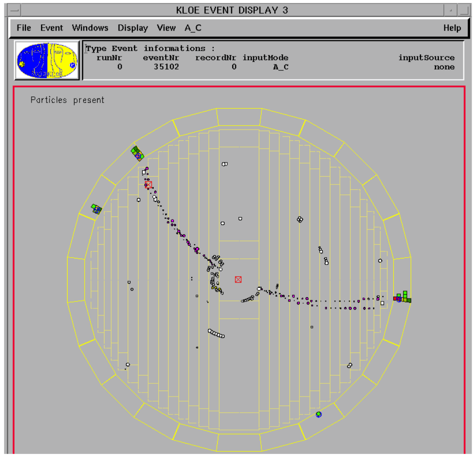
Status of the KLOE-2 Project



Fabio Bossi

LNF-SC

Frascati, June 6th, 2011

Talk Overview

Many things to say. Very limited time. Apologies for being fast and somehow superficial. I will briefly discuss:

- First collision data: the background issue
- Status of the $\gamma\gamma$ taggers
- The tape library problem
- Status of the upgrades: IT, QCALt, CCALt
- What future for KLOE-2?

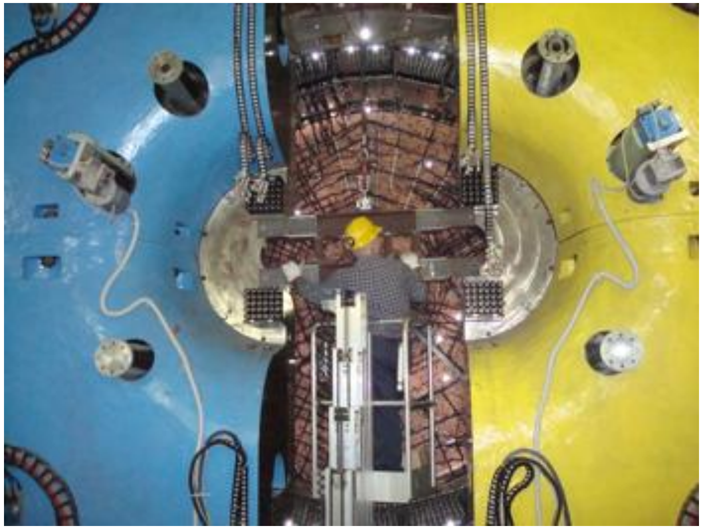
KLOE-2 Data Taking

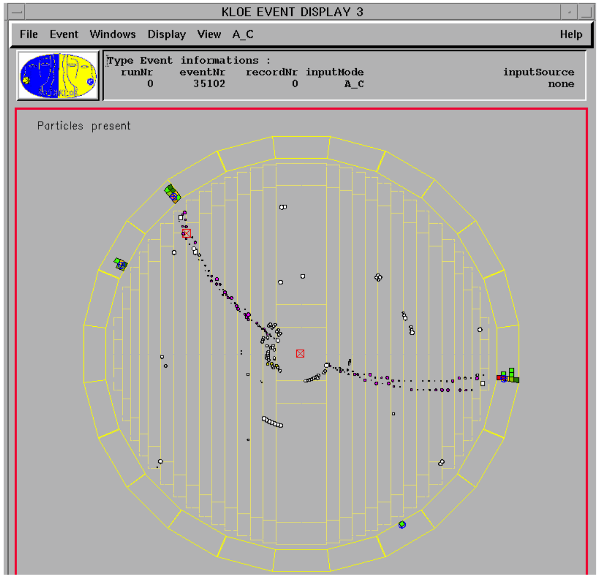
Detector ready on the beam line since May 2010

Full calibration with cosmic rays and magnet on, performed in November (after first magnet “crisis”)

First runs with beams soon after: Trigger, DAQ, Online Monitoring and Calibration tools working

Collisions observed in December at moderate luminosity: a few Bhabha events on disk



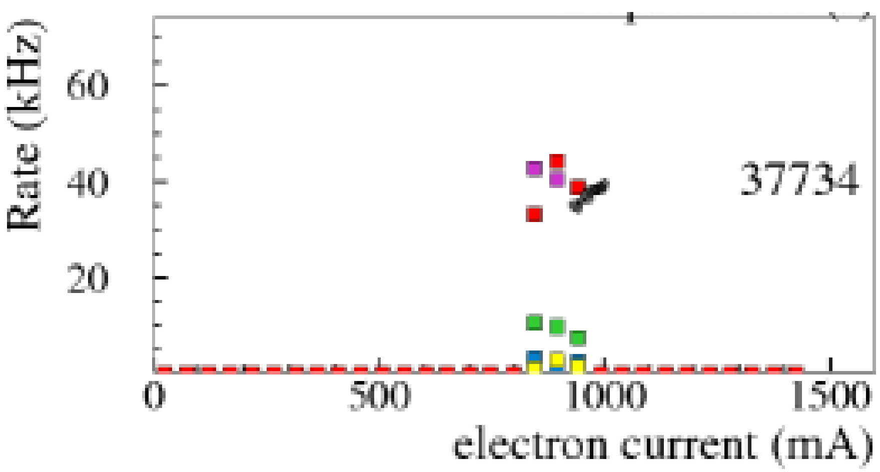


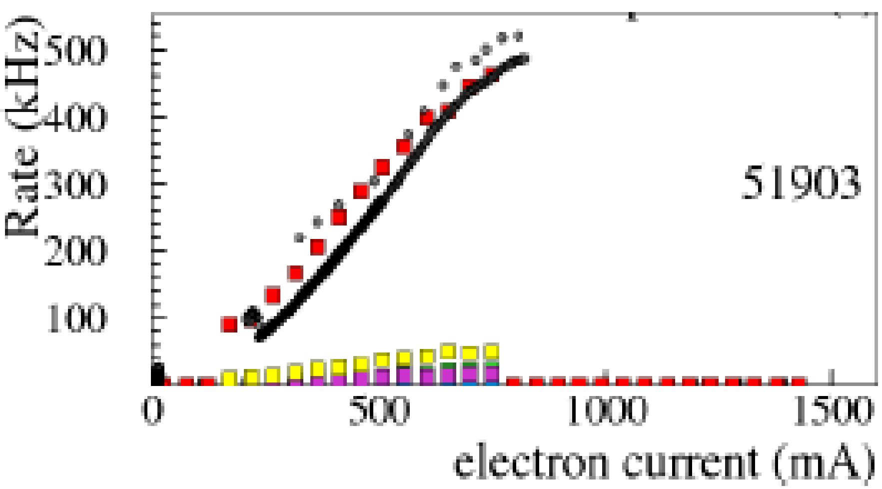
The background issue

It was immediately realised that background levels were much higher with respect to the past

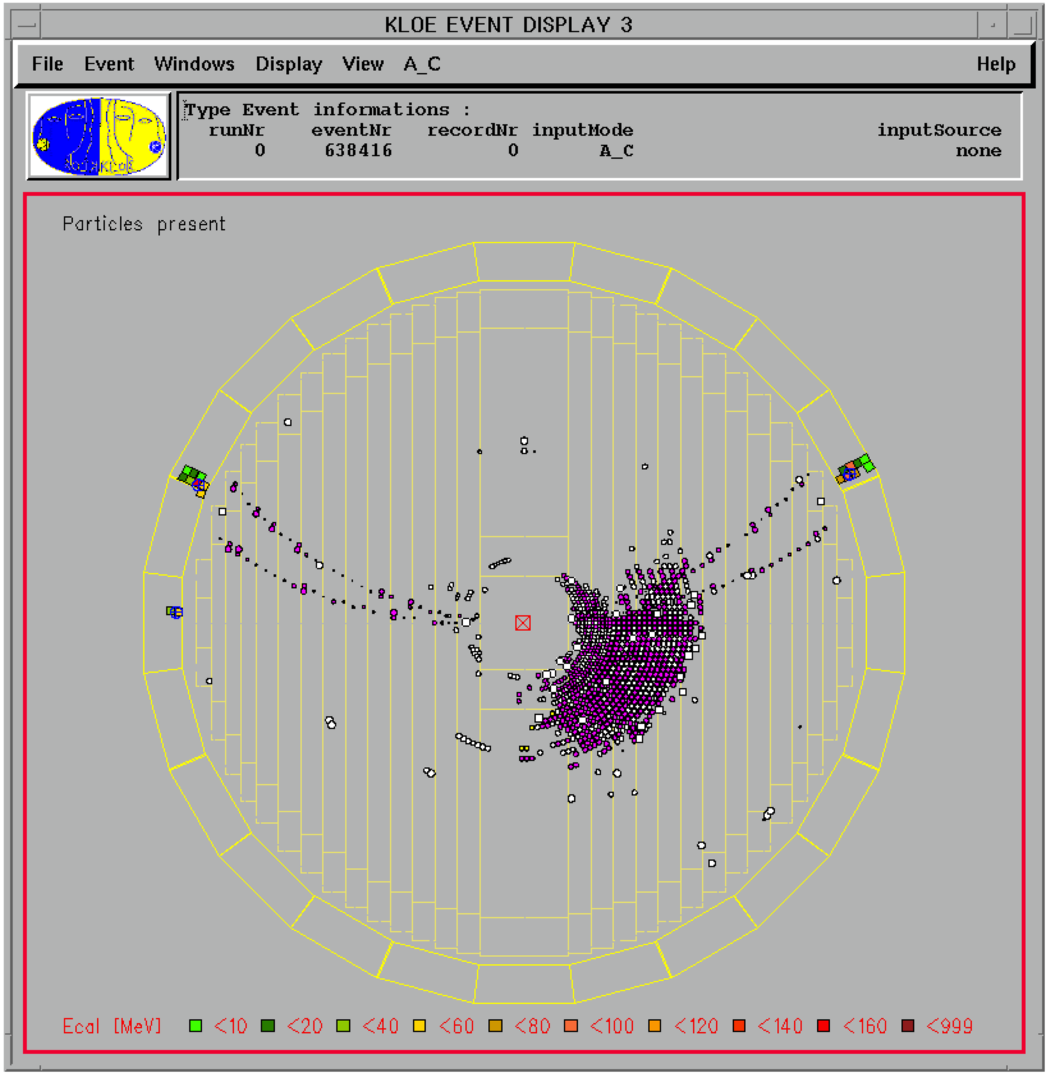
This is true also running with single beams only

Rate of signals above 75 MeV on endcaps. ***Black online counters***. ***Colour offline counters*** ***(Note the different scale for the two plots!)***

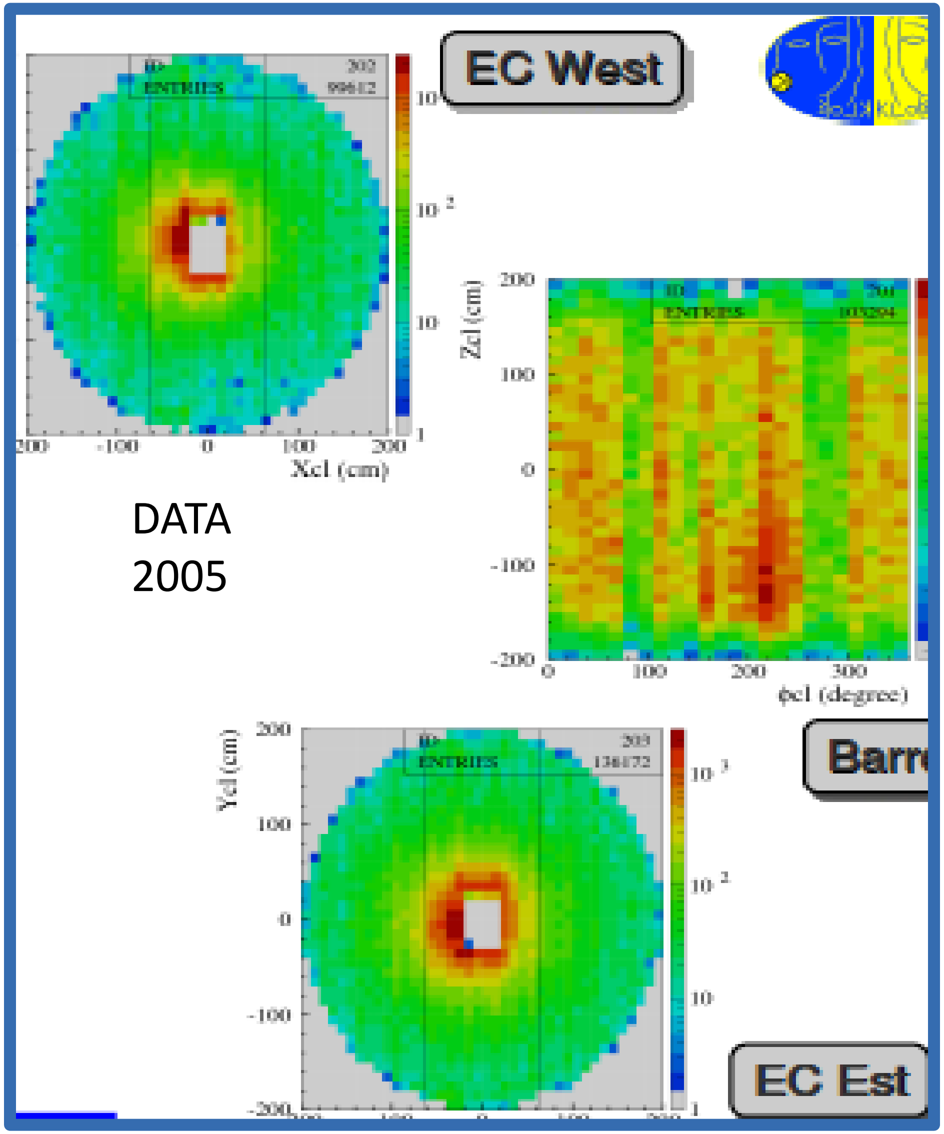


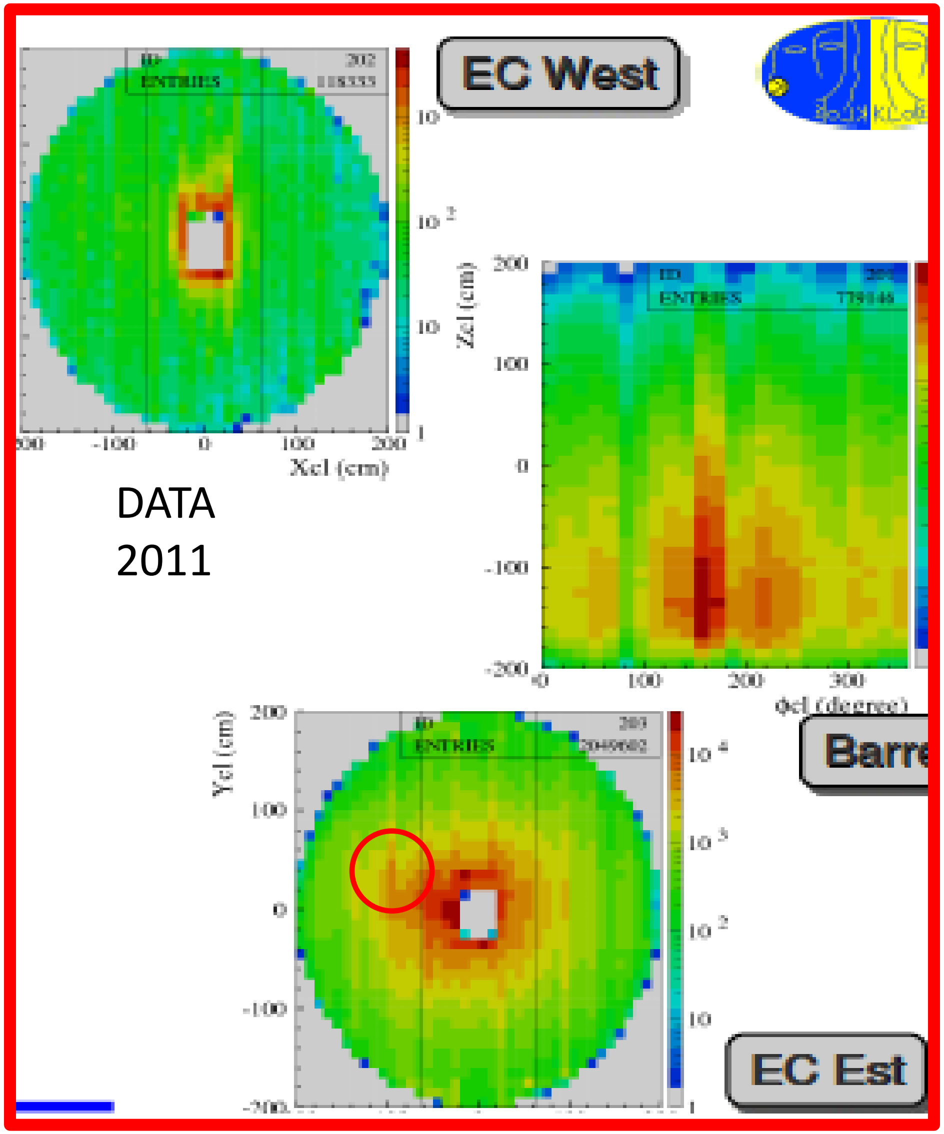


A “splashing” event



Backgrounds radiography



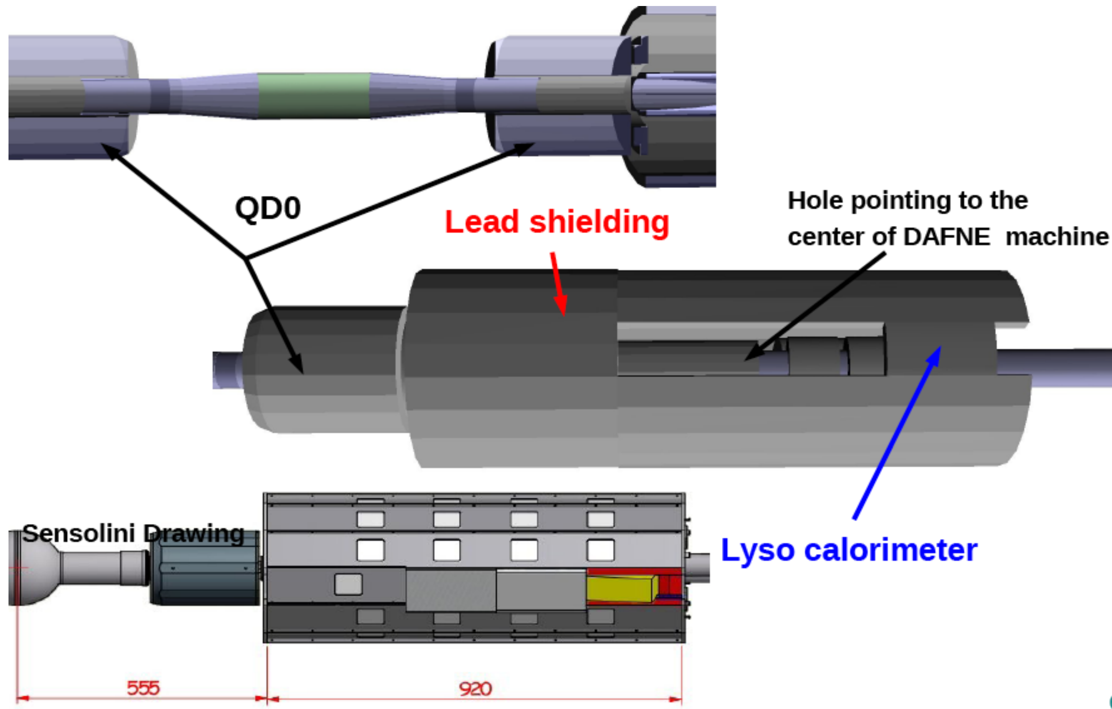


Indication of LET "hole" present in data.

Monte Carlo Studies

We have used a detailed Monte Carlo based on GEANT3, using as input Touschek particles generated by DAΦNE simulation codes (*M. Boscolo*).

There are 3 main sources of background, due to *incoming* $e^{\pm}$ or *outcoming* leptons hitting QD0 or QF1, respectively . The holes left in the fake QCAL to accommodate the LETs also contribute

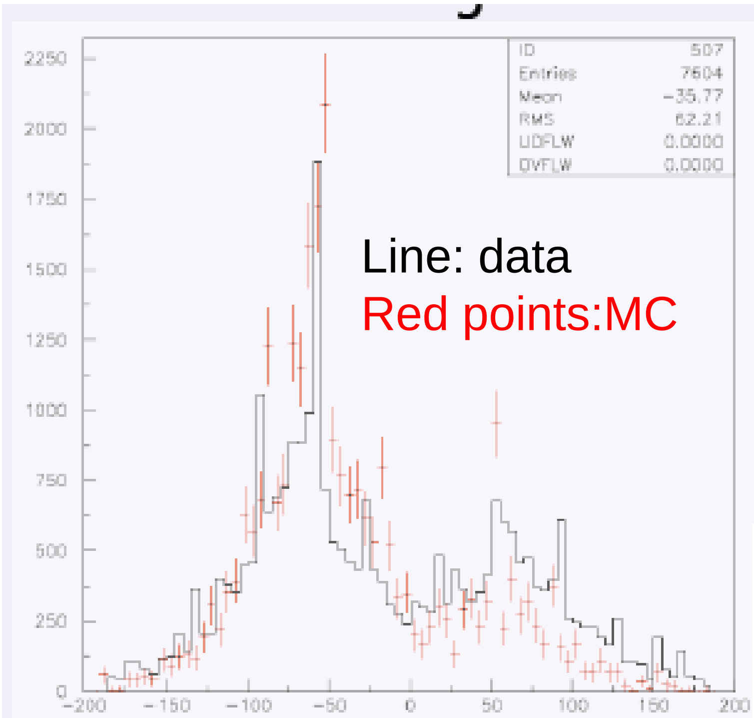


Monte Carlo Results

A fit to the data for the clusters on the EmC barrel provides

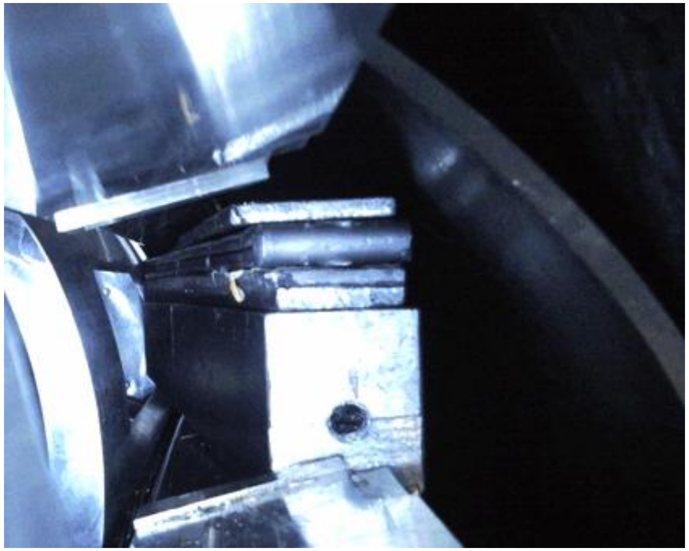
Incoming : 24 (3)%   Out-QD0 : 16 (2) % Out-QF1 : 60 (3)%

Using the above weights as input to the MC, produces a good agreement between simulation and data as long as the shapes are concerned, while MC overestimates the absolute rates by a factor ~4



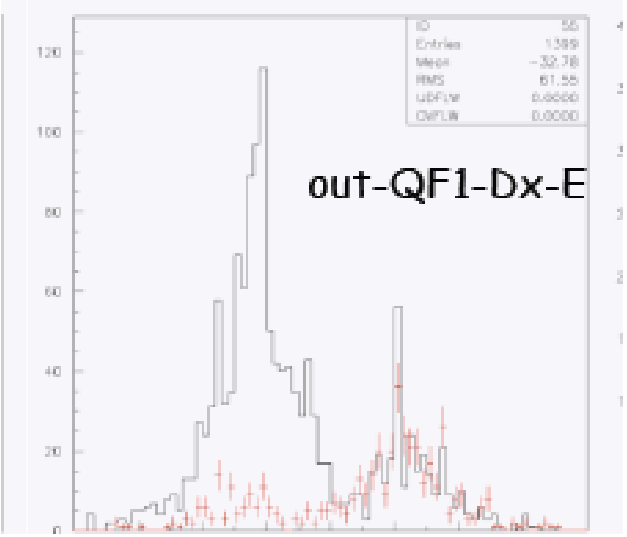
X_{clus} (cm)

Additional lead shielding



During february shutdown additional lead shielding has been installed wherever possible.

1) A plug in the LET hole w/o interfering with leptons trajectories.
2) A 1 cm lead cover on top of previous shields



According to MC, this should decrease background rate by a factor ~ 3. We are waiting for new data to validate this prediction

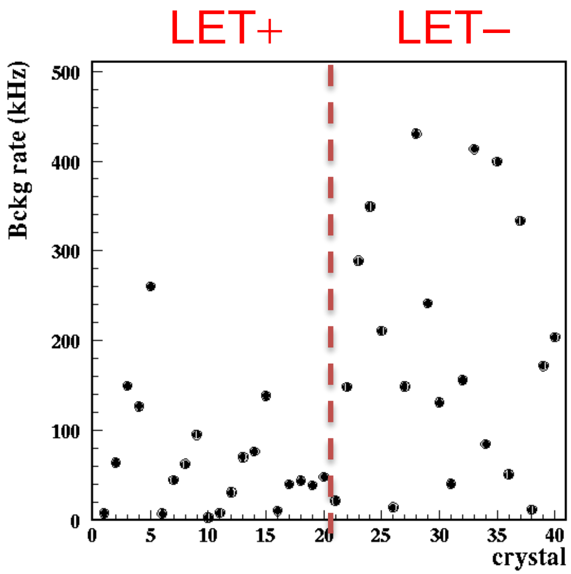
Low Energy Taggers

The LET calorimeters have been installed already in May 2010. It has been realized however that the e^- one was misplaced by 30º in azimuth wrt the nominal position

A partial recovery of 10º was possible in February. A complete recovery requires disintallation of the beam pipe. We have postponed this operation to minimize dead time for the machine run

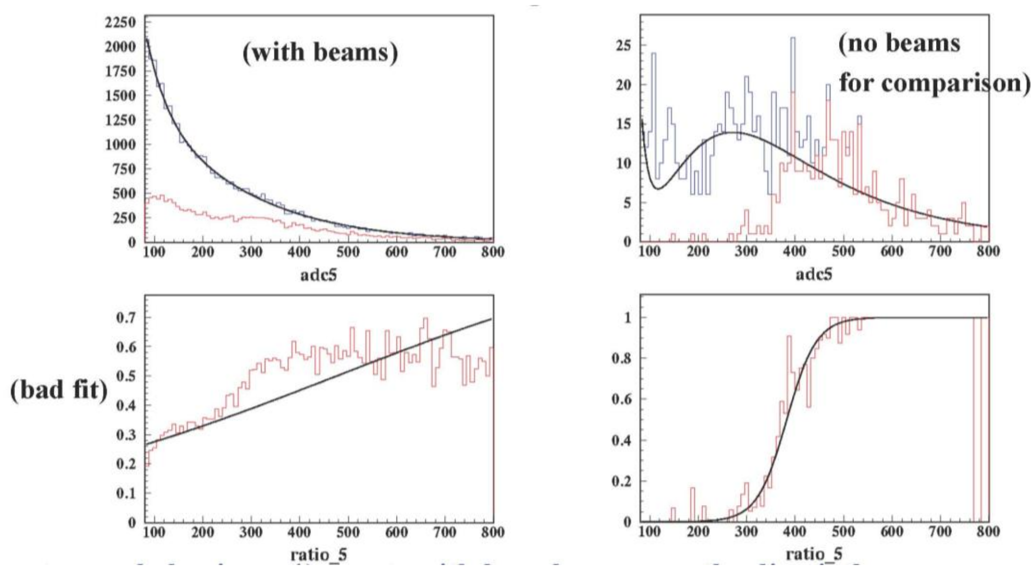
In the meantime we have started testing the detector both with cosmic rays and, especially, with beams in the machine

Low Energy Taggers



We have measured very high counting rates, in particular on the most internal crystals

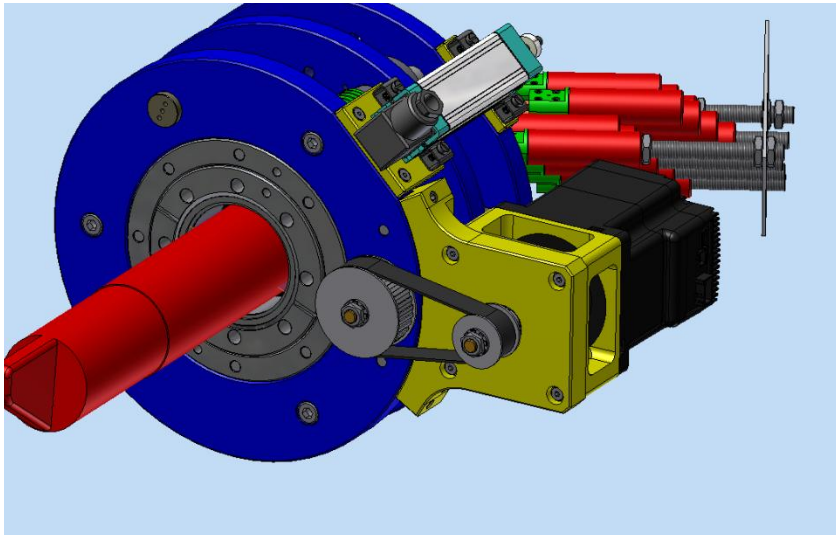
For these crystals ADC spectra gets distorted, probably because of a too large integration time



We are studying possible modifications of the ADC in order to cope with this problem

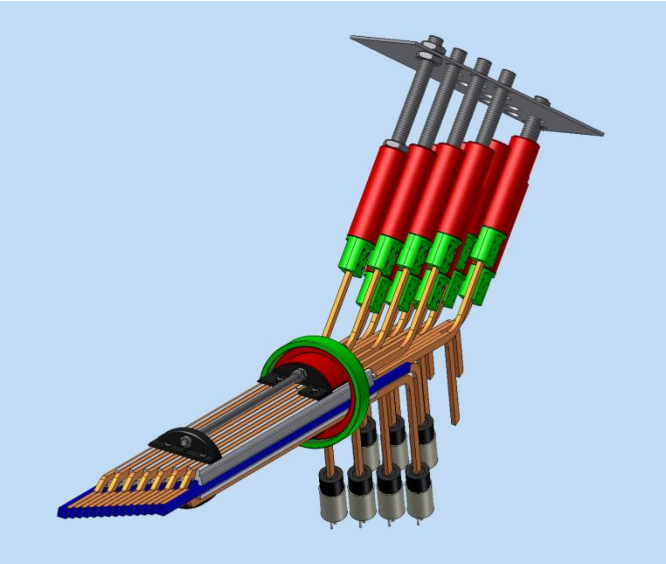
High Energy Taggers

The HET roman pots already in place since last year. All the mechanical designs of the detectors ready, the various subcomponents are being built these days in Frascati and Tor Vergata



The electronics boards will be delivered in Frascati for tests by June 15th

Final installation (one or two days of work) expected by the summer (was originally planned for May)



The Tape Library Problem

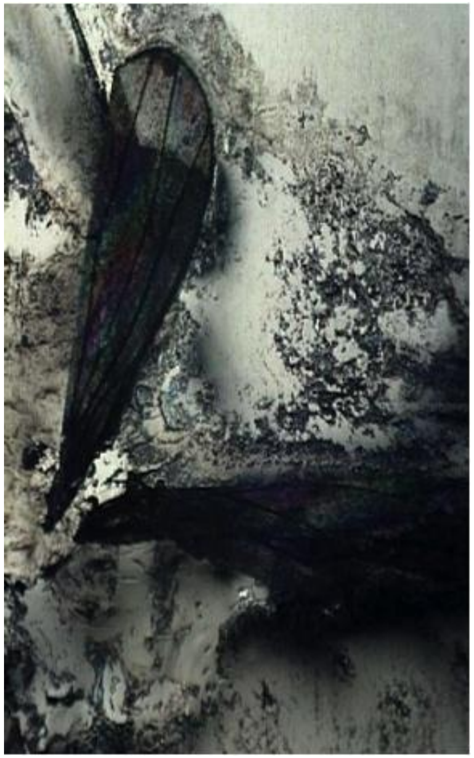
Since summer 2010 we have observed a few failures on some cartridges containing old KLOE data. Also a couple of tape drives badly failed and needed to be replaced

IBM experts were not able to identify the source of the problem up to last February when it was realized that it was due to organic contaminant i.e. *insects having entered the library!* This translates into:

1. All the 12 tape drives potentially contaminated
2. About 600 cartridges (150 essential) potentially contaminated

A plain recovery from this situation based on current market prices would cost enormously (*The cleaning of a single cartridge costs ~$ 5000, not scalable!*)

There is a bug in the hardware!



Wing

Eye

The Tape Library Problem: a way out

After a long discussion involving KLOE-2, IBM, INFN-CSN1 and the LNF Directorate we have elaborated a recovery plan based on the following points:

1. Usage of presently available disk space (~ 60 TB) to store first weeks of new data
2. Acquisition of a large amount of disk space (~120 TB) to allow easiest access to DST's for physics analysis
3. Acquisition of some clean tape drives and virgin cassettes to save the old KLOE data set
4. Study data transmission to a tape library at CNAF (Bologna), at least to have a duplicated copy of raws

Point 1 is ready. We think to have point 2 and 3 completed by this summer. Point 4 is progressing (one skilled person fully dedicated to it)

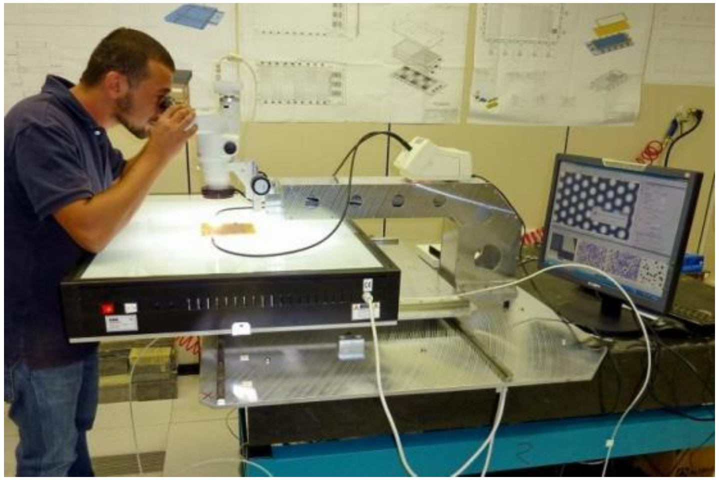
Inner Tracker Status

- Molds for Layer 1 and 2 delivered (3 and 4 under construction)
- GEM and cathod foils for Layer 1 and 2 delivered (3 and 4 ordered)
- Cathode for Layer 1 and 2 succesfully built
- Vertical insertion machine fully commissioned
- Quality control tools ready and operating
- New clean room delivered on May 30 (this week formal commissioning)
- Readout plane for Layer 2 delivered
- GASTONE chips delivered
- FEE test bench under construction
- Signal and HV cables chosen, to be ordered soon

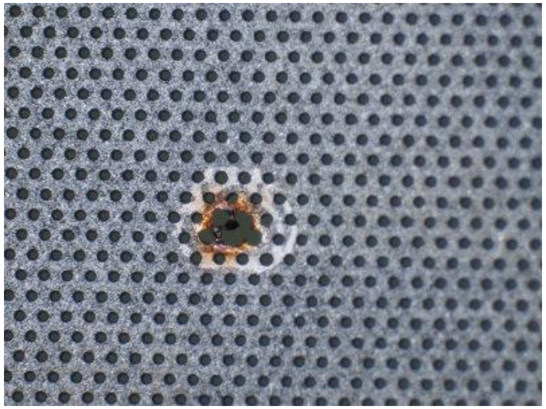
Contributions from: Bari, Frascati, Roma1, Roma3, Uppsala

We expect to have first layer ready by December, and the entire detector by summer 2012

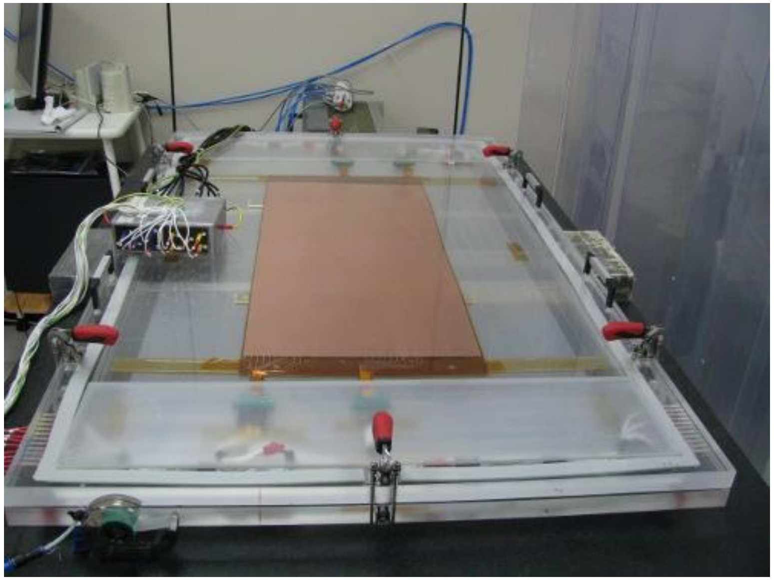
Gem Quality Control

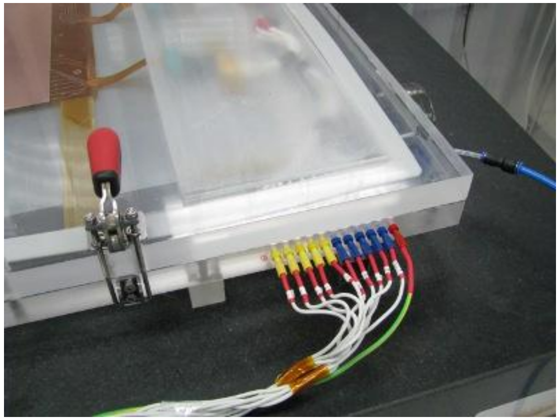


Optical check of GEM



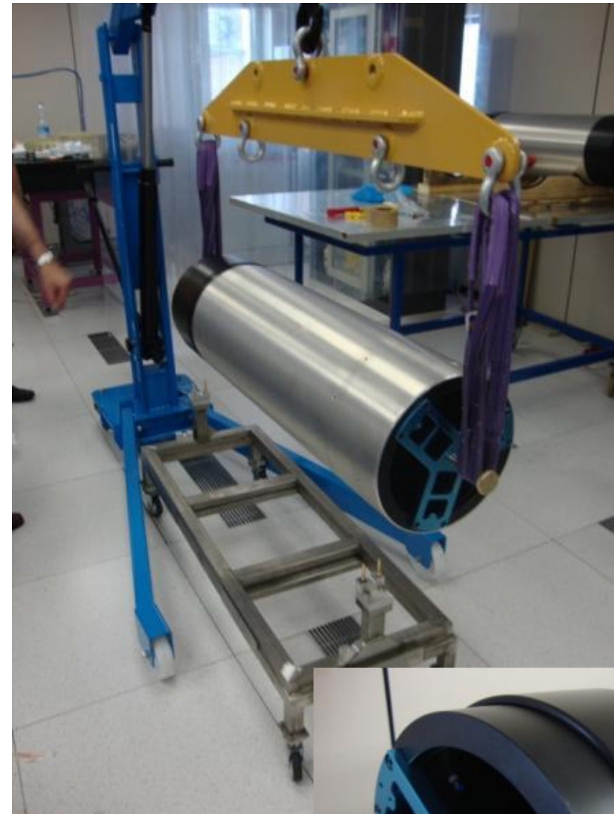
High Voltage test in Nitrogen flushed box

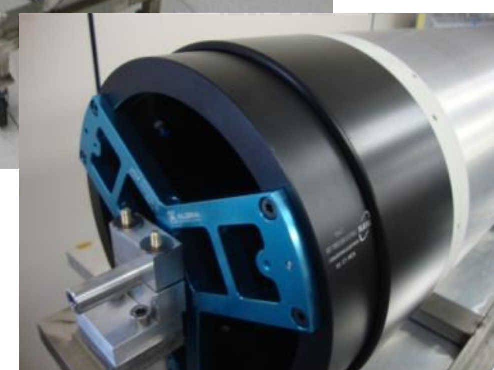




Cylindrical Molds and Rings

Aluminum/Teflon molds from ALGRA





Durostone Fiberglass/Epoxy rings from RESARM

Vertical Insertion Machine

Centering controlled during insertion with 3 cameras at 120°

The tolerance of 150 μm between the rings has been met

Test concluded but still some improvements needed:
- Add cameras also on the bottom side
- Optimize operating parameters of step motors

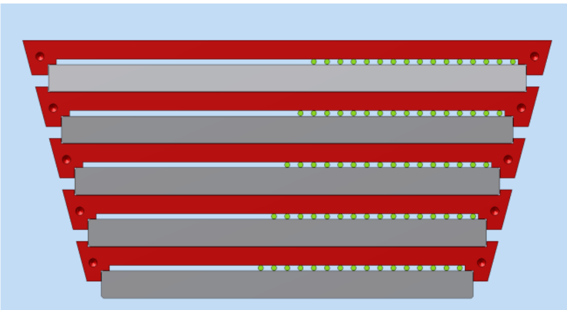
QCALt Status

- Small change in the design wrt module 0, to increase stability
- Tungsten ordered and ready to be sent at LNF
- Scintillators for 6 modules already at LNF
- Tiles preparation for first module in progress
- Mechanical structure for first QCAL/2 ready
- Drawings for structure assembly ready. Construction in progress
- SiPM from FBK succesfully tested
- First prototype of off-detector board ready to be tested

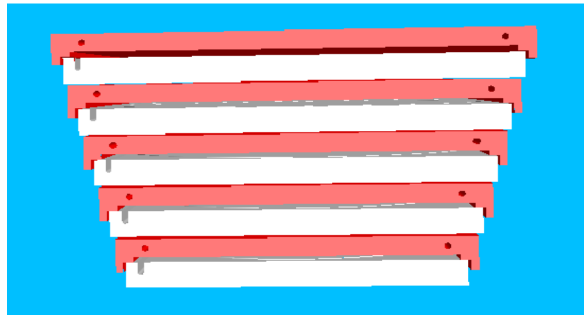
Contributions from: Cosenza, Cracow, Frascati

We expect to start construction by the end of June, full detector ready on Spring 2012

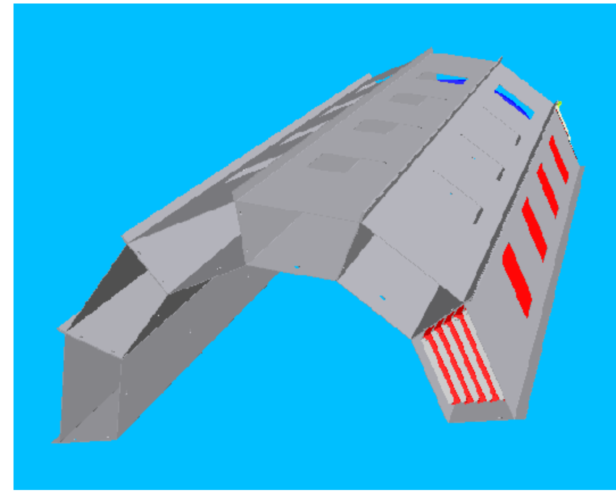
QCALt Detector Design



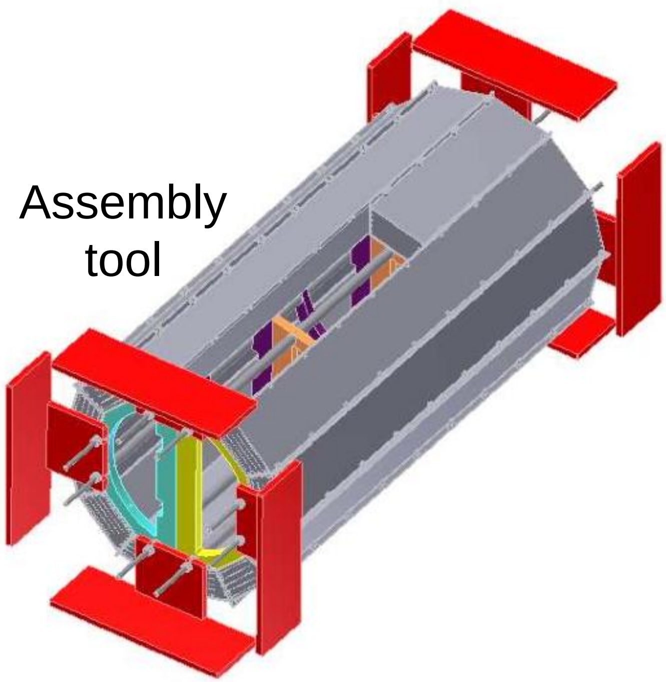
NEW

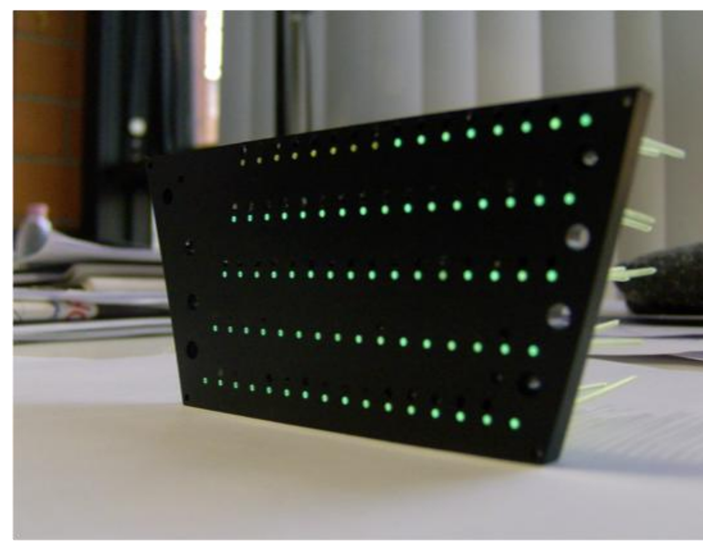


OLD



Assembly tool





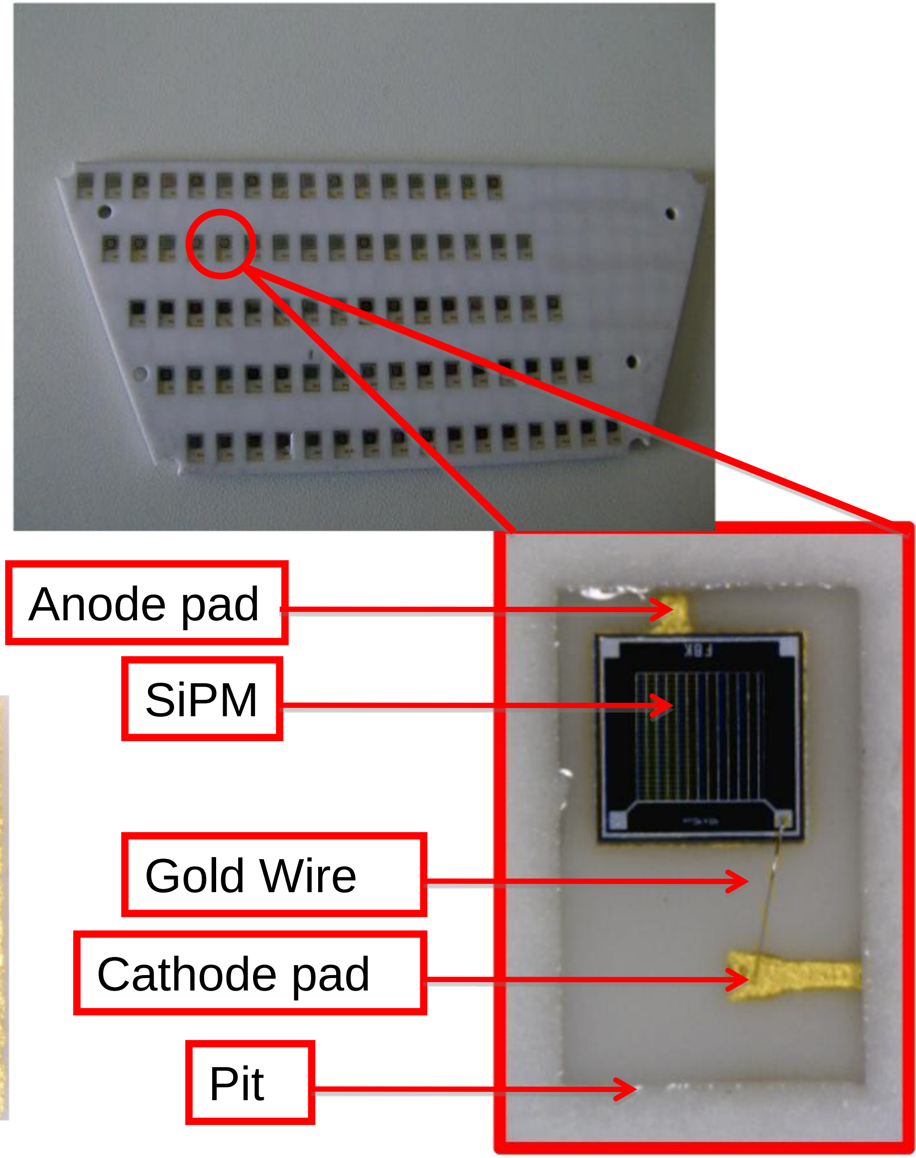
QCALt SiPMs

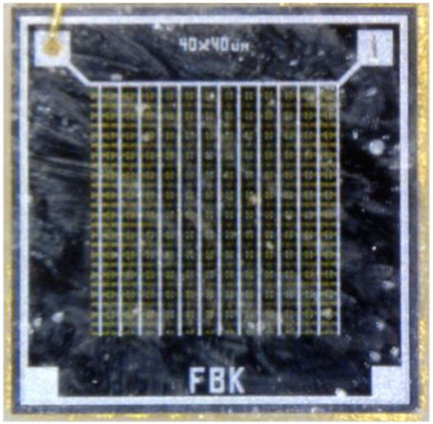
-Using standard procedure, problems during resin deposition (aluminum masks not perfectly glued)

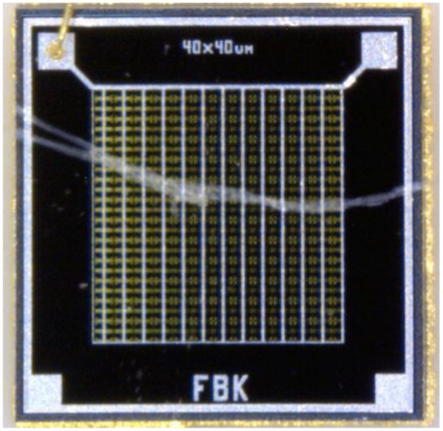
-Now solved using cold resin at 30 degrees

-First prototype with dummy SiPM already at LNF

-PCB planarity respected after bonding and resining at 0.1 mm

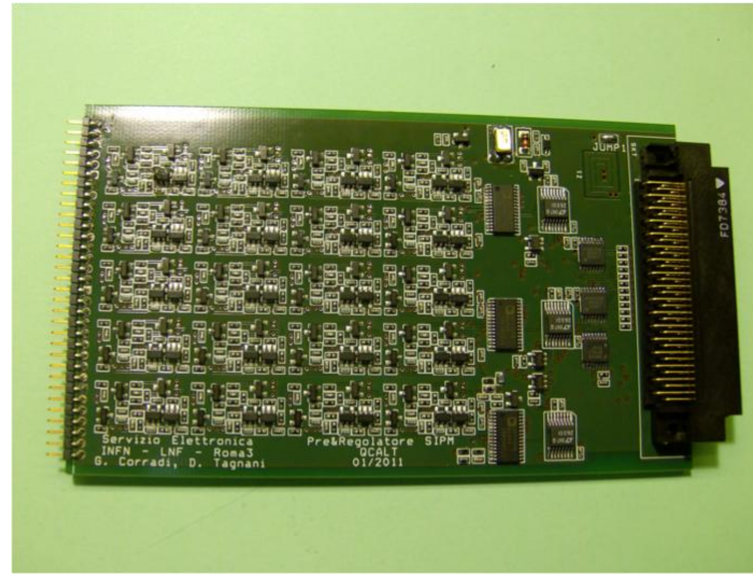


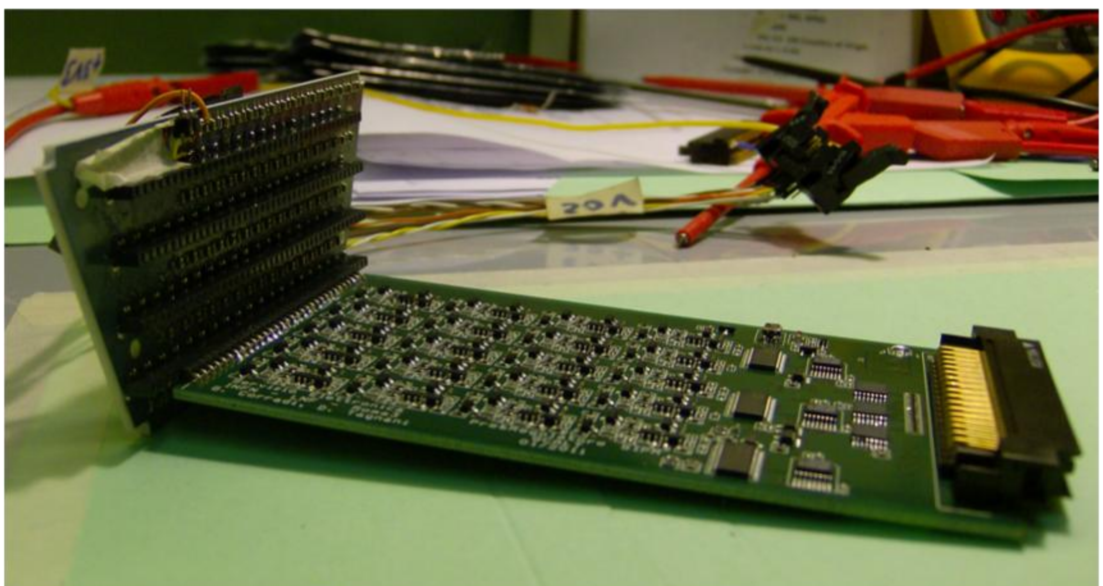


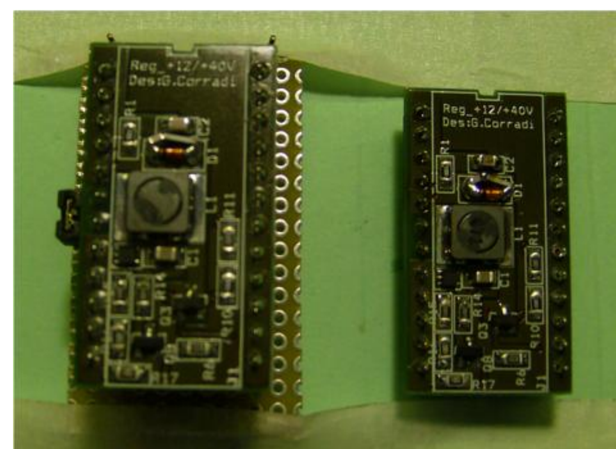


QCALt FEE

-First prototype of “OFF detector board” ready to be tested
-HV 40V supply ready
-Bonding temperature test in progress to check effect on cold resin
-First 20 GIB channels in preparation to test PCB.







CCALt Status

- Drawings of mechanical volumes ready.
- 3D printed prototypes produced
- Tests of single crystals readout with UV leds performed
- Crystal matrix built to study calorimeter response at a test beam in Mainz
- Offers for crystals required to three different companies
- FEE under test (similar to the LET one)

Contributions from: Frascati

We expect to have the full detector ready on Spring 2012

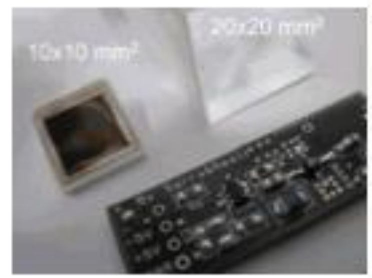
CCALt Test Beam at MAMI

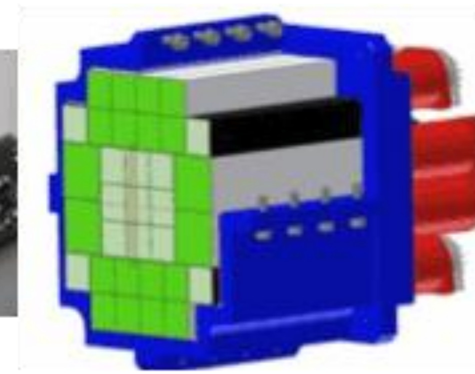
We built a crystal matrix to make a test beam at MAMI(march 2011) to understand the calorimeter response as a function of Eγ.

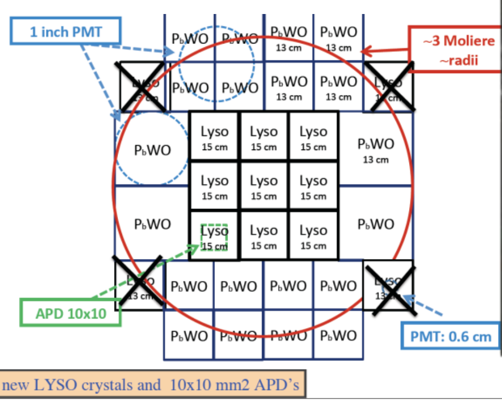
Mami provides 1.5 GeV high quality ~100% duty factor electron beam:

- tagged photon ~10^8 γ sec^{-1} beam with excellent dp(FWHM) = 1 MeV
- selectable rate (from few kHz to MHz) & energy 20-380 MeV

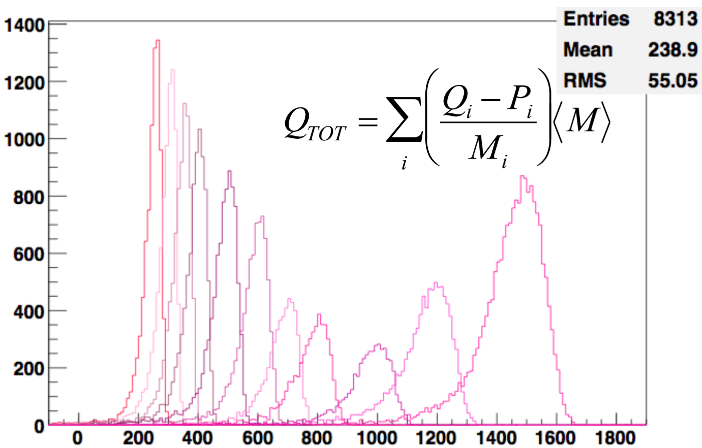
The matrix consists of an inner core of 9 LYSO 2x2x15 mm^3 crystals read out by 10x10 mm^2 APD (we want to study the energy resolution) and an outher section of PbWO crystals read out by bialkali PMT.



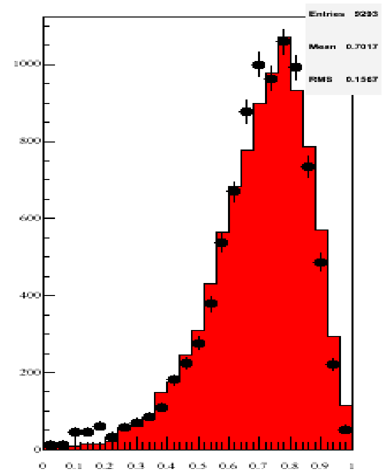




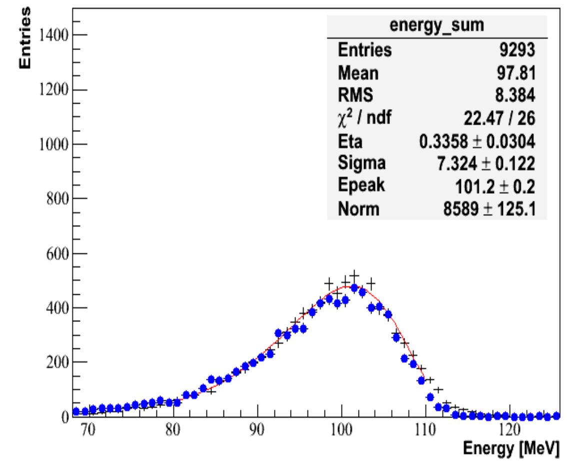
CCALt Test Beam Results



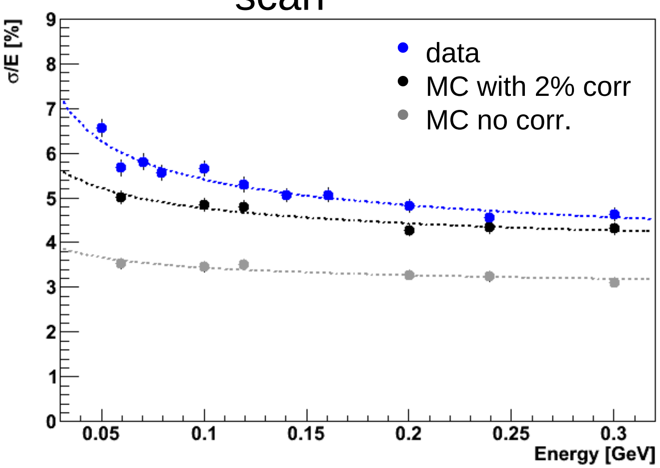
Energy scan

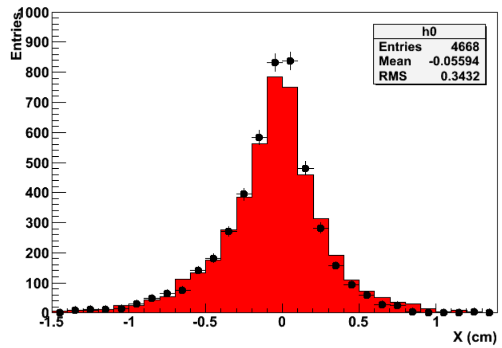


Energy deposited in the central tower Data-MC



Energy sum Data-MC





Position resolution ~3mm

Very good agreement Data Geant4 MC
The extrapolation of all the resolution effects from Geant works fine

Detectors Integration

A dedicated task force including KLOE-2 and DA personnel has been formed to study the crucial issue of integration of the new detectors on the DAΦNE interaction region:

- Verify detector occupancy and interference
- Verify space available for cables, gas piping and cooling
- Define the installation procedure

The installation plan has been already developed. A mockup is being built to test pratically the procedure

The KLOE-2 Project

Despite the many difficulties, the KLOE-2 collaboration is very lively and willing to accomplish its program

Since March, we have started regular (although “light”) data taking shifts. Up to now more than 60 people have partecipated to the effort, *including 13 members of the AMADEUS Collaboration*

At the same time, *other* ~25 physicists, engineers, technicians are working on the new detectors construction

There are 10 PhD and diploma students who are working on their thesis, based on KLOE-2 present and future data

All this people deserve and require clear answers from the Laboratory about the future of the project

Spares

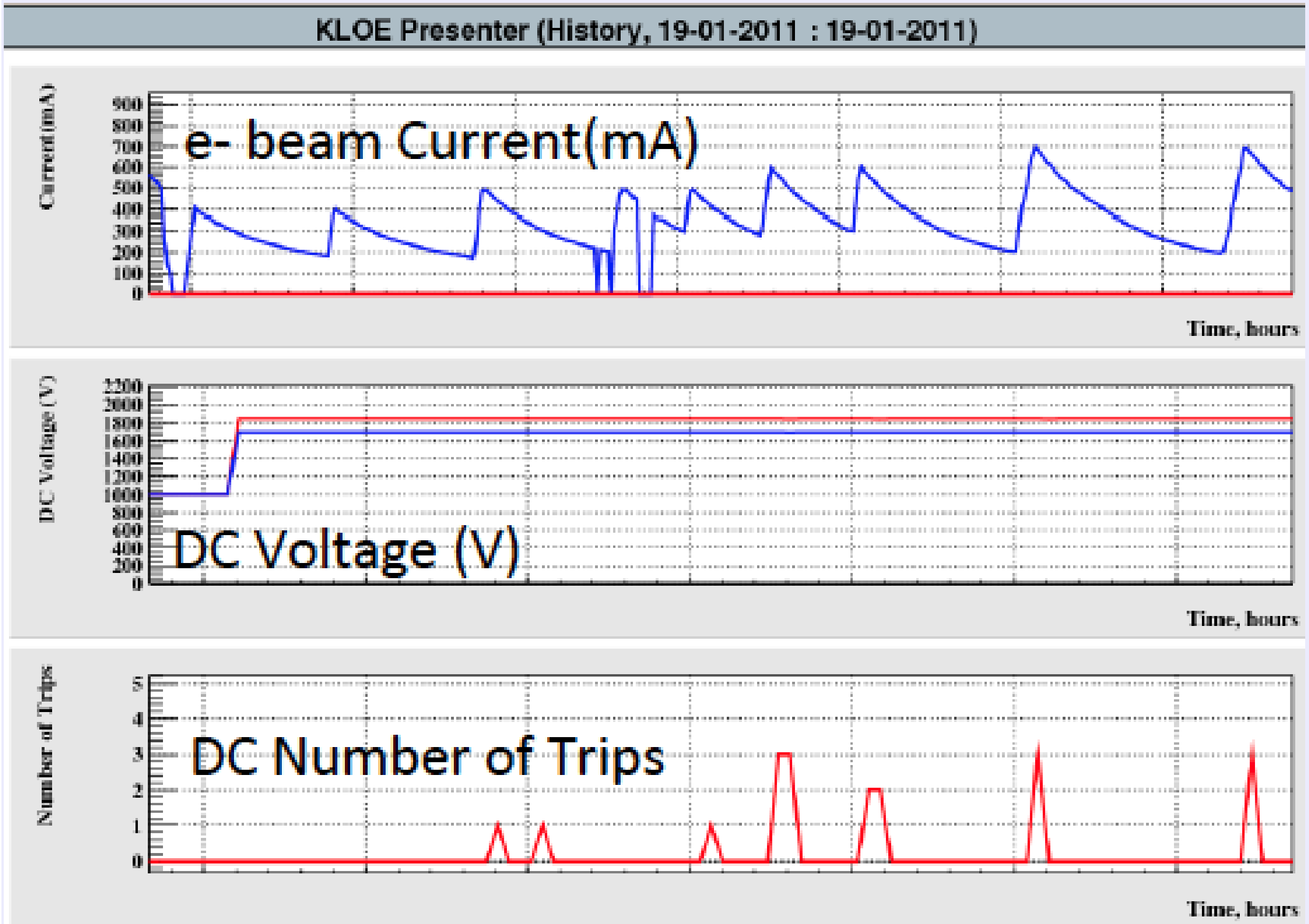
KLOE: DC hardening to trips

V_{SET}
2x2 cm² cells 1750 V -> 1700 V
3x3 cm² cells 1870 V -> 1850 V

I_{SET}
3 μA → 5 μA

Max over-current time
50 ms → 150 ms

0.3% H_2O
(will be 0.5%)



Injections with currents I(e-) 400 → 700 mA with 100mA step

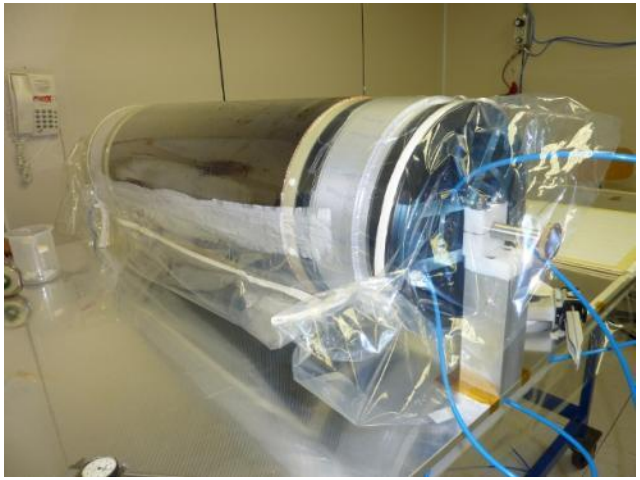
Two injections at each I(e-) value

DC always On

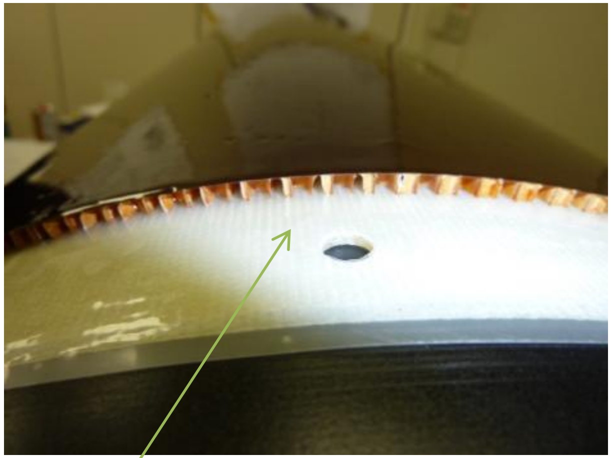
Few trips 1÷3 at injection
Recovered by SlowControl

VERTICAL INSERTION MACHINE

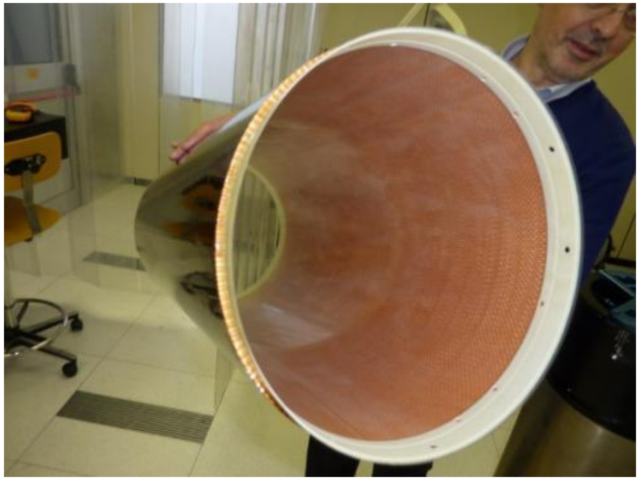
For the insertion test a rigid dummy anode has been realized
with a mylar/honeycomb/kapton composite



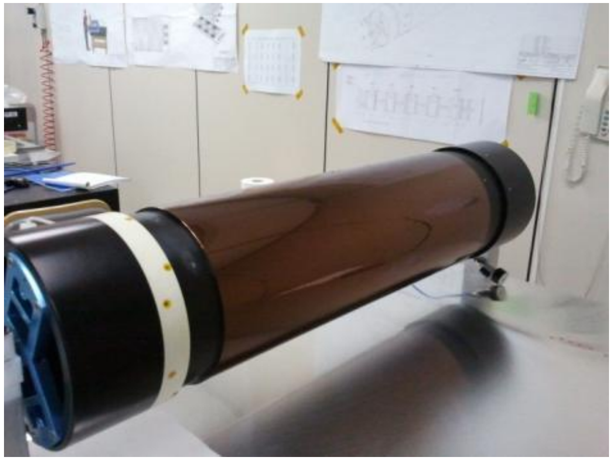
vacuum bag



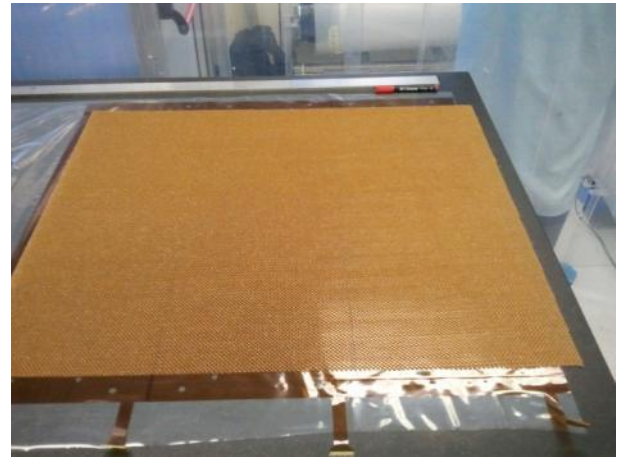
Dummy anode:
Mylar 50 μm
Honeycomb 3 mm
Copper-clad Kapton 50 μm



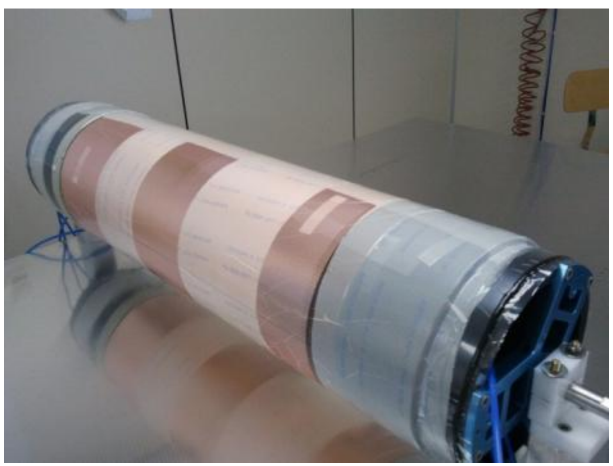
Construction of the CATHODEs



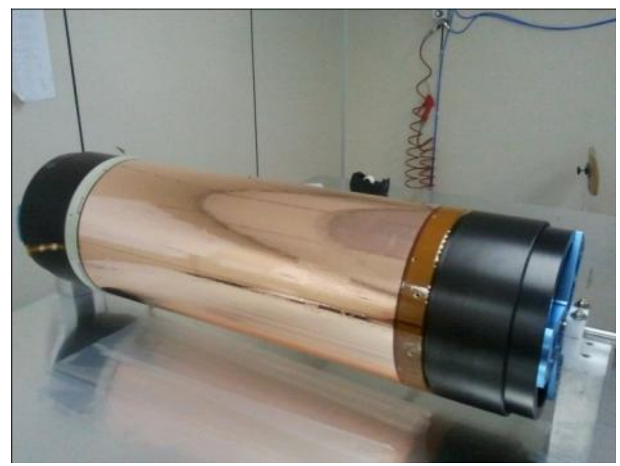
Inner layer is glues on the mold



Nomex honeycomb is glued on the cathode foil

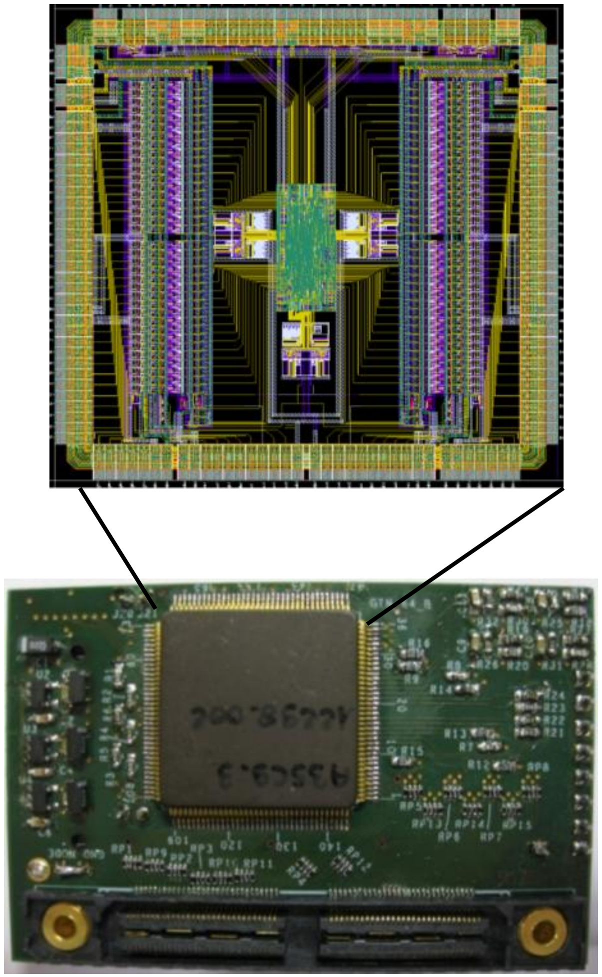


Cathode is rolled on the mold and glued in a vacuum bag



Cathode is ready

GASTONE 64 chip



N. channels	64
Chip dimensions	4.5 X 4.5 mm^2
Input impedance	400 Ω
Charge sensitivity	22 mV/fC (Cdet = 0 pF)
Peaking time	80 ns÷150 ns (Cdet=0 ÷100 pF)
Crosstalk	< 3%
ENC	800 e- + 40 e-/pF
Power consumption	~ 7.5 mW/ch
Readout	Serial LVDS (100 MBps)
Total IT power consumption	200 W

Front-End Board dimensions (120 Channels): 62x40 mm2

QCALT status: beam pipe support

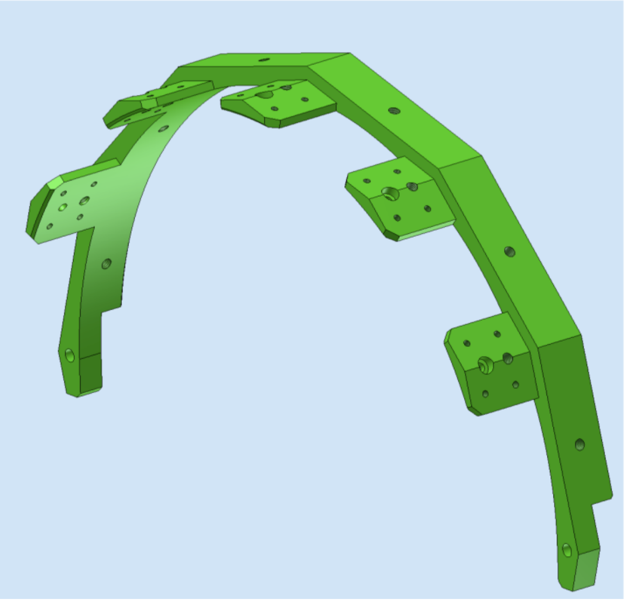
-Drawings of new steel rings completed

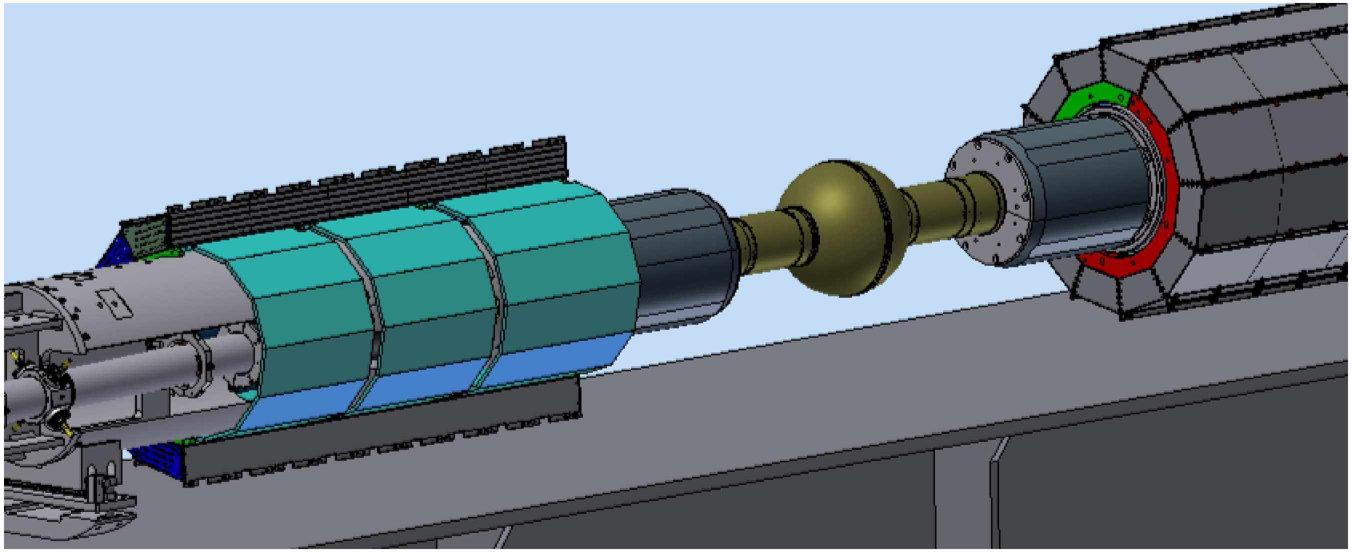
-Construction material already al LNF

-Mechanical preparation at INFN-Padova

-New tungsten shielding to increase QUAD coverage ready

-Quote in preparation by Xi'An refractory





QCALT status: SiPM

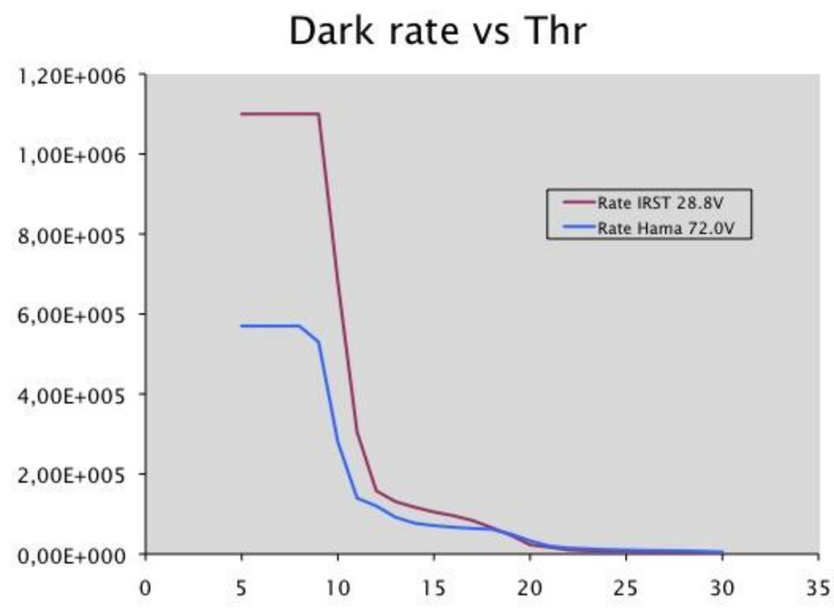
-SMD FBK devices tested for the first time

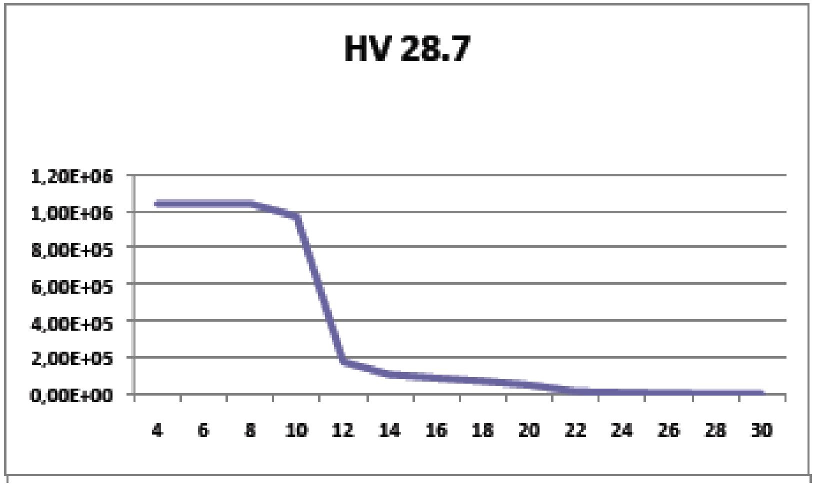
-Comparison with Hamamatsu device very satisfying

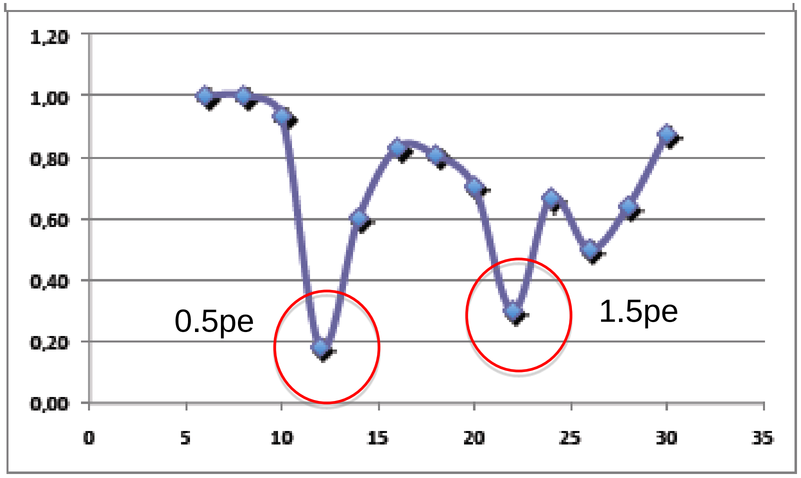
-FBK with low bias (30V vs 80V), less power consumption

-QCALT calibration measuring gain from dark rates

-No ADC in the final FEE scheme

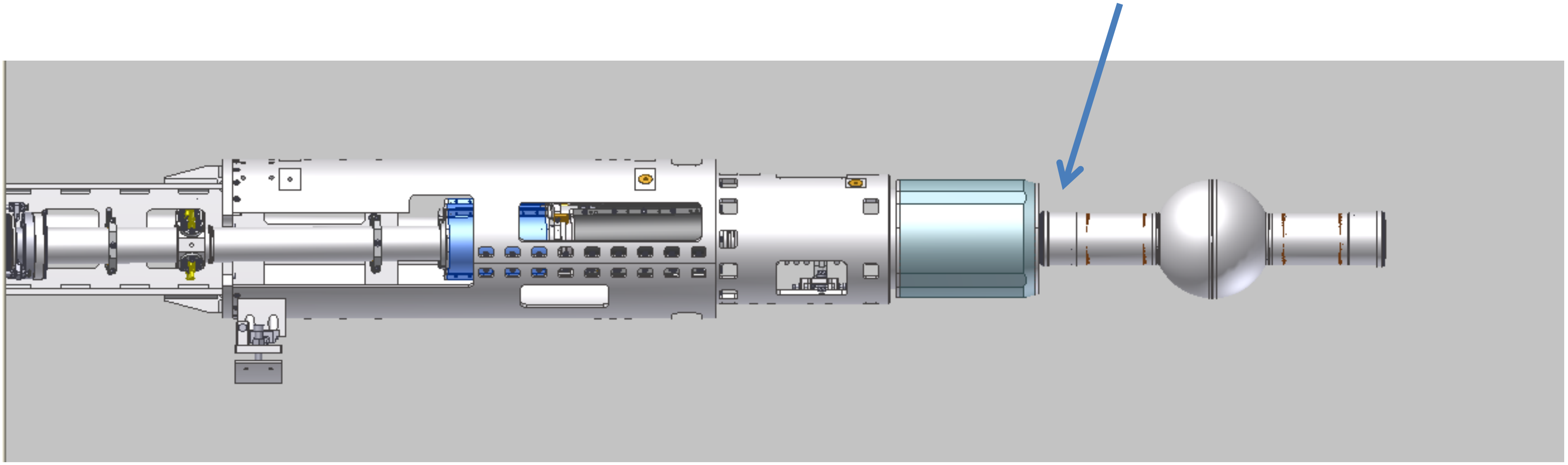


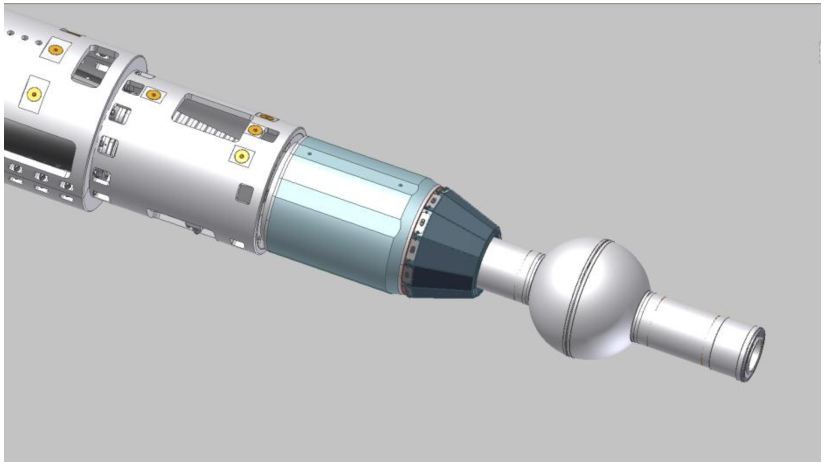




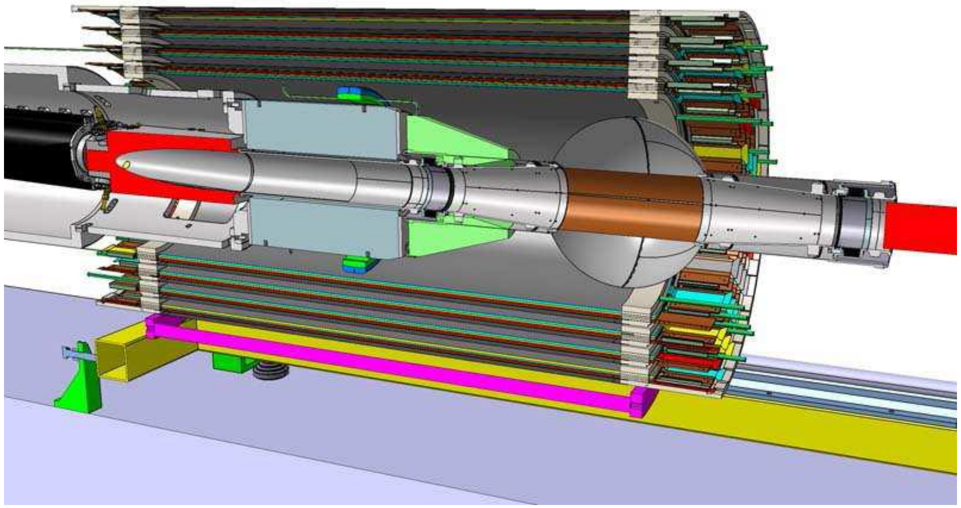
INTEGRATION PROCEDURE

Step 1: 1st soldering Sphere Chamber - BP;



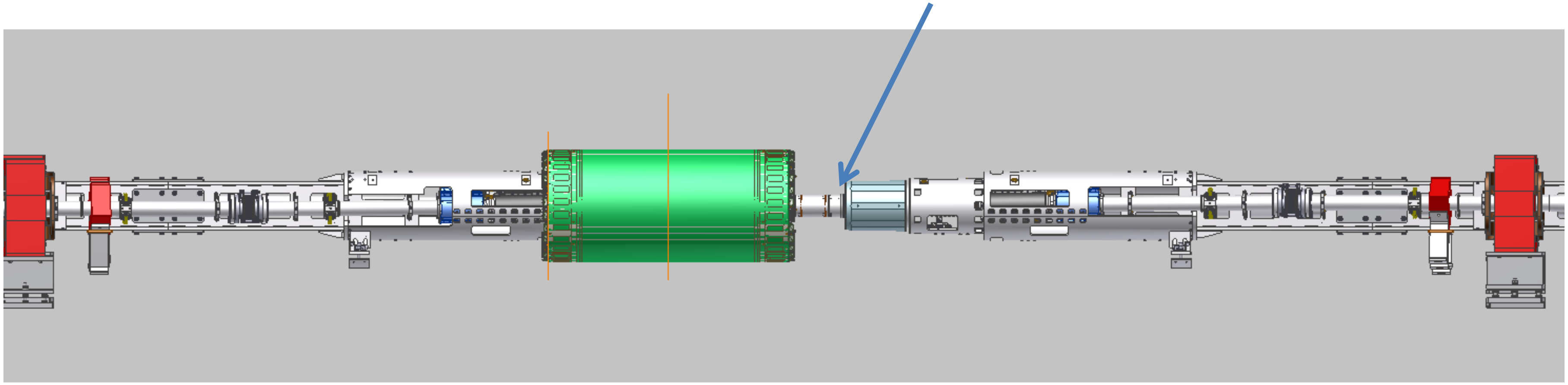


Step 2: Integration and cabling of the CCAL_1;

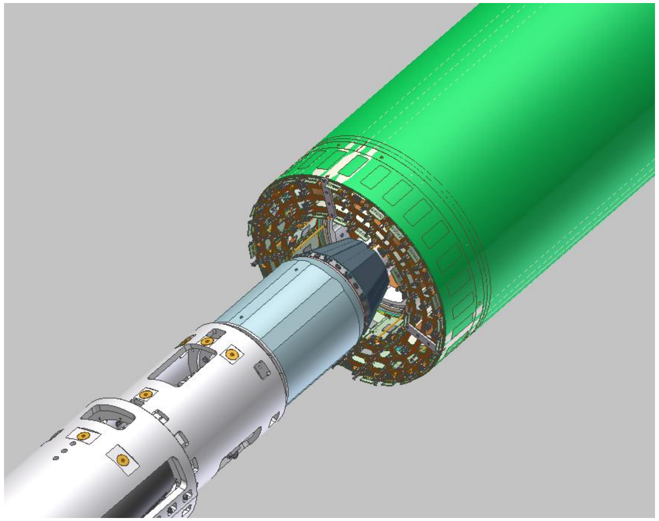


Step 3: Integration of IT with lateral shift;

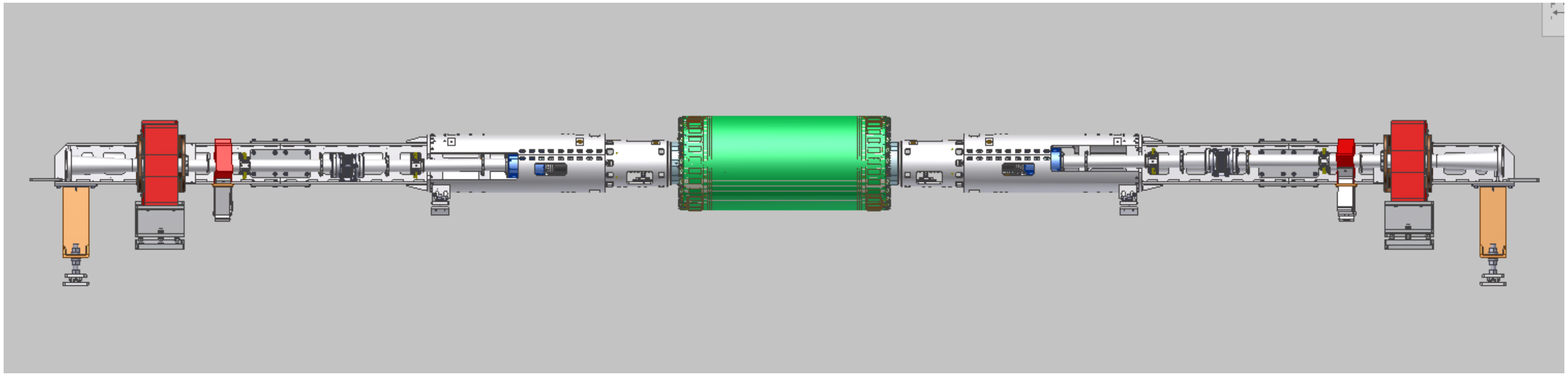
Step 4: 2nd soldering Sphere Chamber - BP;



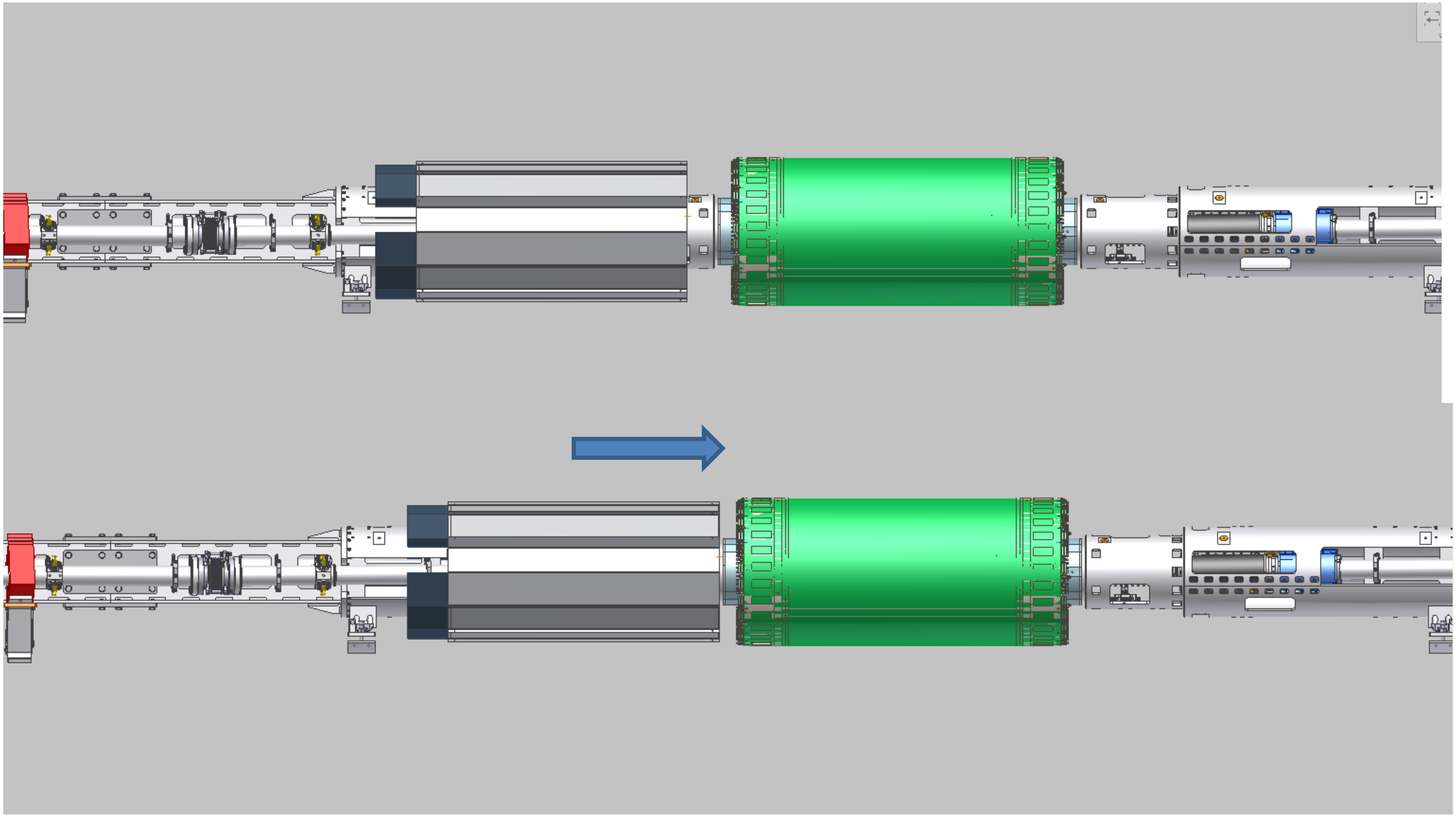
Step 5: Integration and cabling of the CCAL_2;



Step 6: Repositioning of IT;
IT cabling (not defined);

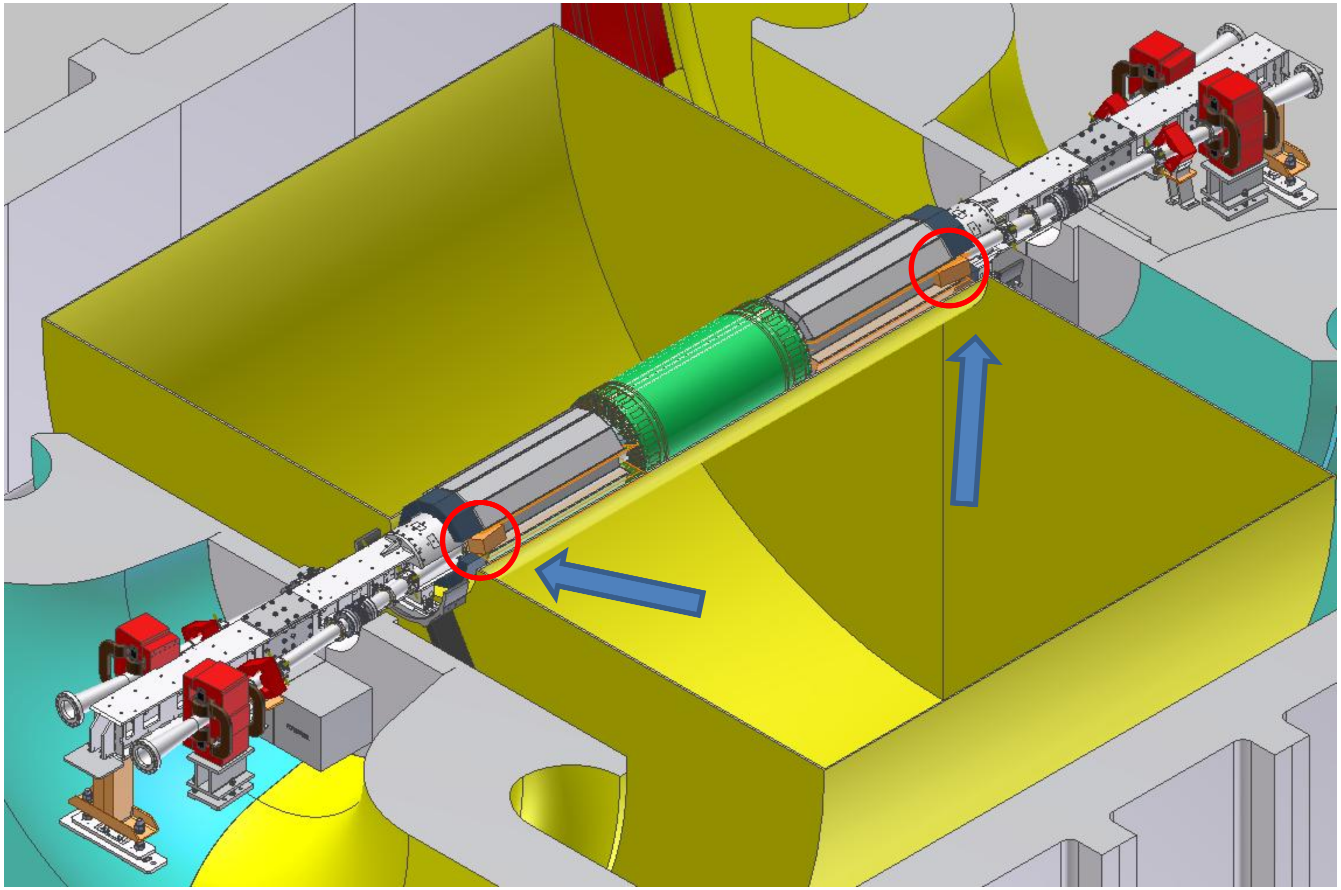


QCALT INTEGRATION



Step 7: 2 parts of the QCALT mounted and shifted

Step 8: Insertion of the BP;
Step 9: Integration of LET_1 and LET_2



INTEGRATION COMPLETE!