

SuperB Detector Status-Elba-2012



- Overview
- System by System Updates and R&D
- Workshop Goals and Structure.

Blair Ratcliff
SLAC

Overview

- **Detector design well advanced**
 - BaBar “prototype”
 - CDR (2007) http://web.infn.it/superb/images/stories/upload_file/superb-cdr.pdf
 - Detector Progress Report(2010): <http://arxiv.org/abs/1007.4241>
- **TDR Detector Geometry defined**
 - Needs implementation by integration team....a goal of this meeting
- **Aim for Completed TDR by Sept.**
- **R&D continuing across detector systems to select from TDR options and validate fabrication methodologies and detailed implementation**
- **TDR in draft.**
 - Reviewed at Techboard yesterday and Monday
- **Short/Intermediate term challenges for detector community**
 - Complete TDR.
 - Integrate (systems, detector, IR, hall)
 - Backgrounds
 - Develop collaboration manpower and revise system leadership
 - Understand costs, schedules, milestones, and funding commitments.
 - Complete R&D, undergo design review, and move on to transportation of BaBar and fabrication.

Detector Proto-Tech Board/Parallel Session Conveners

Detector Coordinators – B.Ratcliff, F. Forti

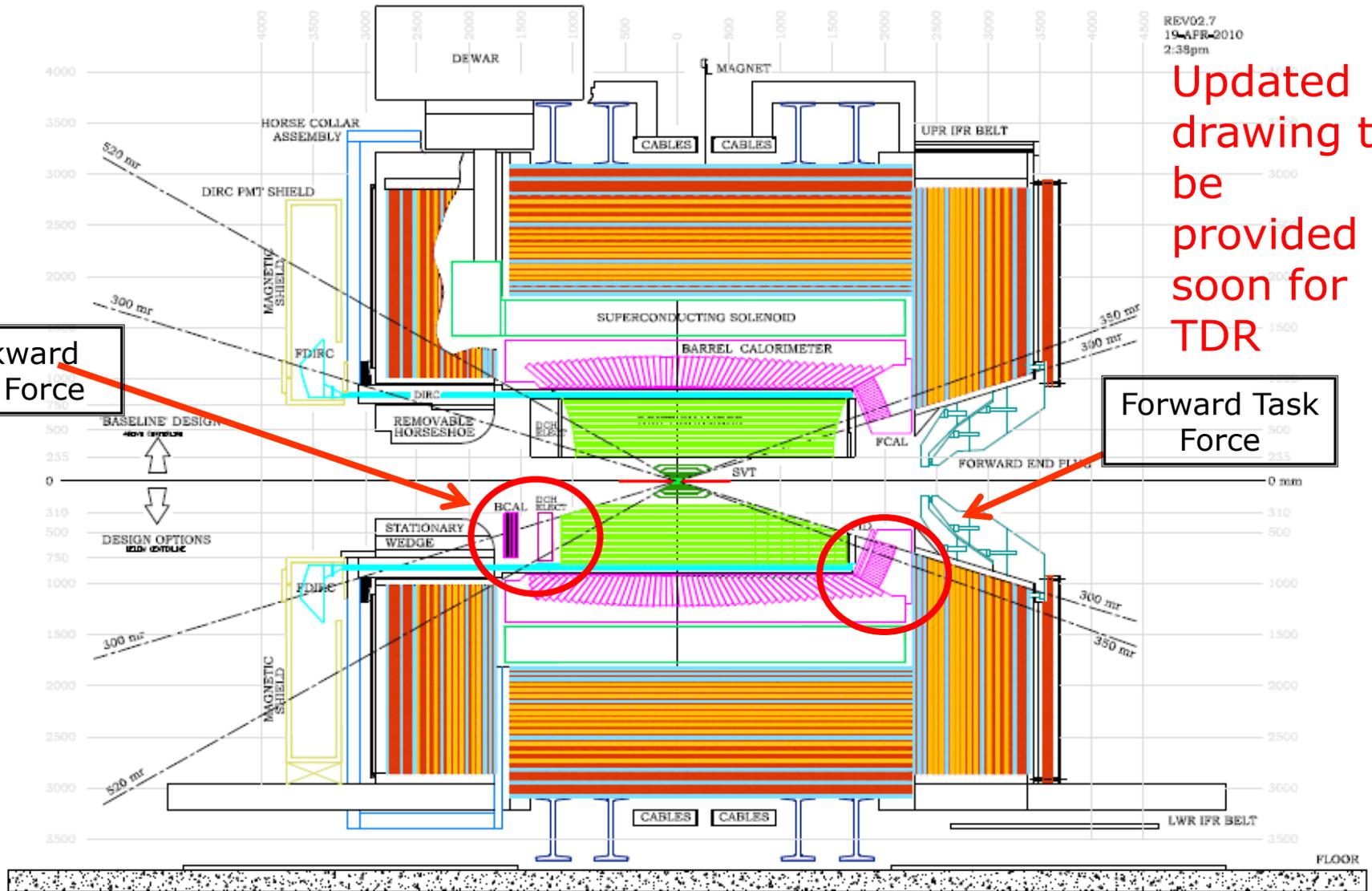
Technical Coordinator – W.Wisniewski

- **SVT** – G. Rizzo
- **DCH** – G. Finocchiaro, M.Roney
- **PID** – N.Arnaud, J.Vavra
- **EMC** – F.Porter, C.Cecchi
- **IFR** – R.Calabrese
- **Magnet** – W.Wisniewski
- **Electronics, Trigger, DAQ** – D. Breton, U. Marconi
- **Online/DAQ** – S.Luitz
- **Offline SW**
 - **Simulation coordinator**
 - **Fast simulation** – M. Rama
 - **Full Simulation/Computing** – F. Bianchi
- **MDI /Background Simulation** M.Boscolo, E.Paoloni
 - **Rad monitor** –
 - **Lumi monitor** –
 - **Polarimeter** -
- **Mechanical Integration Team** F. Rafaelli, W. Wisniewski, System Reps

Detector



SuperB Detector (DPR drawing)



Updated drawing to be provided soon for TDR

TDR Baseline Geometry

Limited envelopes left in the default configuration for the possible installation of FPID and BEMC

- 5cm in the forward direction
- 15-17cm in the backward direction

The decision on inclusion of either of these options will be taken post TDR

IR shielding requirements leads to larger inner radius of DCH, and many challenges in shield support, system cable routing, electronic access, etc.

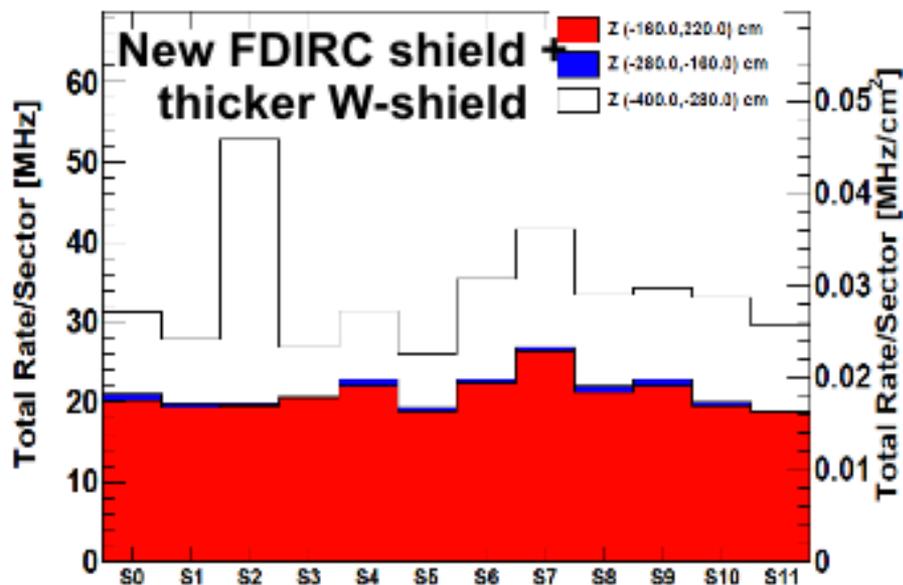
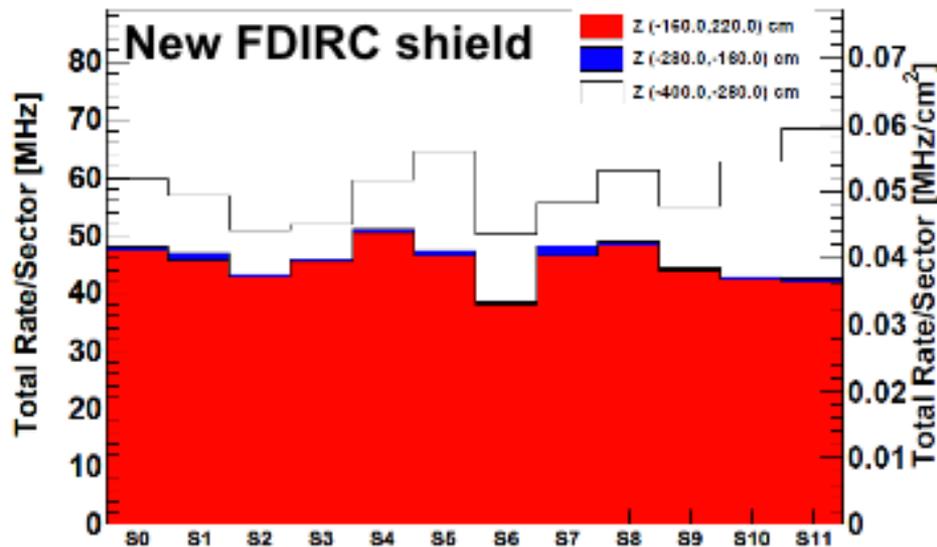
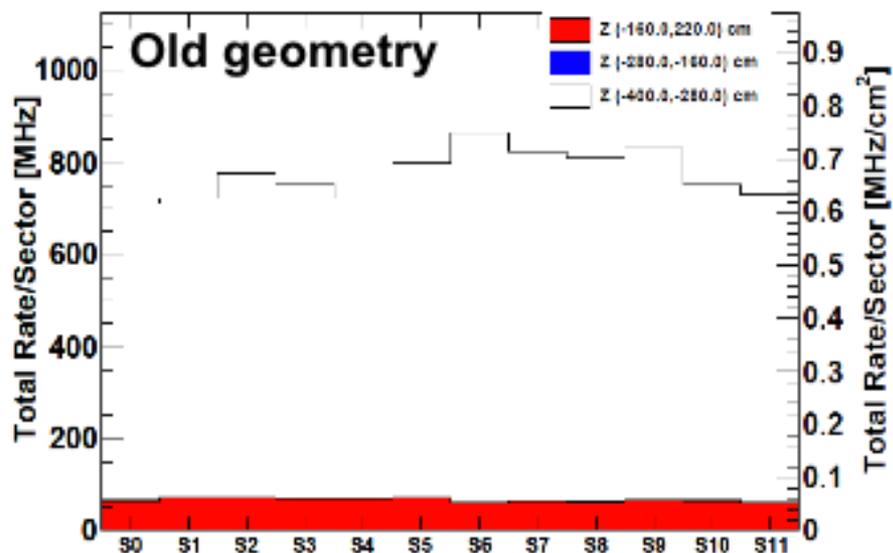
→ Envelopes for default design need to be fixed by integration team at this meeting

MDI-Eugenio Paoloni

Background Simulations

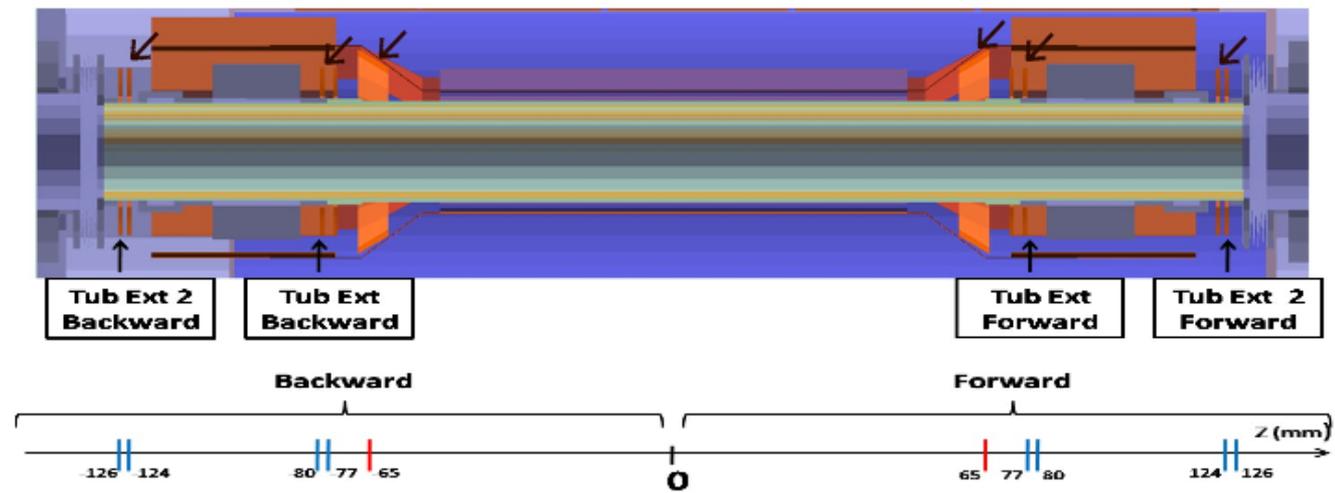
- Performance of the barrel EMC is compromised by radiative Bhabha background when the safety factor 5 is taken into account
 - Beam line shield studies
 - Tungsten thickness increase (30 mm vs 45 mm)
 - Material choice (Tungsten vs Depleted Uranium)
- Beam line magnetic layout optimization
 - Reduction of the dispersion at the QD0 location by a proper displacement of the QD0 magnetic axis
- FDIRC shield:
 - The electronic readout and the and the quartz wedges are now protected by lead, and boron loaded polyethylene

FDIRC Bkg rates from Rad-bhabha: total rates



- **New FDIRC shield effectively reduces the rates on the FBLOCK regions by a factor of ~10 (expected)**
- **Additional W-shield thickness reduces rates on the quartz bar region (a factor of ~2.5)**

Radiation Monitor



- The radiation detectors are now simulated in Bruno
 - The preliminary estimate of the rad. Bhabha rate is in the tens of MHz range
- Excellent candidate for a fast luminosity monitor too

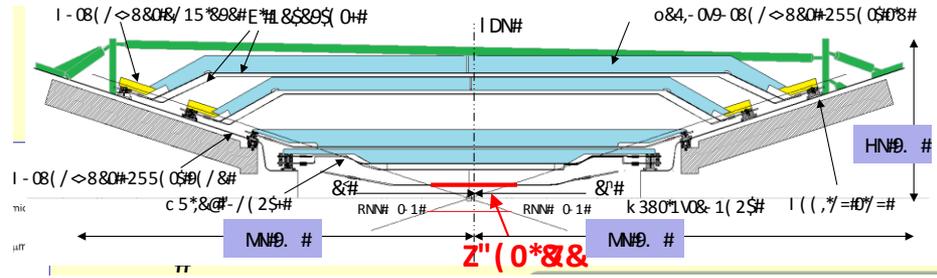
All particles	Rate (MHz)	Edep/sec (GeV/s)	nHits/Event	Edep/Hit (GeV)	Rate/mm2 (MHz/mm2)	Z (mm)	% Hits (>150KeV)
Tube Ext (Back)	19.9	1780	0.09	9.0×10^{-5}	0.035	-80	22%
Tube Ext 2 (Back)	46.4	2080	0.20	4.5×10^{-5}	0.082	-126	10%
Tube Ext (Forw)	12.8	1115	0.06	8.7×10^{-5}	0.023	80	21%
Tube Ext 2 (Forw)	30.0	1305	0.13	4.3×10^{-5}	0.053	126	10%

SVT-Convener G. Rizzo

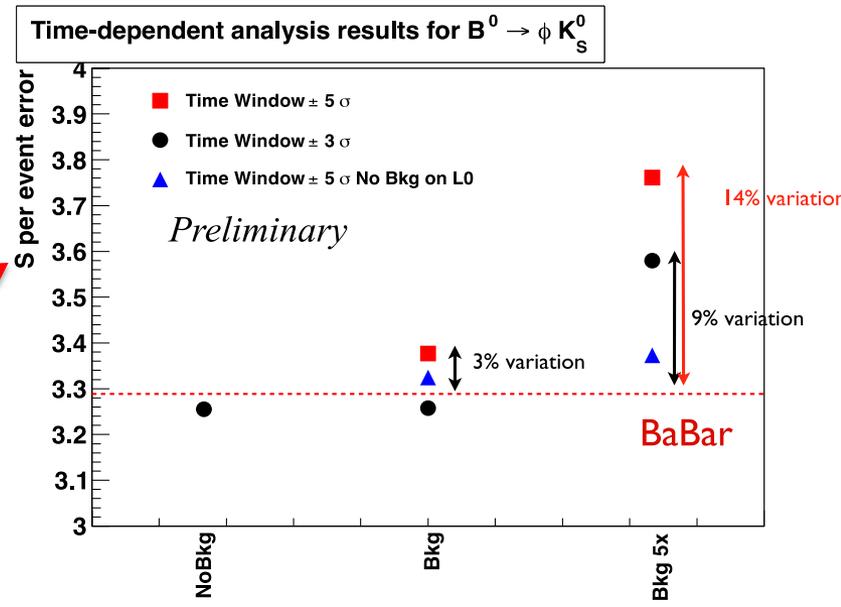


SVT – Update (I)

Several effects of high background on detector performance are being evaluated:



- Low efficiency due to analog dead time evaluated for electronics: **< 90 % in some layers with x5 safety**
- Impact of background on resolution evaluated with Fastsim: performance (with striplets in L0) seems to be still reasonably good in presence of 5x bkg.
 - sizable effect on S per event error: 14% worsening with x5 bkg. Small change with nominal bkg (3%).
- Effect of high occupancy on reconstruction still need to be evaluated.



Layer	View	Shaping time	S/N in 75 ab-1	S/N in 75 ab-1 x5 bkg
1	phi	100	27	20
1	z	100	30	19
2	phi	100	27	21
2	z	100	31	21
3	phi	200	23	15
3	z	200	25	14
4	phi	500	19	13
4	z	500	22	14
5	phi	1000	20	15
5	z	1000	25	17

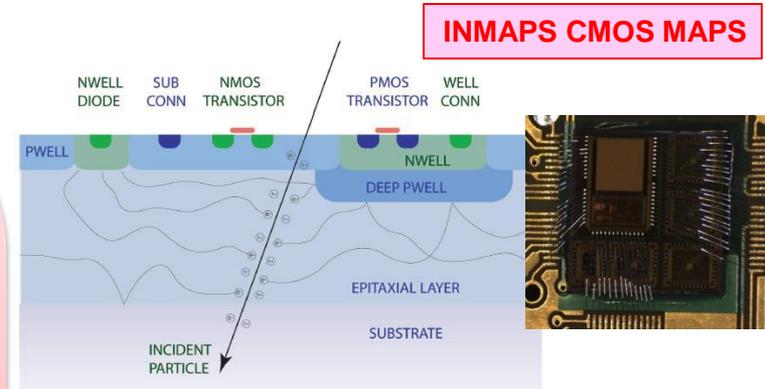
- Effect of radiation damage on sensor (increase on leakage current) and S/N degradation with the full life of the experiment (75ab-1) evaluated.
 - S/N a bit marginal with x5 safety
 - Start to explore extra cooling to lower SVT sensor temperature & leakage current.



SVT – Update (II)

R&D on pixel: first results on new MAPS with INMAPS process: very promising option for thin pixel upgrade for Layer0.

- Noise and gain measured in good agreement with simulation:
 - ENC = 30 e- (~20% dispersion)
 - Gain=920 mV/fC (~10% dispersion)
- Standard functionality of **new readout architecture** verified in the two operation modes available on chip: **data push & triggered**.



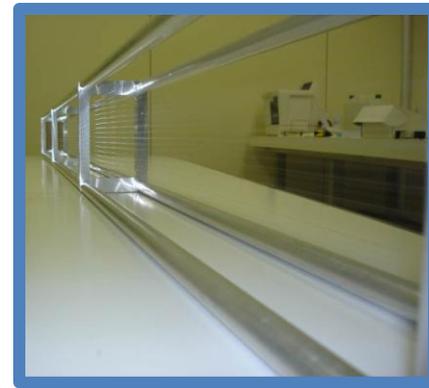
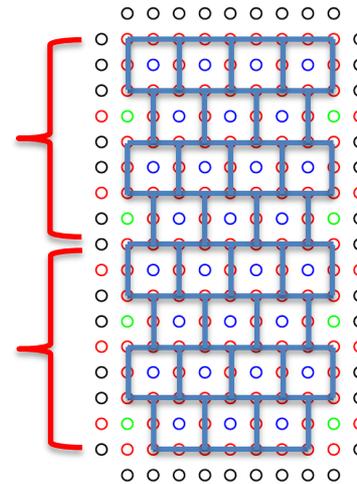
INMAPS CMOS process with quadruple well & high resistivity substrate to improve charge collection efficiency and radiation resistance

- Good progress in the TDR writing:
 - Almost all the sections in the svn repository (not final version!): writing on peripheral electronics and mechanics less advanced.

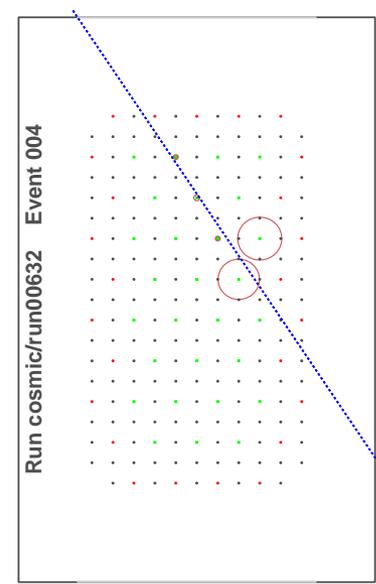
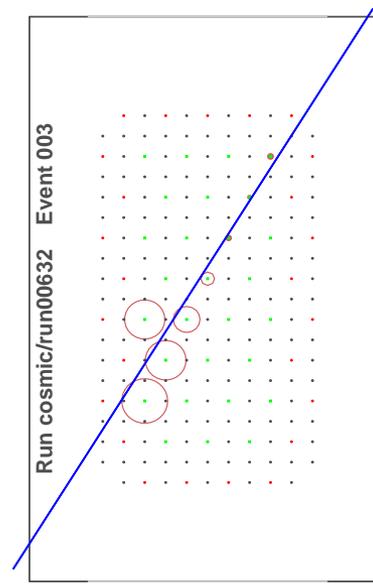
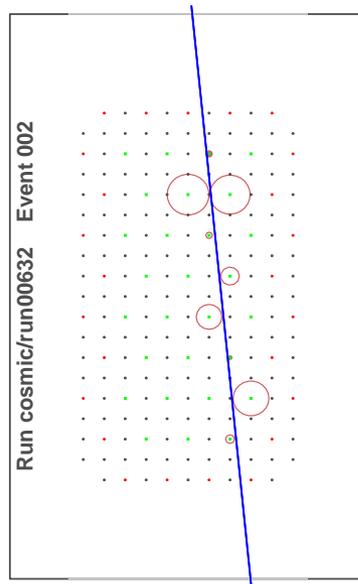
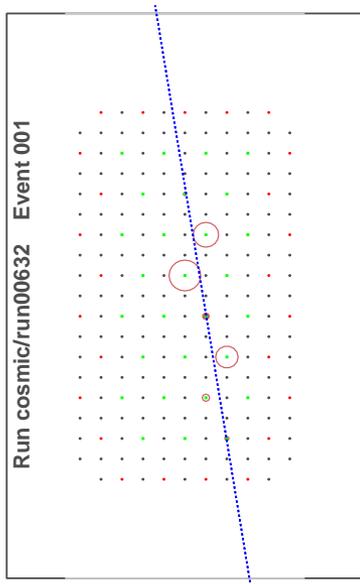
DCH-Conveners Finnocchiaro & Roney

DCH Trigger with Prototype2

- The 8 layers of prototype two are grouped in two 4-layer Super Layers
- DCH Trigger is asserted whenever at least 1 SL has a “good” track segment
- Rate ~25Hz



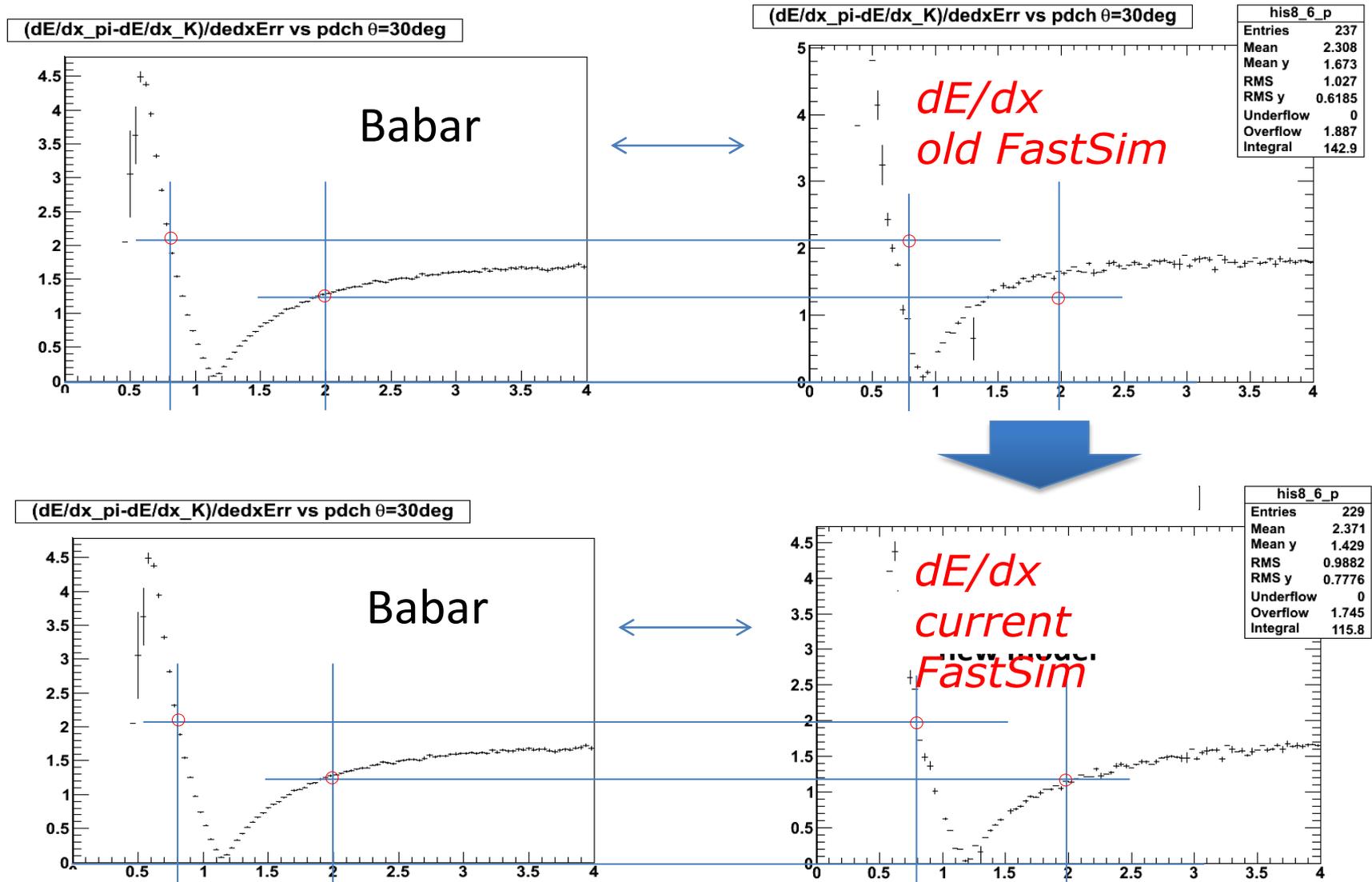
INFN-RM3
INFN-RM3



K/PI Separation in FastSim

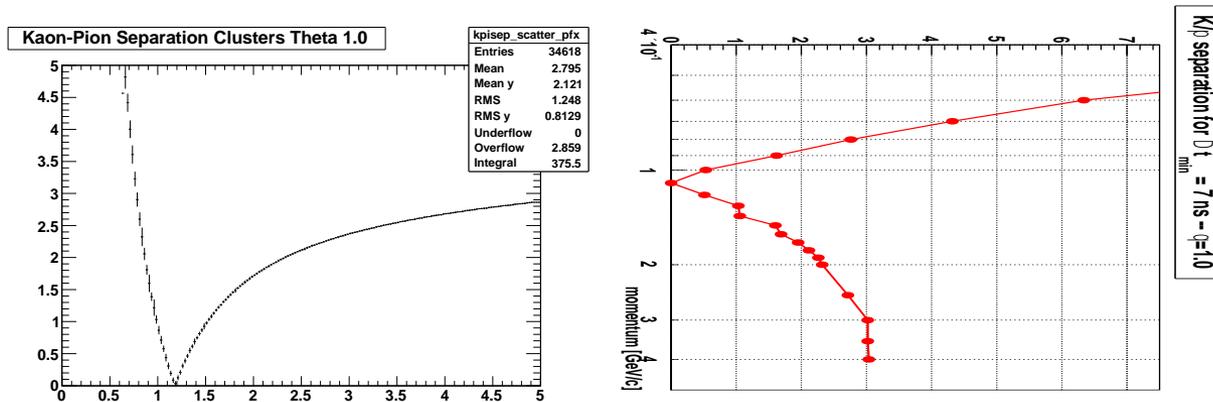
- Realistically model performance of cluster counting vs. dE/dx in FastSim

a. Improve the agreement with the BaBar DCH performance



K/PI Separation in FastSim

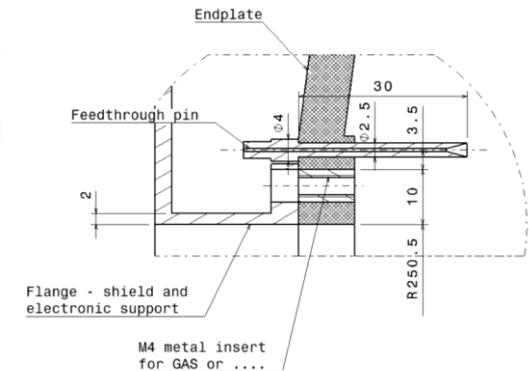
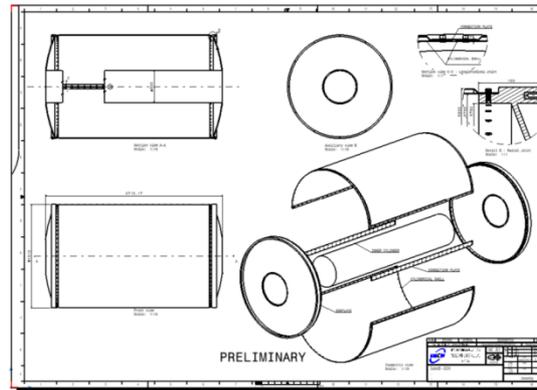
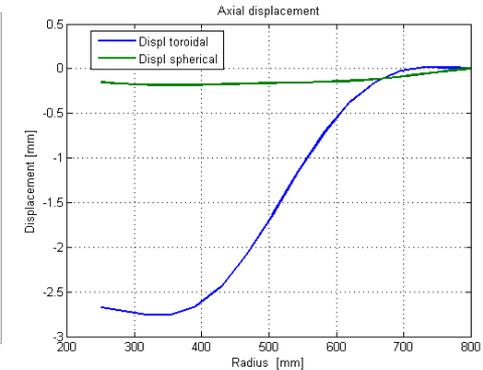
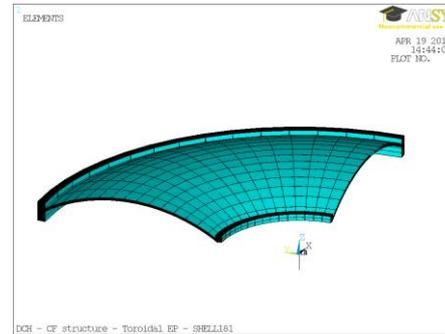
- Realistically model performance of cluster counting vs. dE/dx in `FastSim`
 - Parameterize possible improvement on Physics from Cluster Counting using results from data on prototypes and Garfield simulations



- Study impact on efficiency and purity of Btag and $B \rightarrow K(*) n \nu \bar{\nu}$ signal samples
 - *results to be discussed at this meeting*

DCH Structure and Integration

- Investigate more endplate shapes
 - Examples: toroidal, conical
 - The spherical shape considered so far seems to minimize the endplate deformations for a given load
 - But Need to worry about effect on over-all integration with Fwd Detectors
- More detailed technical drawings



- Expect to make progress at this meeting on integration issues
 - DCH length (FWD TOF, BWD EMC)
 - New optimization of Tungsten shield thickness underway. Will have consequences on the DCH inner radius

PID-Conveners :Vavra & Arnaud

BPID Status

- **FDIRC Prototype Mechanics and Optics Completed**
- **TDR** PID TDR text draft written. To Be discussed at this meeting
- **Good Progress in MC simulation of FDIRC background and DIRC Shield.**
 - Bkg rates significantly reduced (as expected) with the last version of shielding simulated in BRN
 - starting to use the stand-alone G4-based simulation of the FDIRC with the CRT test in mind
 - some documentation is now available on the SuperB wiki
- **FTOF Update at Parallel Sessions and for integration sessions**
- **Recent talks at Elba Instrumentation Meeting**
 - 1 (plenary) talk (FDIRC) and 3 posters: H-8500 studies, PID electronics and FTOF.

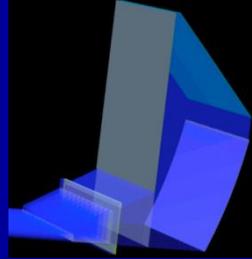
Photon camera being assembled in CRT



- **Optical coupling between FBLOCK and new Wedge is 1 mm-thick RTV. This is to be able to decouple them if we find it necessary.**
- **The electronics will be installed in June. Will start taking data in August.**

FDIRC test in CRT

(Test will start running in July-August)



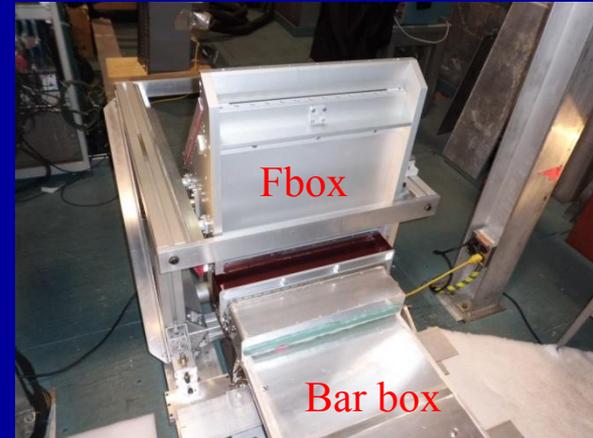
SLAC Cosmic Ray Telescope (CRT):



SLAC-PUB-13873 (2010)

- ~ 1.5 mrad track resolution
- > 1.6 GeV muon energy
- 3D tracking
- 46" thick iron absorber, $\sim 55'' \times 90''$ size

FDIRC prototype located in CRT:



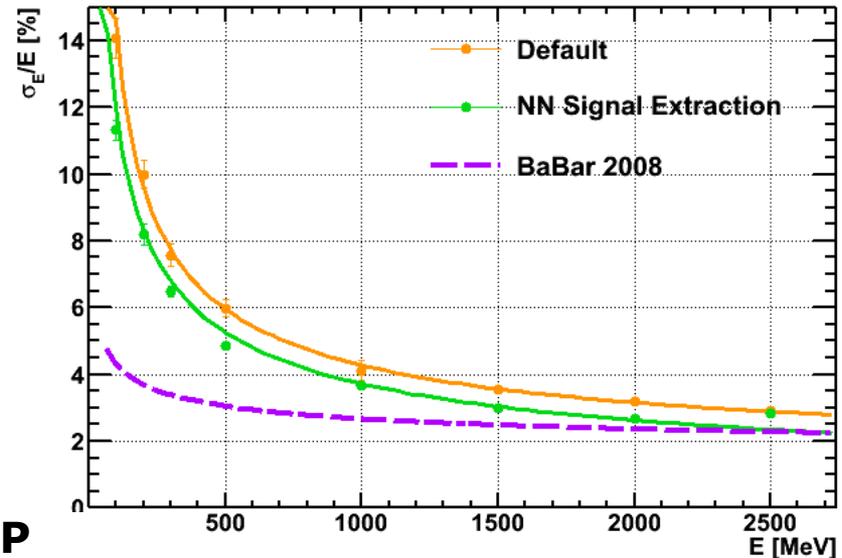
- **Fabrication of the Full scale FDIRC prototype optics and mechanics successfully finished !!!**

EMC-Conveners: Cecchi & Porter

EMC-Background Concerns

Barrel: with x5 background level we have observed degraded detector performance.

Studies have been performed on clustering and signal shaping.
More news during this meeting with the new shielding



Impact is negligible if RMS of the noise is < 0.5 MeV

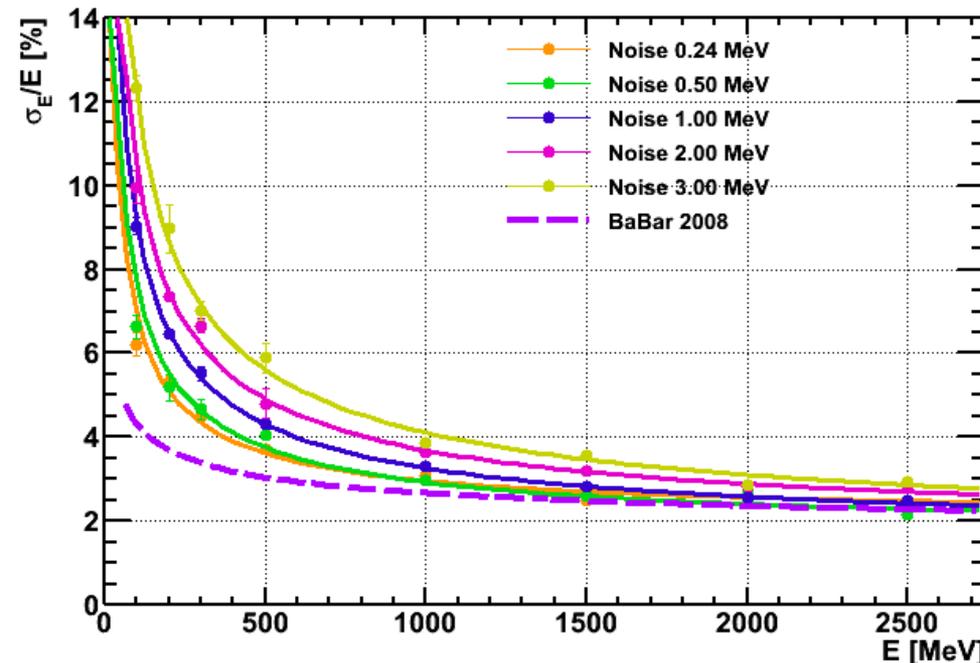
LAB measurements are on going in ROME to study all the possible configurations.

Crucial point for the EMC barrel study:

Arrange the transportation of the spare module from SLAC to perform measurements



NOISE LEVEL STUDIES WITH 100ns CSP



Ad hoc committee was setup at March CM to review the **TDR baseline option**

Recommendation: TDR baseline option should be the hybrid solution...outer rings of CsI(Tl) and inner rings of LYSO.

“Our recommendation is that the hybrid LYSO / CsI(Tl) solution be selected as the baseline, **because it is the the more established technology.** Of course, work needs to continue on understanding and reducing backgrounds, and on verifying that this solution (and the barrel) function in the presence of achievable backgrounds. The committee did not discuss how many rings of CsI(Tl) should be present in the baseline. The studies to decide this should be completed prior to the TDR, or at the minimum, specified in the TDR.”

➔ **PERFORMANCE STUDIES IN FAST SIM AND FULL SIM ARE NEEDED (HYBRID) TO COMPLETE THE TDR. COST ESTIMATE DEPENDS ON THE NUMBER OF LYSO RINGS.**

PURE CsI REMAINS AND OPTION : PERFORMANCE MAY BE ADEQUATE (STILL BEING ADDRESSED). COST IS LESS. R&D IS CONTINUING & RAD HARDNESS OF CRYSTALS NEEDS INVESTIGATION.

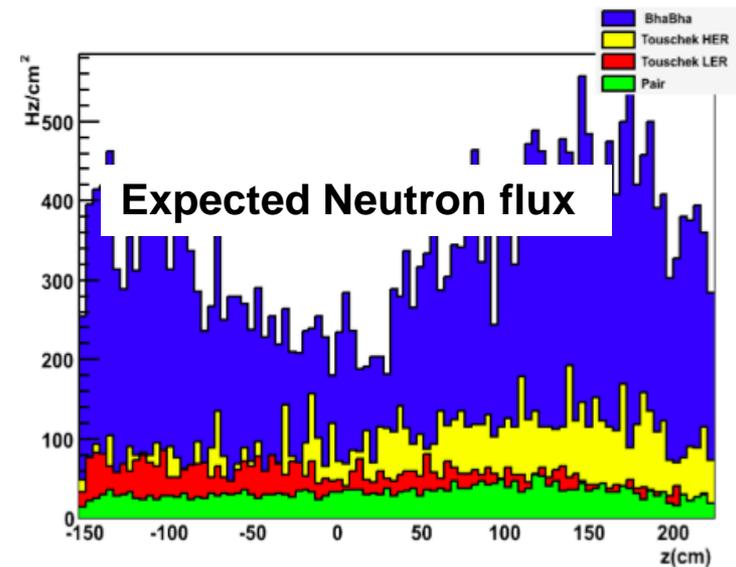
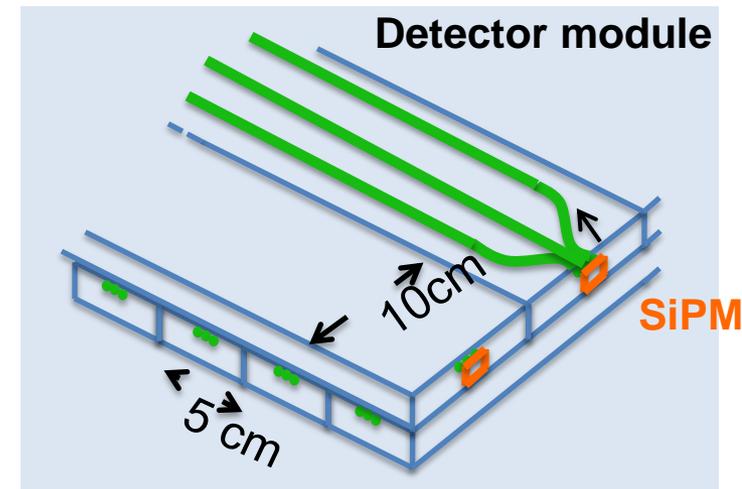
- Expect 3 Busy Parallel Sessions
- Concentrating on TDR Baseline, TDR Text, R&D, and Bkg Simulation

Detector Elements-IFR: Convener Calabrese

IFR overall status

Critical issues and design choices for TDR detector design

- ✓ **Binary readout** is our baseline
- ✓ **9 active layers** is the baseline for the TDR, but the 8-layer option is retained
- ✓ **92cm of iron** is the current baseline for the TDR. The BaBar iron will be reused with no major modification.
- ✓ One of the main issues is now to understand the **SiPMs and FE electronics damage with radiation** (especially neutrons)
- ✓ A test at the facility **Gelina (Geel, BE)** is foreseen in July (9-20)



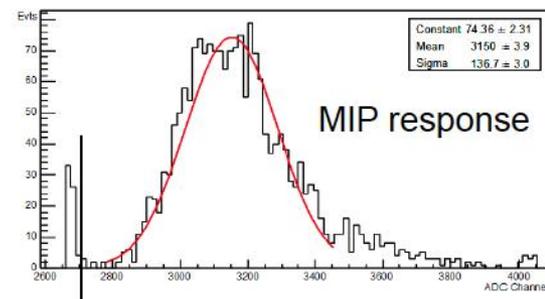
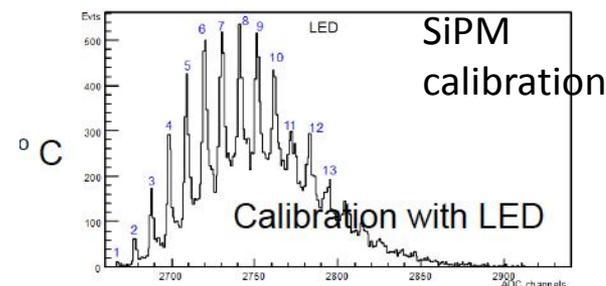
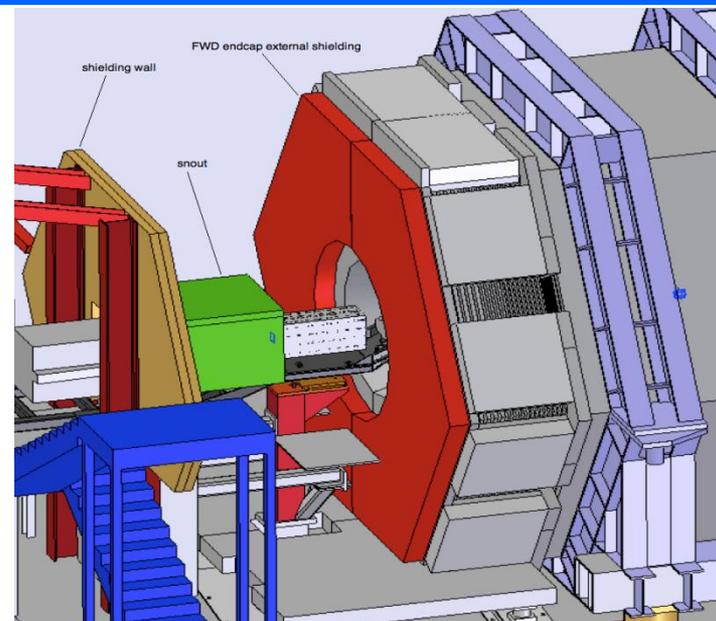
Irradiation test at Gelina

- The facility: 100 MeV linac, electrons on Uranium target + moderator to obtain a **white spectra** neutron beam
- The main goals are:
 - Measure the **Dark current/noise** with dose
 - Monitor the **gain and the signal waveform** with dose (using a LED)
 - Estimate the **neutron flux reduction power** of various amounts of Boron loaded Polyethylene
 - Integrate a total dose of $\sim 5 \times 10^{11} \text{ n/cm}^2$ (~10 years x safety factor 5)



Other ongoing activities

- Background simulation: external mechanical structures and other shielding studies.
- Flux return and detection module mechanics.
- R&D activities in Bologna, Ferrara and Padova to optimize/finalize the module design.
- TDR preparation ongoing.



Electronics, Trigger and DAQ-
Conveners, Breton, Luitz, & Marconi

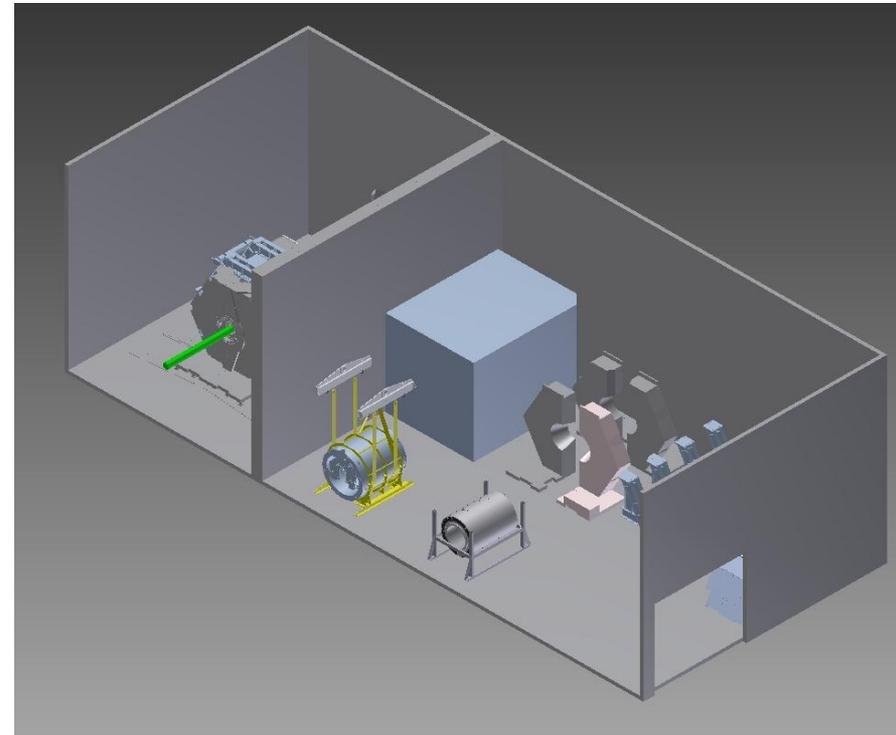
ETD/online

- Since last meeting, work was mostly concentrated on the TDR text:
 - **Common items and online:**
 - most of the subchapters were re-written on the basis of the white paper
 - figures were updated and new figures introduced
 - new paragraphs were added (radiation policy, ...)
 - difficulties with large variations in length and level of details of the different contributions
 - **Sub-detector front-end electronics:**
 - we received the first contributions (IFR, PID, TRG)
 - some challenges in meeting the sharing requirement between subdetectors and ETD chapters
 - same difficulties as above concerning the variation in length of the contributions
- We will have 3 sessions during this workshop. The first two will be fully dedicated to TDR.
 - **common items, trigger and online => Saturday 11:00**
 - **front-end electronics => Saturday 18:00**
- The last session will be shared with background experts. The problems linked with radiation will be covered there => **Sunday 11:00**

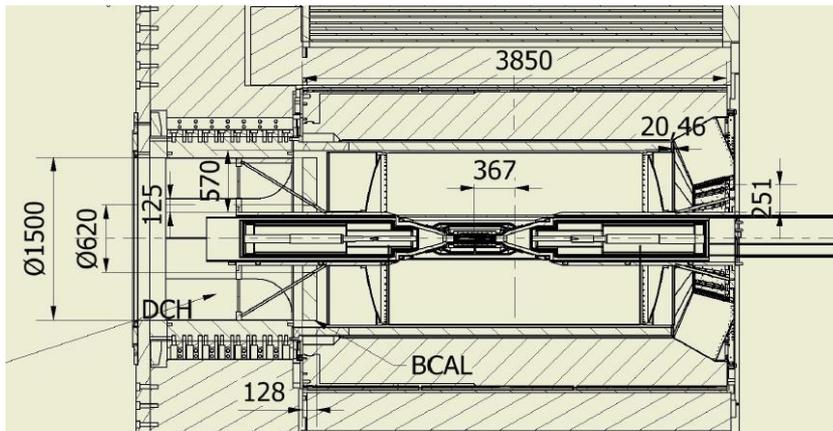
Integration-Rafaelli /Wisniewski

Integration Meetings-This Week

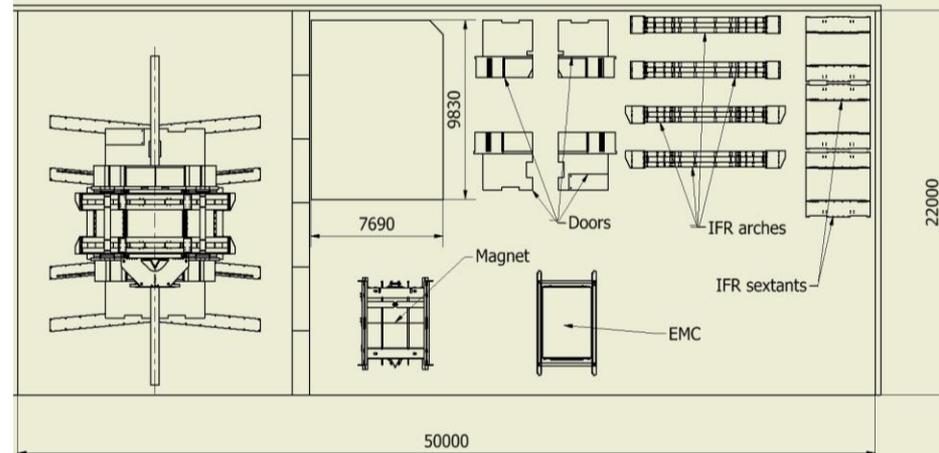
- Hall Layout
- Tungsten Shielding Tube
- **Detector Envelopes**
- Forwd/Bkwd Region of Detector
- Access and Cable Space for Systems
- FDIRC/DCH/FTOF Interface
- Drawings and Dimensions
- TDR



Ref dimensions-SuperB



Hall Layout



Agenda



Meeting Sessions



SuperB Collaboration Meeting
 La Biodola, Isola d'Elba
 May 31 - June 5, 2012
 Agenda

Meeting Registration Desk : Thursday, May 31, 17:00 - Hotel Hermitage

All Plenary Sessions will be held in Sala Maria Luisa

Welcome Reception: Friday, June 1 at 20:00 - Hotel Hermitage - Swimming pool area

Thursday, May 31		Friday, June 1		Saturday, June 2		Sunday, June 3		Monday, June 4	
	08.00		REGISTRATION					06.00	
09.00	08.30		PLENARY	08.30	PARALLEL 3	08.30	PARALLEL 7	08.30	PLENARY
SML	Physics meeting	SML	Introduction and status		SVT DCH PID EMC IFR		COMP: Fulaim+Backgrounds Physics Accel ETD Integration	30 30 30 30	Accelerator Summaries Accelerator Design MDL, IR and Backgrounds Accelerator Organization Cabibbo Lab Status
	1.0 3.0 3.0 3.0		Welcome Project Status Computing Detector						
10.30	Coffee Break	10.30	Coffee Break	10.30	Coffee Break	10.30	Coffee Break	10.30	Coffee Break
11.00		11.00	PLENARY	11.00	PARALLEL 4	11.00	PARALLEL 8	11.00	PLENARY
SML	Physics meeting	SML	Introduction and status		ETD1 Det: Integration and IR Hall		ETD + Backgrounds COMP Physics Accel	15 15 15 15 15	Detector Summaries SVT DCH PID EMC IFR Integration
	4.0 4.0		Physics BELLE-II and SuperKEKB Status						
12.30	Lunch - Fuoco di Bosco	12.30	Lunch - Fuoco di Bosco	12.30	Lunch - Fuoco di Bosco	12.30	Lunch - Fuoco di Bosco	12.30	Lunch - Fuoco di Bosco
				15.00	Exec Board (restricted)	15.00	Council (restricted)		
16.00		16.00	PARALLEL 1	16.00	PARALLEL 5	16.00	PARALLEL 9	15.30	PLENARY
SML	Physics meeting		SVT DCH PID EMC IFR		COMP+Physics: Physics tools Det + Acc: MDL/Backgrounds		COMP Det+Phys: Physics performance in presence of background Accel	2.0 2.0 2.0	Summaries ETD Computing Physics Project outlook
SBI+2	Technical Board (restricted)								Adjourn
17.30	Coffee Break	17.30	Coffee Break	17.30	Coffee Break	17.30	Coffee Break	17.00	Coffee Break
18.00		18.00	PARALLEL 2	18.00	PARALLEL 6	18.00	PARALLEL 10	17.30	CLOSED MEETINGS
SML	Physics meeting		SVT DCH PID EMC IFR		Det: ETD 2 Det + Acc: MDL/Backgrounds COMP Physics		Joint Integration Group (restricted) Physics COMP		Technical Board (restricted)
SBI+2	Technical Board (restricted)								
	REGISTRATION								
19.30		19.30		19.30		19.30		19.30	
20.00	Welcome cocktail	20.00	Dinner at one's own hotel	20.00	Social Dinner	20.00	Dinner at one's own hotel	20.00	Dinner at one's own hotel
		21.00	Concert						
	Meeting Room				Meeting Room				
SBI	Sala Bonaparte 1 - Hotel Hermitage			SML	Sala Maria Luisa - Conference Center				
SBI	Sala Bonaparte 2 - Hotel Hermitage			SA	Sala Ajaccio - Conference Center				
SI	Sala Elba - Conference Center			SBI	Sala Biodola - Hotel Biodola				



Focus of Workshop

- Mechanical Integration Issues
 - Hall Design
 - BaBar Transport and Refurbishment
 - Define Detector System Envelopes
 - Fix requirements for final TDR baseline drawings
- Review R&D Status, Beam tests, and Milestones
- Backgrounds
- Organization
- Refine information needed to complete TDR
 - System Design and Options
 - Integration ,envelopes and drawings
 - Budget and schedule

→ Aim to complete TDR by September 2012