General Overview

G. Cibinetto
University of Ferrara - INFN

Super B workshop - Annecy 16-19 Mar 2010

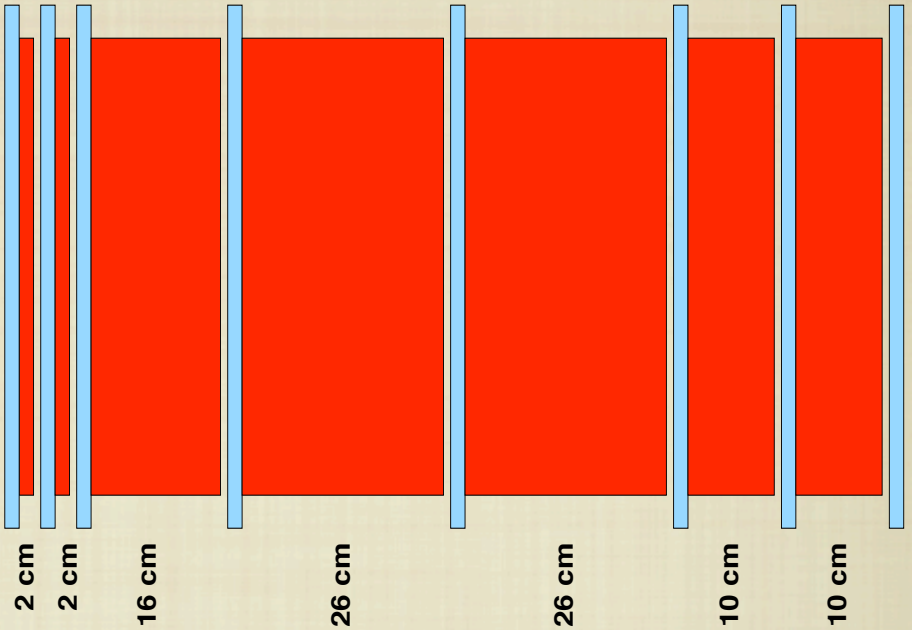
Outline

- Usual introduction to the IFR
- News since Frascati workshop
- Ongoing activities
- Goal for the meeting and plans for the TDR
- Other IFR contributions

The IFR baseline design

- The muon and K_L detector is build in the magnet flux return.
- It will be composed by one hexagonal barrel and 2 endcaps like in Babar.
- Plan to reuse BaBar iron structure

A possible (not optimized) configuration

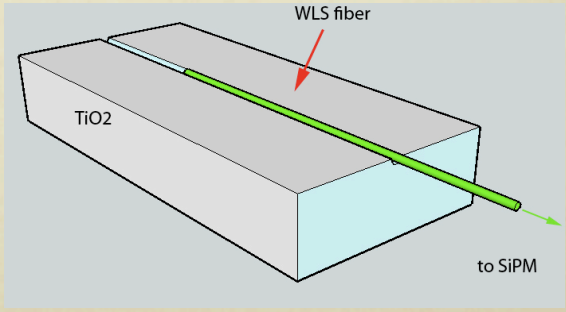


- Add iron to BaBar stack to improve μ ID:

  ➔ 7-8 detection layers should be enough

- Keep longitudinal segmentation in front of stack to retain K_L ID capability.

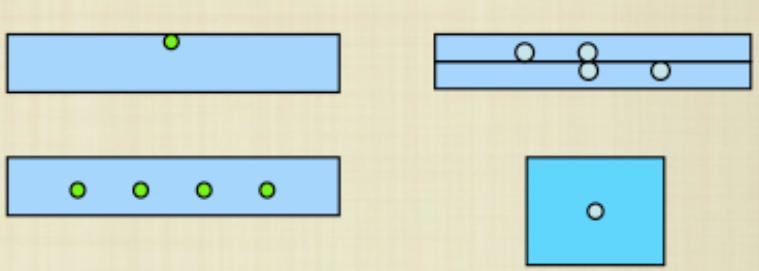
MINOS like scintillators as active material



The scintillator bars

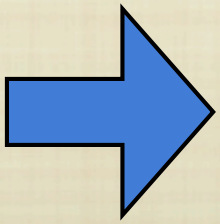
We tested some different layouts made by the FNAL-NICADD facility

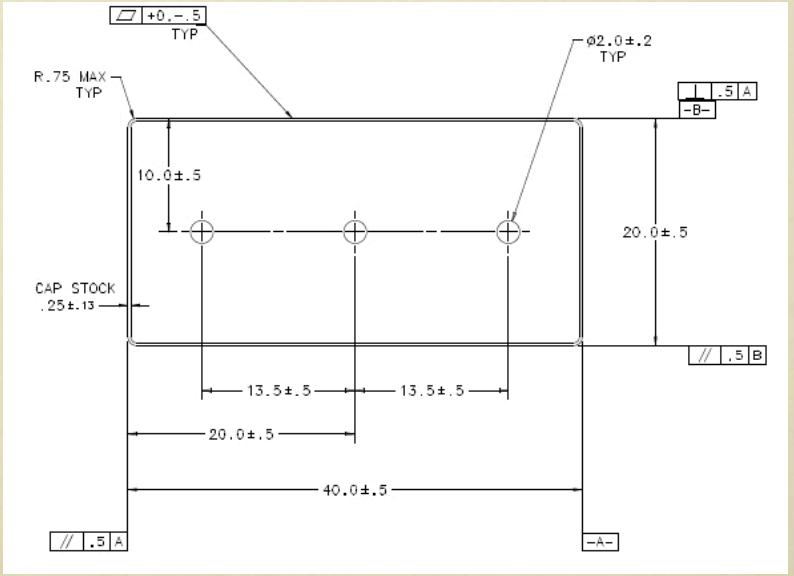
R&D results have been shown at the past meetings.



We ordered our own layout

for the prototype!!!





The WLS fibers

- Kuraray Y11-175 f=1.2mm, round, double cladding
  - Trapping efficiency = 5.4%
  - Attenuation length ~3.5m
  - Emission peak: 476nm

Better light yield

Worst time resolution

Good for binary readout

- Bicron BCF-92 f=1mm and 1.2mm, round, multiclad
  - Trapping efficiency = 5.6%
  - Attenuation length ~3.5m
  - Emission peak 492 nm
  - Decay time 2.7 ns (Y11-200 ~10ns)

Better time resolution

Worst light yield

Good for TDC readout

THE PHOTODETECTORS

- Geiger mode APDs: MPPC (Hamamatsu), SiPM (FBK- IRST)
  - G >10^5
  - DE ≈ 40% (530nm) (DE = Q.E x Fill factor x Aval. prob.)
  - ~ 1ns risetime
  - ≈ 10 times less sensitive to V and T variations w.r.t. APDs
  - Low bias voltage (50-70V)
  - Dark current rate @ room temperature : 100s of kHz thr = 0.5 phe; few kHz if thr = 1.5 phe

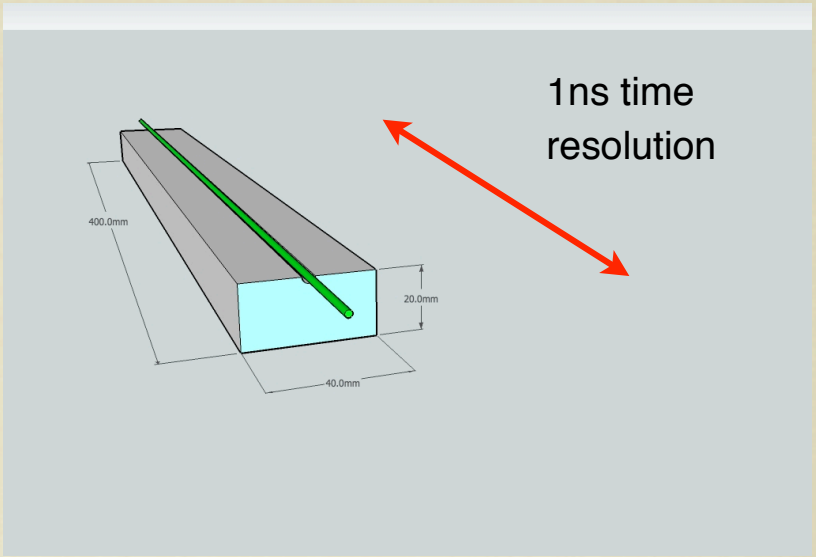
$$\begin{cases} \frac{\Delta G}{G} = 7 \cdot \frac{\Delta V}{V} \\ \frac{\Delta G}{G} = 1.3 \cdot \frac{\Delta T}{T} \end{cases}$$

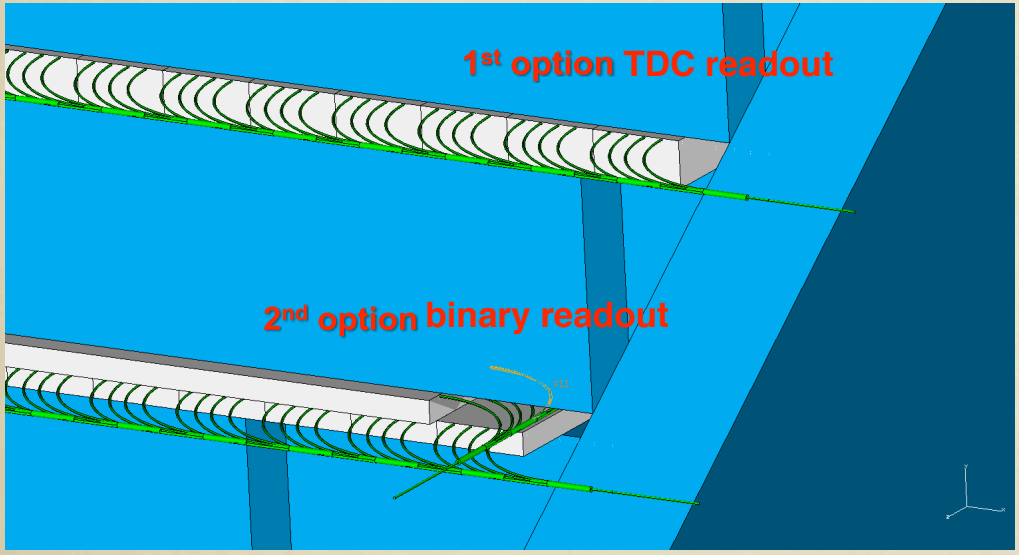
MPPC higher gain and Q.E. - SiPM better time resolution

SiPMs have sizable differences from device to device: need careful characterization for the prototype and detector

Readout options

- Baseline for the Barrel readout: read one coordinate with the bar position and the other with the arrival time of the signal
  - Need a time resolution ~1ns to have ~20cm
  - Read 2 coordinates with the same bar
  - Time distribution helps reducing the SiPM noise





- As baseline for the endcaps we consider the "double coord layout": orthogonal scintillator bars, 1cm thick.
  - binary readout (but better spatial resolution)
  - would be mechanically rather complicated for the barrel
  - Single counts probably ok with 40MHz sampling

Both will be tested on a full scale prototype

The neutron issue

This is a critical item on the path toward the final detector design. We started working on the background simulation after the last meeting, here will be shown some preliminary results.

- SiPM/MPPC aging tests appeared in literature indicate that neutron irradiation ~~can be~~ is an issue.

See IFR session at Perugia meeting

- Waiting for simulations, in the worst case scenario we have to bring all the photodetectors out of the detector:

  4m of WLS + 10m of clear fibers

  Reduction of factor 2 in number of p.e. to be recovered, keeping the same time resolution

  4 fibers/scintill-bar on 2x2 mm² SiPM (or array of 4 1x1 mm² MPPC)

  1.2mm fibers (ordered from Kuraray , expected end Feb.)

  1.5mm clear fibers (ordered from Kuraray , expected end Feb.)

  Coupling WLS/clear fiber

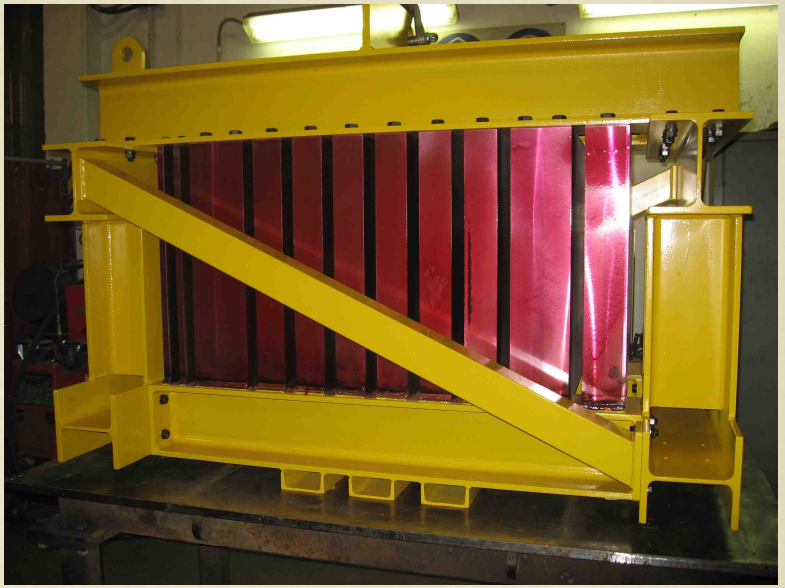
NOT feasible

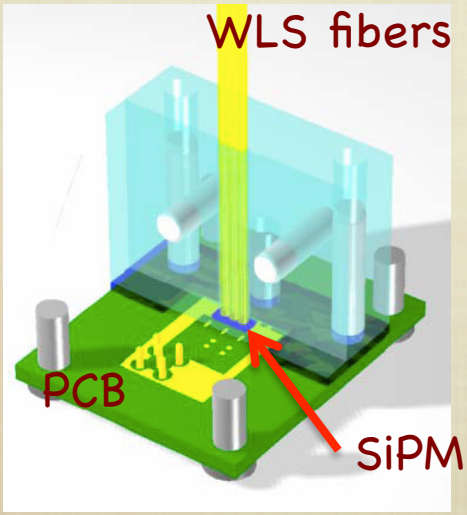
see Wander's talk at Perugia meeting

From SLAC to here

At the Frascati workshop we had the final design of the prototype now the iron structure completed

Thoughts about detector small parts (PCB, fiber-SiPM coupling, module box, etc...) are now defined and/or in production.





Test of assembling procedure in progress: first module coming soon

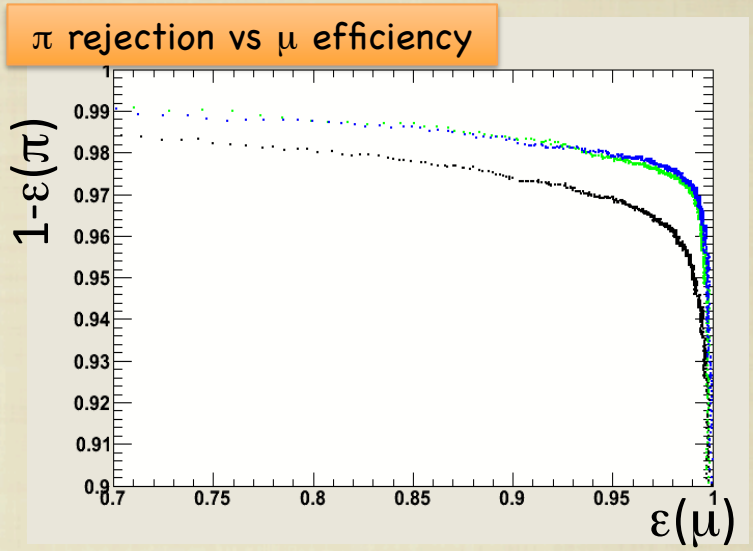
Electronics

Ampli-Bias-Discri board design completed
Binary Readout DAQ board design ongoing

Ongoing activities

Detector Optimization

replaced the cut based selector with a BDT to discriminate among different iron configuration

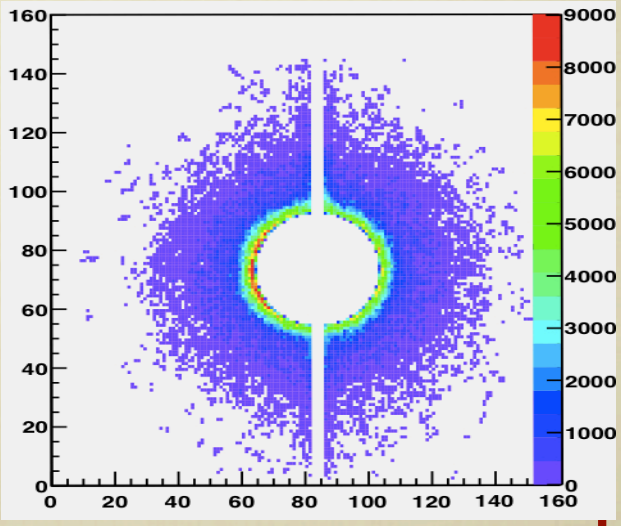


Fast Simulation

tuning of IFR parameterization based on Full Sim results is ongoing

Background studies

Neutron background is one of our priority: data analysis is ongoing to understand damages, sources and possible remediation.



neutron rate on FWD endcap inner layer

Goal for this meeting

Review advancements and achievements in all the development areas

- Particular focus on:
  - ➡ prototype construction: assembling procedure, QC, schedule
  - ➡ detector optimization: is the current optimization for μ/π separation enough accurate? What refinements can be done? Proceed with K_L studies?
  - ➡ neutron background studies

- Review the TDR preparation process and prioritize the short and medium term activities.

Toward the TDR

finalize prototype design (mechanics and electronics)

place orders for prototype construction (needed simulation results first)

begin prototype assembly

Spring 2010

prototype test with cosmics

Summer 2010

test beam @ FNAL

Fall 2010

analyze/review test results and write the TDR

IFR sessions

16:00->*17:30* Parallel - IFR (Convener: Roberto Calabrese (*FE*)) (Salle des Sommets) more information

16:00	General Overview (10')	Gianluigi Cibinetto (*FE*)
16:15	Status of prototype preparation (20')	Wander Baldini (*FE*)
16:40	Status of IFR mechanics (15')	Massimo Benettoni (*PD*)
17:00	Discussion about prototype construction and test (30')	

14:00->*15:30* Parallel - IFR (Convener: Roberto Calabrese (*FE*)) (Salle des Sommets) more information

14:00	Simulation and detector optimization (20')	Nicola Gagliardi ~~Marcello Rotondo (*PD*)~~
14:25	Background studies (20')	Mauro Munerato (*FE*)
14:50	Status of the IFR electronics (20')	Angelo Cotta Ramusino (*FE*)

Other IFR contributions

- Background session: preliminary results on neutron background.
- Detector Geometry Working Group: update on the IFR optimization
- ETD: IFR Frontend electronics