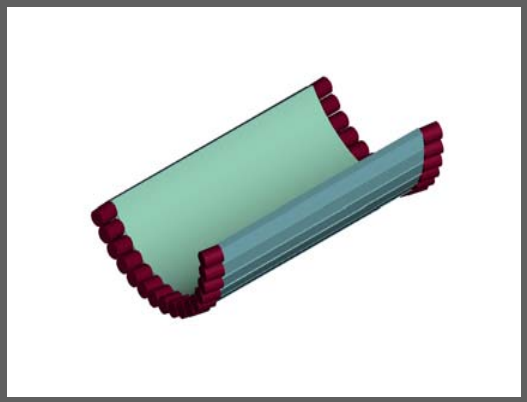
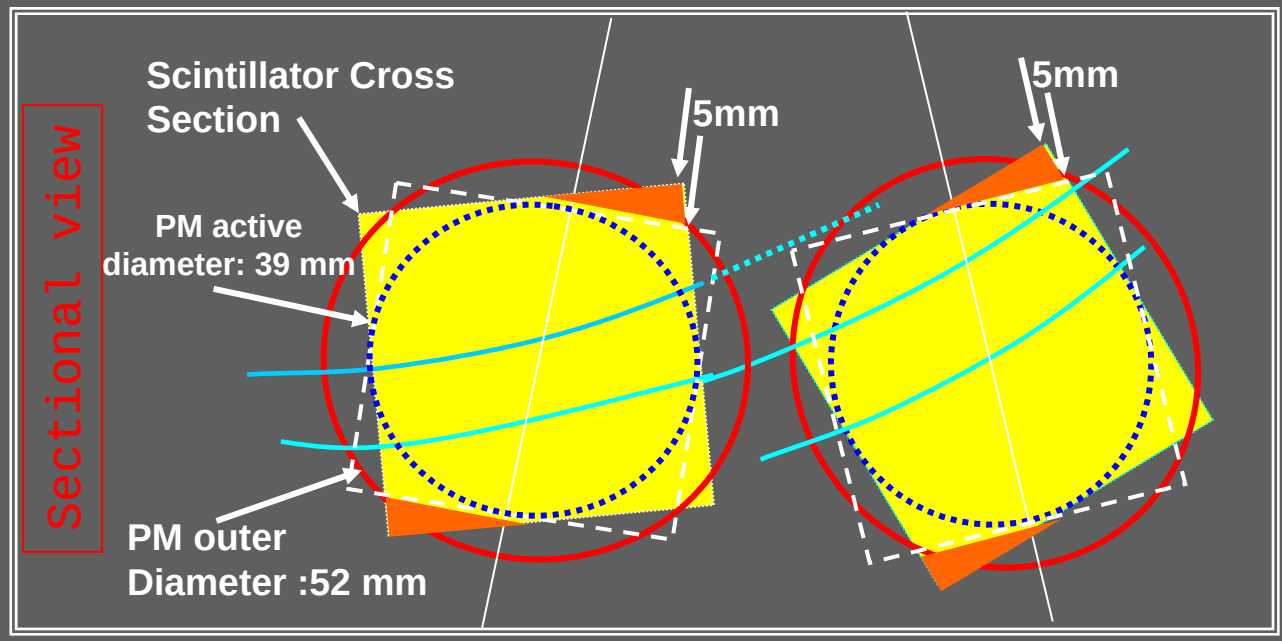
Timing Counter

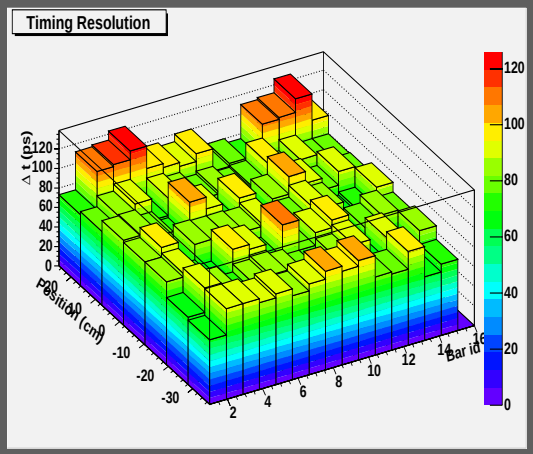
Report of July 18th, 2007

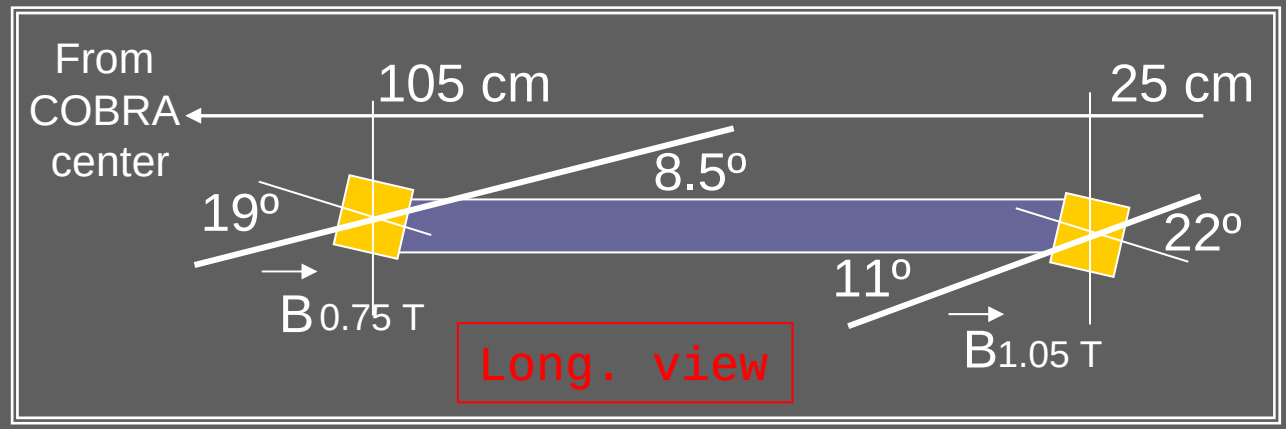
F.Gatti

TC layout, structure, functions



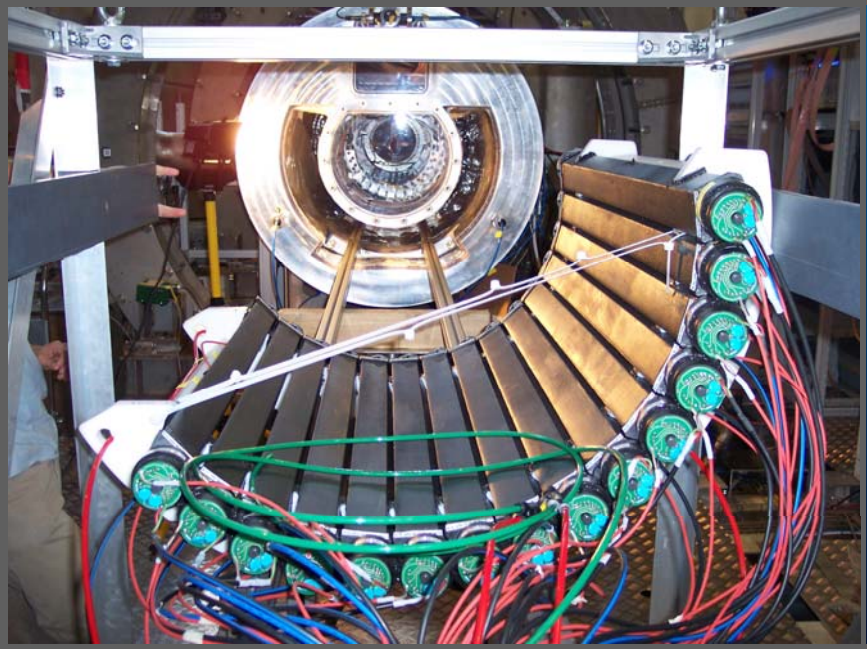


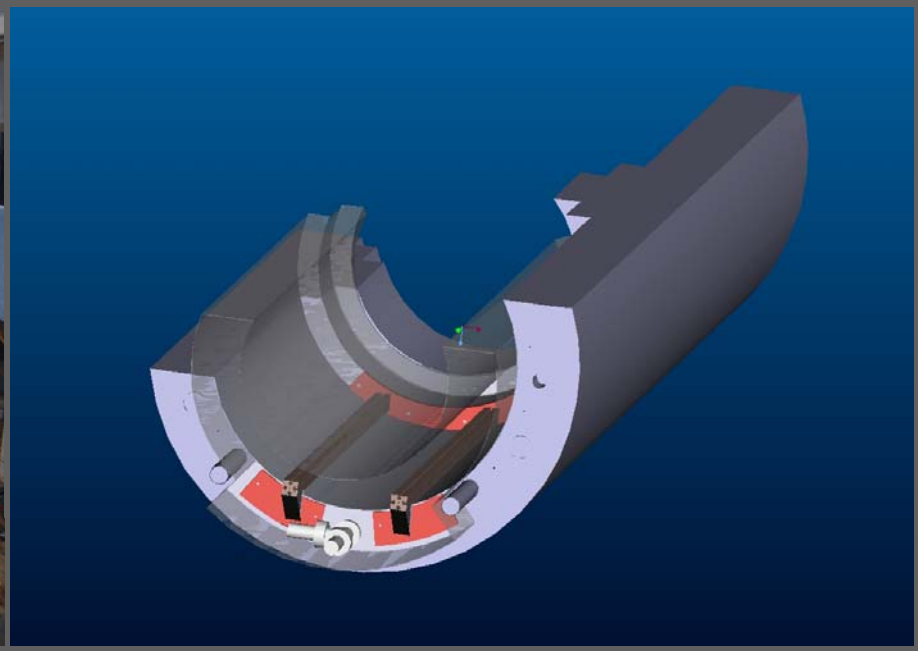




Pre-Run 06 activities

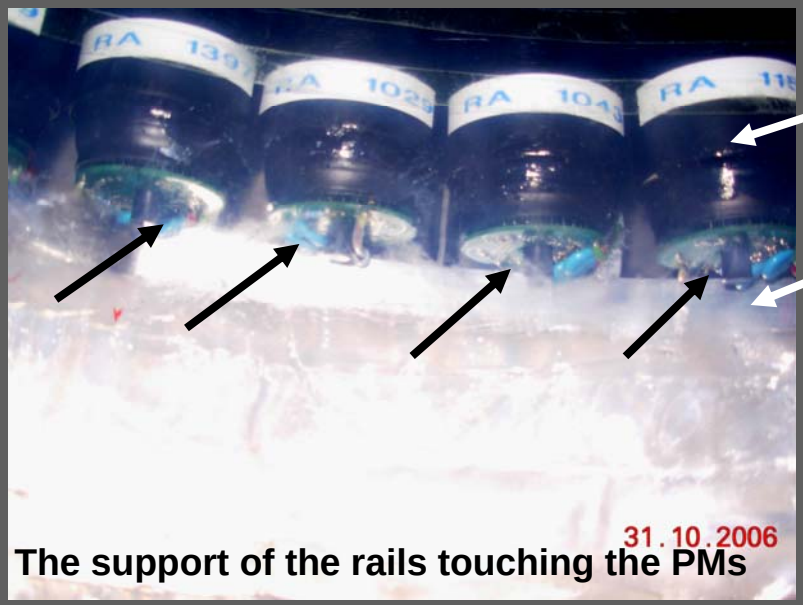
- Sept 06: N2Bag and TC (without APDs) final test (Genova-PSI)
- Oct. 9-13: N2Bag and TC US mounted and tested in COBRA at PSI
- Nov 2: N2Bag DS mounted on COBRA, TC DS ready to be mounted after DC
- Nov 29- Dec 5: N2Bag DS dismounted and re-mounted for the DC insertion.
- Dec 6-9: TC DS mounted and cabled
- Dec 13-21: TC-DC run



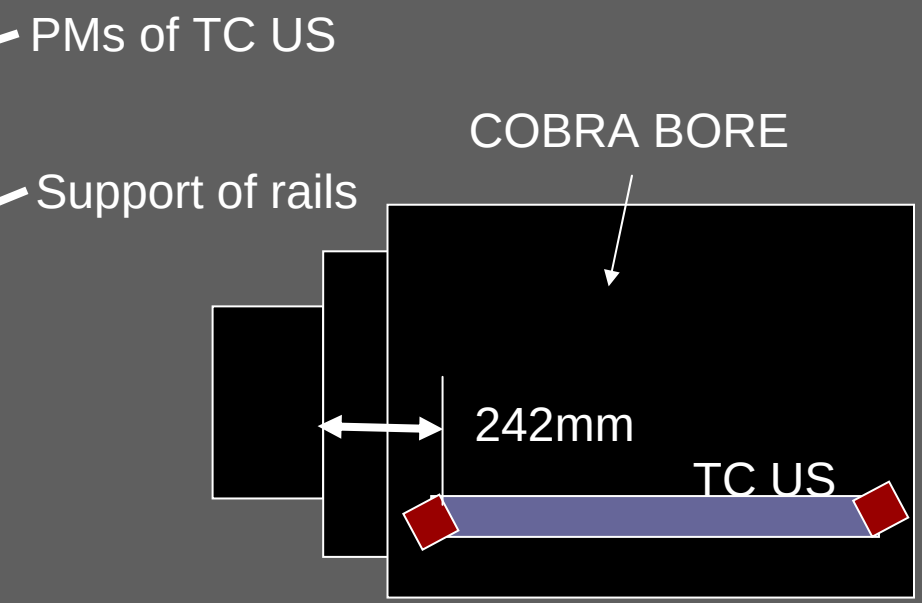


TC-06 Run

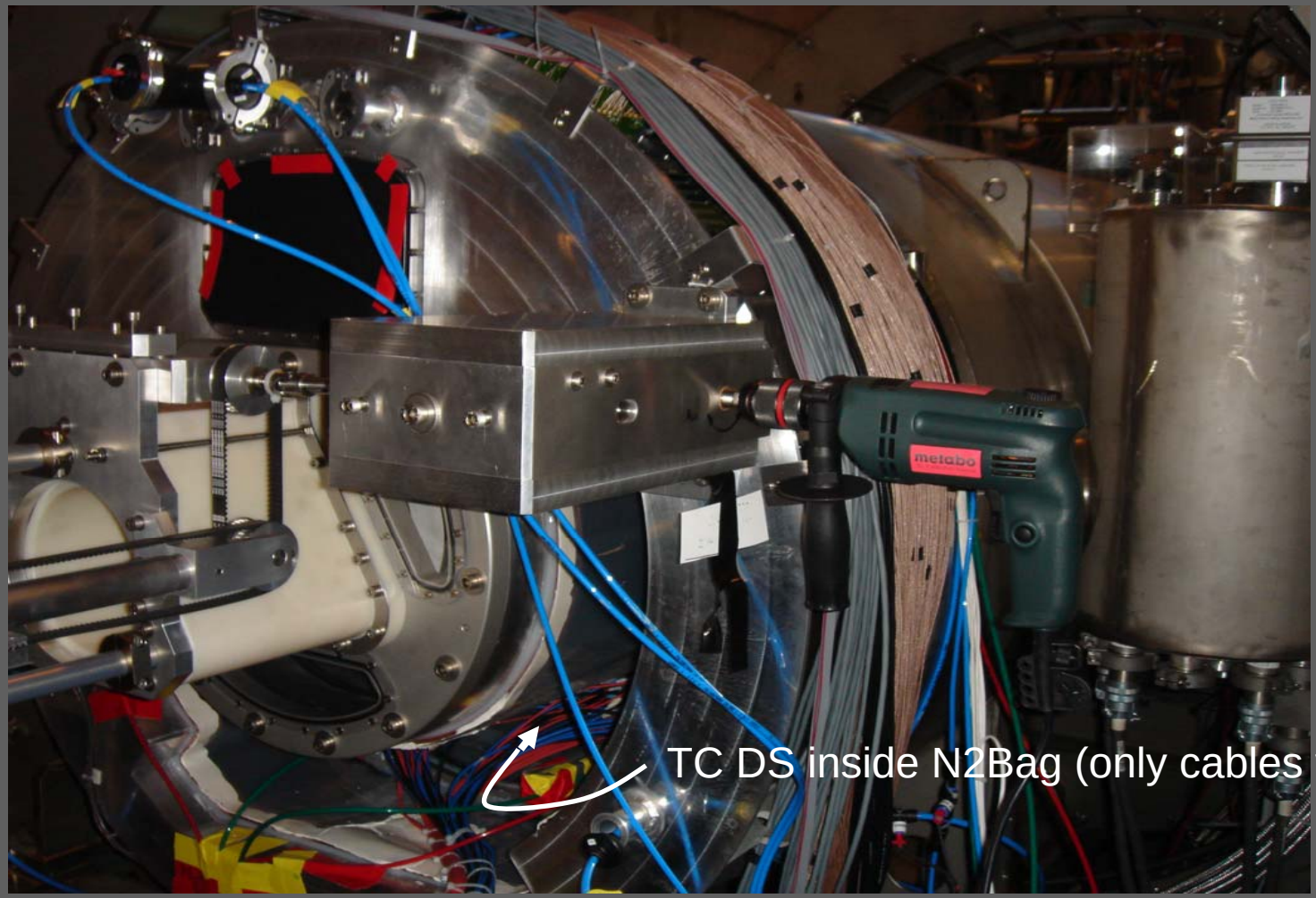
- TC DS and US mounted and cabled and successfully operated in COBRA
- TC US not in final position because of a trivial error of the rail support: 5mm higher than expected. →The inner end of the scintillating bar were at 242mm from the second COBRA step (13 cm from the final position).
- TC DS mounted in symmetrical position for simplicity (analysis).



The support of the rails touching the PMs

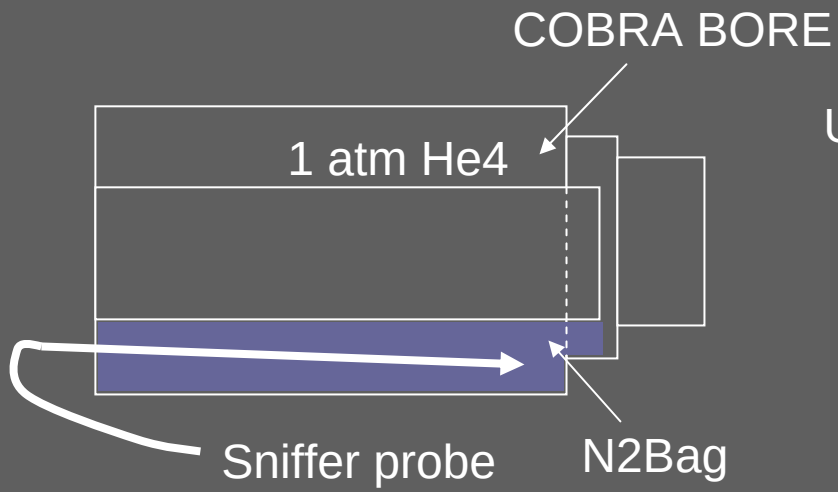


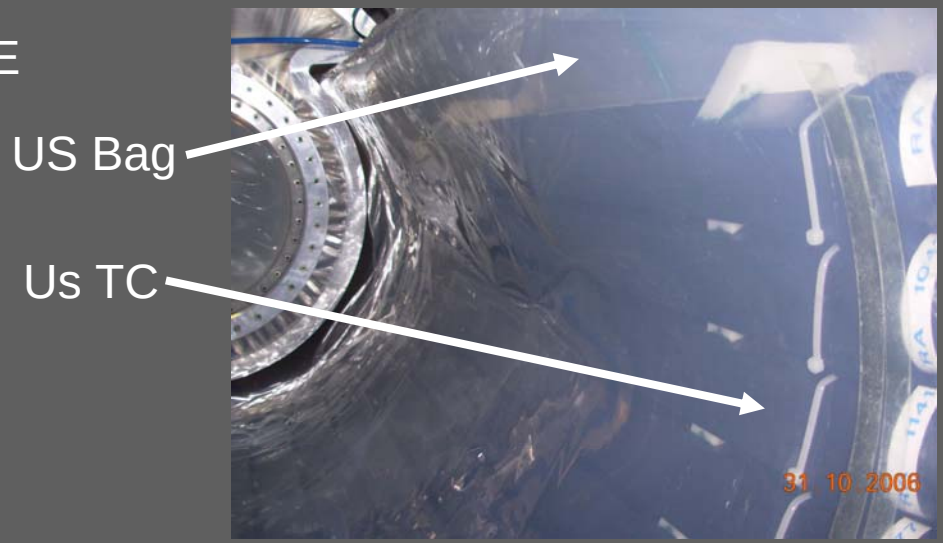
TC inside COBRA in the final configuration



N2Bag

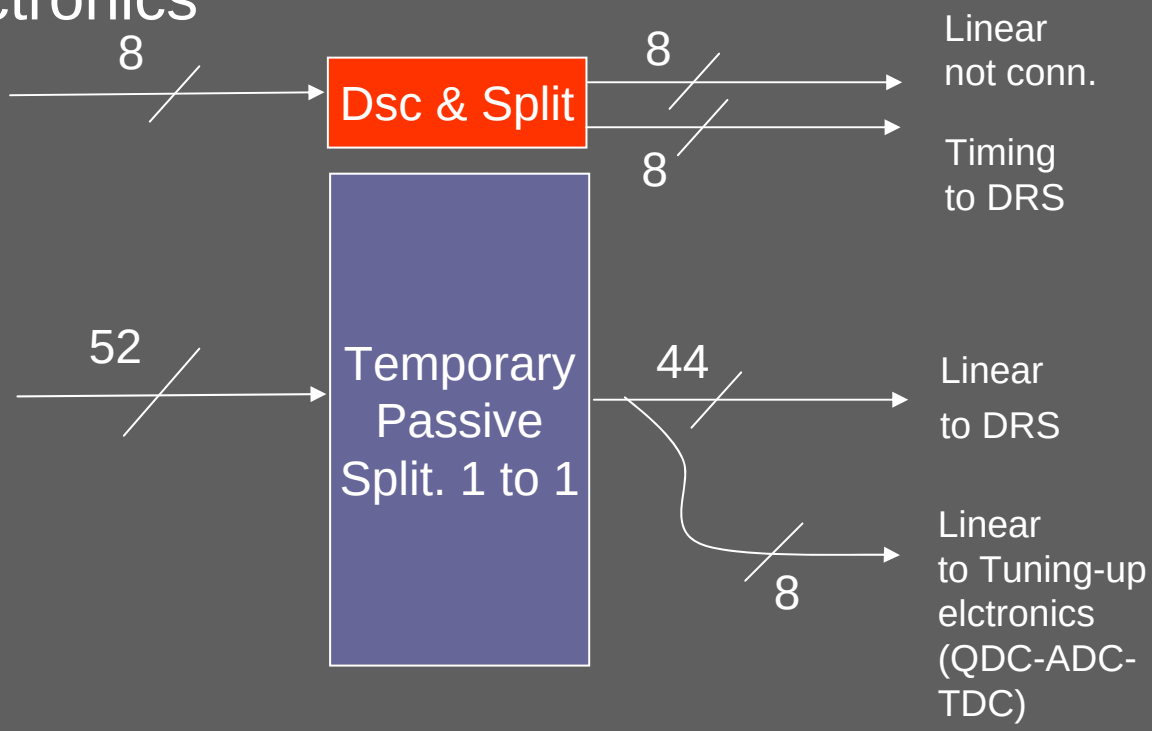
- N2Bag He4 level:
  - The final He4 level inside the bag at the PM positions is about 10 x ABL (Atmospheric Background Level), with 1 atm He4 outside.
  - Gas washing: we reached 1x(ABL), by flushing N2 @ 50l/m. →safe operating condition for PM





Connection to the Electronics

- The PM channels have been sent to the DRS, with the following scheme, which contains only 8 channels in the final configuration. Tuning-up 8 by 8 channels with “Tuning-UP (QDC-TDC-Multichannel analyzer)” electronics



Run 2006: tuning-up and measurements

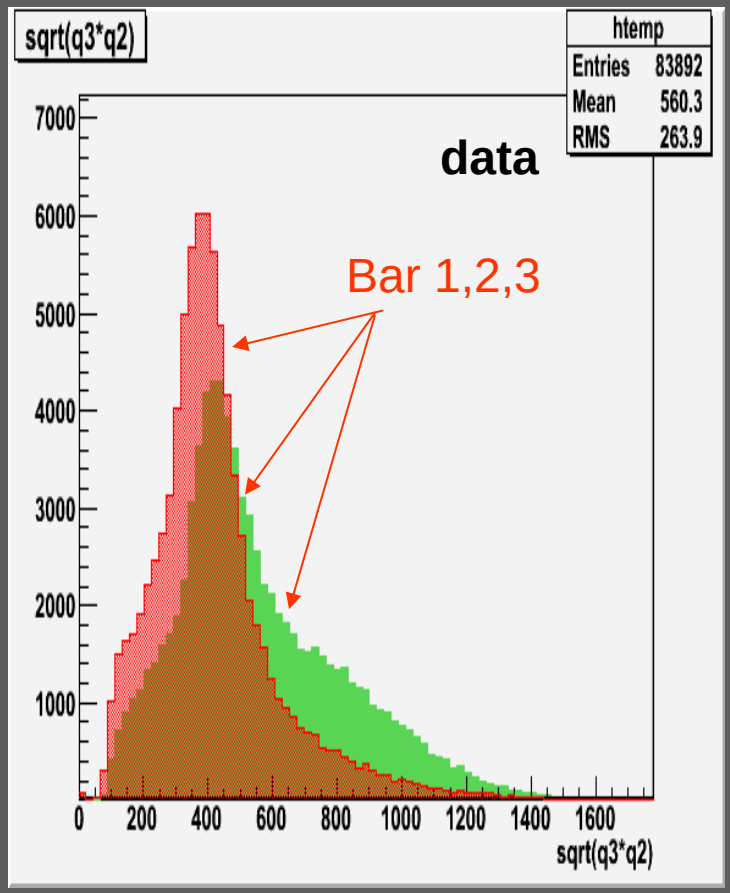
- Final gain of PM in COBRA “ON” calculated with our model (laboratory Gain vs HV, Gain Vs Mag. Field, Gain vs angle).
- Needed a further equalization with cosmics, 3 full days for gain uniformity of 10% (this has been made with the beam-OFF).
- Data taking for charge spectrum of each PM with Beam ON.
- Direct count rate (single PM, 2 PM coincidence, 2 bars coincidence, 3 bars coincidence) → PM anodic current evaluation and Bck contribution.
- Data taking with DRS.

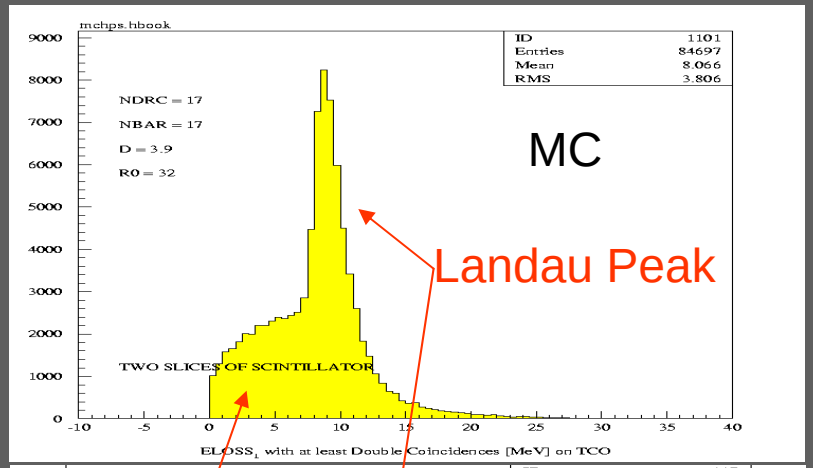
TC-Run schedule

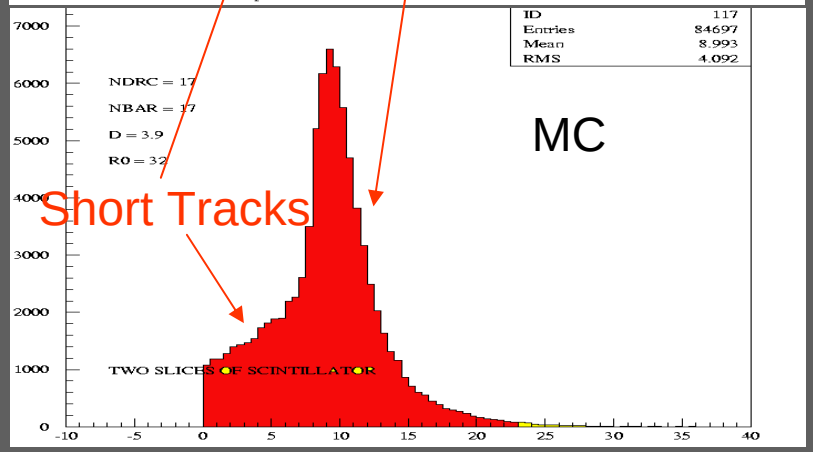
Beam test Dec. 2006	16 A.M.	16 P.M.	17 A.M.		18 A.M.	18 P.M.	19 A.M.	19 P.M.	20 A.M.	20 P.M.	21 A.M.	21 P.M.	22 A.M.
Coarse Equal TC.DS COBRA on													
Coarse Equal. TC.US COBRA on													
PMT 18-29 Fine Equal Beam off													
PMT 0-4/16-17 Fine Equal. Beam off													
PMT 59-52 Fine Equal. Beam off													
PMT 51-38/35-30 Fine Equal. Beam off													
PMT 5-15 Fine Equal. Beam off													
Anodic current test PMT 0-10,12-14													
Anodic current test PMT 38-44,46,47,49-59													
PMT 16-29 TC.DS to DRS					9:40 (14 pmt)								
PMT 46-59 TC.US to DRS								13:40 (14 pmt)					
PMT 8-15 / 34-45 TC.US to DRS										13:05(20 pmt)			
Test dynamic range DRS										17:15			
PMT 0-7 TC.DS / TQ VME													0:55-2:15
Rate measurements PMT 0-3/30-33										21:30		17-21:50	
PMT 0-7 To DRS via DTDisc.													2:30 (8 pm

Analysis: main features

- Minimization of trajectory length spread → narrower energy loss distribution → clear “landau” peak over tails of short tracks.

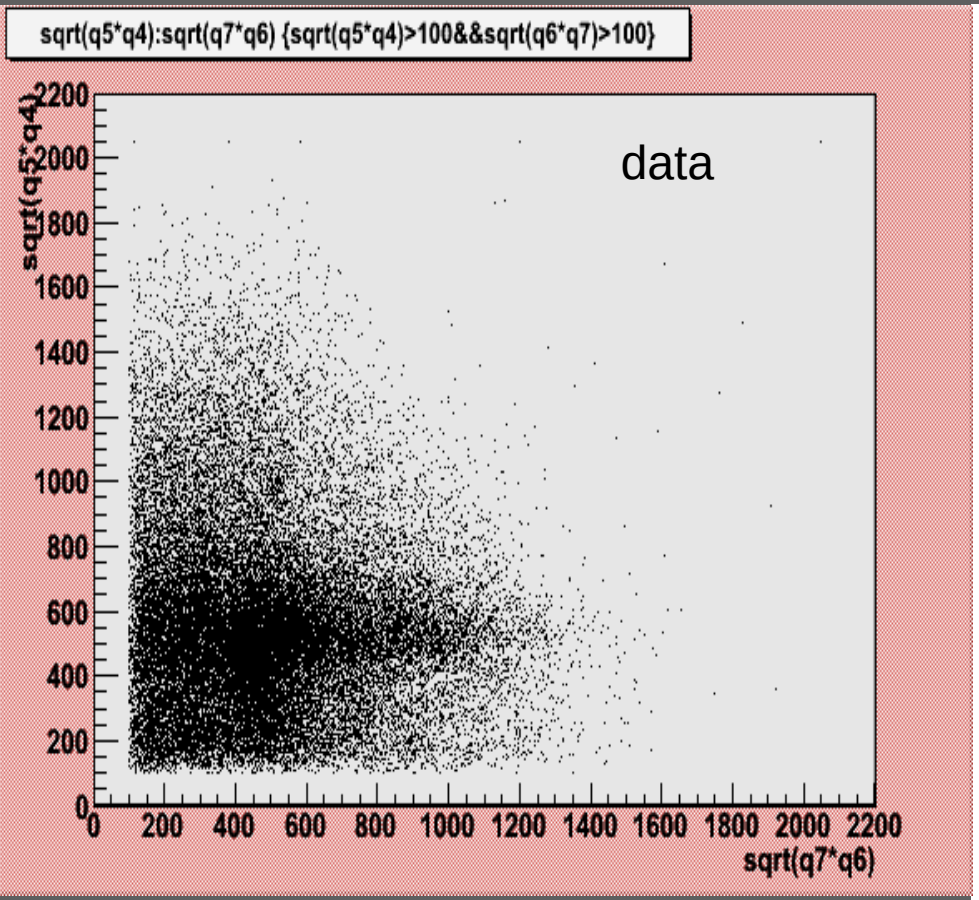


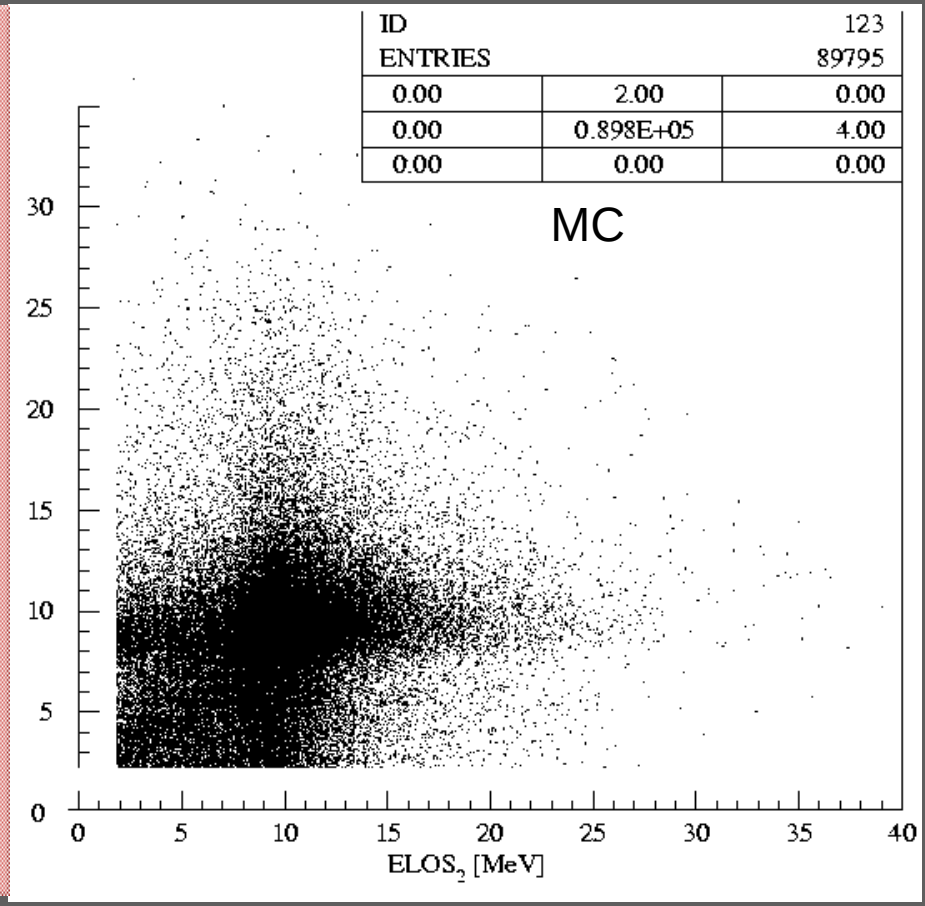




Analysis: main features

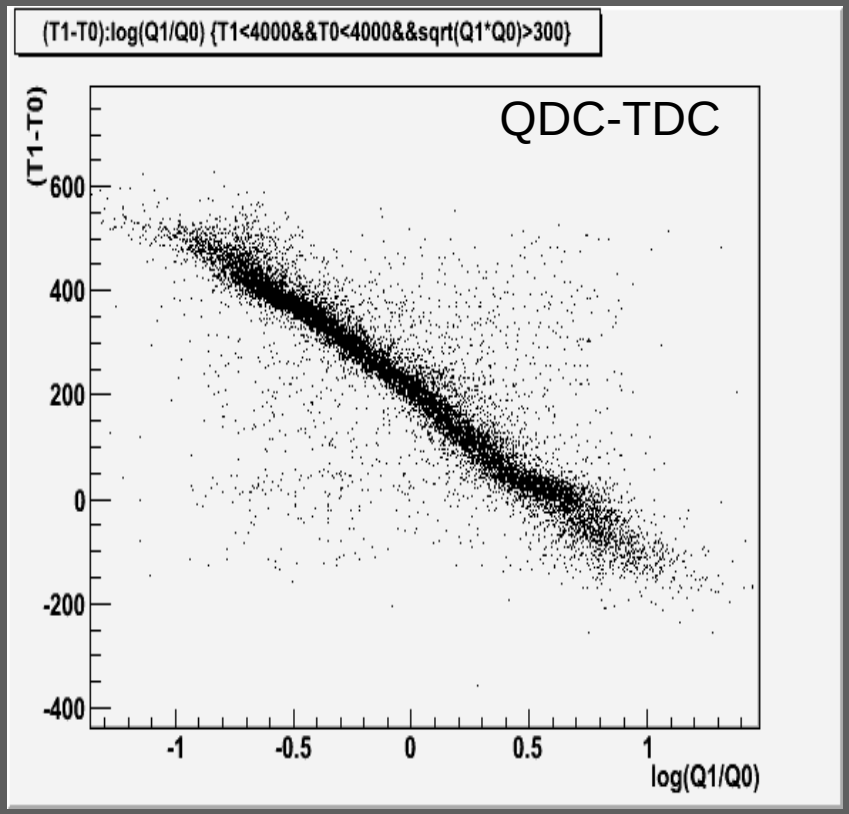
- Expected 2 and 3 bar (and more) coincidences
- MC: 48% hit 1 bar, 52% 2 or more contiguous bars
- Clear signature of positron correlated energy losses among two contiguous bars

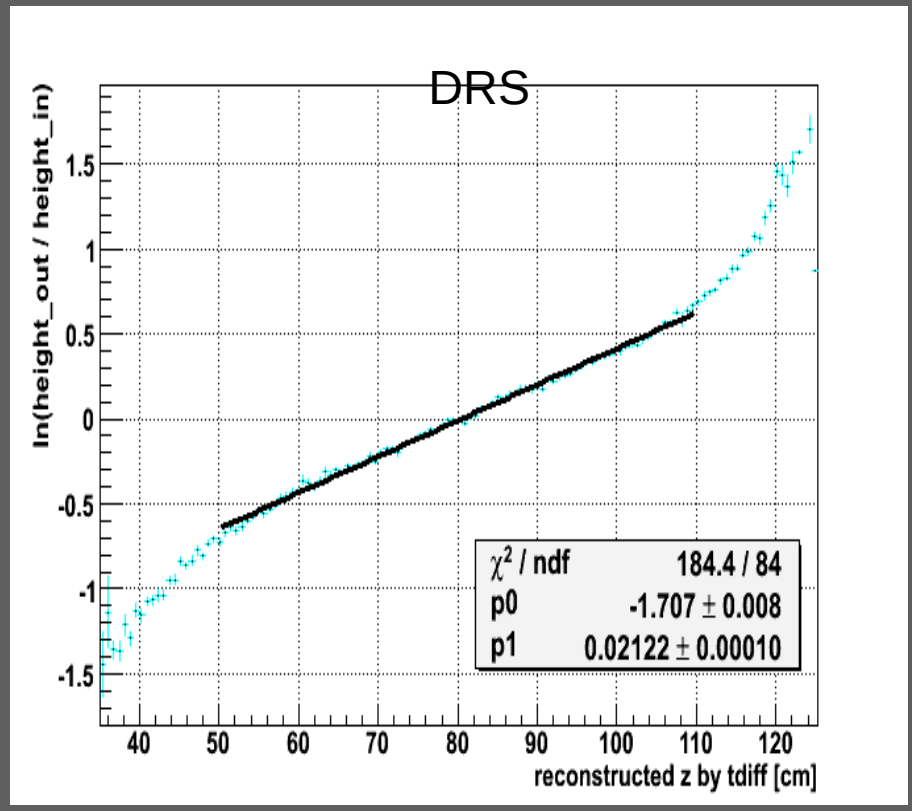




Analysis: main features

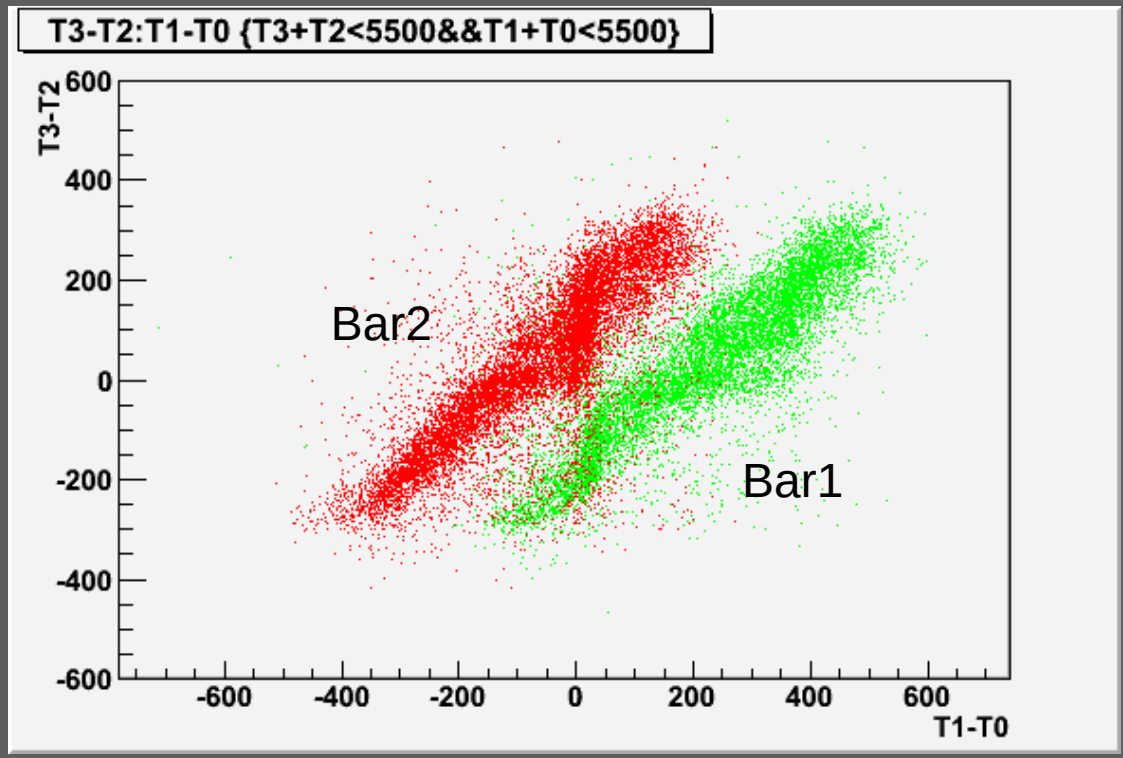
- Charge time correlation: time difference of two pms vs log(chragePM1/chargePM2)





Analysis: main features

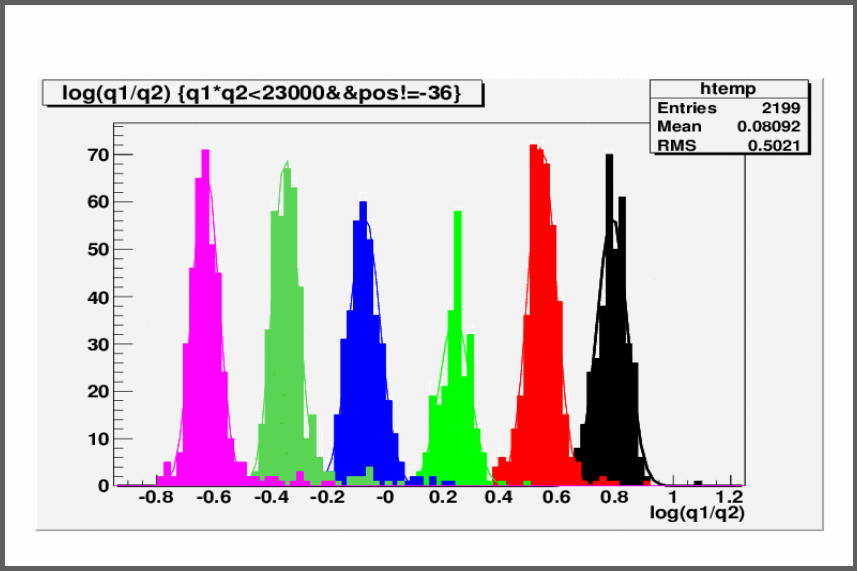
- Time correlation between two contiguous bars: time difference of first bar vs time difference of the second one.

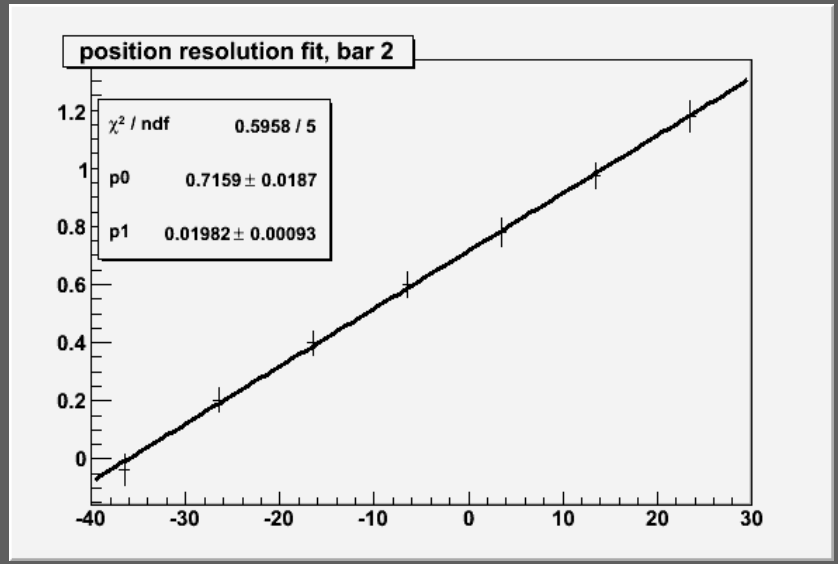


Analysis: main features

- Position reconstruction via charge division methode: by using BTF calibration with 5mm beam spot, 2.2 cm rms resolution achieved

bar #	attenuation length	Dlog(Q1/Q0) – expected	DLog(Q1/Q0) – measured	
1	96	1.6	1.6	
2	97	1.6	1.5	
3	84	1.9	2	
4	101	1.5	1.4	

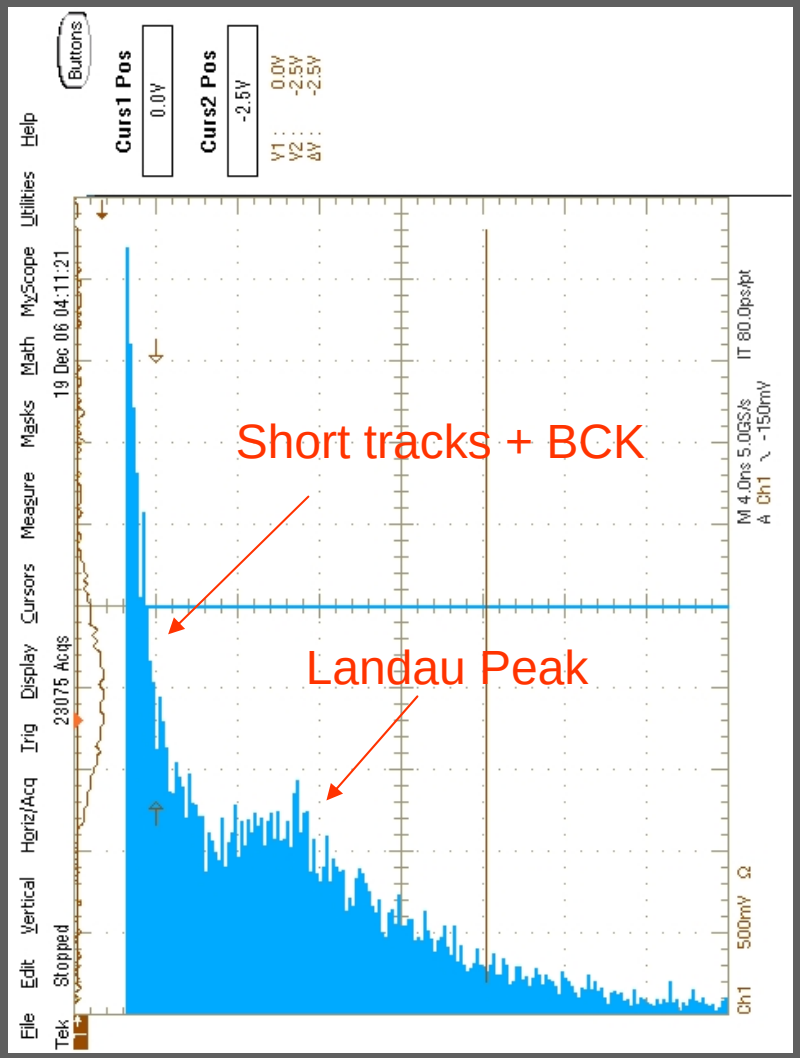


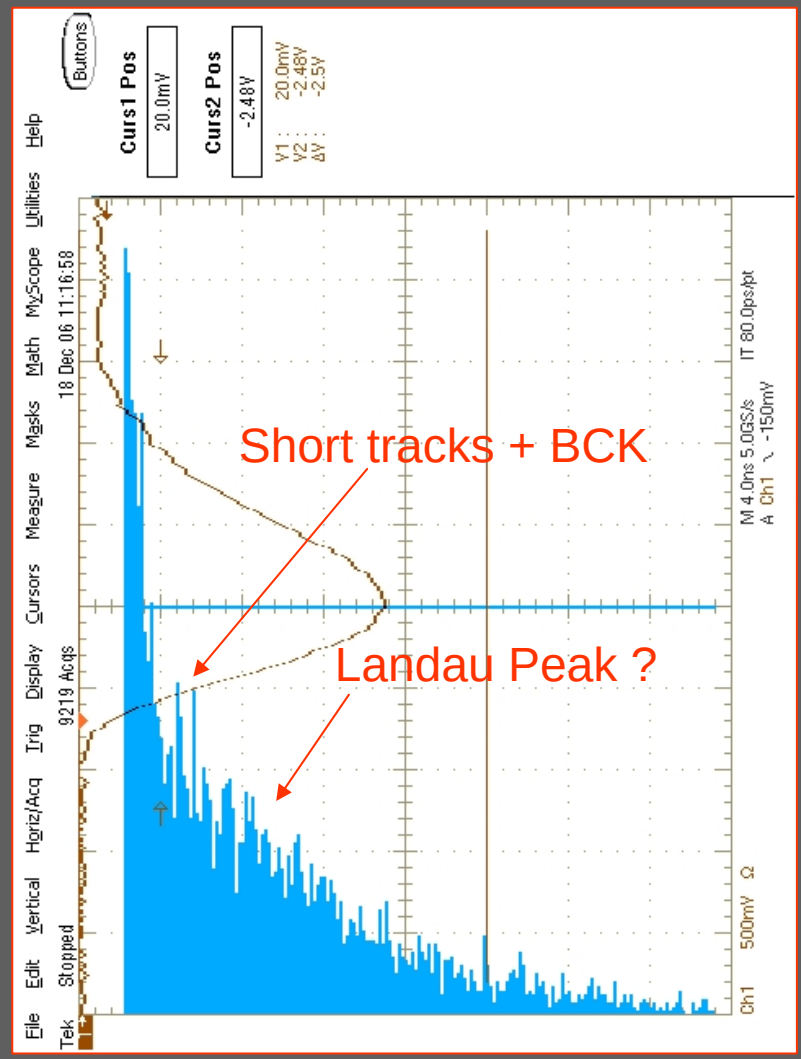


PMT Life

- Life = time of stable gain operation measured as total charge delivered at the anode
- Hamamatsu data for 2” PM life is 360 C at the anode.
- With `06 parameter run (440-610 KHz @ ~0.7 V average amplitude and ~1.5 V Landau peak) we estimate 2 years life.
- What happens after that 360 C are supplied or we exceed the nominal life ?

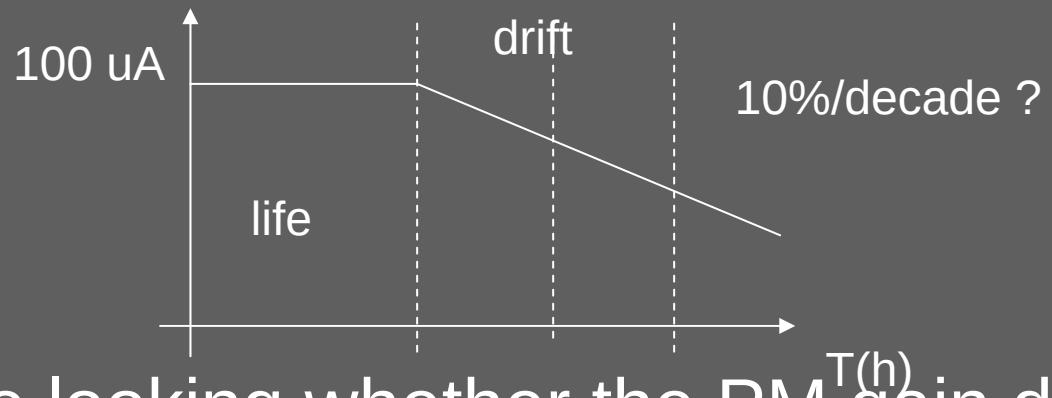
Raw amplitude spectrum of PMs in ‘06 run: two examples





General trend in PMT drift

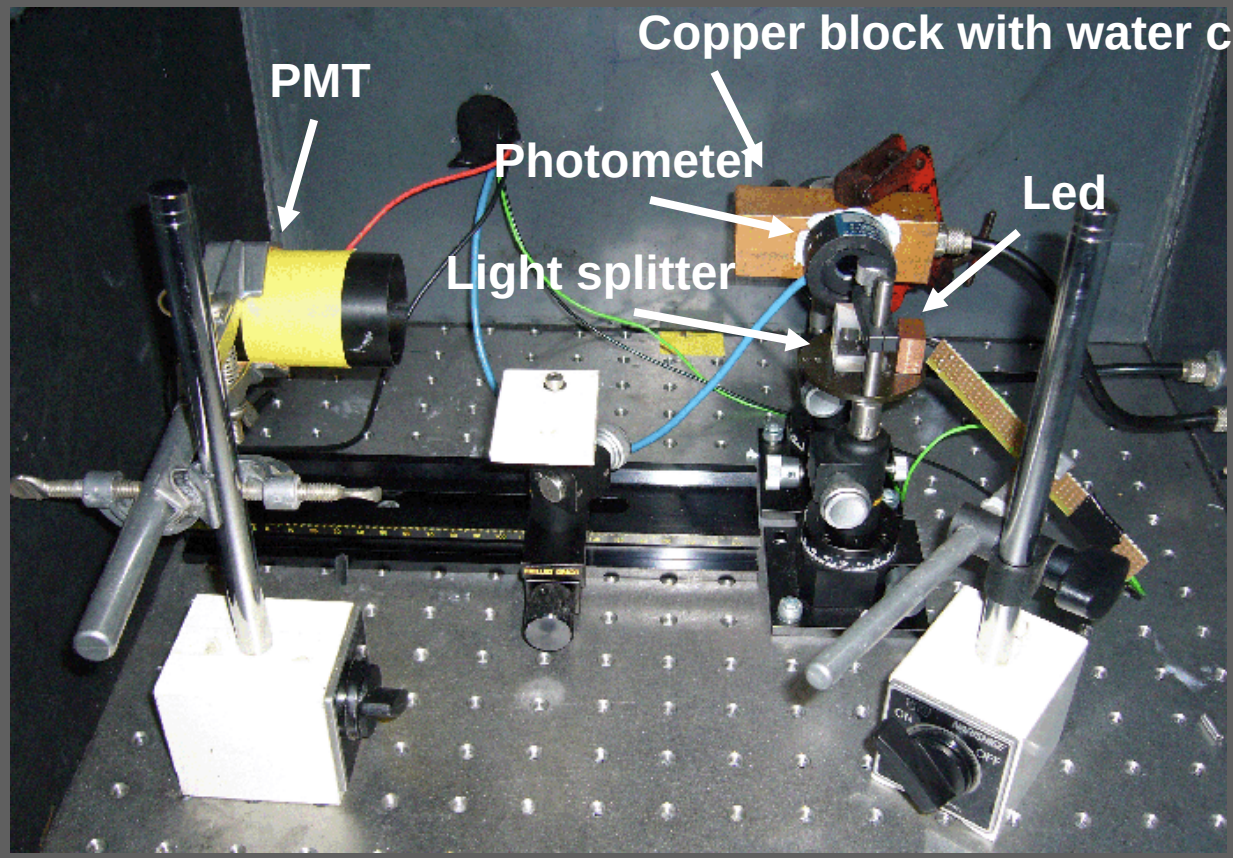
- We are measuring the PM gain vs time in the “drift” region:



- We are looking whether the PM gain drops down much faster or not.
- A first test done with $1^{1/2}$” already used PM
- A second test under course with 2” new PM

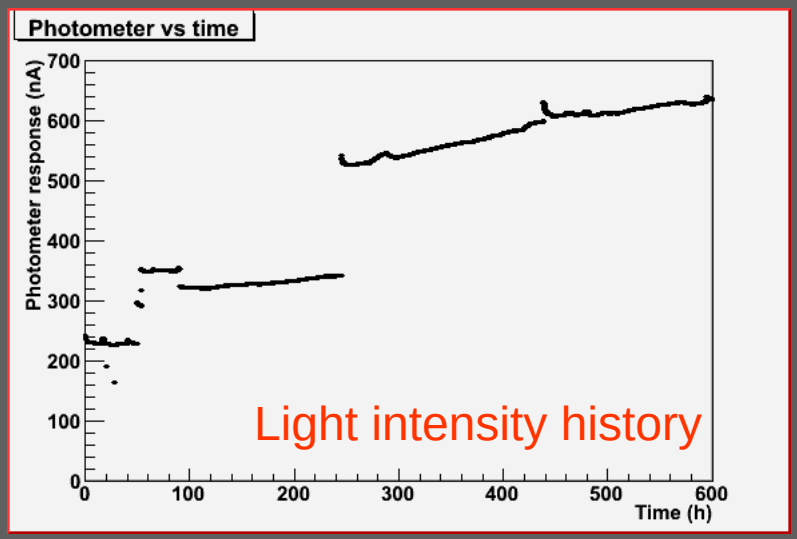
First preliminary Test of PM

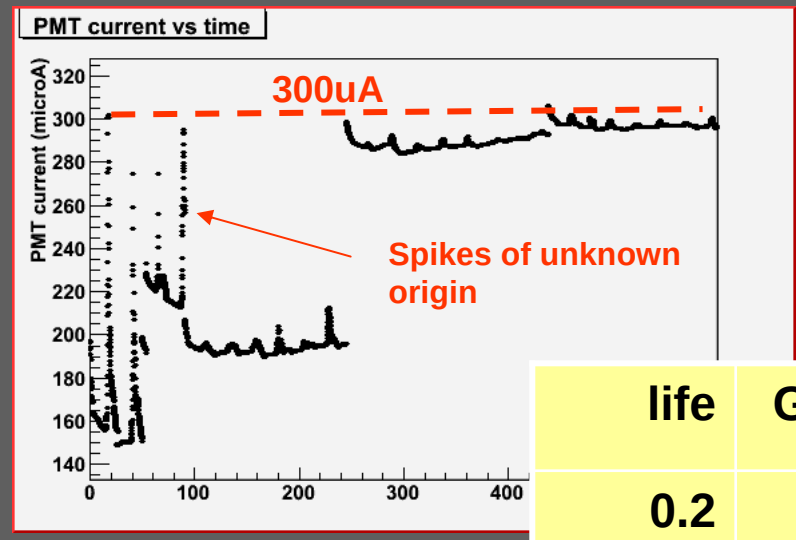
- 1 ½” PM under intense light exposition (cathod area 1/2 of the 2” PM); life=180 C (hamamtsu confirms)

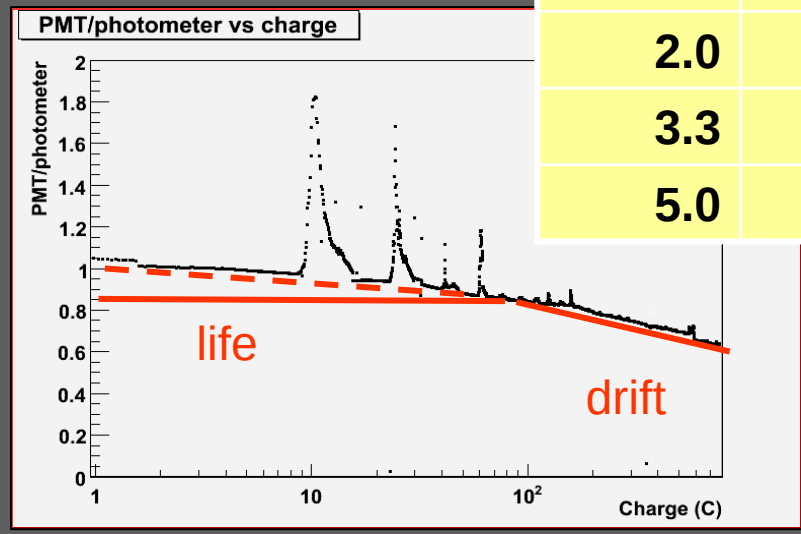


Test of a PM for ~5 times the life

- During the test we decide to speed up the PMT's ageing working at very high current of 300 μA. We increased light on PMT and consequently the anode current





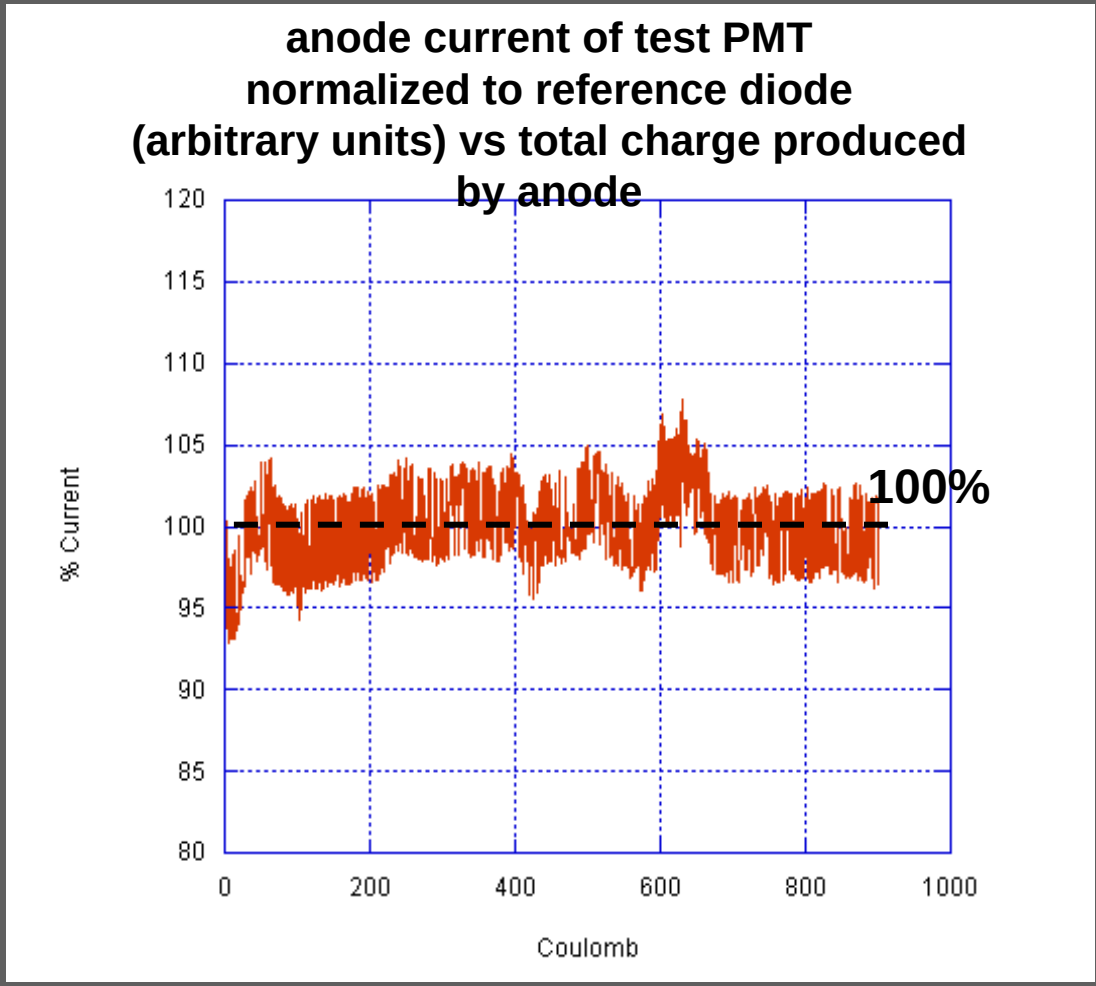


life	G/G(0)
0.2	90%
2.0	77%
3.3	70%
5.0	65%

• Finally: with acceptable slow drift, that can be recovered by increase of HV, the fine mesh PM will survive for the whole duration of the experiment.

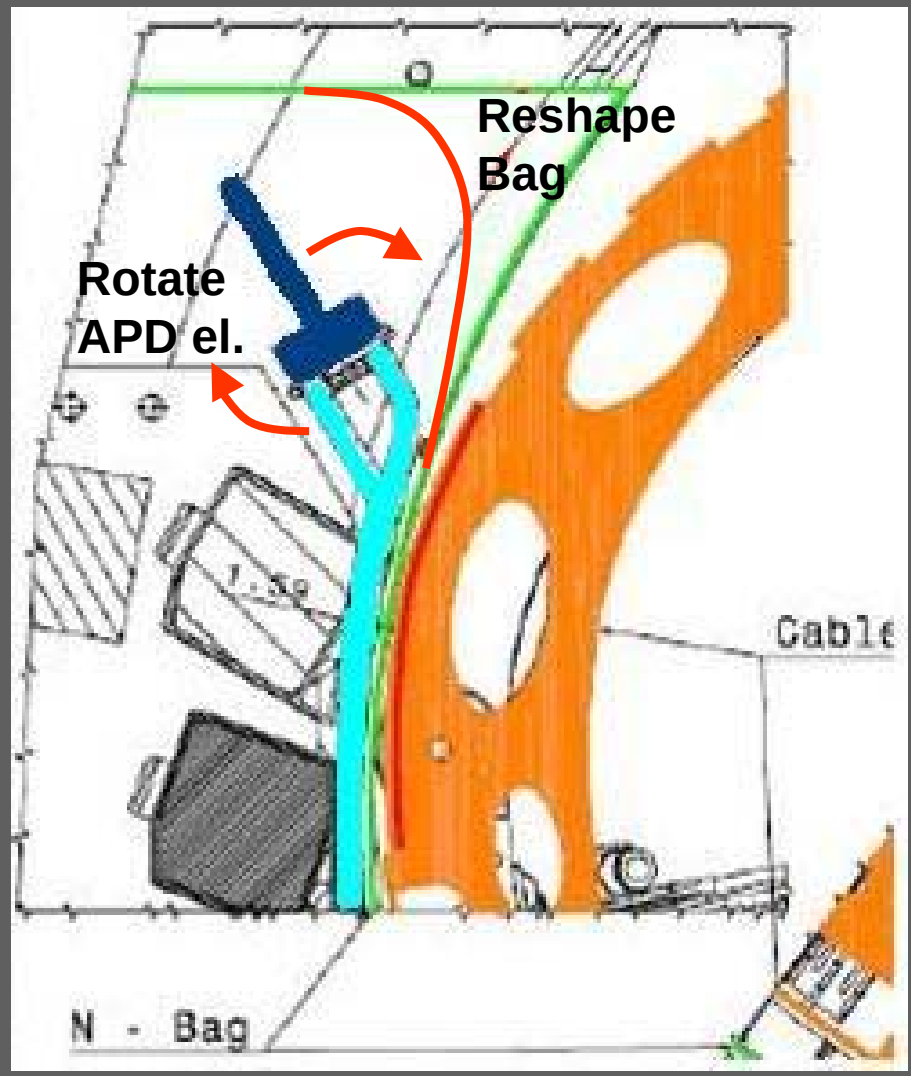
Test on 2” PM under way

- Low Anodic current (90 uA) test on new 2” PM (life=360 C)
- ~ 3 times the life of PM achieved = 6 years of operation



Upgrades

- Upgrade of the N2Bag: shape and material (SSteel end side)
- Rotate and shift up the APD electronics assembly
- Re-shape the scintillating fibres
- Re-design the collar and plug system for the N2Bag- End Cap
- Insert the Optical Splitter for the distribution of laser pulse
- N2 gas distribution and sampling
- Remote operation of He monitor and cooling chillers
- Improve cabling and connectors TC to splitters



New Bag

- SS end side of the bag assure precise and robust, leak free, solution.
- The US N2B delivered and mounted

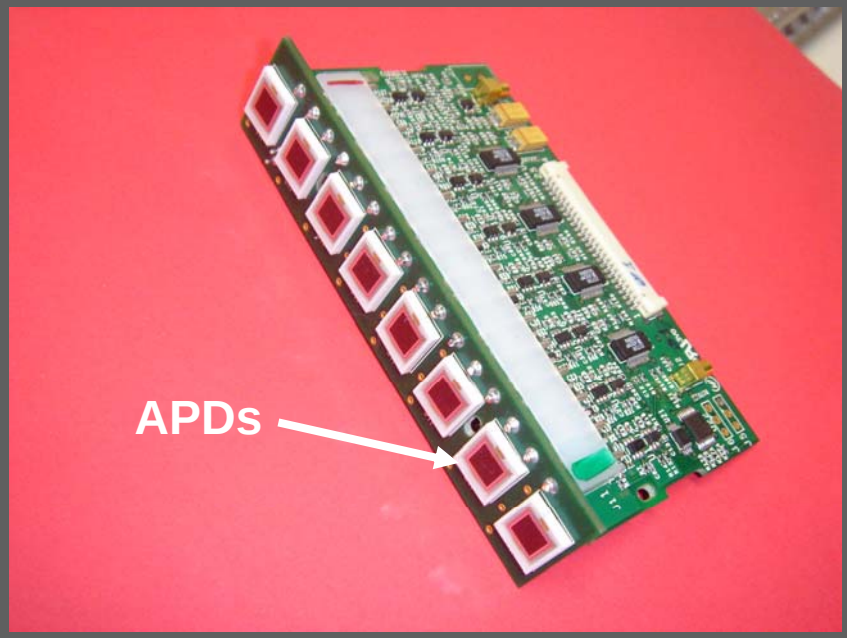

SS end side in the workshop

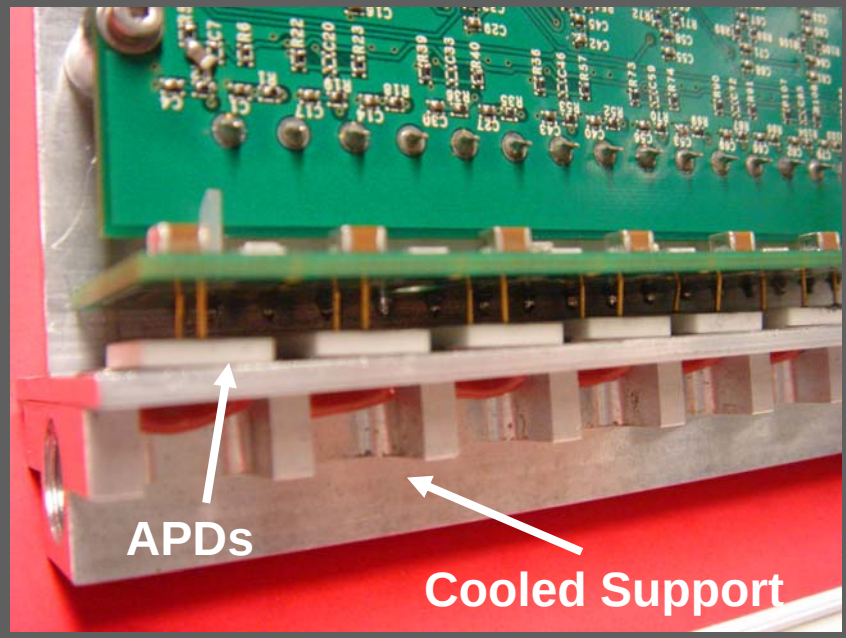

SS end side fits the TC


SS end side fit the COBRA

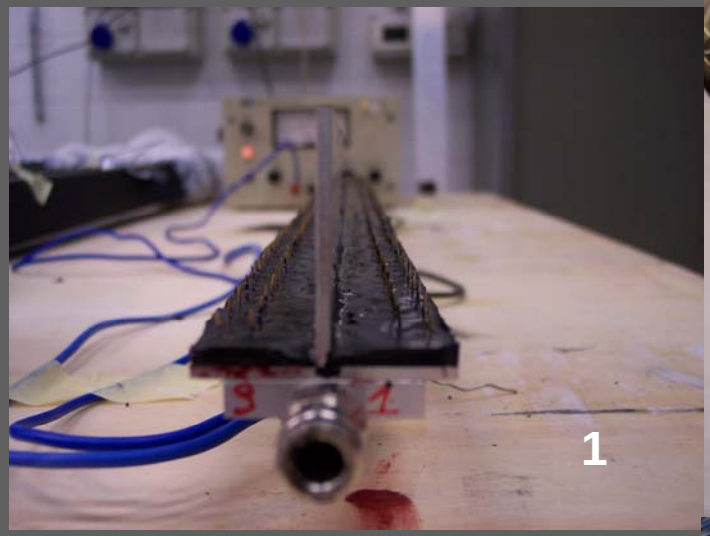
Fiber detector electronics

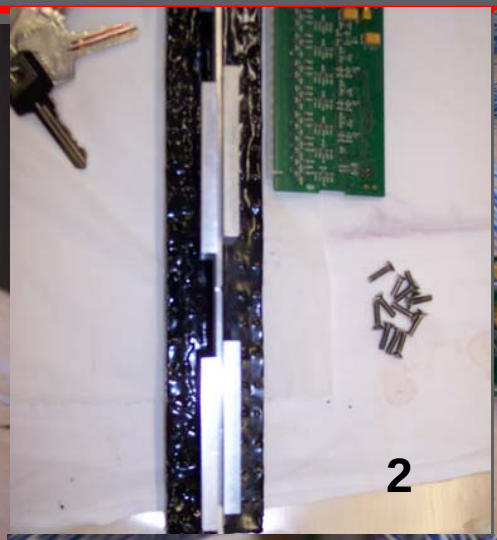
- We are ready to start the mounting of the fiber detector
- We have modified the position of APD electronics.
- We have fixed the cooling: 2 thermoelectric chillers (400w each). A test set-up with one chiller and one final APD support has been already tested in Genoa (125 W per support = 250 W per TC).

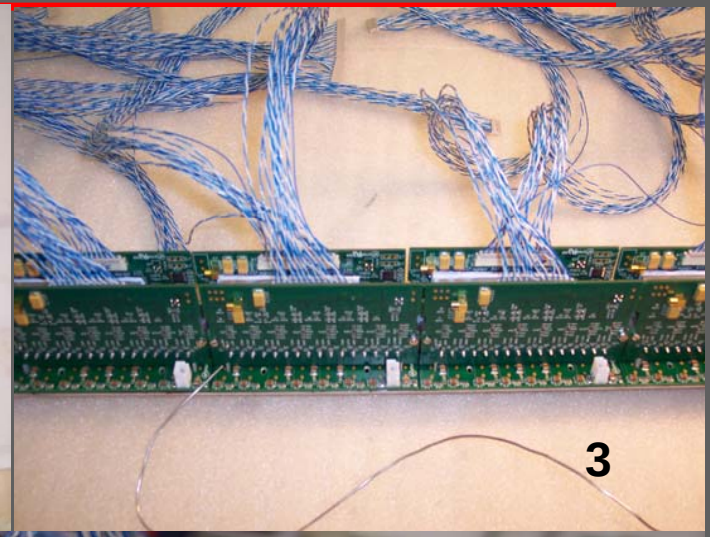


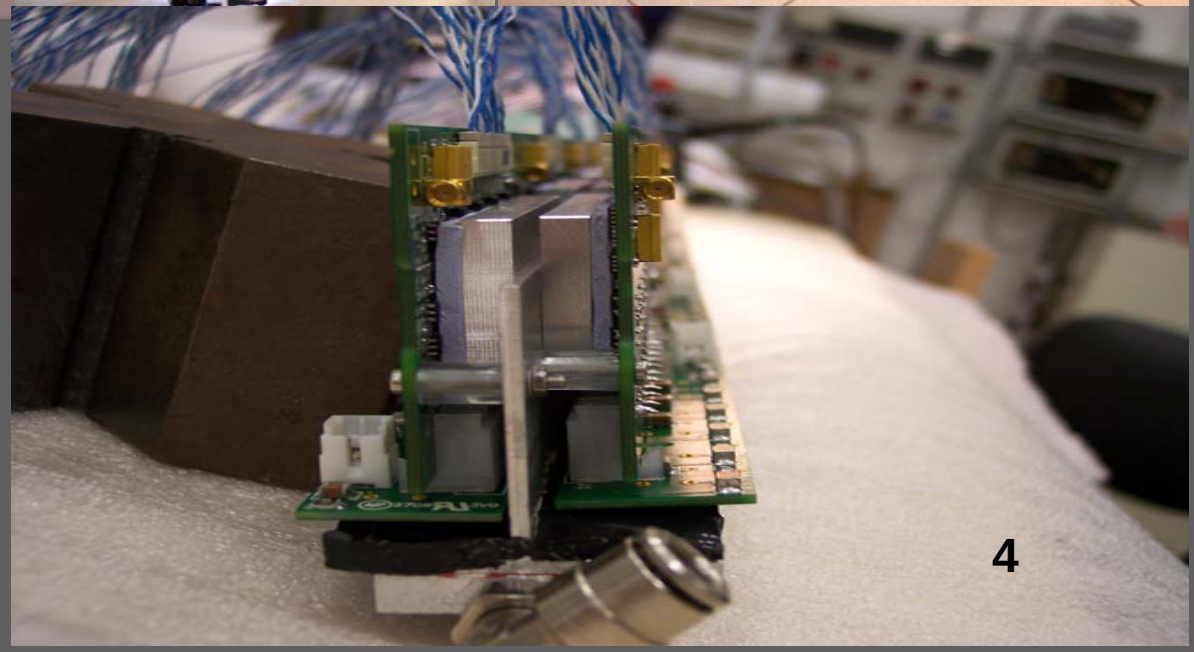


APD readout fabrication phase





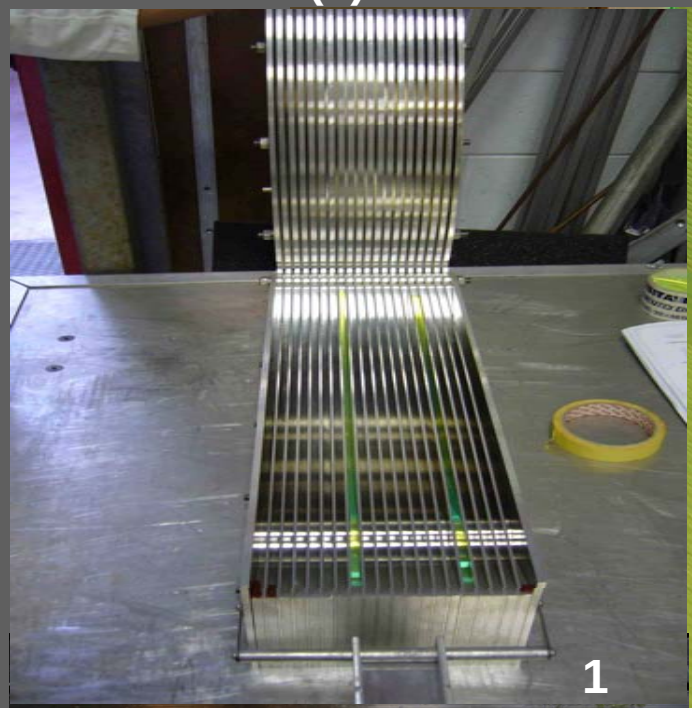


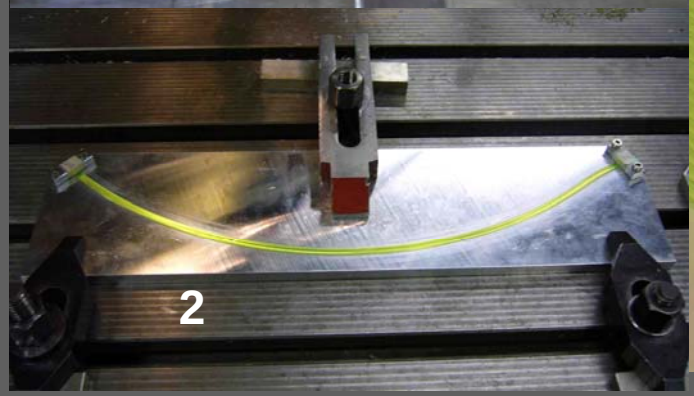


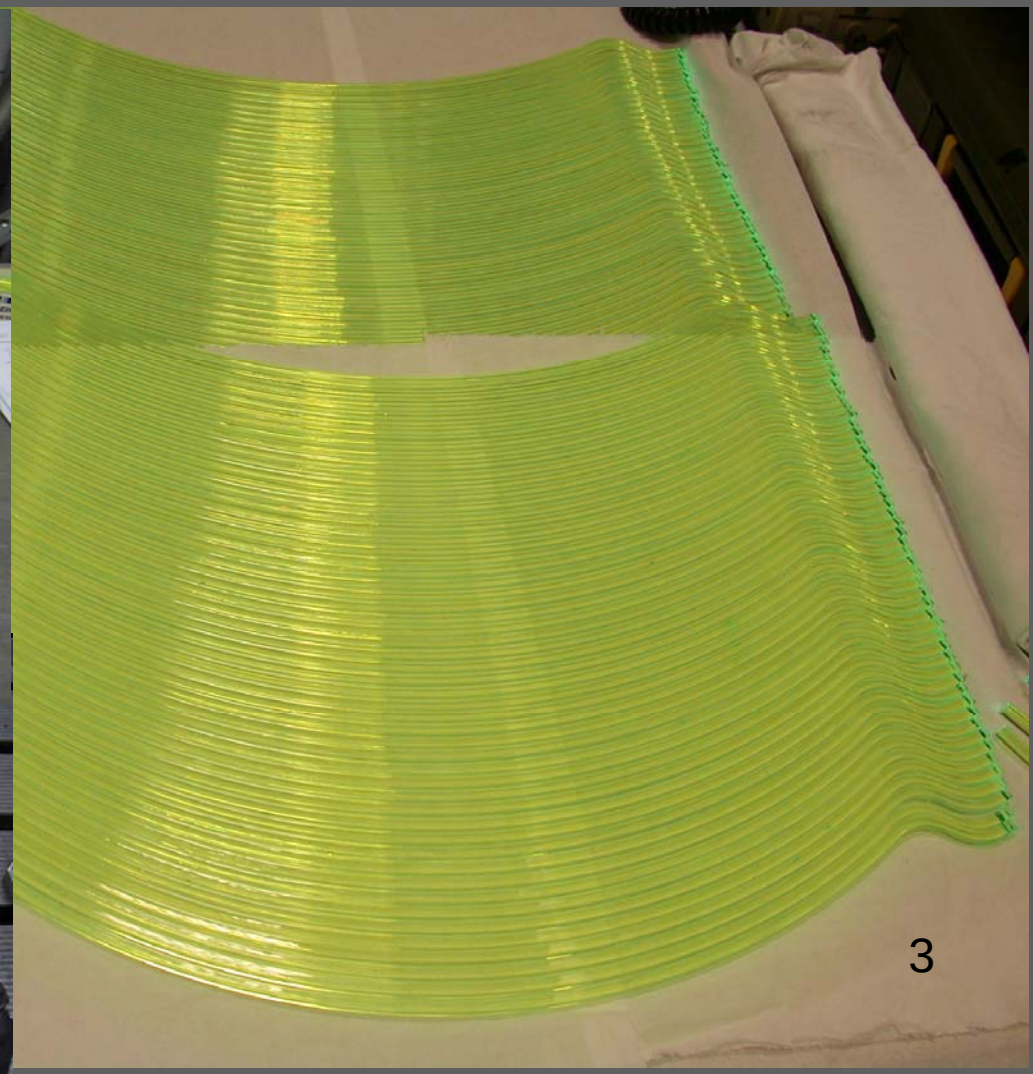
1. APDs glues with Epotek-301-2 and Stycast 1810
2. Preparing for electronics assembling
3. Fully assembled APD electronics with cable
4. Lateral view showing water pipe, electronics with cooling polymer

Scint. Fibers shaping

- **Formed at 120 C (1) and machined for flat ends (2). Ready to be mounted(3)**

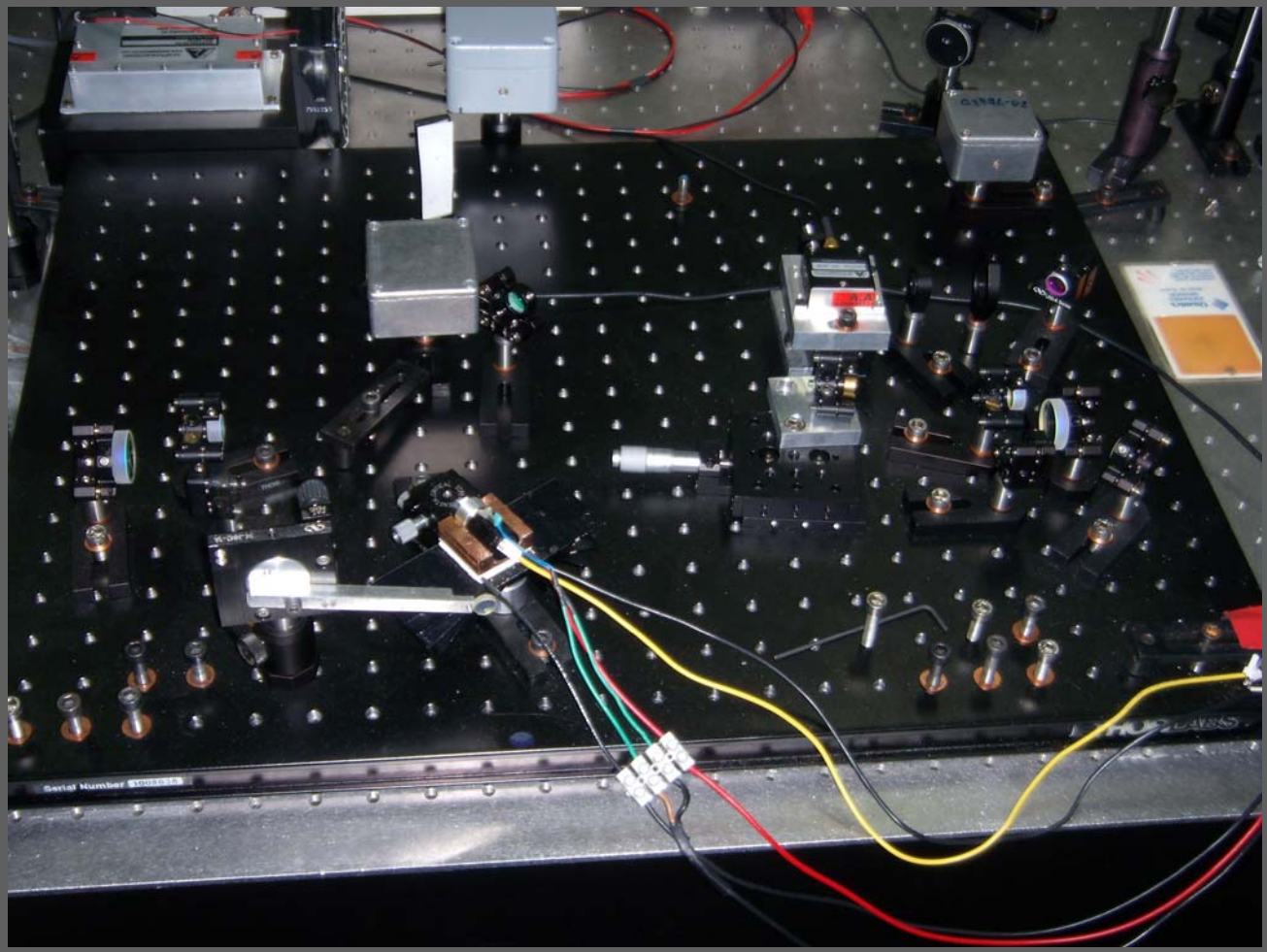






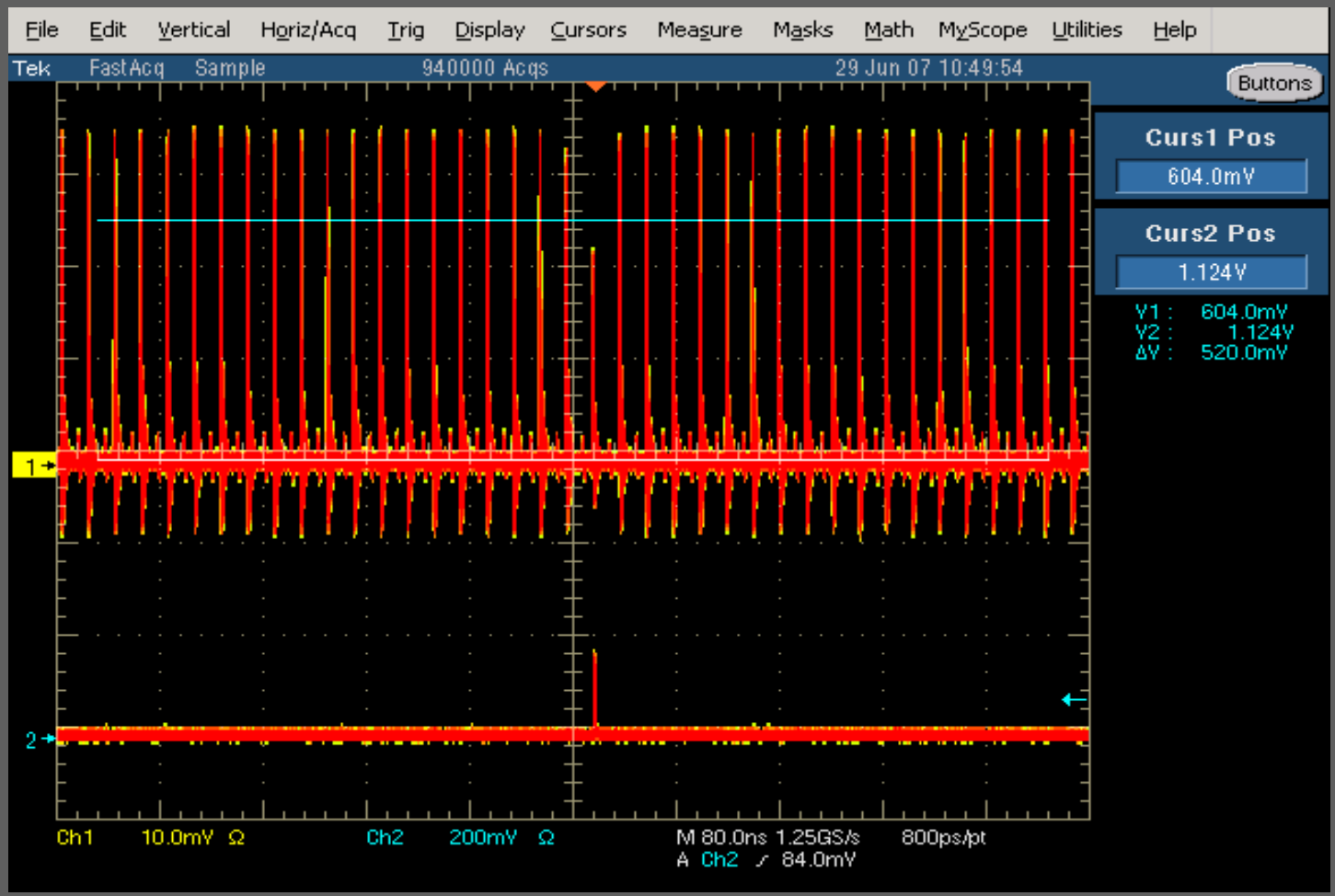
Laser for 532 and 266 nm

- **The system is ready and tested.**
- **Ancillaries (power boxes, enclosure, APD for trig out) to be done**

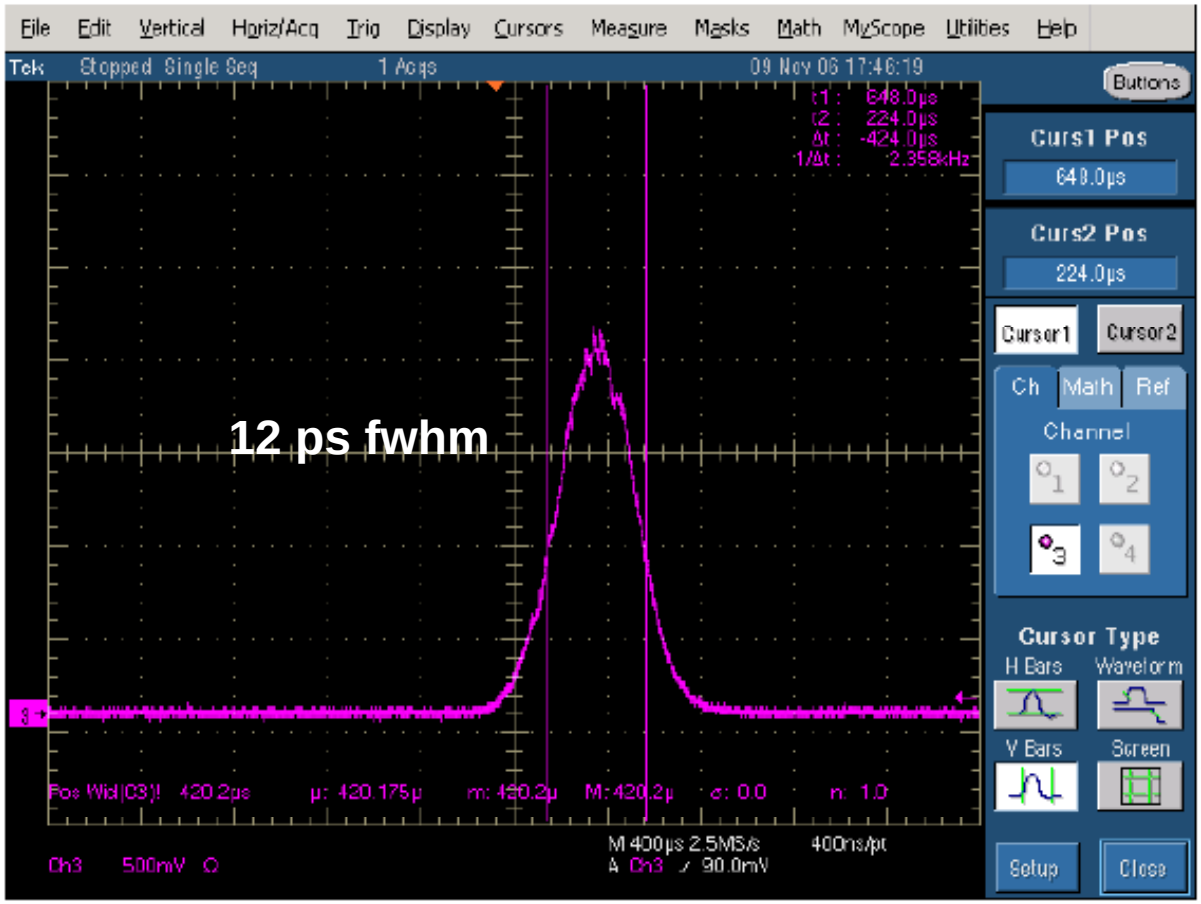


Laser working at the repetition rate of 1-100 Hz

- Oscillator a 48 MHz; power within 1%; output rate 1-100 Hz

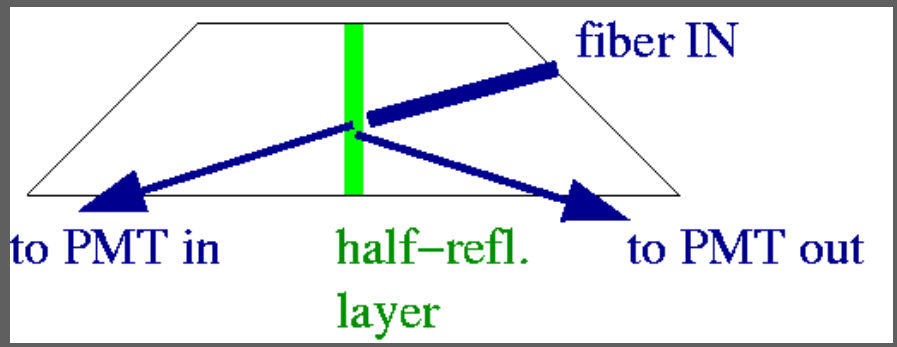


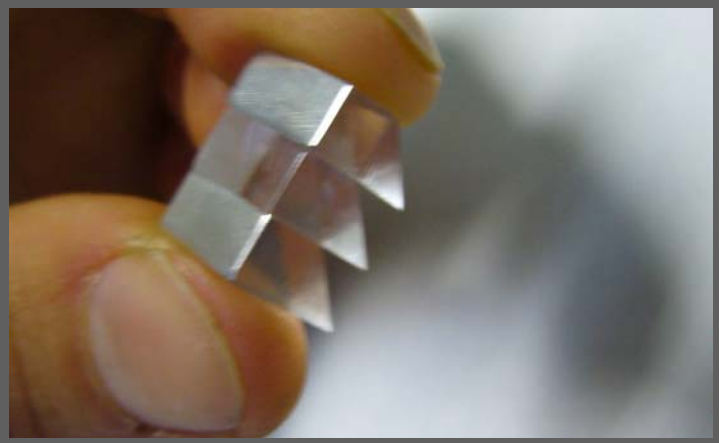
Laser pulse at 100uJ: 12 ps FWHM



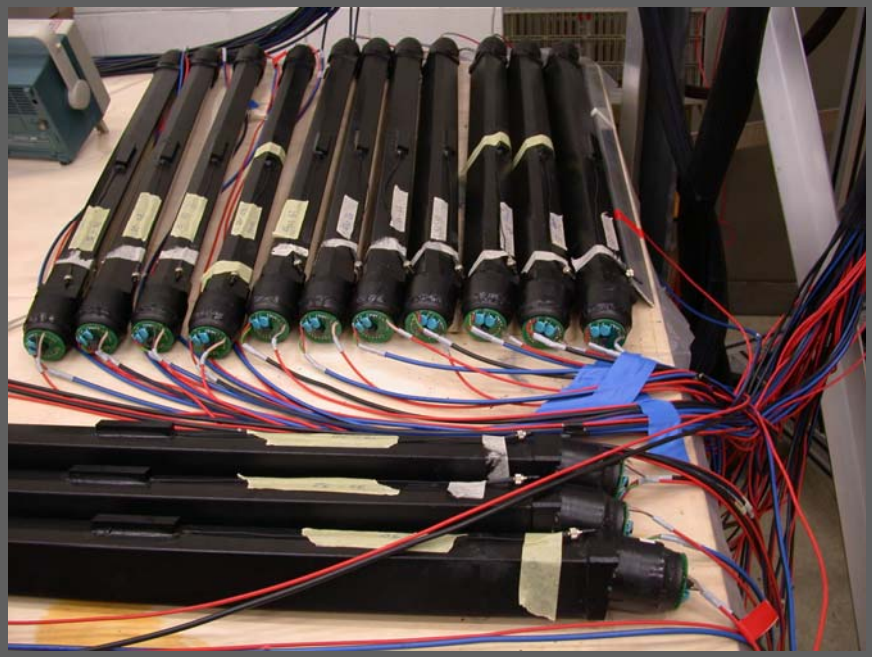
Laser signal distribution

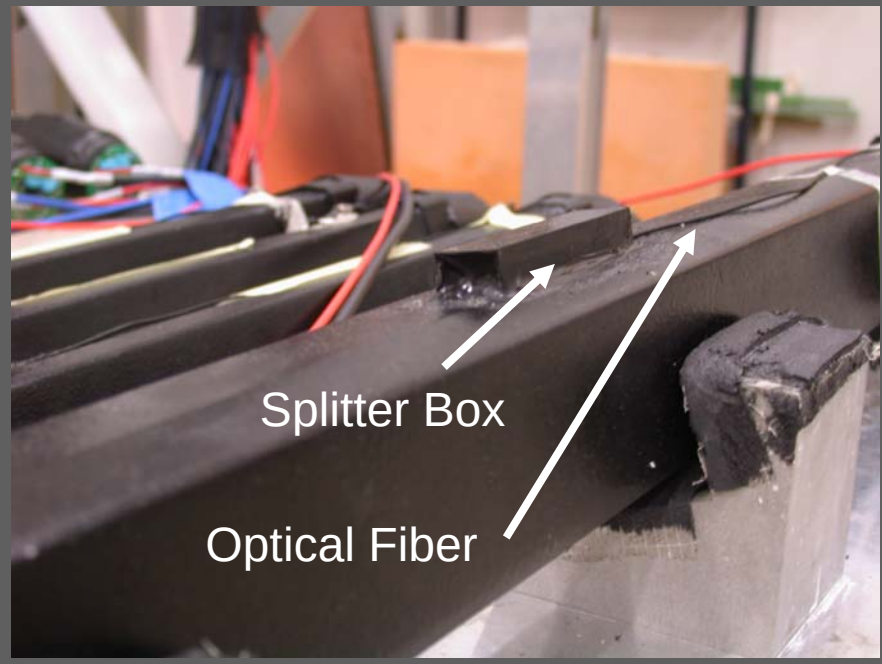
- Beam splitter (about 150°) has been built coupling two prisms with a face covered by thin aluminun film.



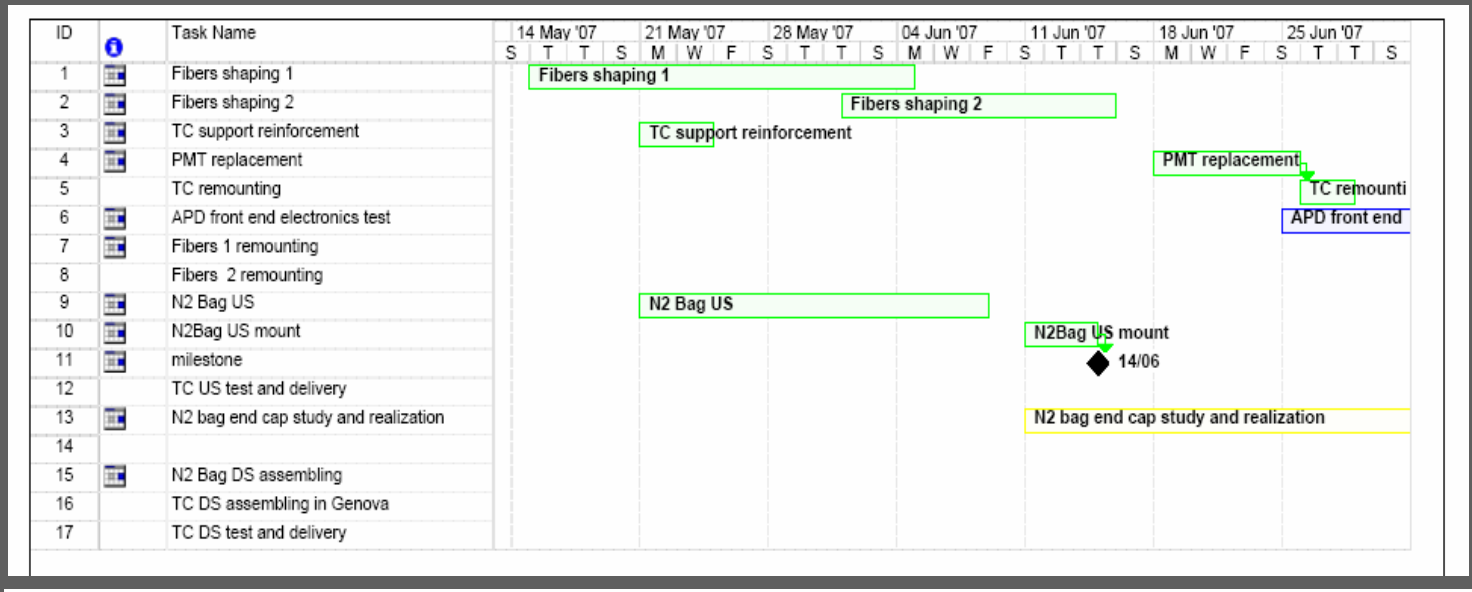


Splitters mounted onto the bars before reassembling





Schedule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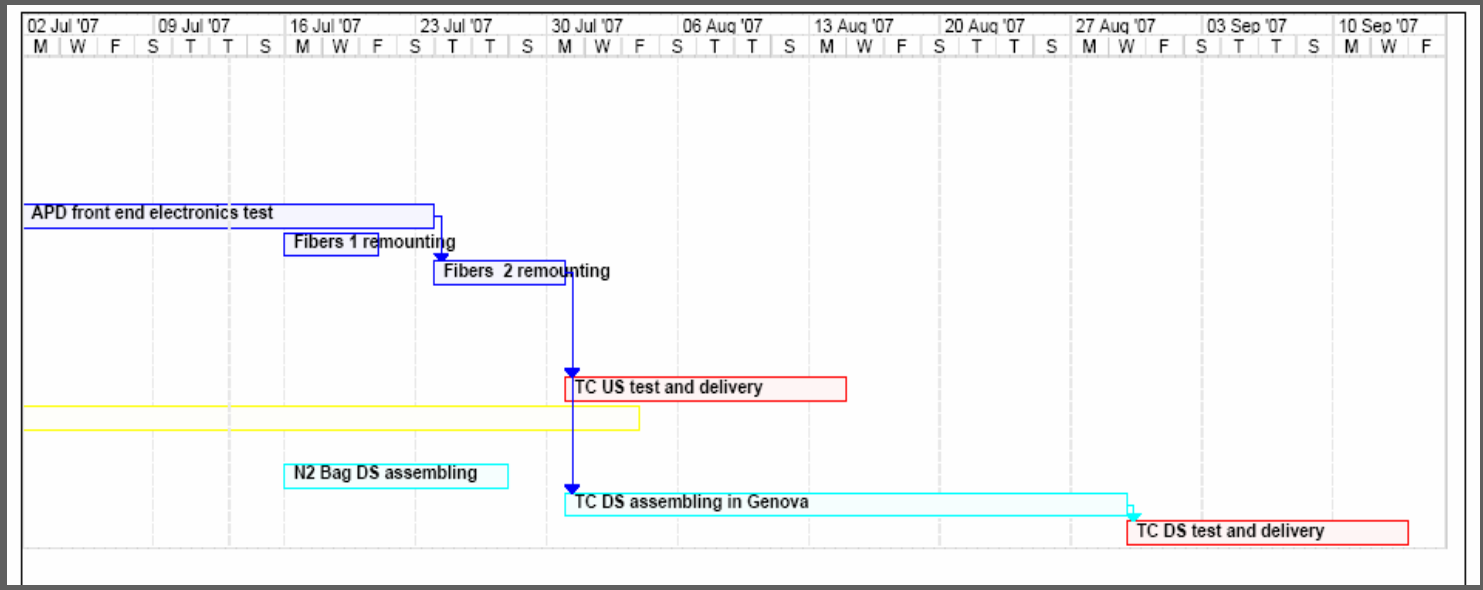
Task Name
14 May '07
21 May '07
28 May '07
04 Jun '07
11 Jun '07
18 Jun '07
25 Jun '07
1 Fibers shaping 1
2 Fibers shaping 2
3 TC support reinforcement
4 PMT replacement
5 TC remounting
6 APD front end electronics test
7 Fibers 1 remounting
8 Fibers 2 remounting
9 N2 Bag US
10 N2Bag US mount
11 milestone
12 TC US test and delivery
13 N2 bag end cap study and realization
14
15 N2 Bag DS assembling
16 TC DS assembling in Genova
17 TC DS test and delivery
Fibers shaping 1
Fibers shaping 2
TC support reinforcement
PMT replacement
TC remounti
APD front end
N2 Bag US
N2Bag US mount
14/06
N2 bag end cap study and realization


02 Jul '07
09 Jul '07
16 Jul '07
23 Jul '07
30 Jul '07
06 Aug '07
13 Aug '07
20 Aug '07
27 Aug '07
03 Sep '07
10 Sep '07
APD front end electronics test
Fibers 1 remounting
Fibers 2 remounting
TC US test and delivery
N2 Bag DS assembling
TC DS assembling in Genova
TC DS test and delivery