



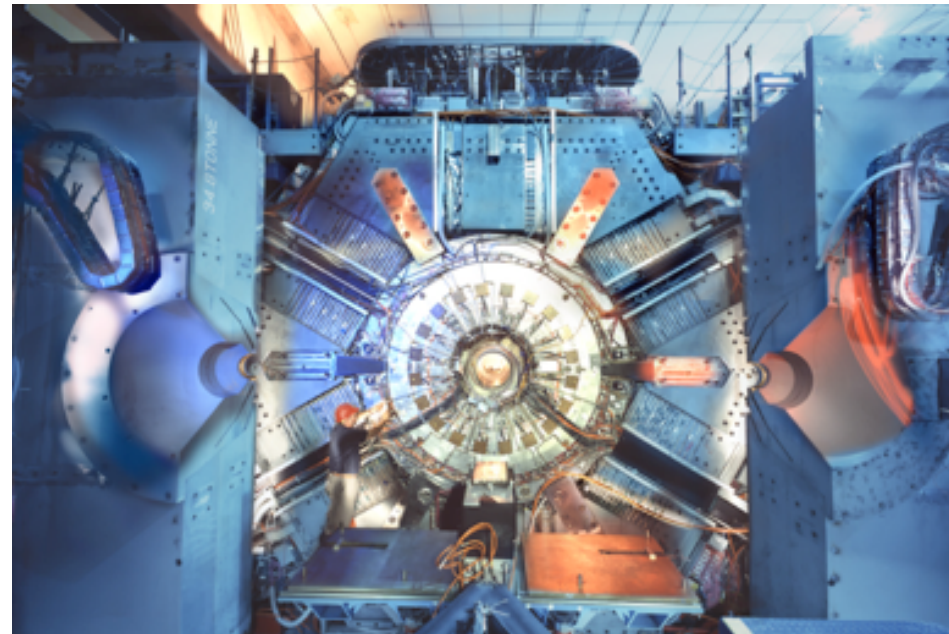
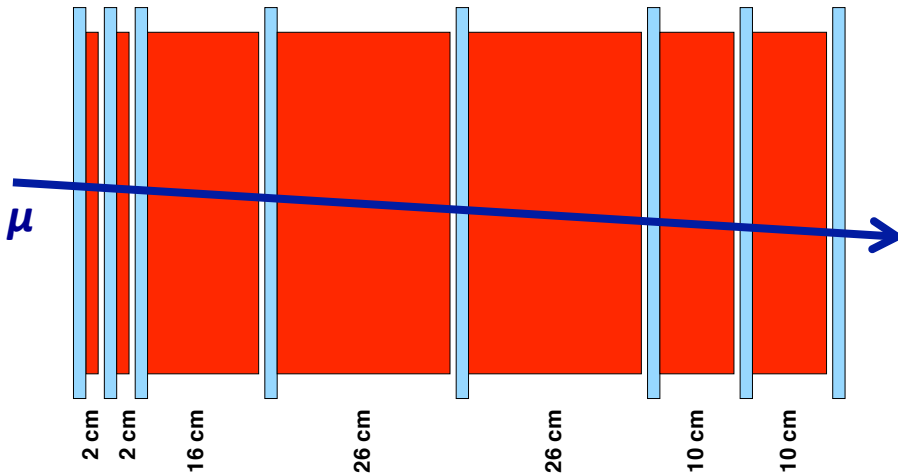
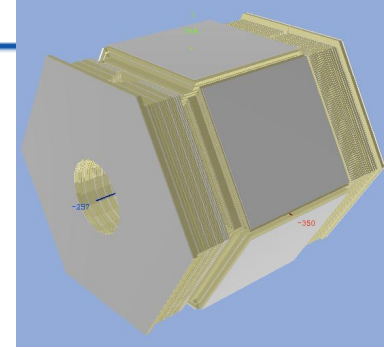
IFR general overview

g. cibinetto

on behalf of the IFR group

The muon and K_L detector (aka IFR)

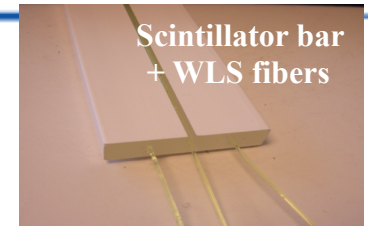
- Built in the magnet flux return, it will be composed by **one hexagonal barrel and two endcaps**
- Large active area
- Very high rates: hottest region up to **few 100 Hz/cm²**
- **Fine longitudinal segmentation** in front of the stack for K_L ID capability (together with the electromagnetic calorimeter)
- Plan to reuse BaBar iron structure: some mechanical constraint (gap dimensions, amount of iron, accessibility, ...)
- Use of 8-9 active layers



The detection technique

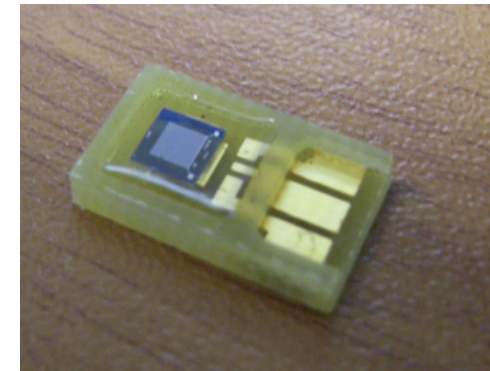
- **Scintillator:**

- 2x4x400 cm³ and 1x4x400 cm³ scintillator bars
- coated with TiO₂
- Light collection through WLS fibers housed in embedded holes or grooves.
- Made by FNAL NICADD facility.



- **WLS fibers:**

- $\phi = 1.0$ mm type Y11(300) (Kuraray)
- $\phi = 1.2$ mm type BCF92 (Saint Gobain)
- Attenuation length $\lambda \approx 3.5$ m
- trapping efficiency $\epsilon \approx 5.5\%$



- **Photodetectors:**

- Silicon Photo Multiplier (FBK-IRST)
- Gain $> 10^5$
- < 1 ns risetime
- Low bias voltage (≈ 35 V)
- Dark current rate @ room temperature few 10 KHz @ 3.5 p.e.

IFR overall status

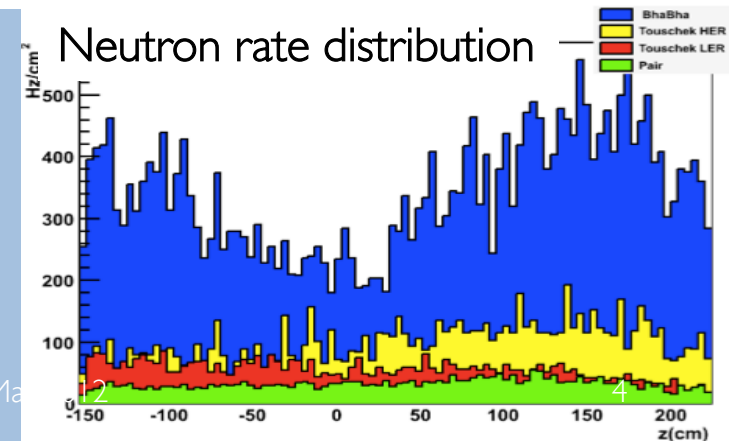
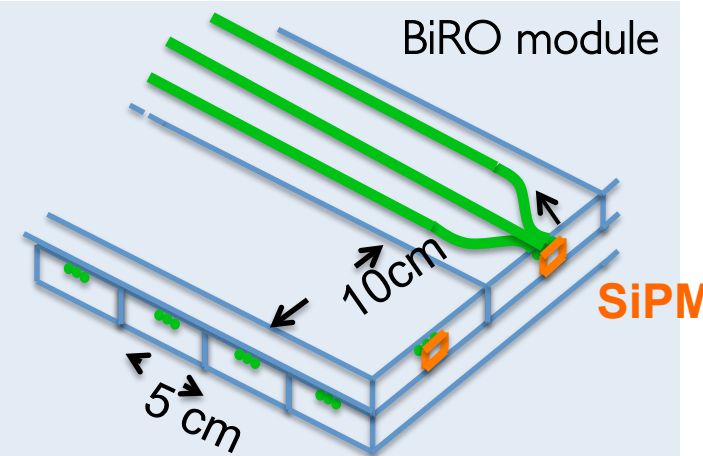
Critical issues for final detector design

✓ Binary readout vs time readout for the barrel → Binary readout is now our baseline

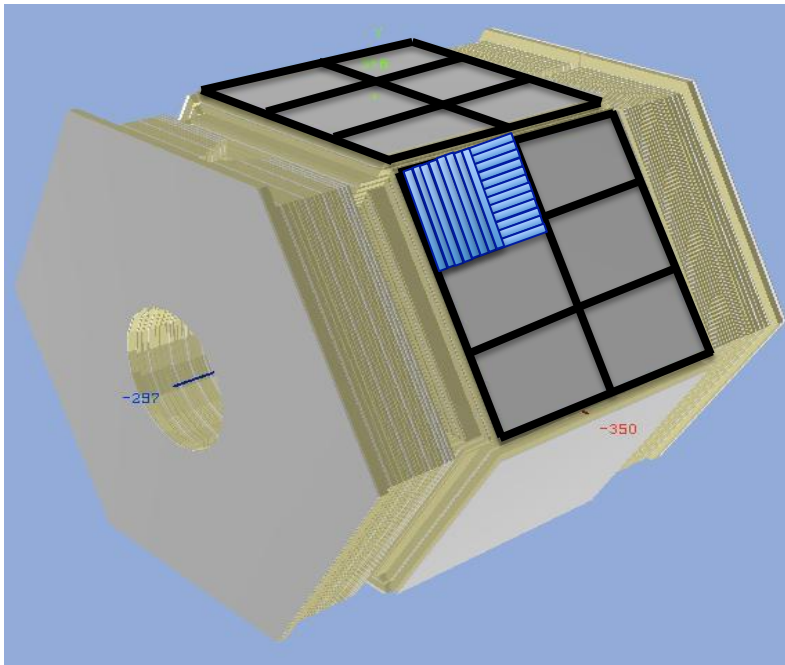
□ Number of active layers: 8 vs 9 → 9 active layers is the baseline for the TDR, but the 8-layer option is not discharged

□ Amount of absorber and flux return configuration → 92cm of iron is the current baseline for the TDR. Under investigation the possibility to use less absorber. In any case the BaBar iron will be reused with no major modification.

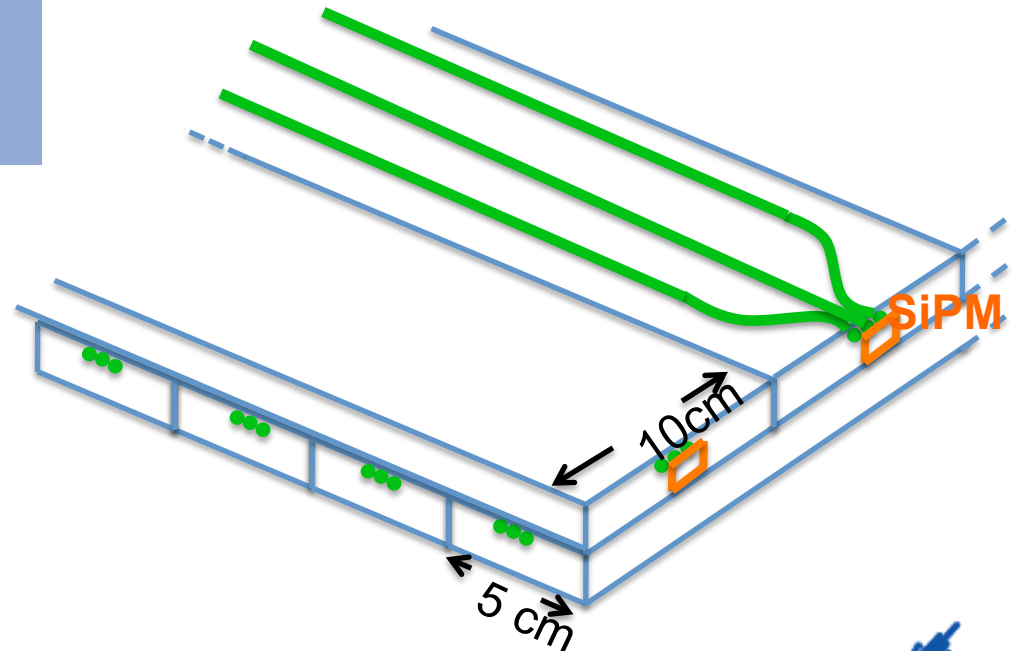
✓ Position of the photodetectors
SiPM will be placed at the end of the scintillators inside the gaps. Neutron rate is high (up to some 100Hz/cm²) but with the binary readout it's possible to rise the thresholds to reduce the increasing of the noise.



BiRO readout



- phi strips:
 - $L \approx 2\text{m}$
 - Thickness = 1cm
 - width = 5cm
- Z strips:
 - $L =$ depends on layer
 - Thickness = 1cm
 - Width = 10cm
- Photodetectors only at one end of each strip



The binary readout is the baseline for all the detector.

Flux Return Mechanics

- Reuse of the BaBar iron as it is, filling the gaps with more material taking advantage of the additional space we may have.
- Is that viable? i.e. do we really have enough additional space (almost) everywhere?



R & D results

- We had two meetings about SiPM technology, one with Hamamatsu and one with FBK representatives.
- New products have been presented by FBK.
- New R&D results will be shown. Very useful crosschecks and interactions between the institutions involved; some longer term planning will be also discussed here.
- The ITEP group provided a different kind of scintillator that is currently under test.
- R&D on ASIC readout is leading to a baseline for the readout electronics. The CLARO readout from Milano Bicocca has been also successfully tested in Ferrara last week.



Beam Test

- Just done our last beam test at Fermilab with muon/pion beam.
- Main purpose: “calibration” run at high momenta (5-10 GeV) where the beam composition is well known and data are cleaner.
- Experimental setup and trigger system improved.



- New analysis strategy: tune Monte Carlo (Bruno) simulation based on high momenta test beam data.
- Great reliability, operational stability and performances of the IFR prototype during all the beam test runs



Data analysis and software update

- After the development presented at the last meeting
 - possibility to handle MC and test beam data
 - improved clusterization
 - improved MC reconstruction
 - prototype hybrid readout implemented
- Another code upgrade has been done for the offline reconstruction (by Jarek and Marcin)
 - new 2D clusterizer
 - new BiRO hits clusterizer
 - new track fitter
- the data analysis will have a large benefit from the new feature: plans for redoing and finalizing all the studies will be shown by Marcello.

Background simulation

- A background workshop has been done in order to cross check the results with Belle2. Valentina will report on that.
- Rate update and new studies on rad Bhabha events will be presented.
- First background estimates from BeamGas source.
- Background shielding has become a common issue, we are evaluating other sub-detector proposals and advancing our own. Massimo and Valentina working on that.

Electronics and SiPM irradiation tests

- New measurements neutron irradiation and remediation are foreseen for the next year at the Gelina Neutron Source at IRMM (Geel, Belgium) in July.
 - plan to irradiate SiPM, FEE and detector materials (scintillators, glue, optical grease,);
 - plan to study the effect of absorbers (probably provided by the facility);
 - energy spectrum from thermal neutron to $\sim 100\text{keV}$
- New tests are foreseen for the end of the year at ISIS with a beam spanning up to some MeV and with the possibility to select the neutron momentum range.



TDR preparation status

- IFR sections and subsections structure has been prepared at the London meeting. Responsible people for each part has been identified.
- A first draft is expected by the end of the year and the full report few months later.
- The present IFR situation is the following:
 - latex structure of the chapter is in place
 - First draft of the introductory paragraph prepared [Roberto and Tadek].
 - background section is in good shape (some text and figures already produced). [Valentina]
 - description of the prototype and beam test setup and data taking has also been done.
 - Other parts maybe in good shape but just not included.
- Please send me your write up as soon as you have it.

Goal for this meeting

- Review advancements and results on different activities so far.
- Decouple the activities needed for the TDR and the ones with a larger time scale.
 - ~~freeze the TDR detector design and circulate it.~~
 - give priority to the most urgent missing pieces (R&D on 10cm bars, beam test data analysis)
 - plan the long term activities (finalize the active module design, photodetector choice, background remediation, effect of background on reconstruction, fine optimization)
- **But... the main focus will be on the TDR preparation**

IFR sessions

09:00->11:00	Parallel IV: IFR (Convener: Roberto Calabrese (FE)) (Aula Conversi Bldg 8a)	 EVO URL ;	 EVO information
09:00	General overview (10')		Gianluigi Cibinetto (FE)
09:10	Mexico activities (15')		Pedro Podesta (Sinaloa)
09:30	Beam Tests at Fermilab (15')		Wander Baldini (FE)
09:50	Status of readout electronics (20')		Angelo Cotta Ramusino (FE)
10:10	Test of CLARO chip readout (15')		Claudio Gotti (MI-Bicocca)

15:00->16:35	Parallel VI: IFR (Convener: Roberto Calabrese (FE)) (Aula Conversi Bldg 8a)	 EVO URL ;	 EVO information
15:00	Flux return design (15')		Massimo Benettoni (PD)
15:15	R&D in Bologna (20')		Alessandro Montanari (BO)
15:35	R&D in Ferrara (20')		Gianluigi Cibinetto (FE)
15:55	R&D in Padova (20')		Flavio Dal Corso (PD)
16:15	Module mechanics (10')		Vittore Carassiti (FE)

17:00->18:30	Parallel VII: IFR (Convener: Roberto Calabrese (FE)) (Aula Conversi Bldg 8a)	 EVO URL ;	 EVO information
17:00	Background simulation status (15')		Valentina Santoro (FE)
17:15	Plans for beam test data analysis (15')		Marcello Rotondo (PD)
17:30	New feature of the IFR reconstruction code (15')		Jaroslawn Wiechczynski (IFJ Cracow)
17:45	TDR preparation (45')		

Other IFR talks

- IFR development status and plans by Marcello Rotondo (Physics Tools – Tue 17:00)
- IFR frontend electronics by Angelo Cotta Ramusino (ETD – Wed 11:30)
- IFR: beam-gas background report by Valentina Santoro (FullSim & Background – Thu 11:30)