Detector Status

F.Forti, INFN and University, Pisa

Overview

- Detector design is fairly advanced
  - Progress report: arxiv.org/abs/1007.4241
- R&D continuing in several areas
- Some geometry options defined
- Proto-collaboration organization is in place and working well
- We are moving towards the Technical Design Report

… but …

- Significantly more physicists and engineers are needed
- Need to transition to fully operational and endorsed collaboration
  - With proper interaction with the Cabibbo Lab.
- Need to define funding sources and committments
- Need to baseline design and move on to construction

Proto-Detector Organization

Detector Coordinators – B.Ratcliff, F. Forti
Technical Coordinator – W.Wisnieswki

- SVT – G. Rizzo
- DCH – G. Finocchiaro, M.Roney
- PID – N.Arnaud, J.Va'vra
- 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 – D.Brown
  - Fast simulation – M. Rama
  - Full Simulation – F. Bianchi
- Background simulation – M.Boscolo, E.Paoloni
- Machine Detector Interface –
  - Rad monitor –
  - Lumi monitor –
  - Polarimeter –

Detector Geometry Working Group
Chairs M.Rama, A.Stocchi

Forward Task Force
Chair H.Jawahery

Backward Task Force
Chair W. Wisniewski

Mechanical integration team
F. Raffaelli

To be created:
Central electronics team

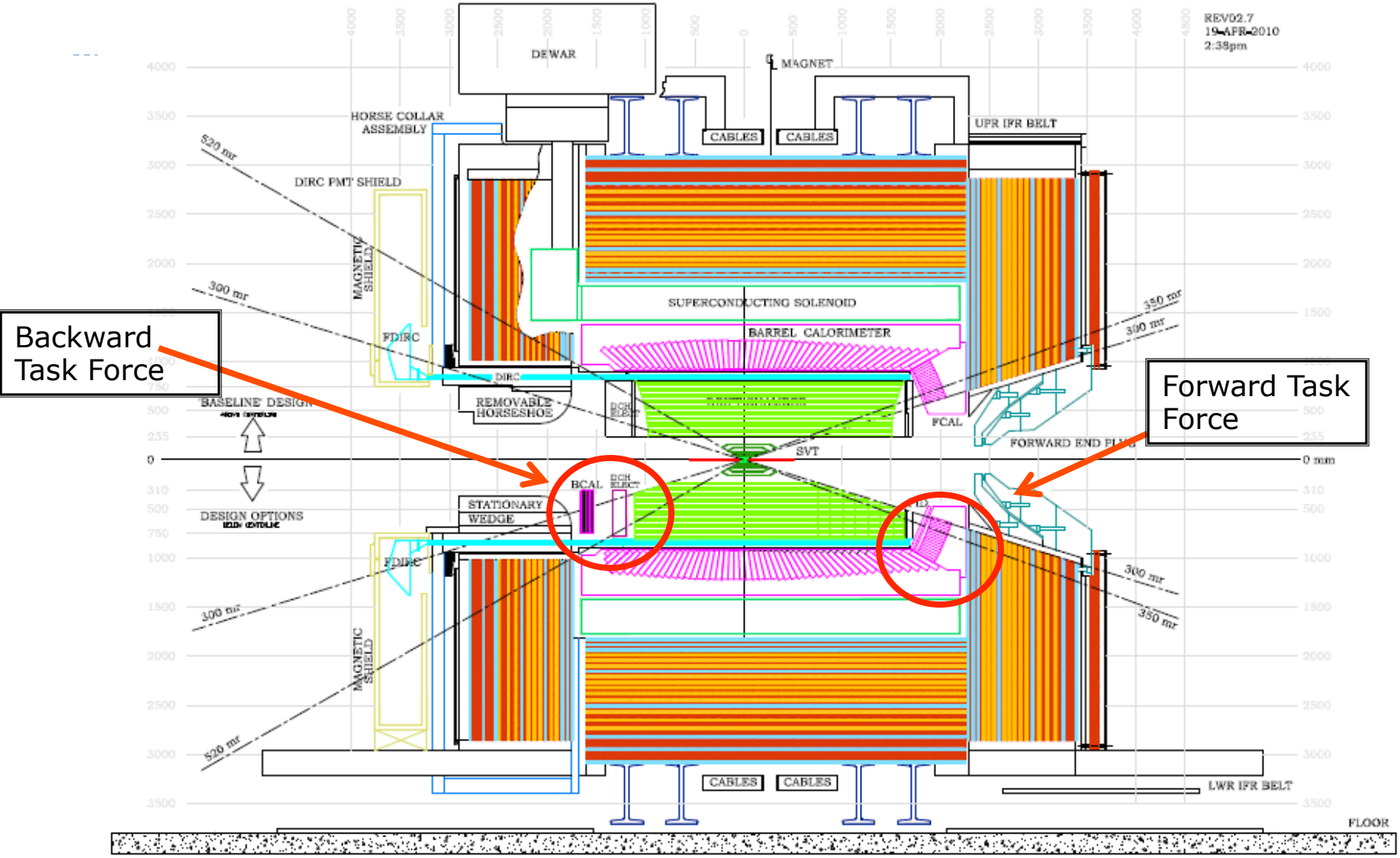
Institutions

System	Institutions
SVT	Bologna, Milano, Pavia, Pisa, Rome3, Torino, Trieste, Trento, LBNL, Queen Mary, RAL, Strasbourg, Bari
DCH	LNF, McGill, Montreal, TRIUMF, UBC, Victoria, Lecce
PID	SLAC, BINP, (Hawaii), Cincinnati, Bari, Padova, Maryland, LAL, LPNHE
EMC	Bergen, Caltech, Perugia, Rome1, Napoli
IFR	Ferrara, Padova, Krakow, Bologna
ETD	SLAC, Caltech, Napoli, Bologna, LAL, Padova, Rome3
Computing	Padova, Ferrara, Torino, Bari, Bologna, Rome2, Pisa, Perugia, LNF, LBNL, Napoli, SLAC
Magnet/ Integration	SLAC, LNF, Pisa, Genova
Backgrounds/MDI	SLAC, Pisa, LNF, LNS, Cagliari, Ohio State
TBD	(Valencia, Barcelona, Annecy, Tel Aviv, Liverpool, Kiev, ITEP, Riverside, Kansas, Livermore, Louisville, Notre Dame,Ohio State, Princeton, Southern Methodist, South Carolina, Austin, Utah)

International Funding of Detector

- Italy
  - General agreement that will provide about 50% of funds needed for detector. Need to work on baseline and funding profile.
- France
  - Request will be presented in Fall 2011
- Canada
  - Request will be presented in Fall 2011
- UK
  - Ongoing negotiations. Desireable a larger participation of UK groups
- Poland
  - Request presented in 2011
- US
  - Request will be presented in late 2011 / early 2012
- Russia
  - Exchange contribution for IGNITOR to be understood. Bulk will be for accelerator work, but some could go to detector
- China
  - Ongoing negotiations.
- Spain, Germany, Norway, Israel, …
- For all it is essential to have a clear picture of the organization and schedule of infrastructure and accelerator

Detector Design (with *fewer* options)



Task forces report

Similar conclusions for forward and backward regions:

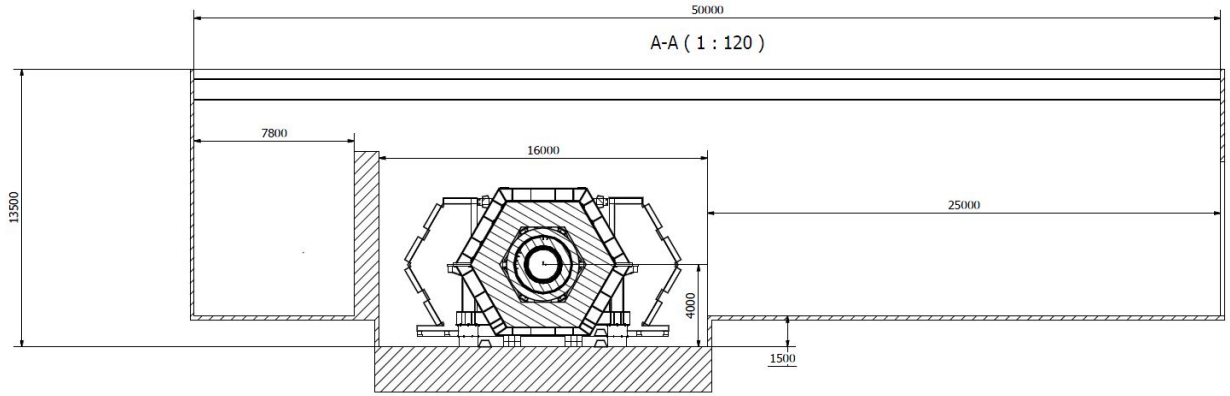
- There is physics merit in increasing the angular coverage of backward calorimetry and forward PID
  - Although not larger than solid angle increase
- It is worthwhile and not too damaging to leave some limited space for the installation of FPID and BEMC
  - About 5cm in the forward direction
  - About 15-17cm in the backward direction
- The decision on the actual construction of these options will need to be taken on the basis of:
  - Overall availability of human and monetary resources
  - Validation of the technology and of the performance of the proposed devices.
  - Specific availability of people and funds for these subdetectors
- Many thanks to Hassan and Bill for the very valuable work.

Detector Design Issues

System	Baseline	Issues (technical OR manpower; R&D)
MDI	Initial IR designed	Magnetic elements and radiation masks. Design of tungsten shields. Cryostats radius Background simulations: global map, detector occupancy
SVT	6-layer silicon	Technology for Layer 0: striplets or pixels. Thin pixels R&D. Readout chip for strips. Mechanical design.
DCH	Stereo-axial He-based	Dimensions (inner radius, length). Mechanical structure. Cluster counting option.
EMC	Barrel: CsI(Tl) Forw: LYSO	Electronics and trigger. Mechanical structure Forward EMC technology: LYSO / LYSO+CsI(Tl); Pure CsI. Backward EMC: cost/benefit analysis
PID	DIRC w/ FBLOCK	FBLOCK design. Photon detection. Mechanical structure Forward PID: cost/benefit analysis. Prove TOF technology.
IFR	Scintillator+ fibers	8 vs 9 layers. SiPM radiation damage and location. Extra 10cm iron. Mechanical design and yoke reuse.
ETD	Synchronous const. latency	Fast link rad hardness. L1Trigger (jitter and rate). ROM design. Link to computing for HLT.

Integration issues

- Mechanical integration group created
- Started to look at:
  - Integration and assembly of detector
  - Experimental hall structure
  - Transportation issue
  - Refurbishing strategies
- Important to define soon:
  - Where are Babar components stored
  - What refurbishing work needs to be done on them
  - When can they be transported to Italy
  - Who is taking care of this work



TDR process and timeline

- The Technical Design Report is an essential step to get funding and get the detector built.
- Conflicting requirements
  - Essential to enlarge the collaboration, define institutional responsibilites and find resources for designing and building the detector
  - Essential that collaboration members, institutions and countries take ownership of the design and fabrication
  - Essential to move forward rapidly to finalizing the design and writing the TDR
- Funding and schedule
  - The TDR must contain an initial definition of funding and resource availability
  - Open question about how to incorporate funding agencies intentions and committments into the TDR

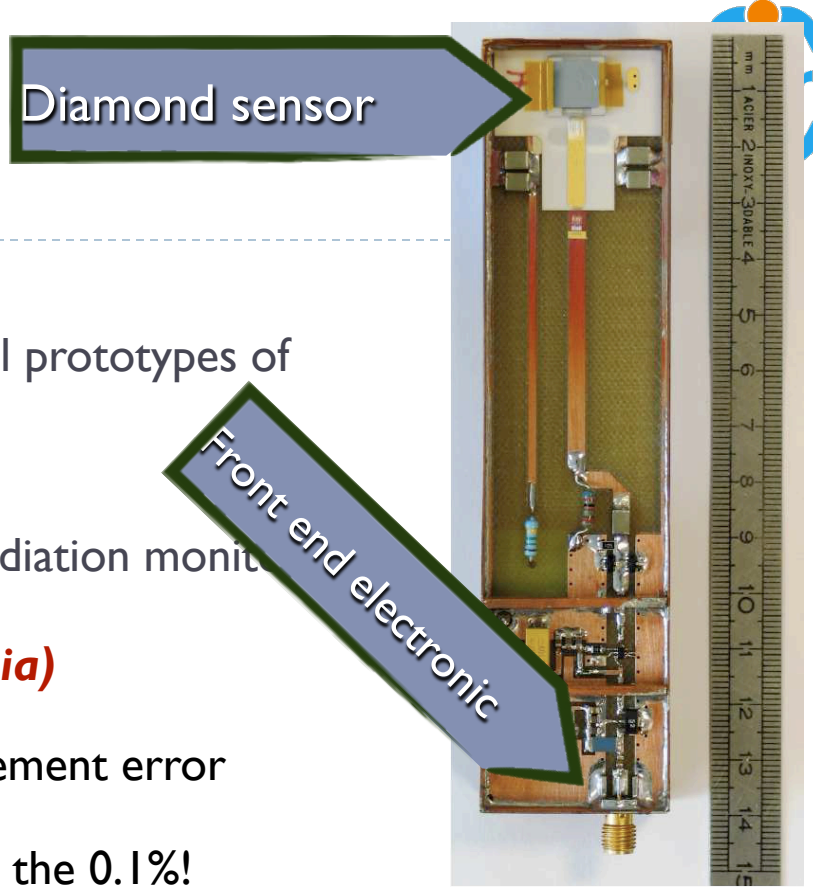
Timeline

- June-July: setup SVN repository + initial outline (done)
- September 2011
  - Detailed outline with page count + editorial responsibilities
  - Tentative institutional matrix of responsibilities and money allocation
- December 2011
  - First (in)complete draft,
  - Decision about what is in and what is out
  - Updated budget and schedule for construction
- February 2012
  - Complete draft into final editing
  - Final readers identified
- April 2012: Publish

MDI

Eugenio Paoloni

MDI detectors



- ***Radiation monitors (Roma2 SuperB group)***
  - Plan to study in lab and at beam facility small prototypes of diamond sensors (poly and single cristalline)
  - Development of a fast readout amplifier
  - Bruno simulation of their effectiveness as radiation monit

- ***Polarization Monitor (Roma2, Cagliari, Catania)***
- GEM/Diamond detector to decrease the measurement error
- Absolute measurement of the LER momentum at the 0.1%!
  - No more $\beta\ \gamma$ troubles! (In BaBar "s" was accurately determined by the Υ(4S) peak position, but $\beta\ \gamma$ accuracy was limited by tracking systematic)
- ***Luminosity Monitor (Roma2, Cagliari, Catania)***
- Proposal to use diamond detector to build a tracking detector able to withstand high rates and radiation levels

Machine Background Simulation Activities

- **Migration to a Packaged version of Bruno code ⇒ BRN**
- **Latest Full-Simulation Production:**
  - BRN code validation:
    - Rad-BhaBha events (10% of Elba 2011 production)
    - Comparison with latest Elba production (old Bruno code)
  - New Fwd-EMC geometries:
    - Rad-BhaBha events (20k bunch crossings)
    - Study of different Fwd-EMC geometries (CSI and BGO crystals)
  - Touschek simulation:
    - Touschek losses from STAR code (Manuela Boscolo)
    - Use losses as primaries for Bruno simulation
    - Samples for LER and HER losses are being analysed
  - Background frames production for FastSim:
    - Short production is being validated
    - Larger scale production in the coming days

SVT

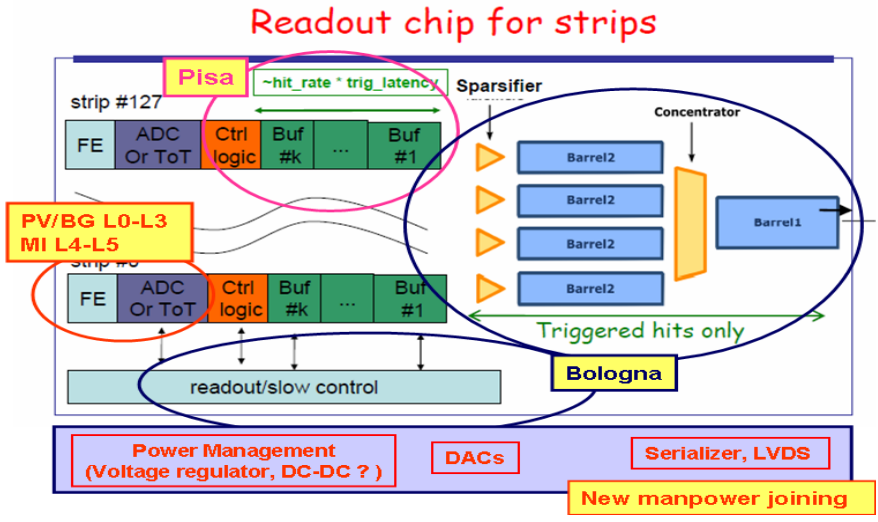
Giuliana Rizzo

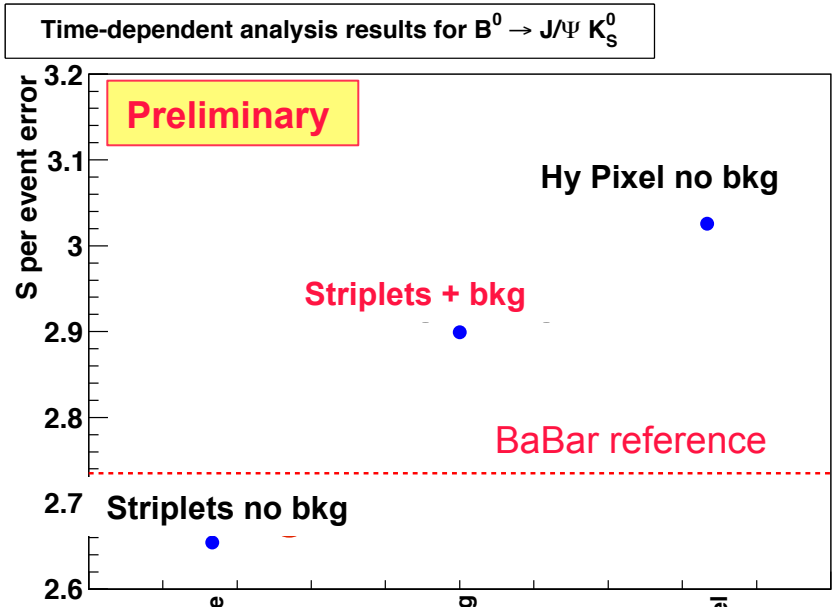
SVT (I)

- Progress on Baseline configuration (Striplets L0+L1-L5 design)

Readout chips for striplets/strip:

- detailed plan for chip development by Italian groups presented to INFN.
  - Develop fast (L0-L3) and slow (L4-5) channels & adapt readout architecture used for pixel.
    - Full VHDL simulation for TDR.
    - Prototypes chips in 2012 & 2013
    - Production run in 2014





First preliminary results on striplets performance in high background with Fastsim

- Hits from background pairs added to signal for time dependent analysis.
  - Still safety factor not included on back rates.
- Checks on fundamental quantities still to be done and and several technical problems need to be fixed to perform systematic studies.

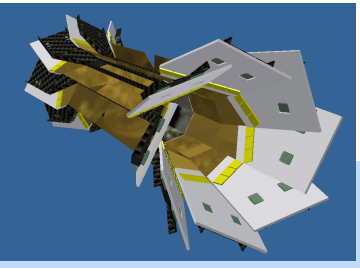
SVT (II)

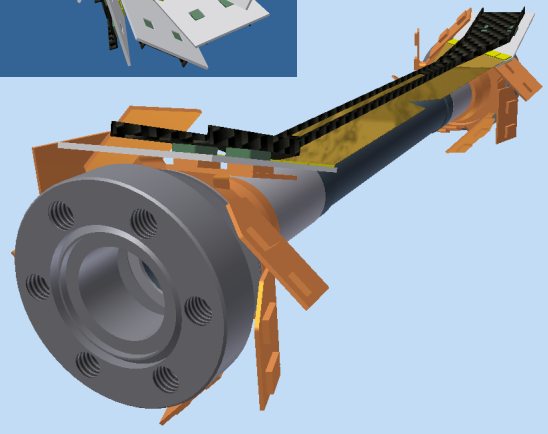
Background simulation:

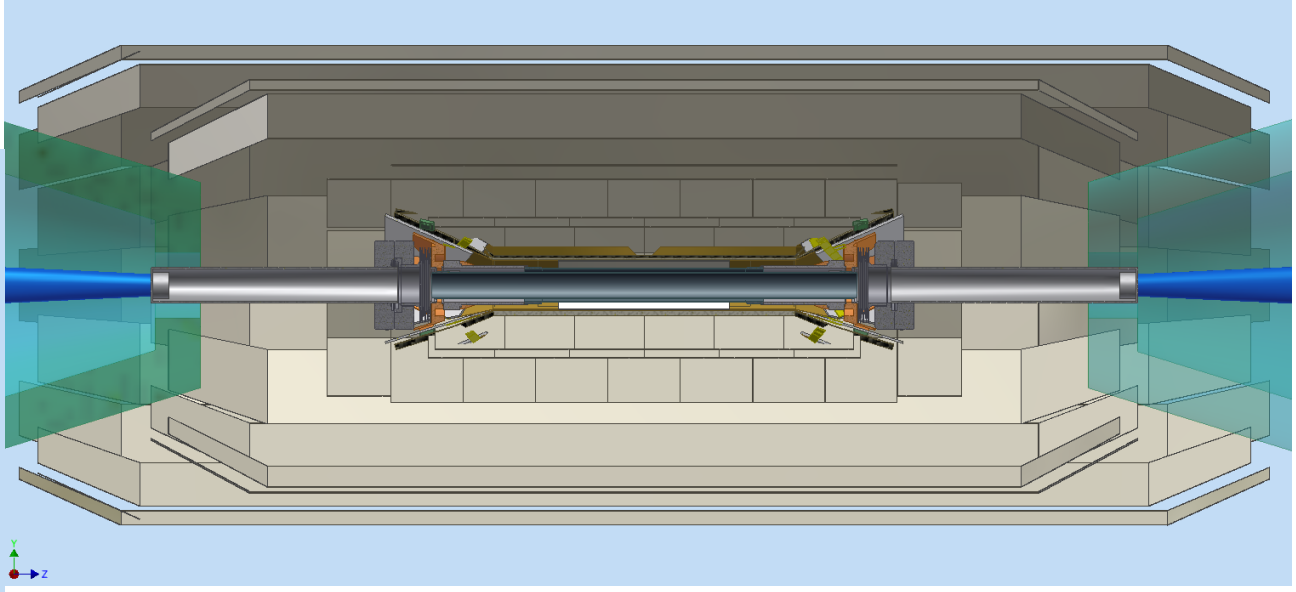
- Strip detail implemented in Bruno for a more accurate rate calculation
- Very useful contribution from Trieste group to cross check results and get more solid background estimates!

Layer	RO PitchZ (or +45°) μm	Cenci Rate Z or +45° (MHz / cm^2)	Rate Z or +45° (MHz / cm^2)	RO Pitch ϕ (or -45°) μm	Cenci Rate ϕ or -45° (MHz / cm^2)	Rate ϕ or -45° (MHz / cm^2)
0	50	29.9	24.3	50	23.3	24.3
1	100	0.7	0.93	50	1.5	1.61
2	100	0.35	0.4	55	0.72	0.73
3	100	0.097	0.12	55	0.19	0.19
4	210	0.0076	0.0036	100	0.012	0.007
5	210	0.0041	0.0024	100	0.006	0.005

Mechanics: Layer0 design with striplets revised and L1-L5 module design started







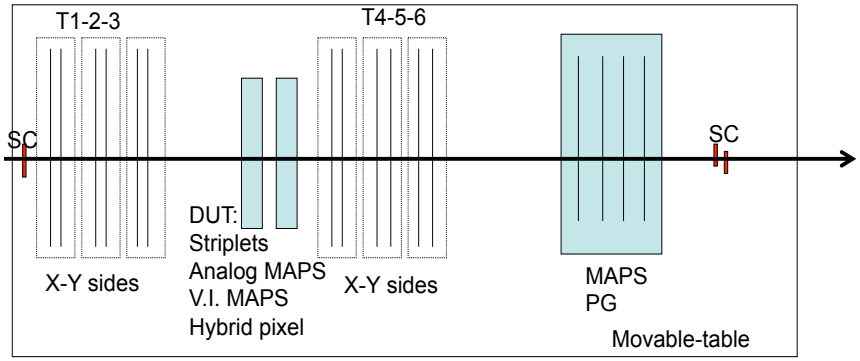
SVT (III)

Pixel R&D:

- First MAPS matrix (APSEL like) submitted in July with INMAPS CMOS process:
  - high resistivity substrate & quadruple well available → to improve radiation hardness & charge collection efficiency.
- After a long delay 3D MAPS are now ready and will be on test in the next weeks.

Testbeam @CERN starting next week

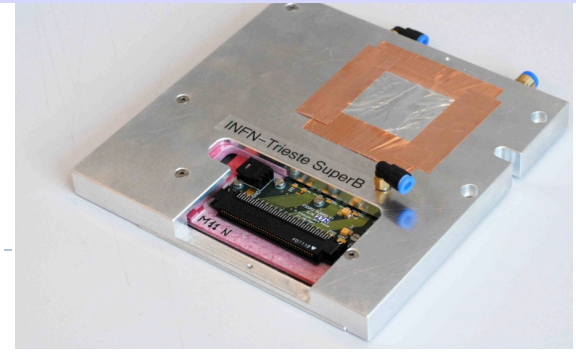
- Most of the SVT group working hard over the summer to get things ready
  - Thanks to S. Bettarini for the organization
- Several pixel structures and striplets on test



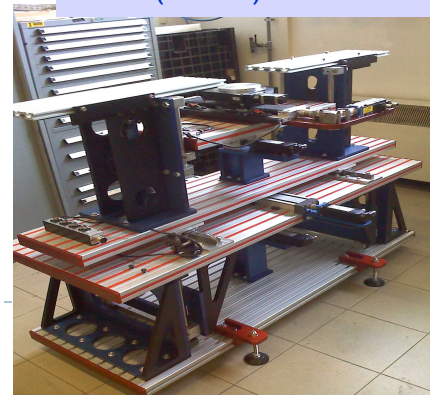
New flexibility implemented in DAQ system (Bologna) to test all the different DUT's

Analysis team (Pi+BO+MI) is getting the new code ready

5 new telescope modules with FSSR2 readout built in Trieste to a have a 3+3 telescope configuration.



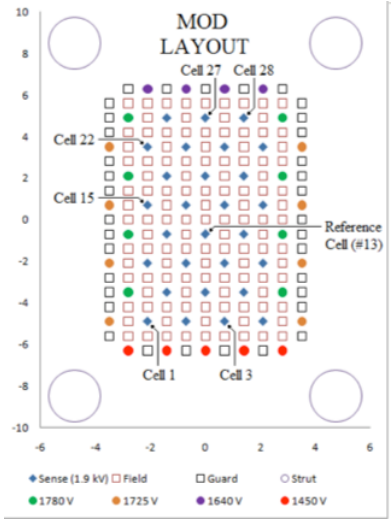
More robust movable table (Torino)



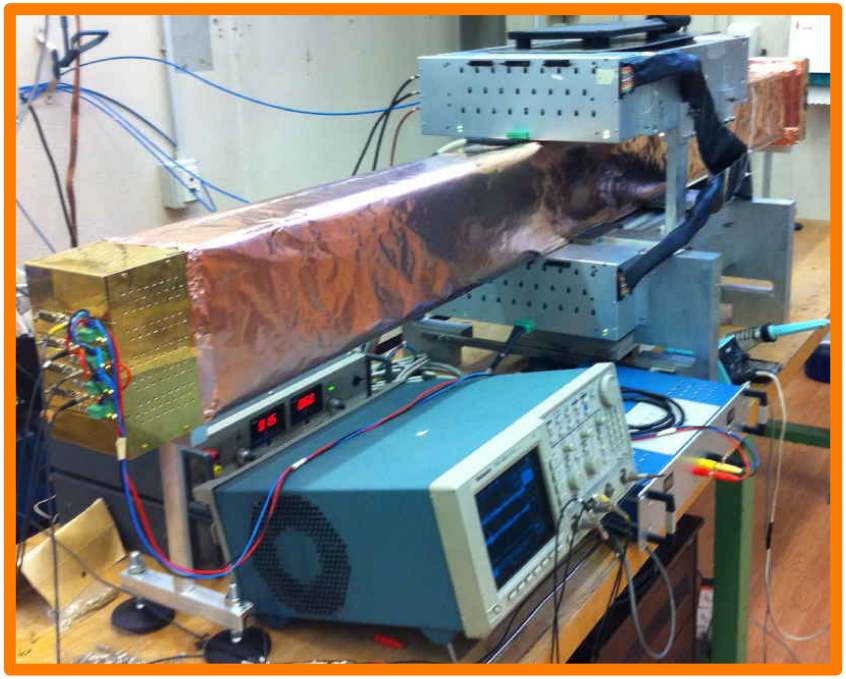
DCH

Giuseppe Finocchiaro and Mike Roney

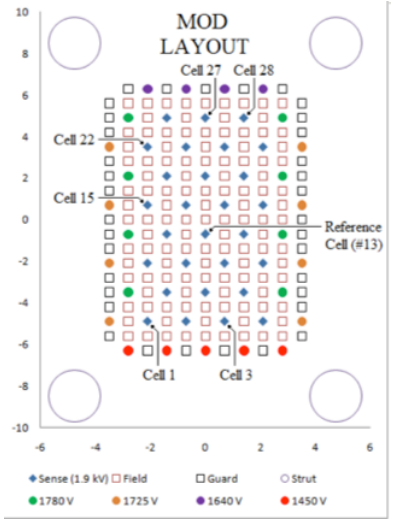
Prototype 2



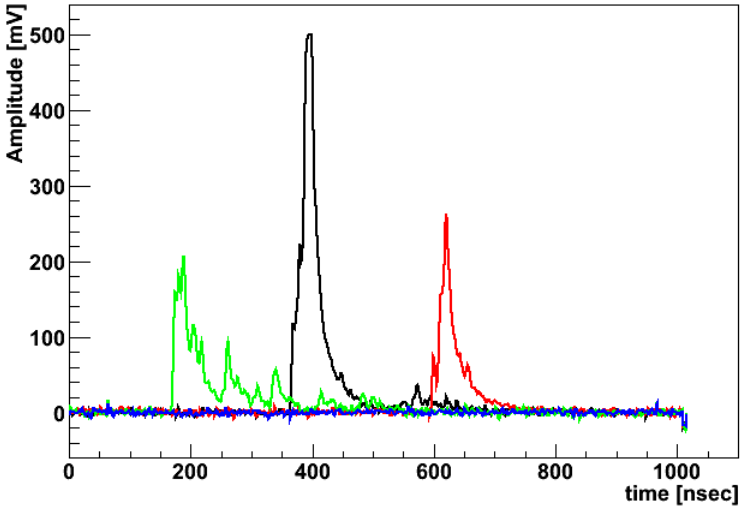
- *2.5m* long prototype with 28 sense wires arranged in 8 layers
  - Goal: study DCH response from single clusters in a realistic environment, and serve as a test bench for the final FEE and for test of DCH trigger implementation
  - Prototype 2 is currently integrated in the tracking telescope system at LNF



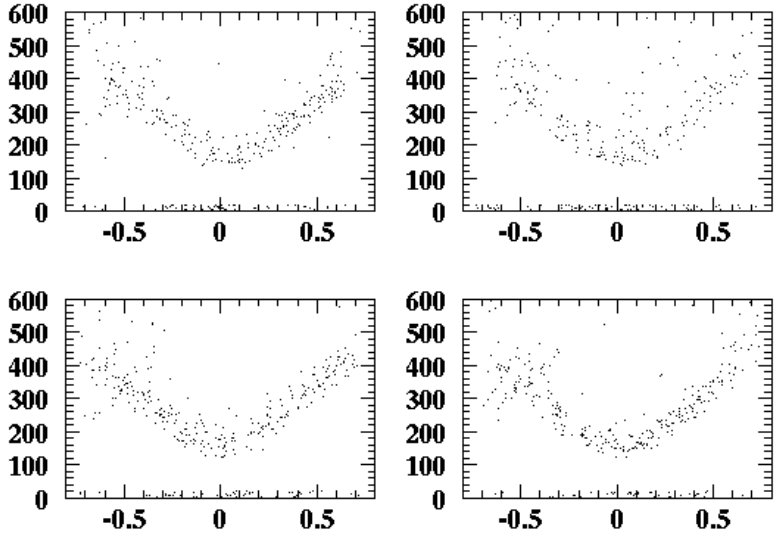
Prototype 2 (cont.)



- Full commissioning and debugging is ongoing using cosmic ray data



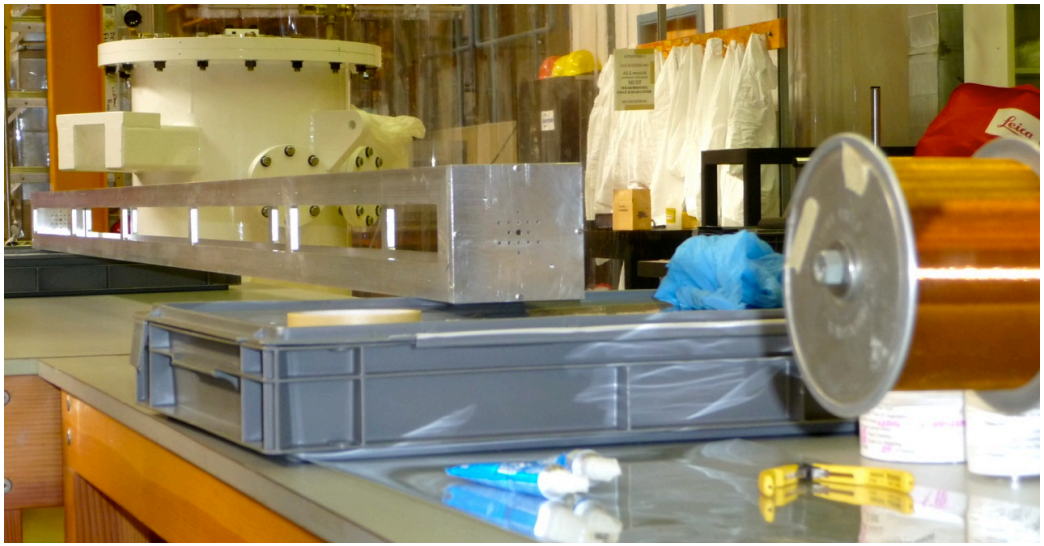
Digitized waveforms from 4 of the cells in a sample event



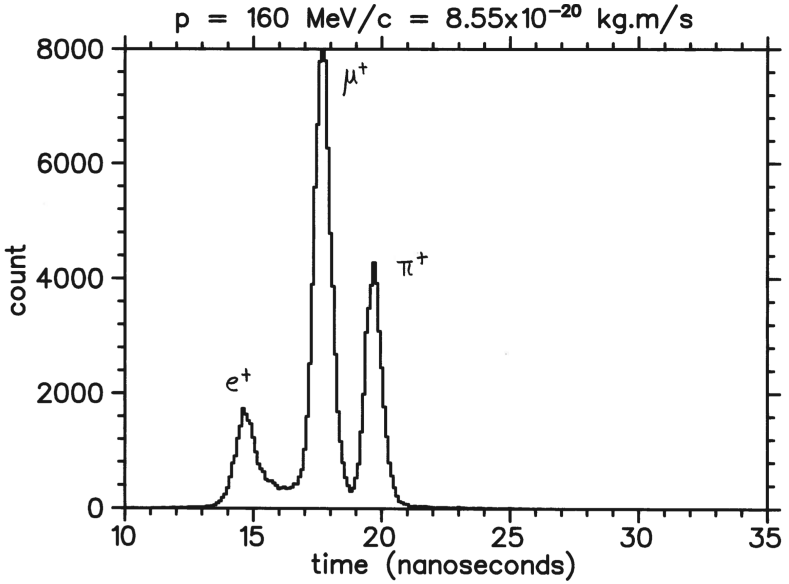
(Preliminary) space-time relations in the same 4 cells

DCH beam test at TRIUMF

- Test a 2.7m-long single cell DCH prototype with prototype preamp to test the practicality of using cluster counter for particle identification.
- M11 beam: 62 – 400 MeV/c; e^+, μ^+, π^+, plus p above 300 MeV/c. Nov. 15 – Dec. 2.



Chamber ready for stringing in TRIUMF clean room



TOF provides μ/π separation to ~200 MeV/c

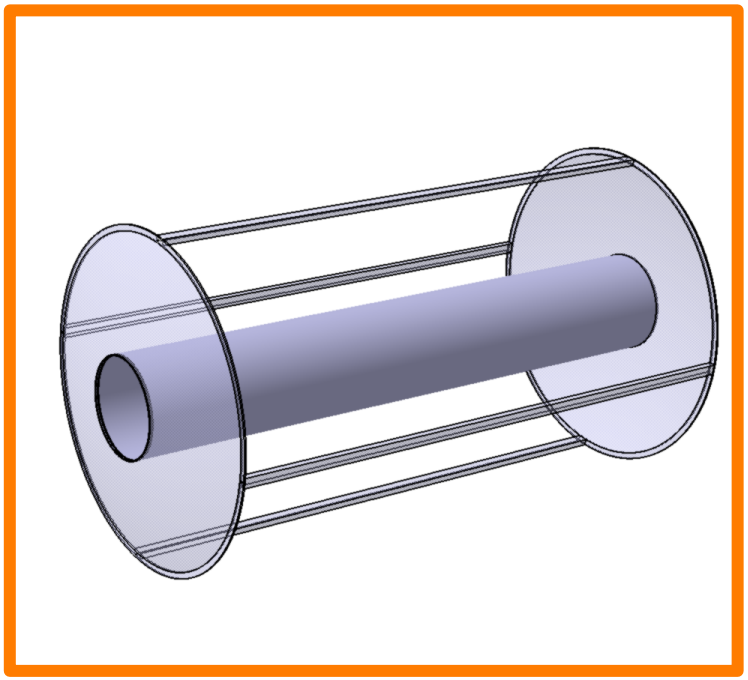
FEE

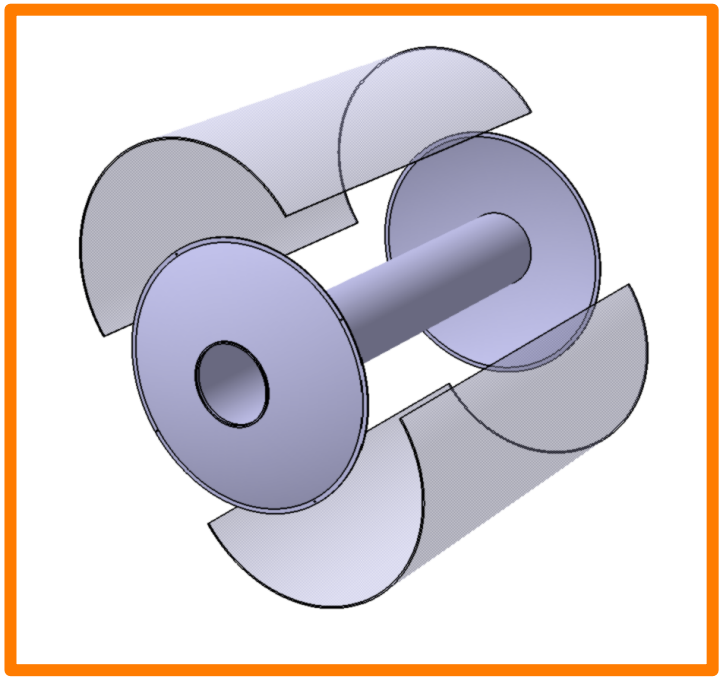
Improved estimate of power and number of crates requirements for FE, HV, LV systems and signal cables for the "standard" and Cluster Counting -based options (9000 channels)

- OFF-DETECTOR
  - "Standard" front-end power requirement basis of estimate:
    - Analog section: coarse design of the analog section implemented as basis of selection of Commercial, Off The Shelf (COTS) components for analog signal processing (ADC/Discriminators/Operational Amplifiers) chain
    - Digital section: the power consumption of a Xilinx ML605 board (26 W) has been considered.
      - 192 boards, 12 crates, ~6kW
  - "Cluster Counting" front-end power requirement basis of estimate:
    - The 8 channels 1 GS/s CAEN board
      - 1152 boards, 72 crates, ~46kW
- ON-DETECTOR
  - Commercial, Off The Shelf (COTS) option based on ProtoII front-end → power ~2kW
  - Dedicated devices (ASIC) based on pre-layout simulation of Current Conveyors topologies → power ~0.2kW
- HV
  - 32 12-channels boards, 12 crates
- LV
  - 2 on-detectore power supply crates
- Cables
  - Cluster Counting requires high frequency cables → ~ x4 bigger cross section

Mechanical Structure

- First FEA calculations of endplate deformations under various hypotheses (e.g., load-bearing/no-load-bearing inner cylinder) and different mechanical constraints





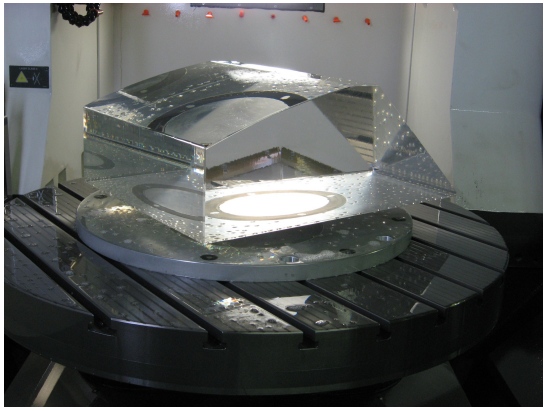
PID

Nicolas Arnaud and Jerry Va’vra

FBLOCK and Wedge

J. Va'vra interacting with Cosmo

- **Polishing of the new Wedge is finished. It will be delivered to SLAC this week. We will use the coordinate machine to measure its shape.**
- **FBLOCK (Focusing Block) polishing will be finished by the end of September. Then it will go to the plating company to produce two mirrors. We will get it sometimes in October.**
- **FBLOCK (Focusing Block) and Wedge are part of photon camera optical focusing scheme. They are made of the Fused Silica material.**



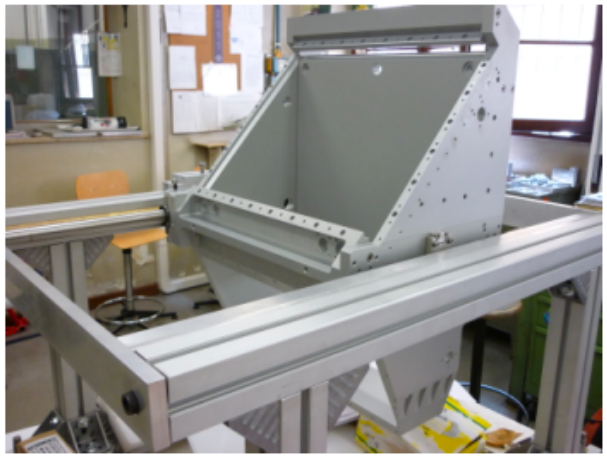
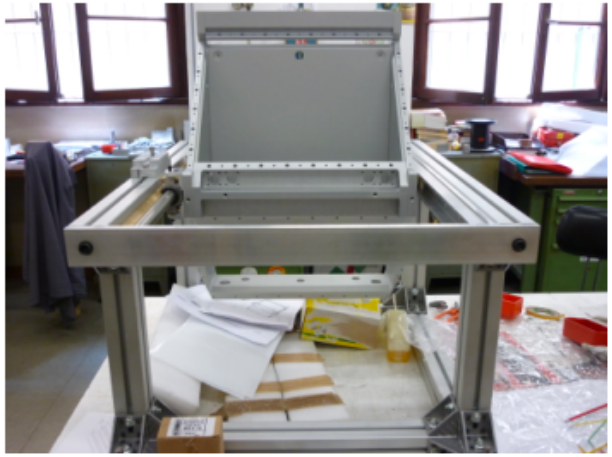
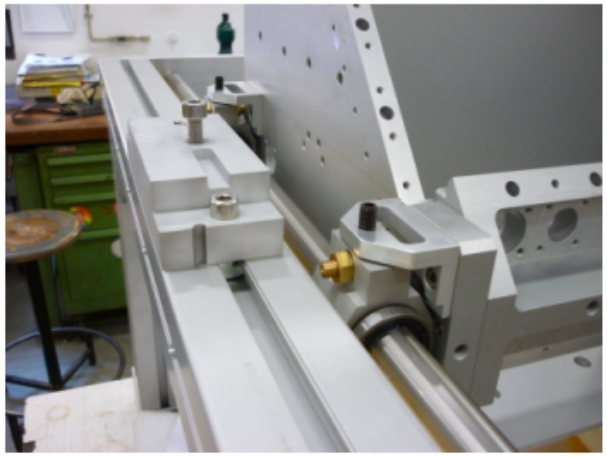
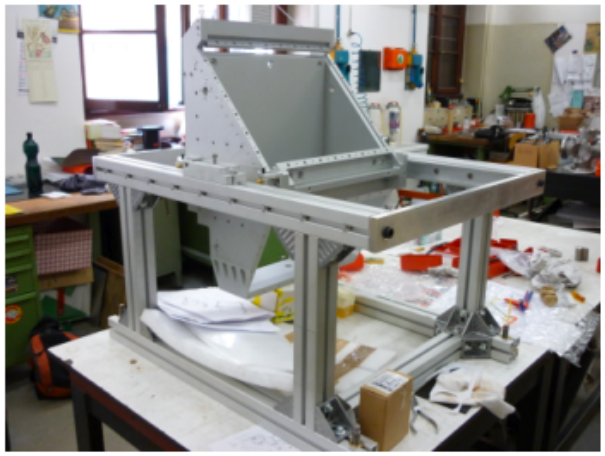
Fbox = photon camera

Massimo Benettoni, Nicola Mazziotta, and technicians from Padova & Bari

- **A very good work.**
- **Shown FBLOCK is a dummy made of plastic.**

Fbox support in CRT

Massimo Benettoni, Nicola Mazziotta, and technicians from Padova & Bari

- **CRT = Cosmic Ray Telescope**
- **Items delivered to SLAC.**

Progress on other issues

- **Fbox (with its dummy FBLOCK) and its CRT support was mechanically tested successfully in the CRT structure.**
- **Getting ready for receiving a real FBLOCK and Wedge.**
- **Detector holder is being designed and and will be built shortly.**
- **Electronics shield enclosure and its cooling being finished.**
- **Tested various diffuser schemes for the laser calibration.**
- **A large area "Bar box-to-Wedge" optical coupling with the Epotek glue was tested successfully with a new gluing fixture.**
- **Tests are under way to understand the H-8500 pad charge sharing.**
- **The 1-st BLAB3 electronics package for the scanning setup will be available in October. The rest of packages for FDIRC will be installed in January. At that point we expect start running.**
- **TDC chip design for FEE well underway: layout completed, submission in November after extensive post-layout simulations.**
- **Added a small hodoscope with 2mm x 2mm square fibers to the CRT tracking system to improve a precision for some class of tracks. This will be useful for either TOF counter studies, and for the chromatic corrections studies, to define a precise spot.**

EMC

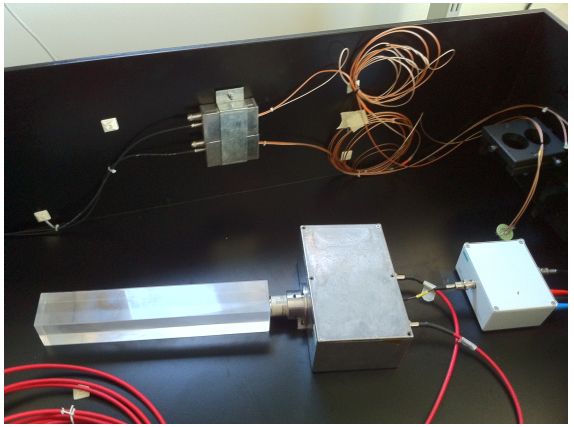
Claudia Cecchi and Frank Porter

LYSO + possible alternatives

Perugia INFN Istituto Nazionale di Fisica Nucleare

- **LYSO -> finalizing results from Beam Test at BTF, roughening of crystals is ongoing, readout with 2 APD's per crystals is ready….but….**

….beam lines not available until beginning of 2012 (we are in contact with people for BTF, Mainz, SLAC) more news soon



1) CsI pure, readout VPT and Photopentode
Measurements in LAB have started

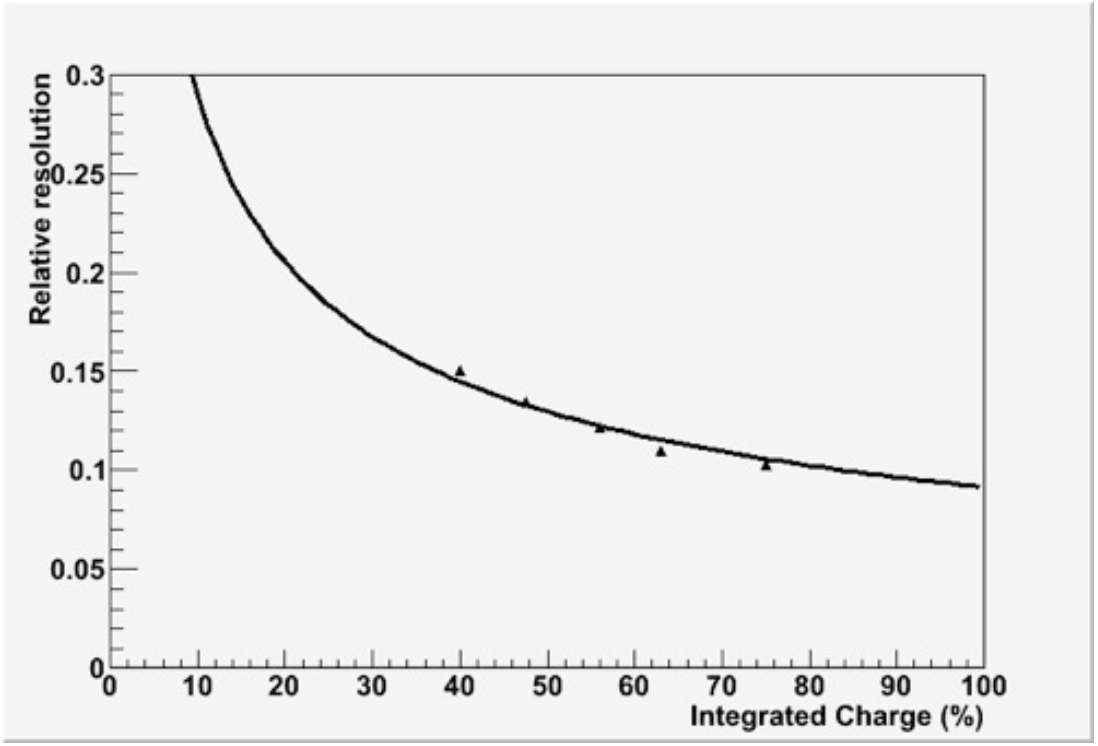
2) PWO-II (second generation of crystals L.O. increased by 85%) + LAAPD
In contact with producers to order one crystal

3) BGO readout PMT
already some studies have been carried out → PMT readout + APD (to be done)

4) BGO and PWO measurments of LY with radiation damage at Caltech

- **FULL MATRIX TEST with ONE of the alternatives (1-2-3) in 2012 after measurements in LAB and simulation studies**

BGO Resolution Measurements



Resolution at 50MeV with an integration time reduced to 100ns (56% of the total charge) 12.5% resolution is obtained.
Statistical term lower than 1.5% is expected at 50MeV

What is ongoing….

- We are finalizing test beam results.

- More effect included in MC (shape of electric signals, pile-up, timing resolution and non linearity response at low energy)

- Work in the barrel has started

  We have started to study the effect of the electronic noise in the barrel to understand the contribution at the resolution → should we change the preamp? Shaping time…to be studied…

  A group of people from RM-NA-PG will go to SLAC to study a to do list and timeline for the barrel transportation (mechanics, electronics)

ALTERNATIVES TO LYSO → BACKGROUND + PHYSIC STUDIES

Perugia

Istituto Nazionale di Fisica Nucleare

Quantify impact of different EMC resolution on physics reach for B→K*νν (other channels can be studied) and study figures of merit (S/sqrt(S+B), gamma and pi0 reconstruction efficiency , π^0 mass resolution….

Study: $\sigma(E)/E = a/\sqrt{E} + b/E + c$

BARREL

Performance of the electronic chain (readout+board) on *a* and *b*

From FullSim → produce single beam particles for different energies

FWD

Resolution parameter are different for different technologies

LYSO from TB data
CsI and BGO from FullSim and literature

Extract parameters to describe the smearing → FastSim
Validation on single particle and then produce signal and Bbar
Evaluate figure of merit

IFR

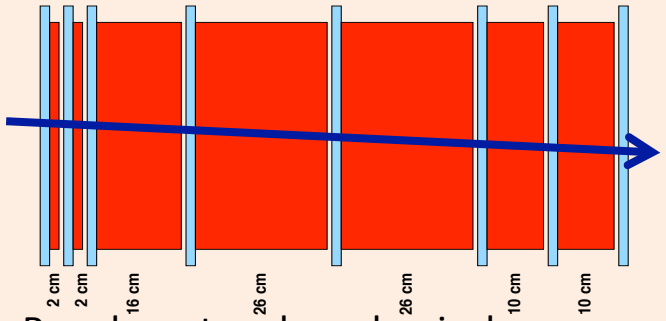
Roberto Calabrese

Path toward the TDR

IFR

- Few core technical decisions need to be made for the TDR
  - Amount of iron (and its segmentation)
  - Number of active layers (8 vs 9)
  - Position of the SiPM in the barrel

Driven by cost and performance.

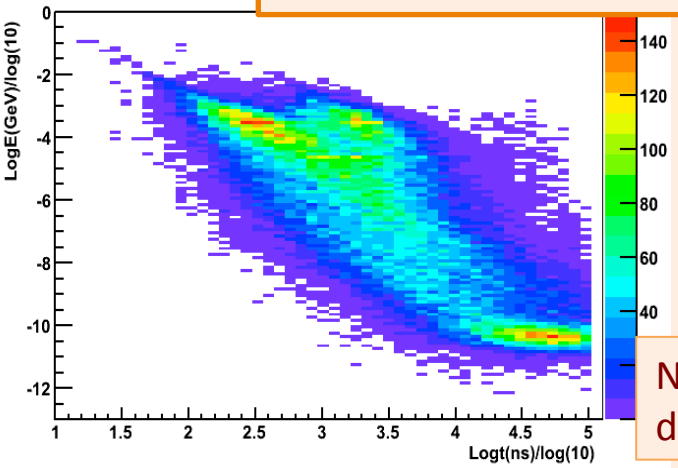


Rough cost and mechanical evaluation of different possibilities ready.
Beam test data analysis ongoing.

Mainly driven by machine background.

Simulation studies are in progress to find the best place and for shielding development.

New SiPM irradiation tests with and without shielding to be done.



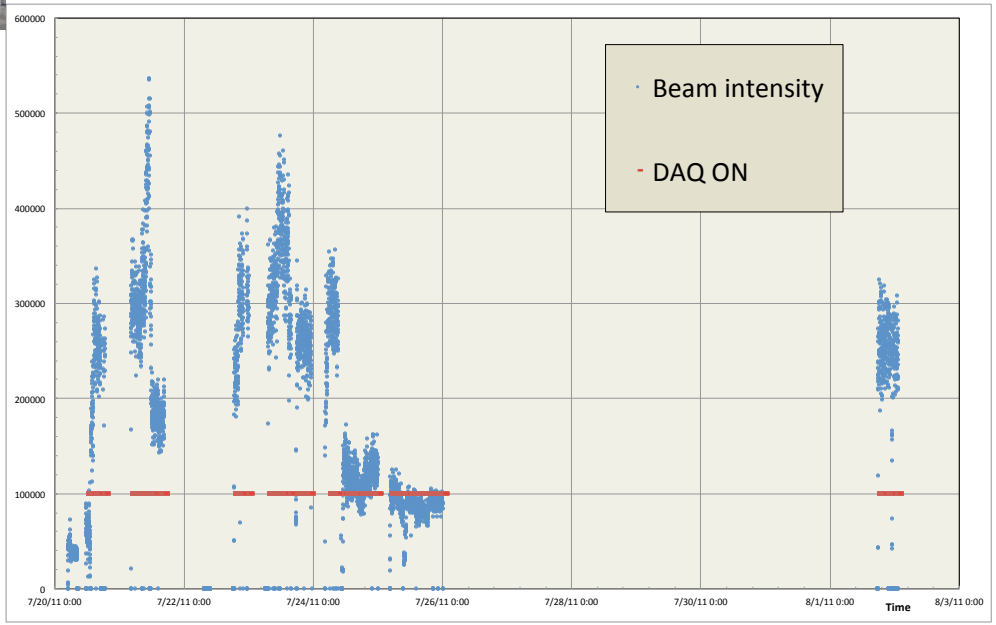
Neutron energy degradation

New test beam @ FNAL

IFR

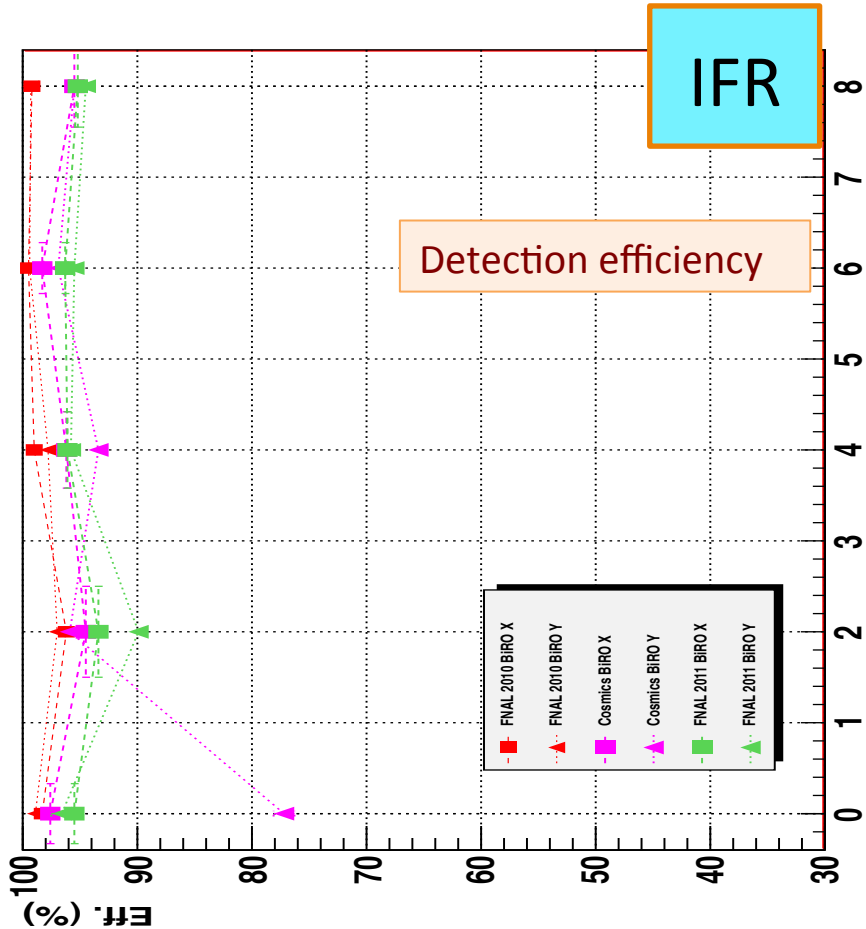
- A second beam test has been done in July with an improved setup.
  - More compact apparatus
  - Time of Flight information added
  - Temperature controlled environment

- Unfortunately during the two weeks of data taking a storm took the accelerator down for most of the time.
- New beam test are scheduled for October 2011 and February 2012.

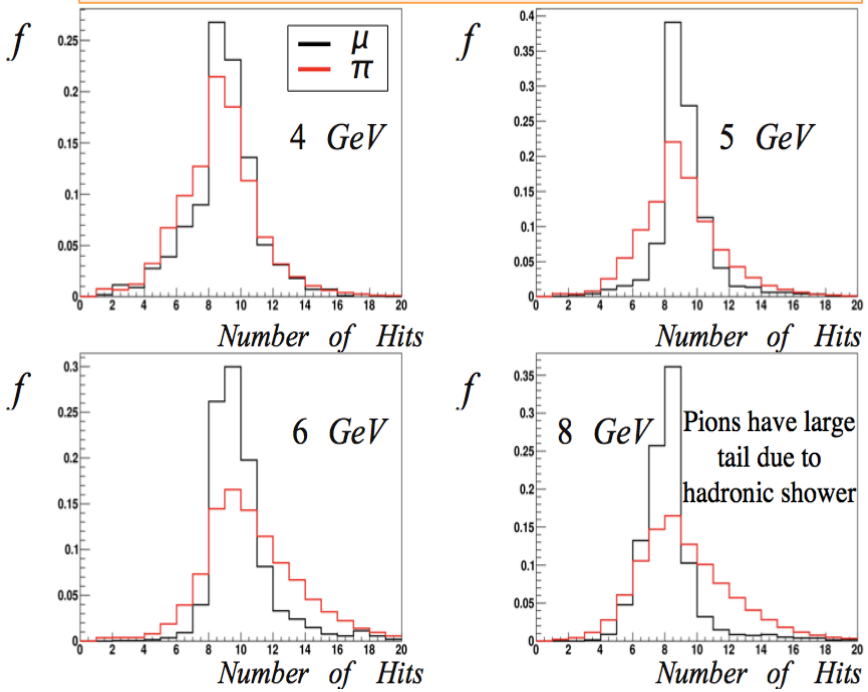


Test beam results

- Data analysis is moving forward:
- Prototype performances of the July test confirms the results found during the December beam test and cosmic runs.



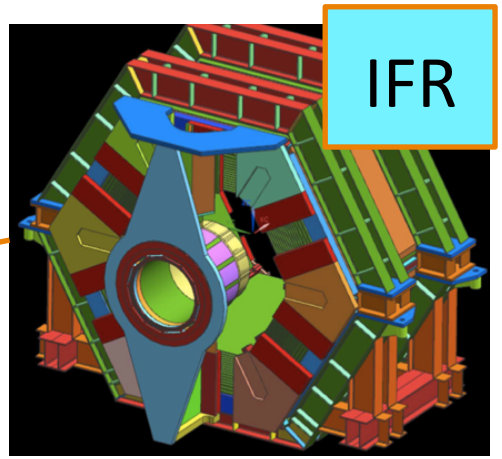
Total number of hits in the event



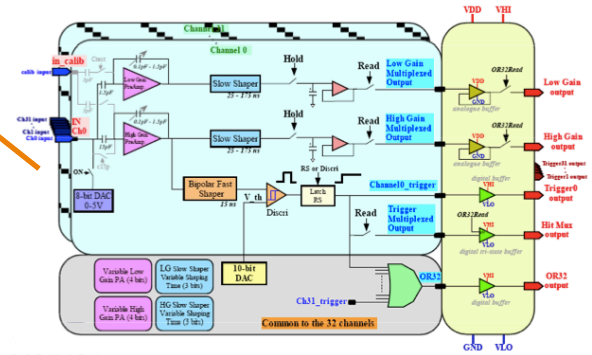
- A set of variables to discriminate muons and pions has been studied.
- The test beam simulation (based on Bruno Full Sim package) has been improved.

Other activities

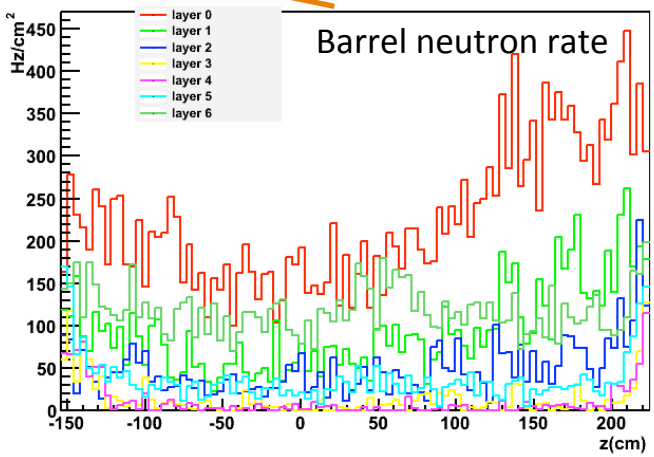
- Mechanics: Finite Element Analysis of the iron structure ongoing.



- Electronics: continue exploiting the SiPM readout ASICS from Orsay OMEGA group.



- Background Simulation: evaluation of SiPM and Front End electronics radiation doses and impact of the background on the reconstruction.



- TDR preparation: IFR outline structure done.

ETD/Online

Dominique Breton, Umberto Marconi, Steffen Luitz

ETD

- We will have 3 sessions during this workshop:
  - one concerning common items => Wednesday 8:30
  - one concerning front-end electronics => Wednesday 11:00
  - one dedicated to hardware trigger => Thursday 8:30

- During all sessions, we will discuss the outline of the ETD chapters of the TDR.

- Clock and control links:
  - Raffaele will present results about radiation tolerance of Xilinx FPGAs
  - New strategy option for upgradable readout links will be introduced
  - Could QPLL ASIC be used for clock reliability ?

- ROM:
  - Study about how distribute the load to many CPU cores is ongoing.
  - Preliminary tests performed. Needs to be extended to more advanced hardware.
  - FPGA based solution with 10 GbE implementation under study.
  - Possibility to deal with higher trigger frequencies at a reasonable cost with a solution entirely relying on FPGA under study.

- Common Front-End Electronics: new simulations of the actual hardware implementation (VERILOG model) of the front-end derandomizer of will be presented

- Trigger:
  - New results on CSI crystal signals will be shown (Paolo)

Agenda

SuperB Meeting

Queen Mary University, London

Sep 13 - 16, 2011

Agenda

All Plenary Sessions will be held

Meeting Registration Desk :

Welcome Reception:

	Monday, September 12, 2011		Tuesday, September 13, 2011		Wednesday, September 14, 2011		Thursday, September 15, 2011		Friday, September 16, 2011
8:00		8:00	Registration						
9:00		8:30	PLENARY	8:30	PARALLEL 4	8:30	PARALLEL 8	8:30	G. O. Jones (Physics) 410
			Introduction and Status						Project Board
		5	Welcome	FB 320	DET: ETD	FB 320	DET: ETD		
		20	Project status (M. Giorgi)	FB 321	COMP: FULLSIM	FB 321	COMP: R&D		
		30	Physics (A. Bevan)	FB 240	PHYS	FB 240	PHYS	9:00	Detector Techincal Board
		25	Detector (F. Forti)			tbc	DET: INTEGRATION		
		20	Computing (L. Tomassetti)						
10:30		10:30	*Coffee Break*	10:30	*Coffee Break*	10:30	*Coffee Break*	10:30	*Coffee Break*
11:00		11:00	PARALLEL 1	11:00	PARALLEL 5	11:00	PLENARY	11:00	G. O. Jones (Physics) 410
				FB 320	DET: ETD	30	ACCELERATOR STATUS		
		FB 240	SVT	FB 240	COMP+PHYS: FASTSIM TUTORIAL		(M. Biagini)		Detector Technical Board
		FB 320	DCH						
		FB 321	PID						
		FB 322	EMC			11:30	PLENARY		
		FB 323	IFR						
							TOPICAL SEMINAR		
							(J. ELLIS)		
		12:30	*Lunch*	12:30	*Lunch*	12:30	*Lunch*	12:30	*Lunch*
14:30	G. O. Jones (Physics) 410	14:00	PARALLEL 2	14:00	PARALLEL 6	14:00	PLENARY	14:00	
							Summaries and outlook		
	Detector Technical Board			FB 320	DET: BACKGROUNDS				
		FB 240	SVT	FB 321	COMP: DIST COMP	15	Physics Summary		
		FB 320	DCH	FB 240	PHYS	15	SVT		
		FB 321	PID			15	DCH		
		FB 322	EMC			15	PID		
		FB 323	IFR			15	EMC		
						15	IFR		
15:30	*Coffee Break*	15:30	*Coffee Break*	15:30	*Coffee Break*	15:30	*Coffee Break*	15:30	
16:00	G. O. Jones (Physics) 410	16:00	PARALLEL 3	16:00	PARALLEL 7	16:00	PLENARY	16:00	
							Summaries and outlook		
	Detector Technical Board			FB 320	DET: MDI				
		FB 240	SVT	FB 321	COMP: PLANNING	15	MDI		
		FB 320	DCH	FB 240	PHYS	15	ETD		
		FB 321	PID			15	COMP		
		FB 322	EMC			15	INTEGRATION		
		FB 323	IFR			15	LNF&SuperB (U. Dosselli)		
						15	Project outlook		
17:00	Project Board								
18:00		17:30		17:30		17:30	*END OF GENERAL MEETING*	17:30	
		18:00	*Wine and cheese reception*	17:30	*COLLABORATION COUNCIL*				

Room Codes		*Call ID #*	Phone Conference Number:	*Room Codes*		*Call ID #*	*Phone Conference Number:*
FB 240	*Francis Bancroft Room 240*			*FB 323*	*Francis Bancroft Room 323*		
FB 320	*Francis Bancroft Room 320*			*P 410*	*G. O. Jones (Physics) 410*		
FB 321	*Francis Bancroft Room 321*			*P 410B*	*Working room: G. O. Jones 401B*		
FB 322	*Francis Bancroft Room 322*						

Meeting focus

- Review ongoing R&D and detector design
- Examine mechanical integration effort
  - Experimental hall
  - Transport and refurbishing work
- Focus on issues to be resolved for TDR
  - Remaining geometry issues
  - Many issues in the subsystems
- Start working on budget update and construction schedule
- Advance understanding of backgrounds
  - Dominate detector design in many areas
- Recruit new collaborators
- Progress in the collaboration from proto to full.