QCalT: a tile calorimeter for KLOE-2 Upgrade

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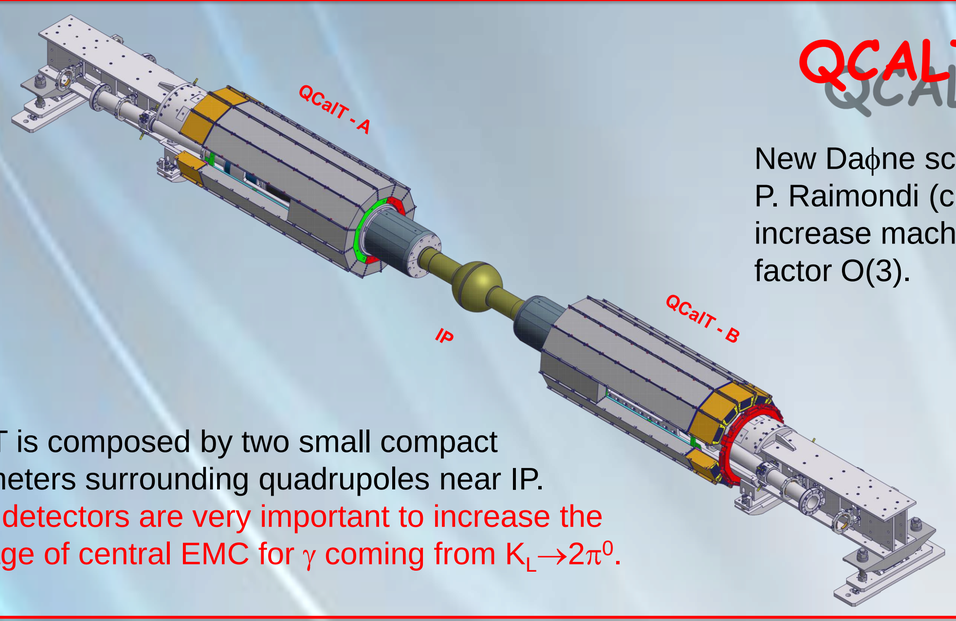
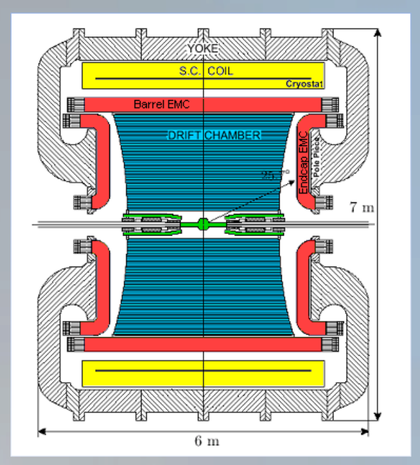
QCALT requirements



QCALT is composed by two small compact calorimeters surrounding quadrupoles near IP.
These detectors are very important to increase the coverage of central EMC for γ coming from $K_L \rightarrow 2\pi^0$.

New Daϕne scheme proposed by P. Raimondi (crab waist) to increase machine luminosity by a factor O(3).



-The QCAL used in KLOE were 5 cm thick with 16/15 layers of 2 mm Pb, 1 mm BC408 scintillator.
- Readout by 1 mm WLS fibers (Kuraray Y11-200) optically coupled to standard PMs.
- Small number of pe: 3 pe/tile
Z position by time difference (12-14 cm resolution)

Detector design

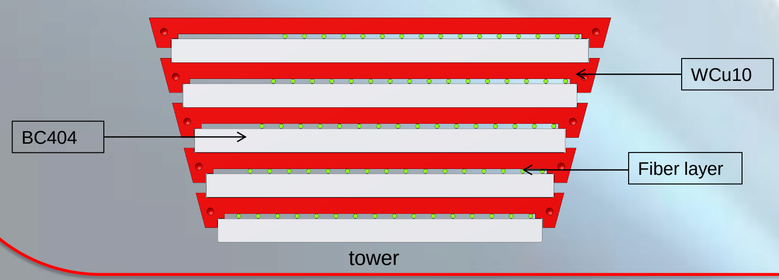
Sampling of tungsten and scintillator tiles readout by SiPM

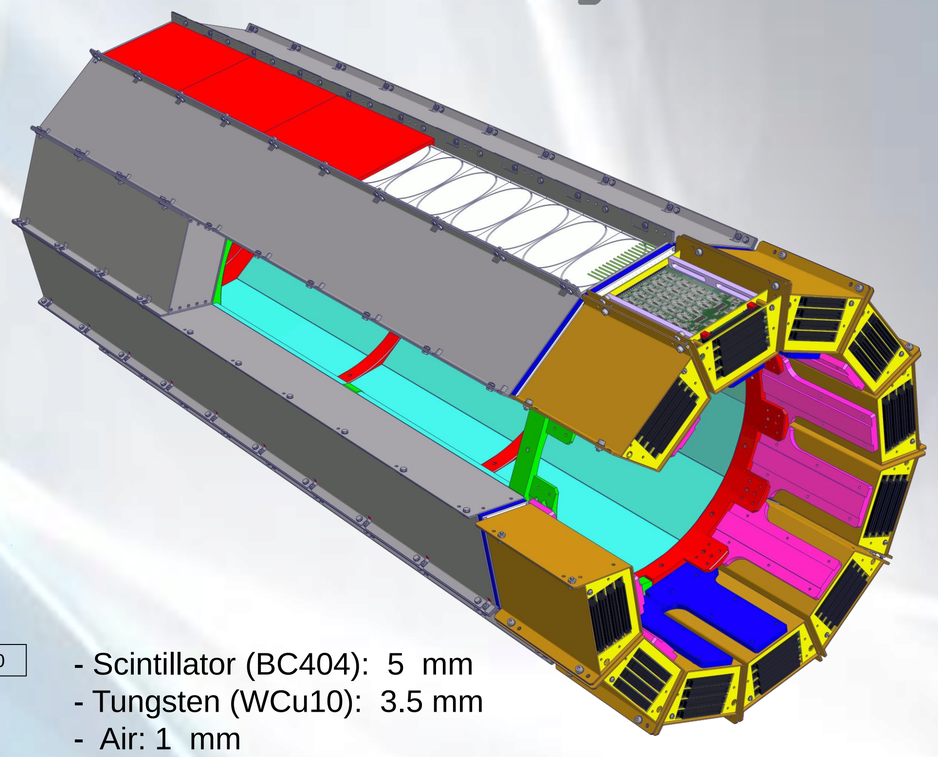
Stainless steel structure since inserted in a strong magnetic field (0.52 T)

A dodecagonal structure with one module without active readout to allow inserted of LET calorimeter.

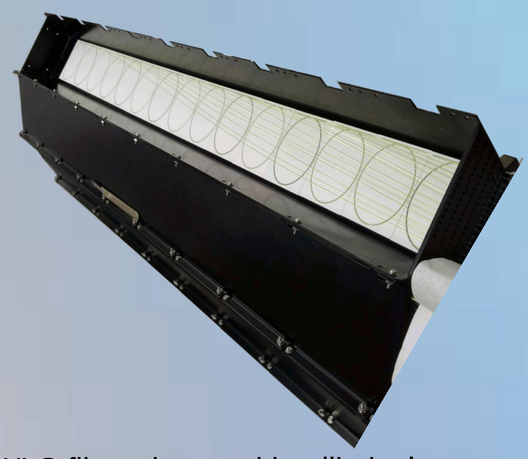
-Total calorimeter length: 800 mm
- Inner/External radius: 270 mm / 418 mm
-Total weight: 300 kg

Each module is composed by 16 towers of 5 layers for a total of 80 readout channels.
Total independent channels: 880 Ch/QCalT



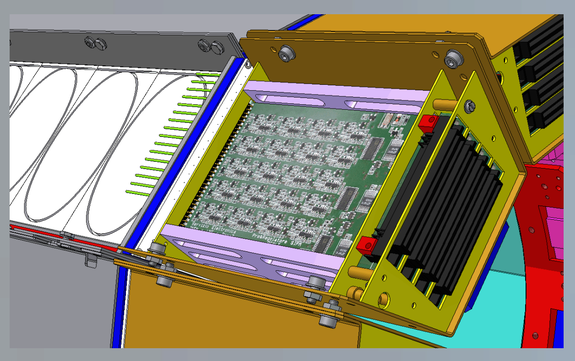


- Scintillator (BC404): 5 mm
- Tungsten (WCu10): 3.5 mm
- Air: 1 mm
- 5 cm tiles along Z
- Total calorimeter depth 4.75 cm, equivalent to 5 X_0



- WLS fibers inserted in elliptical groove in the tile at different depth along path with 6 degrees angular exit. This allow to place different tiles close to each other.
- Scintillator: BC404
- Tiles painted using BC620 refractive paint.
- Fiber: Saint Gobain multicladding 1 mm, emitting green light
- Calorimeter assembled completely without glue.
- 80 fibers/module glued in a black Plexiglas fiber holder directly coupled to SiPM board.

Calorimeter readout and FEE

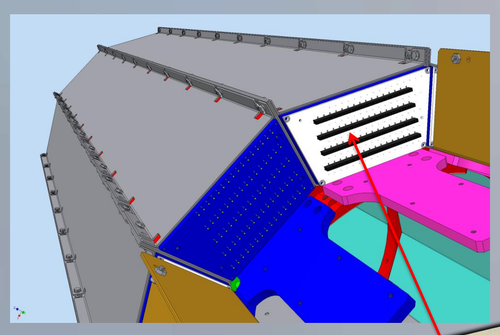


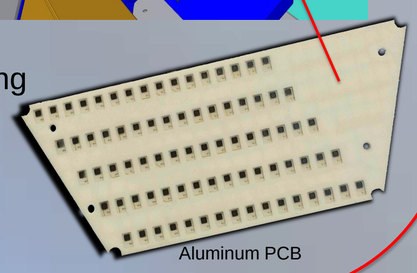
Each fiber readout by a single 1.2 diameter circular SiPM.
Custom photodetector developed in collaboration with Italian FBK. Round SiPM, peak response on green, 25 micron pixel size.
Bias voltage at 35 V.
80 SiPM on aluminum PCB: planarity (0,01 mm) and SiPM positioning (0.05 mm).

On Detector FEE board with 20 channels/each (4 boards/module). HV regulation (0.1% precision, 0.01% stability), transimpedance preamplifier (x 20) and single threshold discriminator. Differential output.

Global Interface Board (GIB) developed for KLOE-2 upgrade to control FEE.

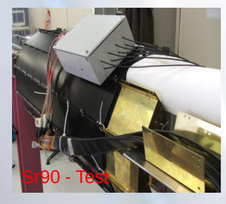
Calorimeter reconstruction based only on timing, using 0.5 ns resolution TDC.
QCALT calibration achieved by dark counts rate, no ADC required, 10 bit scaler.

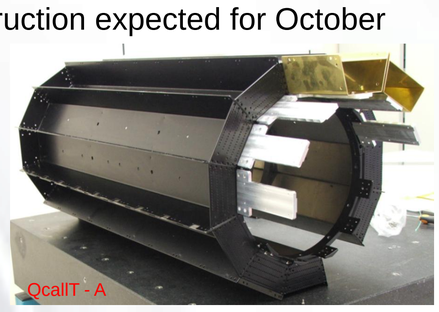


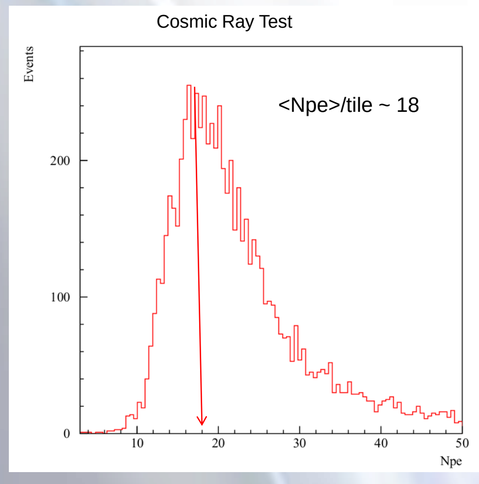


Now in progress….

- QCALT construction now in progress.
- First half calorimeter realized and tested.
- Second mechanical structure already in preparation.
- End of construction expected for October 2012.







Now in progress test beam at Frascati beam test facility (e^- from 200 to 500 MeV).

Each single tile tested during assembly using Sr90 source to check fiber/tile optical coupling and fiber damage.