$ Spin Asymmetries on longitudinally polarized **p** & **d** to access $g_1(x, k_\perp)$ & $h_{1L}^\perp(x, k_\perp)$

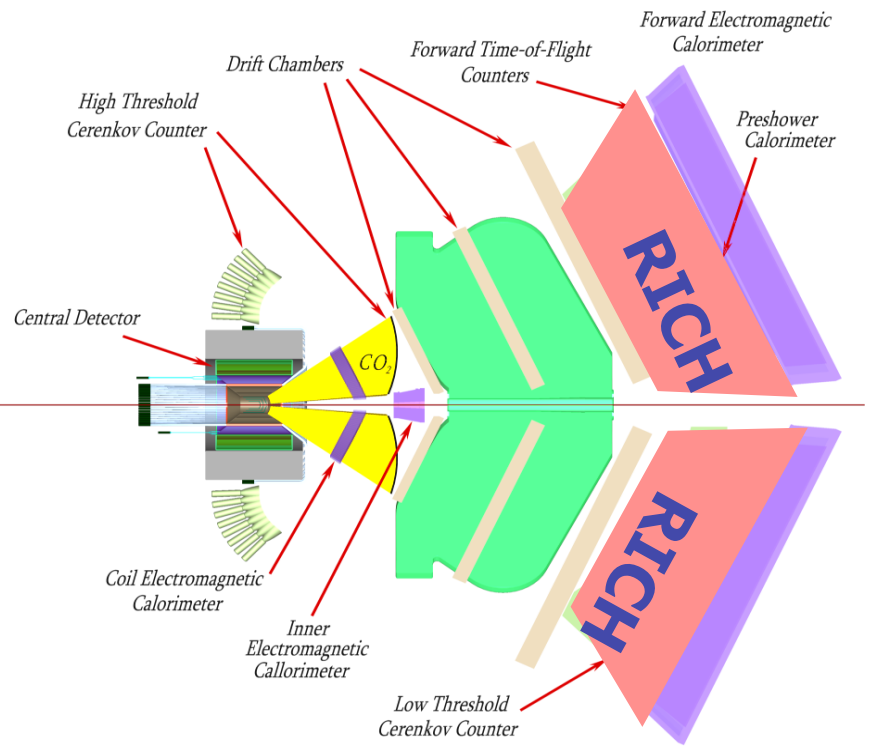
- Paper submitted to PLB
  π^0 A_{LU} (higher twist) on proton

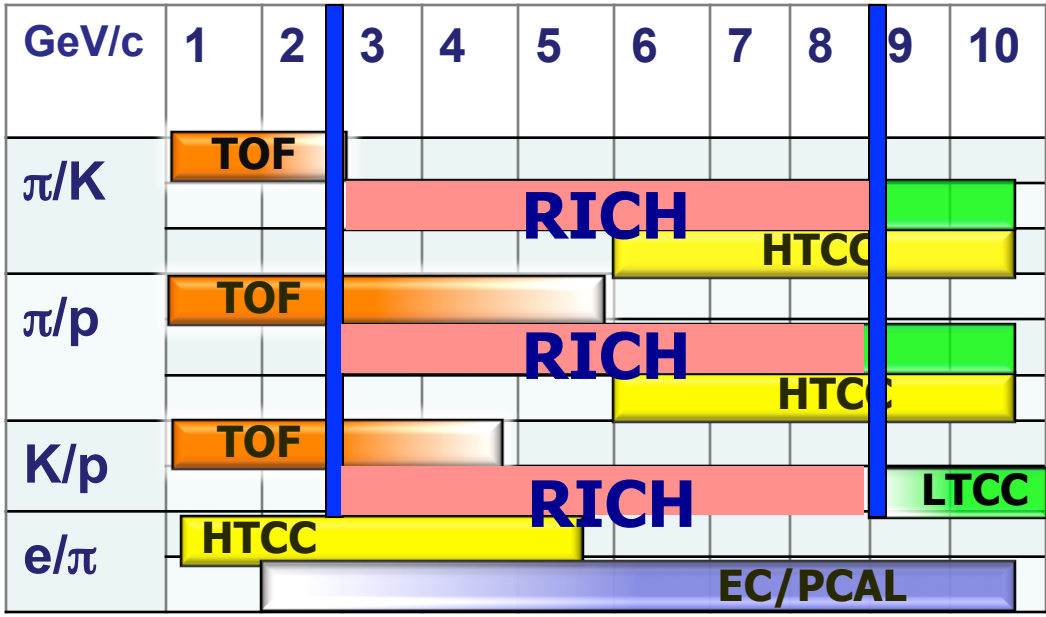
- 2 new proposals to next JLab PAC (August 2011)

- Studies of pion and kaon Electroproduction in semi-inclusive DIS with Transversely Polarized Hydrogen and Deuterium Targets (M. Aghasyan co-spokesperson)

- Studies of Dihadron Electroproduction in DIS with Unpolarized and Longitudinally Polarized Hydrogen and Deuterium Targets (S. Pereira co-spokesperson)

CLAS12 PID



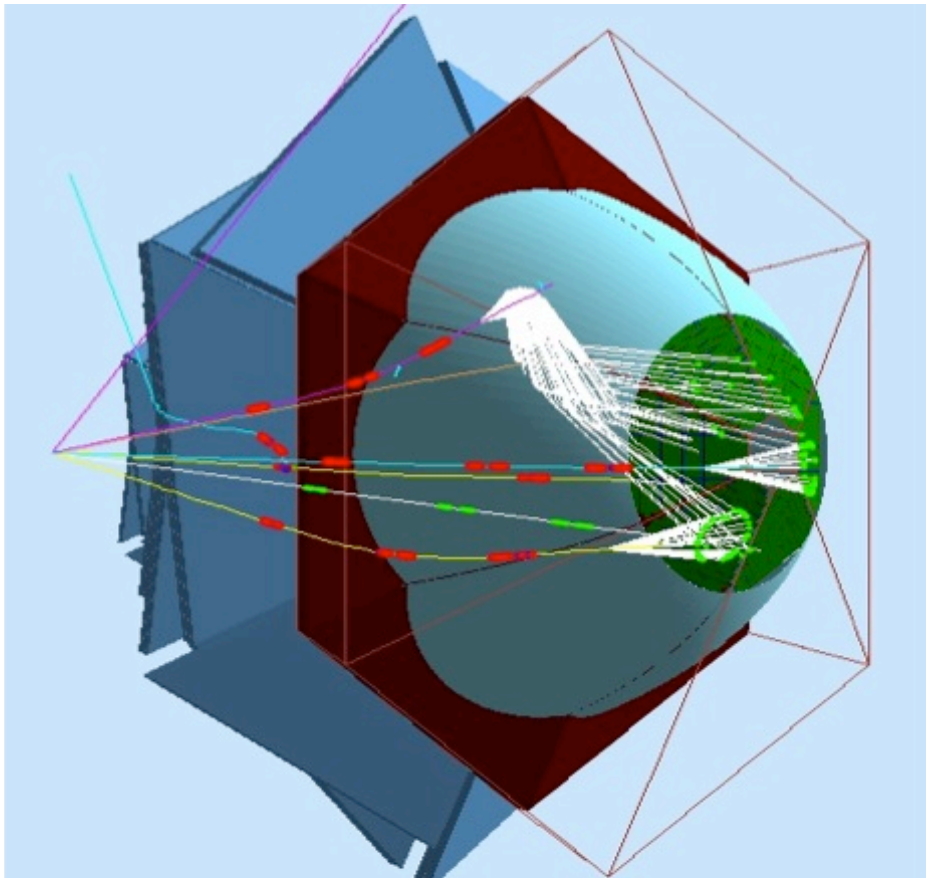


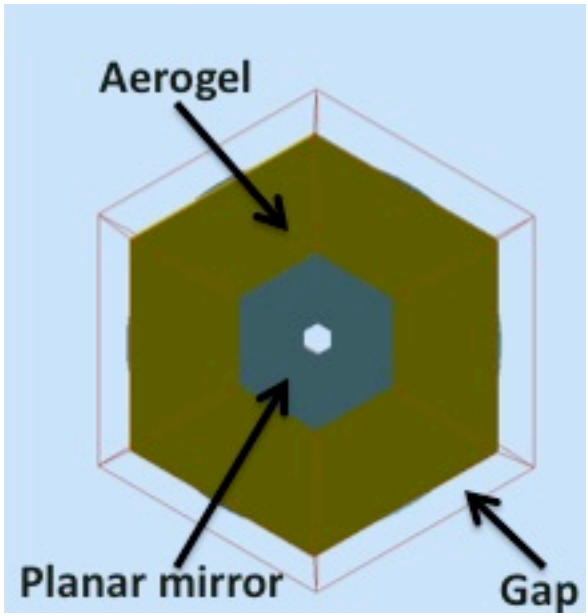
4-5 σ π/K separation @ 8 GeV/c

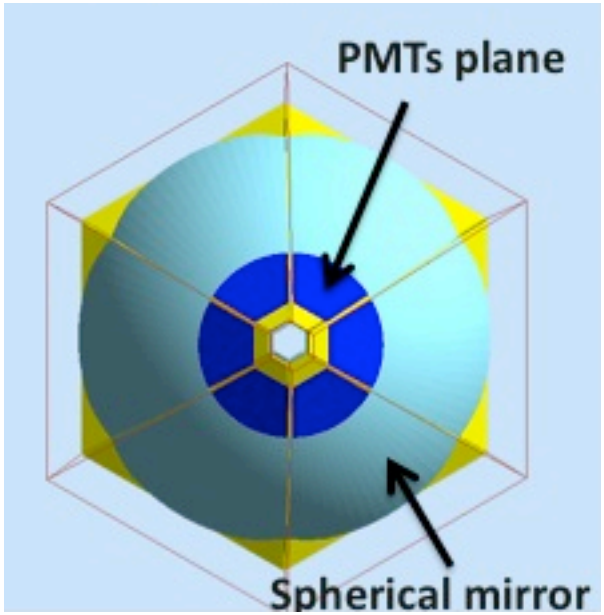
- **Aerogel** mandatory to separate hadrons in the 2-8 GeV/c momentum range → collection of **visible Cherenkov light** → use of **PMTs**
- Challenging project, crucial to minimize detector area (**several m²**)
- Option under investigation:
  - **proximity focusing RICH + mirrors**

  to reduce the ~ 8 m² of photo-detection area to ~1-1.5 m² (each sector)

CLAS12 RICH





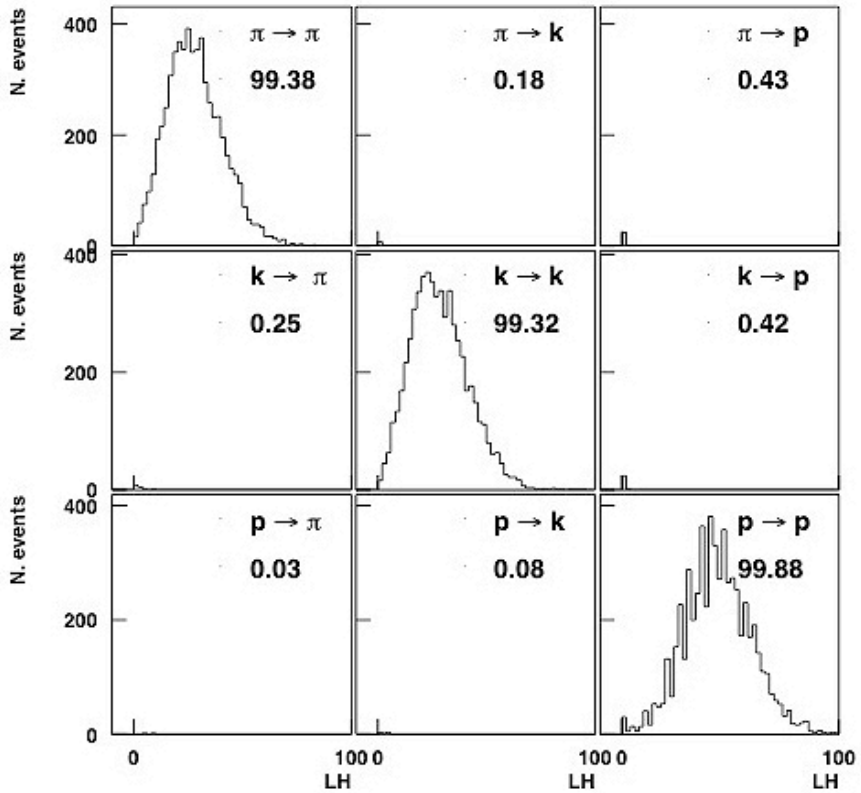


- **The Italian Groups are responsible for the R&D of the detector**
  - software simulation and pattern recognition
  - **tests of photon detectors MA-PMT (LNF)**
  - **construction of a prototype (LNF)**

RICH for CLAS12

- **Monte Carlo simulation** with GEANT4 in progress
- **Reconstruction algorithm** in progress
- **MA-PMTs tests** at LNF in progress
- **Test beam at CERN** (July 11-22) in preparation
- **Conceptual Design Report** in preparation

INSTITUTIONS
ARGONNE NL (USA)
INFN (Italy) Bari, Ferrara, Genova, Frascati, Roma/ISS
GLASGOW U. (UK)
JLAB (USA)
U. CONN (USA)
UTFSM (Chile)

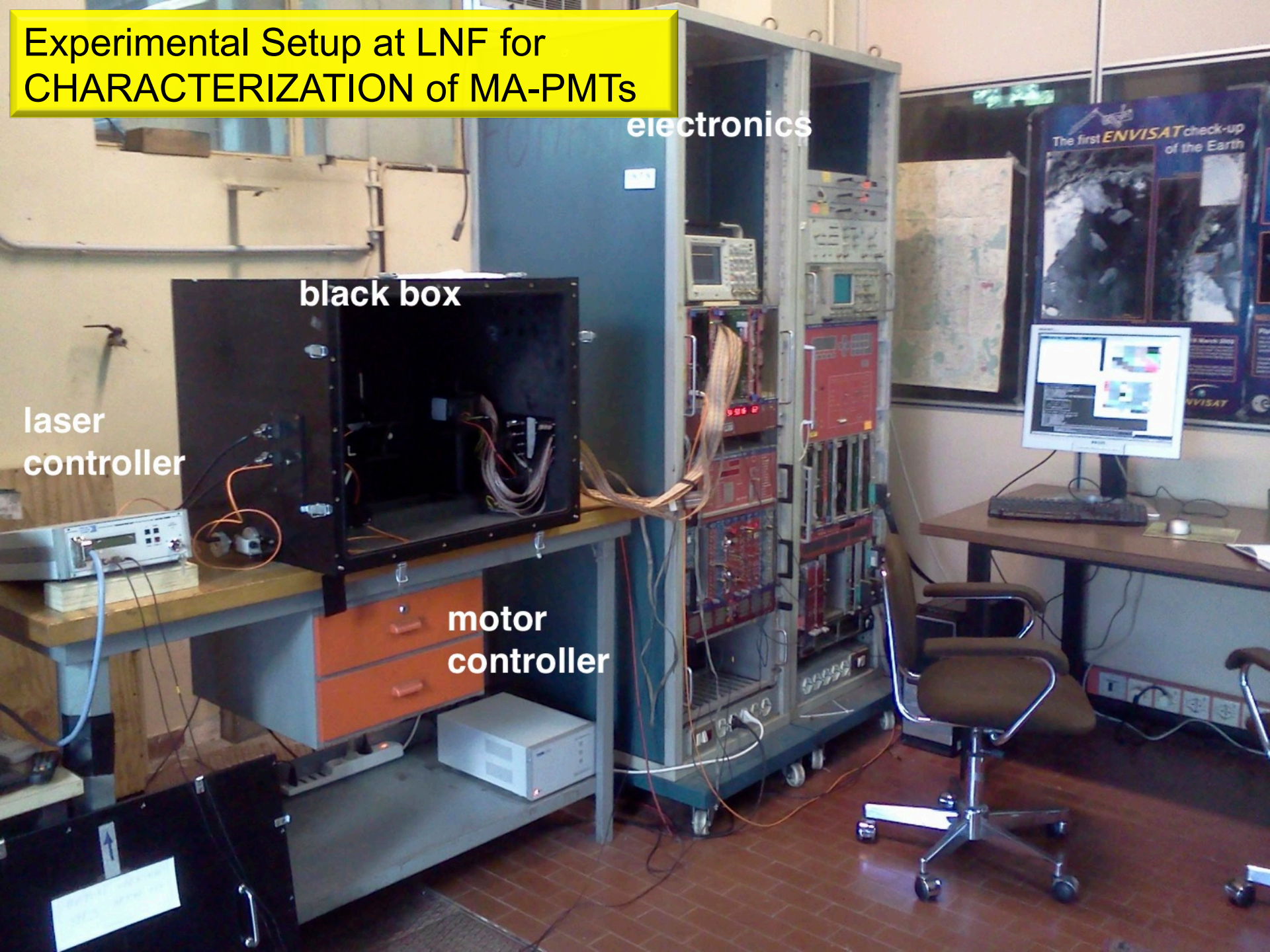


MC simulation +
DRT reconstruction algorithm

π contamination 0.18% @ 8 GeV/c

➔ **~4-5 σ π/K** separation

Experimental Setup at LNF for CHARACTERIZATION of MA-PMTs



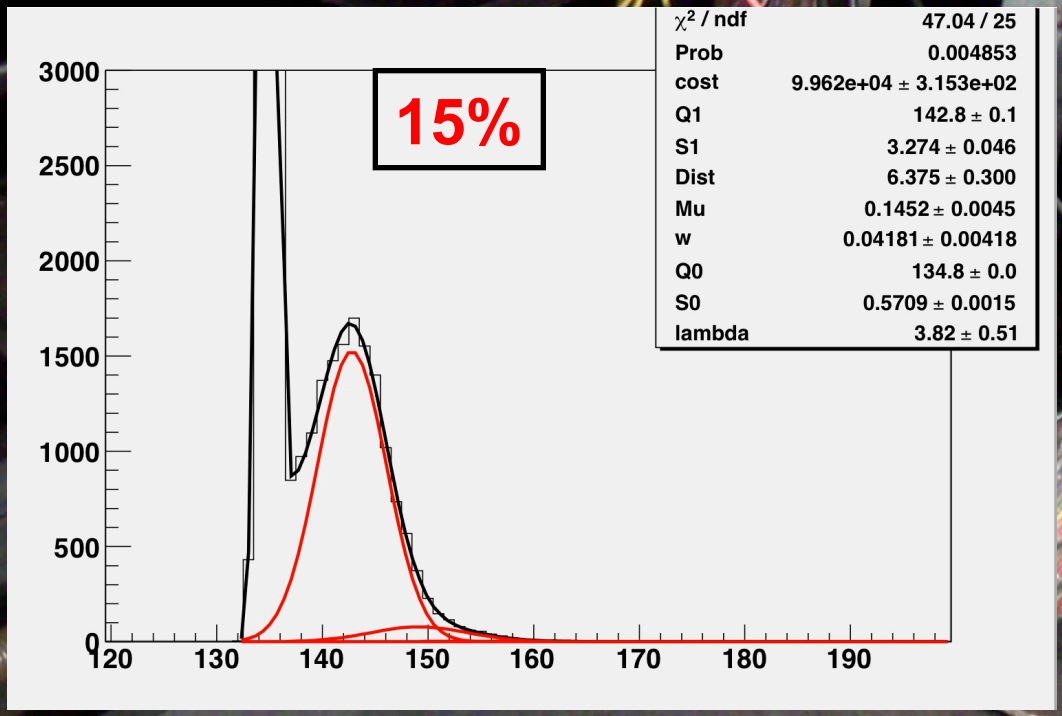
CHARACTERIZATION of MA-PMTs

H8500C, H8500C-03, R8900-00, R8900-100

MAPMT – H8500C

Red/Blue Laser

fiber head + collimator + filters



Milestones 2012 & Financial Reques

Milestones

I. RICH prototype test at CERN (aerogel + photon detectors + mirrors)

II. Paper submission:
"Semi-inclusive Λ polarization at CLAS"

III. Continuation Analysis:
"Measurement of the spin azimuthal asymmetry of the ρ^0 and ρ^+ in polarized electron Semi-Inclusive Deep-Inelastic Scattering experiments"

"Measurement of the spin azimuthal asymmetries of the $\pi^{0/+/-}$ in polarized electron Semi-Inclusive Deep-Inelastic Scattering experiments"

"2 hadrons production with CLAS at 6 GeV"

IV. Development of a Monte Carlo generator for TMDs studies

V. New Proposal to Jlab PAC
"Semi-inclusive Λ polarization with CLAS12"

FINANCIAL REQUESTS:

- Apparati+Inventario+Consumo : ~150 KEuro
- Missioni Interne+ Estere : ~150 KEuro
- Altro : ~10 KEuro

PANDA LNF

- Stato del progetto FAIR
- Attività del gruppo LNF
- Richieste 2012

The FAIR project

On October, 4th 2010,
the international owners founded the FAIR GmbH.

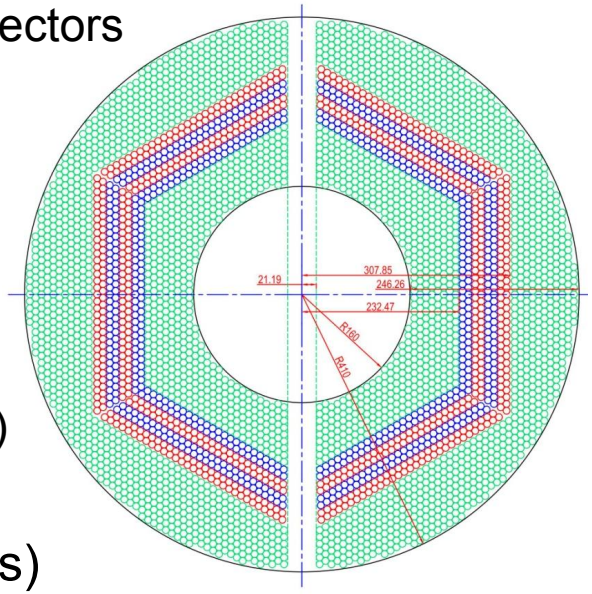
Finland
France
Germany
India
Poland
Romania
Russia
Slovenia
Spain
Sweden

The FAIR GmbH will coordinate the construction of the accelerator and experiment facilities. The participating countries will contribute their technical and scientific expertise to the project, in addition to their financial and in–kind input.

Attività gruppo LNF

P.Gianotti è deputy spokesperson dell'esperimento e responsabile del gruppo Tracking di PANDA. Ai LNF si sta sviluppando il Central Tracker con Straw tubes

- 4636 Straw tubes
- Al-mylar: d=27μm, ∅=10mm, L=1500mm
- 23-27 planar layers in 6 hexagonal sectors
  - 15-19 axial layers (green)
- 4 stereo double-layers for 3D reco.
  - ±2.89° skew angle (blue / red)
- Time readout (isochrone radius)
- Amplitude readout (dE/dx)
- $\sigma_{r\Phi}$ ~ 150 μm, σ_z~ 3.0 mm (single hit)
- σ_p ~ 1-2% at B=2Tesla
- X/X_0 ~ 1.2% ($^2/_3$ tube wall + $^1/_3$ gas)



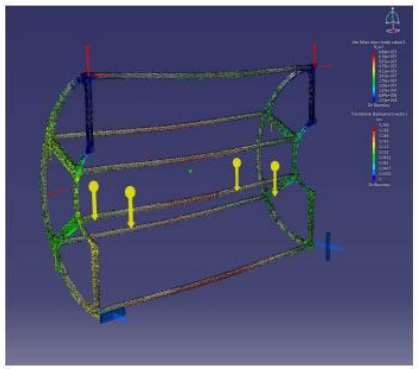
R_{in}/R_{out}: 160 / 410 mm
Length: 1500 mm

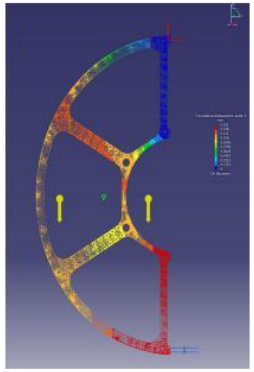
STT Mechanical Frame

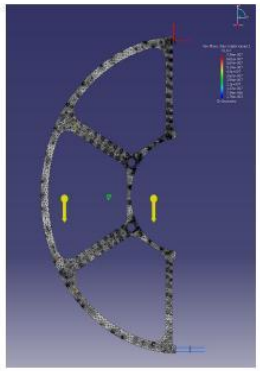
- 2 Separate semi-barrels with end flanges, connected by spacer bars
- Flanges are mounted to "Central Support Frame"
- Flanges with precision holes to fix straw modules
- FEM analysis: 0.03mm max. deflection
- Inner & outer protection skins (~1% X/X_0)
- Mechanical frame weight: 2× 9 kg
- 11.6 kg Straw tubes (4636× 2.5g) with
  - strong wire stretching (230kg equiv.)
  - strong tube stretching (3.6t equiv.)

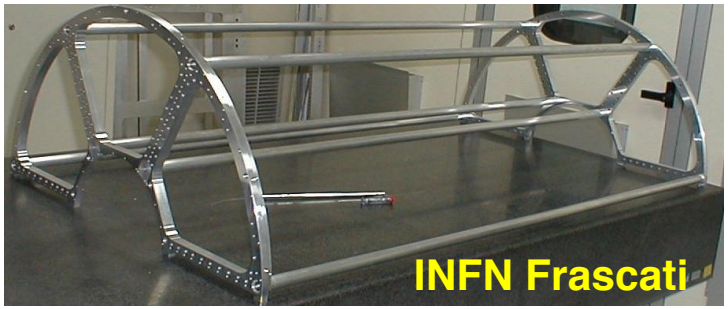
Semi-barrel components for	**FEM analys**
2 End flanges	60 N
6 Connecting bars (4 needed)	30 N
2300 Straw tubes	60 N
Straw grounding, boards	20 N
Electronics, gas supply	110 N
Total weight	**280 N**

Material	**Aluminum**
Density	2.7 g/cm^3
Youngs modulus	70 GPa
Radiation length (X_0)	9 cm
Thermal expansion	24 ppm/°C

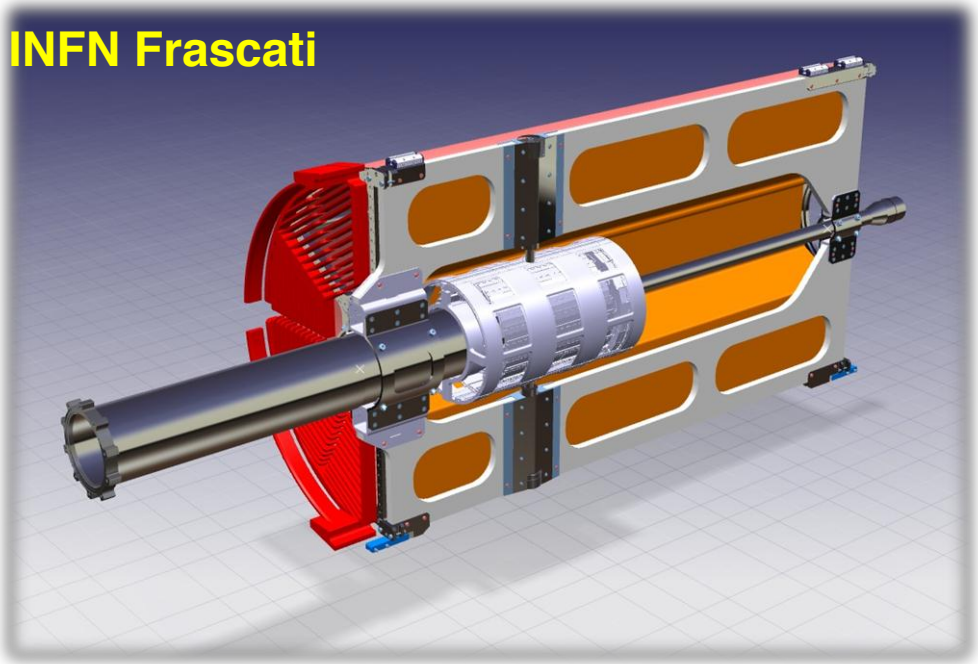








STT Central Frame



- **“CENTRAL SUPPORT FRAME” (INFN Turin WShop)**
- **“STRAW SUPPORT FRAME” (INFN Frascati)**
- **“AUXILIARY INSERTION STRUCTURE” (INFN Frascati)**
- **“VERTEX” mechanical prototype under development**
- **“CROSS-PIPE” prototype planned in the next months**

Anagrafica 2012

Nome	%
Nicola Bianchi	20
Bragadireanu Alexandru Mario	20
Gianotti Paola	60
Giardoni Mauro	40
Iliescu Mihail Antoniu	30
Pace Elisabetta	60
Sirghi Diana Laura	20
TOTALE	2.5 FTE

Latest news: P.Gianotti e S.Bertolucci membri FAIR Scientific Council per l'Italia

Supporto Tecnico: L.Passamonti, A.Russo, D.Pierluigi, D. Orecchini

Supporto servizio Elettronica 3mesi uomo; Supporto officina 3mesi uomo

Richieste 2012

Interno	sj	Estero	sj	Consumo	sj	Trasporti	sj	Calcolo	sj	Manutenzione	sj	Inventario	sj	Apparati	sj	Licenze-SW	sj		Totale	Totale sj
6		27		8		1,5						5							47,5	

L'esperimento ALICE

1. N.Bianchi
2. G.P.Capitani
3. A.Casanova
4. L.Cunqueiro
5. P.Di Nezza
6. A.Fantoni
7. P.Gianotti
8. S.Liuti
9. A.Moregula
10. V.Muccifora
11. A.R.Reolon
12. F.Ronchetti

A.Orlandi (tech)

A.Viticchiè (tech)

12 ricercatori per 11.5 FTE

Partecipazione media del 96%

2 Period Run Coordinator

1 expert on call

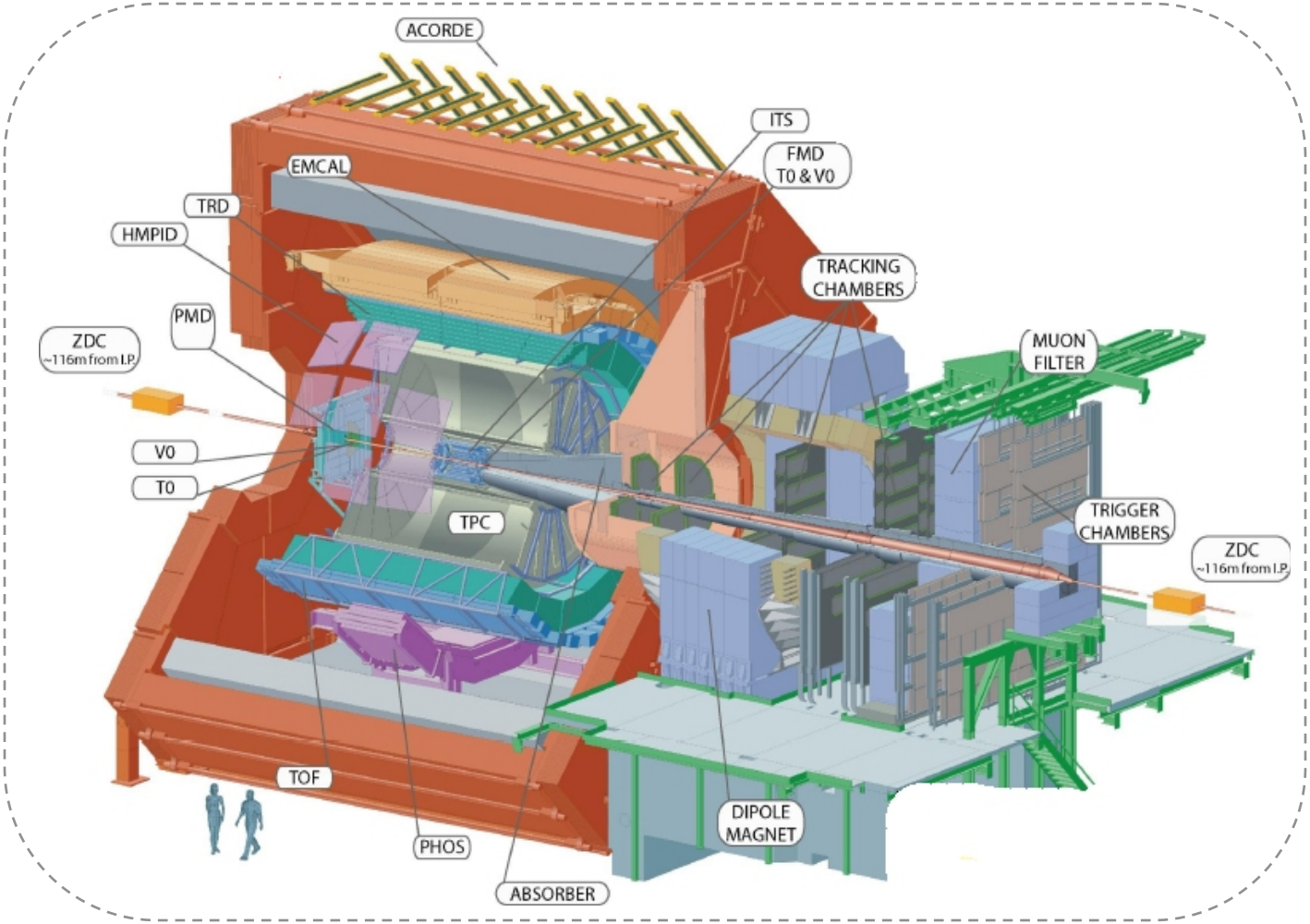
3 shift leader

1 deputy spokesperson for calorimeter

2 members of the calorimeter Management Board

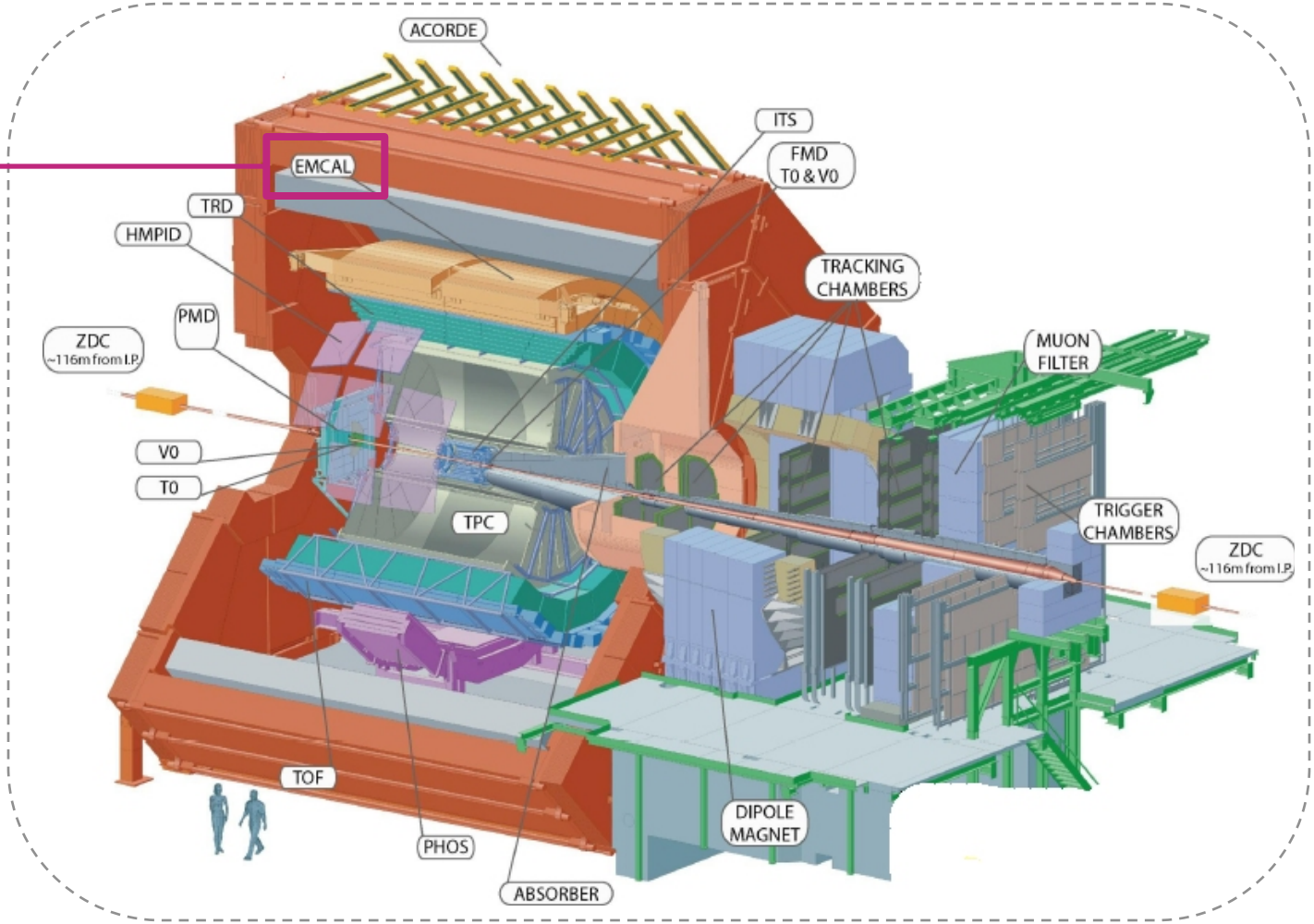
1 calorimeter construction coordinator

The activity of the LNF group



The activity of the LNF group

Construction of the e.m. calorimeter

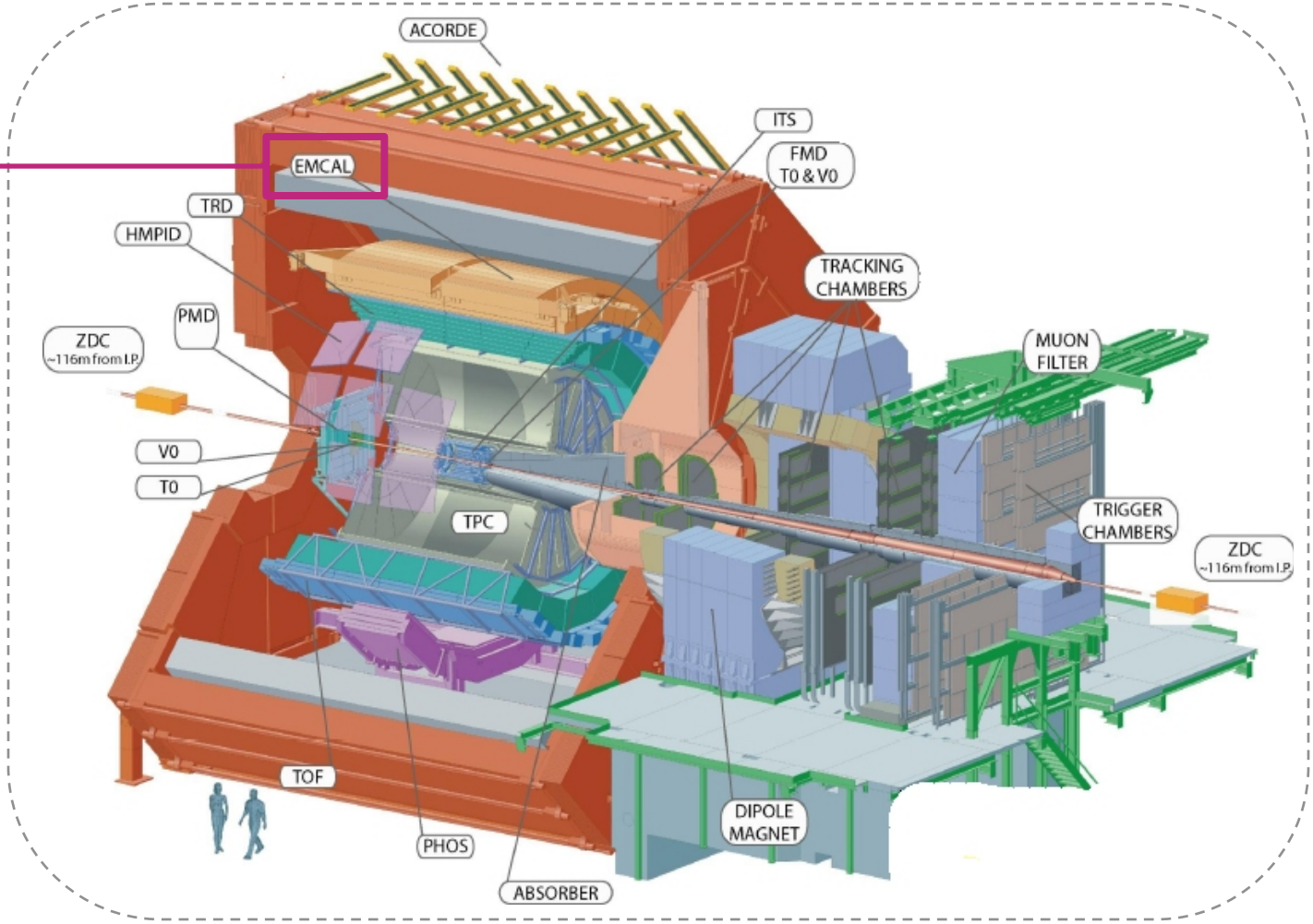


The activity of the LNF group

Construction of the e.m. calorimeter

- Online monitoring
- Offline codes

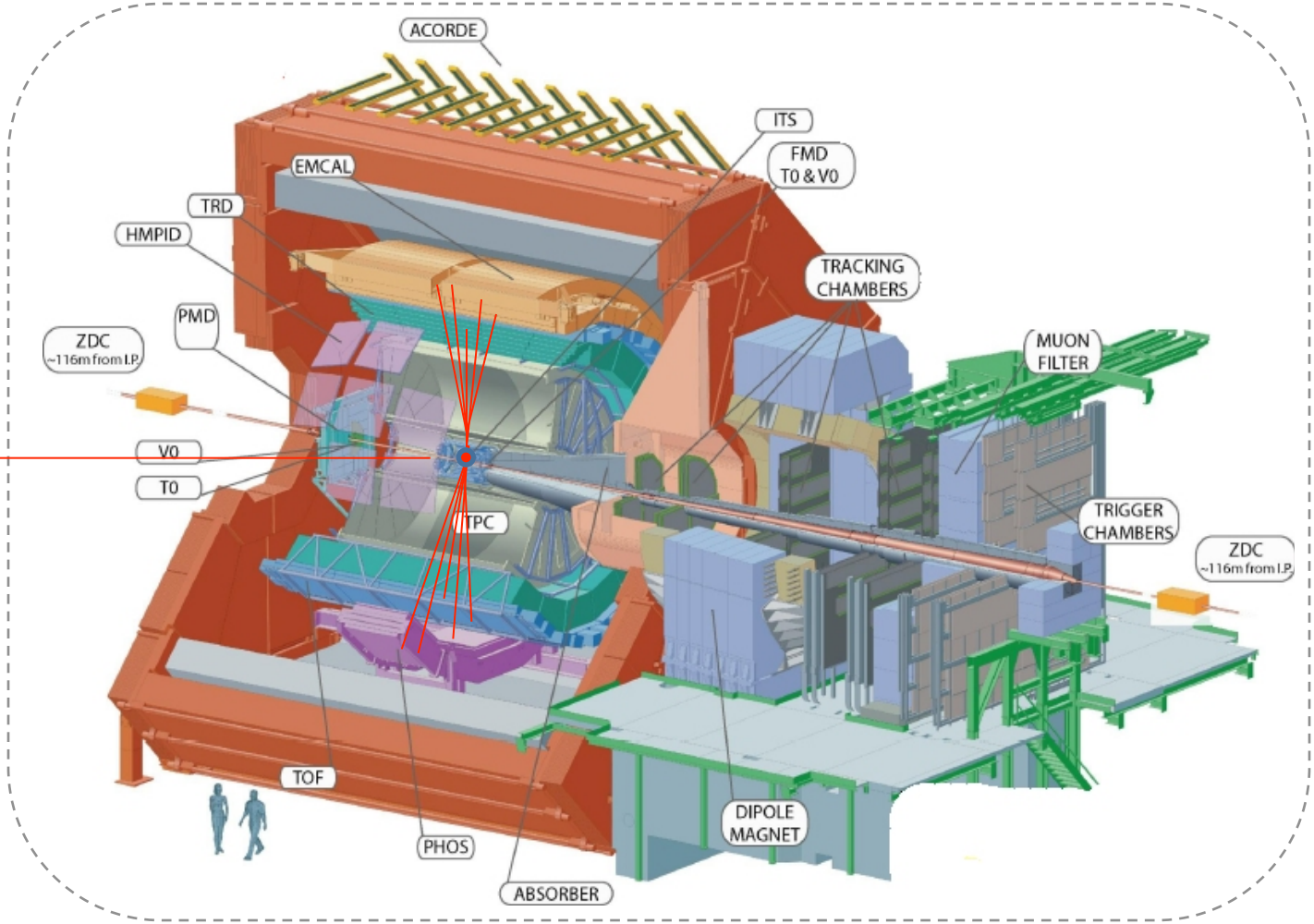
- High Level Trigger



The activity of the LNF group

Jet physics

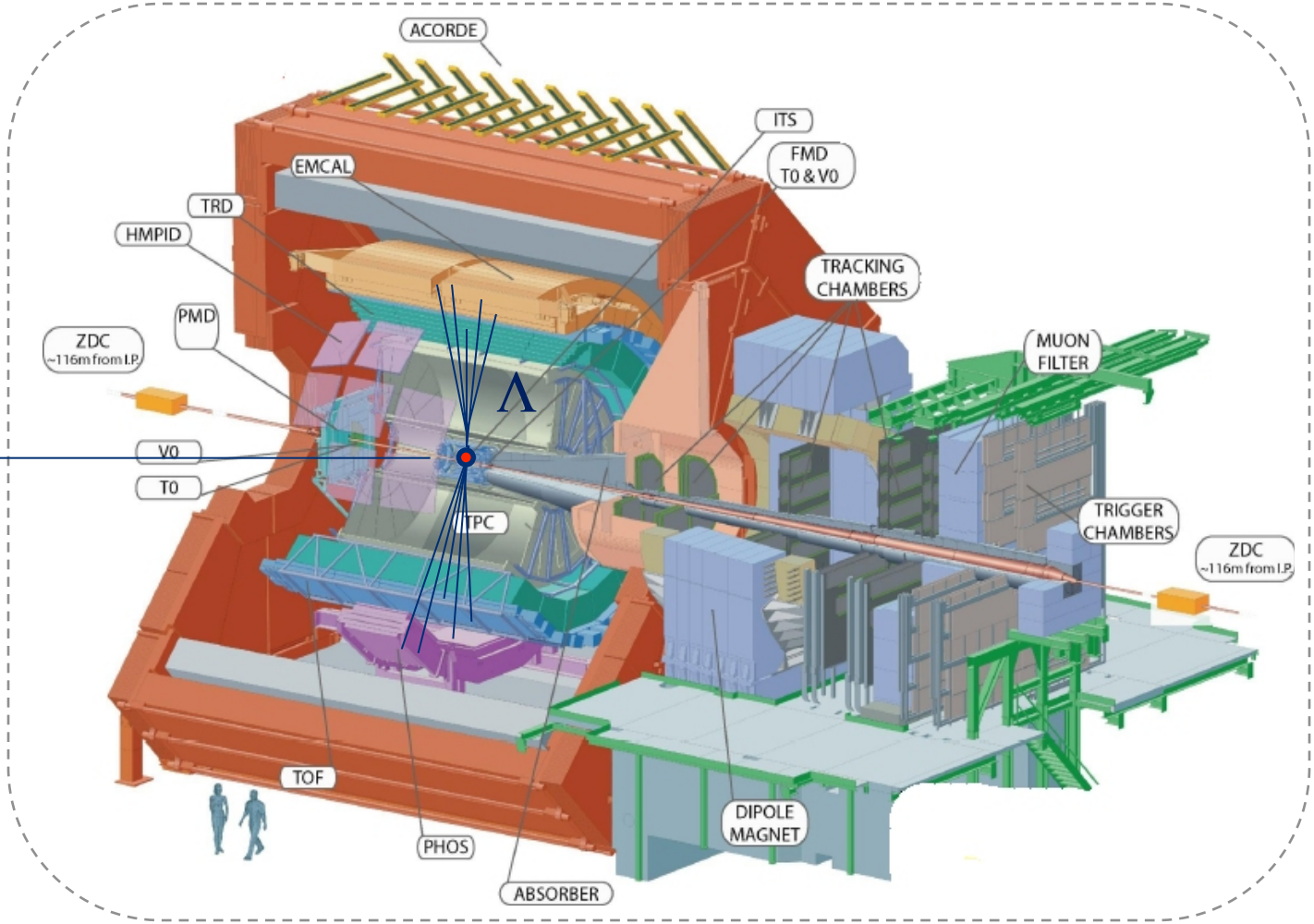
Jet reconstruction
MC in QGP



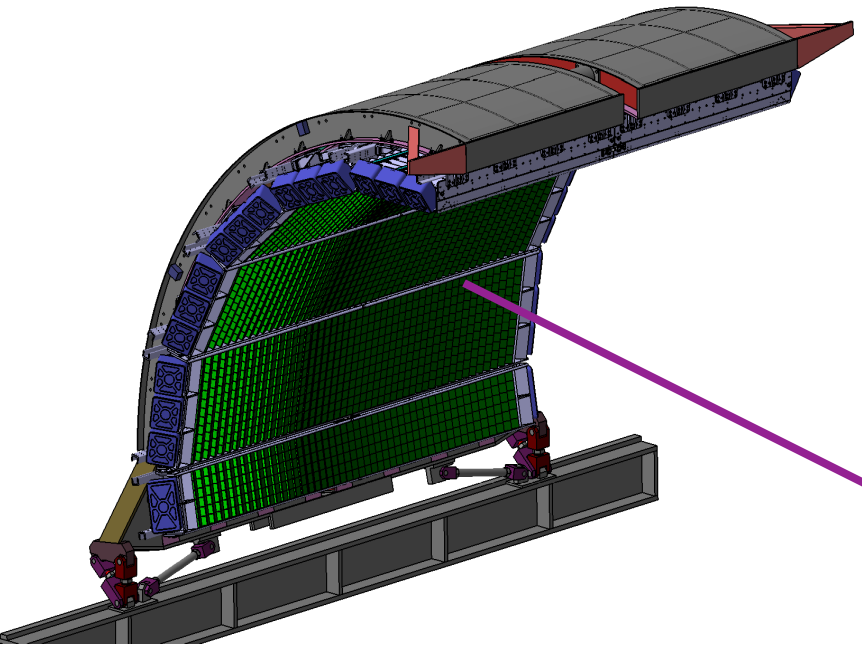
The activity of the LNF group

Jets with associated Λ

TMDs in pp

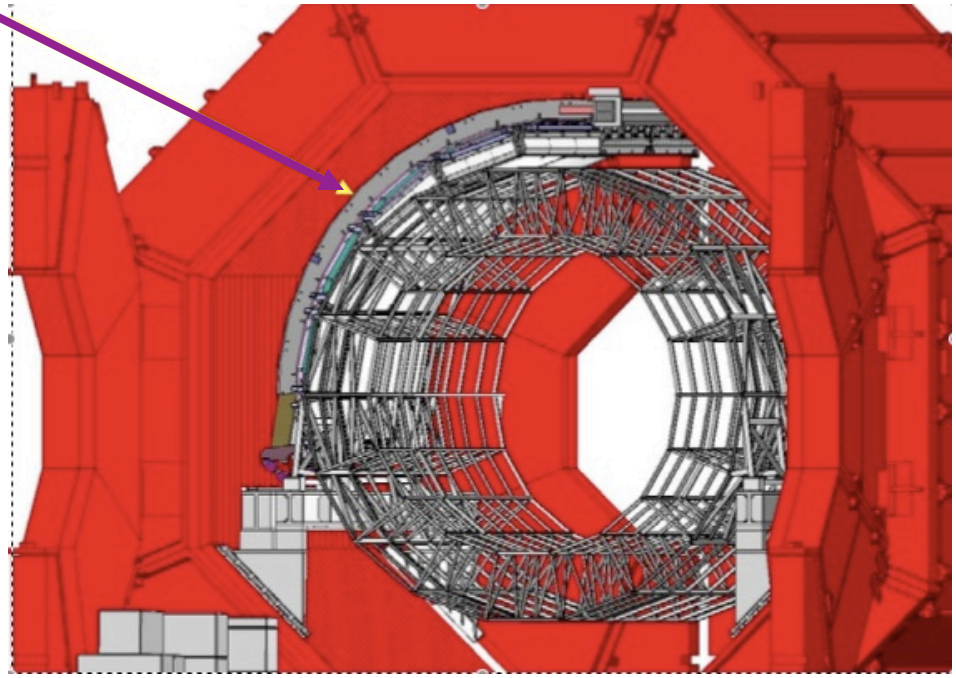


EMCal



France, Italy and USA Collaboration

- 7 US Super-Modules (SM)
- 3 EU SMs (Italy and France)
- Construct started in 2008
- 4/10 SM installed in 2009
- Complete installation in 2011



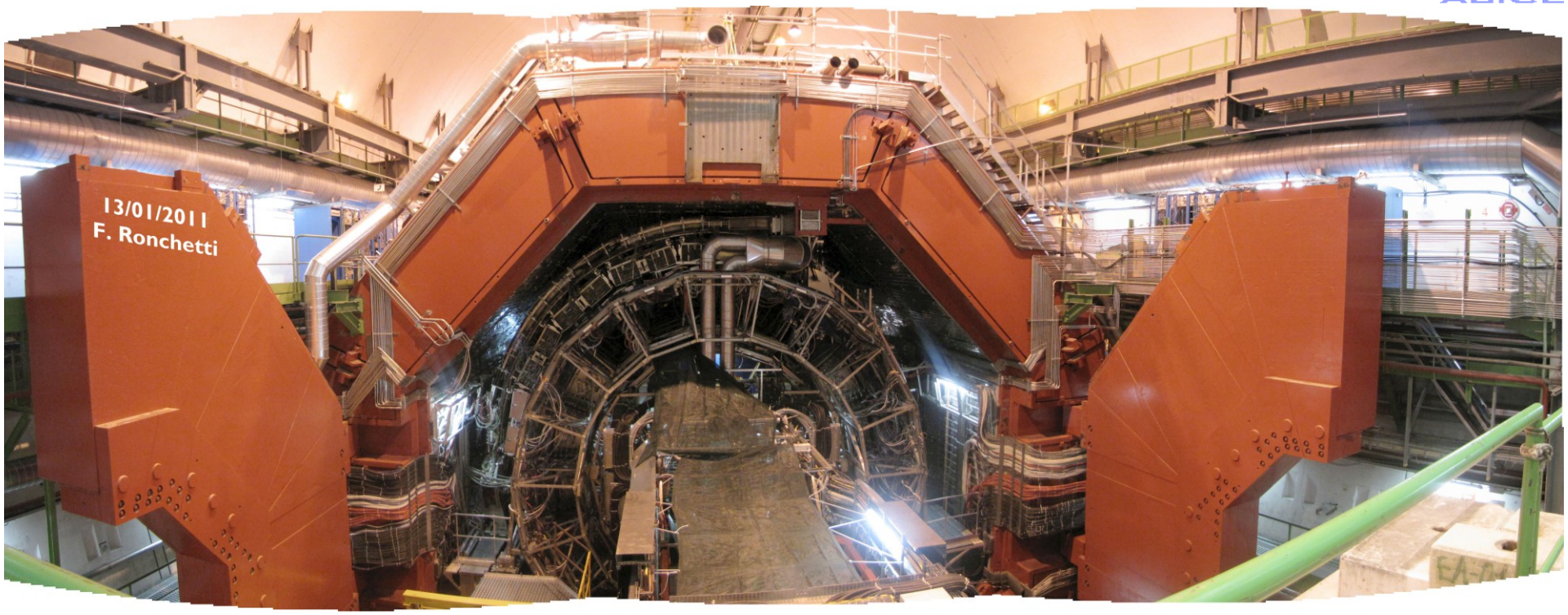
Lead-Scintillator Sampling Calorimeter

$\Delta\eta = 1.4,\ \Delta\phi = 100^{o}$, 20.1 X_0

Shashlik Geometry, APD Photosensor

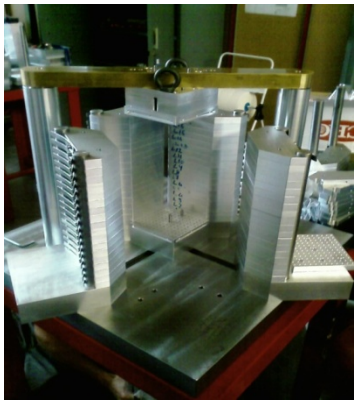
12k Towers

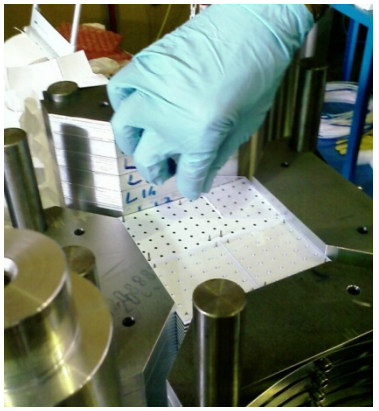
EMCal Installation



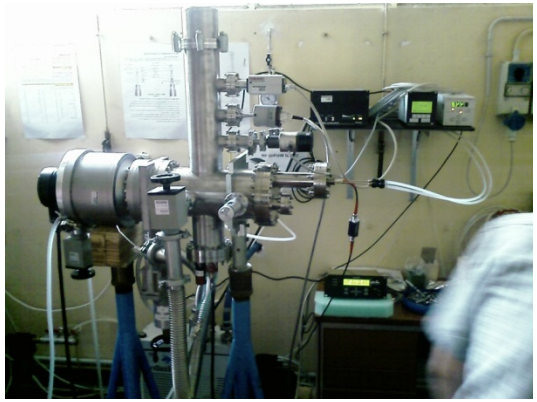
- Executive summary
  - All 10 EMCal SMs are installed and ~operational !
  - Commissioning work just getting underway
    - Check readout of all channels, check trigger

Basic Unit = 4 channels



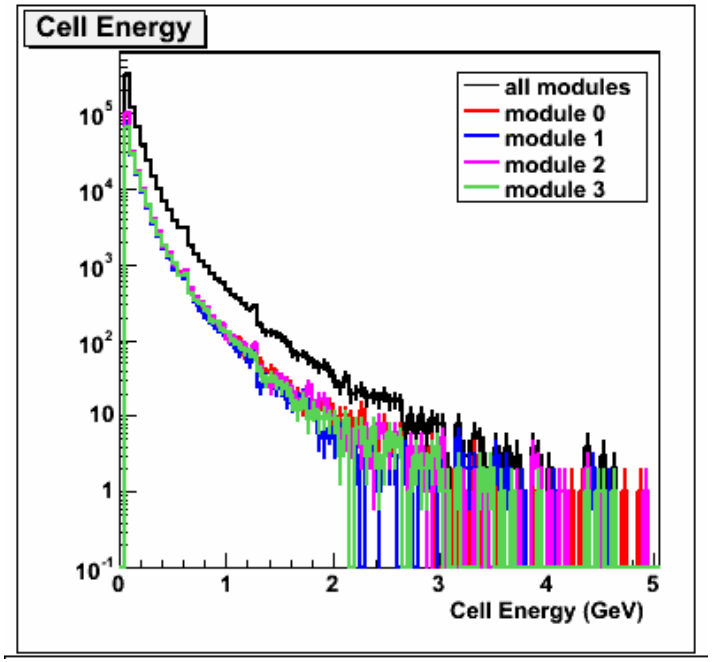


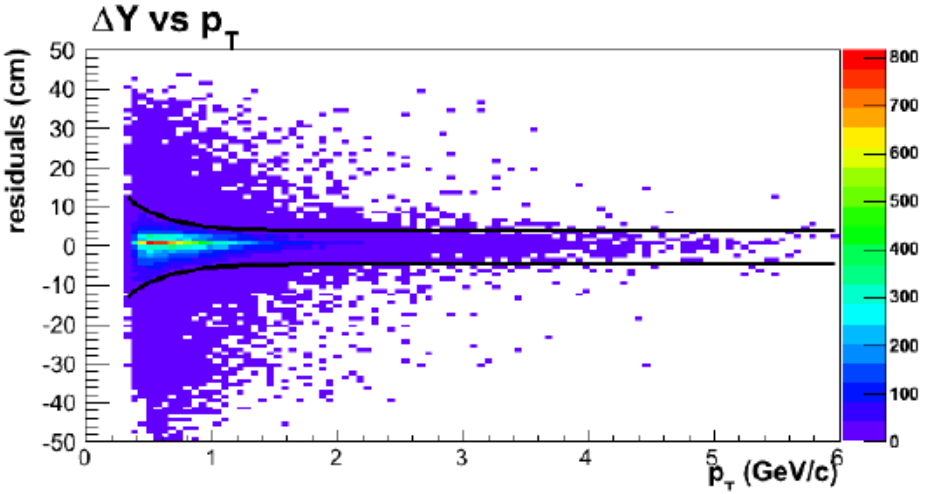
Assembling station (2 on site)

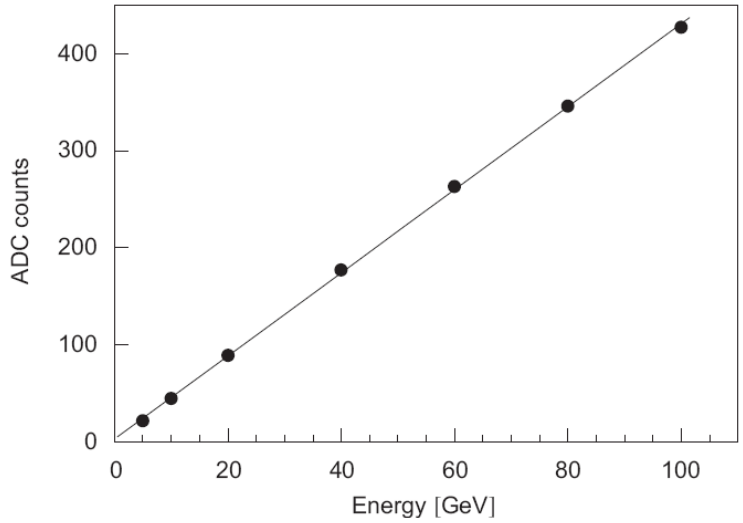


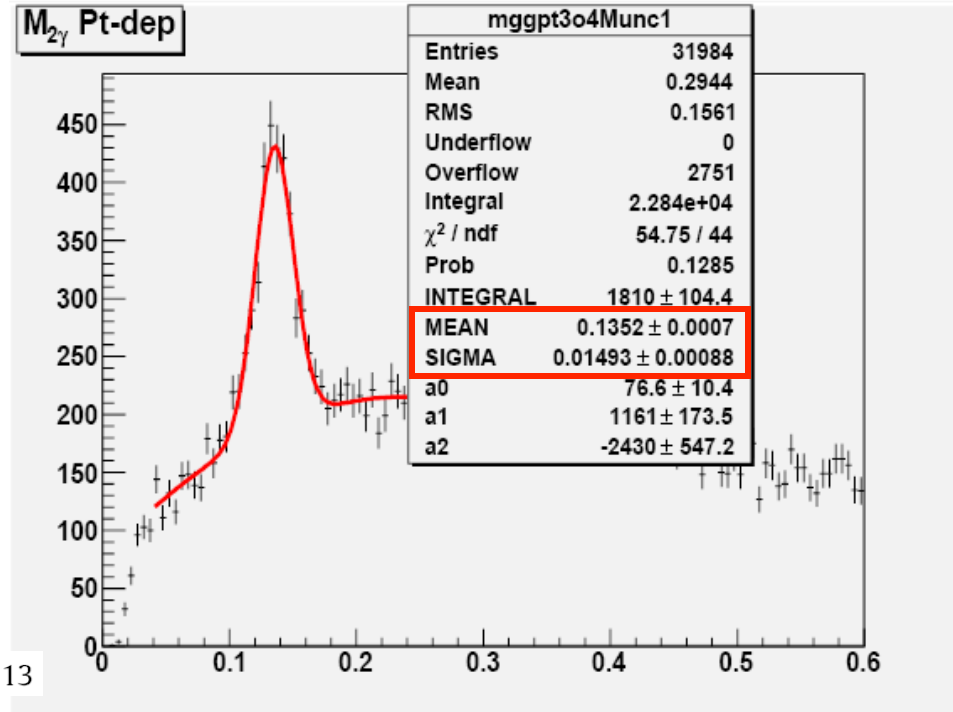
Aluminization of
200k fibers (WLS)

Quick overview on the calo performances



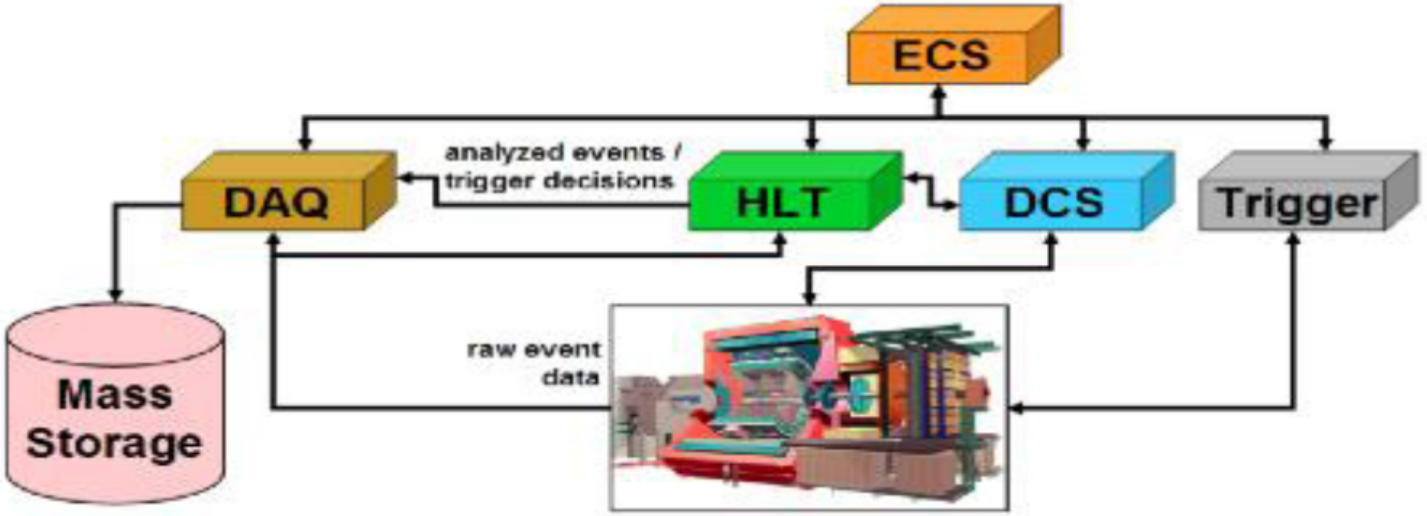






Nuclear Instruments and Methods in Physics Research A 615 (2010) 6–13

High Level Trigger for EMCal

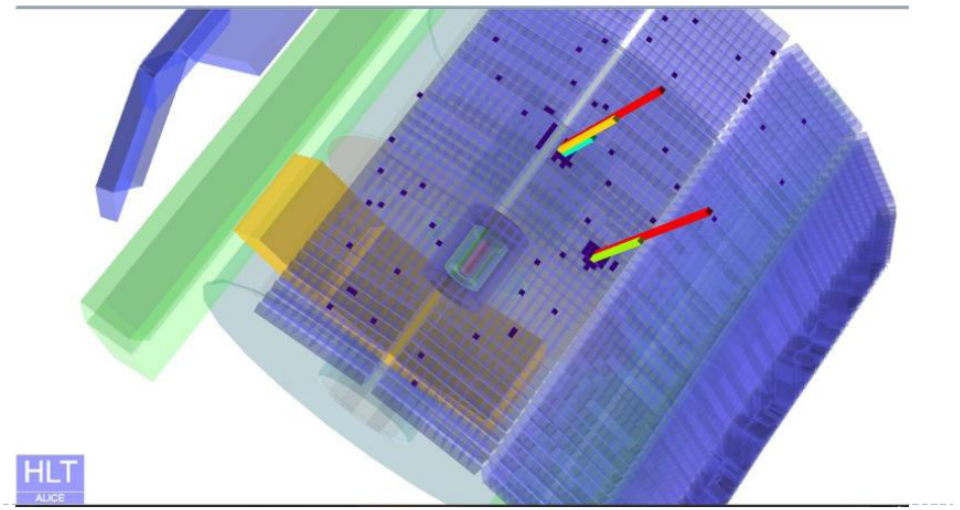


PbPb collisions @ 8 kHz corresponds to 2 kHz calo tower hit rate

HLT reduces to a 40% EMCal data occupancy

Main HLT strategy:

- Reconstruction for calibration and monitoring
- Event rejection using high-E_T (cluster) trigger OR jet trigger

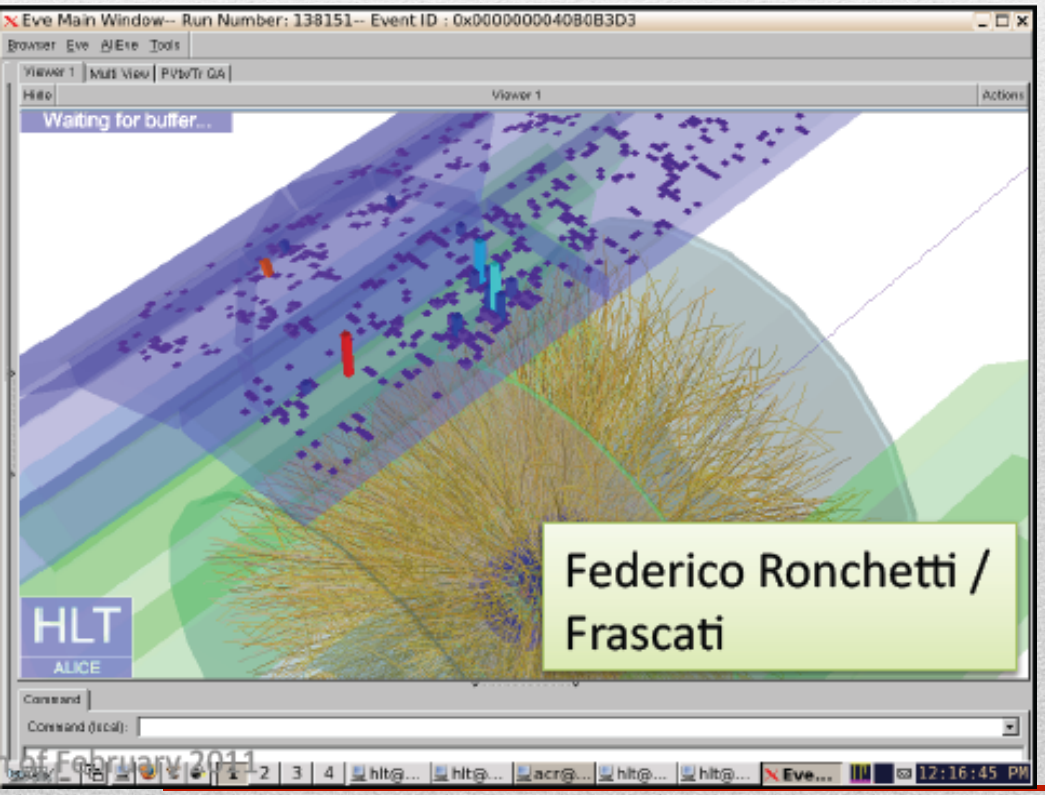


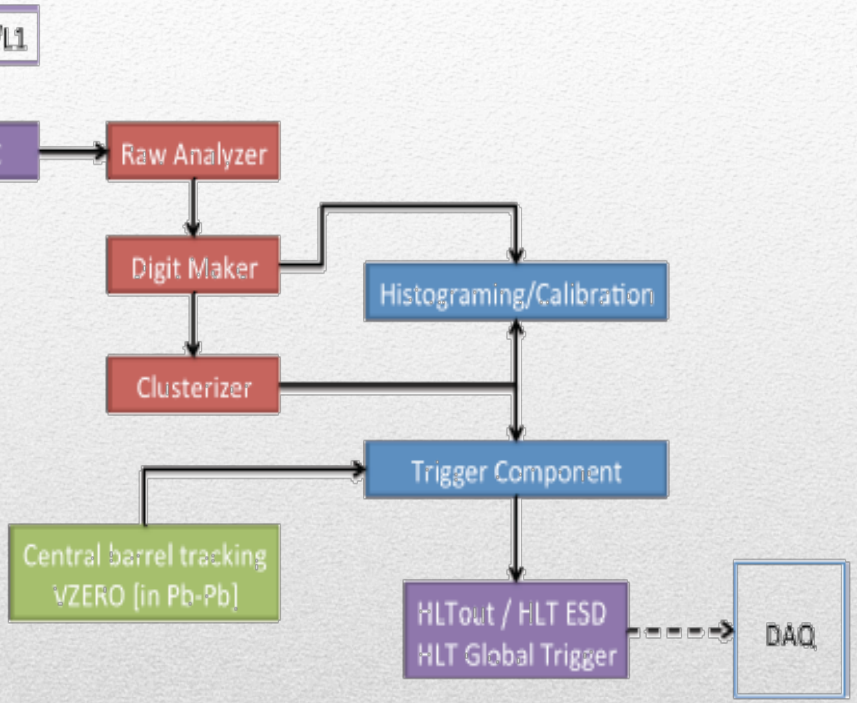
EMCAL Triggering with HLT

- Rate to HLT is limited by L1 trigger rate, which is limited by ALICE readout BUSY time currently about:
  - ~800 Hz for p+p (@100kHz interaction rate)
    - At least x100 rejection for p+p at L1 (or L0)
  - ~200 Hz for Pb+Pb (@ 1kHz interaction rate)
    - At least x5 rejection for Pb+Pb at L1 (or L0)
  - But rates likely must be x10 smaller if require >80% livetime at L0
- HLT rejection need be around x10 (80%LT) or x100 (50% LT)
- Possible HLT triggers with EMCal input:
  - "Clean" EMCal showers with improved calibration, shower shape cut
    - Should "run" only on EMCal L0 or L1 shower triggers
    - Rejection mostly depends on increasing threshold (V0)
  - "Clean" Jets with EMCal clusters + Central Barrel Tracking
    - Should "run" only on EMCal L1 jet triggers (or L0 shower triggers)
    - Rejection mostly depends on increasing threshold (V0)
  - Electrons: EMCal shower with matching track
    - Should "run" only on EMCal L0 or L1 shower triggers
    - Very large rejection due to few electrons

EMCAL HLT Reconstruction

- EMCAL Online chain successfully run in November 2010.
- Ongoing effort for this year lead-lead running period.

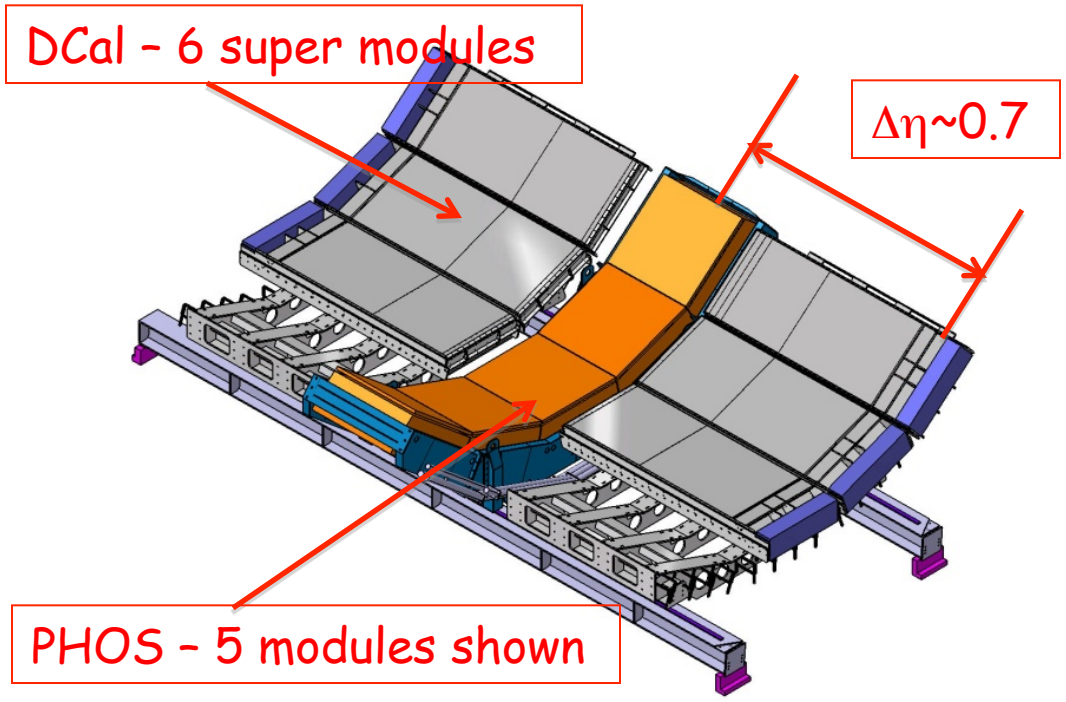


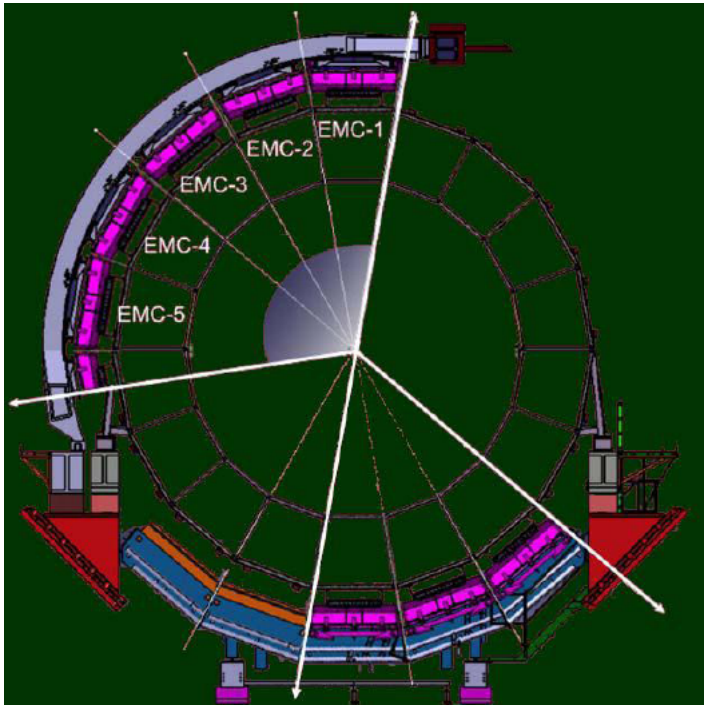


EMCAL/HLT task force:
6 people under Frascati Coordination (F. Ronchetti)

From EMCal to DCal

DCal, the first upgrade approved by the Alice collaboration: extension of EMCal for jet-jet and γ-jet physics





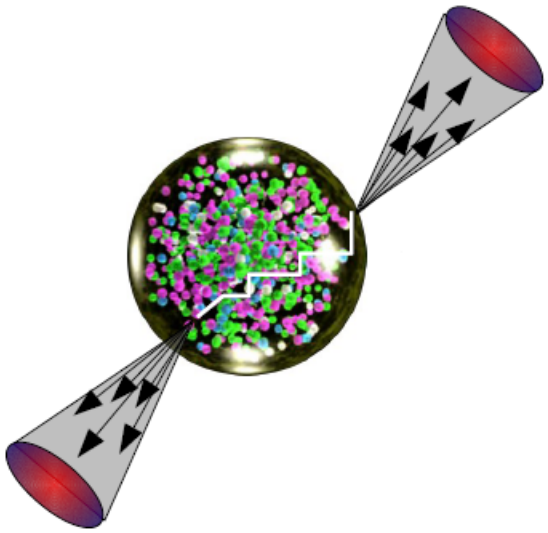
DCAL modules:
same technology than EMCal

LNF contribution with tools, expertise and manpower

- messa a punto delle 2 stazioni di assembaggio LNF inviate a Wuhan
- messa a punto di 1 stazione di assemblaggio costruita a Wuhan
- tutorial per il personale tecnico-scientifico cinese
- preparazione primi moduli DCAL a Wuhan
- lavorazione, sputtering e preparazione di 90K fibre WLS

Coord. A.Fantoni

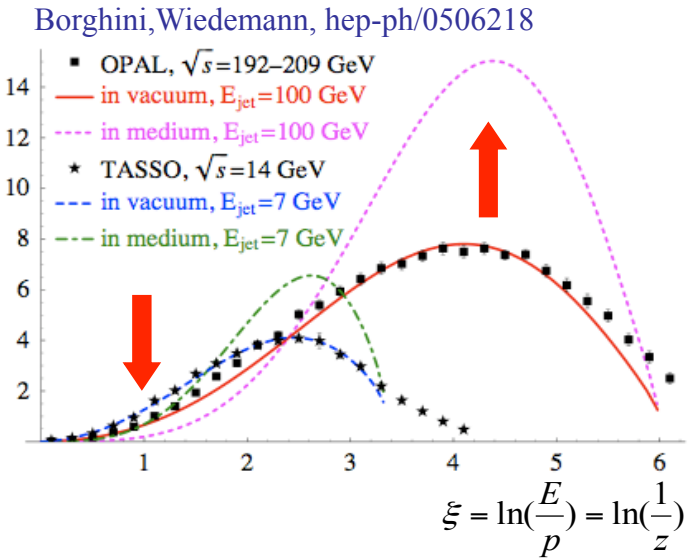
Jets to access to the QGP



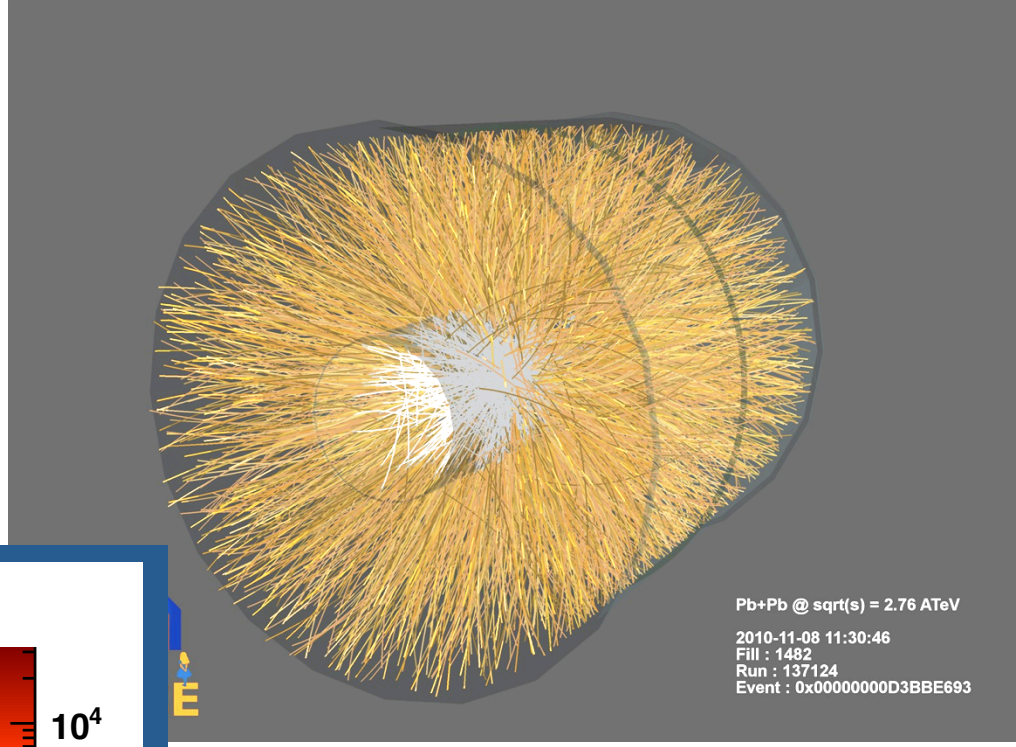
High-p_T partons produced in hard interactions undergo *multiple interactions* inside the collision region prior the hadronization … so they *loose energy through medium induced gluon radiation* → the *jet quenching* as a golden channel to probe the QGP

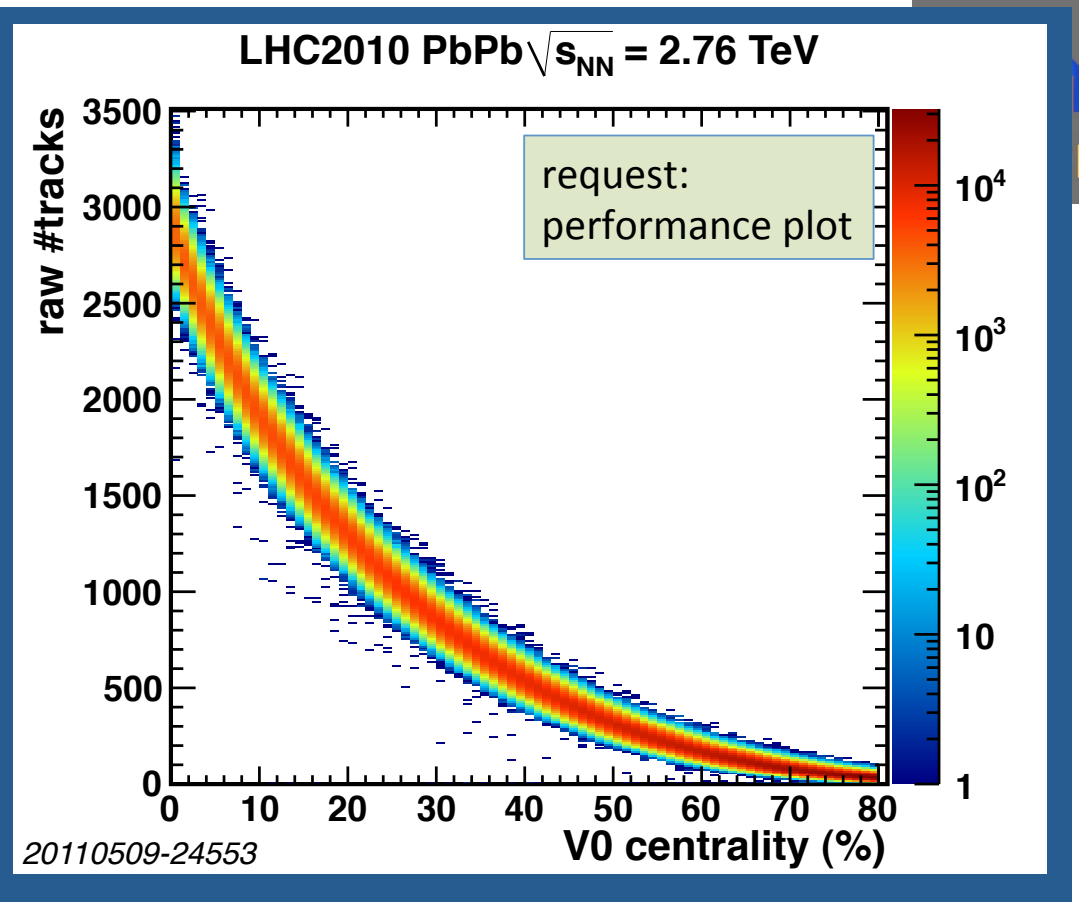
Jet →Jet' + soft gluons + soft hadrons from UE

- Decrease of leading particle p_T (energy loss)
- Increase of number of low momentum particles (radiated energy)
- Increase of p_T relative to jet axis (j_T)
  - Broadening of the jet
  - Out of cone radiation (decrease of jet rate)
- Increased di-jet energy imbalance and acoplanarity.



Prima collisione
PbPb @ 2.76 TeV

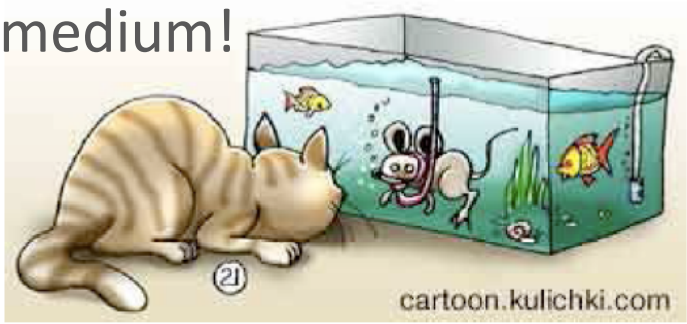




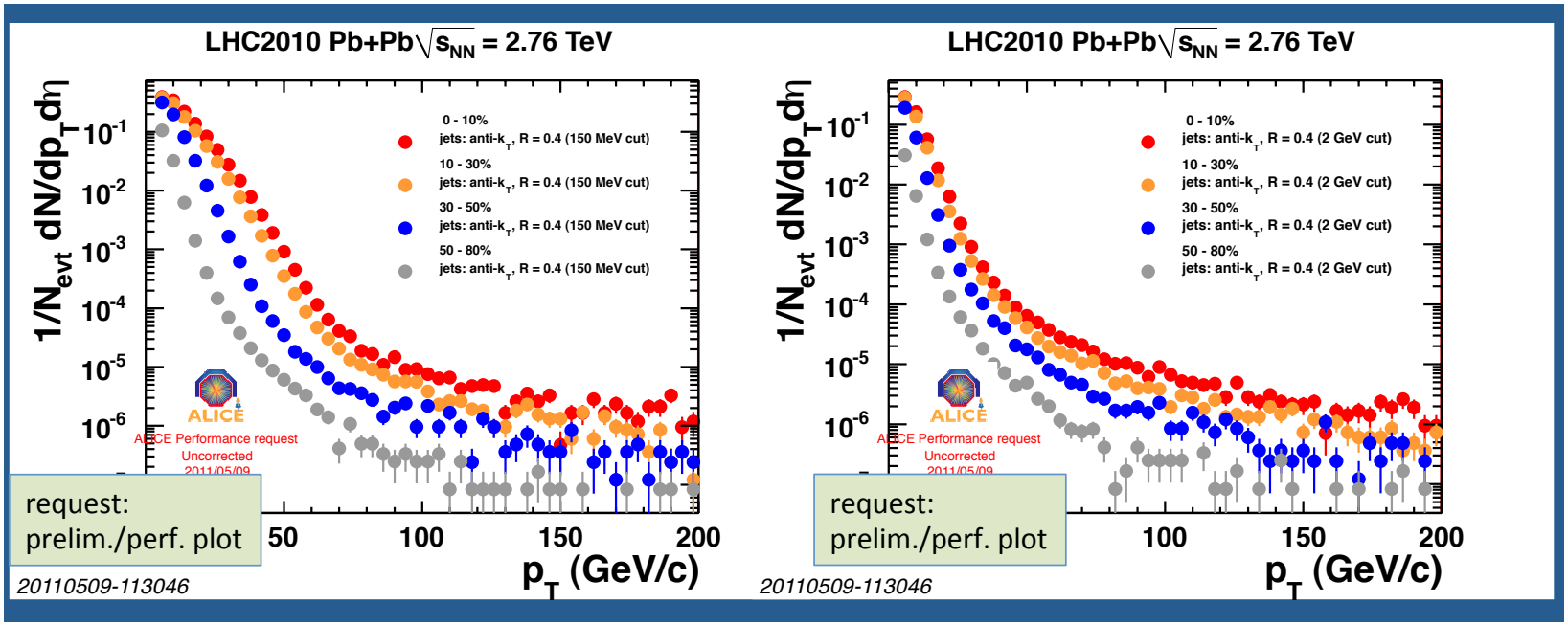
Molteplicità vs centralità
PbPb @ 2.76 TeV

Wealth of new intriguing phenomena in the medium!

→ What's new for jets in the LHC (PbPb)



$$\langle \delta p_T \rangle = \langle \delta p_T^{hadronization} \rangle + \langle \delta p_T^{perturbative\_radiation} \rangle + \langle \delta p_T^{underlying\_events} \rangle$$



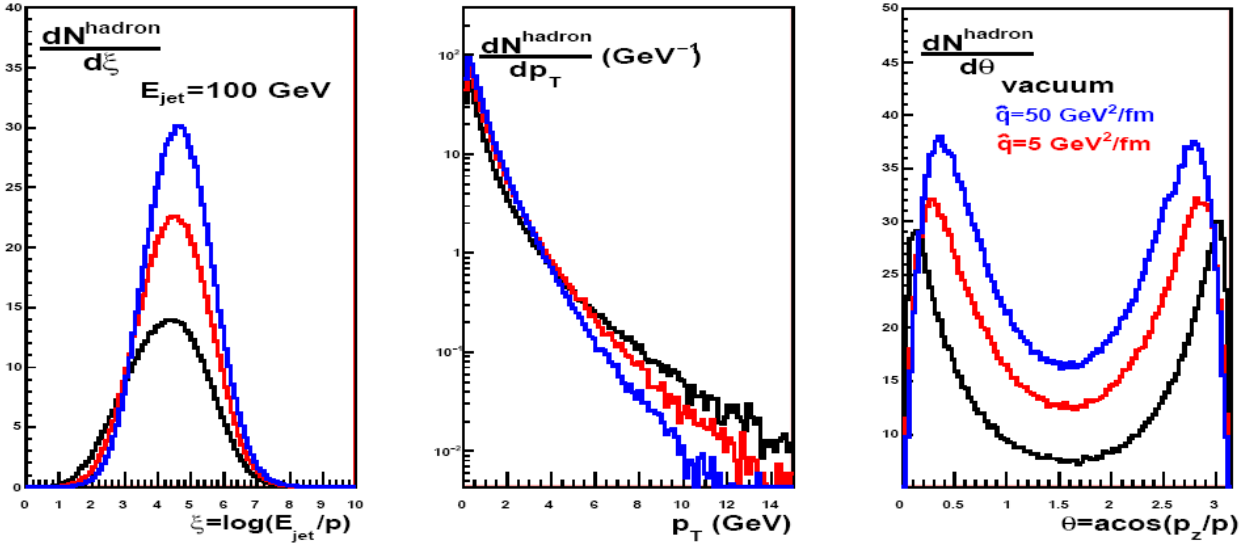
LNF, con L.Cunqueiro, è first author del primo paper sui jet in PbPb

Qpythia e Q-HERWIG: Monte Carlo per il Jet Quenching

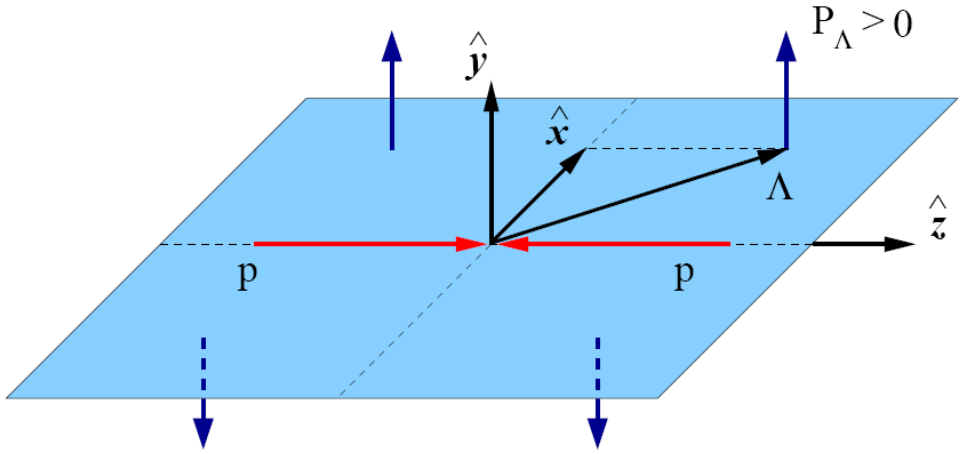
L.Cunqueiro e G.Corcella (LNF)
in collaborazione con l'Università di Santiago (Spagna) [Armesto, Salgado, …]

- medium-induced gluon radiation effects enter through medium-modified splitting functions.
- The longitudinal evolution of the shower is taken into account by considering the formation length of the emitted gluons.
- The energy loss and the transverse broadening of the shower are dynamically related by the relevant parameter: $\hat{q}$, the transport coefficient.

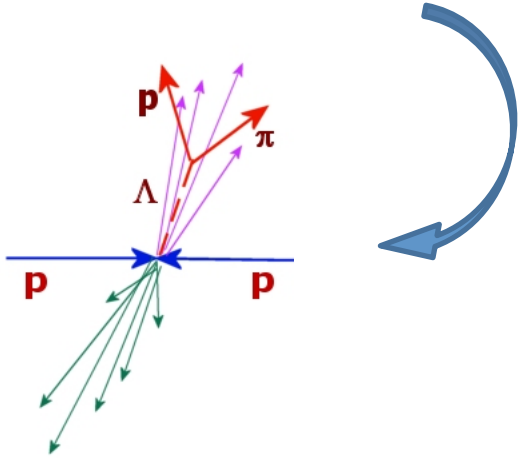
Distribuzioni per diversi valori di quenching



Transverse Λ polarization in unpolarized pp scattering

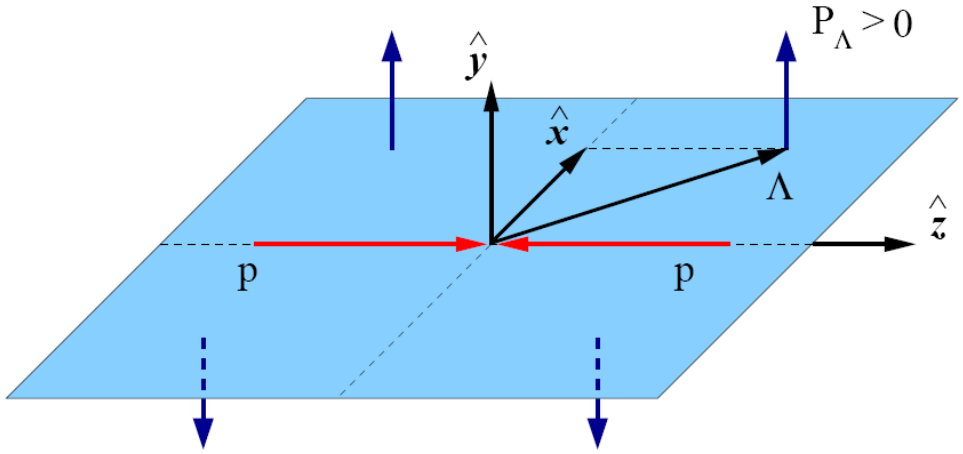


Λ polarization is high only at large x_F. At ALICE, restricted at midrapidities where x_F is very small (1/pt) … unless



This opens the new channel of the *TMDs* (Transverse Momentum dependent Distribution and fragmentation functions)

Transverse Λ polarization in unpolarized pp scattering



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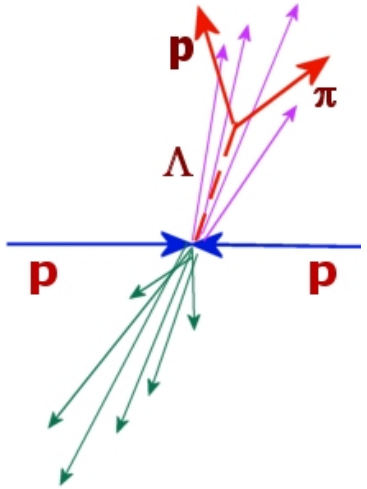
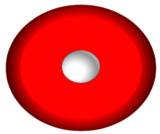
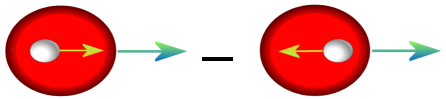


This opens the new channel of the *TMDs* (Transverse Momentum dependent Distribution and fragmentation functions)

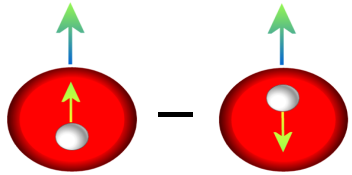
$$\Phi^{\mathrm{Tw2}}_{\mathrm{Corr}}(x) = \frac{1}{2}\left\{ f_1(x) + \mathrm{S_L}\, g_1(x)\gamma_5 + h_1(x)\gamma_5\gamma^1\mathrm{S_T} \right\} n^+$$

$f_1^q =$ 

unpolarised quarks and nucleons

$g_1^q =$ 

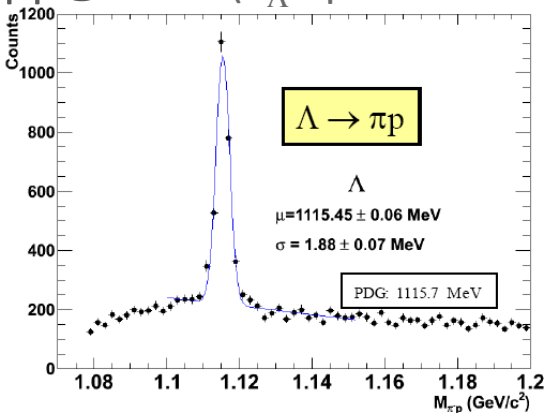
longitudinally polarised quarks and nucleons

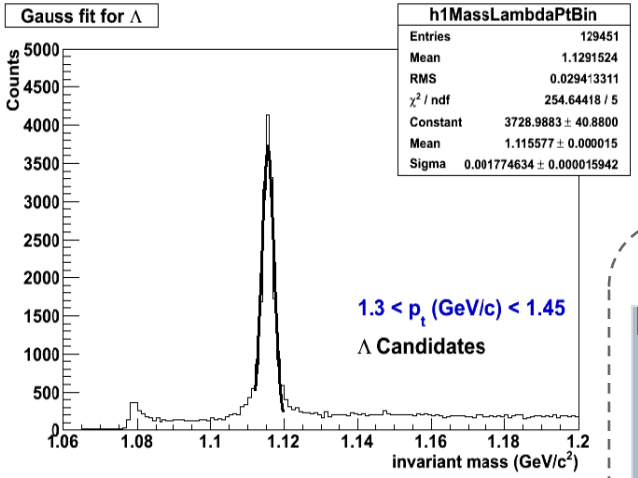
$h_1^q =$ 

transversely polarised quarks and nucleons

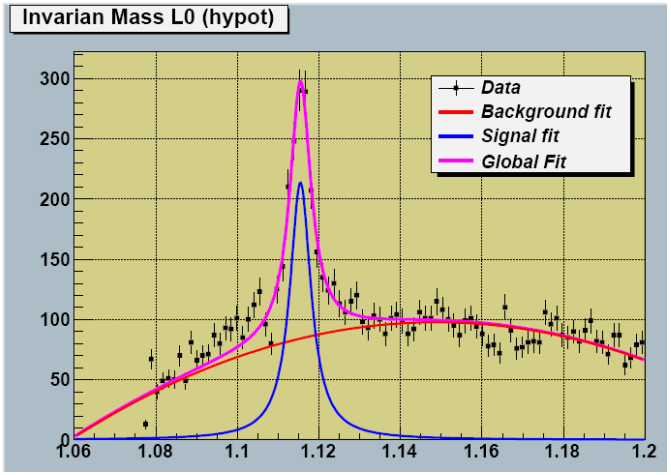
chiral-odd functions

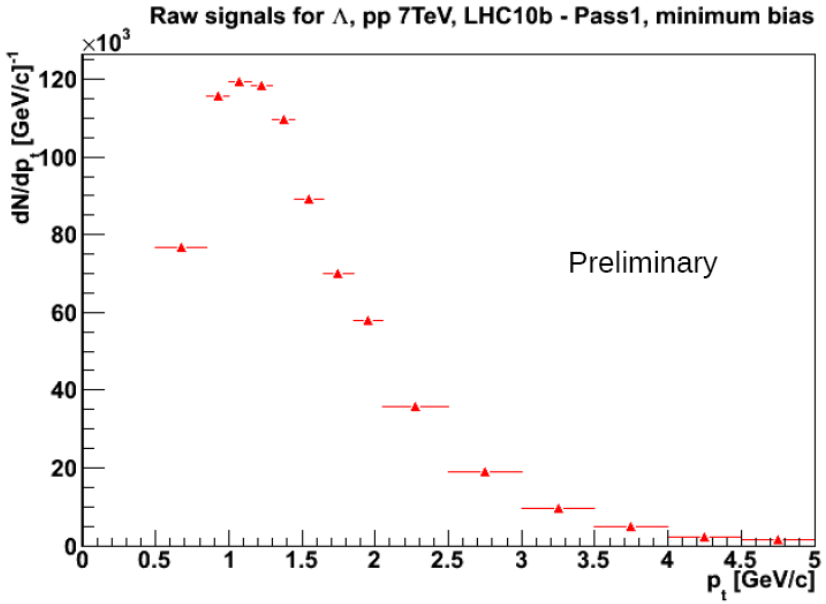
pp@7TeV (E_{Λ} up to 16 GeV)

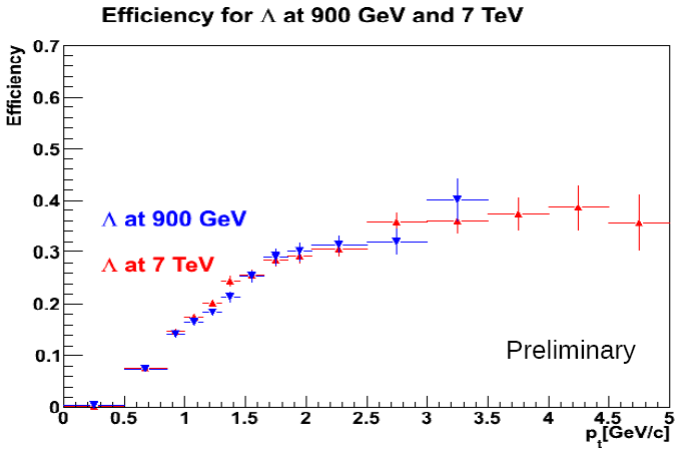




Λ inside jets







Alice is running happily:

Il gruppo LNF è impegnato in:

- hardware (EMCal+DCal)
- online/offline software calorimetry (HLT)
- jet physics
- QGP phenomenology
- fisica polarizzata in pp
- varie responsabilità

con 12 persone al 96% di FTE è fortemente attivo nel progetto!

Richieste finanziarie: Tot 171 kE
MI=12 kE, ME=119 kE, Cons=38 kE, Trasp=2 kE

Impareggiabile lavoro di segreteria

di Donatella Pierluigi

(periodo 7/10-6/11)

- 130 Ordini
- 100 Ospiti/Associati
- 10 Conferenze/Workshop
- 8 Seminari
- 2 Corsi per il Personale
- 1 Segreteria di Concorso

La linea scientifica nucleare ai LNF attraversa un periodo di attività intenso e dinamico con esperimenti in chiusura, altri in partenza o appena partiti

- *Gruppo "premiato" a livello di CSN*
- *Alta percentuale di authorship in lavori scientifici*
- *Alto numero di responsabilità assunte negli esperimenti*

43.6 Ricercatori + Tecnologi (fte) e
5.7 Tecnici (fte)

Richieste finanziarie 2012 totali ~780 k€ → ~18 k€ /fte