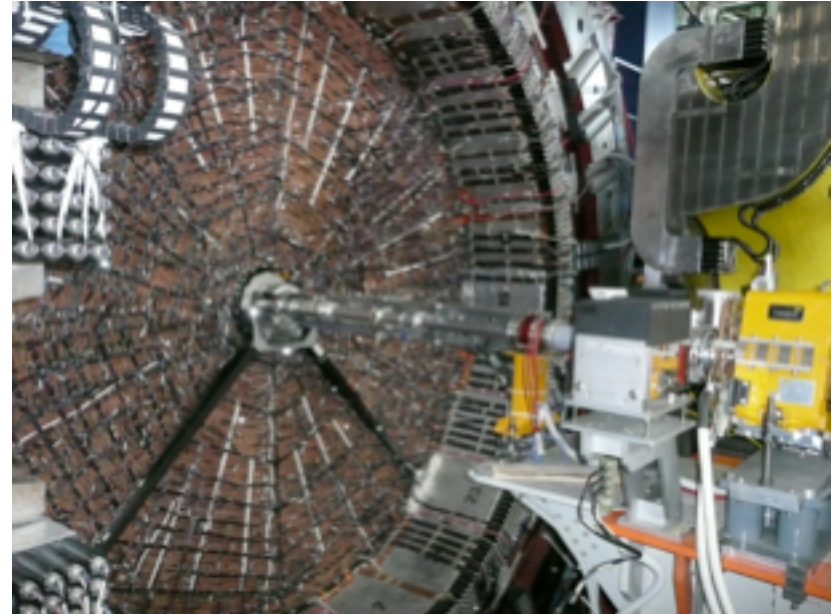


# Status of the KLOE-2 experiment



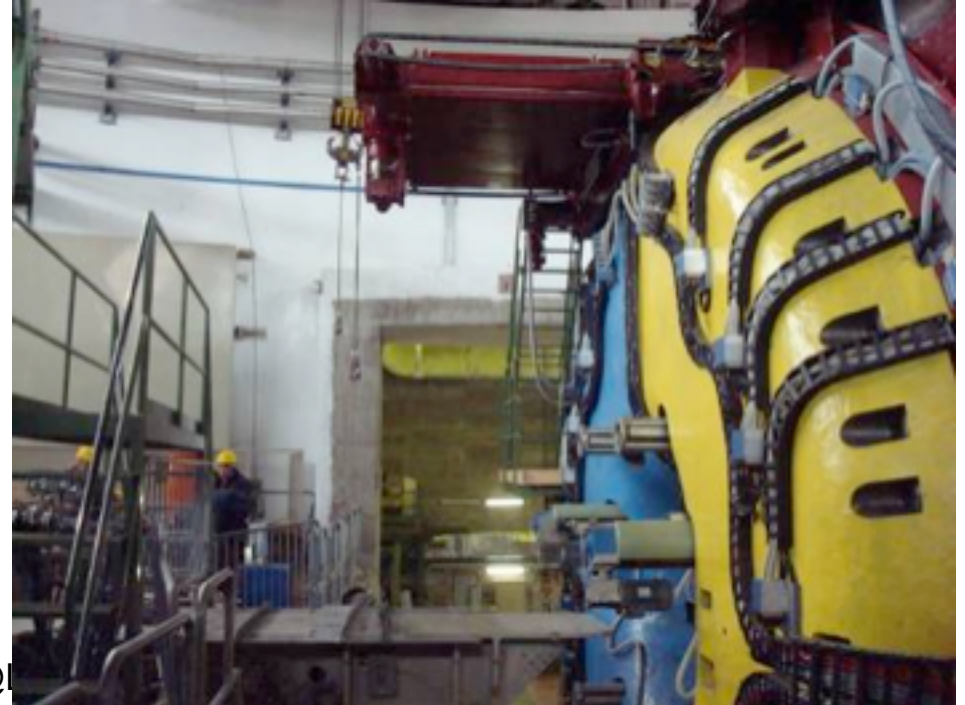
S.Miscetti  
LNF/INFN  
for the KLOE-2 collaboration

LNF Scientific Committee, Frascati 24/6/2010

# A very short summary of the KLOE-2 Roll-in

KLOE-2

- Operation started 9/1/2010,
- Completed 29/1/2010.  
(web movie:  
<http://www.lnf.infn.it/public>,  
under Novita'Lnf)
- Connection to services: water, power, gas and cryogenic plant completed 26/2/2010
- Safety and Alarm system: crate temperatures and gas leaks tested on March. Approved this month.
- Cryostat cooling started 19/4  
Completed the 12th of may.

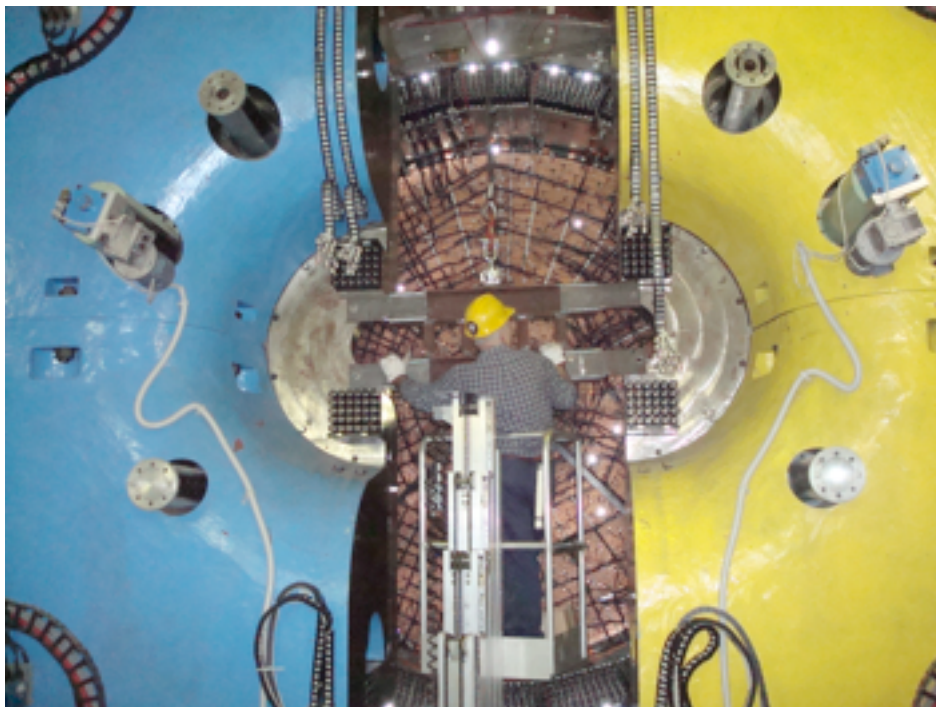




# Modification to the EndCap Iron Yoke

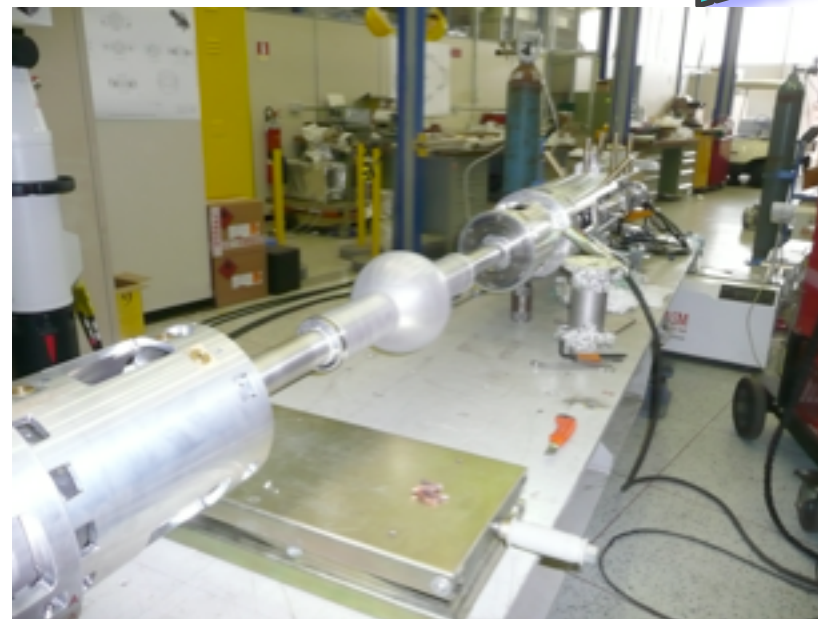
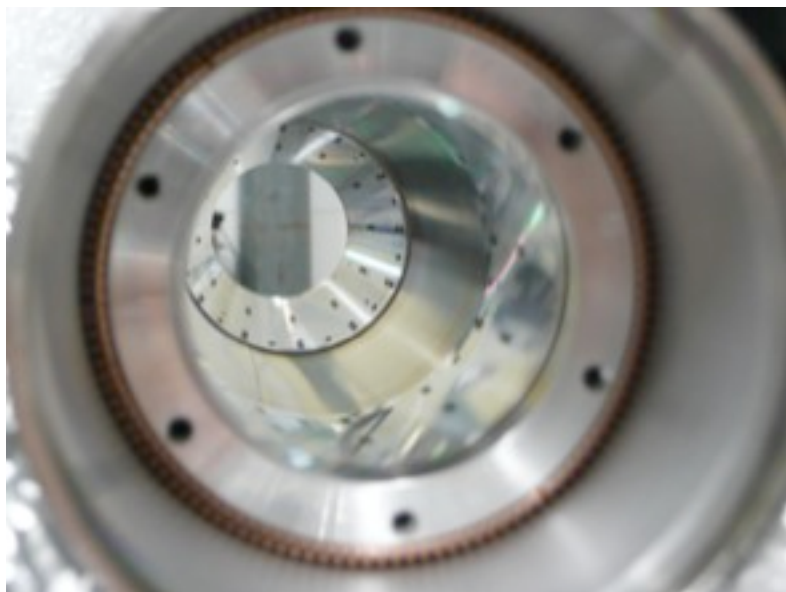
KLOE-2

Due to the "V"-shape of the new beam ---> needed a cut on the EndCap HalfMoon closing iron ("lunette"). Done in Dec 2009/Jan2010. See next slides of IR1 insertion..



# IR1 realization & assembly + transportation

KLOE-2



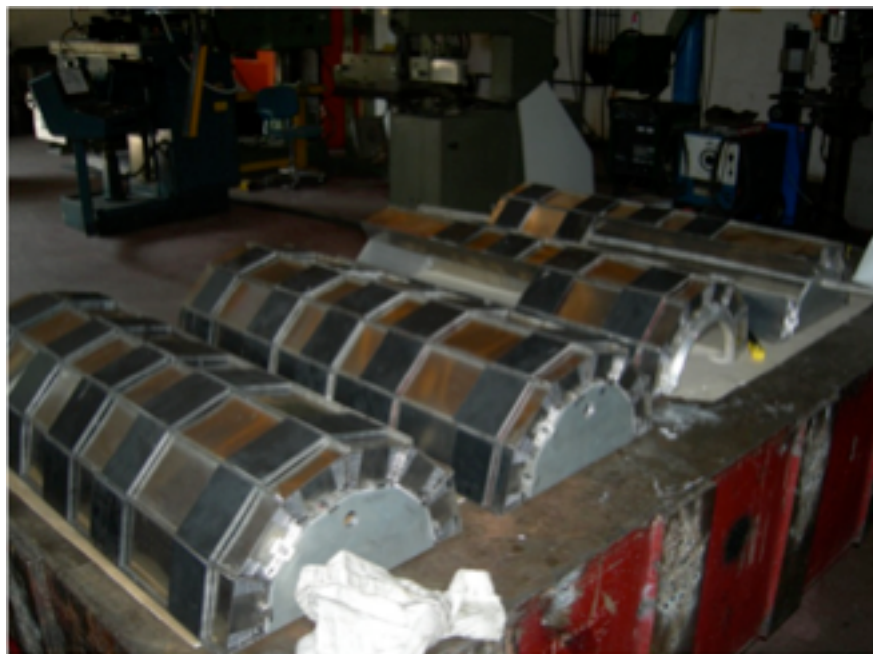
- Great job on IR1 done from SIM group of DAFNE.
- Inner Be (30  $\mu\text{m}$ ) screens mounted
- IR1 fully assembled + transported to DAFNE beginning of may.





# Lead Screens on IR1 + getting on rails

KLOE-2

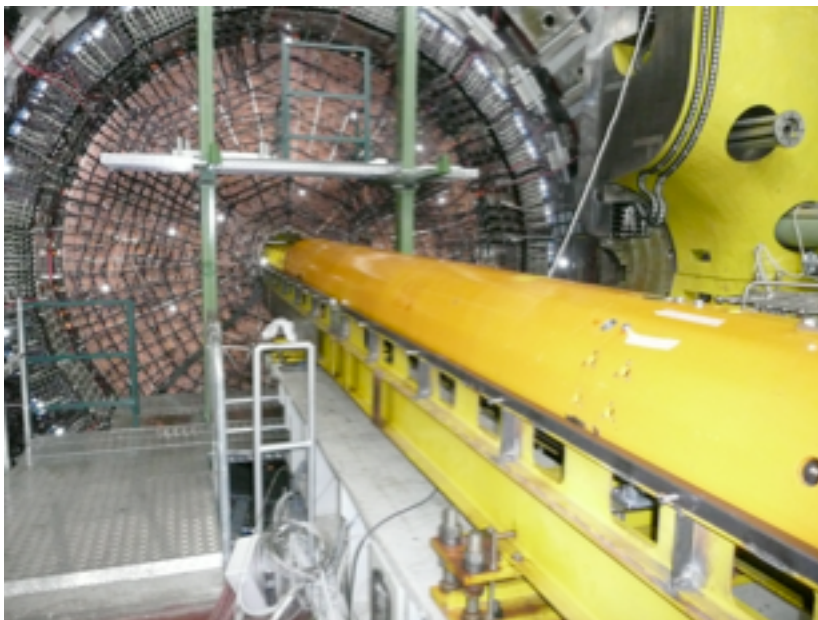


- Lead Screens prepared @ LNF mechanical shop.
- Installed over IR1 the 28/5
- IR1 over rails the 31/5



# IR1 insertion on KLOE .. The risky business

KLOE-2

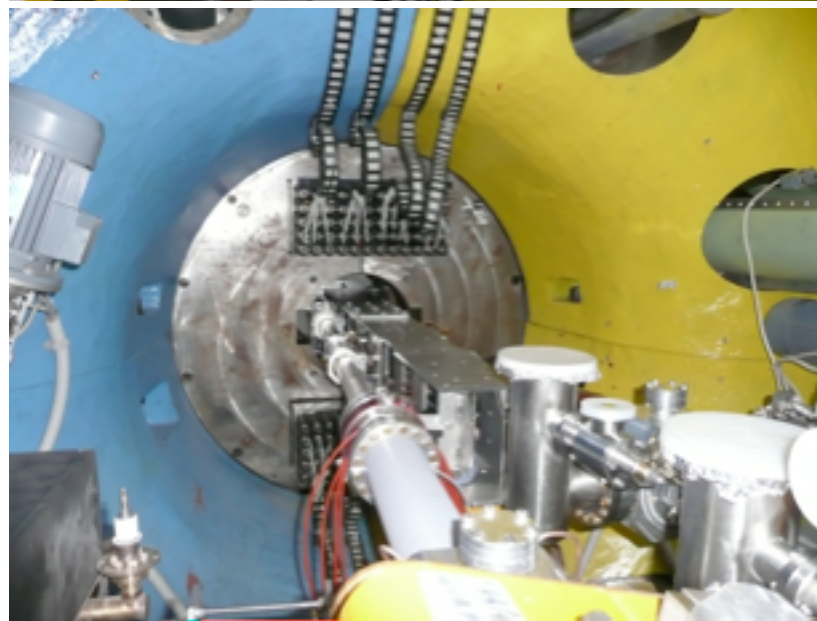
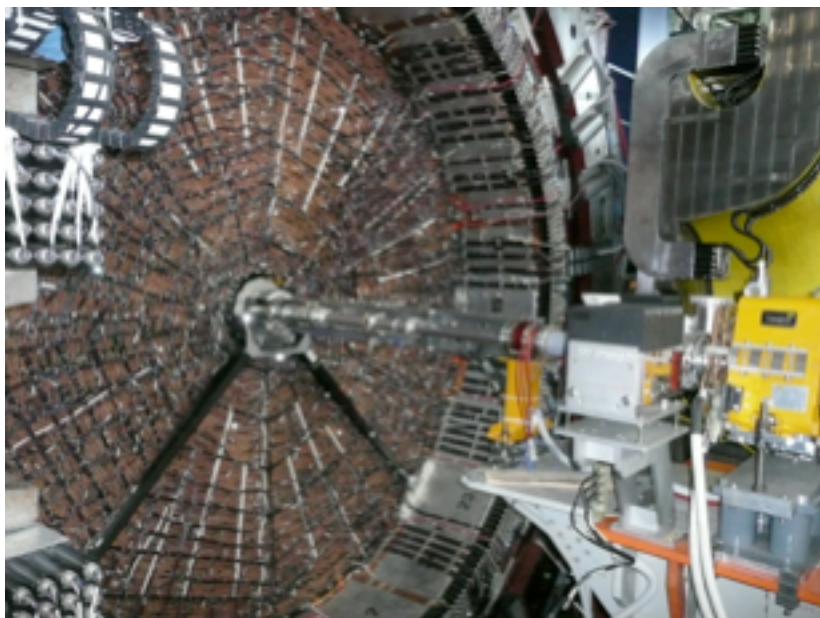


- IR1 insertion in KLOE the 1/6
- Extraction of transportation shell on the 3/6
- Insertion of LET calorimeter on the 4/6



# EndCap closing with IR1 (Thursday 17/6)

KLOE-2



24/6/2010

S.Miscetti@LNFSC\_jun2010

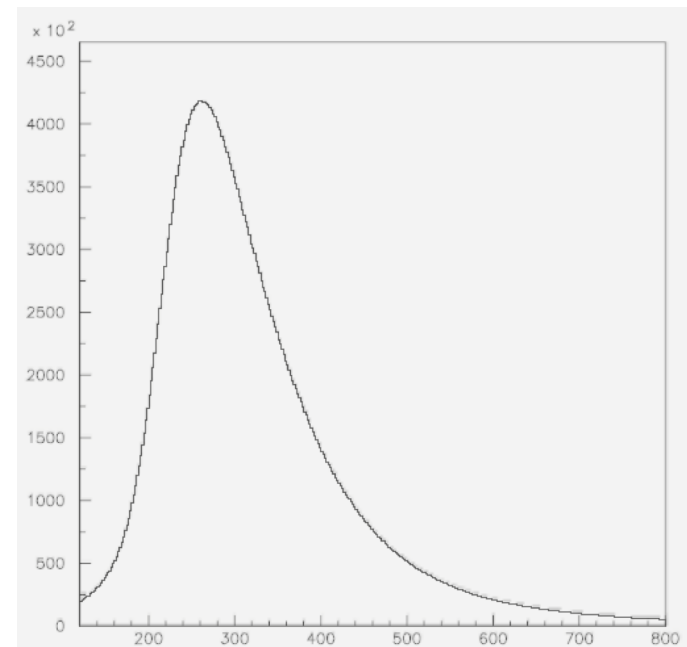
# Status of EMC

KLOE-2

Check/maintenance of PMs, base divider, HV supply, TDC , ADC

- PM OK
- Base dividers: 5 replaced
- HV board: 9% of channels/year to be replaced as in old gone times. O(100) channels replaced so far.
- TDC/ADC : replaced 2, repaired O(10)

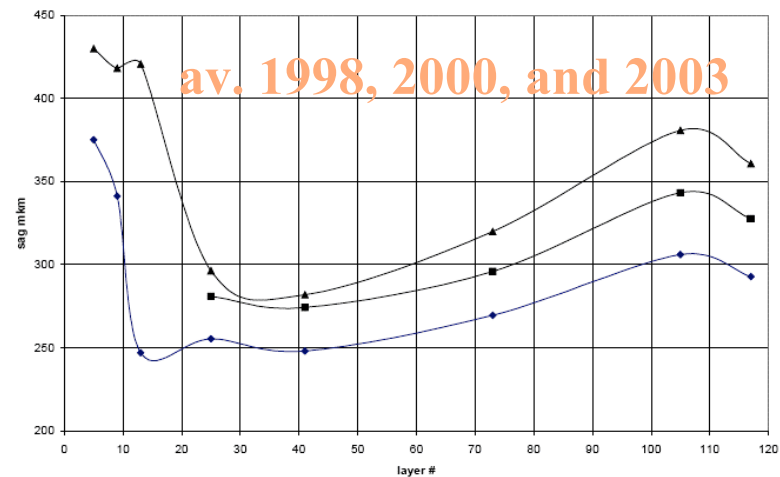
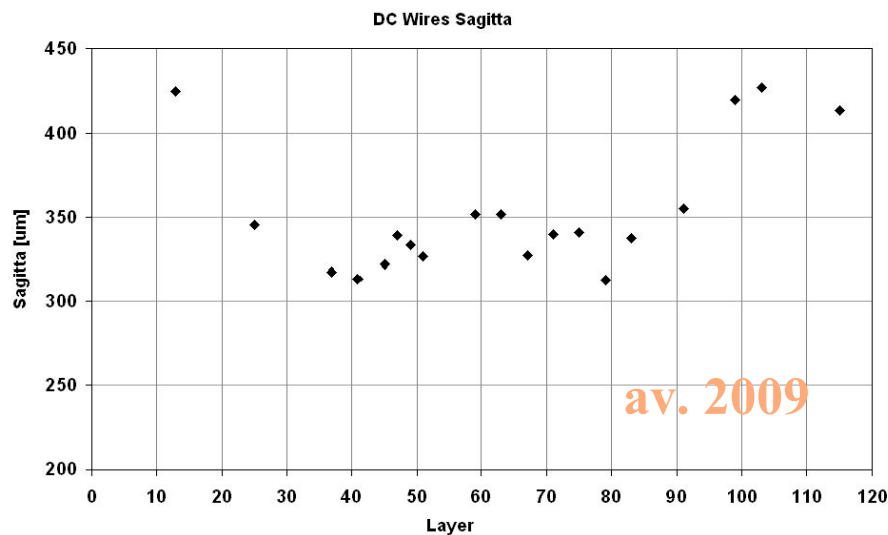
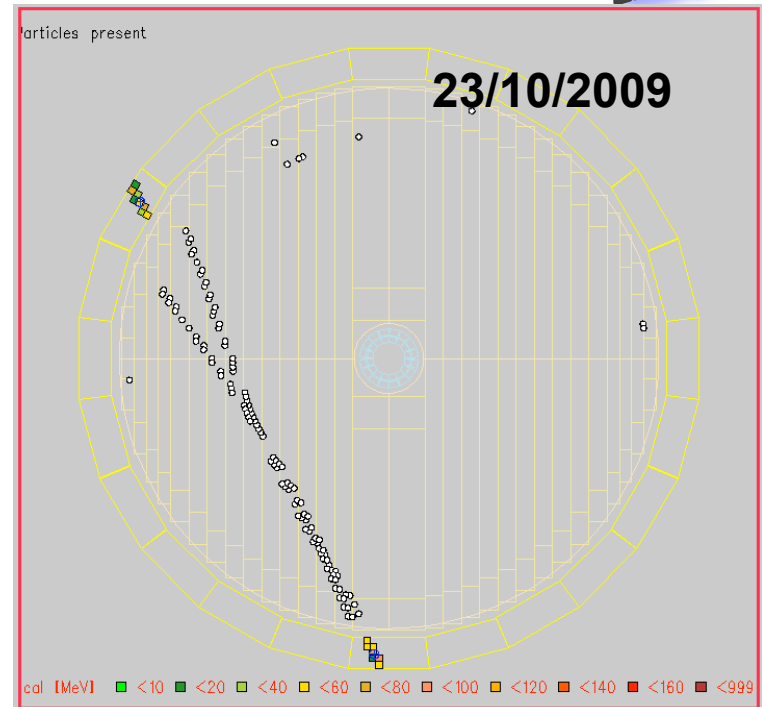
Remaining Dead channels < 3 (over 4880)





# Status of DCH

- preamps: replaced 60
- ADS: fixed O(10)
- HV board replaced 5
- TDC/ADC: replaced 2
- **HV ON with final gas mixture since end of may.**
- IsoButane flow removed to allow beam-pipe insertion & soldering of compensator supports.
- Now back to normal.
- Wire tensioning have been measured.
- Slight deterioration of sagitta  
Values inserted in simulation and reconstruction.



- L2: all new CPU's working, 2 spare boards
- Bandwidth of DAQ limited by VME to 20 MB/s/chain (overall throughput 200 MB/s)
- Calorimeter Trigger OK. Few more works needed on DC trigger
- All DAQ chains working: 10 for detectors + slow control + trigger
- New slow-control stable functionality
- Automatic running under test: " A great help for a long data taking"

ONLINE SHIFT training started. Collaboration with AMADEUS group alive --> they are helping our experts & starting training.

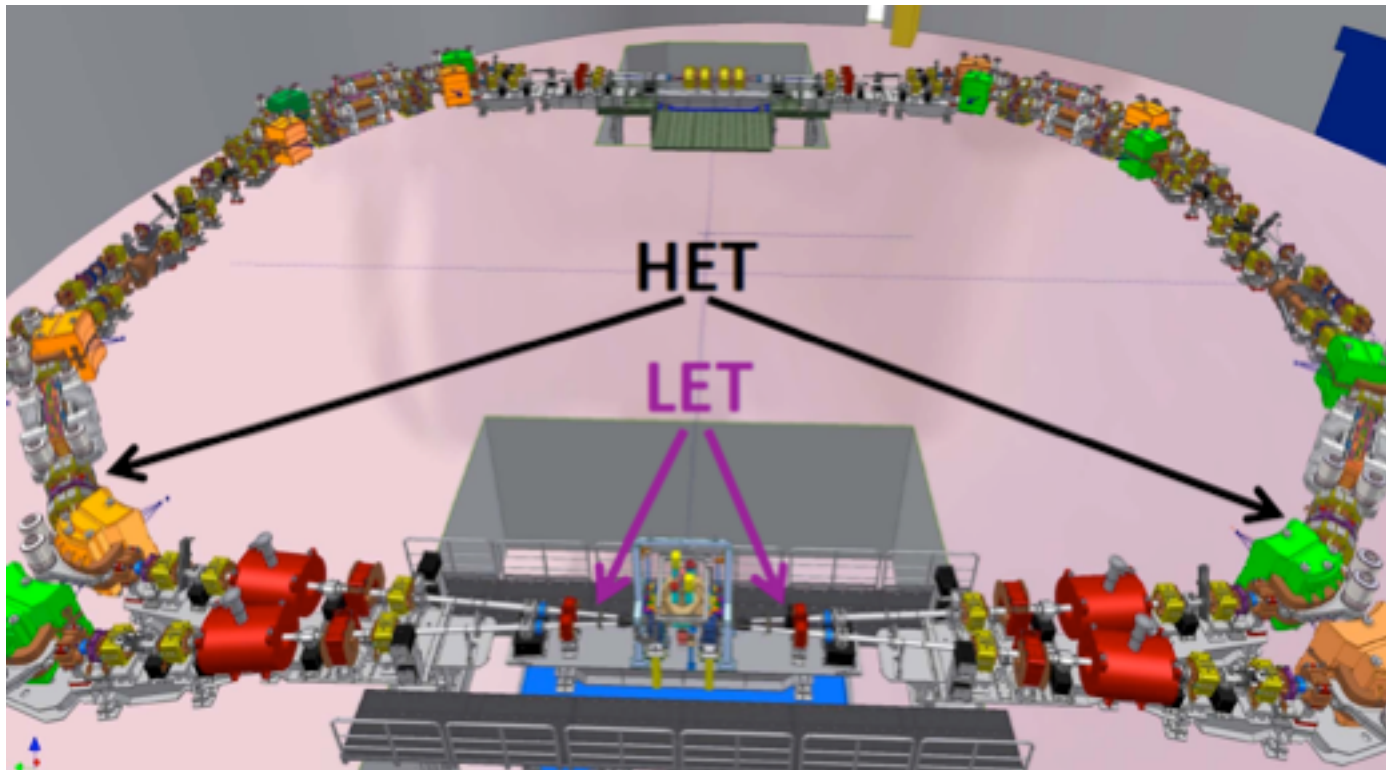
- DATA Storage on tape: 1.4 PB available for the data taking: new drives + copy of old data in new more performing 500 tapes .
- Temporary storage on disk: 1.3 TB online, 28 TB datarec
- New DaTAREC submission program under test
- Migration of DB from HEPDB to DB2 completed



# Status of the $\gamma\gamma$ -tagger

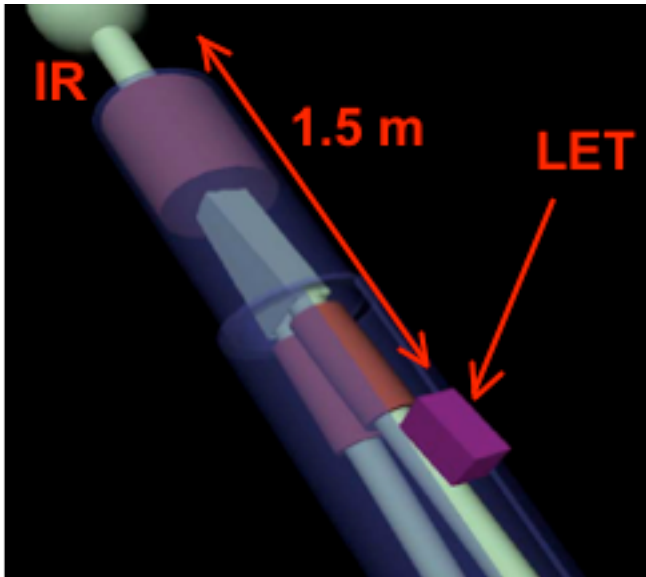
KLOE-2

- **LET (Low Energy Taggers)** are LYSO calorimeters placed inside KLOE
- **HET (High Energy Taggers)** are scintillator hodoscopes placed 11m on the beam line



# LET calorimeter status

130-230 MeV/c electrons are tagged in this position



The detector is composed by a **LYSO crystal matrix** with  $3 \times 3 \text{ mm}^2$  **SiPM readout**



All crystals obtained by SICCAS (Shanghai), QA done @Rome1  
 $3 \times 3 \text{ mm}^2$  SiPM from Hamamatsu, **FEE from SELF (LNF)**



# LET positioning on the "QCALT" screens

KLOE-2



- ❑ LET insertion tried in its own "slit" before mounting lead screens on IR1
- ❑ Positioning at the right 11 degrees angle to minimize leakage from Low Energy electrons
- ❑ The assembled LET detectors has been tested with final electronics on a bench checking with CR (at a scope) that all SIPM and Crystals were working.

Adoptep solution is SIPM + long cable + FEE in the pit.

# LET insertion on KLOE

KLOE-2

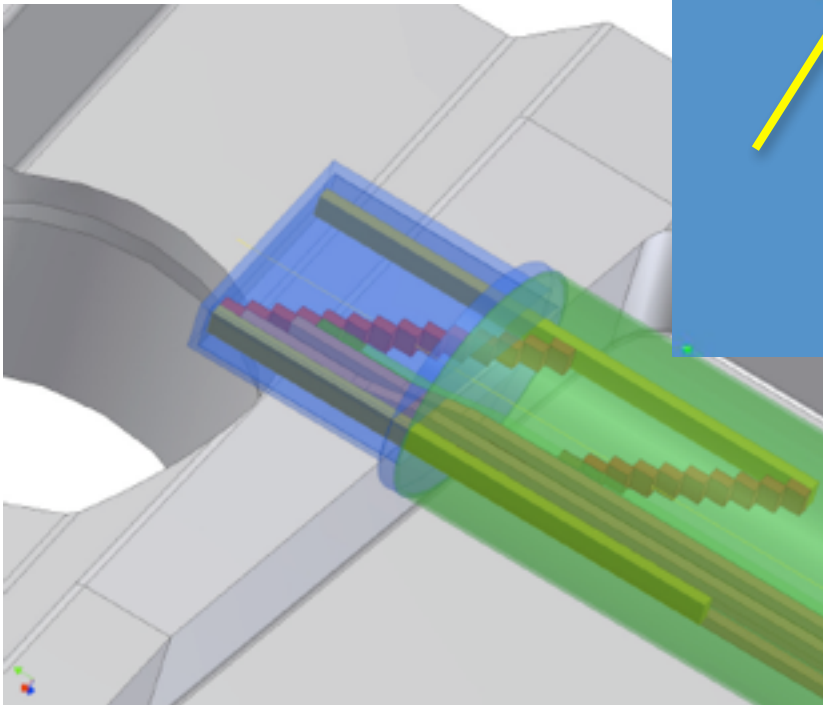
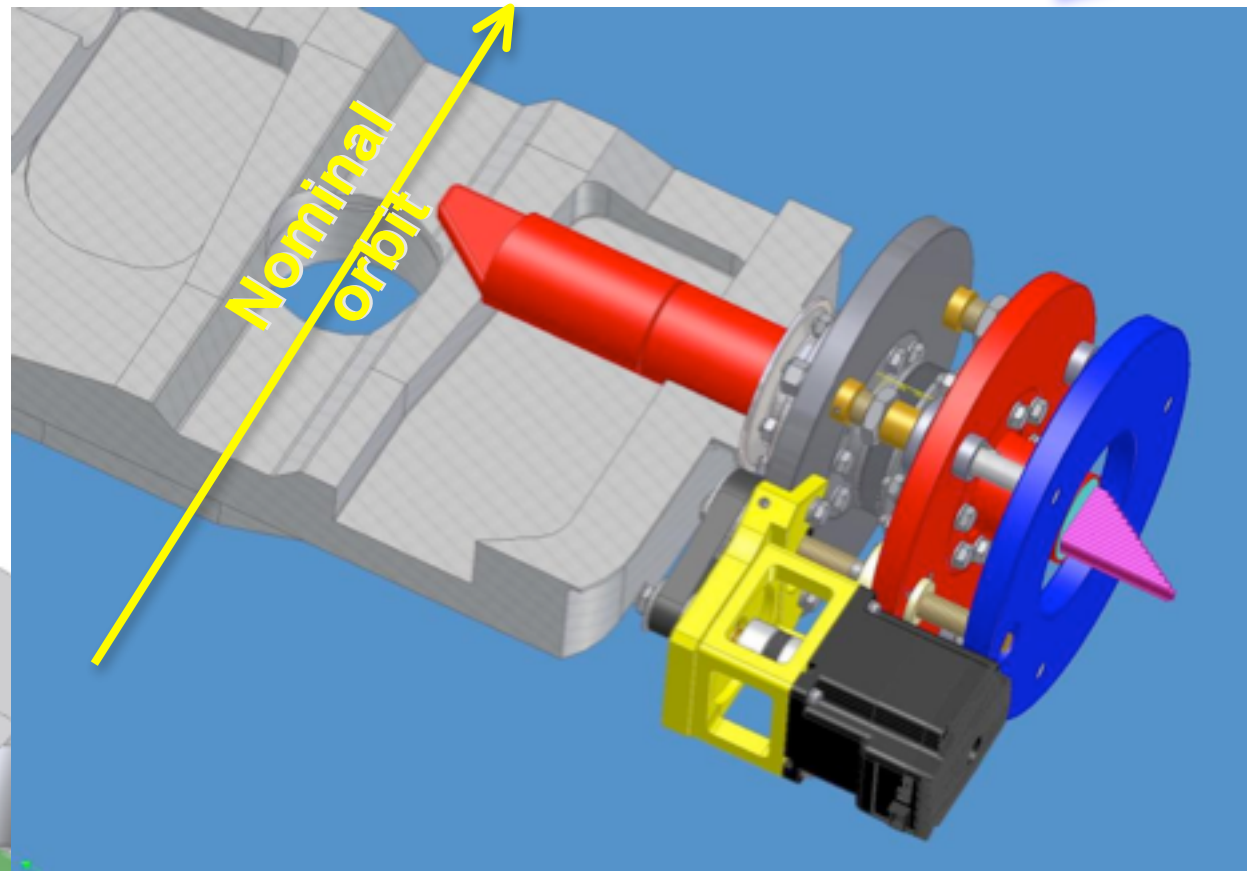


- ✓ LET inserted the fourth of june.
- ✓ Cables from SIPM to FEE (located in the pit) routed (3.5 m distance)
- ✓ FEE amplifier boards ready. Cables from FEE to SDS under preparation (routing external to KLOE)
- ✓ GIB board for HV driver and LED calibration driver ready. It will be positioned in a "temporary" crate in KLOE pit in the coming weeks.
- ✓ Calibration scheme in progress

# HET: A position sensitive detector

KLOE-2

Tracking of  $e^+e^-$  of high momentum in machine lattice in good agreement with MAD

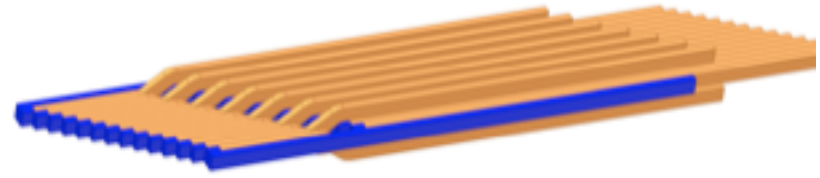
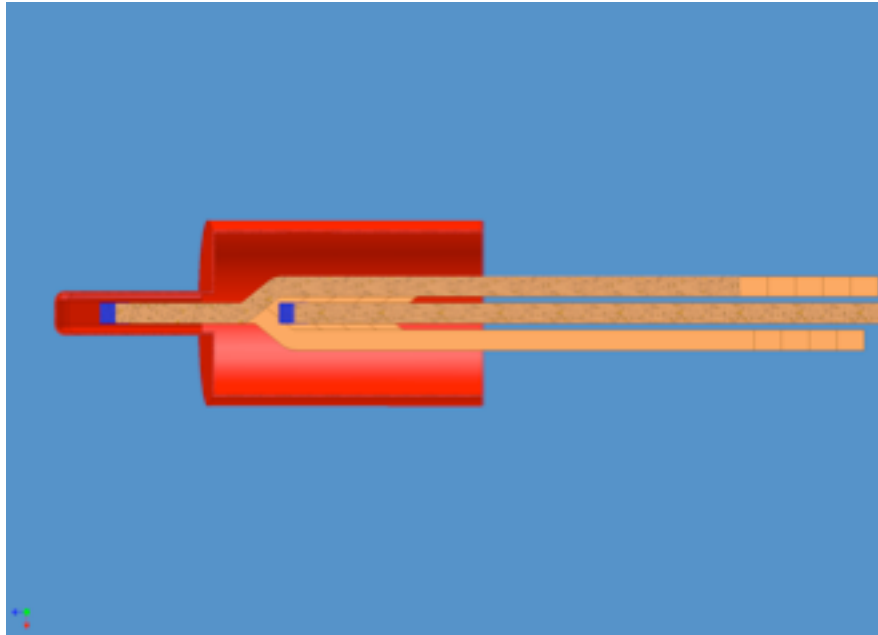


Scattered  $e^+/e^-$  position reconstructed with 1 mm precision by means of a scintillator hodoscope inserted in the DAFNE beam-pipe with a dedicated **motorized Roman Pot**



# HET: CAD of the Scintillator Hodoscope

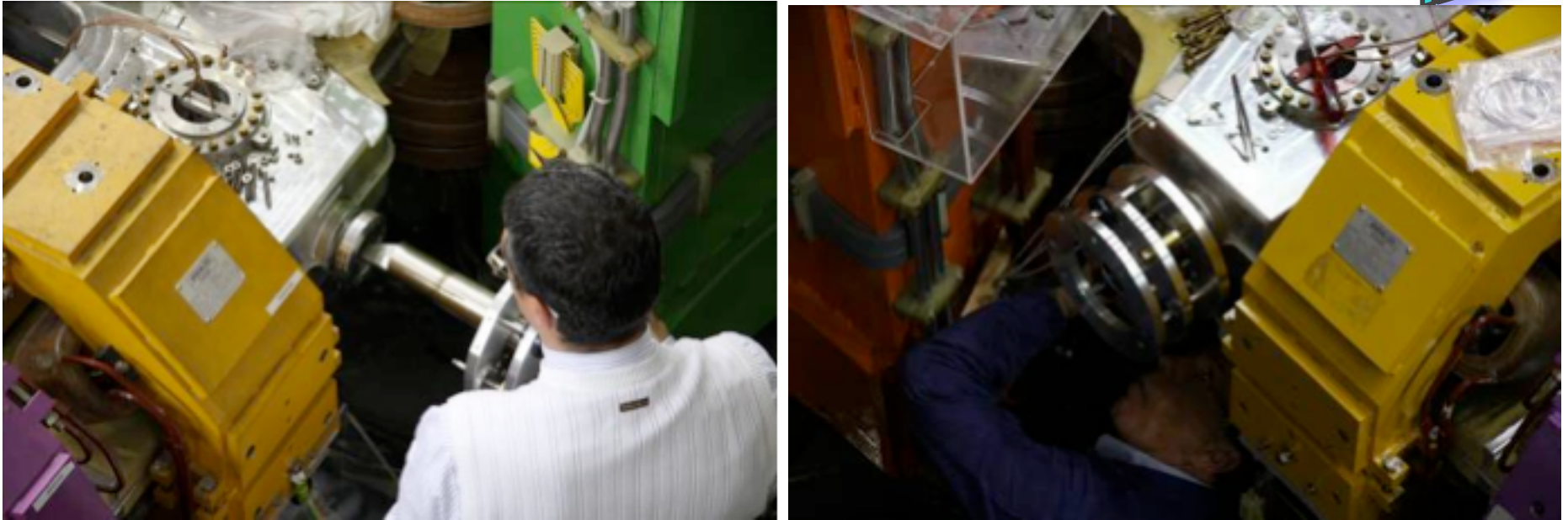
KLOE-2



- ❑ The hodoscope is composed by two rows of **15  $3 \times 5 \times 6 \text{ mm}^3$  scintillator** + 2  $3 \times 5 \times 120 \text{ mm}^3$  long scintillators for coincidence
- ❑ Fast signal by EJ-228 fast scintillator + PM R9880-110
- ❑ 300 ps time resolution measured at BTF. OK for the needed bunch separation ( $T_{\text{rf}} = 2.7 \text{ ns}$ ).
- ❑ **new Tbeam at BTF in one week to check effect of material (with a spare "nose") on the electron reconstruction**

# HET: Status of Roman Pot & plans

KLOE-2



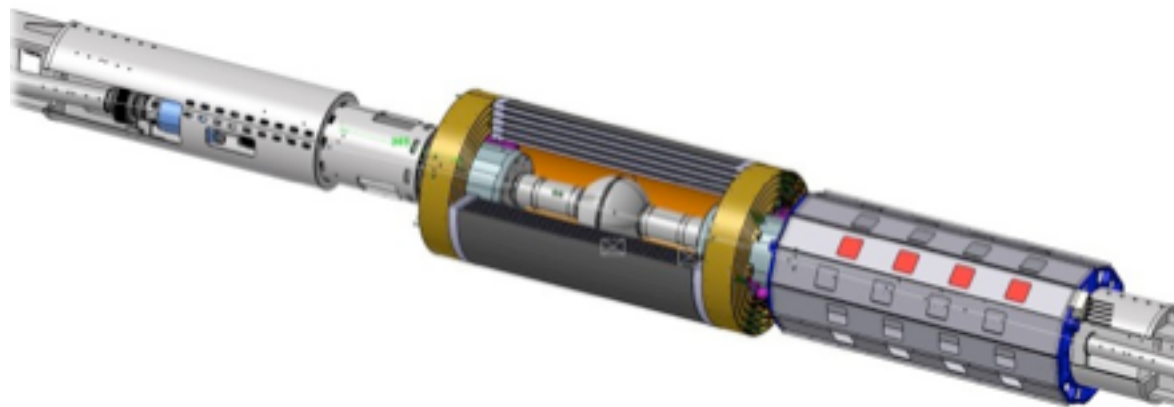
- ✓ Roman Pots inserted in DAFNE since half of may.
- ✓ Nose positioning system ready but still to be connected. Safe position at 5 cm from the beam. Minimum distance needed for single mesons ( 3.5 cm).
- ✓ Positioning of crates for electronics of standalone readout "agreed" with DAFNE
- ✓ First runs simple detector and standalone readout. Then real hodoscope will be inserted + readout integrated in KLOE-2 event reconstruction.
- ✓ Possibility to use SUM(Q) as dafne beam dump under discussion





# UPGRADES: status of integration over IR1

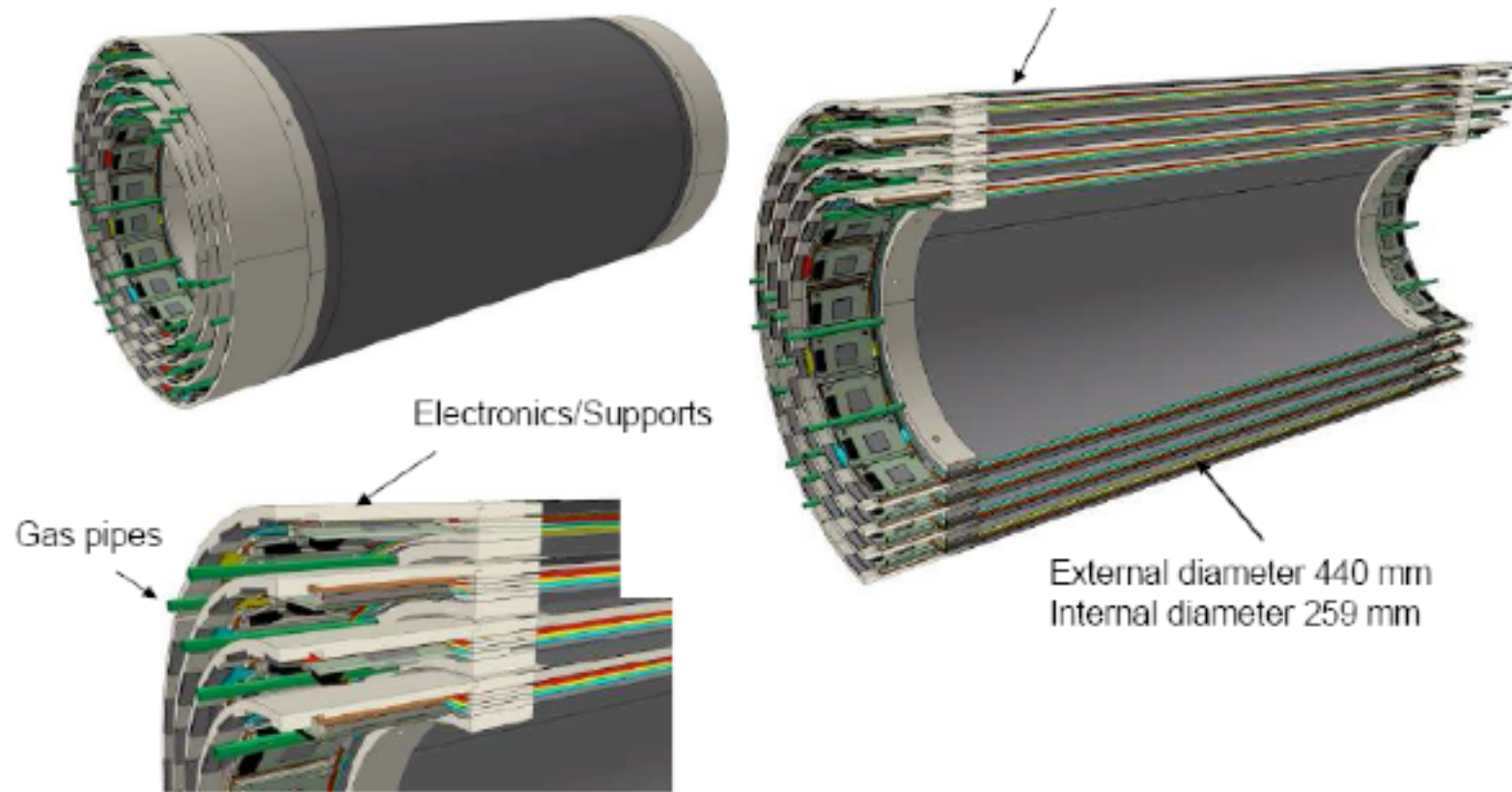
- The complications in inserting the IR1 in KLOE suggests to start a serious integration effort with DA of all the new detectors for the upgrade.
- *Cabling /services problems and interference btw upgrades also to be considered*
- *A "renewed" insertion system of IR1 probably needed*
- First implication limits the KLOE-2 detector diameter to 440 mm diameter:  
*IT moved from 5 layers --> 4 layers*



## IT: VTX resolution 4 vs 5 layers

- ✓ Studies performed using a VERY CLEAN sample:
- ✓  $K_S \rightarrow \pi^+\pi^-$  ,  $K_L \rightarrow \pi^0\pi^0\pi^0$
- ✓ Assumes external tracking on DC plus adding IT hits along helix
- ✓ No significant drop in efficiency
- ✓ Acceptable loss on VTX resolution

# layers	dx@vtx (mm)	dz@vtx (mm)	dx@pca (mm)	dz@pca (mm)
5	1.6	1.1	0.5	0.85
4	1.7	1.18	0.5	0.85
NO IT	4.2	3.1	1.6	2.2



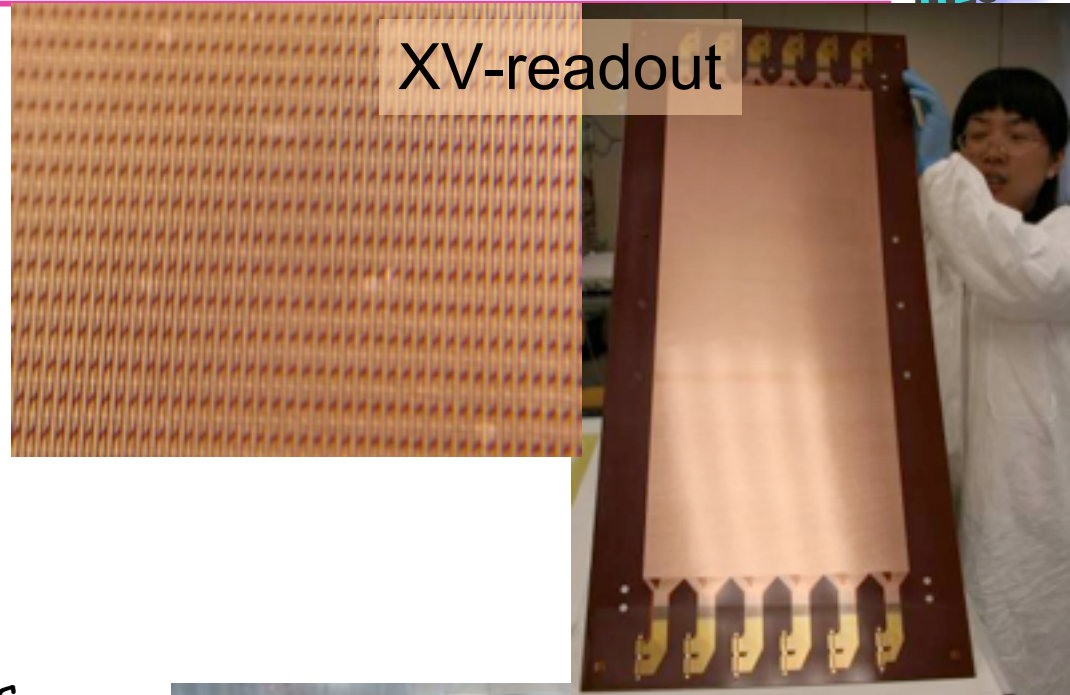
- Fiber glass rings used to mechanically couple the cylindrical electrodes of each layer (3 GEMs + 1 cathode + 1 readout anode)
- The anode is embedded in a thin (0.1 mm) skin of Carbon Fiber
- Cylindrical extensions in Fiber Glass allows to support GAS, HV and FEE.



# IT : status of GEM, readout & planar protos

KLOE-2

- The **gerbers** of various printed circuits designed together with the CERN PCB department where they will be build
- 6 first prototypes of "large area " GEM arrived in april (single mask technique, 300x700 mm<sup>2</sup>)
- Two large area planar prototypes built. One with a XV readout as in final detector.(650 mum pitch)
- The large proto of planar GEM will be equipped with final FEE (Gastone 64) + readout with final DAQ system to be tested at the T9 area (PS @CERN) in October.  
CR week-test planned



# IT: GEM survey & electrodes assembly

KLOE-2

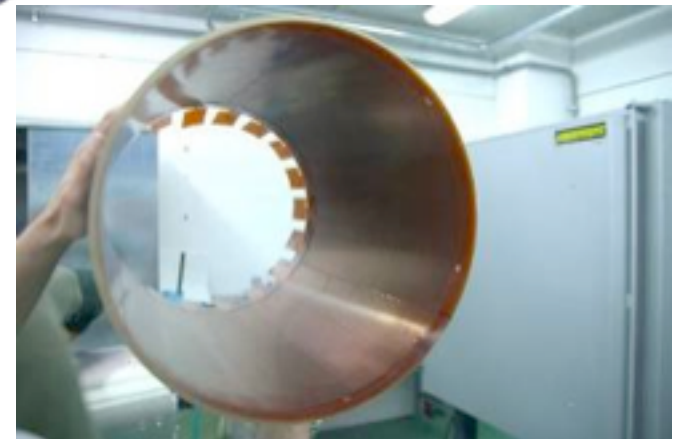
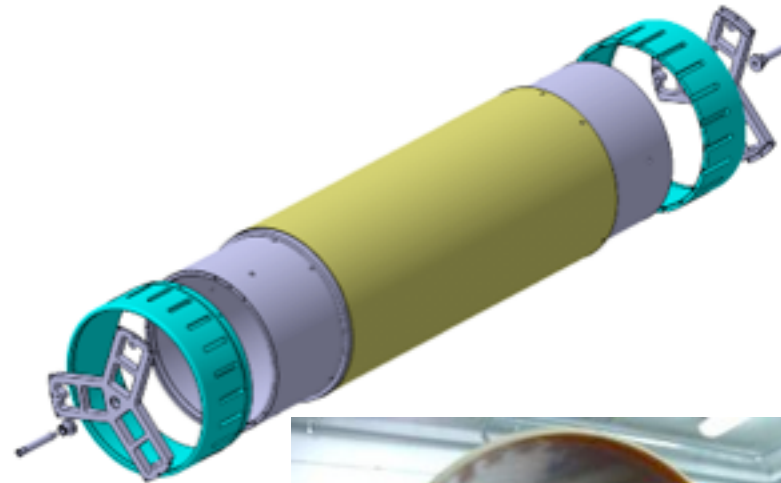
## QA of GEMS:

- (1) Optical inspection ( Microscope with X-Y positioning system connected to a camcorder with image software)
- (2) HV control box (plexiglass box filled with N<sub>2</sub>)

□ Cylindrical Moulds ( Aluminum covered by a Teflon foil) are the basic tool for the construction allowing to build the cylindrical electrodes starting from Kapton fo (GEM, cathodes and anodes)

□ 5 moulds/layer (3 GEM, 1 cathod, 1 anode)

Purchase order done --> arrival on july

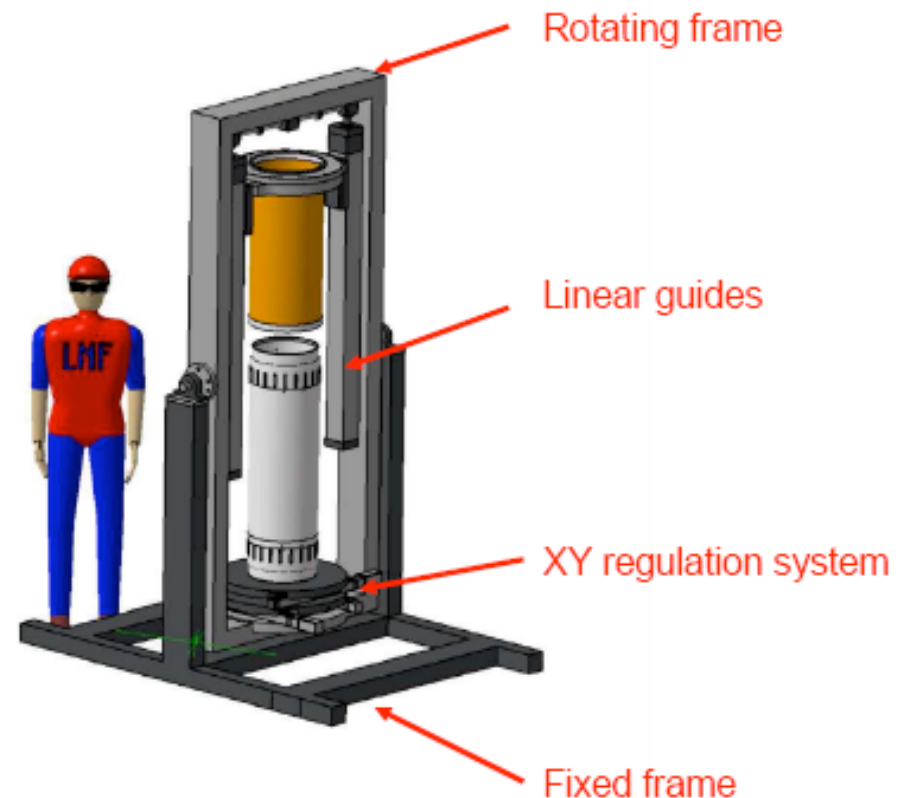


# IT: Vertical Insertion System (CLESSIDRA)

KLOE-2

- The Vertical Insertion System (VIS), allow to assembly each IT layer by inserting the cylindrical layers one inside the others with high precision while keeping the GEM tensioning w.r.t to the CF embedded anod.
- Insertion executed by means of precise linear guides moved by step-motors.

- Survey of the insertion carried out by 3 camcorder each at 120 degrees.
- The rotating system w.r.t. to an horizontal axis allows to glue the detector on both sides.
- Executive Drawings ready, ordering under way!
- Expected completion October





# IT: Overall status of the project

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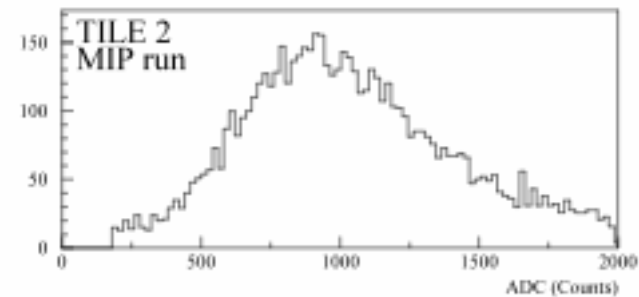
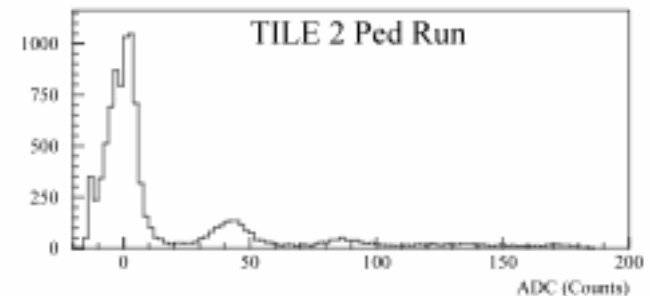
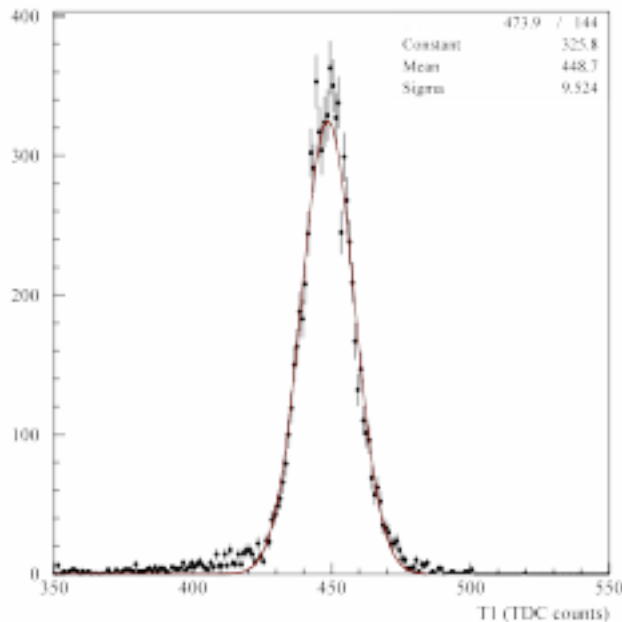
KLOE-2

- ✓ Design of the detector and assembly tools completed.
- ✓ Purchase orders for construction of the first IT layer done.
- ✓ The first large area GEMs and the readout anodes are in our hands.
  - First current tests are ok.
  - Construction of two planar prototypes done.
- ✓ FEE chips (final version of Gastone64) will be used to equip the planar prototype to be tested at CERN the coming October.
- ✓ Construction of first layer planned for september
- ✓ At the last CSN1 meeting (middle of may) we got financed also the construction of the second layer.

# QCALT: lessons from module 0

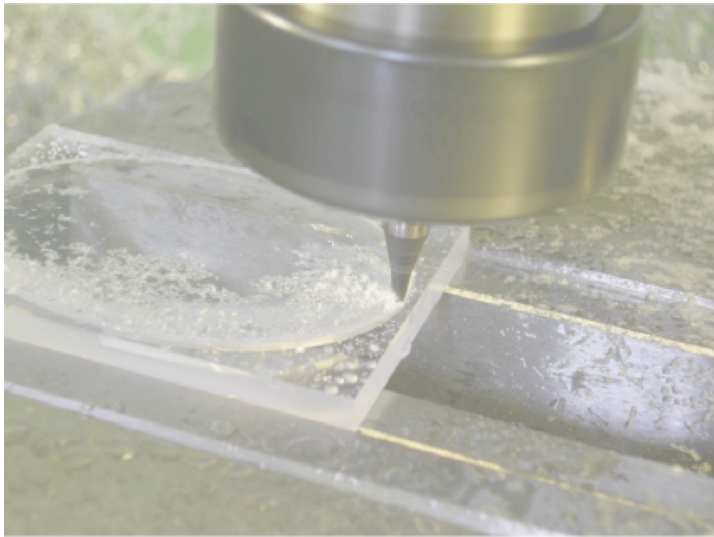
## Module 0 construction financed in 2009

- Light yield study vs tile wrapping (Tyvek vs reflective paint)
  - Construction technique learned: tile preparation, fiber routing, fiber-sipm coupling.
  - Integration with IT & KLOE: size , cable routing + SMD SiPM
- 
- First 15 tiles/100 measured with CR
  - First test @ BTF with electrons of 100 - 500 MeV done last week

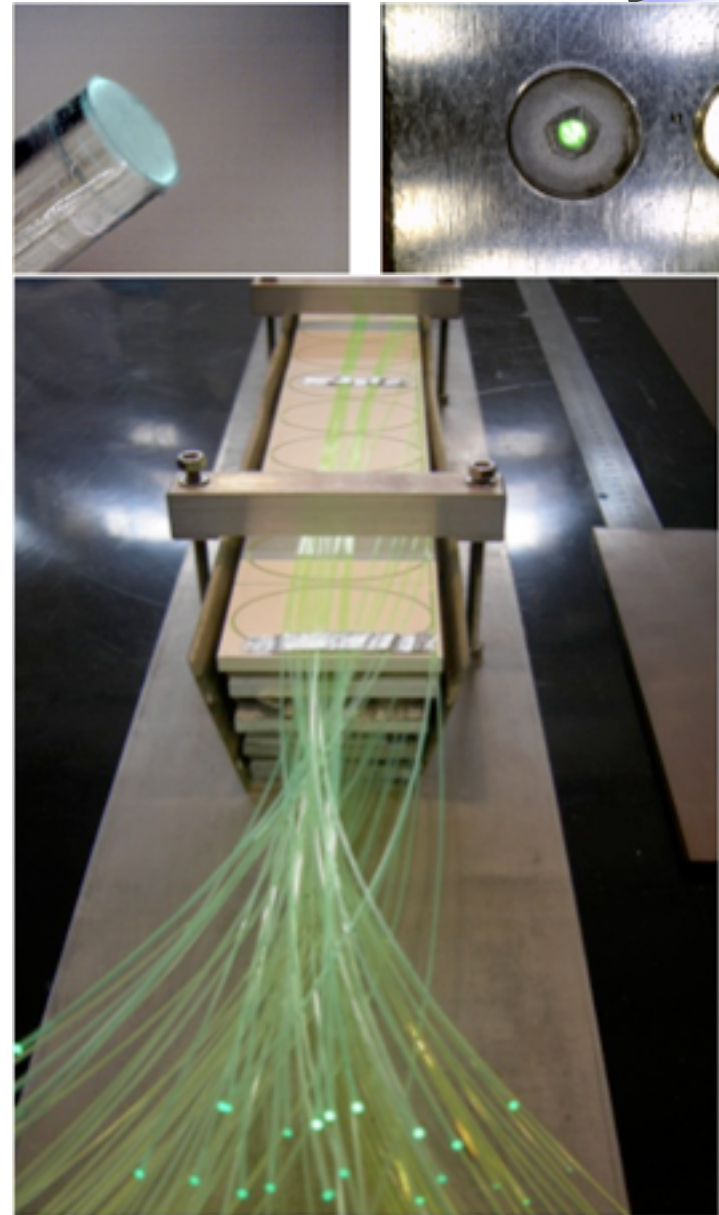


## Tooling per QCALT

Tiles preparation, as for module 0, will be done @ LNF mechanical shop.



- Tile painting at an external firm.
- Survey of tile dimension needed before assembly
- Fiber polishing should be done by milling
- Test during construction could be done by Cosmics for each single module

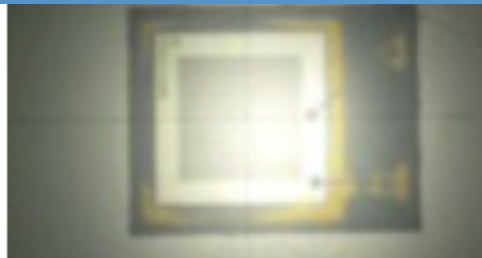
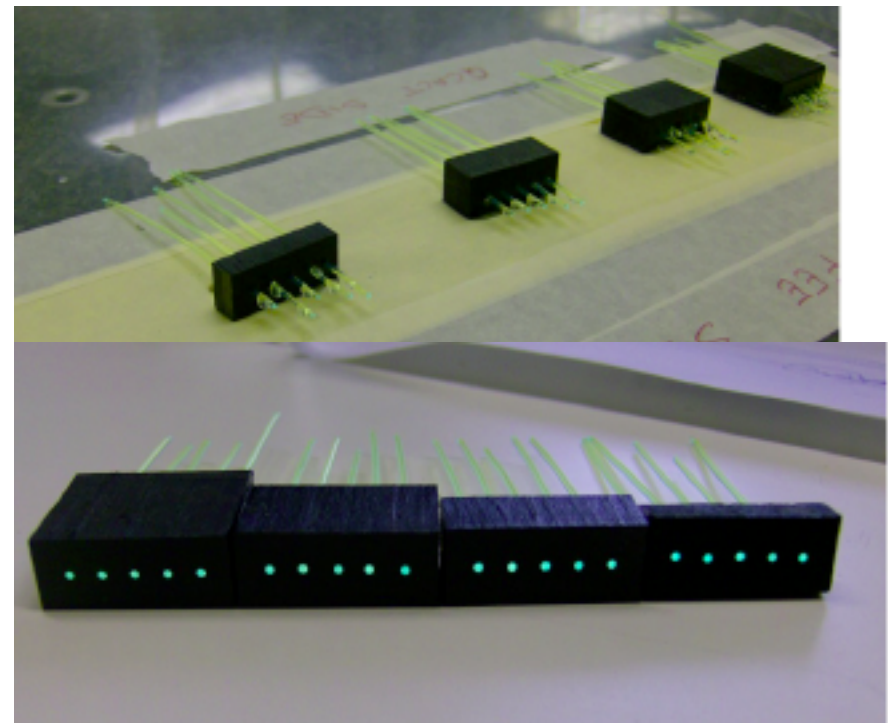
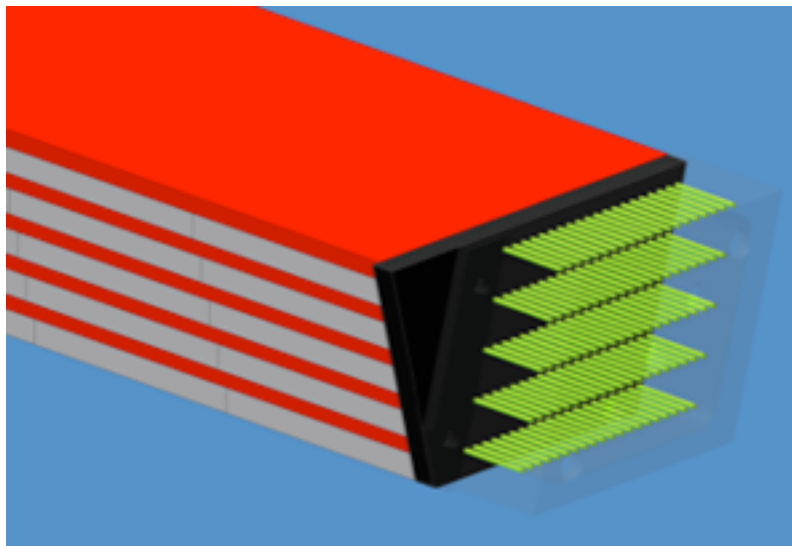




# QCALT: final interface fiber-SiPM

KLOE-2

- The lack of space in KLOE asks for smd-SiPMs mounted on a PCB facing a flat surface of WLS fibers.
- First 10 smd-SiPM from Hamamatsu ok. Another sample being delivered byIRST-fbk (Trento)
- The survey of a smd-SiPM showed perfect planarity & dimensions
- Fiber edges finished with the milling machine
- No broken fiber/16 tried with ~ 1 cm tick fiber holder.



# QCALT: Overall status of the project

---




- CAD Drawings for mechanical assembly almost completed (Needing to be blessed by Integration Meetings with IT/IR1)
- Next month dedicated to complete the engineering for SIPM-Fiber Interface
- At last CSN1 meeting we got financed for mechanical construction of six modules + the first prototype of final FEE readout board
- Orders for tiles, fibers underway
- Orders for mechanics/W plates after the summer
- Tiles preparations starting in september
- Module assembly starts in november

# Status of the KLOE-2 collaboration

KLOE-2

- The upcoming step of moving from a "virtual" to a real experiment is bringing renovated resources to KLOE-2:
- Krakow group is actively working on analysis item
- Uppsala group has obtained two PHD students to work in KLOE-2
- 2+1 new postDocs are coming via European Networks and INFN Fellowships

## Nuclear and Hadron Physics Research



UPPSALA  
UNIVERSITET

Nuclear and  
Particle  
Physics

På svenska

Listen

Research:  
Nuclear Physics

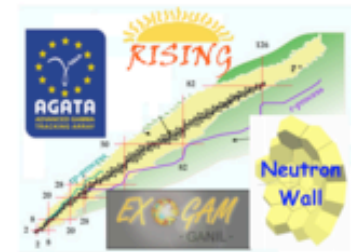
### PhD student positions

Two PhD student positions in Experimental Hadron Physics are available at the Division of Nuclear and Particle Physics within the Department of Physics and Astronomy at Uppsala University. Here you can look at the [details](#) and the [instructions](#) for the application. Application deadline is 29 April 2010.

### In-beam gamma-ray spectroscopy:

Nuclear structure studies using multidetector arrays like the Neutron Wall, EXOGAM, and RISING. Research and developments of the advanced gamma-ray tracking array AGATA.

Contact person: [Johan Nyberg](#)



### KLOE-2:

KLOE-2 detector is operating at the improved DAFNE e+e- collider of the Laboratori Nazionali di Frascati, Italy. The KLOE-2 physics program is wide, including studies on: neutral kaon quantum interferometry, precise tests of lepton flavour violation and measurements of rare Ks,  $\eta$  and  $\eta'$  decays.

Contact person: [Andrzej Kupsc](#)





# Conclusions & Plans

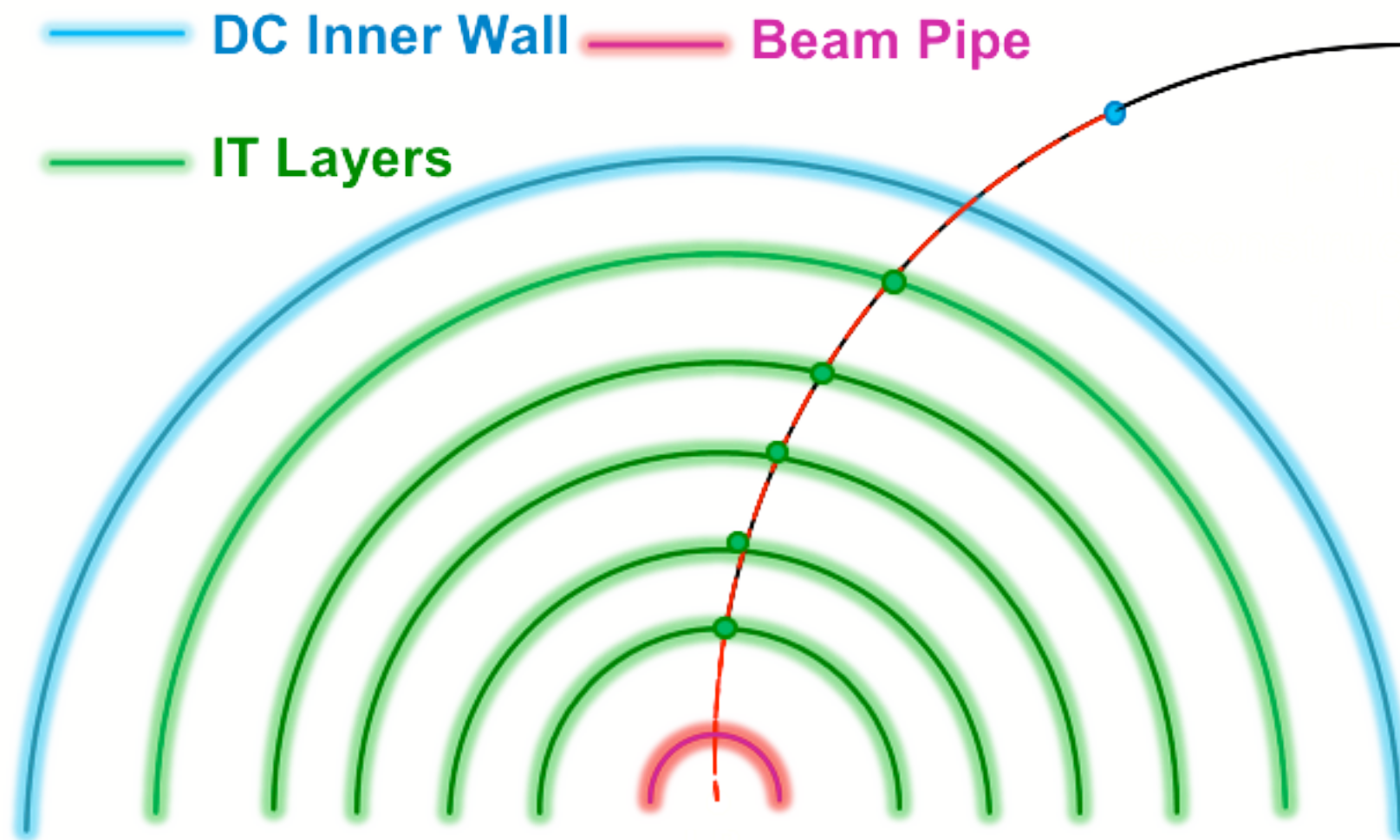
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- ✓ Seven months after the closing of Siddharta, DAFNE is almost ready  
KLOE-2 is in place with IR1 installed , EndCaps closed.
- ✓ The preparation of the apparatus has been completed including installation of new gamma-gamma taggers
  - SHIFT training started.
  - **Upgrades will be ready for installation in autumn 2011.**
- We plan to run as continuously as possible after a short engineering run for ~ 1 year. The run will then be stopped to allow upgrades insertion (IT corresponds to a factor x 4 gain in luminosity ).

## First Run physics Milestones:

- gg-physics
- Pseudoscalar and scalar mesons (ex .  $\phi \rightarrow K_s K_s \gamma$ )
- Rare limits:  $K_s$  to  $3\pi^0$
- Interferometry :  $K_s K_l \rightarrow \pi^+ \pi^- p^0 p^0$
- Limits on dark matter search

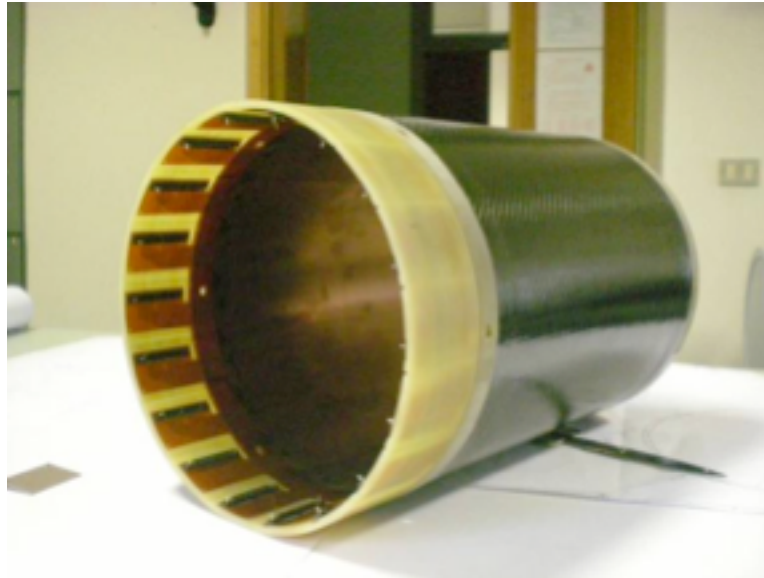






# Mechanical Tests

Built the full size “*mechanical model*” of the first layer of the IT including the FEE and the detector support (in CF). 3-D measurement & load test done.



Buckling ~7.5 ton, well above the 100 kg load needed for GEM stretching.

Radial deformations ~70 $\mu$ m @ 600 kg

# L'elettronica per l'IT

I test effettuati sulla prima release di Gastone a 64 canali, consegnati a fine 2009, hanno confermato le ottime prestazioni sulla linearità e uniformità alla carica, come la precedente da 16 canali.

Si sono stressati gli ingressi con cariche superiori ai 10 fC, per misure "worst case" di cross-talk tra canali. Needs of a second release with a better ground distribution and to optimize the number of PINS I/O.

- **Mixed analog-digital circuit**
- **Low input equivalent noise, low power consumption and high integrated chip;**
- **4 blocks:**
  - charge sensitive preamplifier
  - shaper
  - leading-edge discriminator (prog. thr.)
  - monostable (stretch digital signal for trigger)



## Tooling and Components

- **Cylindrical moulds to make electrodes: end of June (L1) – end of July (L2)**
- **Detector mechanics (fiberglass rings): end of June**
- **Quality control system (microscope + HV test box): ready**
- **GEM foils: mid of July**
- **Readout anode circuits: end of July**
- **Vertical assembling machine (mechanics + electronics): mid of September**

## Production

- **July: test of all GEM foils and production of a fake layer**  
**September: start of Layer1 construction**
- **October: Integration and test of vertical assembling machine**  
**November: Layer1 assembling**
- **December: Layer1 test**