

# Status of KLOE-2 upgrades

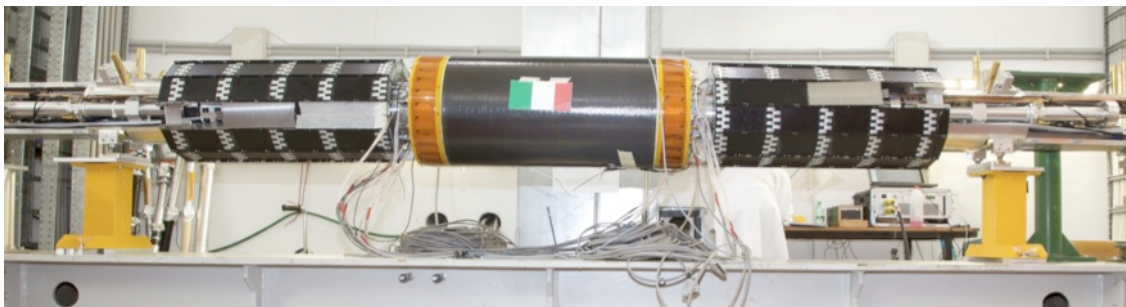
M.Martini

Univ. degli Studi Guglielmo Marconi (Sure)  
INFN, Laboratori Nazionali di Frascati (Maybe)

On behalf of the KLOE-2 collaboration



From CAD...



... To exp

# Conclusions at last SciCom



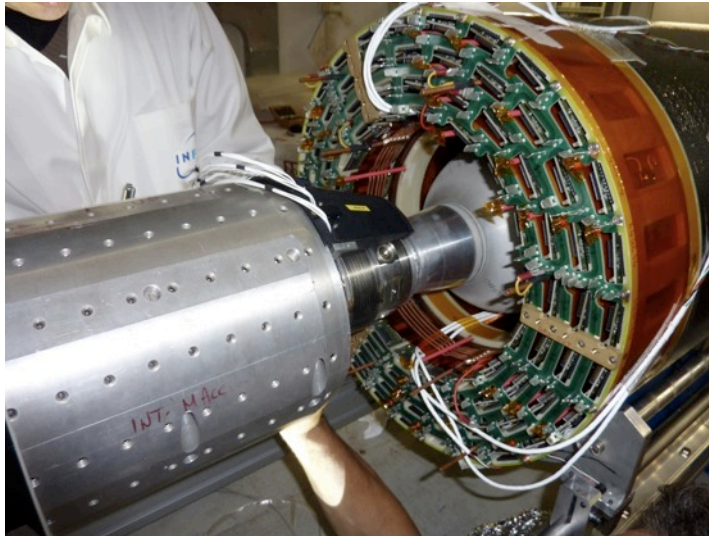
Summary of work done at last Scientific Committee (from G.Morello):

- CCalT installation done on May 6th
- IT insertion on the beam pipe done on May 7th
- Closure of the beam pipe done on May 8th

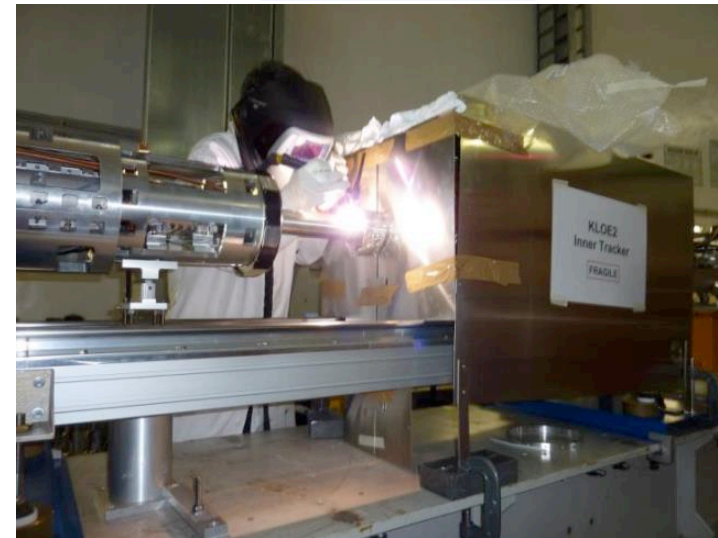
# Conclusions at last SciCom



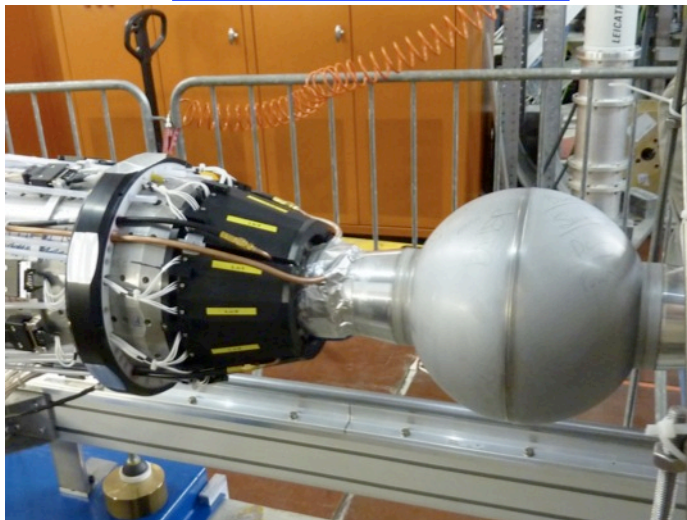
IT insertion



IR soldering



CCALT positioning



Final IP configuration



# Conclusions at last SciCom



Future perspective at last Scientific Committee  
(from G. Morello):

... and the future

- QcalT 1 & 2 installation since May 9th
- IT piping starting since May 10th; the cabling will start on May 17th
- Insertion of the BP with the detectors in KLOE in the middle of June





*May 2013:  
QcalT installation  
and IR completion*

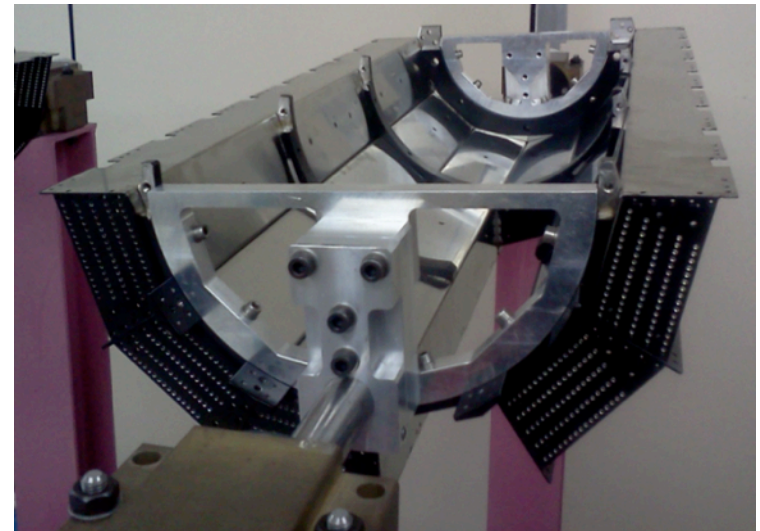




# QCALT installation



Each QcalT divided into 2 halves of 6 modules for installation



LET house and shileding

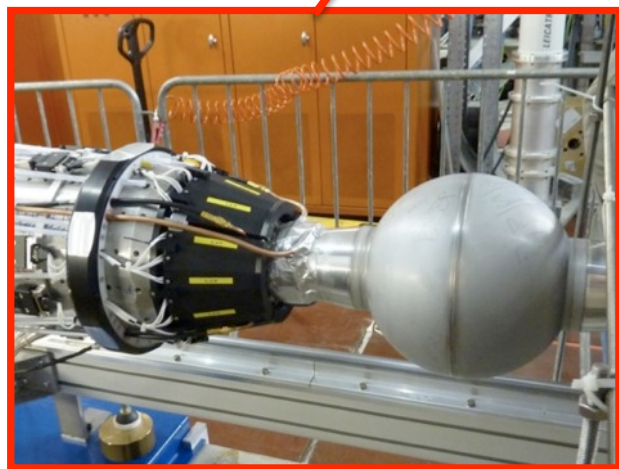
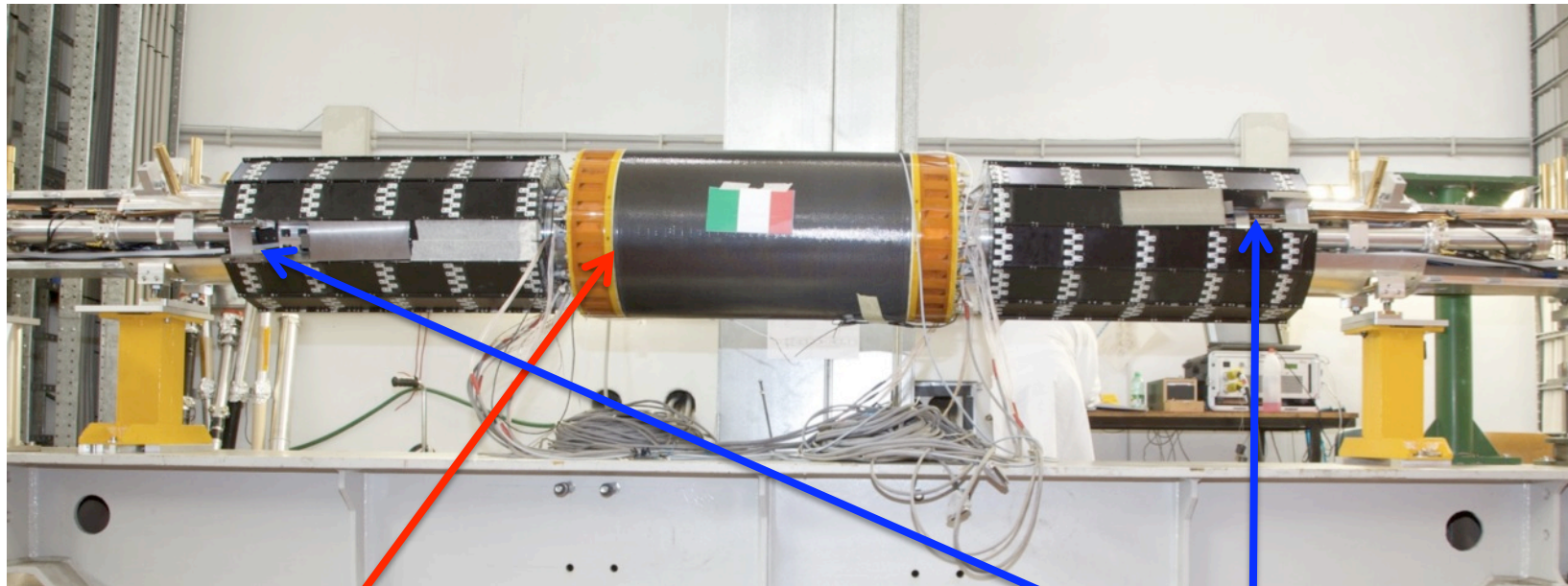


Both QCALT installed on May 2013

# *New Detector installation*



Final integration completed on May 2013





# QCALT cabling



QCALT:  
44 flat cables on each side,  
10 m long

Special support prepared to  
insert cables into DCH





# IT cabling



Per side:

- 90 signals
- 69 HV
- 36 gas pipes
- 8 cooling pipes
- 6 temperature probes

Copper foil used as Faraday cage







*June 2013:  
QCALT and IT test  
after integration*

# QCALT test

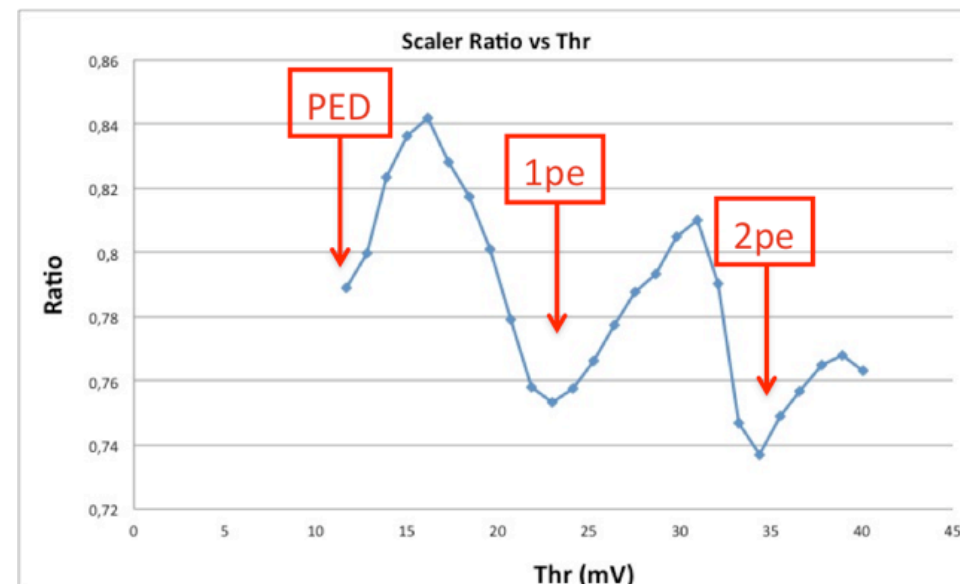
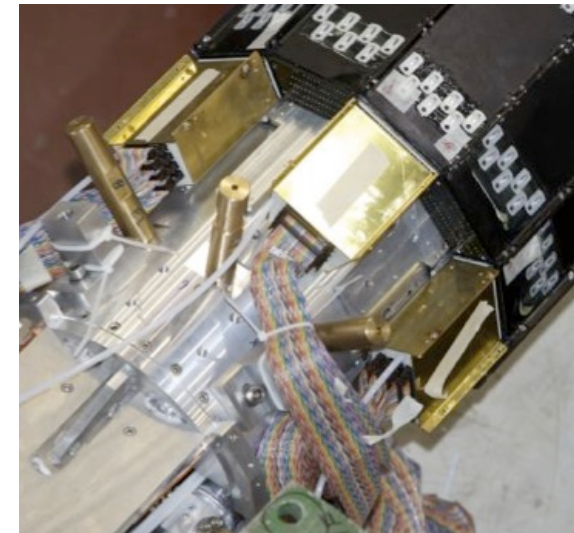


**After integration over the BPS and after completing the cabling some important tests were done both on QCALT and IT:**

QCALT:

- Electrical test on FEE boards
- Threshold test
- Test HV working point for database preparation

Threshold scan using Scaler. Each minimum corresponds to a discrete jump in p.e. counting.



# IT Test



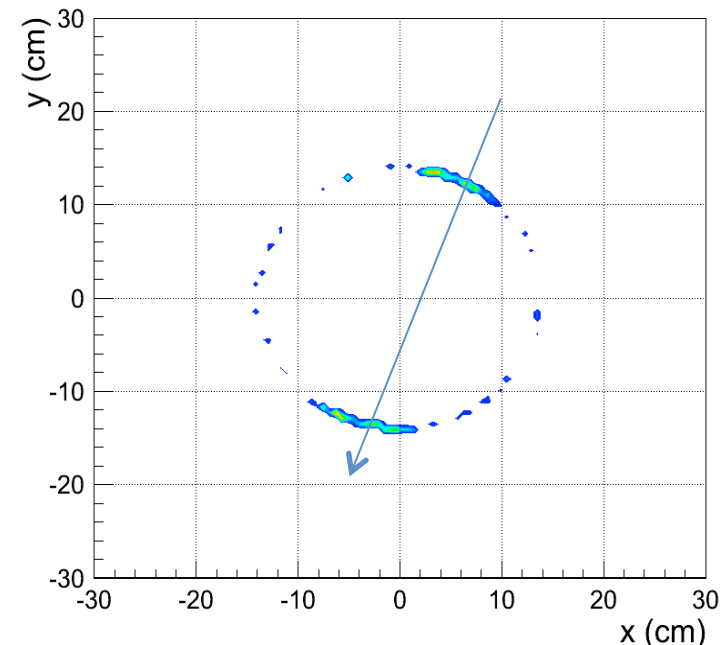
**After integration over the BPS and after completing the cabling some important tests were done both on QCALT and IT:**



Inner Tracker:

- Electrical test
- Gas distributor preparation
- Cooling test
- Cosmic test using scintillator trigger on each layer in different position

Cosmic ray event on a single IT layer triggered by Scintillator

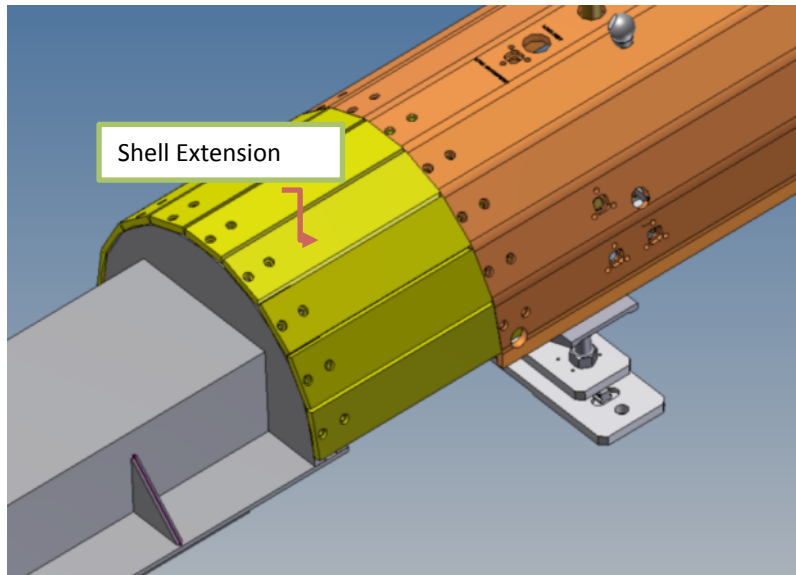




The image shows the interior of a large, circular particle accelerator tunnel. The central feature is a long, straight section of the tunnel, lined with a complex grid of metal mesh. This section is flanked by two vertical green support structures. The tunnel is surrounded by various mechanical components, including blue and yellow panels, pipes, and electrical conduits. A yellow crane or support structure is visible on the right side. The overall scene is a detailed view of the infrastructure used for high-energy physics experiments.

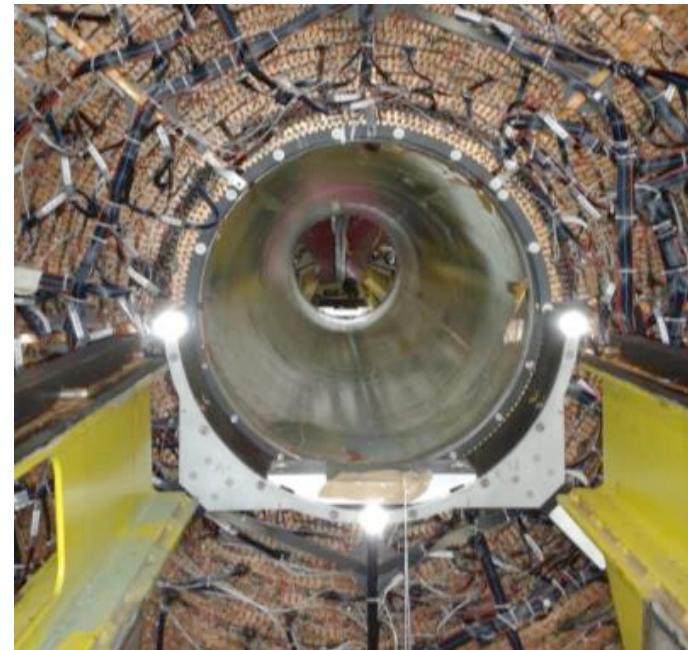
*July 2013:  
IR insertion*

# Insertion tooling preparation



A 50 cm shell extension has been built to allow the routing of the cables

- DCH internal diameter 500 mm.
- Shell milling to increase clearance from IT
- **Maximum distance between tooling and DCH 10 mm**

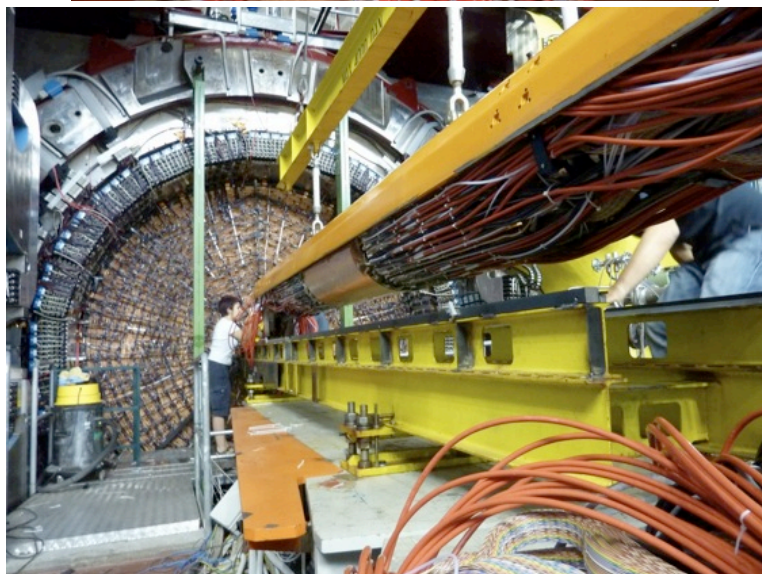
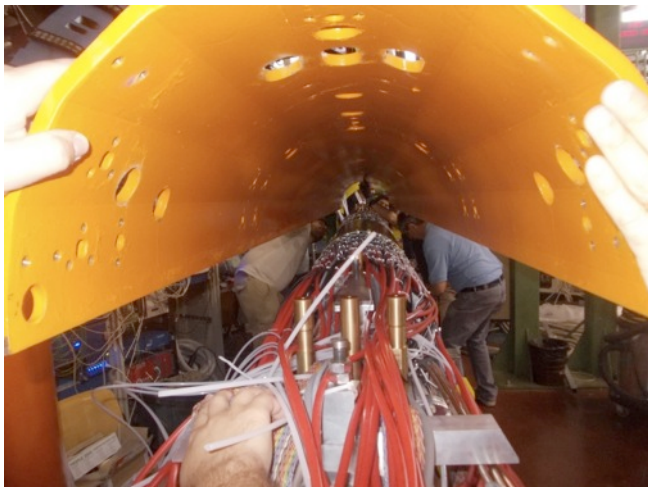






# IR insertion

Steel shell used to grab the IR

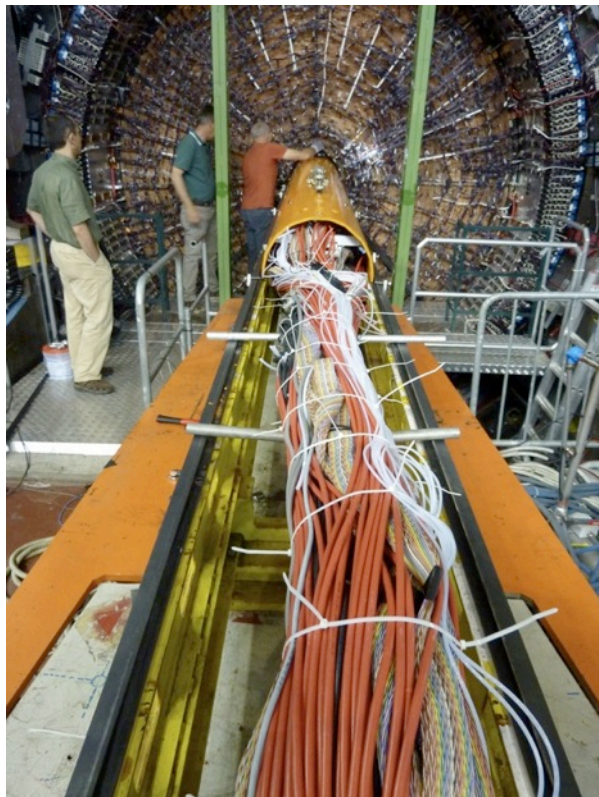
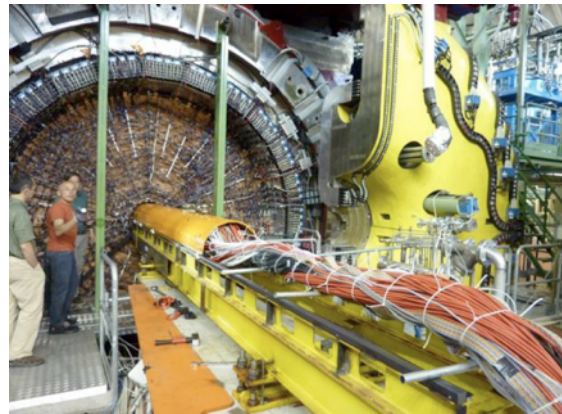






# IR insertion

Rails to support and insert IR inside KLOE



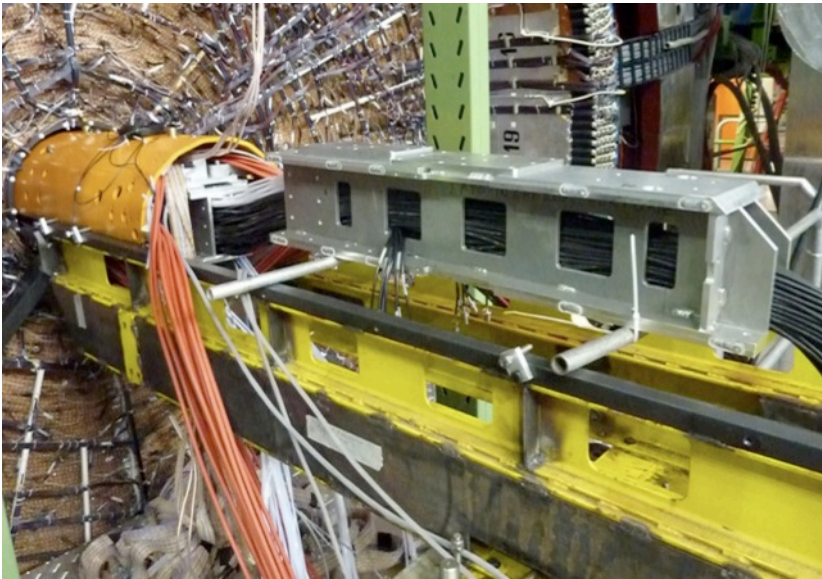
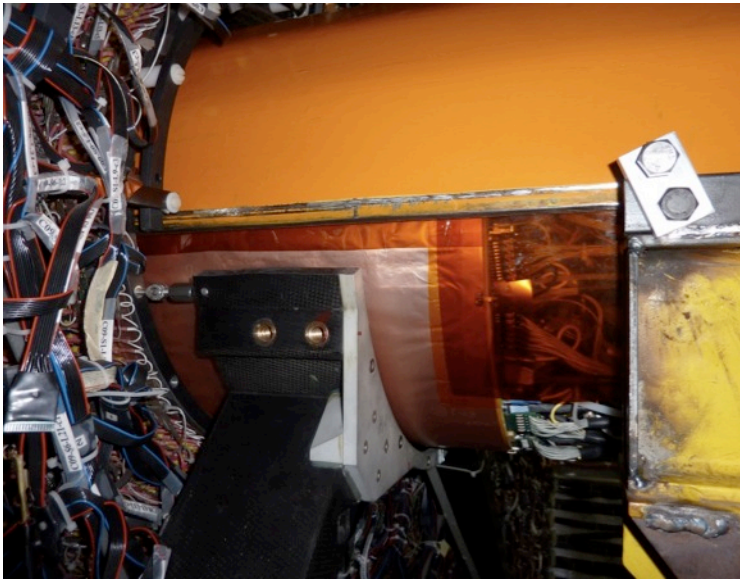
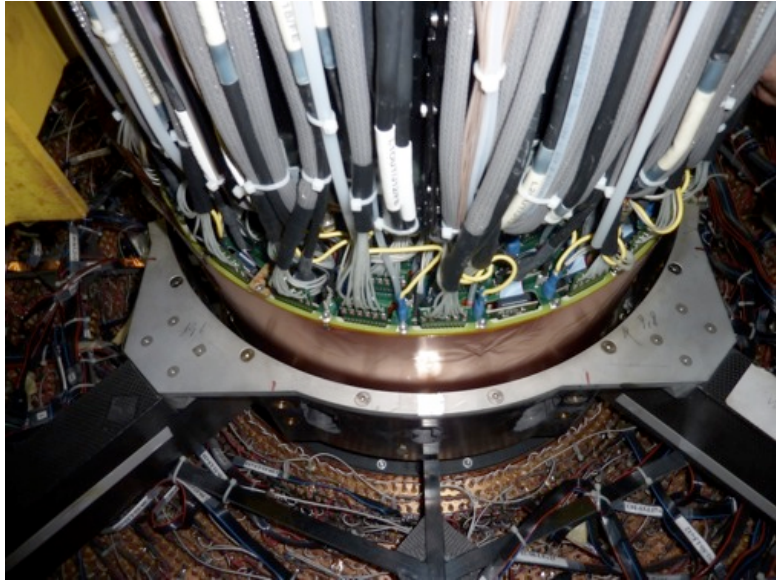
Special box prepared to route cables inside DCH. Total cables weight 100 Kg/side.



IR insertion with all cables connected.



# IR insertion

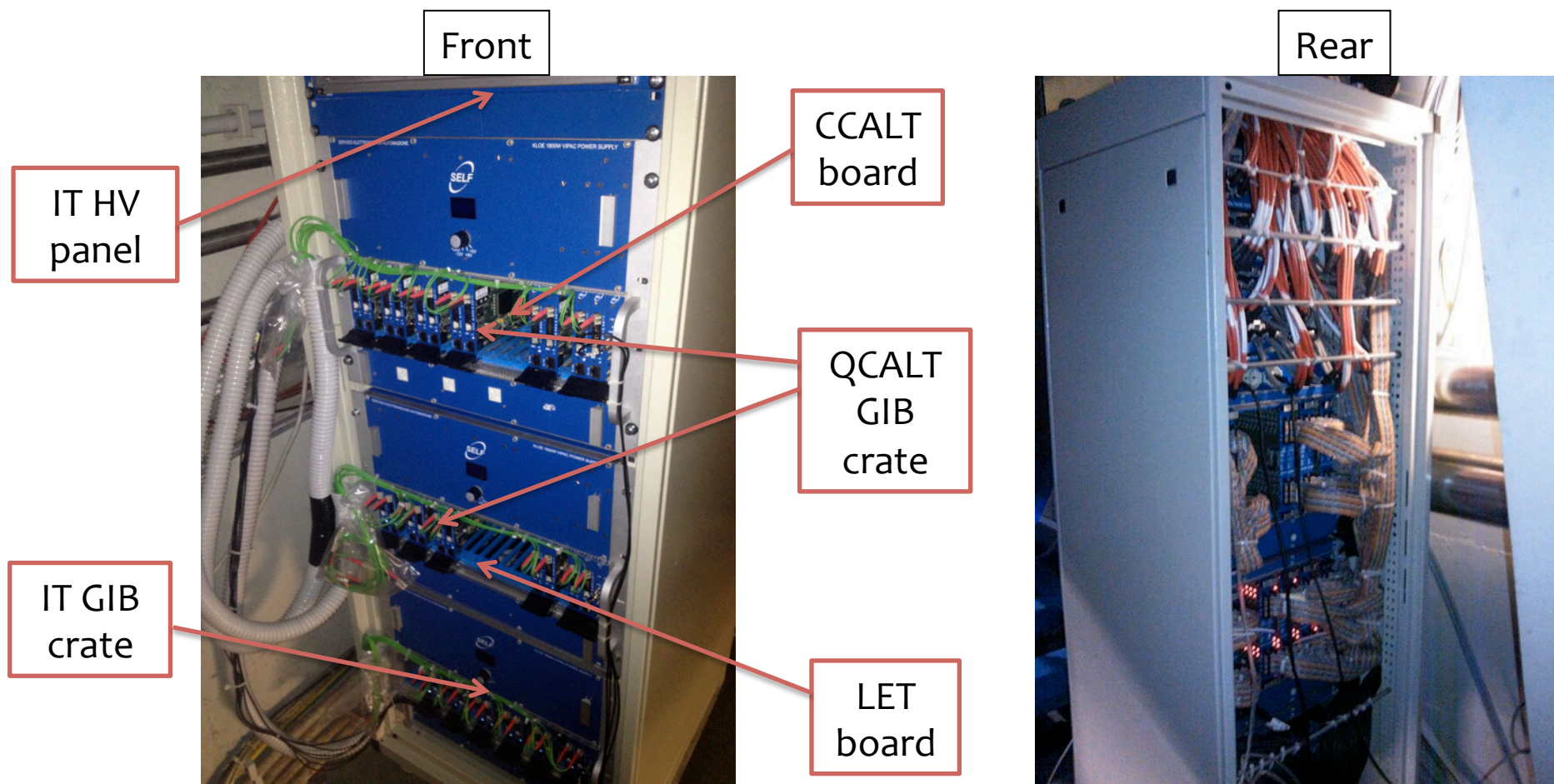






# Detector readout cabling

**Final cabling of new detectors:  
1 FEE rack per side with HV system, transition board and GIB to  
manage signals and provide optical links**



# IR insertion: problems



**IR insertion was a successful operation completed thanks to the collaboration between KLOE-2 and AD. Nevertheless, due to mechanical stress, some problems were detected.**

## **QCALT:**

7 modules with problems (4 completely out with 80 channels/each):  
cables damaged, PCB not connected, 1 regulator boards broken.

Problems solved on July 2013: all modules refurbished

## **Inner Tracker:**

20 signal cables broken (2000 channels).

Problems solved on October 2013 during machine stop: only 2  
cables not recoverable (problem @ IT side, not reachable)



The image shows the interior of a particle accelerator tunnel. A central beam pipe runs through the center, supported by a complex network of metal structures and cables. The walls of the tunnel are lined with various components, including magnets and diagnostic equipment. The lighting is bright, highlighting the metallic surfaces and the intricate engineering of the facility. A yellow structure is visible on the right side of the frame.

*August 2013:  
Dipole rotation*

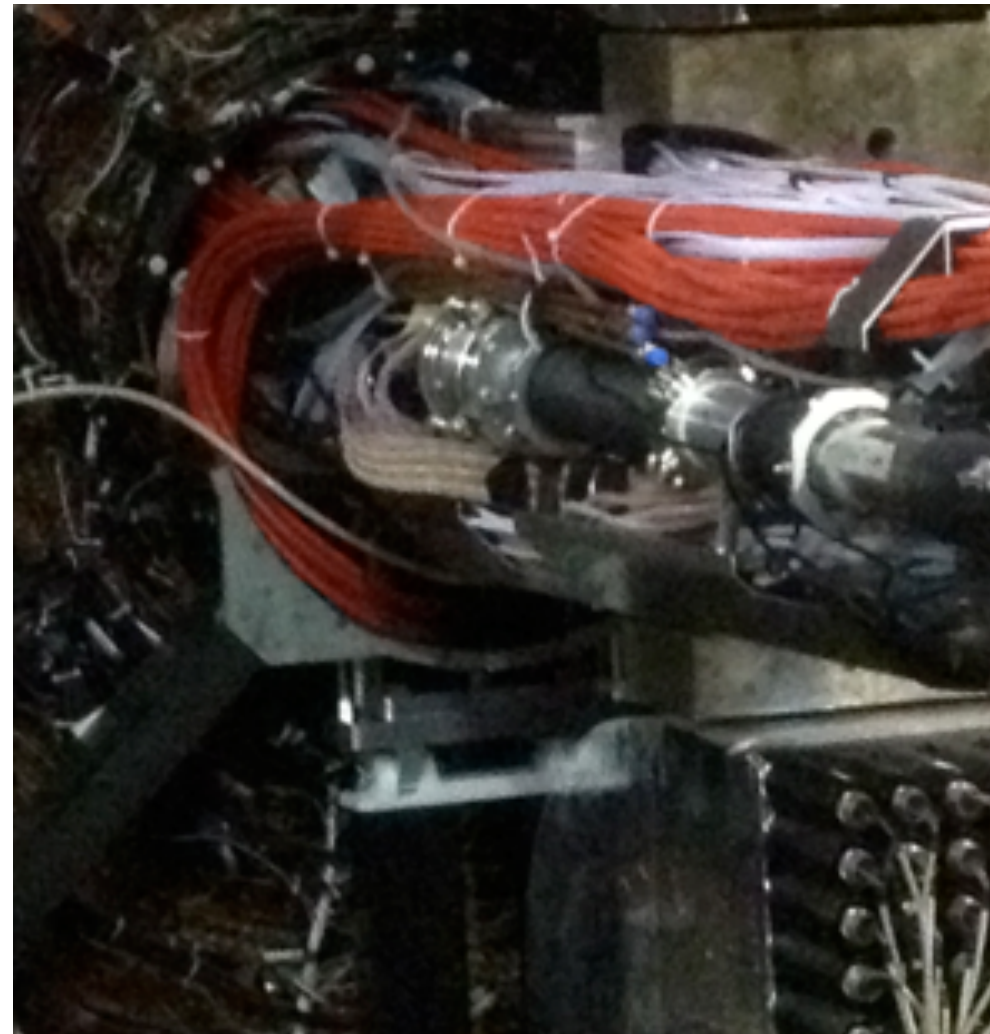


# Dipole rotation



## Endcap opened again at $e^+$ entrance to fix Dipoles

- 2 dipoles/line misaligned by 30 degrees
- Z-Position: 25 cm far from QCALT FEE
- Magnets unreachable with cables and beam position support (BPS) installed
- **Real operation risk: a new IR extraction!!!**

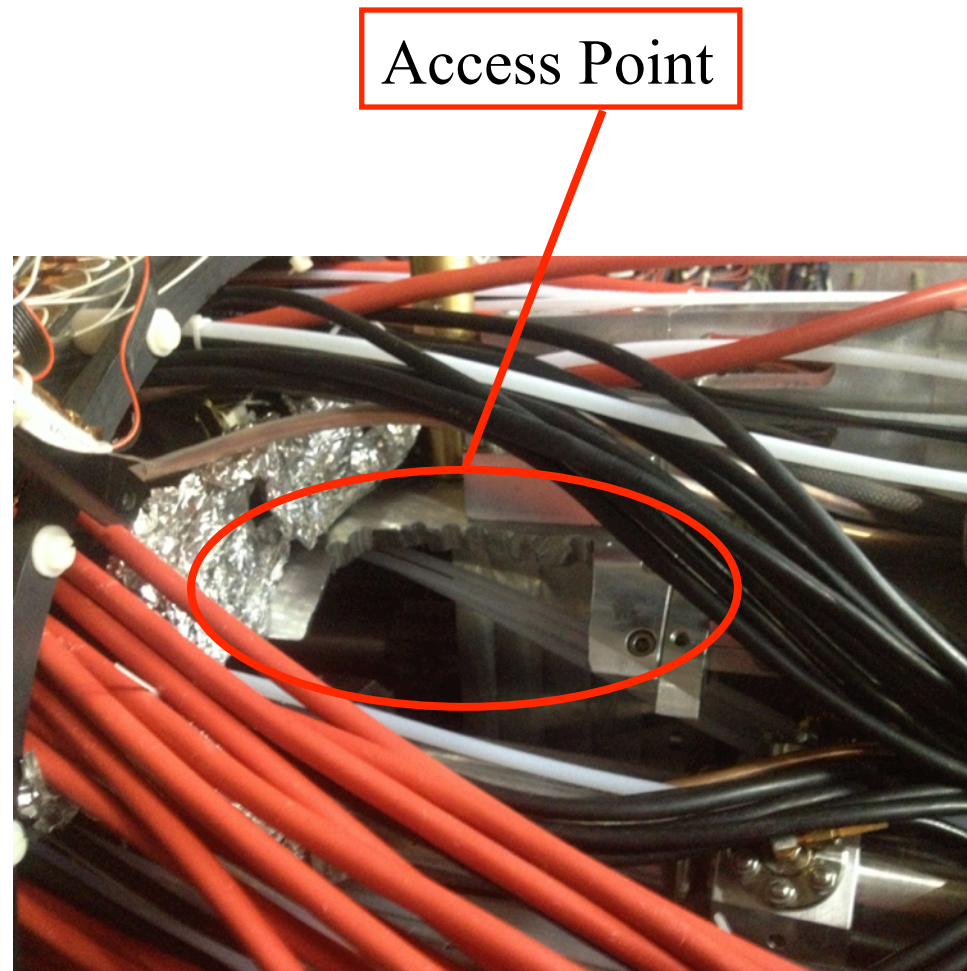


# Beam line operations



**KLOE-2 and AD “special” team performed this operation:**

- IT cables rearranged
- Cables of 5 QCALT modules completely removed
- BPS drilling
- Window sufficient for arm insertion
- Movimentation possible using endoscope
- BPS alignment checked at each step



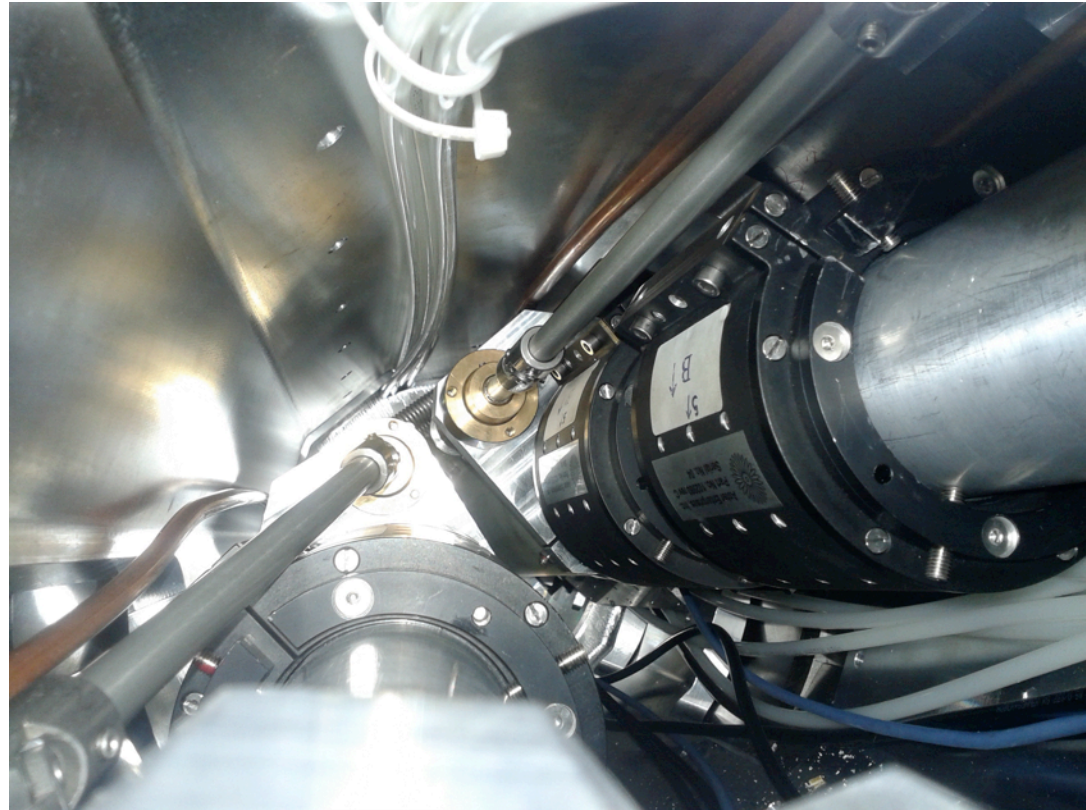




# Dipole rotation

- 6 screws/magnet, 3 per side @ 120 degrees
- Screws removed to permit rotation
- Special bubble level to check alignment
- Operation completed on 19/8
- **IR extraction avoided with minimal impact on detector!**

**BPS internal wall**



**Internal diameter 230 mm average**

**Operation completed &  
Endcap closed on Sept. 10**

**Electron beam inside  
Dafne on Sept. 12**

The image shows the interior of a large, cylindrical particle detector, likely the ATLAS detector at CERN. The central region is filled with a complex arrangement of detector components, including a central calorimeter and surrounding tracking chambers. The structure is supported by a network of metal beams and cables. The overall environment is industrial and technical, with various colored panels (blue, yellow, red) and structural elements visible. A semi-transparent white box is overlaid on the center of the image, containing purple text.

*Now:  
Detector  
commissioning*



# New detector commissioning



September 2013: first test of QCALT and IT with new DAQ

Test important to:

- Check electrical connection and detector functionality
- Implement Event builder structure
- Check operating temperature for sub detectors

**With this run we found:**

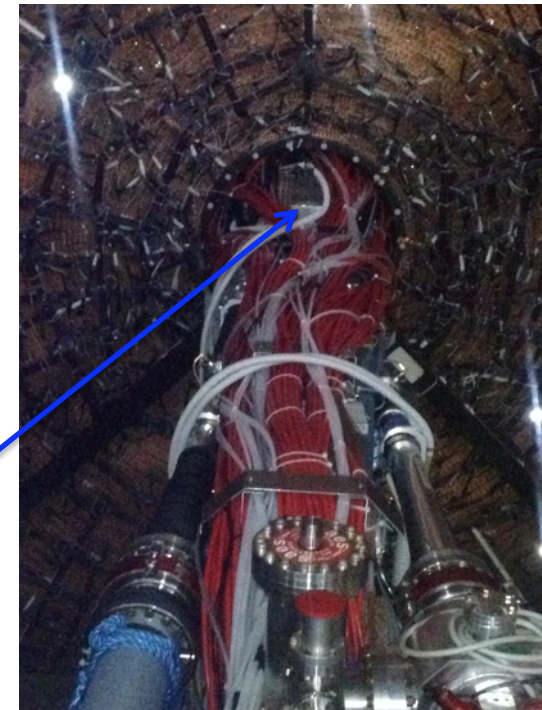
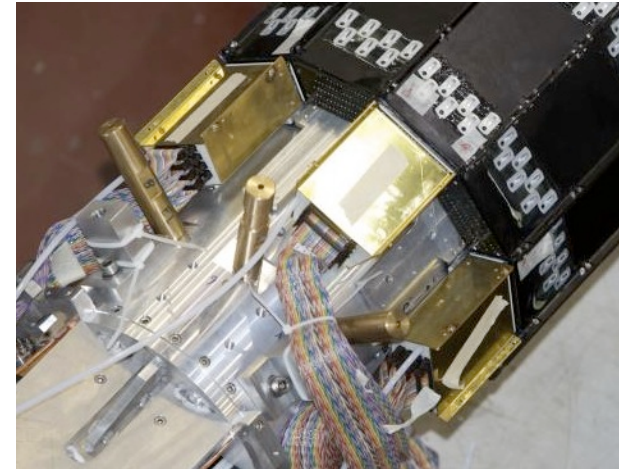
- **few cable problems for the IT**
- **a too high temperature (50 °C) for QCALT FEE.**



# Qcalt Temperature

Cooling of QCALT FEE box by air blowers

Air flux not sufficient → **FEE reached a temperature of 50 C. SiPM dark noise too high and Gain too low for operation.**  
Optimal working temperature below 30 C



In August additional air pipes from blowers installed in one side. Temperature lowered to 37 degrees.



# Qcalt Temperature



Installation of dedicated compressed air line for QCALT cooling.

Connection directly with existing air distributor (no EndCap opening required)

Oil free compressor purchased. Installation expected in December.

Compressor will be positioned in KLOE assembly hall (close to DAφNE building).



System chosen after a dedicated laboratory test →  
It should guarantee 25 °C for both FEE boards and SiPM.

# *Cosmic run*

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**During October we performed various CR run with IT, HET and LET.**

QCALT and CCALT were not acquired due to:

## QCALT

- Temperature problem
- HV and THR final setting still to be defined
- Final slow control in progress

## CCALT

- Cables from crate to TDC to be installed.
- Final transition board in production



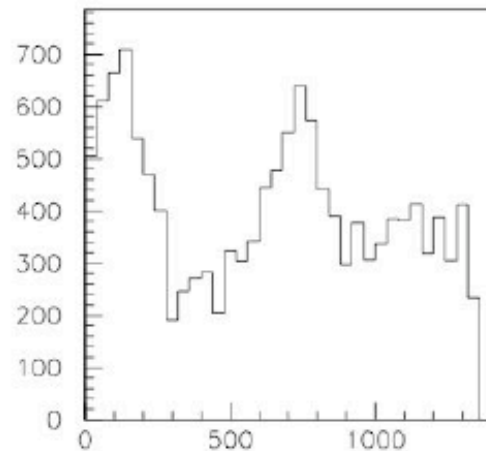
# IT CR results



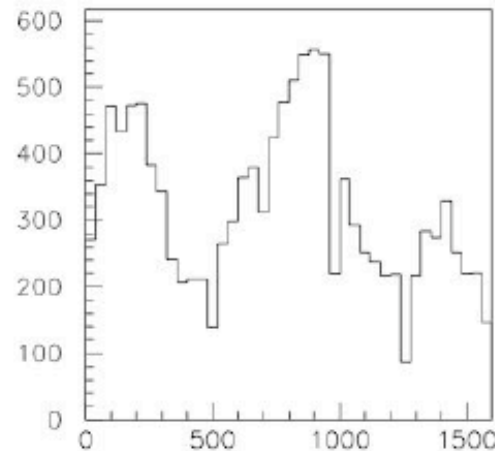
**Run 67753** HV On (Oct 17th) Cross-checked with Updated List of Cables with Problems



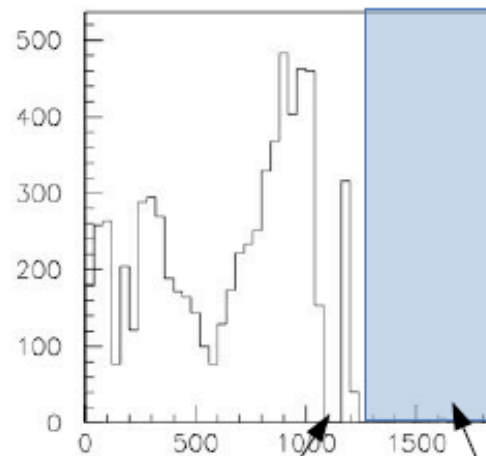
# IT CR results



X Occupancy Layer 1

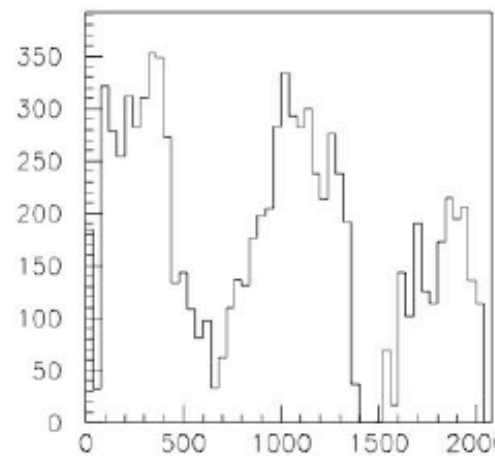


X Occupancy Layer 2



X Occupancy Layer 3

FEE problems



X Occupancy Layer 4

HV problems: 1/12 of the Inner Tracker is off

**Run 67808 (12/11/2013)**

IT on (gain  $\sim 10^4$ , lower than in the tests)

Cosmic filter on:

- 2 clusters with  $E_{clu} > 150$

**MeV** on EMC Barrel

- distance between clusters  $> 4m$

- Rdist =

$$\sqrt{(X_{mean} - X_{ip})^2 + (Y_{mean} - Y_{ip})^2} < 30 \text{ cm}$$

- $|z| < 35. \text{ cm}$

Selections:

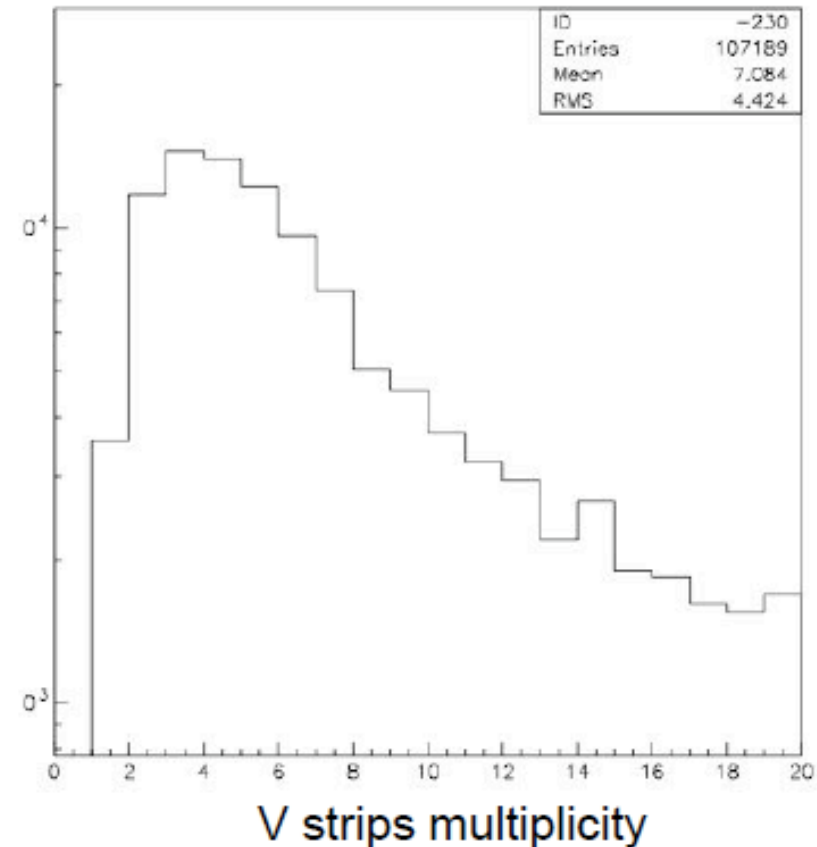
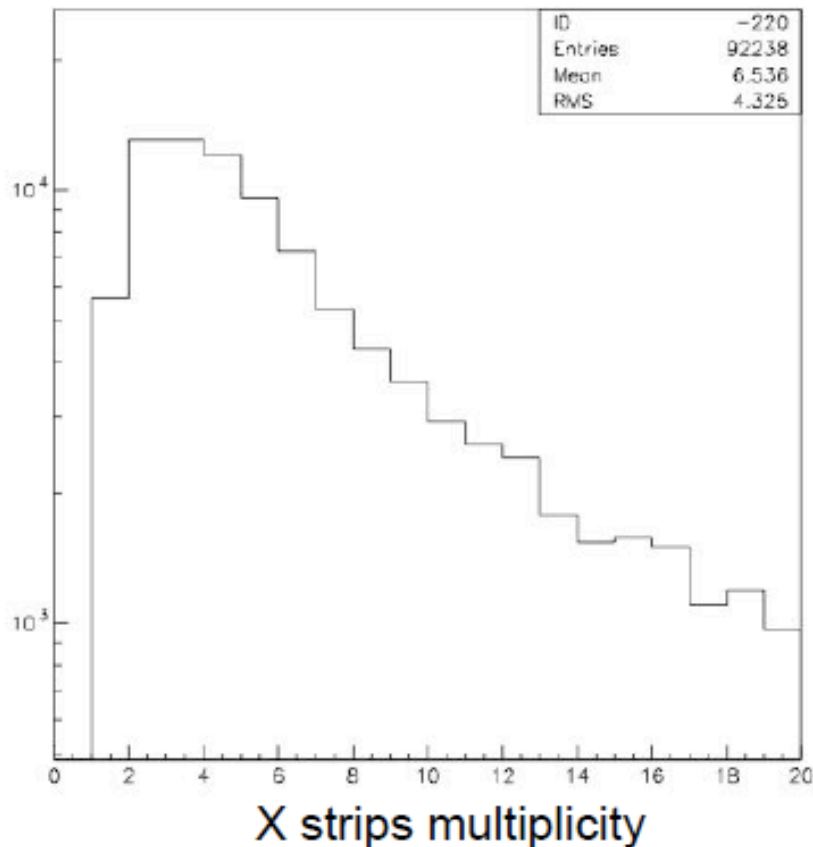
- Hits coincidence of **at least 3 layers**

$\sim 19000$  strips fired

3.7 M triggers



# IT CR results



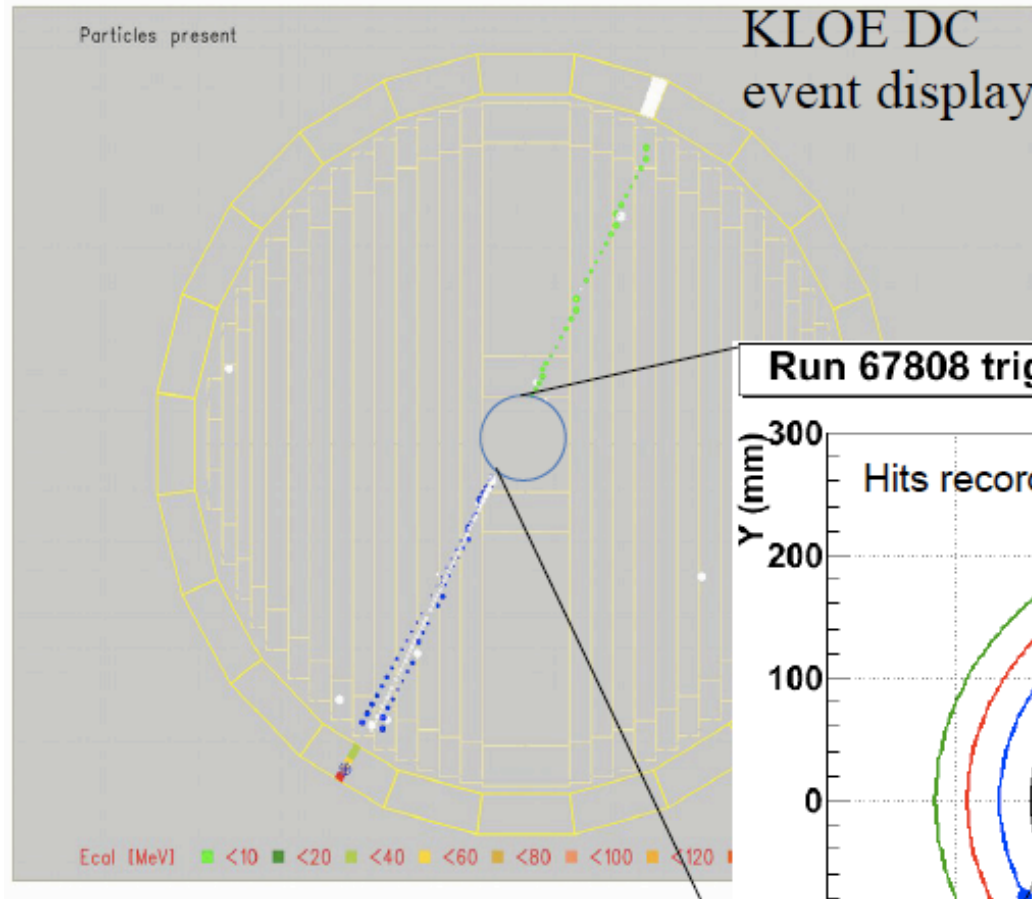
Run 67808

# of strips hit for event on all the layers

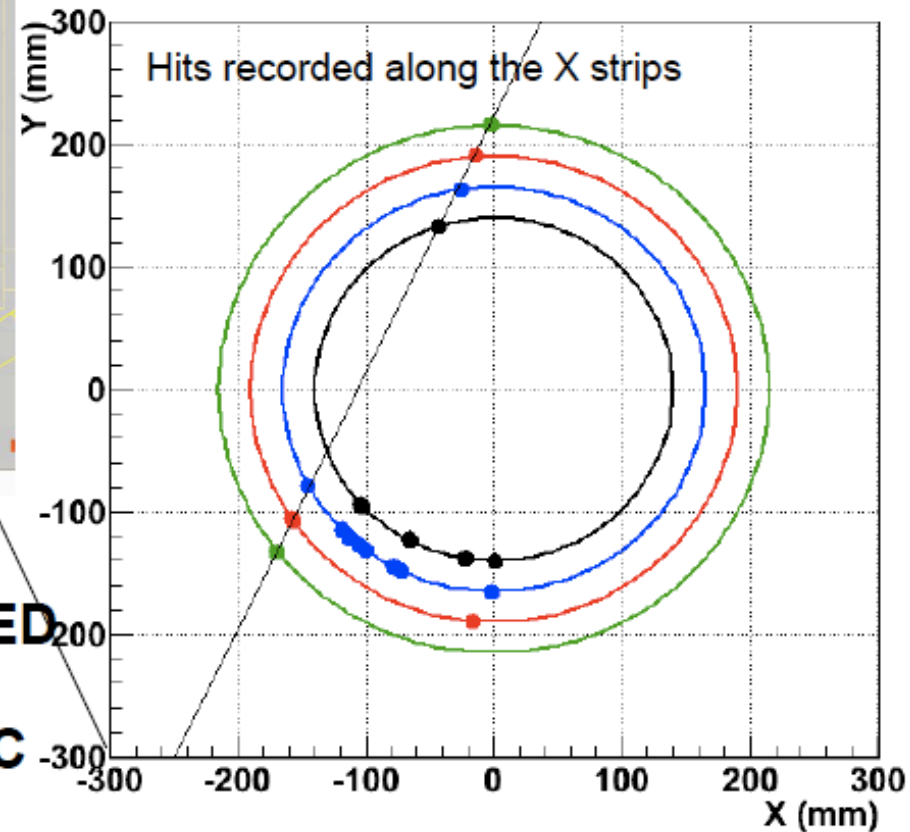
Selections: at least 3 layers with hits on both views

Expected multiplicity from tests: about 4 for both views

# IT CR results



Run 67808 trig\_num=144974



**JUST HITS.**  
**THE LINE IS NOT OBTAINED**  
**BY ANY FIT, BUT**  
**EXTRAPOLATED FROM DC**

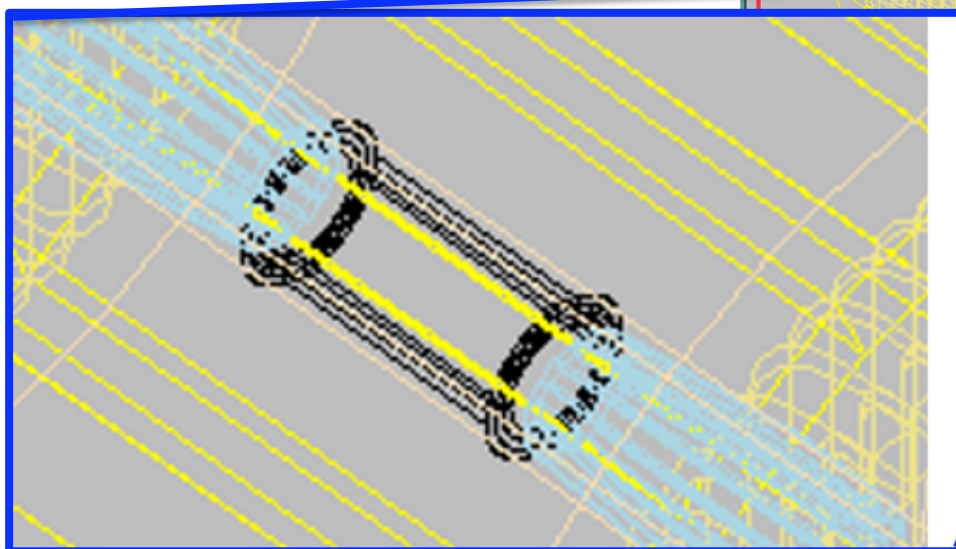
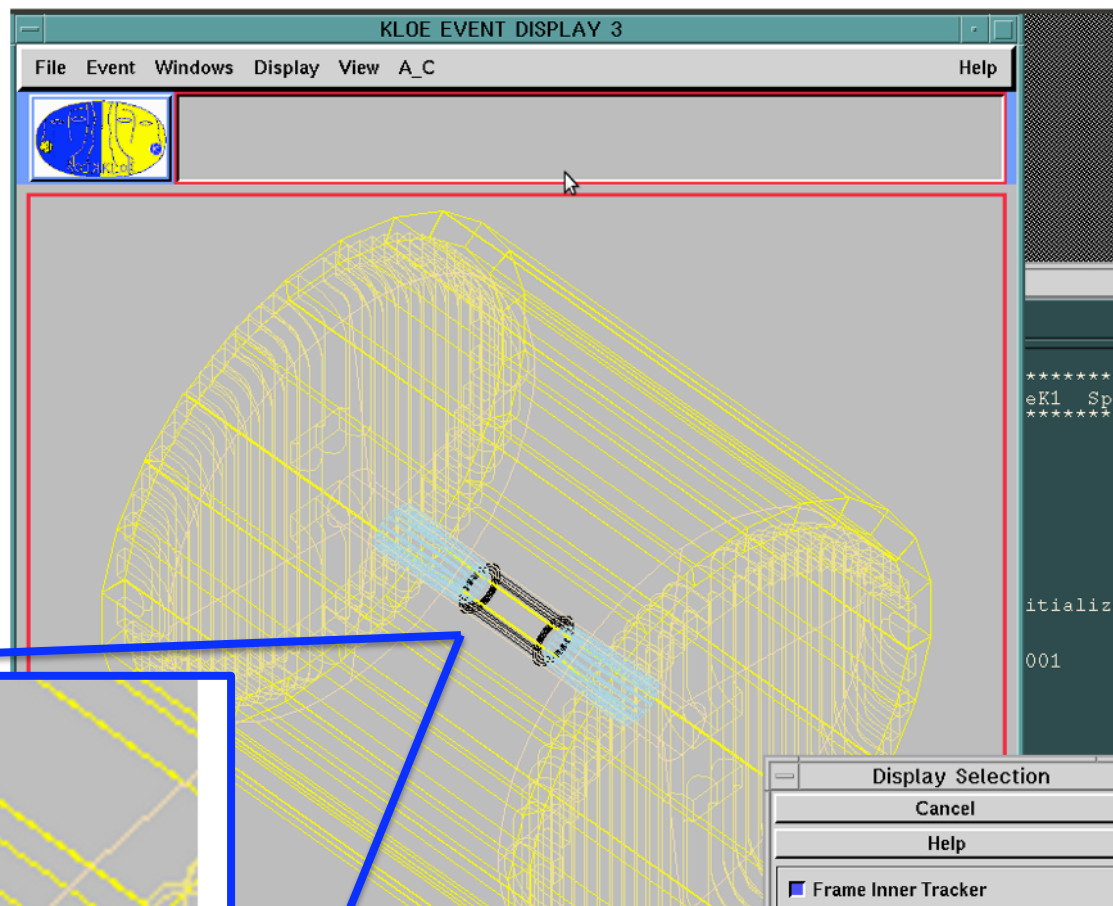


# DIDONE update with IT



Integration of IT in KLOE display has been done.

We are now working to include also QCALT and then CCALT.



# DIDONE update with IT



Inner Tracker Event Display ver 0.1

Options

Display

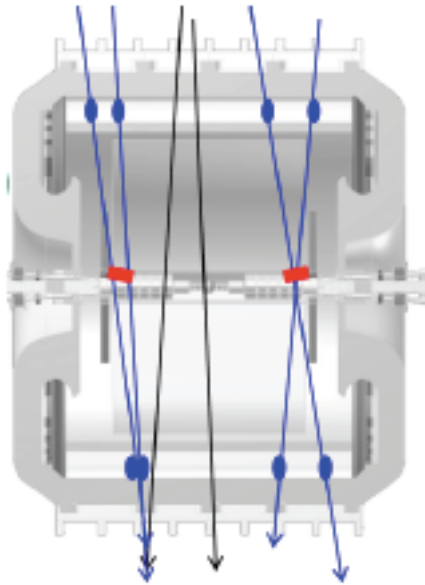
Next >    Reset >

Step     Event no

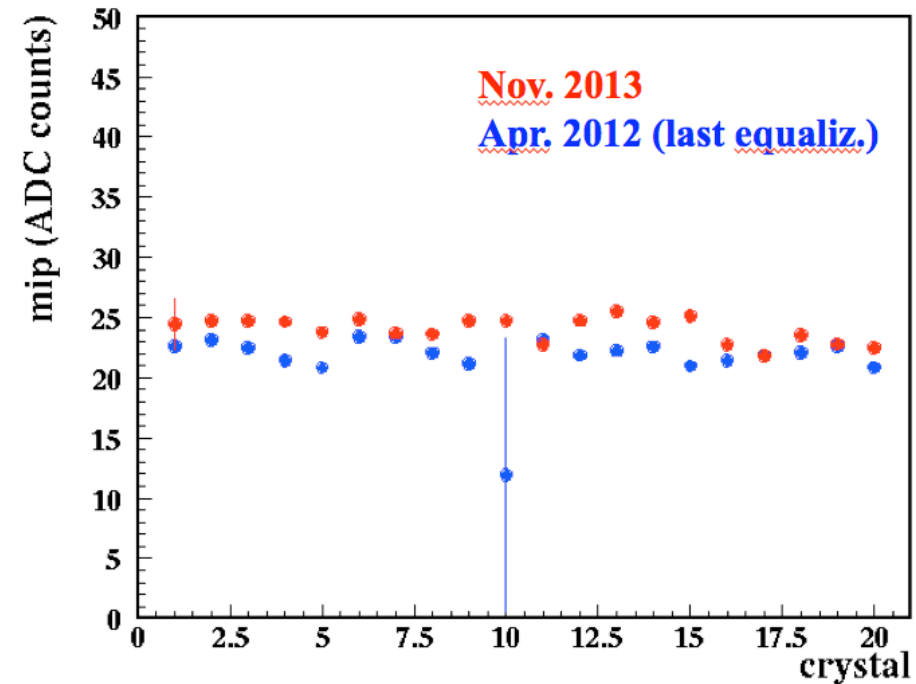
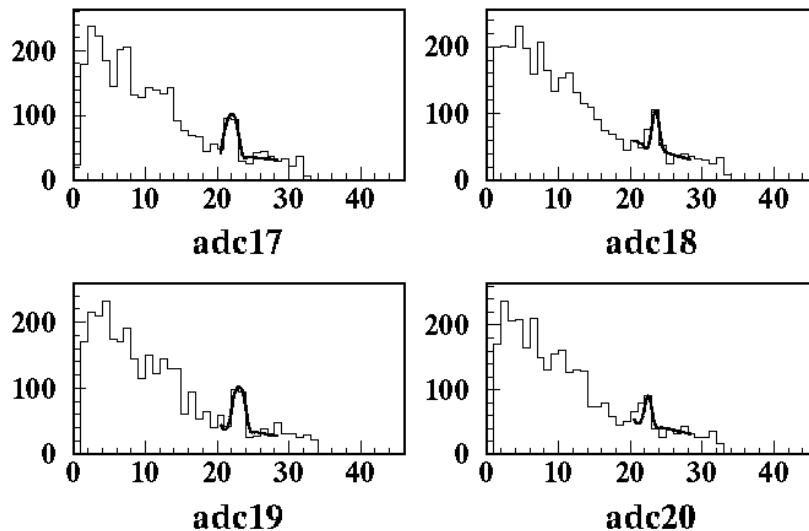
The software interface displays four wireframe views of a detector structure. The top-left view is a top-down perspective of a circular structure with multiple concentric rings of segments, highlighted with a red border. The top-right view is a perspective view of a conical structure. The bottom-left view is a perspective view of a cylindrical structure. The bottom-right view is another perspective view of a cylindrical structure. The interface includes a 'Next >' button, a 'Reset >' button, a 'Step' dropdown menu set to '1', an 'Event no' dropdown menu set to '0', and a text box showing '0 events'.



# LET CR results



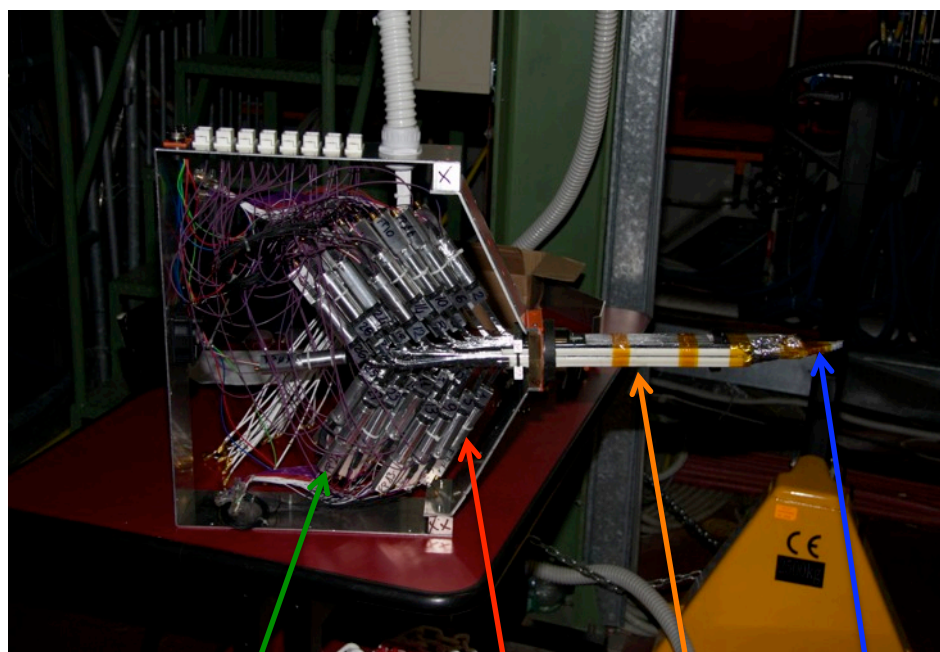
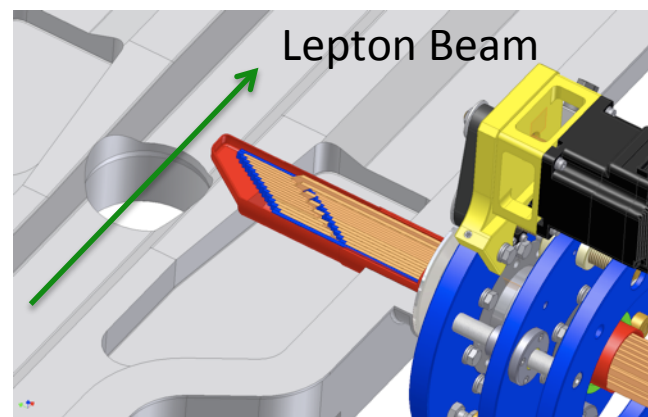
- LET A on, LET B off (problems in setting  $V_{bias}$  → new GIB in construction )
- Only 3000 good events in Oct. 23 run (selected with EMC)
- MIP peak expected around 22 ADC counts, according to old equalization done in 2012





# HET status

- Modification/Improvement of the mechanics of the movement system
- New Detector BOX in order to locate Front End board very close to the PMT for noise reduction



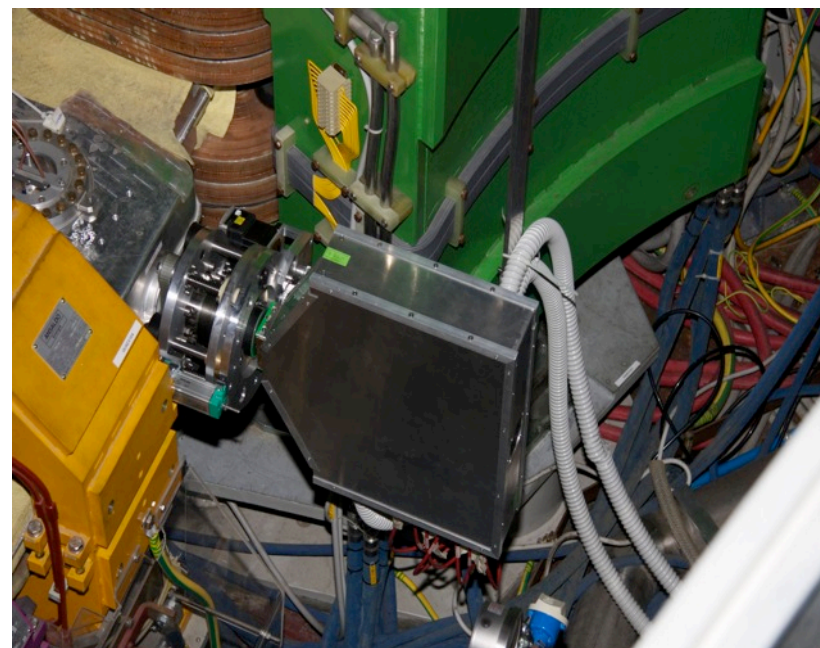
Front End Board

PMT

Light Guide

Plastics

HET installed





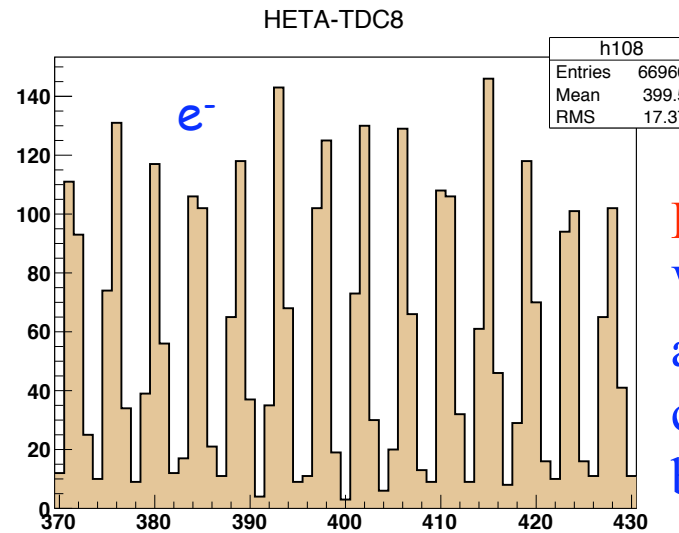
# HET status



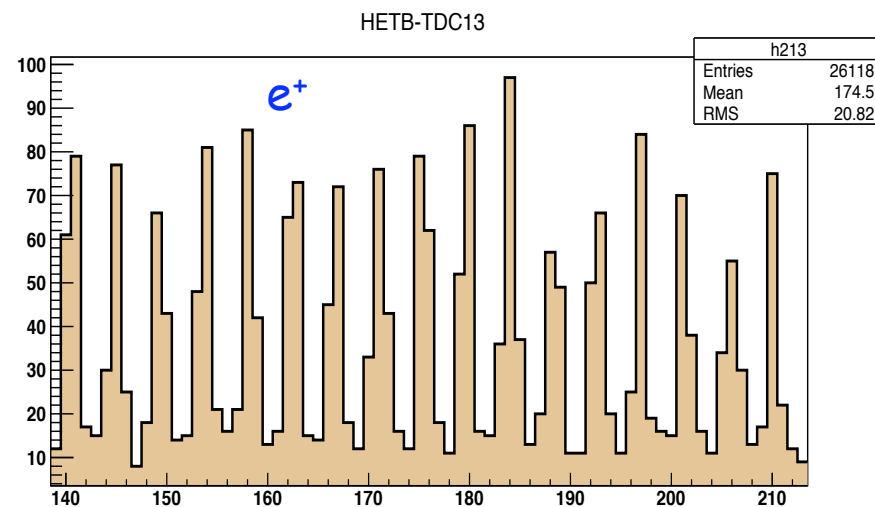
## Test of both HET with beam:



Noise without Beam :  
A threshold of about 20 mV  
reduce the noise at level of  
few Hz



Data with beam :  
We clearly identify  
and distinguish  
contiguous (2.7 ns)  
bunches



# Monte Carlo new IR



- Preliminary simulation of new IR already prepared
- Simulation of QCALT and IT in progress
- Stand alone simulation for gamma tagger completed
- All detectors will be included in official simulation on December
- Now in progress test of detector response

**Target: December 2013, first simulation of KLOE-2 experiment with new IR geometry and new sub detectors included**



# Main detector



Full maintenance of main detector performed in the summer.

- **All of the 110 water cooling radiators for FEE, HV and LV on apparatus replaced --:)**
- EmC fully operational. **Few HV problems to be fixed.**
- DC fully operational (< 2% dead channels overall).
- All DAQ boards working. **Still some erratic problem to be fixed.**
- Spare situation under control with the main exception of DC TDCs: new boards being designed.

# Conclusions

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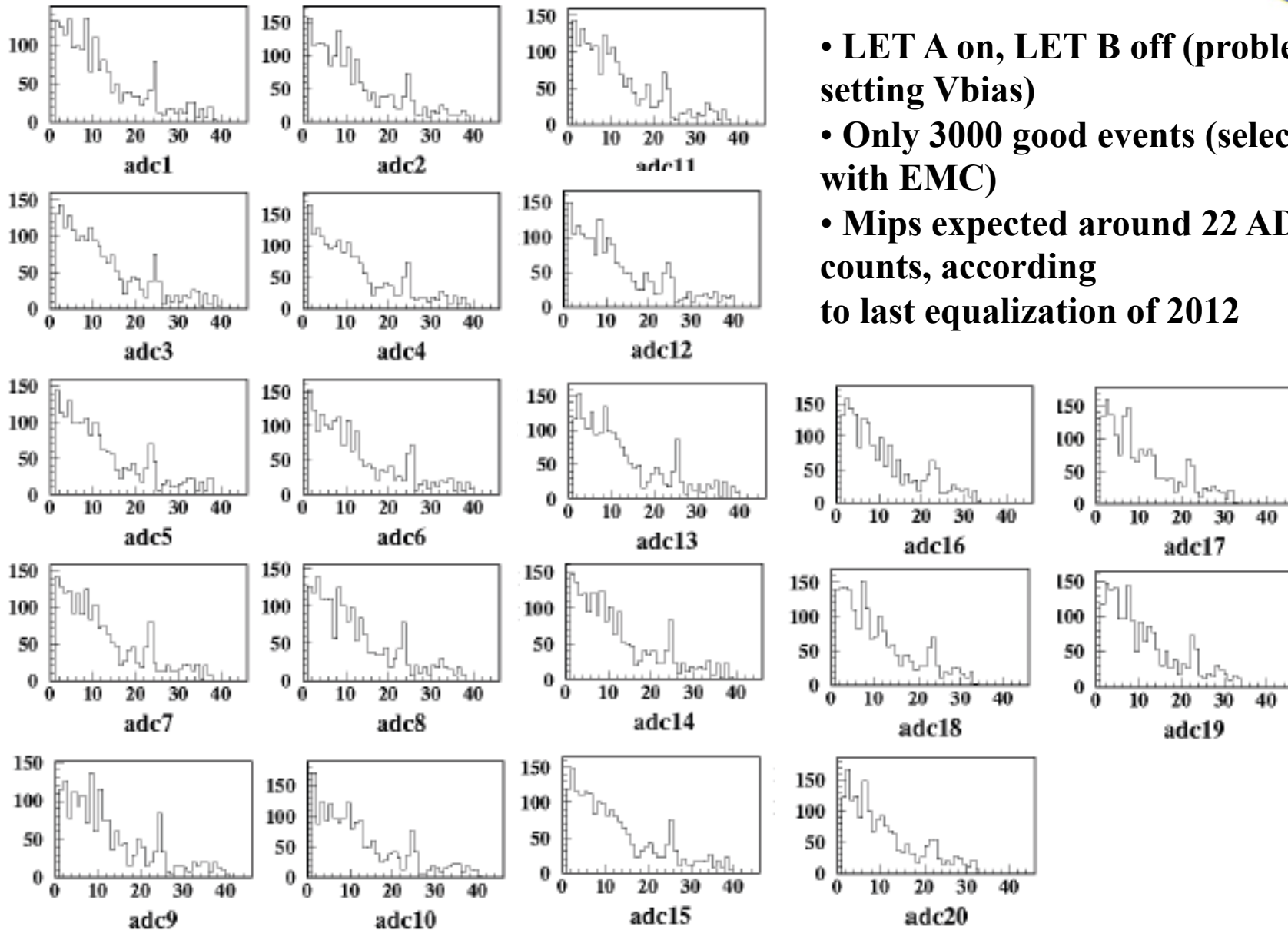
- Since last Scientific Committee, a lot of work has been done to complete the installation of the new sub detectors
- QCALT and IT were installed and fully cabled
- Preliminary test on IR has been done to check electrical functionality
- The August dipole rotation was a very successful KLOE-2/AD joint operation
- After summer some preliminary cosmic run has been done with both gamma taggers and IT
- Temperature problems in QCALT exist but will be solved before the end of the year with the installation of a new air compressor
- Completion of slow control, monitoring & display for new detectors in progress
- Preliminary version of standalone simulation for IT, QCALT and CCALT exist and will be integrated in the official Monte Carlo in December.

The image shows the interior of a large, circular particle accelerator tunnel. The central feature is a long, narrow beam pipe that recedes into the distance. The walls of the tunnel are lined with a complex network of metal structures, including support beams and various components. The lighting is somewhat dim, highlighting the metallic surfaces and the perspective of the tunnel. A semi-transparent white box with the word "Spares" in purple cursive font is overlaid on the center of the image.

*Spares*

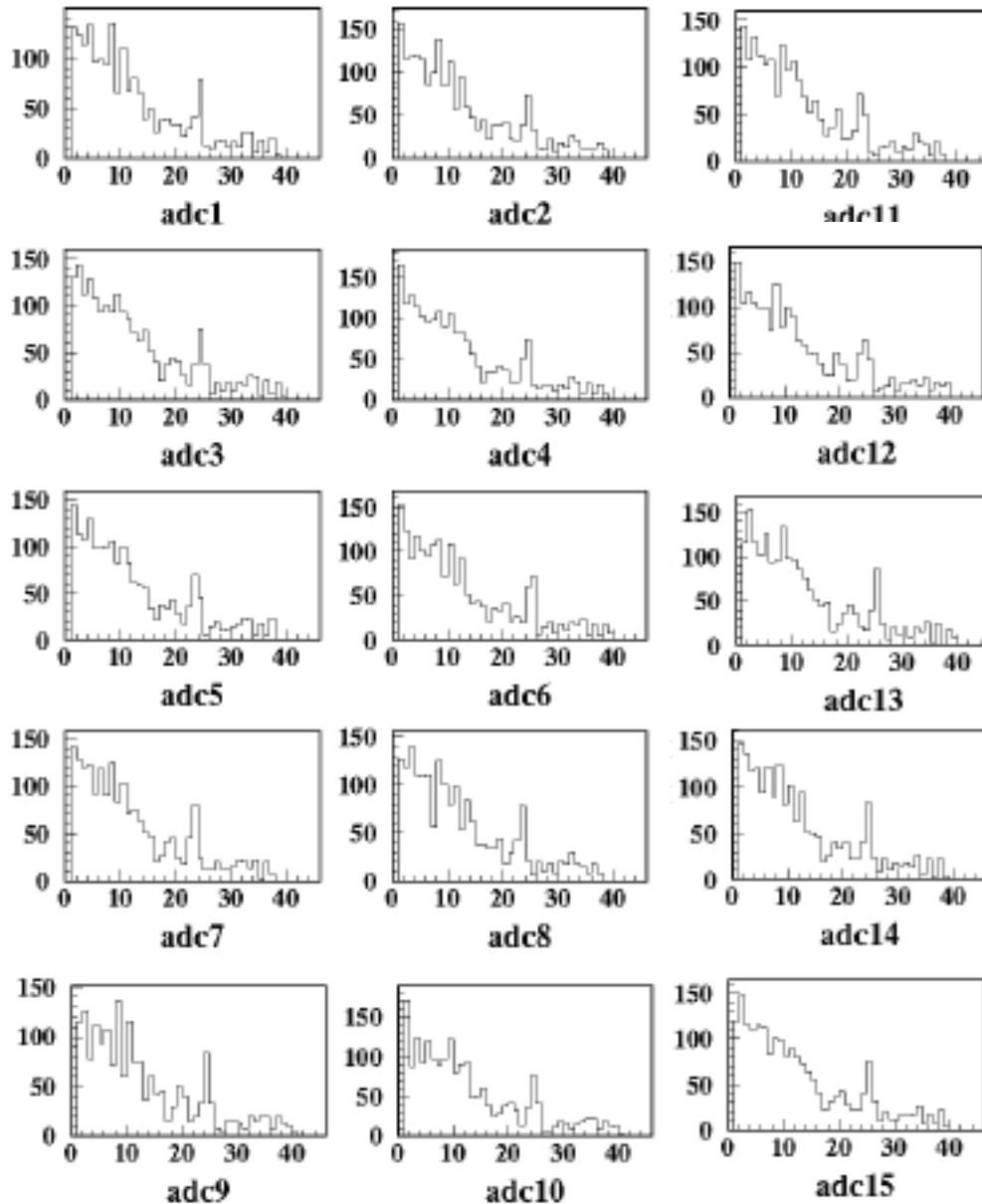


# LET cosmic rays results



- LET A on, LET B off (problems in setting Vbias)
- Only 3000 good events (selected with EMC)
- Mips expected around 22 ADC counts, according to last equalization of 2012

# LET CR results



- LET A on, LET B off (problems in setting Vbias → new GIB in construction )

- Only 3000 good events (selected with EMC)

- MIP peak expected around 22 ADC counts, according to old equalization done in 2012

