Update on the DIRC-like TOF detector

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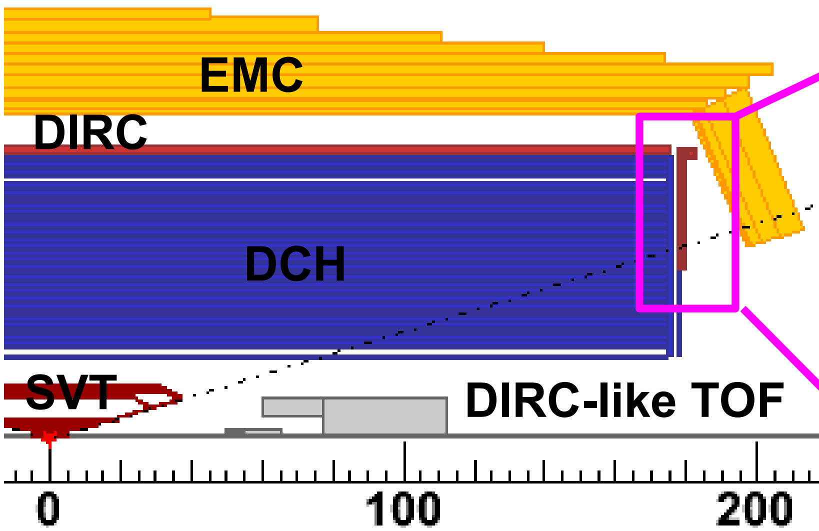
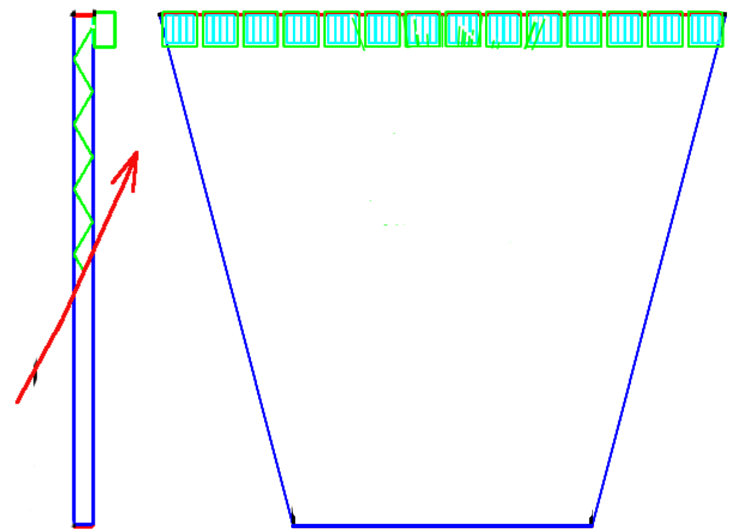
SuperB Workshop
Elba May 31, 2012

Reminder



Front and side view of the FTOF detector



- PID device (K/π separation)
- Detector made of 12 quartz sectors
- Polar angle coverage is about 10° (15°–25°)
- Each sector is readout by 14 MCP – PMT SL10 (TTS~35ps)
- Thickness of the detector 1.5cm (12% of X_0)

R_{max}	90 cm
R_{min}	45 cm
θ_{max}	26.0°
θ_{min}	15.5°
z_{max}	175.0 cm
z_{min}	180.0 cm

FTOF optimization

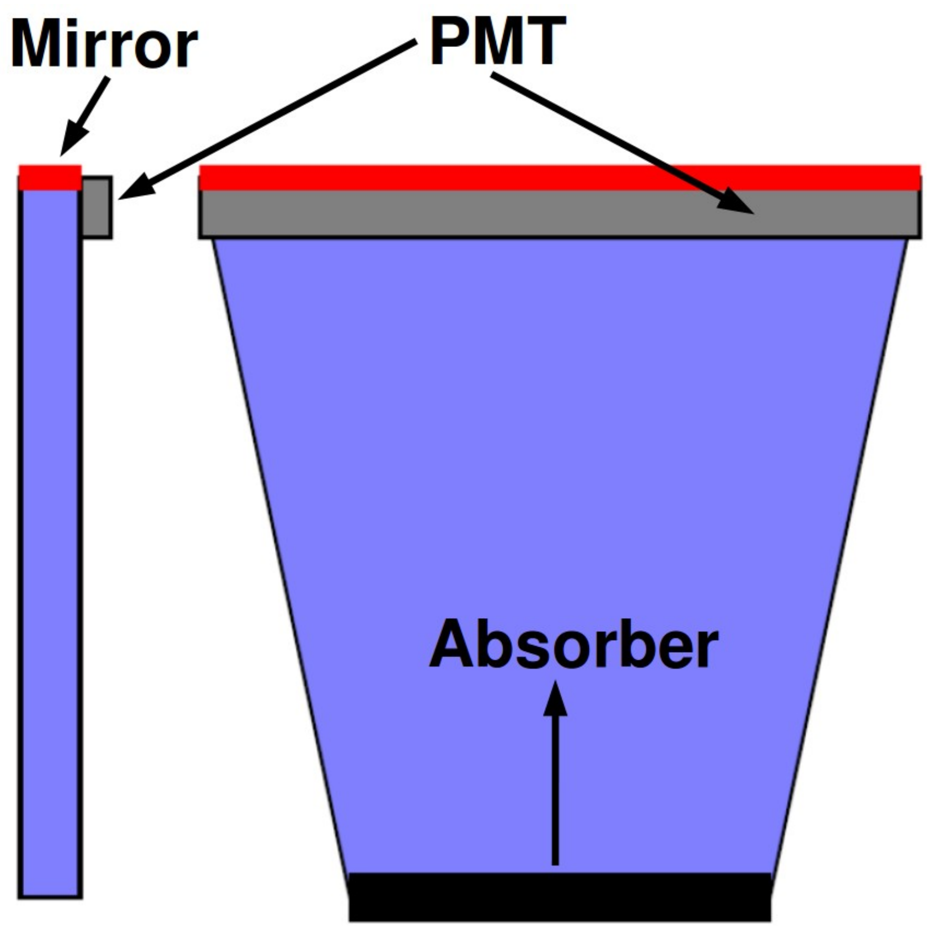
→ increase p.e. yield.

→ minimize timing jitter.

Optimal choice of the FTOF Geometry

See backup slides

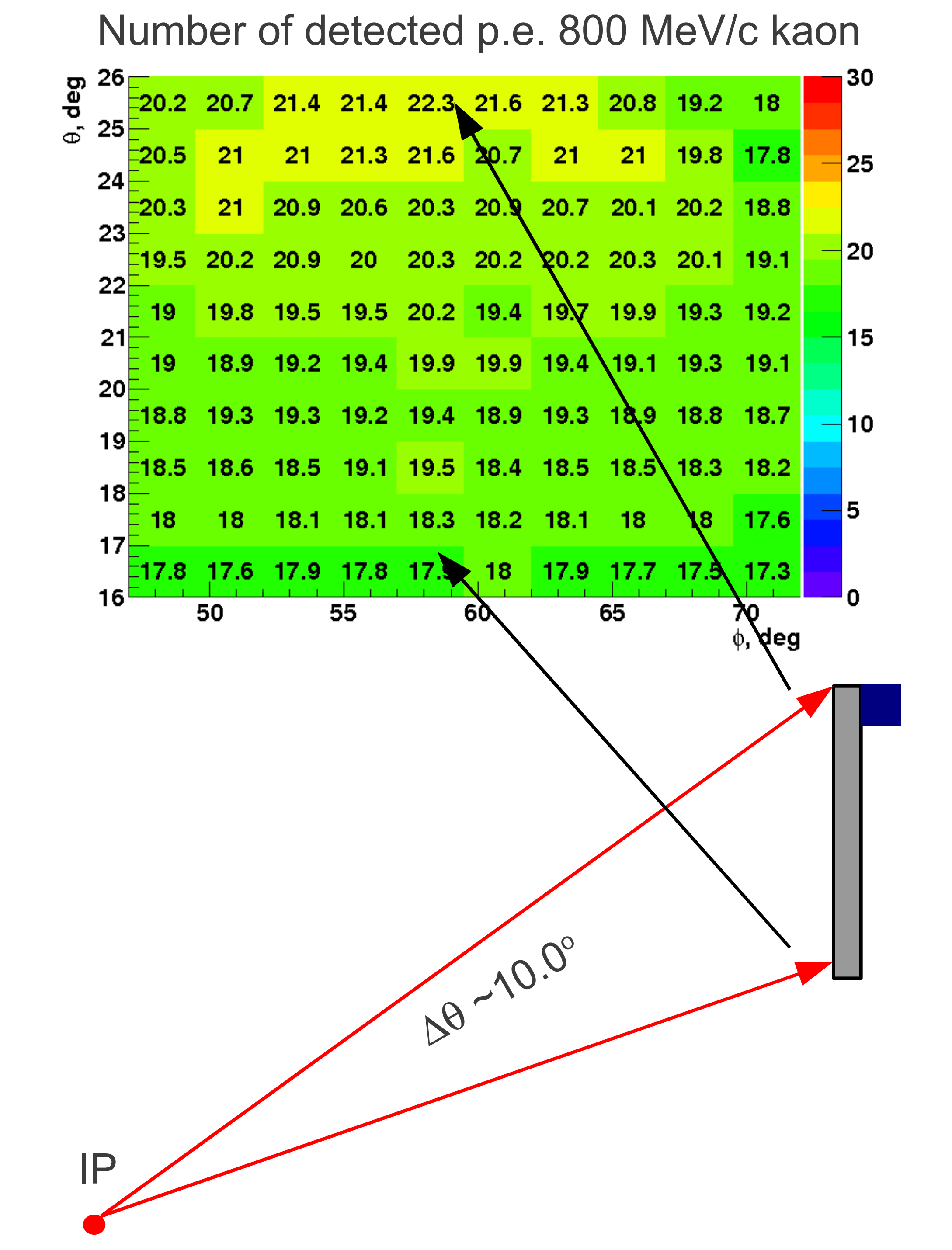
Quantity	value
PMT position	B
PMT orientation	V or H
Mirror	+
Absorber	B
Tilting	-
Radiator thickness	15 mm
MCP-PMT	[illegible]
Number of channel per PMT	4
Total number of PMTs	168
Total number of channels	672
MCP-PMT photocathode	Multialkali
Reconstruction algorithm	complex
Time window	10 ns
$\sigma_{\text{electronics}}$	10 ps
σ_{TTS}	40 ps
σ_{detector}	80 ps
σ_{trk}	10 ps
σ_{t0}	20 ps
$N_{\text{p.e.}}$	>10
Total time resolution	<40 ps



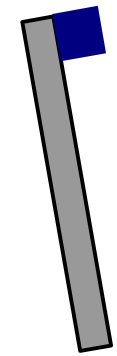
σ_{tot} ~ 1/sqrt($N_{\text{p.e.}}$)

For 3 GeV/c momentum kaon, $N_{\text{p.e.}}$ ~ 18 => time resolution ~ 30 ps

Small tilting of the FTOF



Tilting by 10° decreases the p.e. yield by about 15%.



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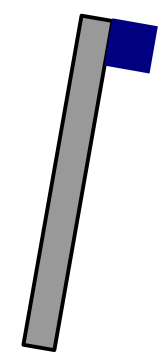
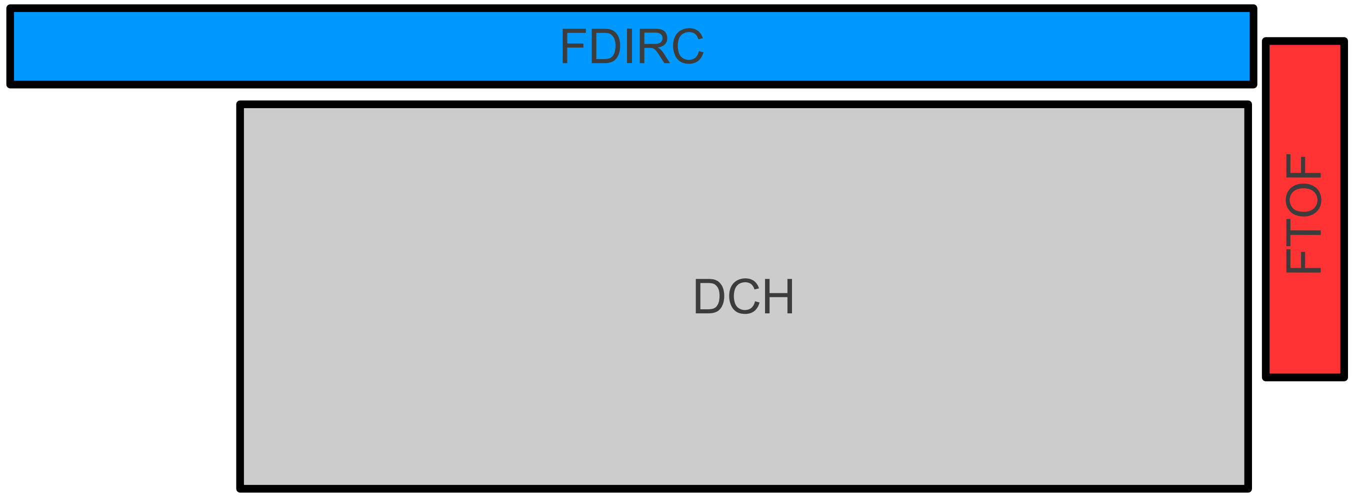


Information from the Geant4 about detector which surround FTOF



Present state

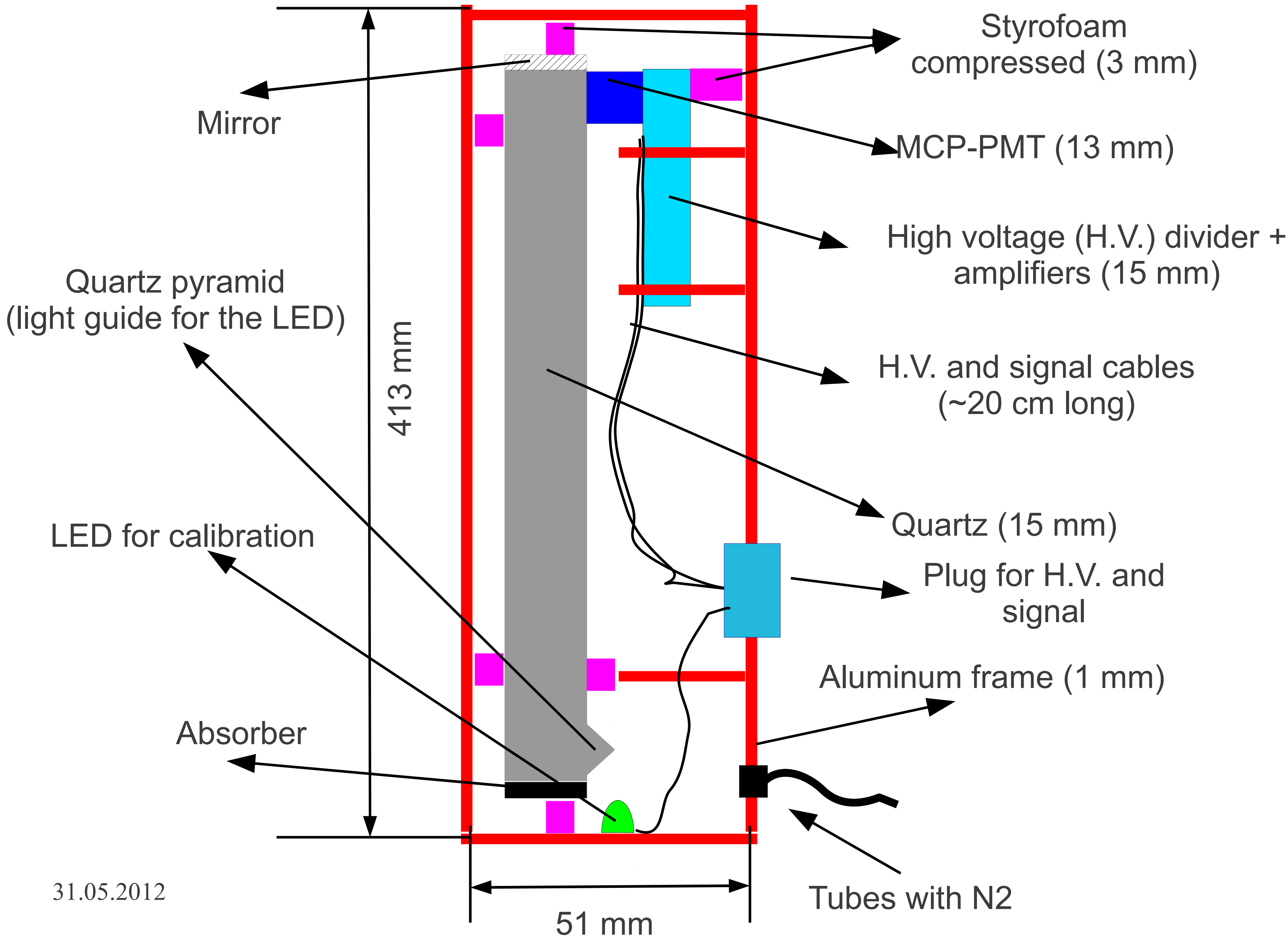
```
//////////////////////////////////////
//--------DCH------------//
// Z_max     =  173.0 //
// Z_min     = -104.0 //
// R_max     =    80.5 //
// R_min     =    23.5 //
//////////////////////////////////////
```

```
//////////////////////////////////////
//-------FDIRC----------//
// Z_max     =  173.0 //
// Z_min     = -160.0 //
// R_max     =    90.0 //
// R_min     =    82.0 //
//////////////////////////////////////
```

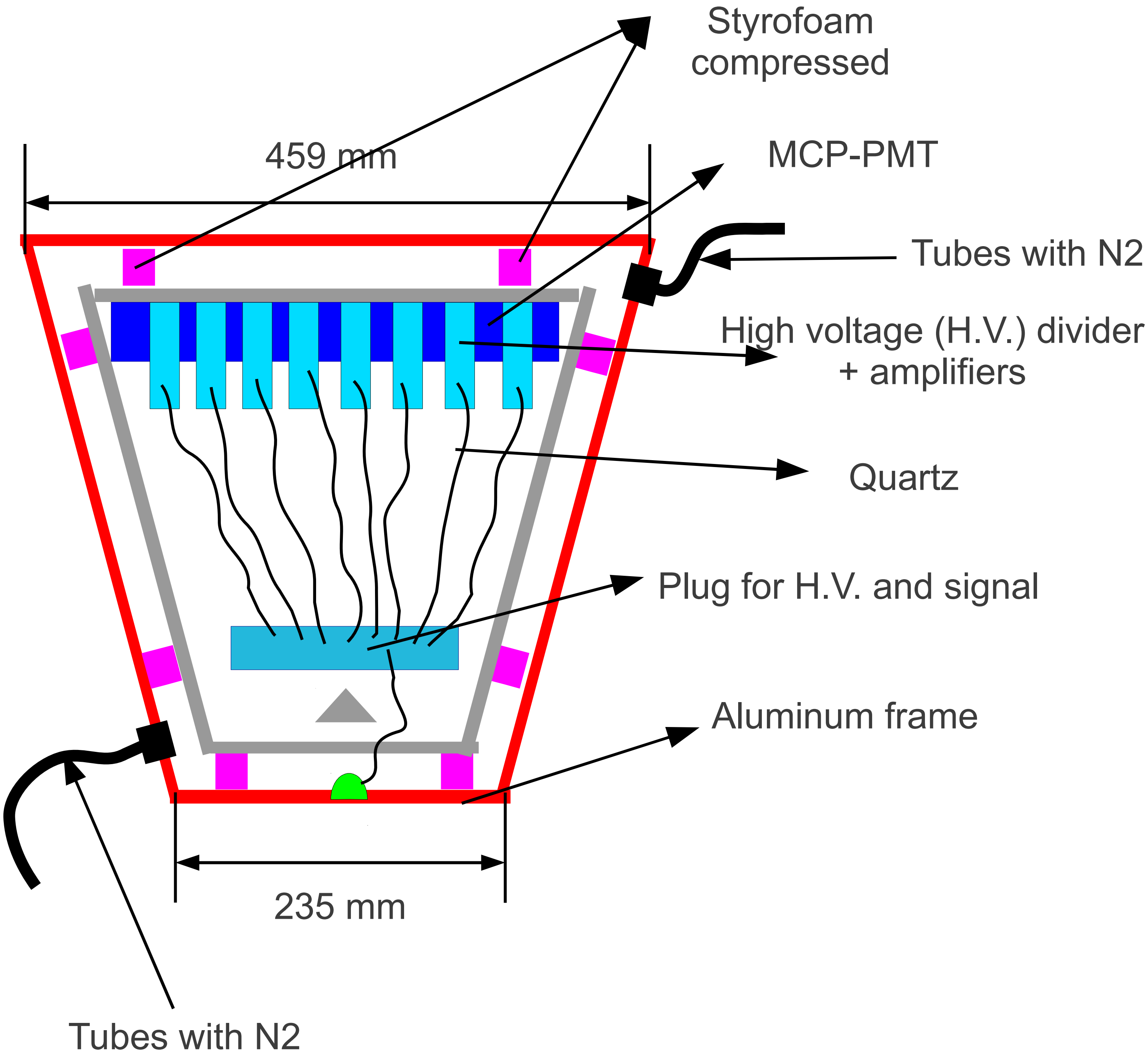
```
//////////////////////////////////////
//--------FTOF----------//
// Z_max     =  175.0 //
// Z_min     =  180.0 //
// R_max     =    90.0 //
// R_min     =    45.0 //
//////////////////////////////////////
```

Need to be update

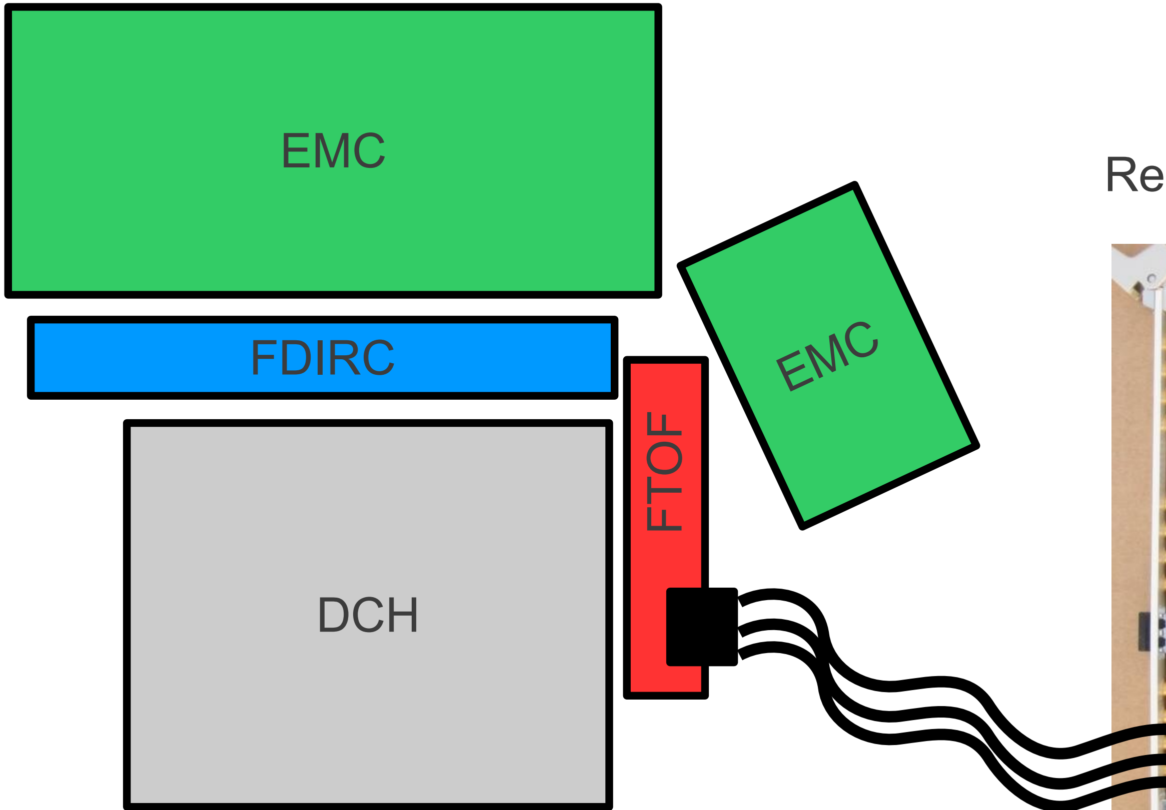
Side view of the FTOF detector



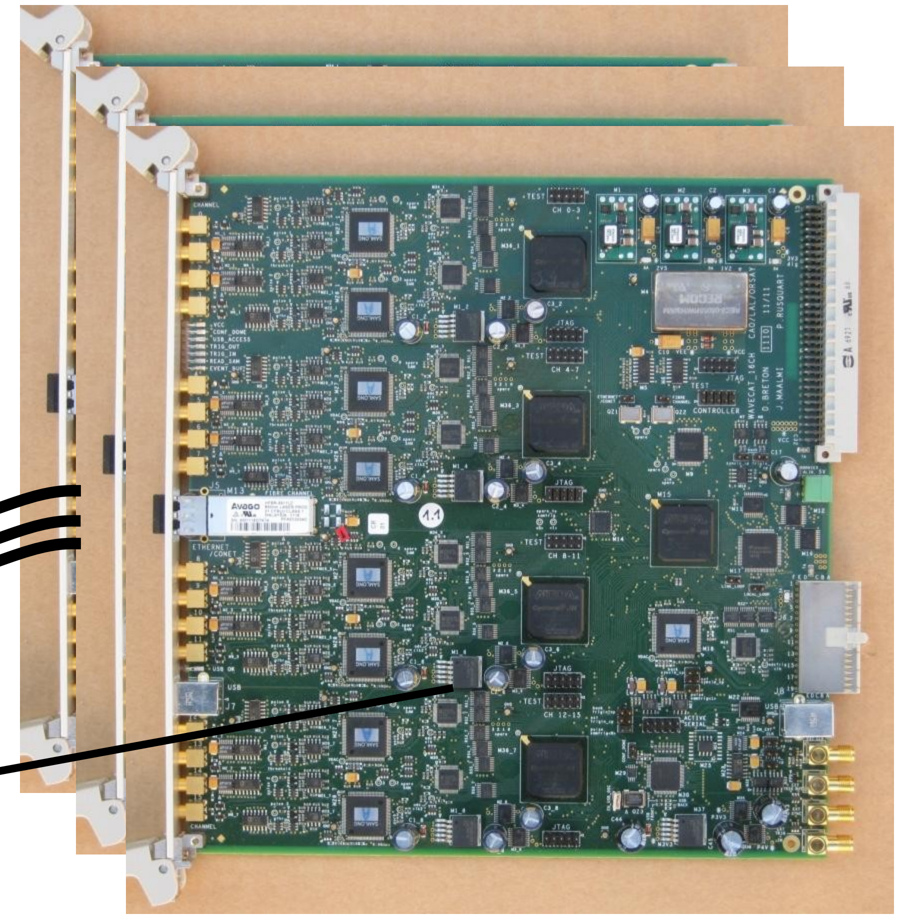
Front view of the FTOF detector



USB WaveCatcher readout electronics



Resolution per channel is around 10 ps



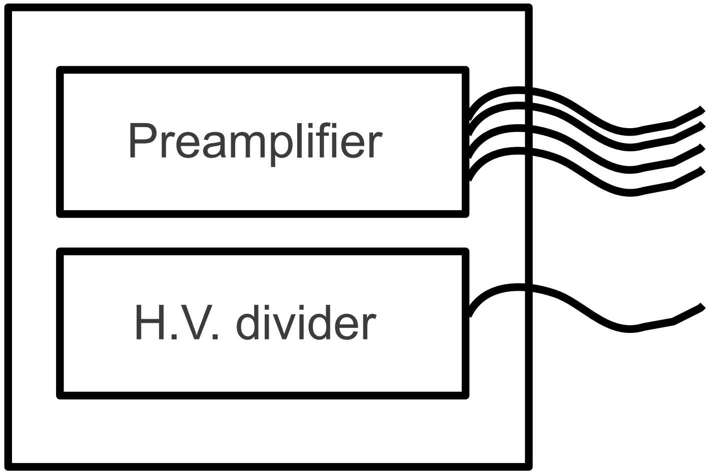
16-channel
WaveCatcher board

Boards are outside the detector volume

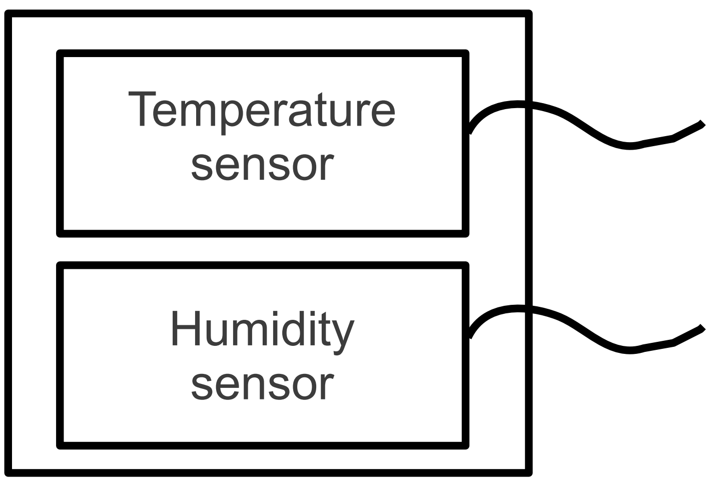
This board will be used for the prototype sector test,
final version will use SAMPIC TDC.

PC board attached to the MCP-PMT

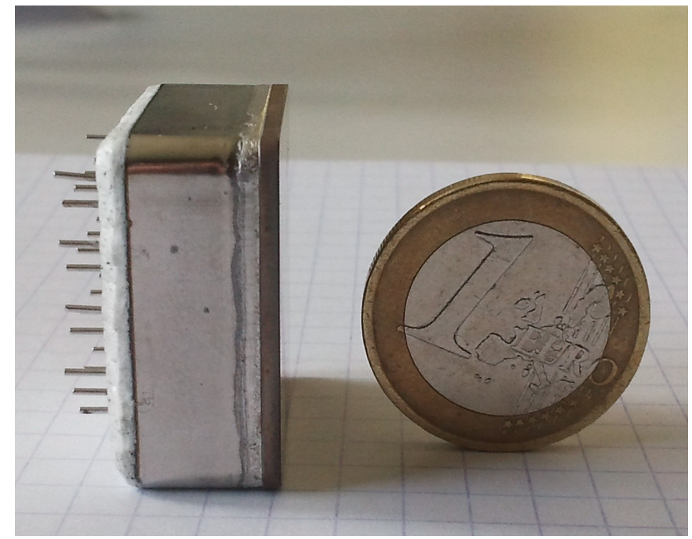
14 boards per sector

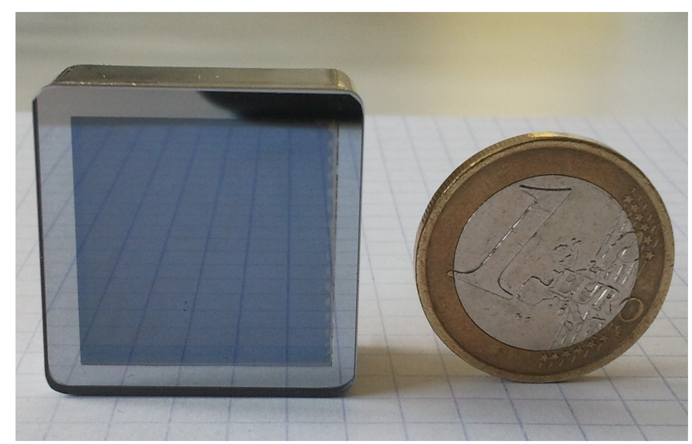


1 board per sector

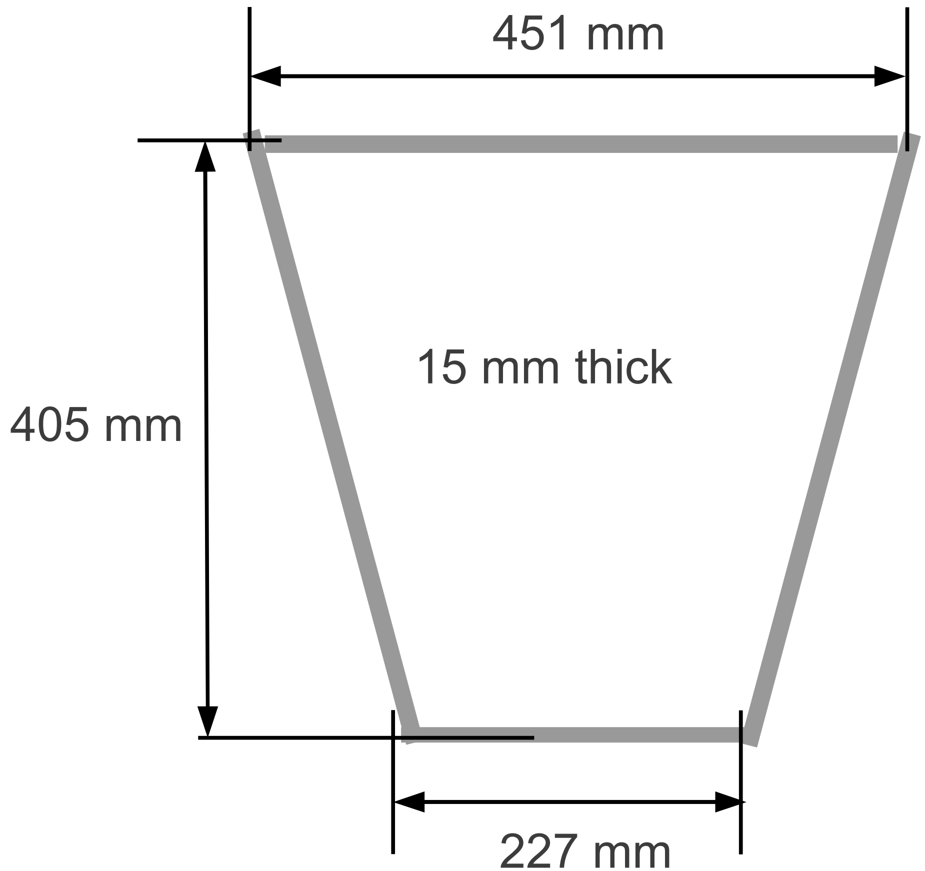


MCP-PMT (SL10)





Updated sizes of the quartz radiator

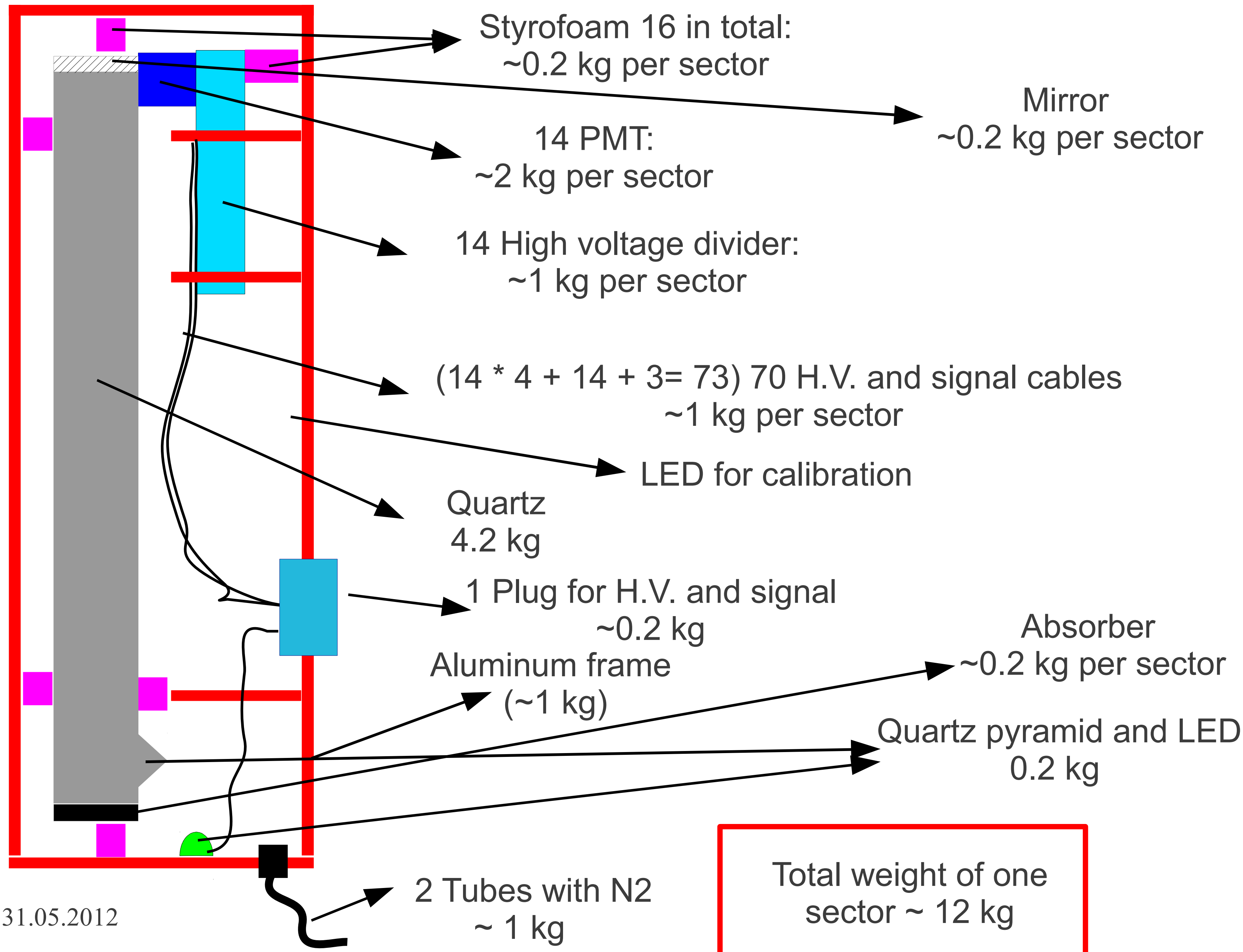


Quotes are coming from Jerry

NOTES, UNLESS OTHERWISE SPECIFIED:

1. ALL SURFACES FLAT TO 0.001 cm OR BETTER
2. SURFACES PER MIL SPEC 60/40 OR BETTER
3. ALL EDGES BEVELED WITH A WIDTH OF 0.025 cm
3. NO EDGE CHIP > 0.2cm DIAMETER. NO MORE THAN 0.5 cm^2 LOST TO CHIPS/EDGE
4. SURFACE FACE & SIDE POLISH QUALITY: 20 ANGSTROMS rms
5. TYPICAL FACE-TO-SIDE SQUARNESS: < 25 mrads (0.0143^0)
6. ALL DIMENSIONS IN cm
7. MATERIAL: FUSED SILICA CORNING HPFC 7980 STANDARD GRADE
8. FINAL SYSTEM HAS 12 IDENTICAL TILES (SIDES CAN BE GROUND AND POLISHED AT THE SAME TIME AS ONE PACKAGE OF 12 TILES; THIS IS ALSO THE WAY TO ACHIEVE THE REQUIRED PRECISION ON SQUARENESS)

Weight estimation



FTOF studies

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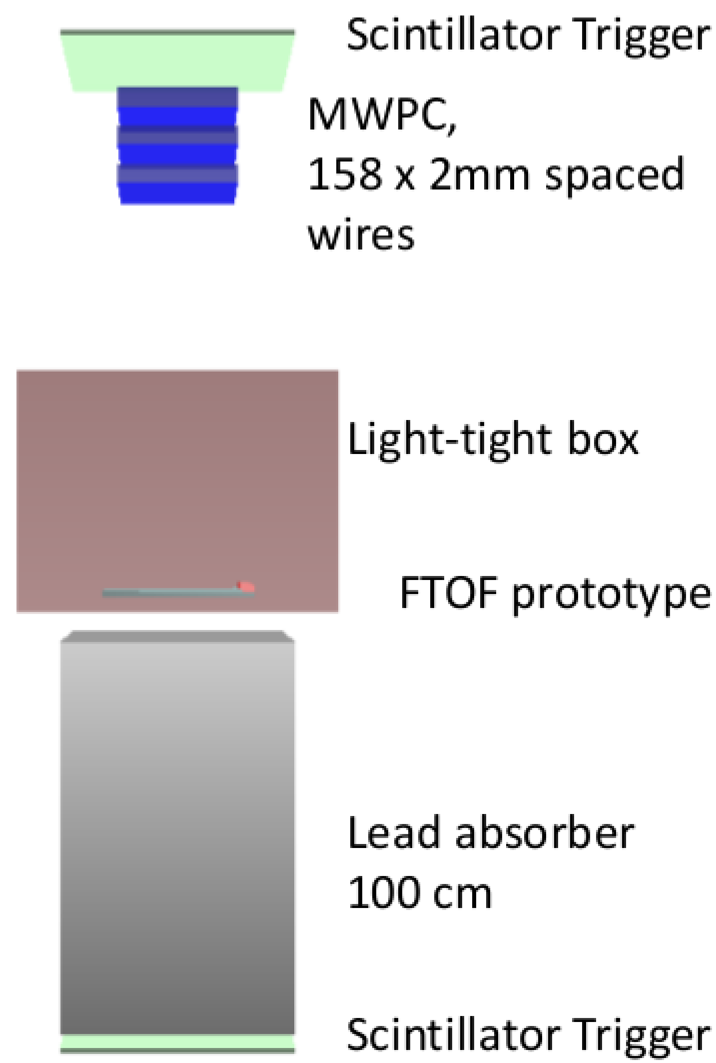
Other contributors: D. Bondoux (mechanics), G. Bossons (electronics)

Cosmic Telescope at LPSC

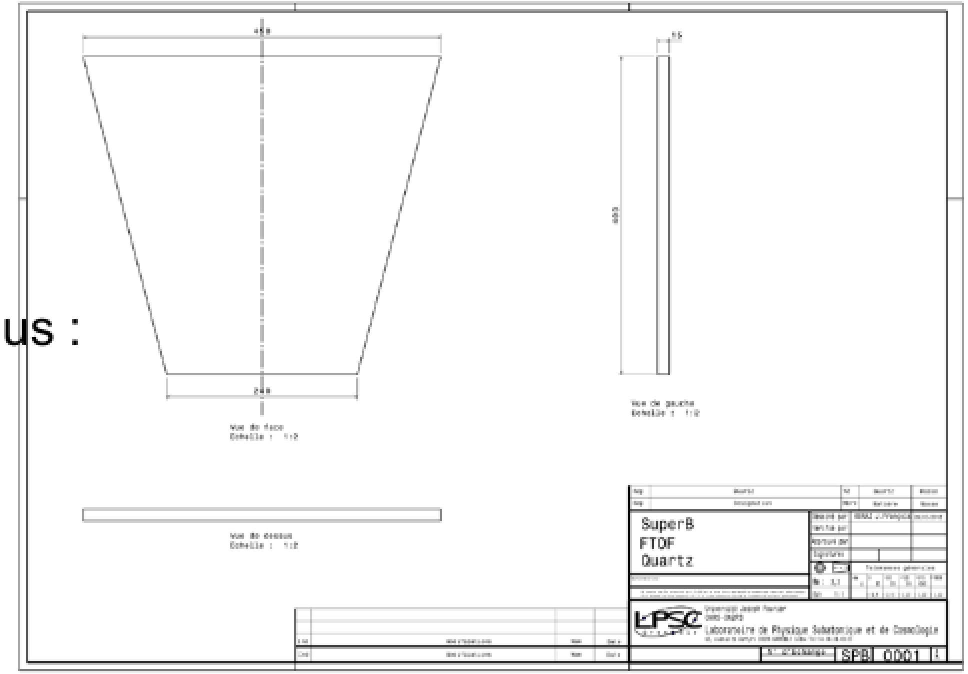
- Select hard muons (>1.5GeV) with lead
- Directions measured with 3 mwpc (x, y)
- Specially design for FTOF geometry
- Good precision on position and angle at FTOF quartz level.
- Possibility to tilt the quartz tile to mimic SuperB geometry



- First muon in July with a small quartz tile commissioning of setup and DAQ
- *Possibility to shorten absorber thickness as necessary*

FTOF measurement

- Tile will be delivered by septembre. *(Spectrosil 2000 from heraeus, same as BABAR DIRC)*



Goal si to study collection of photon versus :

track position,
incident angle,
revetment
Quartz angle

Use data to validate optical simulations.

Planning:

septembre/october :

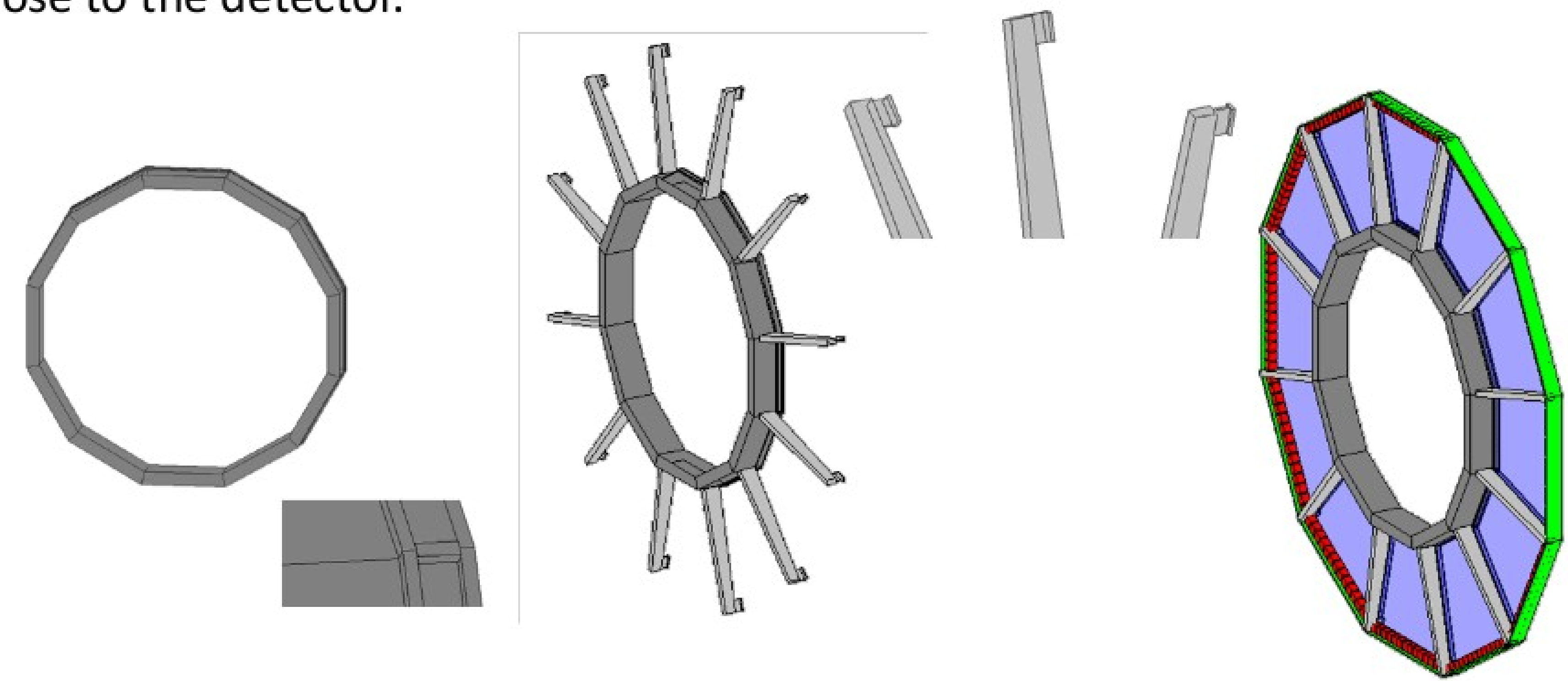
measure photon collection efficiency with large PMT and SiPm

novembre/december : (in collaboration with LAL)

measure photon collection timing with wave catcher, SiPm and MCPP

FTOF mechanics study

- First step to define mechanics (does not include electronic nor PMT).
- To go further need to define PMTs (MCPP or SiPm) and electronics needed close to the detector.



Backup

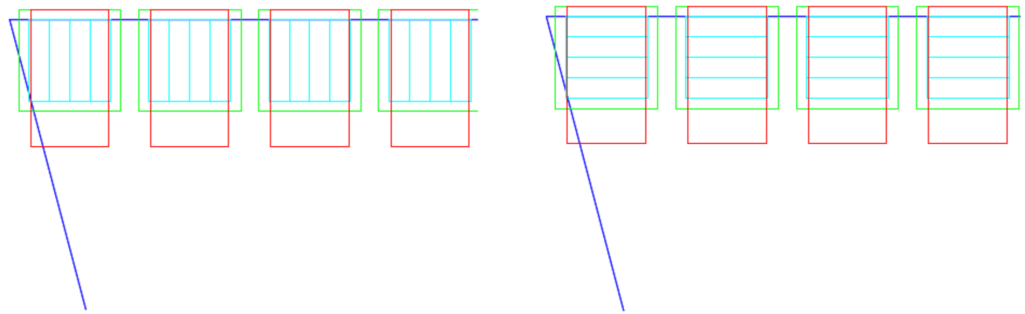


Figure 1.20: The PMT channel orientation vertical (V) from the left and horizontal (H) from the right. In dark blue is the quartz tile radiator, the light blue correspond to the sensitive area of the PMT, green box is the PMT body and in red the electronics are shown.

A) the PMT is on the face of the quartz tile. As we will see later this is the best position for timing but it is not possible to use MCP-PMT due to bad angle to the magnetic field. One could use SiPM [61] but they are sensitive to neutron background; studies are in progress within SuperB [62] to test their performances after irradiation.

B) the PMT is attached from the top of the quartz tile: this is our baseline position for the PMTs as it takes into account the magnetic field of the SuperB detector.

C) same as B but the PMT attached from the opposite side of the quartz sector. This particular configuration (GeomID=7) will be used later to study effects on the number of collected photons; it should not have any effect on their timing.

D) the PMT is attached to the bottom of the detector. All configurations with this PMT position have tilted quartz radiators (by 22.7◦ degrees).