Stato IFR e richieste 2010-2011

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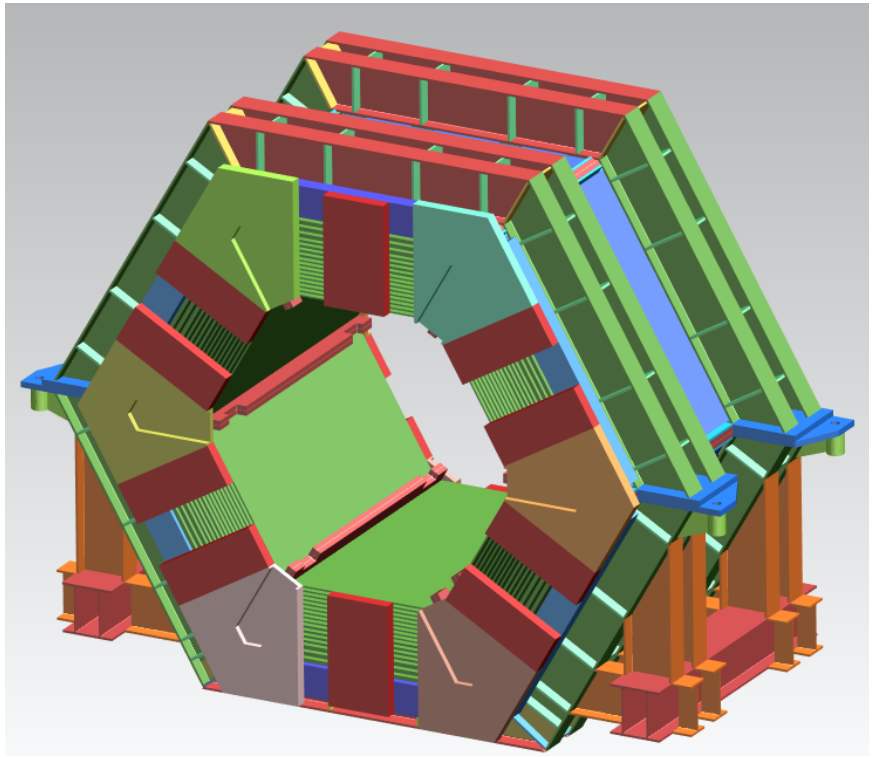
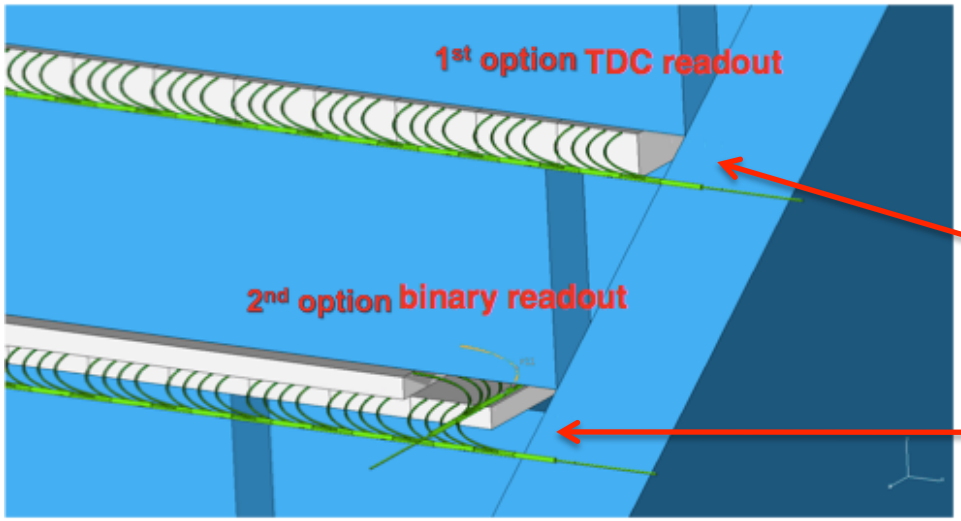
Instrumented Flux Return

The muon an KL detector will be built in the magnet flux return reusing the Babar iron structure with some modification.
Modeling and FEA calculation in progress.

Iron will be added to improve the muon ID.
8-9 active layers will be used.

Keep longitudinal segmentation in front of the stack to retain KL capability





Two readout option will be used:

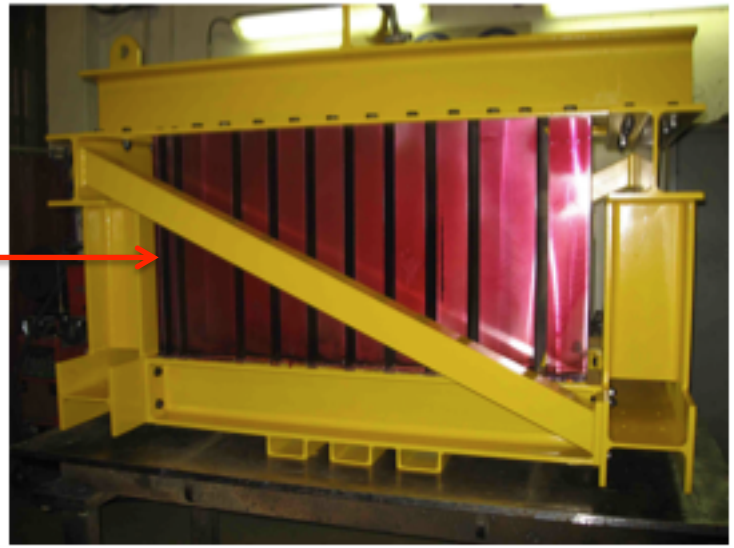
1. read one coordinate with the bar position and the other with the arrival time of the signal (barrel)
2. “double coordinate layout”: orthogonal scintillator bars (endcap)

Prototype preparation

A full scale prototype is in construction to test the R&D results and to validate/tune the simulations.

It has a segmentation that allow testing different iron configurations.

It will be tested on a muon/pion beam at Fermilab next December, with energies varying from 0.5 GeV to 5 GeV.



Jul 19 - Aug 16	No Beam: SHUTDOWN				
Sep 15 - Sep 29	T992	SLHC sensor tests	Yun	1-B	Primary
Sep 30 - Oct 6	Facility Development				
Oct 7 - Nov 2	T978	CALICE	Repond	2-D	Primary
Nov 3 - Nov 9	T1004	Dual Readout Calorimetry	Para	2-B	Primary
Nov 10 - Nov 23	T992	SLHC sensor tests	Yun	1-B	Primary
Nov 10 - Nov 16	T979	Fast Timing Counters for PSEC	Albrow	2-B	Secondary
Dec 1 - Dec 7		SuperB prototype	Posocco	?	Primary
Dec 8 - Dec 23	T994	JASMIN	Nakashima	2	Primary
2011					
Jan 5 - Feb 1	T978	CALICE	Repond	2-D	Primary

The iron structure is ready, the scintillator assembly started and will be completed by September.

Photodetectors delivery time drives the schedule.

Prototype in a nutshell

Scope of the prototype:

- confirm on large scale the R&D results

- validate/tune simulation optimization

- spot any mechanical/electronics/simulation/ technology issue

The iron has a segmentation that allow testing different absorber configurations.

- different amount of material

- 8 and 9 active layers

additional test:

- different SiPM geometry

- different fiber size

baseline configuration:

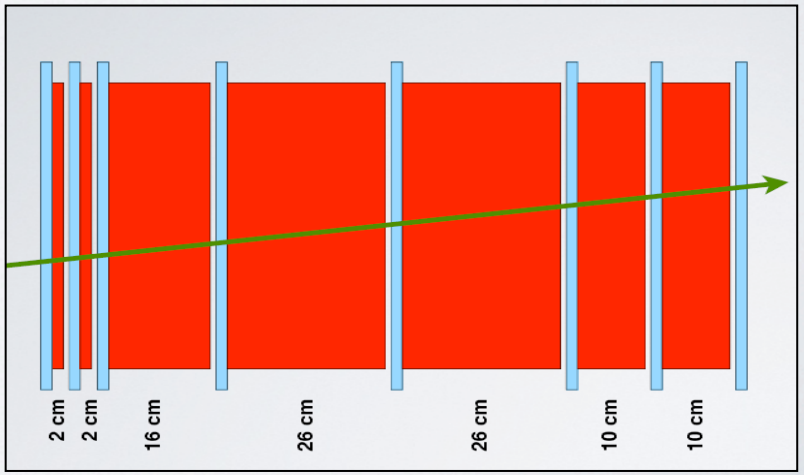
- 8 active layers (4 BiRO + 4 TDC)

12 active modules:
- 4 standard TDC,
- 4 standard BiRO,
- 2 special TDC, 1 special BiRO, 1 MPPC

228 scintillator bars:
- 98 2cm thick -
- 130 1cm thick

684 fibers:
- 210 bicron 1mm -
- 84 bicron 1.2mm -
- 390 Kuraray 1.2mm

326 photodetectors (PCB, couplers):
- 54 round -
- 126 1.2x3.2 -
- 132 1.4x3.6 -
- 14 MPPC



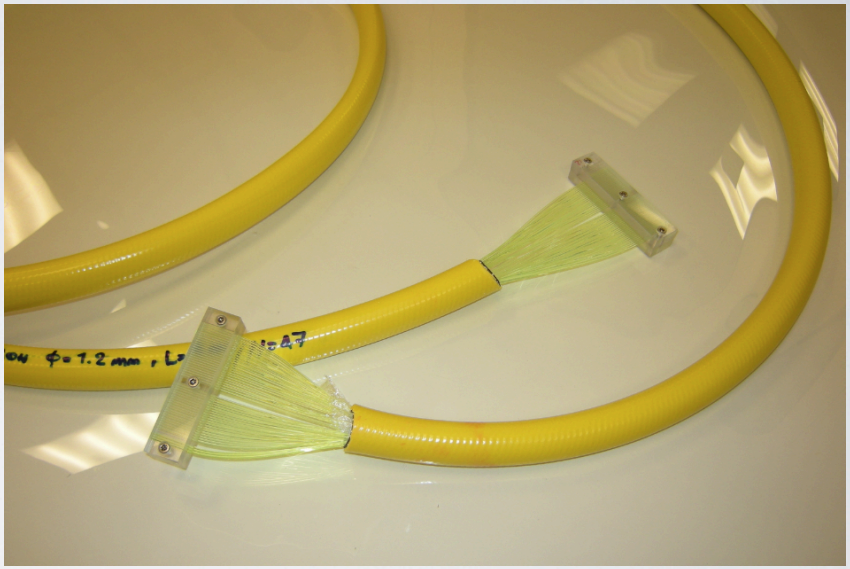
Overall advancements

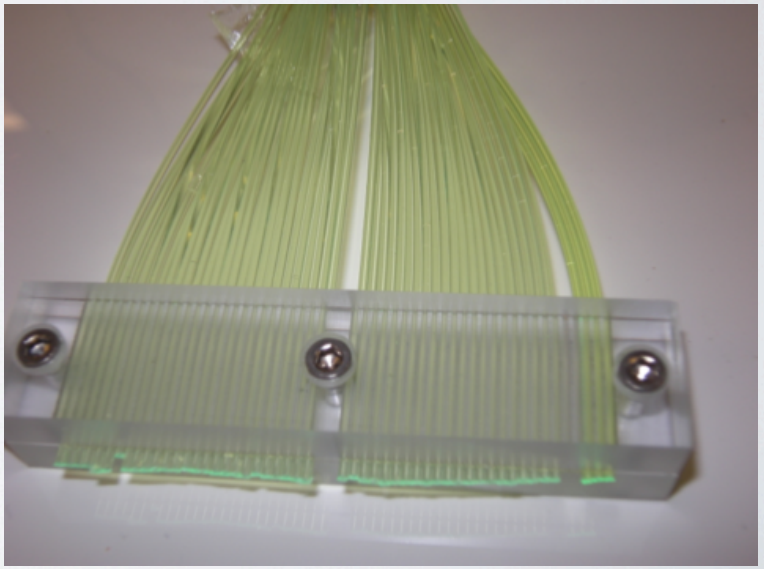
	ANNECY (March 2010)	July 2010
Mechanical structure	arrived	arrived
WLS Fibers	arrived	arrived
Scintillators: 1 cm thick	arrived	arrived
2 cm thick	in production	arrived
PCB	arrived	arrived
SiPM	expected end of July (critical)	
Mechanical small parts	in preparation	arrived
Assembly studies	started	established
QC procedures	critical	established

The scintillators

- All the scintillators have been delivered to Ferrara
- The scintillators for BiRO have been cut to have the same length: either 50cm or 60cm depending on the view (vertical bars must allow the fiber to bend therefore they will be shorter).
- The scintillators for BiRO have 2 holes: an additional groove has been done with a diamond tool.
- Also 2-cm scintillators for Time readout ready for the assembling.

Fiber cutting and handling



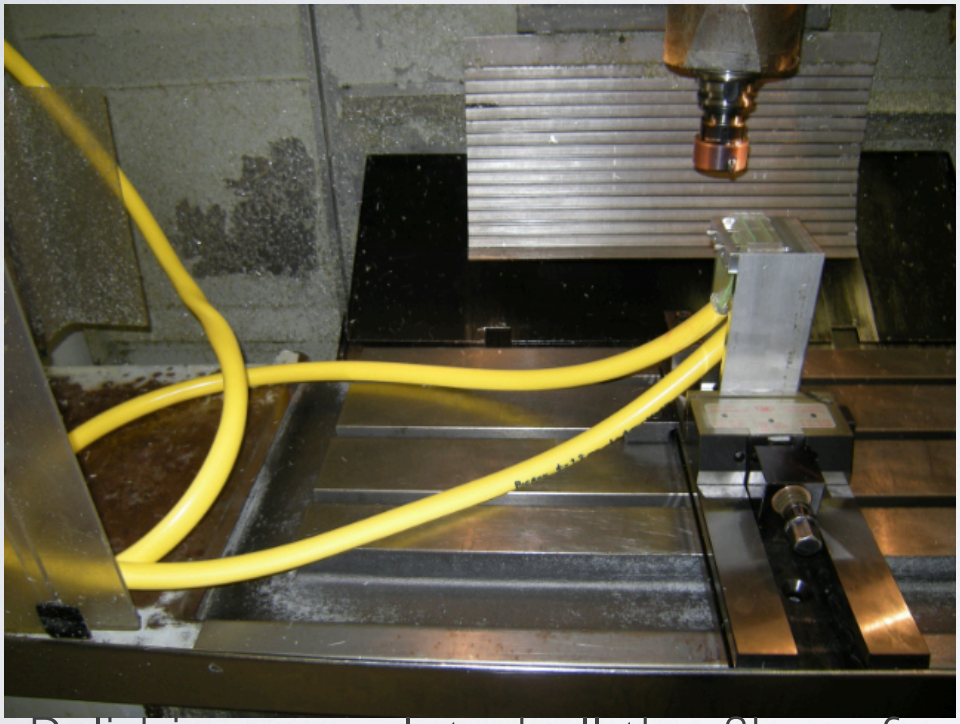


All the fibers have been cut and stored in plastic tubes to keep them protected from light and from mechanical stresses during the polishing.

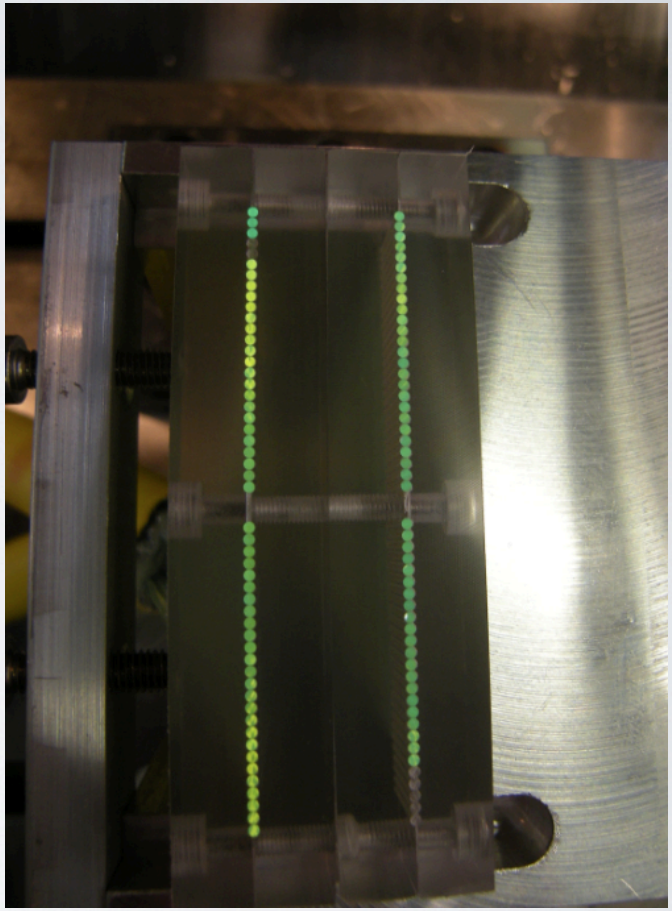
Fibers are grouped into a plexiglass connector for the polishing.

Fiber polishing

Results on diamond mill polishing have been shown at the previous meeting: about 25% more light wrt the polishing machine used during the R&D.



Polishing completed: all the fibers for BiRO and TDC readout + spares have been machined.
Good quality from a visual check.

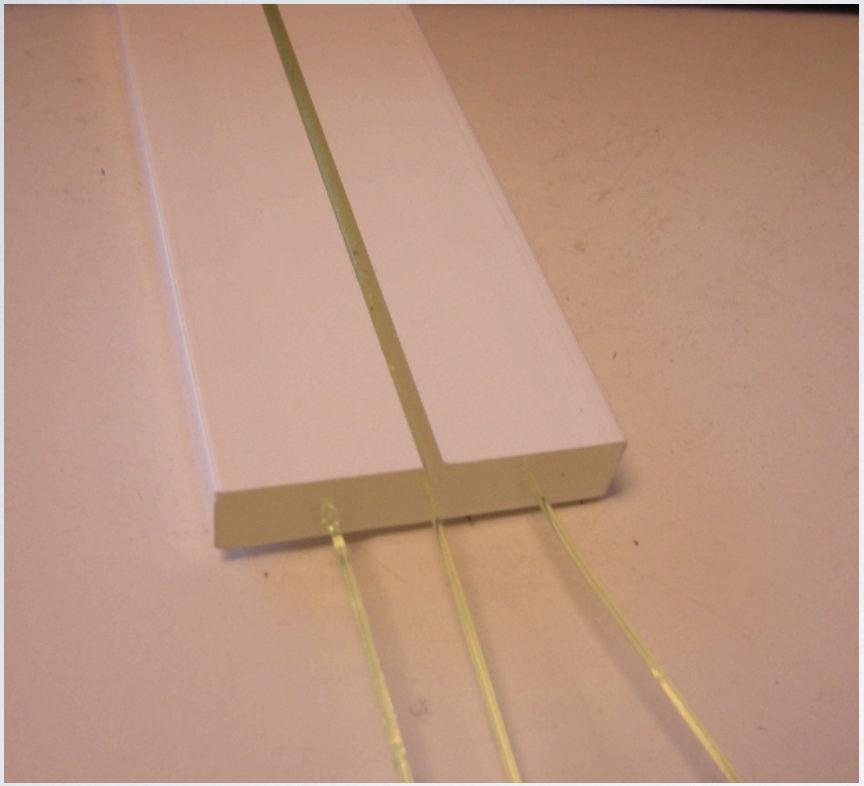


Additional QC:

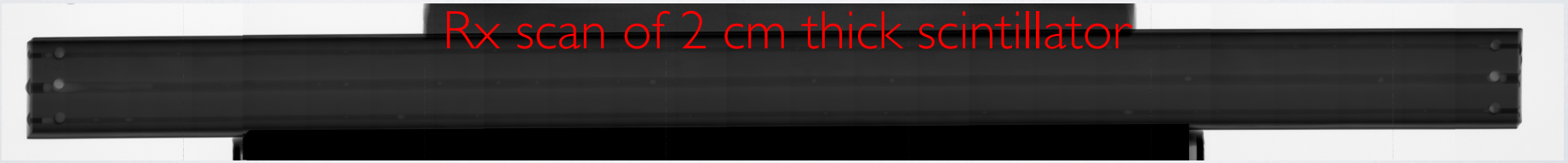
3 test fibers (L=50cm) every polishing (50 fibers)

Analysis ongoing, preliminary results show very good uniformity

Fiber gluing

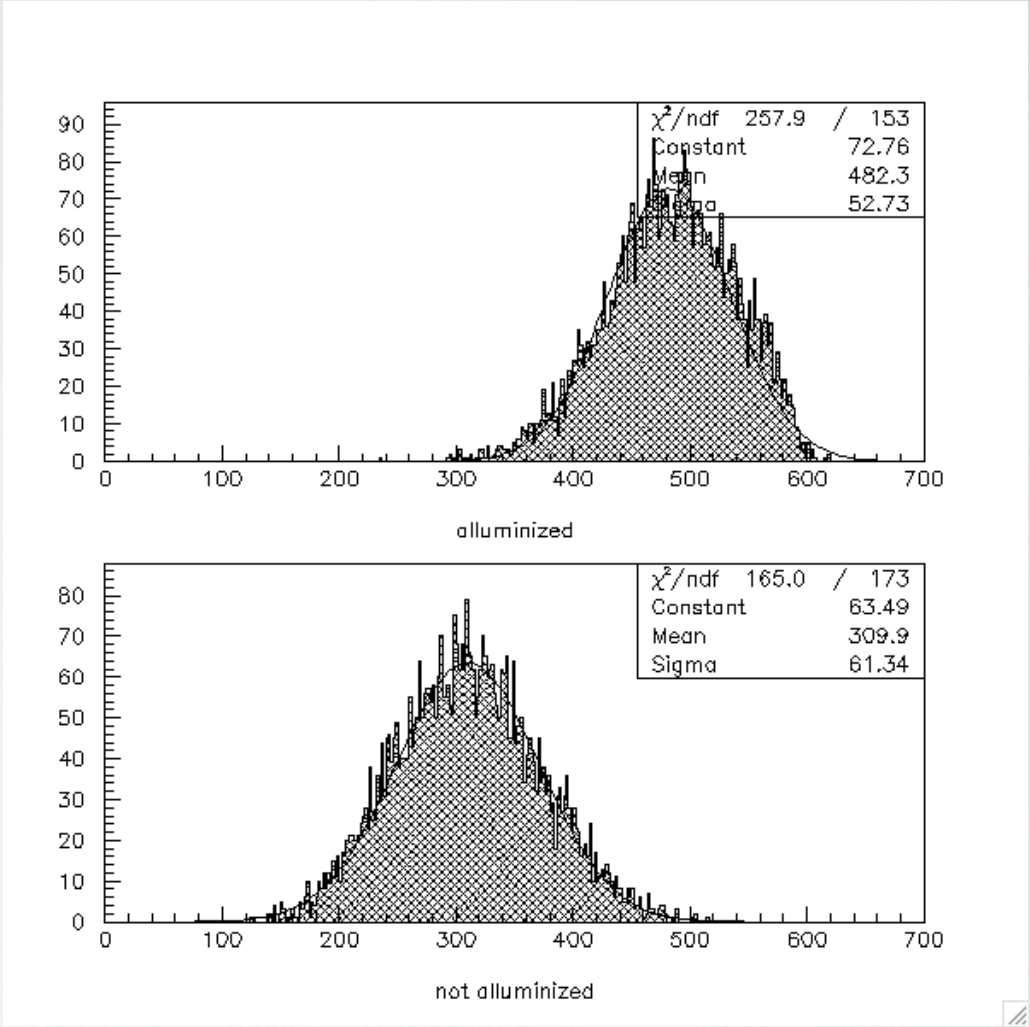


- The gluing of the fibers in the scintillator holes is perhaps the most complicated part of the module assembling.
- We are using a very fluid epoxy to be able to fill all the 60 cm of scintillator. Drawback: long curing time.
- After several tests the filling procedure has been established, Rx scan shows good results



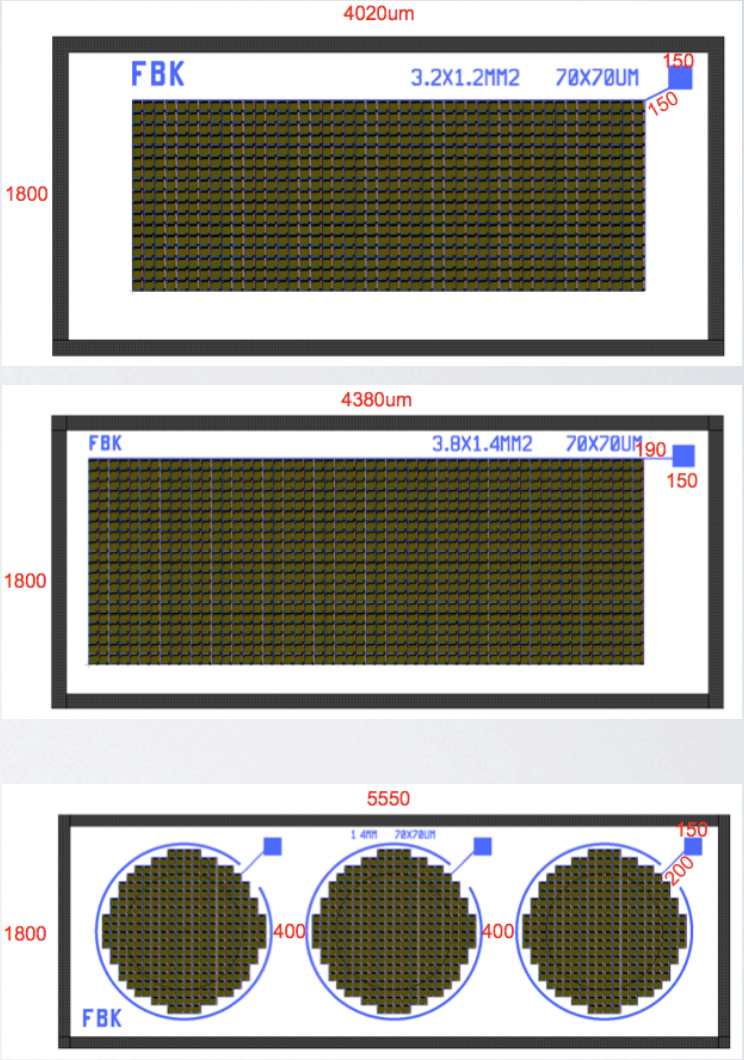
Fiber aluminization

- To recover some light on the BiRO modules (read by one end) we tried to aluminize the not-read end.
- This should help to improve the signal on the far end where the direct and the reflected signal arrive at the same time.
- Aluminization done on 2 fibers, tests ongoing.
- First results on a ~30cm fibers are very encouraging: about 60% more light
- Plan to aluminize all the fibers of one pizza box

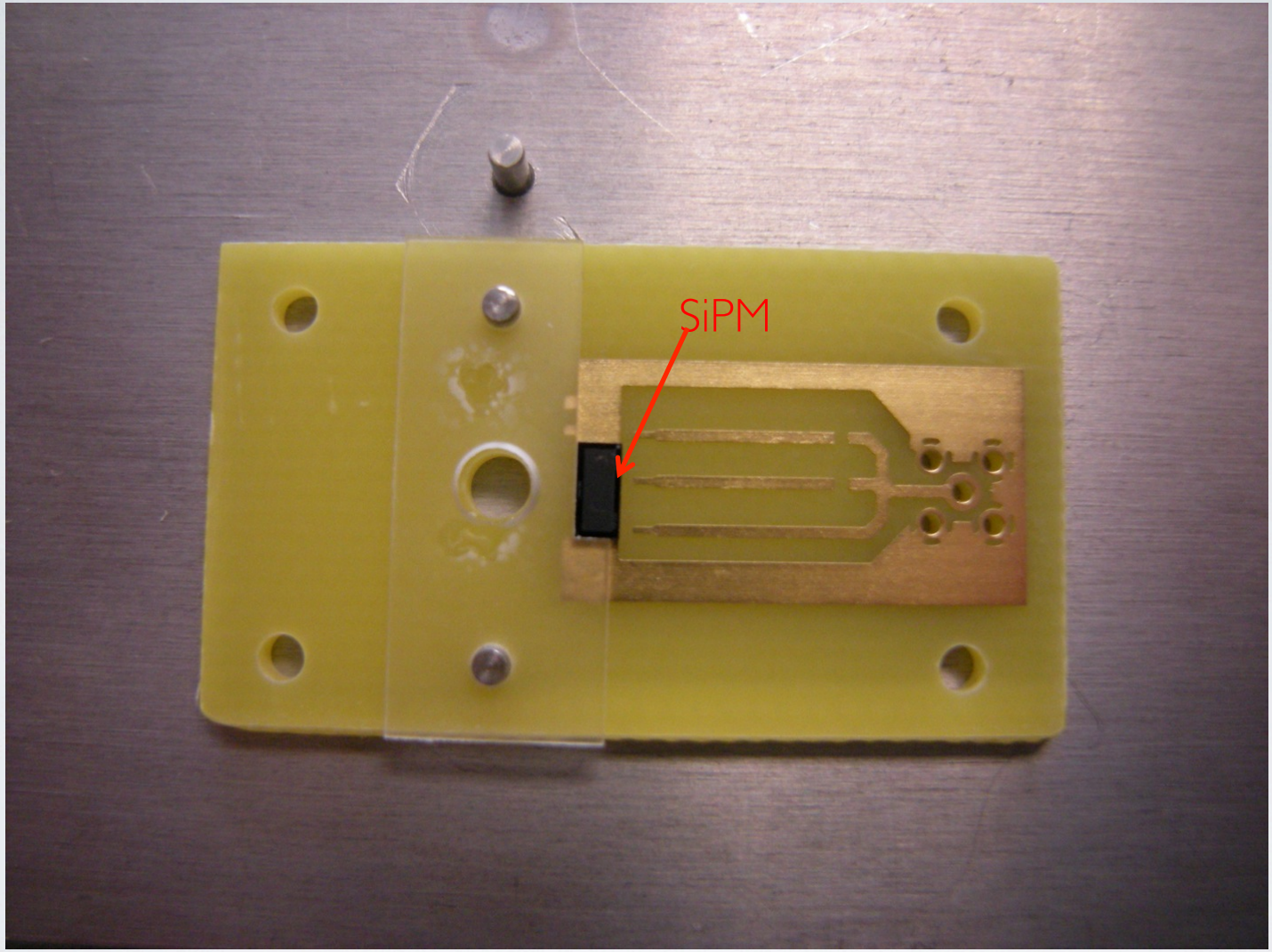


The SiPM

- 3 types of SiPM ordered:
  - for 1mm fibers: active area 1.2x3.2mm^2
  - for 1.2mm fibers: active area 1.4x3.8mm^2
  - for 1.2mm fibers: round 1.4mm radius
- SiPM produced in Trento at FBK-IRST
- Test of devices ongoing, will take few days
- Expected to be shipped to Perugia ≈ July 20-th
- Then:
  - bonding (in Perugia)
  - QC and characterization (in Ferrara)
  - installation in the pizza box



PCBs and SiPM positioning



Gluing of all SiPM positioners on all the PCBs done, they will be shipped to Perugia in the next days

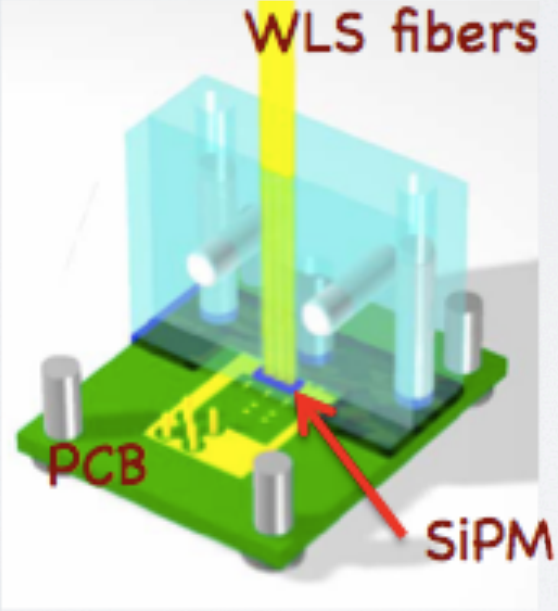
Fibers SiPM coupler

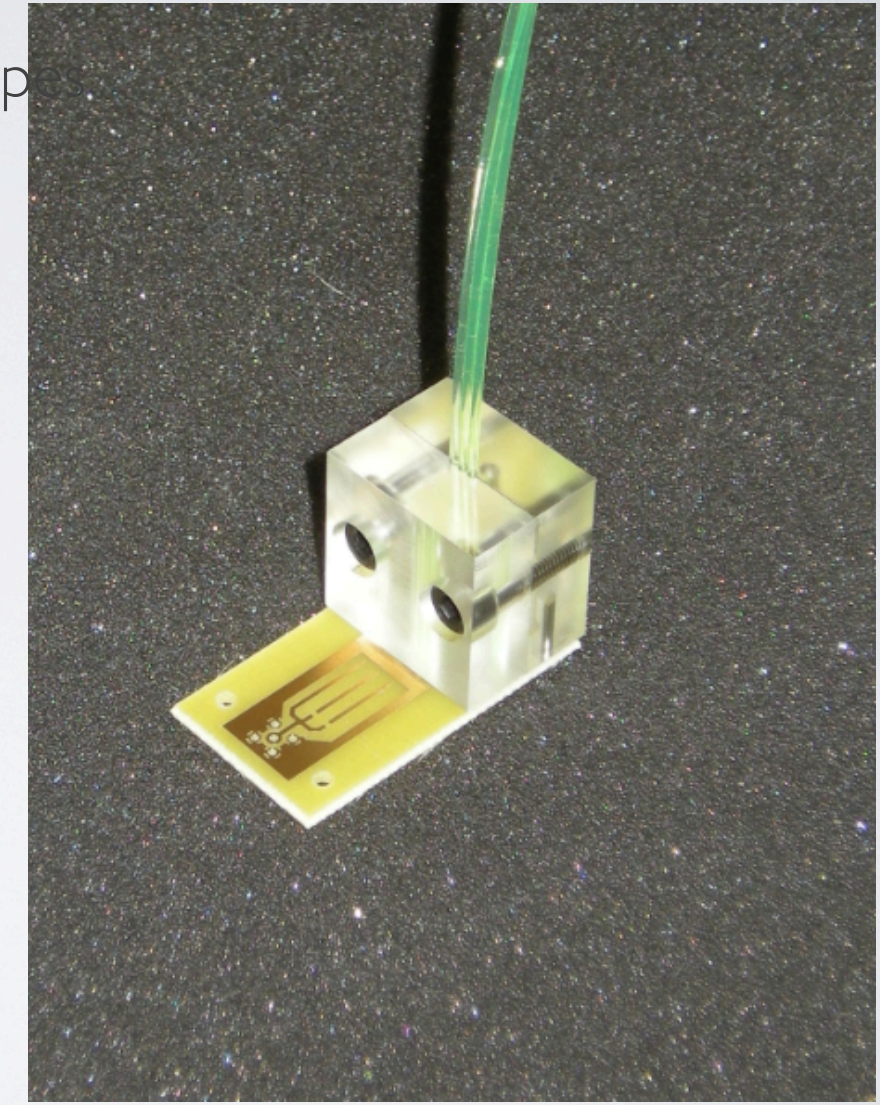
- SiPM-fiber couplers arrived: 3 types

4020* for 1mm fibers and 1.2x3.2mm^2 SiPM

4380* for 1.2mm fibers and 1.4x3.8mm^2 SiPM

5550* for 1.2mm fibers and round 1.4mm SiPM

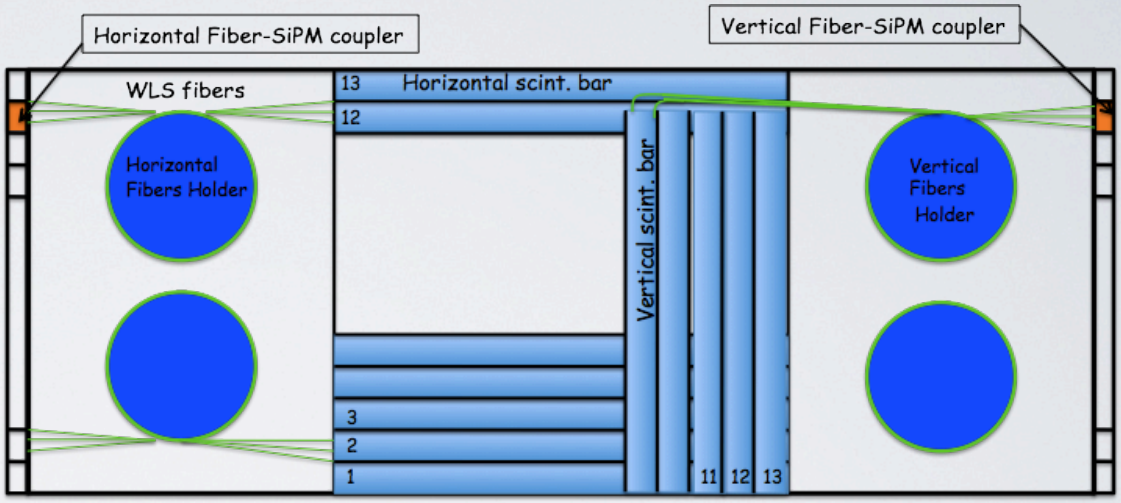




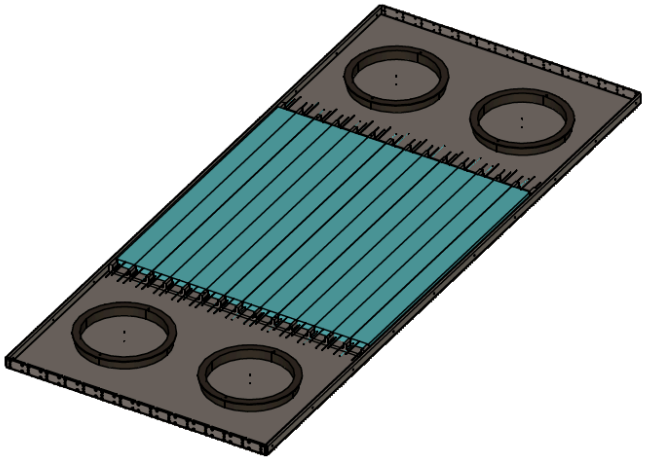
* The number identify the longer external dimension (in microns) of the SIPM

Putting everything together: the Pizza box

- Scintillator planes will be assembled in a light-tightened box (a.k.a. Pizza Box) to avoid dealing with single fiber/module light isolation and to give mechanical rigidity to the active layers

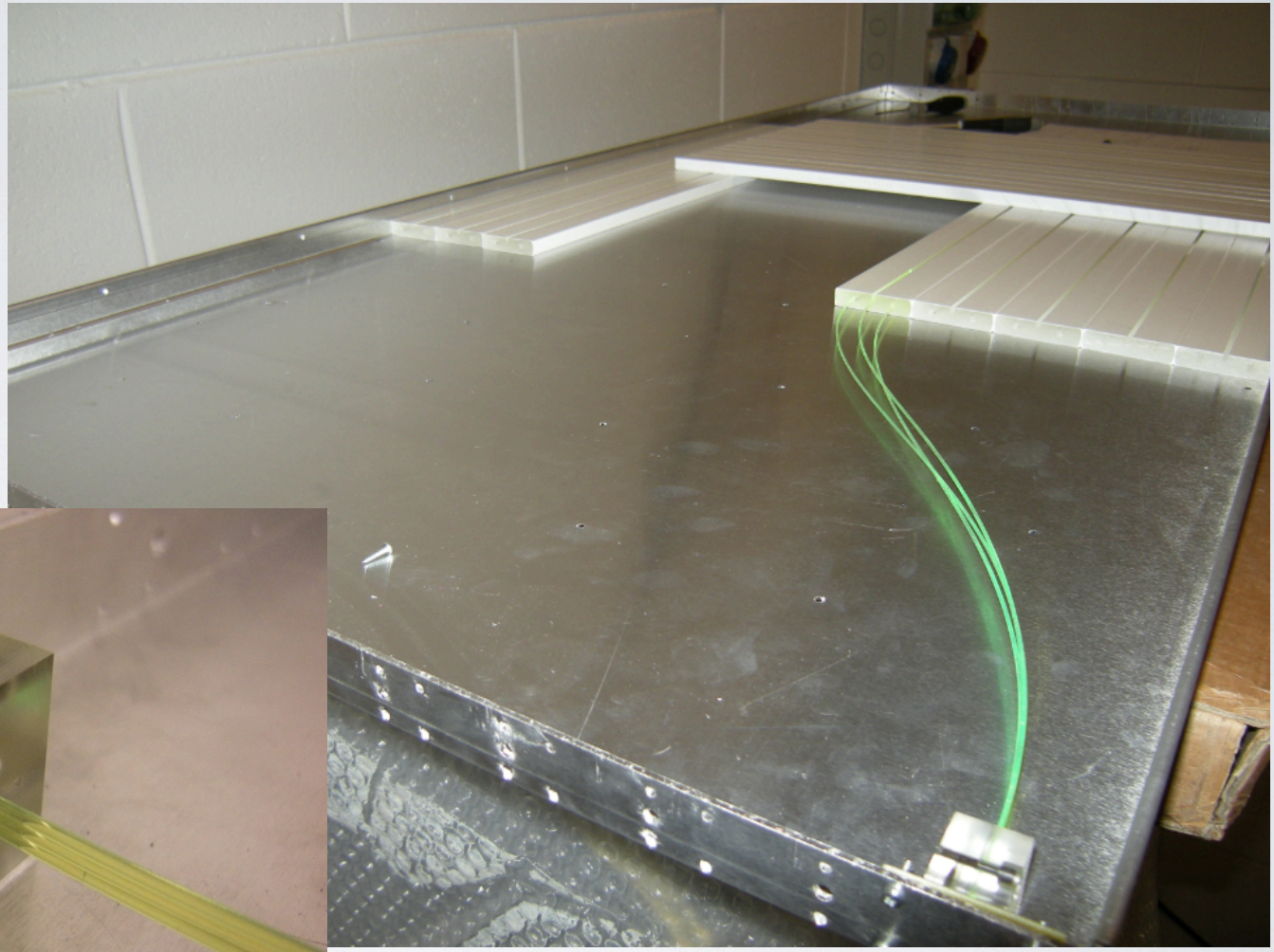


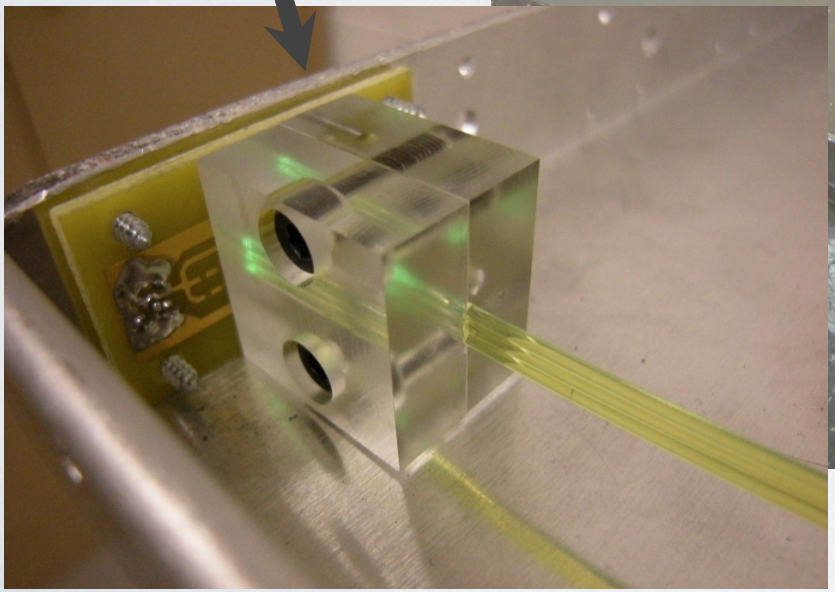
- The boxes are made of aluminum and will contains scintillators, fibers and the photodetectors.



Pizza box prototype

Fibers coupled to the SiPM on the side of the Pizza Box

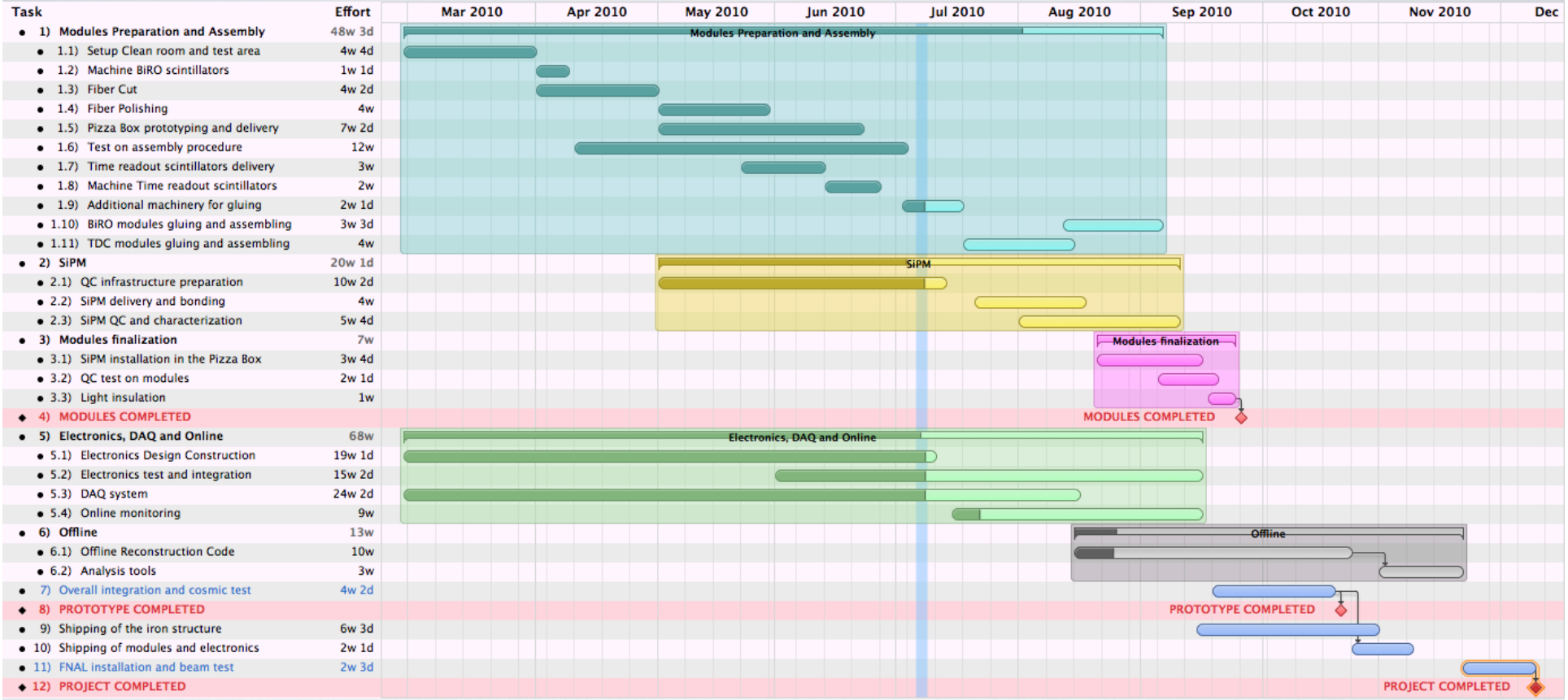




Critical items

- SiPM production. Expected in June → still to be delivered
- SiPM characterization: preliminary characterization of 7 test devices shows good results, about ½ hour for each batch (4 devices), i.e. 2-3 weeks of full time work → 1 month to be conservative.
- Glueing not trivial (start next week, ≈ 1 month)

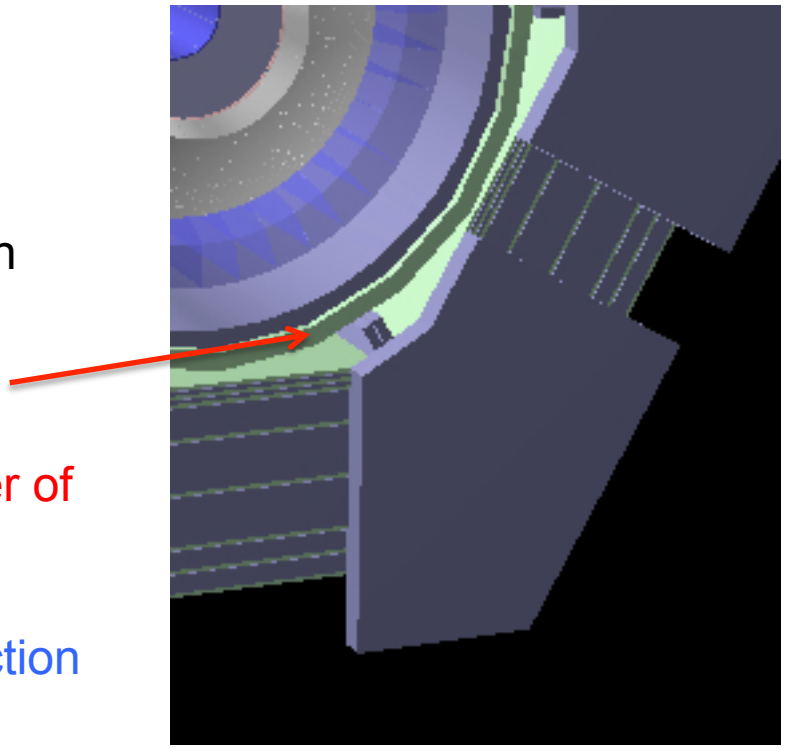
Prototype schedule



Background studies

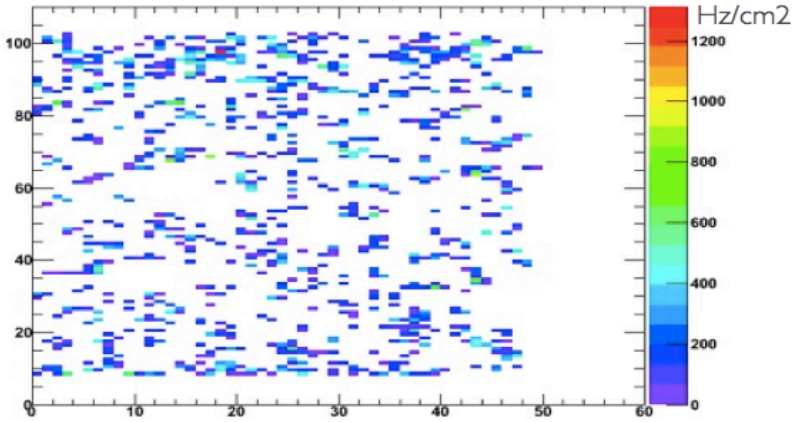
Neutron background is the main concern for the SiPM damage.
The present rate is too high for SiPM life.

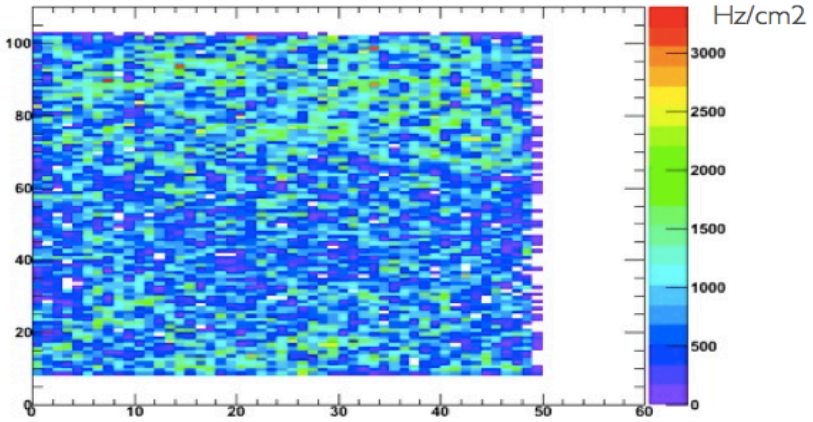
A polyethylene shield has been inserted between the solenoid magnet and the barrel to study possible reduction.



Preliminary results show a reduction of one order of magnitude with 10cm of shielding.

Promising, but need more study and more reduction



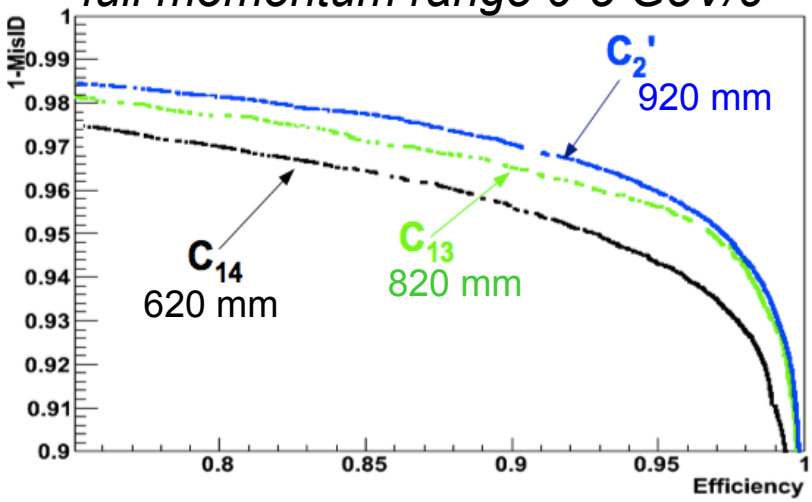


Detector optimization

Already generated large sample of muon and pions with the FullSim BDT optimization already performed

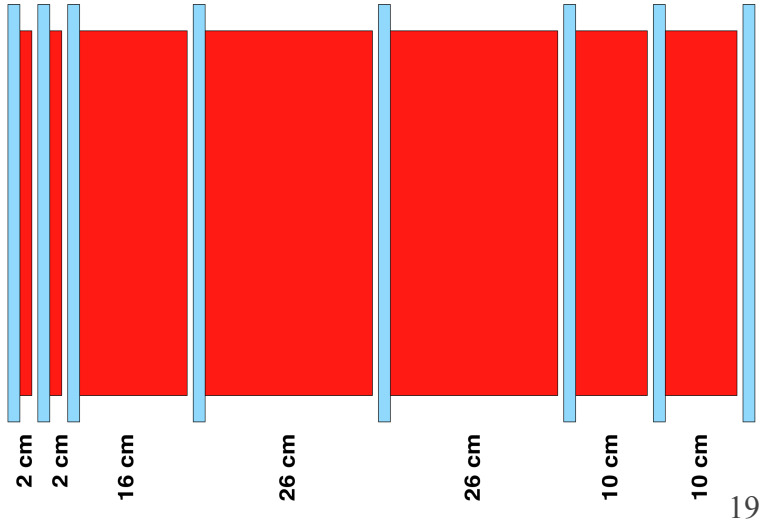
Next Step:
Produce PID Tables, one for each configuration
Make available these tables in FastSim

BDT results on muon ID on the full momentum range 0-5 GeV/c



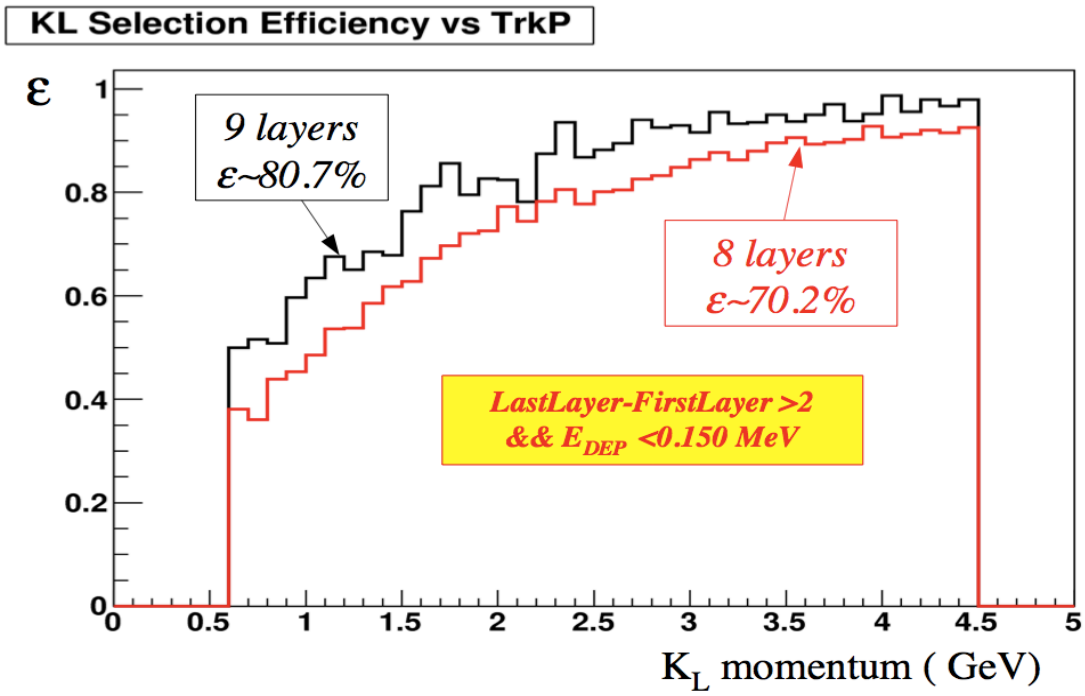
Study the impact of various IFR Configurations on physics channels:
- channels that require high efficiency
- channels that require high pion rejection

Baseline 8 layers configuration (C_2' - 920 mm of iron)



First look at K_L identification

-Simulated 110k of single K_L using baseline configuration and 10k using a 9 layers configurations;
-Momentum: range from 0.6 GeV/c to 4.5 GeV/c
-Distinguish K_L interacting in the EMC from K_L interacting in the IFR volume
-Use the energy deposited in the EMC to distinguish these K_L categories



Performed a Very Loose K_L selector to compare configuration with 8 and 9 active layers → Configuration with 9 layer gives better K_L efficiency
-Need to simulate background samples to have meaningful results, but it's a good start

Technical choices for the TDR

- SiPM damage and remediation
  - **Reduction of neutron flux**
  - **Location of SiPM**
- Electronics readout
  - **TDC readout: meet the required specs**
- 8 layers vs 9 layers
  - **Comparison of performances/costs**
- Decision to add 10 cm iron (external) to the flux return

Attività da ora a fine 2010

- Simulazioni
- Test neutroni
- Preparazione prototipo (assemblaggio, QC)
- Test beam sul fascio di Fnal

Richieste 2010 (specifiche IFR)

- M.E. 19 KE FE + 19 KE PD :

  -beam test del prototipo su un fascio di mu (4 persone FE + 4 persone PD per 10 giorni a FNAL) 14 KE FE + 14 KE PD

  -preparazione beam test 5KE FE + 5 KE PD

- Consumi 3 KE FE + 5 KE PD
  - FE: schede aggiuntive per leggere 9 layers nel prototipo
  - PD: extra costo per trafila
- Trasporti 8 KE PD

Attività 2011

- Simulazioni
- Test neutroni
- Analisi dati test beam, (eventuale) nuovo test beam
- Scrittura TDR
- Consolidamento gruppo IFR
- Inizio attività costruzione

IFR construction (2011-2015)

- Design of electronics and mechanical parts
- Procurement of material (scint, fibers, SiPM, electronics, ..)
- Infrastructures for production and assembling

  (fiber polishing, grooving, aluminization, glueing)
- Module production

  (assembling scintillator, fibers, SiPM bonding, light tightening,..+ electronics)
- QC system for all detector (in particular for SiPM and electronics)
- Installation

  (module installation, routing fibers between layers, cabling, electronics, test, QC)
- Commissioning

Other activities (IFR related)

- Design, FEA calculation of flux return
- Disassembly, transportation and assembly of flux return
- Design and construction of installation tooling
- Manpower for hall crew (installation)

Costi 2011 relativi all'inizio attività di costruzione

- produzione SiPM dedicata (produzione fatta con la massima cautela senza problemi di tempo, con qualità eccellente) (25KE PD)
- prove di bonding automatizzato (adattamento macchina esistente) (5 KE PD)
- progettazione e produzione di prototipi di piccole parti per la costruzione dei moduli (PCB, accoppiatori fibre/SiPM,..) (10KE PD)
- test di assemblaggio di moduli di 4 metri: servono
  - fibre (15 KE FE)
  - nuova trafila x scintillatori 1cm (30KE PD)
  - materiale vario (5 KE FE)
- sviluppo ed acquisti per la costruzione di macchine per la costruzione dei moduli (10KE FE) (5KE Inv)
- sviluppo e attrezzatura per caratterizzazione SiPM e QC (moduli di elettronica, cavi, connettori, pc) (10KE FE) (5KE Inv)

Elettronica: costi 2011

- SiPM front end ASIC: 25KE
- scheda TDC (ACAM + LAL_Orsay): 22.5KE
- Crate VME-9U: 10KE (Inv)
- prototipo di SiPM bias generator rad-tolerant con interfaccia ECS: 20KE
- Totale 77.5KE FE

Missioni 2011 (specifiche IFR)

- M.I. convener IFR 3 KE FE, contatti con IRST 3 KE PD
- M.E. 39 KE FE + 29 KE PD :

  -convener IFR 10 KE FE

  -IFR flux return dismounting 10 KE FE + 10 KE PD

  -beam test a Fnal 14 KE FE + 14 KE PD

  -preparazione beam test 5KE FE + 5 KE PD

Riepilogo generale IFR richieste 2011

	FE	PD
M.I.	3 KE	3 KE
M.E.	39 KE	29 KE
Consumo	97.5 KE	70 KE
Inv.	20 KE	
Trasporti		8 KE
Totale	159.5 KE	110 KE

Richieste 2011: FTE

Fisici FE
Andreotti
Baldini
Calabrese
Fella
Luppi
Manzali
Negrini
Santoro
Tomassetti
TOT 5.4 FTE

Tecnologi FE
Carassiti
Cotta Ramusino
Donati
Gianoli
TOT 1.2 FTE

Fisici PD
Feltresi
Gagliardi
Morandin
Posocco
Rotondo
Sartori
Simi
Stroili
TOT 4.5 FTE

Tecnologi PD
Benettoni
Corvo
Dal Corso
Longo
Montecassiano
TOT 3.2 FTE