

L'esperimento ALICE

Alessandra Fantoni

*INFN, Laboratori Nazionali Frascati
Collaborazione ALICE*



*Consiglio di Laboratorio Aperto - Preventivi
07 Luglio 2010*

1. Stato ALICE @ LHC
2. Il gruppo ALICE LNF (anagrafica e attività')
3. Attività hardware EMCAL
4. Attività software
5. EMCAL upgrade: DCAL
6. Conclusioni

pp collision at 7 TeV



-
- 03-01
- Oct
- Wk
- Mo
- Tu
- We
- Th
- Fr
- Sa
- Su
- 39
- 40
- 41
- 42
- 43
- 44
- 45
- 46
- 47
- 48
- 49
- 50
- 51
- Cryogenics stop
- Ion Beam Setup
- Start Ion Physics
- End non-LHC Physics
- 20 days
- 20 days
- 24 days
- IONS
- Xmas Day
- Ion Run

Il gruppo Alice LNF: anagrafica

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

+

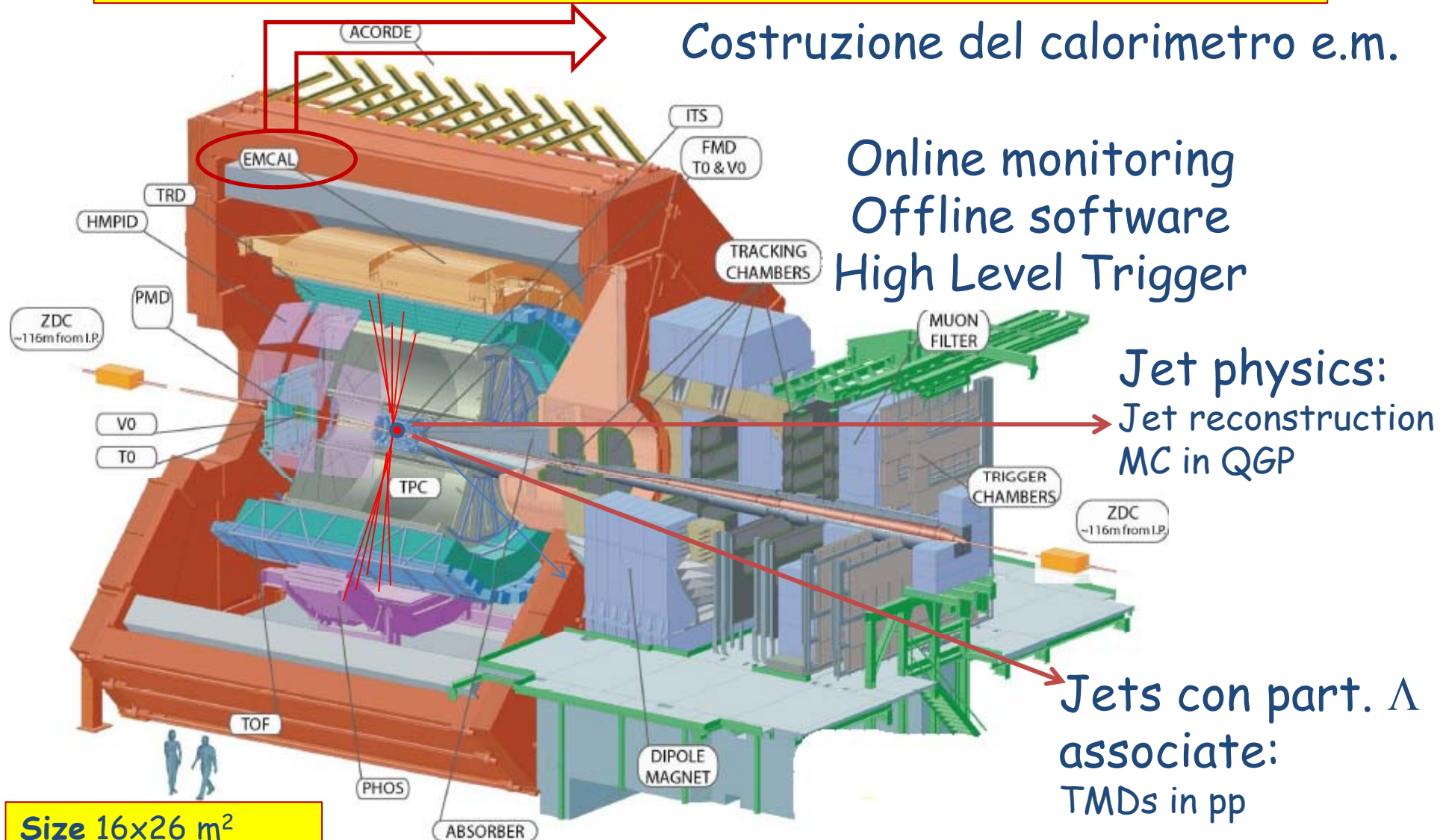
A. Orlandi
A. Viticchiè

12 ricercatori con 11.2 FTE
Partecipazione media 96%

INCARICHI RESPONSABILITA'

- 1 Deputy spokesperson EMCAL *N. Bianchi*
- 1 Coordinatore costruzione EMCAL (EU) e DCAL (EU-Asia) *A. Fantoni*
- 2 Membri Management Board Calorimetro *N. Bianchi e P. Di Nezza*
- 1 Expert on call *F. Ronchetti*
- 2 Shift leaders *P. Di Nezza e A. Fantoni*

Il gruppo Alice LNF: attivita'



Size 16x26 m²
Weight 10000 tons
Detectors 18

EMCAL Characteristics

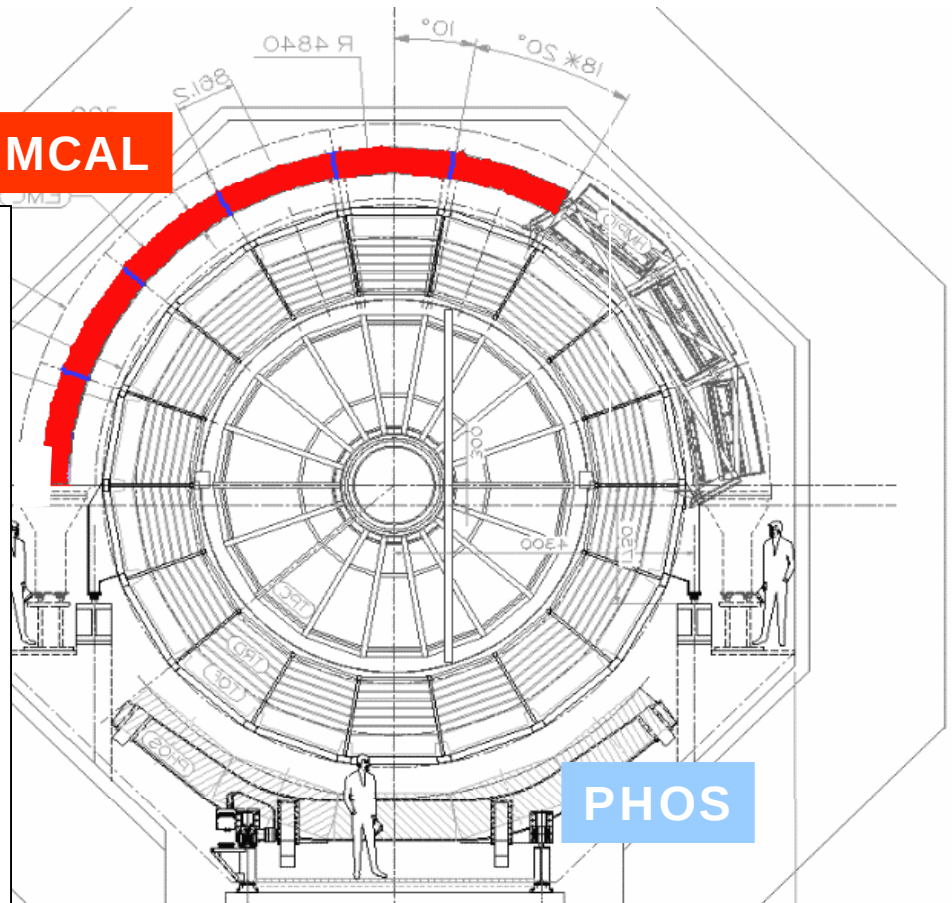
To do **jet (quenching) physics**:

- large coverage
- good granularity

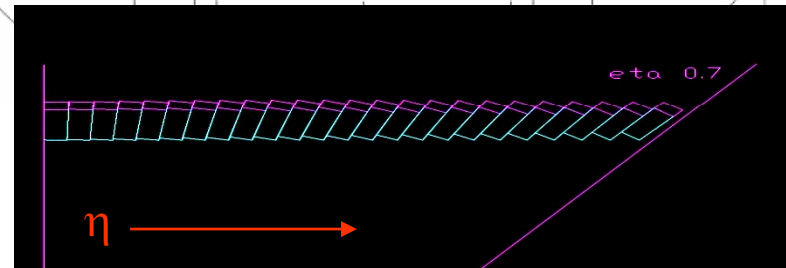
EMCAL

- located **inside** the L3 solenoidal magnet
- **sampling** calorimeter: $20.1 X_0$
- **sandwich**, 1.44 mm Pb/1.76 mm Scint
- final geometry when installation completed**
 - $-0.7 < \eta < 0.7$
 - $\Delta\Phi = 100^\circ$
 - small Φ gaps (~ 3 cm)
aligned w/ TPC gaps
- sampling fraction 1/10.5
- density 5.86 g/cm^3
- $R_M = 3.20 \text{ cm}$; $X_0 = 12.3 \text{ mm}$
- Scintillator = Polystyrene (BASF143E + 1.5% pTP + 0.04% POPOP)
- 10 super-modules in total
- granularity: **11520 towers**
tower size: $\Delta\eta \times \Delta\phi \sim 0.0143 \times 0.0143$
- $\sigma_E/E \sim 10\%$
- installed back to back with PHOS

EMCAL



PHOS



Containment: **88 parts**

- 1) Back (holes: 144 thru for fibers + springs + mech. support), 1
- 2) Compression (holes: 144 thru for fibers + springs), 1
- 3) Front Plate (holes: 144 thru for fibers + springs + mech. support), 1
- 4) 5) Plungers (10)
- 6) Belleville washers (75)

Tensioning and Isolation: **40 parts**

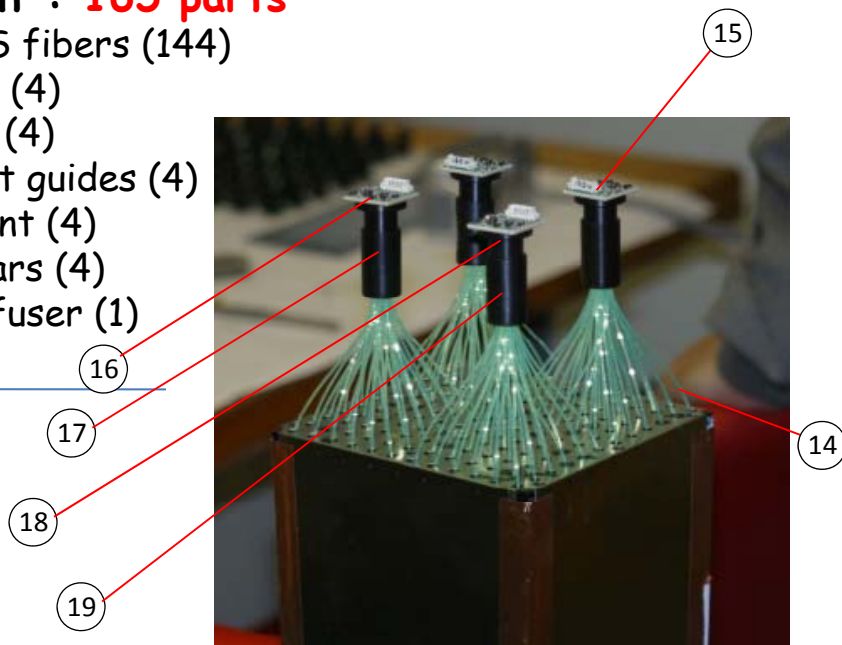
- 7) Stainless steel straps (4)
- 8) Screws (24)
- 9) Flanges (8)
- 10) Light tight stickers (4)

Sandwich: **538 parts**

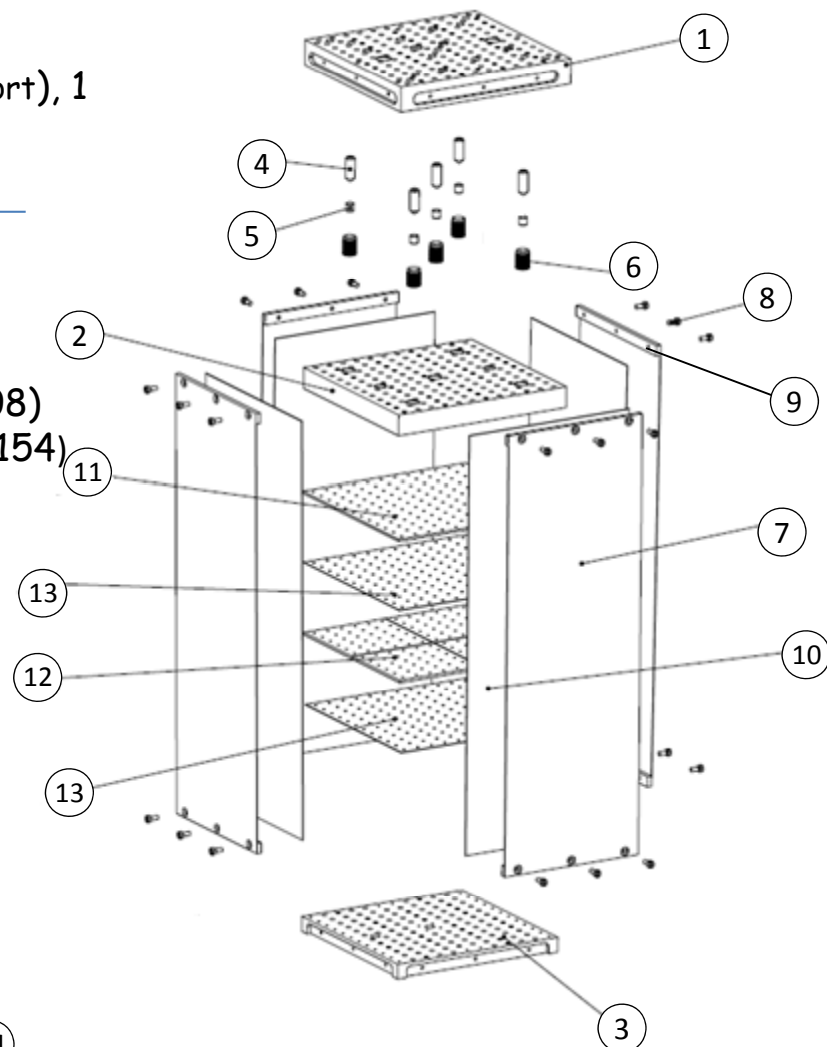
- 11) Lead tiles (76)
- 12) Scintillator tiles (308)
- 13) Bond paper sheets (154)

Readout : **165 parts**

- 14) WLS fibers (144)
- 15) APD (4)
- 16) CSP (4)
- 17) Light guides (4)
- 18) Mount (4)
- 19) Collars (4)
- 20) Diffuser (1)



Module Parts

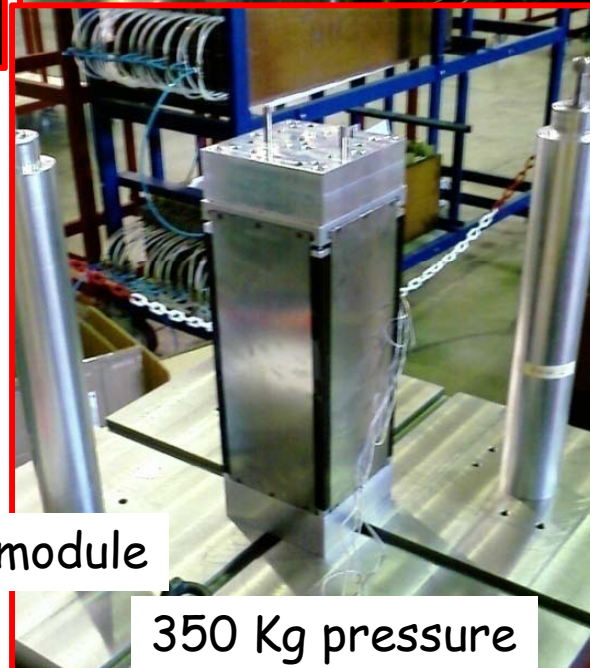
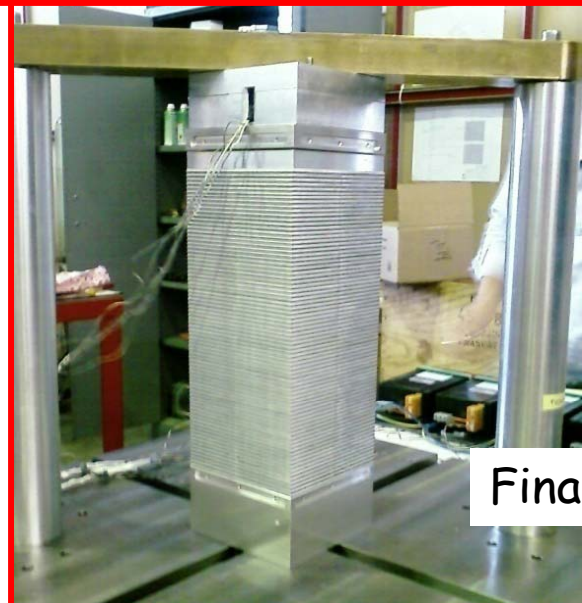


TOTAL components: 20

TOTAL parts: 831

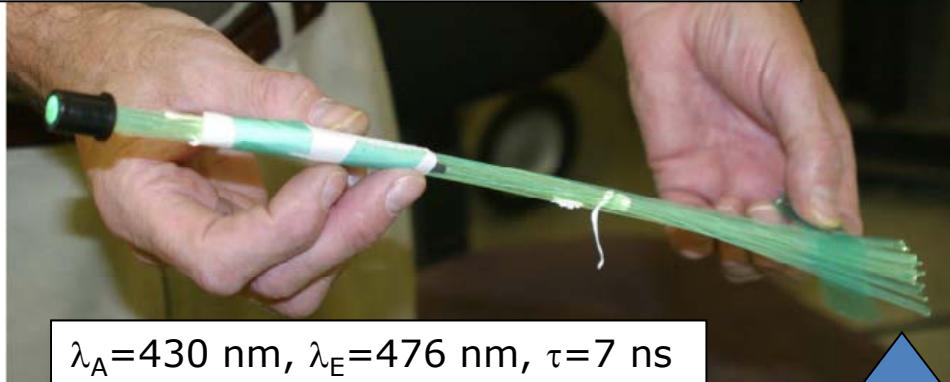
Plus cabling, GMS and mech. supports

Module Production



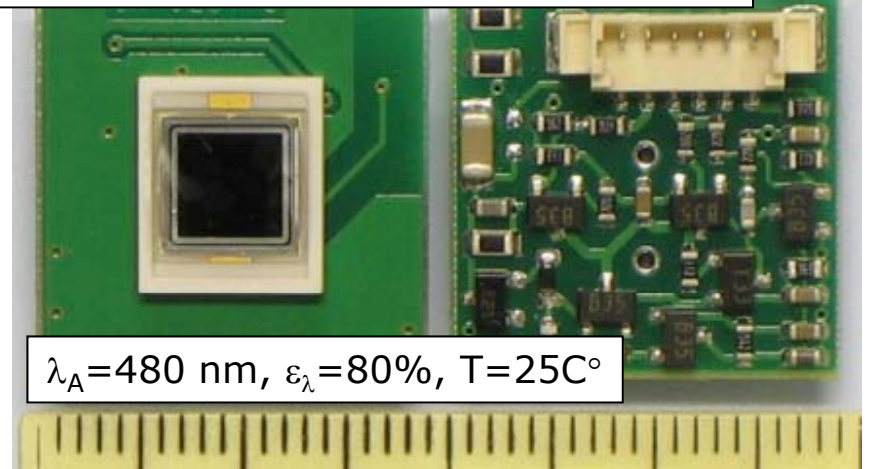
The EMCAL Readout

Y-11 (200) WLS double clad fibers

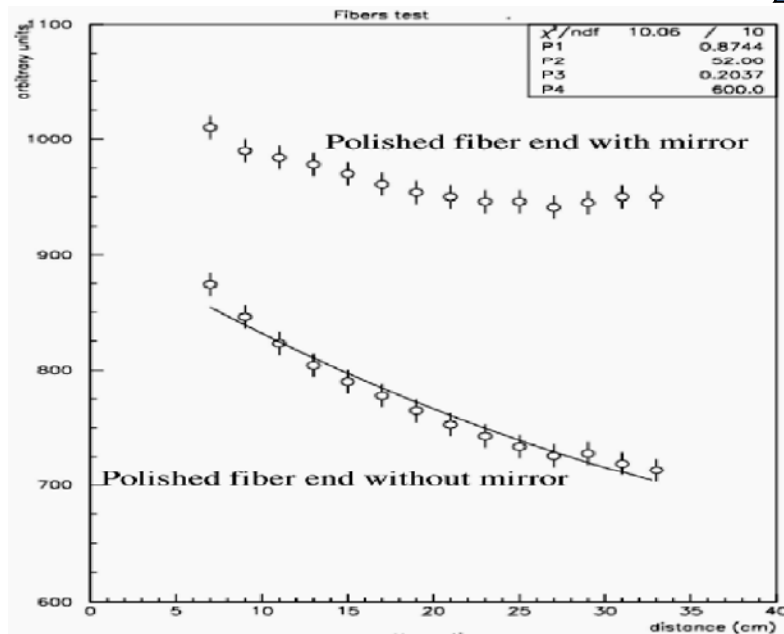


$\lambda_A=430\text{ nm}$, $\lambda_E=476\text{ nm}$, $\tau=7\text{ ns}$

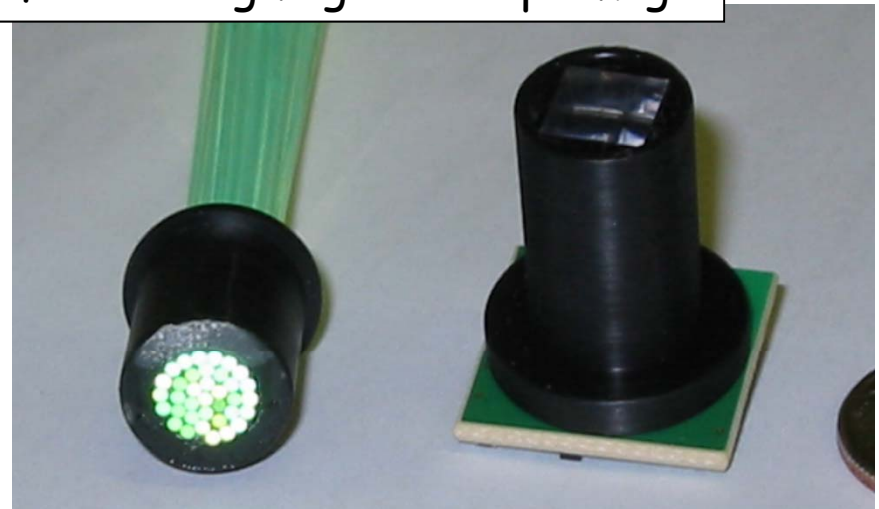
S8664-55 APD+CSP package



$\lambda_A=480\text{ nm}$, $\varepsilon_\lambda=80\%$, $T=25\text{C}^\circ$

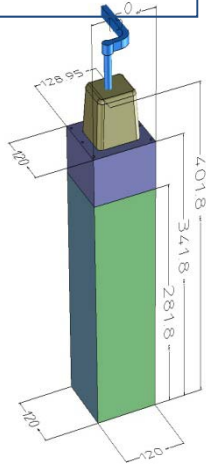


fibers + light guide on package



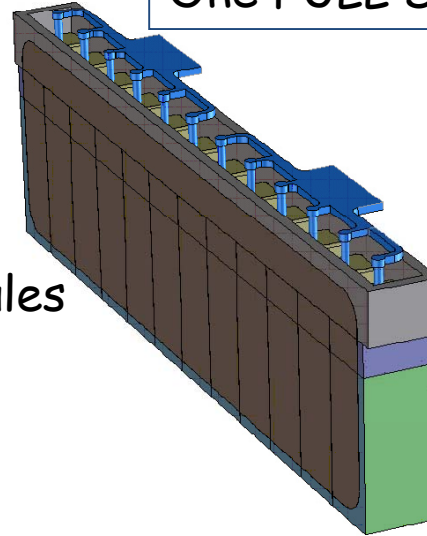
The EMCAL Modular Structure

One Module



- 1 Module = 26.7 kg
- 1 Strip Module = 324 kg
- 1 Super-Module = 288 modules ~ 7.7 tons

One FULL Strip Module

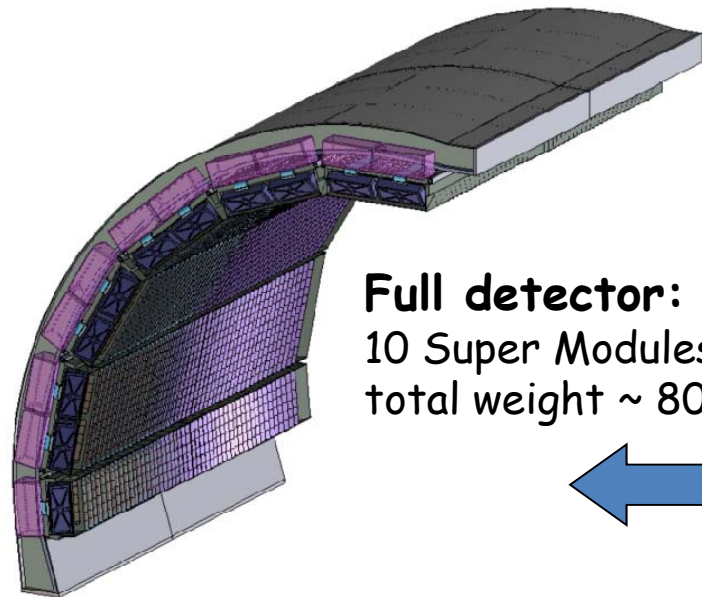


12 modules

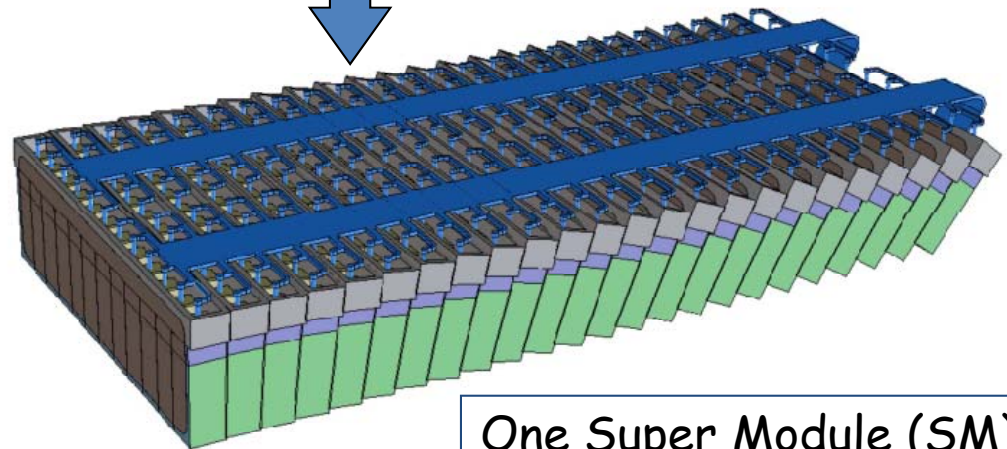
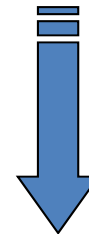
Collaborazione
Francia, Italia, USA

7 US SMs

3 EU SMs (Italy and France)
Construction started in 2008
4/10 SMs installed in 2009
Complete installation in 2011



Full detector:
10 Super Modules,
total weight ~ 80 tons



One Super Module (SM)

Attivita' hardware LNF EMCAL 2010 - 2011

COSTRUZIONE MODULI

- 2 assembly stations al Capannone Gran Sasso
- Camera di sputtering costruita interamente in loco (e richiesta anche da altri gruppi)
- Assemblaggio 1/3 contributo Europeo (1 SM, 24 stripmoduli, 288 moduli)
- Lavorazione, sputtering, assemblaggio ed incollaggio fibre per 3 SMs Europei EMCAL e 3 SMs Eu-Asia DCal (piu' di 200.000 fibre, raggruppate in circa 6000 bundles)

RICHIESTA INTERVENTI SPCM

- Misure metrologiche sugli scintillatori
- Test punti rottura straps per chiusura moduli

Contributo LNF 2010 - 2011

Hardware

Data taking

Data analysis

High Level Trigger for EMCal

MC simulation - QPythia per Jet Physics

Data analysis on Jets with Λ particles associated

Online monitoring

EMCal - Dcal debugging

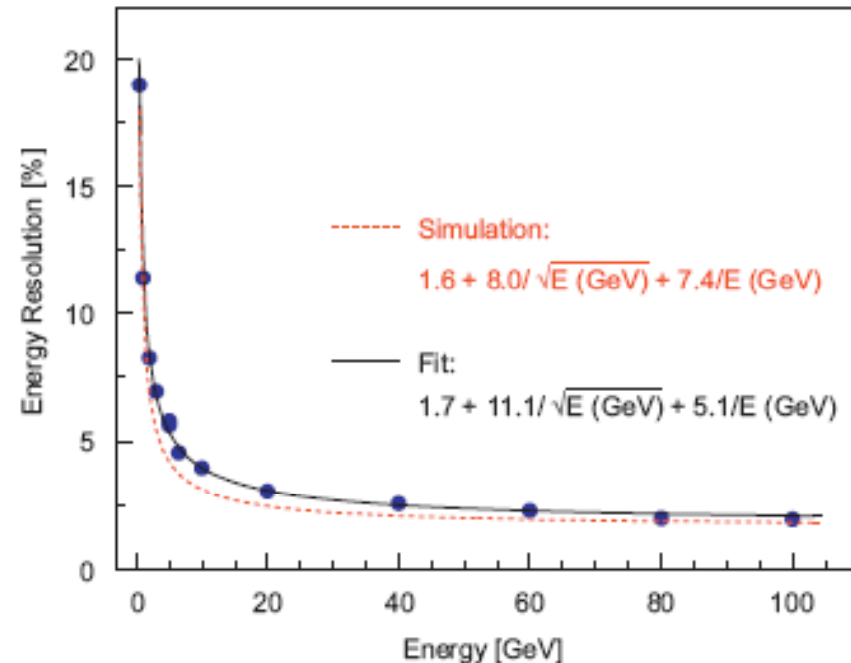
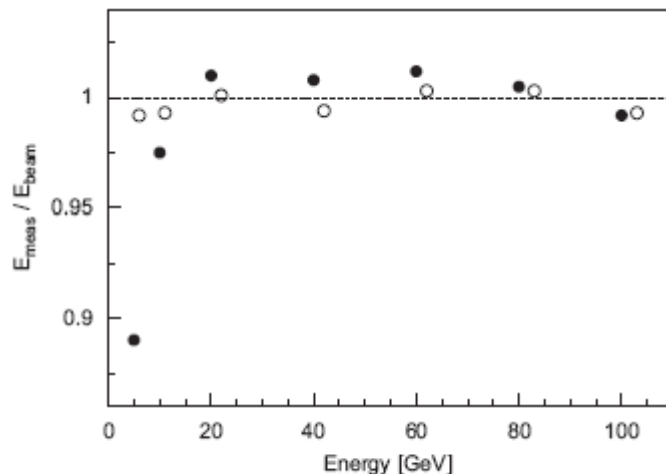
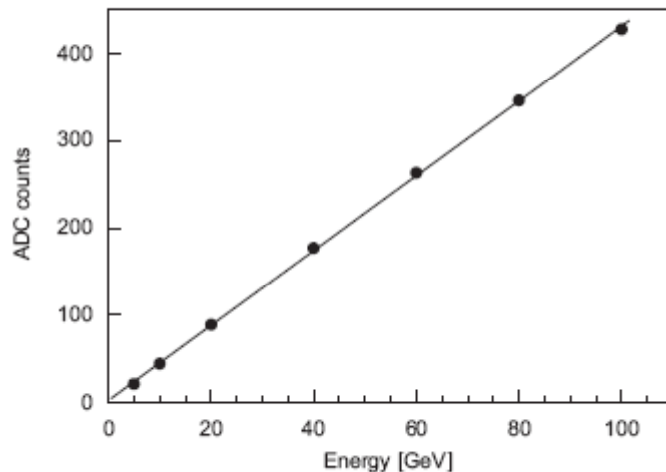
Calibration

F. Ronchetti (online)

P. Di Nezza, L. Cunqueiro Mendez, A. Moregula (offline)

EMCAL caratteristiche from test beams

EMCAL prototypes (4 modules x 4 strips) under test beams:
FNAL, November 2005 & SPS + PS, September - October 2007



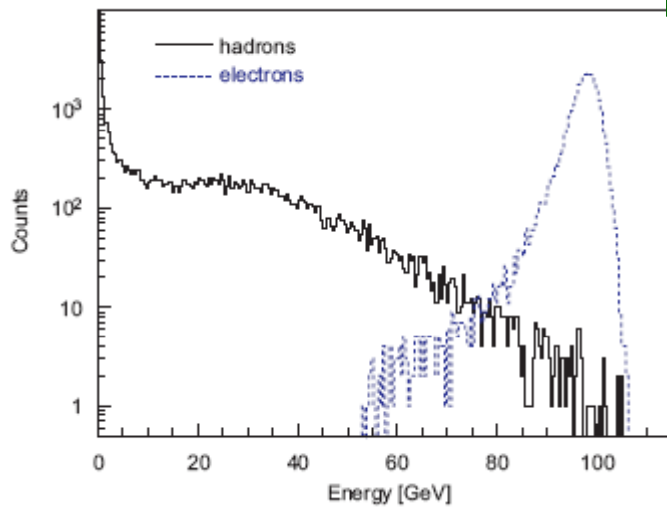
Energy resolution for electrons as
a function of the incident beam
momentum:

$$\sigma(E)/E = 1.7 + 11/\sqrt{E} + 5.1/E$$

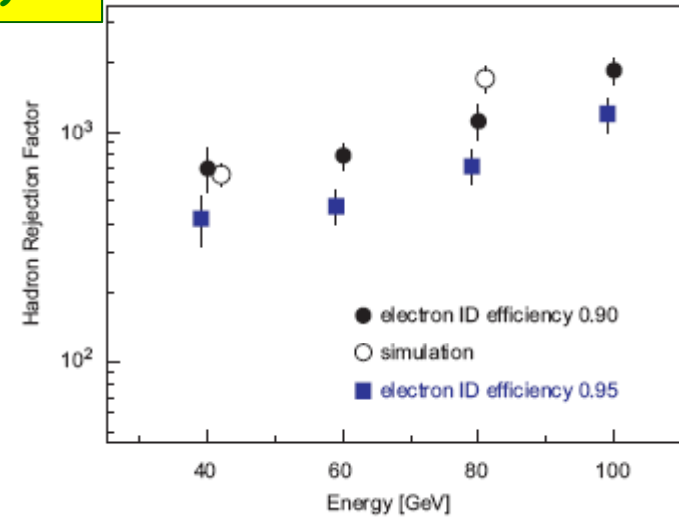
Linearity better than 1% above
20 GeV (3x3 tower cluster)

Articolo preparato LNF

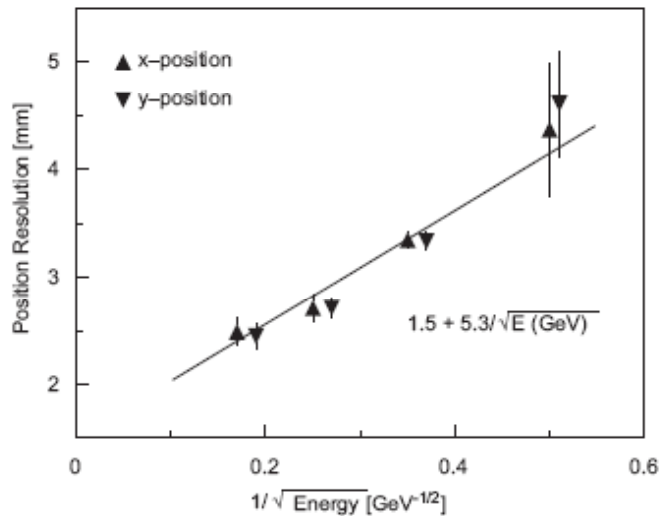
NIM A 615 (2010) 6



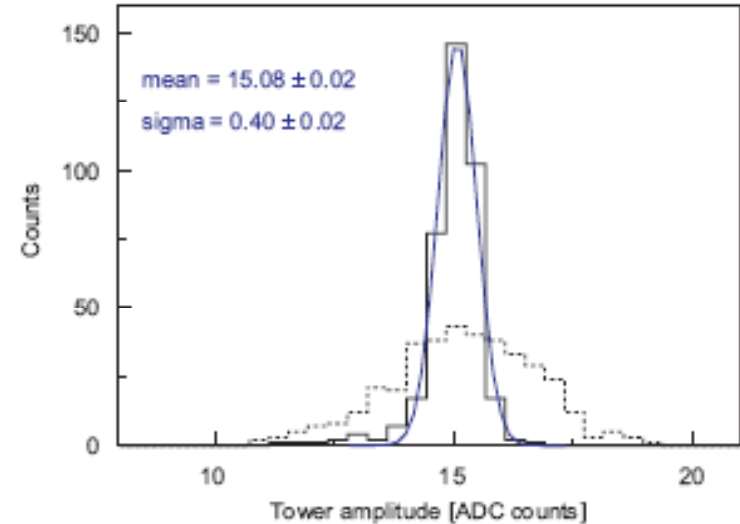
EMCAL response to h and e^-



Hadron Rejection Factor 10^2 - 10^3



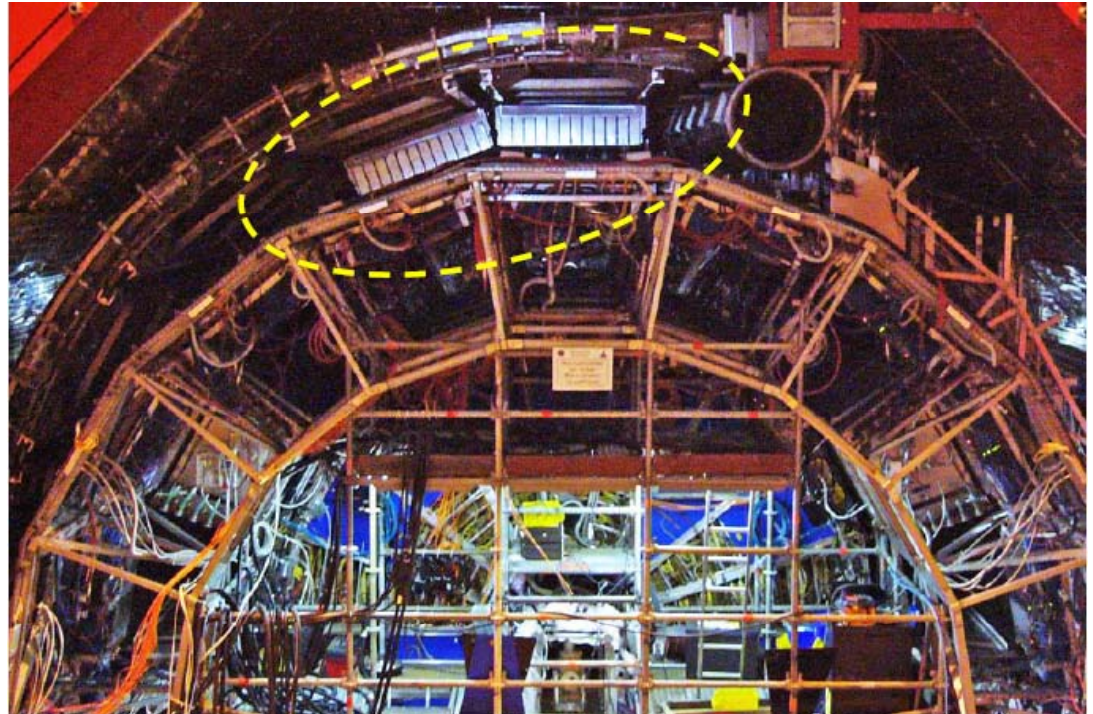
Position Resolution (mm):
 $\Delta x = \Delta y = 1.5 + 5.3 / \sqrt{E}$



Response of 384 towers
 before/after gain calibration

Stato EMCAL

- 4 SMs installati in ALICE (2 a Marzo 09, 2 a Luglio 09), operativi e in presa dati
copertura parte installata:
 $\Delta\eta \times \Delta\phi = 1.4 \times 1.05$



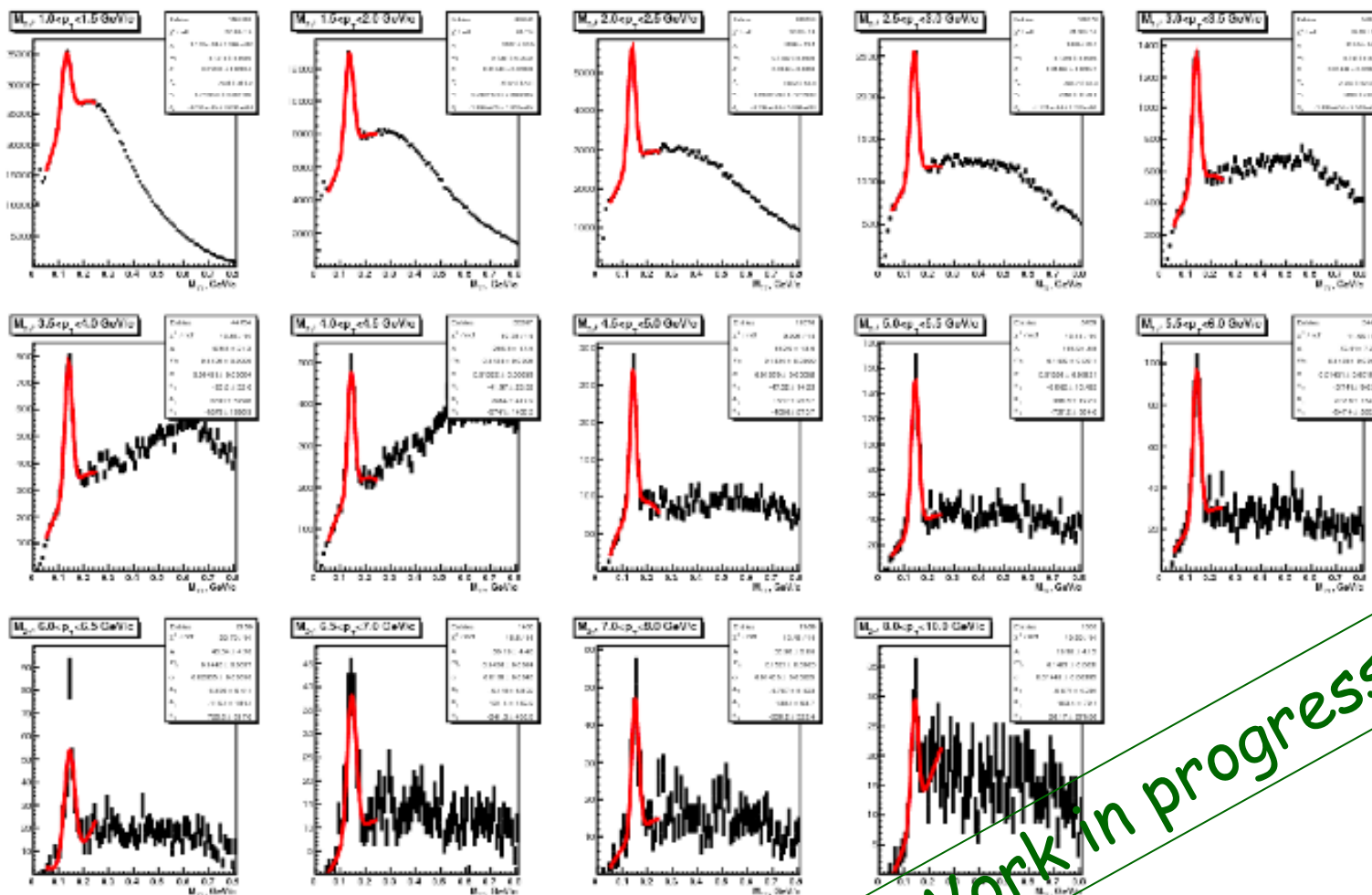
- 4 SMs pronti e in fase di test/calibrazione
- 2 SM in preparazione
- Assemblaggio di EMCAL completed prima dell'estate 2010
- Calibrazione con cosmici da completare in autunno 2010

Installazione EMCAL completa appena disponibile un lungo shutdown a LHC (2001) (2011)

Data taking

EMCal π^0 's

EMCAL: $N_{\text{dig}} = 1$, $E_{\text{clu}} > 0.3 \text{ GeV}$, $600 < T < 700 \text{ ns}$



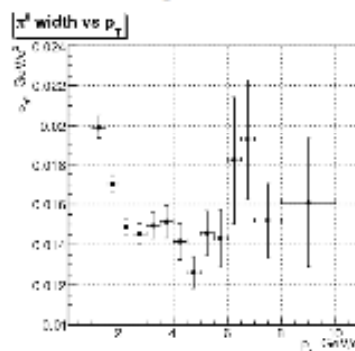
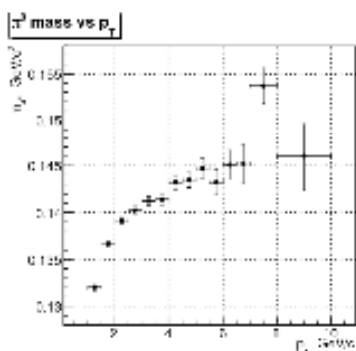
28.04.2010

π^0 in calorimeters

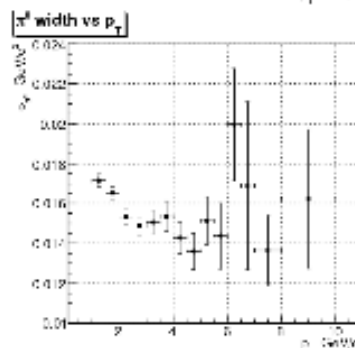
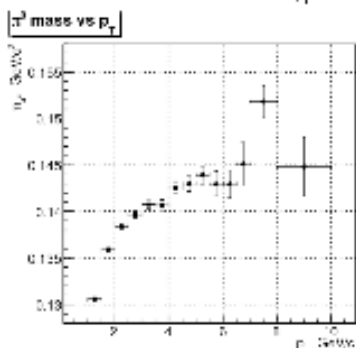
Work in progress

EMCal π^0 's - Non linearity

EMCAL: π^0 mass and width

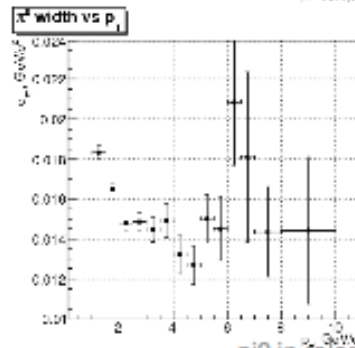
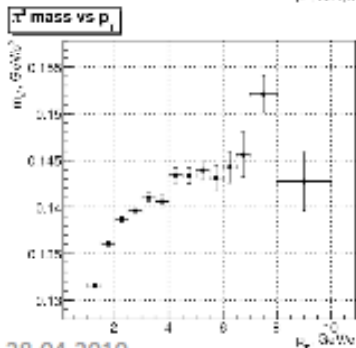


$N_{\text{dig}} = 2, E_{\text{clu}} > 0.3 \text{ GeV}$



$N_{\text{dig}} = 1, E_{\text{clu}} > 0.3 \text{ GeV}$

Need to get non-linearity correction
and geometry correct before
rescaling energy scale



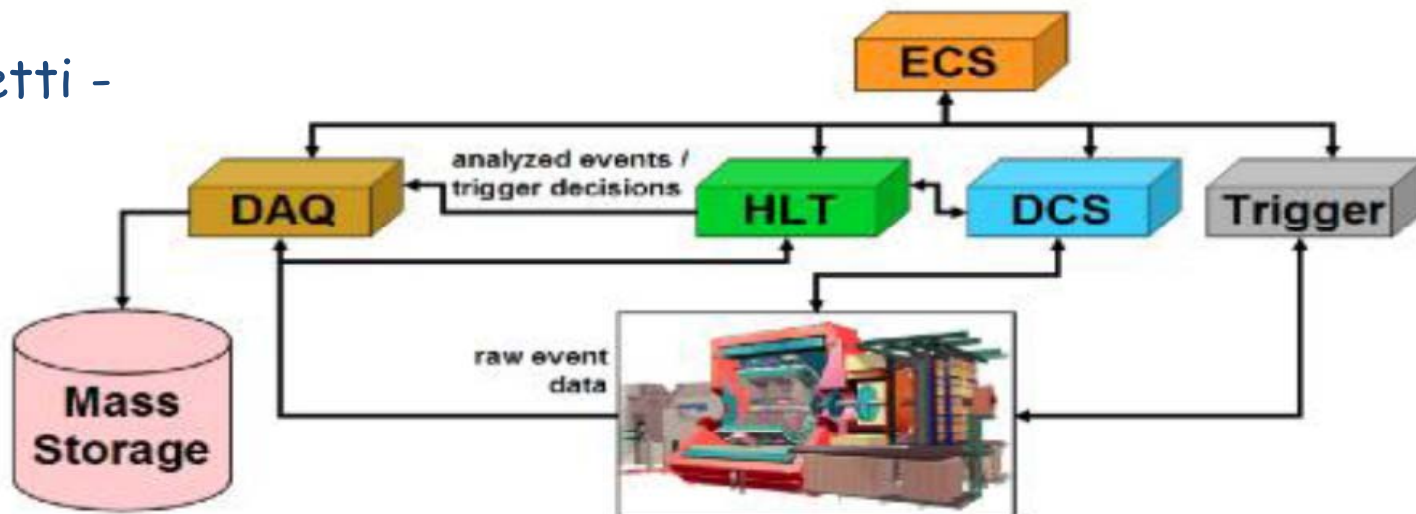
$N_{\text{dig}} = 1, E_{\text{clu}} > 0.3 \text{ GeV}, 600 < T < 700 \text{ ns}$

Cluster selection does not affect the π^0
mass and width

Work in progress

High Level Trigger for EMCal

- F. Ronchetti -

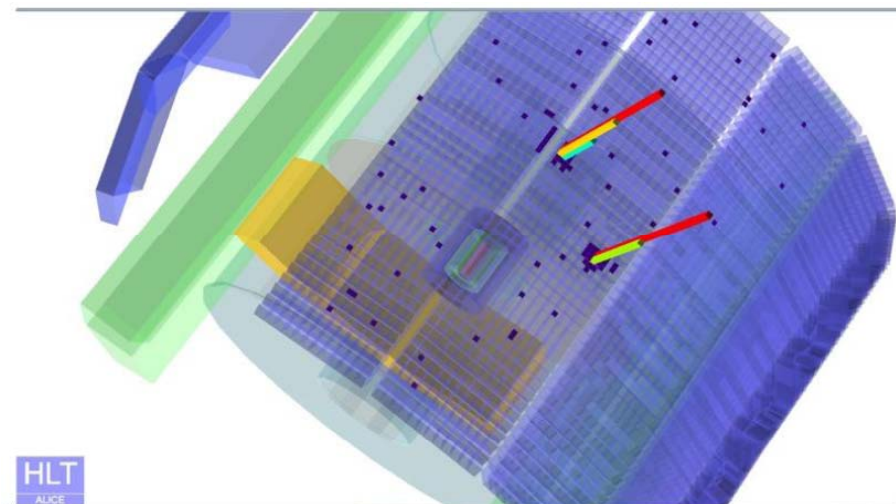


PbPb collisions @ 8 kHz corresponds to 2 kHz calo tower hit rate

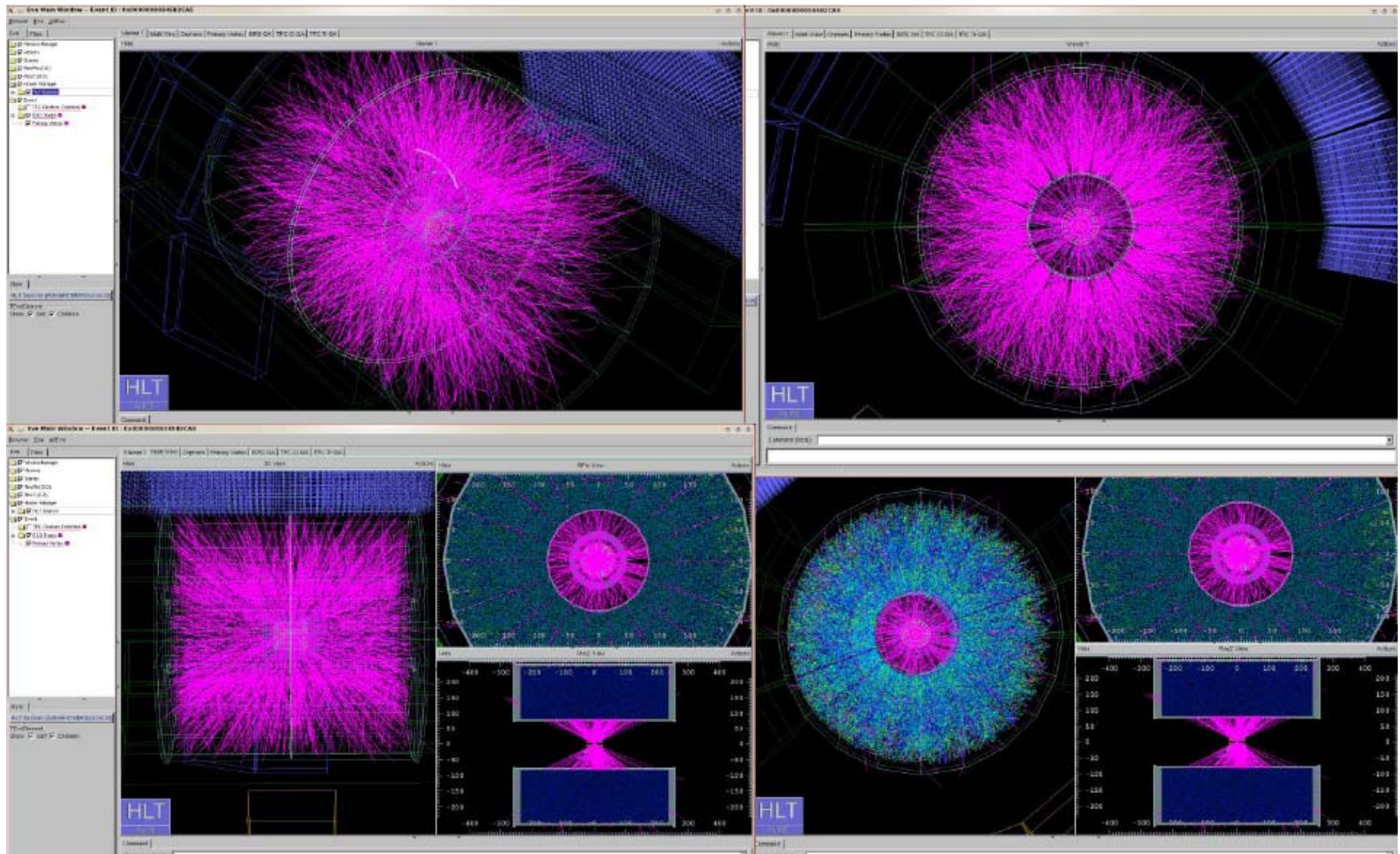
HLT reduces to a 40% EMCal data occupancy

Main HLT strategy:

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



HLT study overlapping few hundreds of pp real events to simulate PbPb collisions

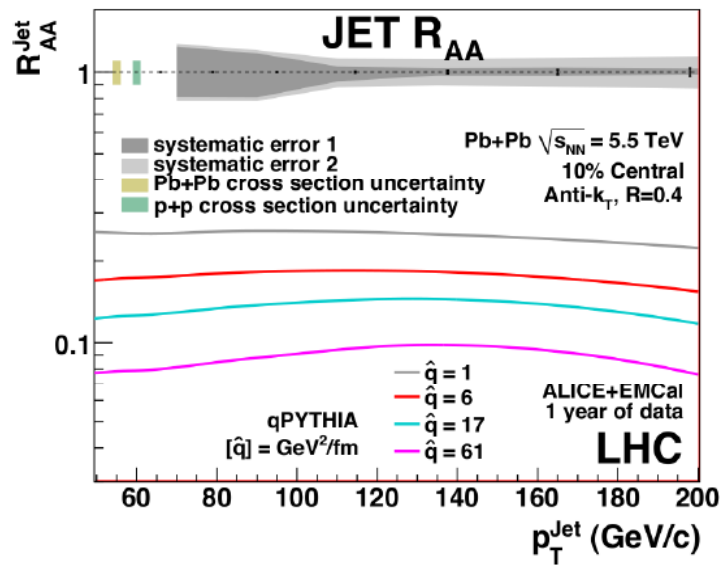
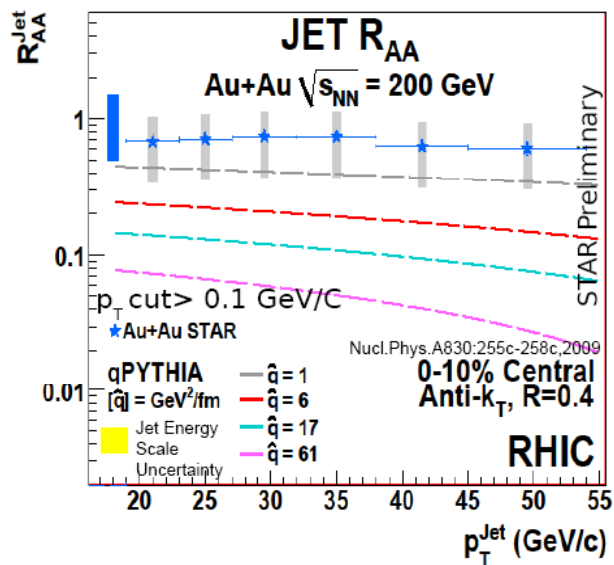
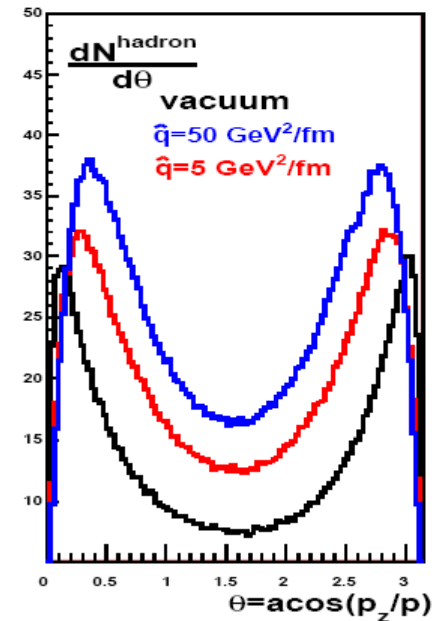
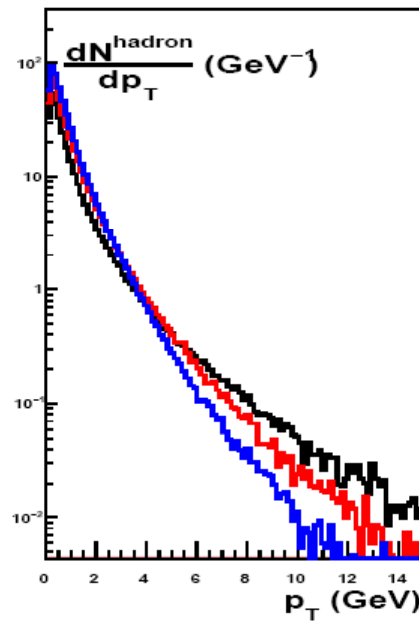
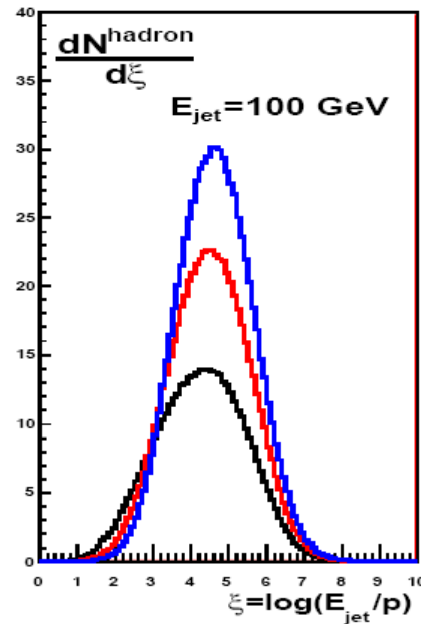


Jet Physics - QPythia: MC for Jet Quenching

- L. Cunqueiro -

In collaboration with
Santiago Univ. theory
group [Armesto,
Cunqueiro, Salgado]

Distributions
for different
quenching



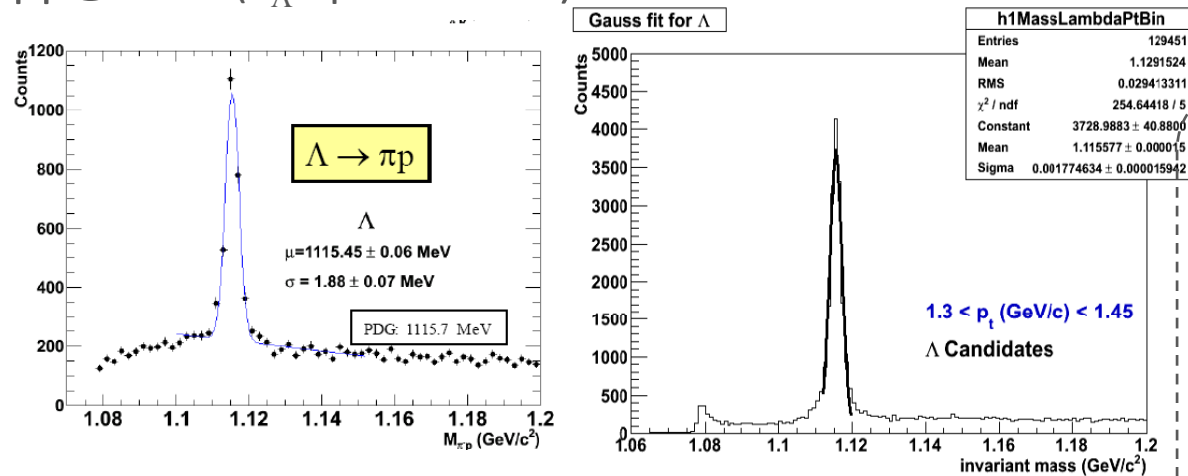
Comparison
with RHIC data

Transverse Λ polarization in unpol. pp scattering

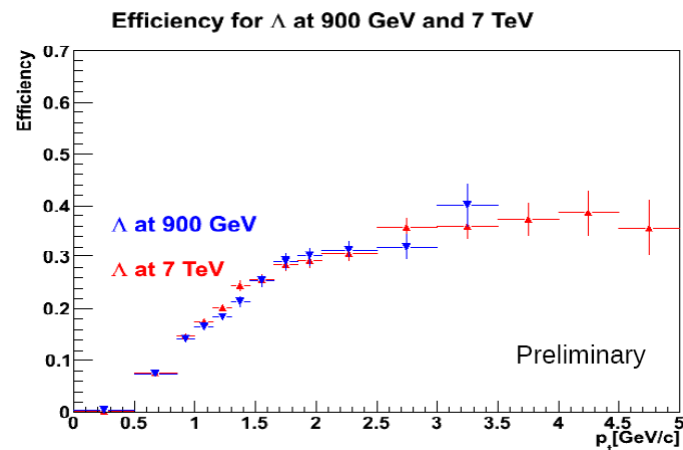
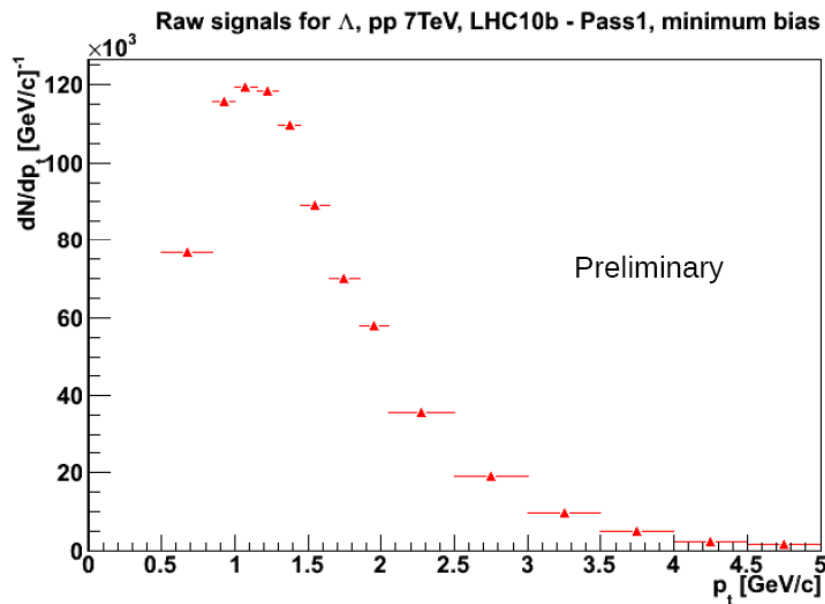
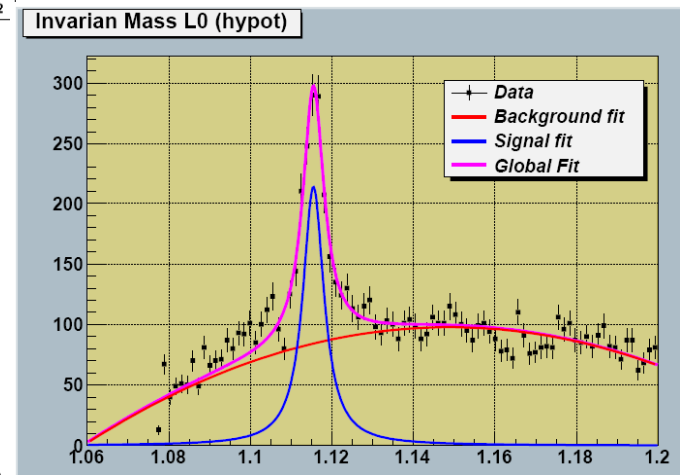
- P. Di Nezza -

pp@7TeV (E_Λ up to 16 GeV)

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



Λ inside jets



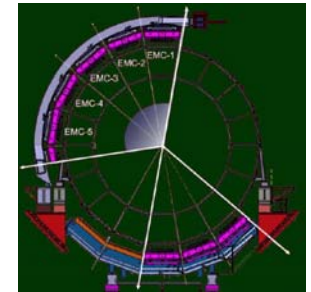
Estensione EMCAL: DCAL

EMCal ultimo rivelatore proposto in ALICE, solo parzialmente installato
Primo upgrade approvato (Nov. 2009) estensione EMCal = DCAL
→ DCal back to back con EMCal per jet-jet e γ -jet physics

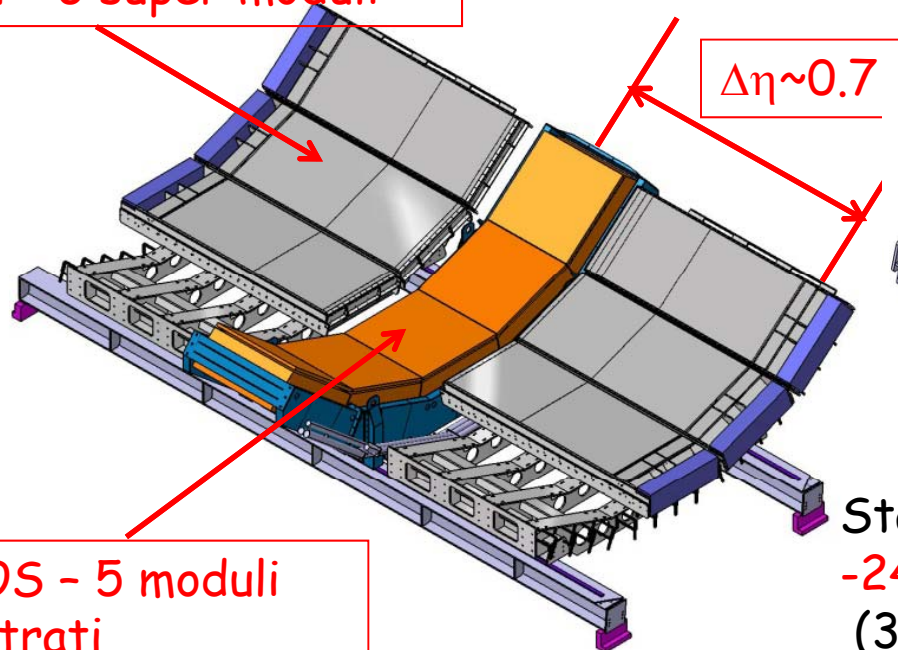
Inizio assemblaggio 6 DCAL SMs dopo completamento EMCAL fino a 2011

Moduli DCAL:

Stessa tecnologia EMCal
SM piu' corti (2/3 EMCal SM)



DCal - 6 super moduli

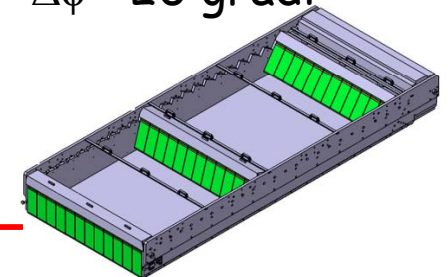


$\Delta\eta \sim 0.7$

PHOS - 5 moduli
mostrati

DCal SM
- 16 strip moduli
(2 mostrati)
- Installazione
 $\eta = 0$ to ~ 0.7
(incluso PHOS)
- $\Delta\phi \sim 20$ gradi

Standard EMCAL SM
- 24 strip modules
(3 shown)



Contributo LNF DCAL

Tools:

2 assembly stations, 4 stazioni compressione, 1 camera sputtering, 4 stazioni incollaggio fibre, tools assemblaggio stripmoduli

Expertise:

- Assemblaggio moduli, stripmoduli
- Produzione fibre
- Test scintillatori

Manpower:

- Produzione (lavorazione, sputtering, assemblaggio ed incollaggio) fibre per DCAL Eu-Asia (3 SMs, circa 90.000 fibre in 2500 bundles) per 2011
- Contributo all'assemblaggio moduli, stripmoduli
- Contributo alla calibrazione con cosmici a Grenoble
- Contributo all'installazione SMs al CERN

Richieste 2011

- MI** 17 kEuro (Riunioni capigruppo, contatti ditte italiane per componenti DCAL e missioni Ct per assemblaggio, Convegno Nazionale Fisica Alice)
- ME** 130 kEuro (Partecipazione run, Alice weeks e Physics week, Physics working group, Offline weeks, Manutenzione EMCal, Installazione terzo SM al CERN + cablaggi, Commissioning con cosmici SM EmCal/Dcal a Grenoble)
- Consumo** 23 kEuro (M&O_B EMCal, Metabolismo per lavorazione, sputtering, assemblaggio e incollaggio fibre)
- Trasporti** 12 kEuro (Spedizione e smistamento materiali DCAL a Catania, Nantes, Grenoble, Wuhan e Tsukuba)
- Inventario** 8 kEuro (Pompa turba per sputtering)
- Totale** 190 kEuro per 11.2 ricercatori FTE

Conclusioni

- 12 persone coinvolte (11.2 FTE) in diversi settori:
- Hardware (EMCal + Dcal):
 - 4 EMCAL SMs installati per π^0 , γ e jet physics
 - Primi risultati presa dati: EMCAL funzionante, ottimizzazione in corso
 - Installazione EMCal durante lungo shutdown (2011)
 - EMCAL upgrade: DCAL per γ -jet e jet-jet, lavoro iniziato, completamento nel 2011
- Online/offline software calorimetro
- Data taking
- MC
- Analisi dati
- Diversi incarichi responsabilita'