

PID Summary

Perugia SuperB Meeting, June 19th 2009

Nicolas Arnaud, for the SuperB PID group



- Sessions
- Updates on Barrel PID
- Updates on Forward PID
- Current issues, next steps

Sessions

- Three Parallel PID sessions

16:00->17:30 Parallel - PID I (Convener: Jerry Vavra (SLAC) ,
NICOLAS ARNAUD (LAL ORSAY CNRS-IN2P3))

Description:

Location: Room SAX 2

16:00 Studies of SiPMTs for a forward TOF PID detector (20') Flavio Dal Corso (PD)
(Slides)

16:20 DIRC engineering studies (20') Massimo Benettoni (PD)
(Slides)

16:40 Status of PID in FastSim (10') NICOLAS ARNAUD (LAL ORSAY CNRS-IN2P3)
(Slides)

16:50 Orsay electronics R&D (20') Dominique Breton (LAL ORSAY) ,
(Slides) Christophe Beigbeder (LAL)

17:10 LAL-Orsay status report (10') NICOLAS ARNAUD (LAL ORSAY CNRS-IN2P3)
(Slides)

09:00->10:30 Parallel - PID II (Convener: Jerry Vavra (SLAC) ,
NICOLAS ARNAUD (LAL ORSAY CNRS-IN2P3))

Description:

Location: Room SAX 1

09:00 Status report of the Novosibirsk activities (20') Evgeniy Kravchenko (Budker
(Slides) INP)

09:20 New SOB design for a SuperB fDIRC (20') Jerry Vavra (SLAC)
(Slides)

09:40 Status of the FDIRC prototype tests with a new electronics (20') Jerry Vavra (SLAC)
(Slides)

11:00->12:30 Parallel - PID III (Convener: Jerry Vavra (SLAC) ,
NICOLAS ARNAUD (LAL ORSAY CNRS-IN2P3))

Description:

Location: Room SAX 1

11:00 Target chip evaluation for forward TOF detector (20') Jerry Vavra (SLAC)
(Slides)

11:20 Status report on Cincinnati activities (20') Brian Meadows (University of
(Slides) Cincinnati)

11:40 Looking at DIRC bar boxes using BaBar dimuon events (20') NICOLAS ARNAUD (LAL ORSAY
(Slides) CNRS-IN2P3)

12:00 Aging tests of MCP PMTs and MAPMTs (20') Peter Krizan (Ljubljana Univ. and J. Stefan
(Slides) Institute)

Sessions

- PID-related DGWG presentations

09:00->10:30 Parallel - DGWG I (Convener: Achille Stocchi (LAL - Univeriste Paris Sud and IN2p3/CNRS) , Matteo Rama (LNF))	
Description:	
Location: Room TRUMPET 1	
EVO - Phone Bridge ID: 1071377	
09:00 Forward PID studies (K*gamma/rho gamma) (20')	leonid Burmistrov (LaL)
09:20 forward PID: K(*) nu nubar with semileptonic tag (20')	Alejandro Perez (LAL)
(Slides)	
Impact of forward PID on Vub measurement	Evgeniy Kravchenko (Budker INP) ,
09:40 and possible momentum resolution	Alejandro Perez (LAL)
improvement (20') (Slides)	

First reports
on forward PID
performance

- Parallel session on mechanical integration

16:30->18:10 Parallel - Mech. Integration (Convener: William Wisniewski (SLAC))	
Description:	
Location: Room TRUMPET 4	
16:30 IR magnets and services (20')	Mike Sullivan
16:50 Forward DCH geometry update and services (20')	Giuseppe Finochiaro
17:10 Forward EMC geometry update and services (20')	David Hitlin
17:30 Forward PID: geometry, attachment schemes, services (20')	Jerry Vavra
(Slides)	
17:50 Thoughts on SVT services in the age of Layer 0 (20')	Giuliana Rizzo

First
TOF
designs

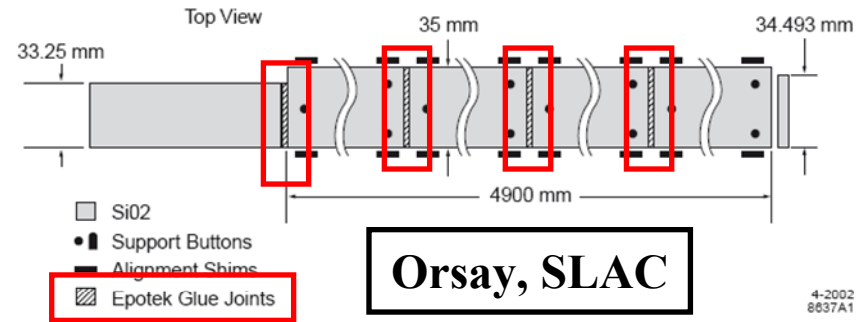
PID status in a nutshell

- Despite evident **lack of manpower and money**, things are moving **forward**
- **Barrel** PID
 - **DIRC bars**: QA & mechanical studies in progress
 - **SOB design** in progress; two options: focusing or non-focusing (DIRC-like) barrel
 - Progress on **electronics**: discussion on specs, R&D ongoing efforts
 - Improvements foreseen in **FastSim** to match design progresses
- **Forward** PID
 - First **designs** for **TOF** and **aerogel RICH** solutions
 - First **physics studies** quantifying improvements brought by forward PID (→ DGWG)
 - Todo: **mechanical integration** on the crowded forward side (**drawings needed!**)
 - Discussion on **electronics** specs. for TOF designs; still tbd for aerogel
 - Detectors to be made more realistic in **FastSim**
- Some **photodiode studies** ongoing:

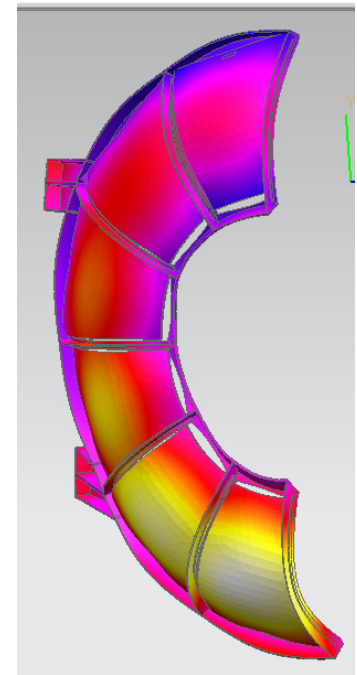
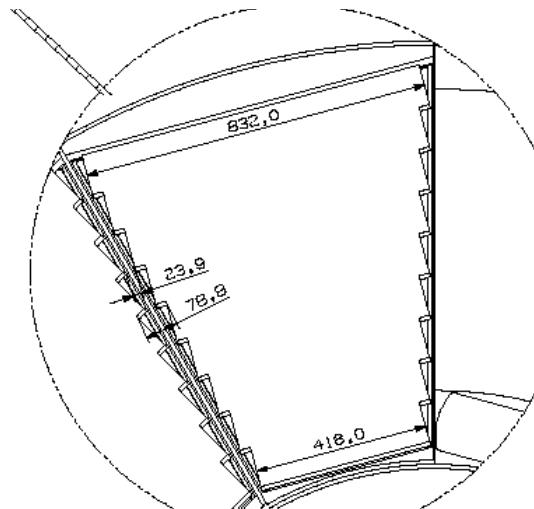
→ More to come	$\left[\begin{array}{l} \text{SiPMT performances} \\ \text{MaPMTs and MCP-PMTs ageing} \end{array} \right.$
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- Continuous development of **PID selectors** in **FastSim**
→ **Truth-based** selectors for now; realistic (**dE/dx**, **E/p**, **IFR**) ones foreseen soon⁴

From the BaBar DIRC to the SuperB Barrel

- One 4.9m-long bar = four 1.225m-long bars glued with **epotek joints**
 - ‘**Yellowing**’ effect on joints left on air
→ How are the BaBar joints?
 - Ongoing study with **dimuon events**
→ **no hint of degradation so far**
 - More **tests with laser planned** when bar boxes available



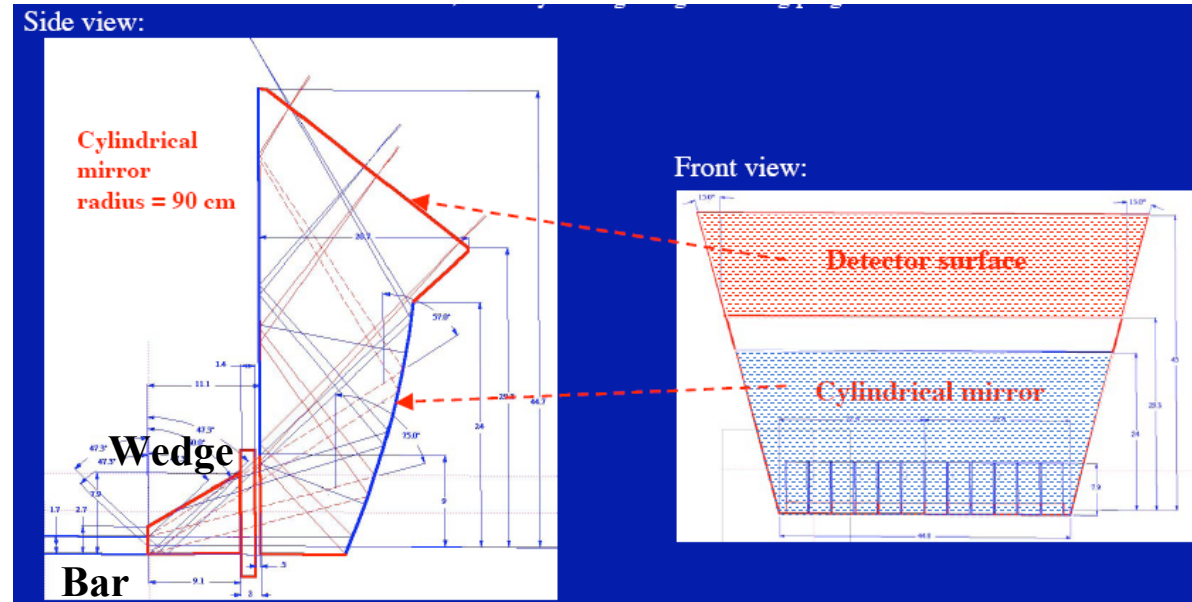
- **M. Benettoni** (Padova) is working on the **mechanical design of the new SOB** for a non-focusing DIRC
→ switch to fDIRC if option favoured
 - 2 doors
 - volume = 3600l (50% of BaBar)
 - **PMTs behind quartz windows**
[outside fluid volume]
 - 12 sectors
 - 2,600 PMTs in total (× 32 channels)
[~10% dead area]



From the BaBar DIRC to the SuperB Barrel

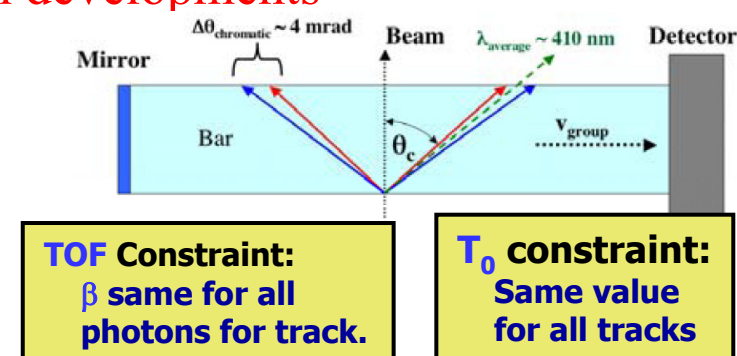
- Jerry Va'Vra (SLAC) presented first optics studies for a **fDIRC SOB**

- Volume **10× smaller**
- 12 sub-SOBs (1/bar box) **made of fused silica**
- Highly pixilated MaPMTs [~ 40 kChannels]
- **Design still in progress**
→ improved performances
- **LDRD proposal @ SLAC**
to build prototype
→ Decision by Fall



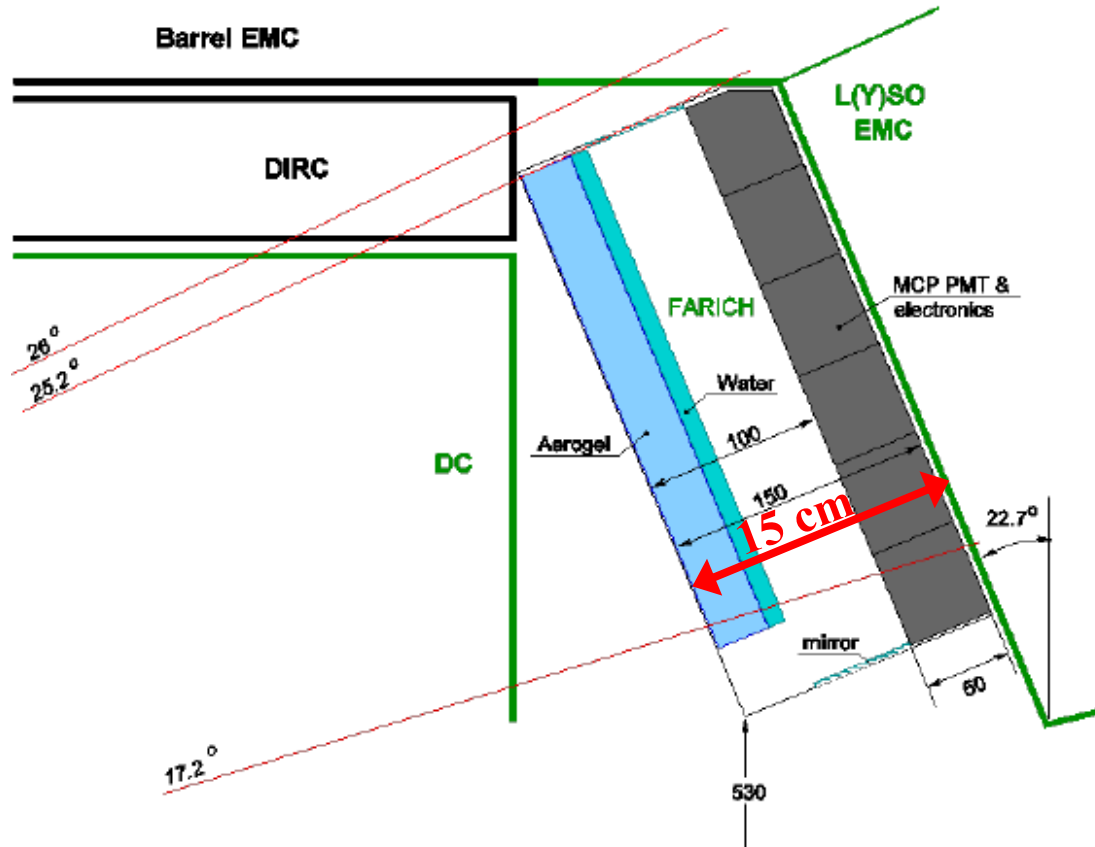
- Brian Meadows (Cinci.) reported plans for **FastSim developments**

- **fDIRC simulation**
- Use TOF_γ to measure $1/\beta_{\text{track}}$
- Goal is to **improve $\Delta\theta_\gamma$** by at least a factor 3
- Should **improve π/μ separation** @ low p



First forward PID designs

- **Aerogel Rich** (Evgenyi Kravchenko, Nsk.)

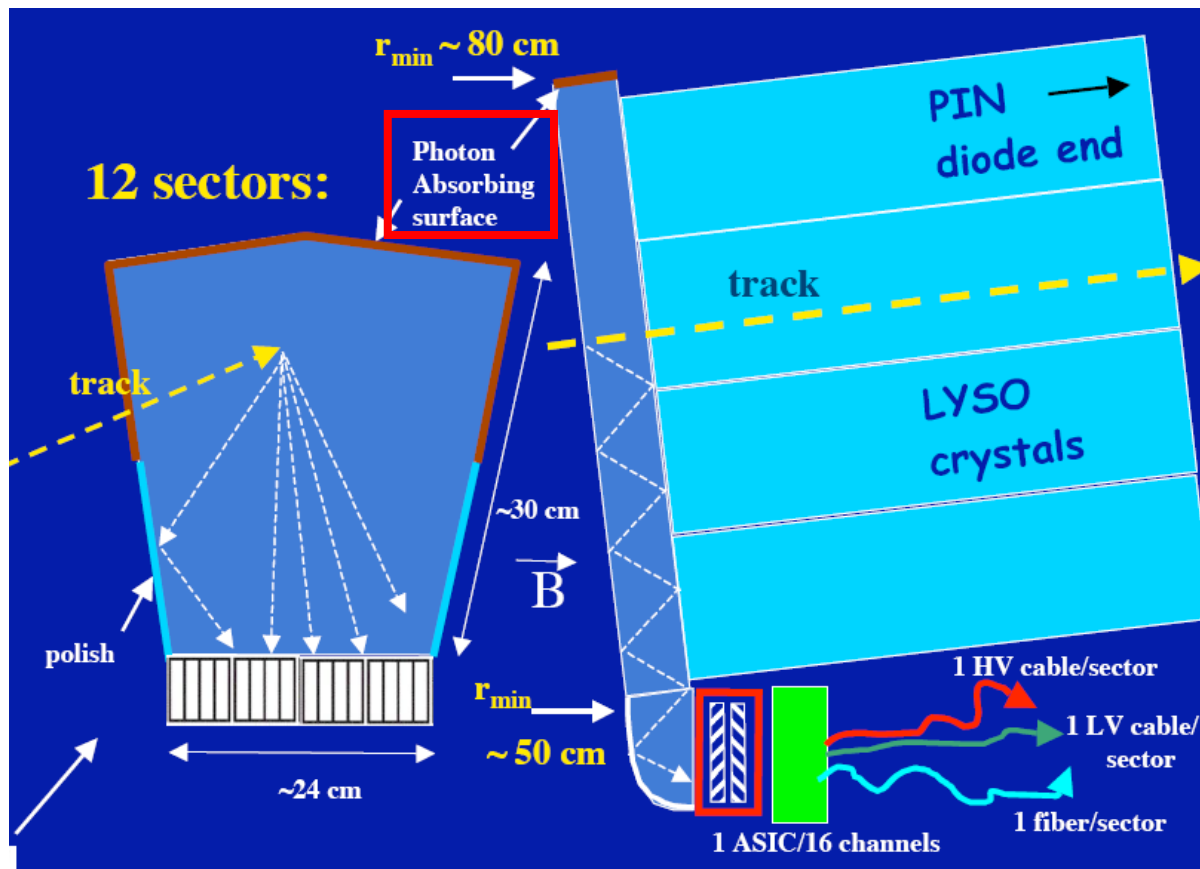


- 3-layer focusing aerogel
- 32×32 matrix Burle MCP-PMTs
- 550 PMTs
- **28% X_0** aerogel = 3.5%
water = 2.5%
PMT = 14%
support, cables = 8%
- Tests with **standalone simulation**
→ short-term plan is to **switch to FastSim**

- **Test beam** preparation at VEPP-4M
→ Should start by the end of the year

First forward PID designs

- TOF (Jerry)
 - Very **limited space** on the forward side
 - **Lack of accurate BaBar drawings** (so far?)
 - Two possible drawings: ❶ « **DIRC-like** »



Sector:

12 mm thick quartz bar
 Ave. photon path: ~15 cm
 2 MCP tubes /sector
 1 ASIC chips / sector
 16 pixels / sector
 1 fiber/ sector
 1 HV cable / sector

Total:

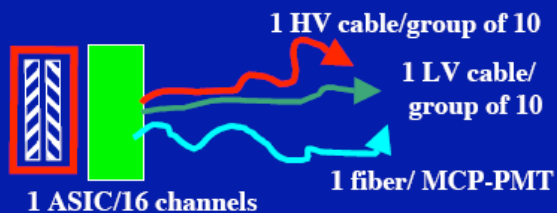
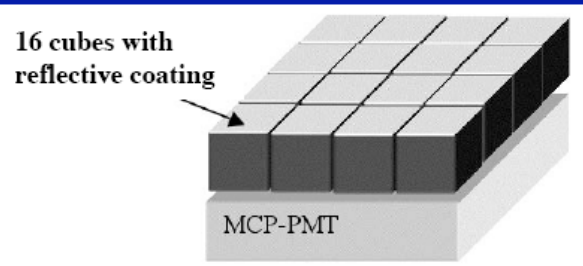
12 sectors - total
 48 MCP-PMTs - total !!!
 Req. pos. accuracy: ~0.5 mm
 Hang it off EMC support ?
 $r_{\min} \sim 50 \text{ cm}$ ($\theta \sim 15\text{-}16^\circ$)
 $r_{\max} \sim 80 \text{ cm}$ ($\theta \sim 25^\circ$)
 $\Delta r \sim 30 \text{ cm}$

- **Very few channels**
 - **Issue: PMT rate** [O(MHz)]
 - MCP-PMT with protection foils
 - cost is 50% γ less
- ⇒ Need accurate numbers!
- $\sigma_{\text{TOF}} \sim 20 \text{ ps}$

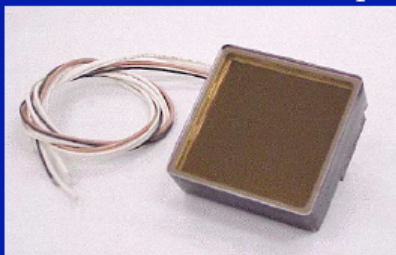
First forward PID designs

- TOF (Jerry)
 - Very **limited space** on the forward side
 - **Lack of accurate BaBar drawings** (so far?)
 - Two possible drawings: ② « **Highly Pixilated counter** »

Quartz cubes radiators:



Photonis MCP-PMT with 64 pixels



Numbers:

10mm thick qtz radiator
 ~ 7200 quartz cubes - total
 ~ 7200 pixels - total
 ~ 450 MCP-PMTs - total
 1 ASIC chips/MCP-PMT
 ~ 450 ASIC chips - total
 16 pixels/MCP-PMT
 1 fiber cable/ASIC
 ~ 450 fiber cables - total
 1 HV cable/5 MCPs
 ~90 HV cables - total
 $r_{\min} \sim 50 \text{ cm}$ ($\theta \sim 15-16^\circ$)
 $r_{\max} \sim 80 \text{ cm}$ ($\theta \sim 25^\circ$)
 $\Delta r \sim 30 \text{ cm}$
 Total area: $\sim 12,300 \text{ cm}^2$
 Req.pos. accuracy: $\sim 0.5 \text{ mm}$
 Hang it off EMC support ?
 ~\$3k/MCP-PMT ?
 ~1.35 M\$ - total detectors

Pros:

- low gain (2×10^4)
→ less ageing
- good beam results
- use all photons
- simpler analysis

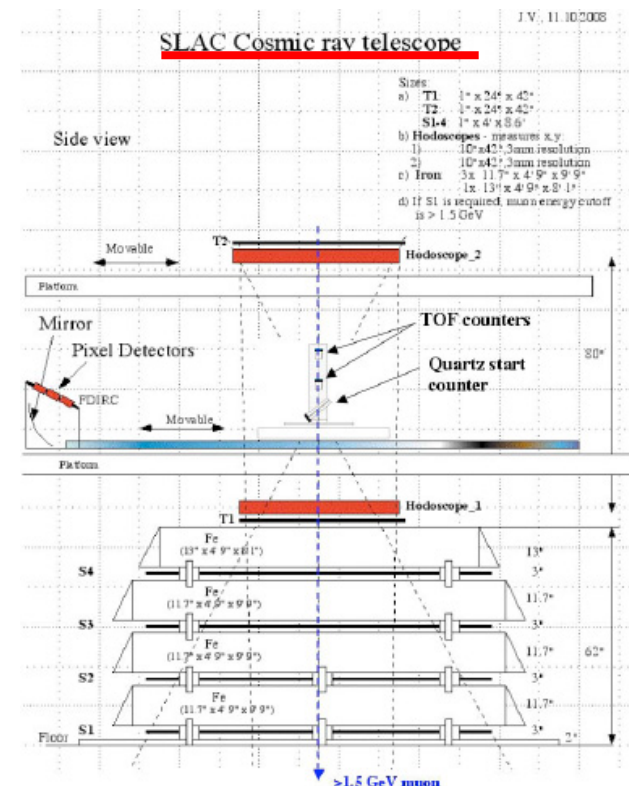
Cons:

- Many channels
→ many cables [space?]

⇒ May be the only viable design
TBC

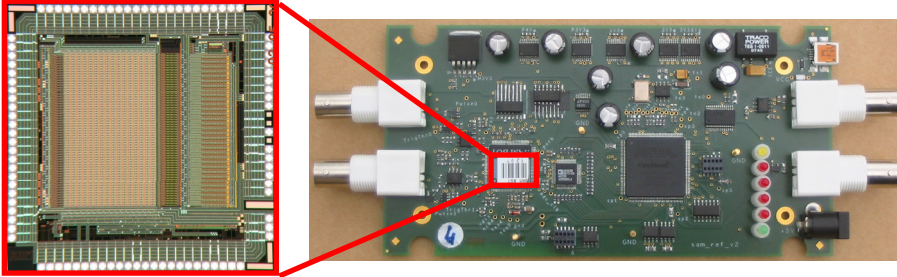
Electronics R&D for barrel PID

- Presentations in parallel sessions summarizing ongoing work at SLAC, Hawaii, Orsay
- Nice summary presented yesterday at ETD 2nd parallel session
→ Look at these slides for a comprehensive and detailed review
- Jerry reported on Hawaii electronics test in SLAC Cosmic Rays Telescope (CRT)
 - BLAB2 chip for fDIRC barrel detector
 - Timing resolution issues under studies
 - Most systems working reasonably well
 - Related MC developments in progress
 - Current tests will help designing BLAB3 and prepare CRT for tests with fused Silica SOB
- Talk from Christophe Beigbeder (Orsay) about the SuperNEMO SNATS chip which could be the basis of a ~ 100 ps TDC design for the barrel PID



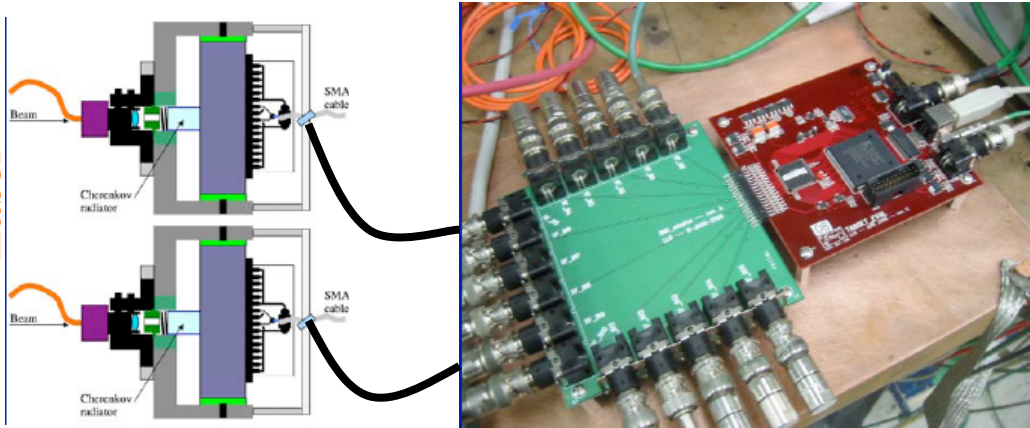
Electronics R&D for forward PID

- **Dominique Breton** (LAL Orsay) talked about a prototype board based on the **SAM** (Swift Analog Memory) **chip** for precise timing measurements



- **Timing precision ~ few ps RMS**
- Board being designed for tests in CRT
- Current chip still being tested, new ones to be designed

- **Jerry** presented tests of the Hawaii **TARGET** **chip** for timing measurement



MCP-PMT
@ low gain

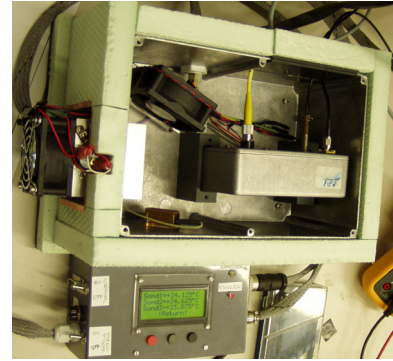
- 2.5 GS/s
- spline interpolation \rightarrow 10 ps/bin
- **Current timing precision is ~24 ps** for about 40-50 pe per laser pulse
 \Rightarrow **Proof of principle for TOF**

Summary at ETD parallel session (Christophe)

- **Electronics R&D** should go on **in parallel** for **barrel** and **forward** PID detectors
→ **Different requirements** (# of channels, timing performances, etc.)
- **Barrel** PID
 - ~ 50 kChannels, ~ 100 ps timing resolution
 - **Amplitude measurement** in addition to time
→ Analog chip to be developed
 - TDC-based Orsay solution + BLAB2 Hawaii test
 - **Current technologies seem to meet the design requirements**
- **Forward** PID: more **challenging**
 - 10-100 times less channels, ~ **10 ps timing accuracy**
 - Main other issues: **occupancy** \Leftrightarrow **radiation level**
 - Board based on analog memories (amplitude + time)
→ TARGET (Hawaii) and SAM (Orsay) ongoing tests
- **CRT: main test bench**
→ Boards to be prepared in Orsay; few months timescale
- **Proposal for PID electronics integration in ETD architecture to be presented soon**

Photodetector R&D

- **Flavio Dal Corso** (Padova) presented a report on the **characterization of SiPMTs**:
 - I/V curves, gain & efficiency, dark rate, time resolution, long-term/ T° stability, etc.
 - Search for the best working point
 - Comparison of performances
 - Work in progress
 - **Radiation tests** to start soon
- **Peter Križan** (Ljubljana) reported on **aging tests** for **MaPMTs** and **MCP-PMTs**,
 - **MaPMTs**: compare performances of tubes from low and high irradiated regions
 - **low irradiated tubes do not show degraded performances** w.r.t. installation
 - high irradiated tubes to be tested soon
 - Ageing mechanism for **MCP-PMTs**: residual molecules ionized by secondary electrons
 - Photocathode degradation + lower amplification
 - Cure: to improve the vacuum
 - Irradiation by LED (rate ~ 1 MHz) started
 - **expect to see ageing effects within a month**



Thermostatic chamber

**FBK and
Hamamatsu**

**Hamamatsu
from HERA-B**

Photonis/Burle

FastSim

- Two classes of **truth-based selectors** (Orsay)
 - (mis)-ID decisions based on true particle type + hardcoded (mis)-ID probabilities
 - **PacPidTruthBasedSelector**: flat efficiencies
 - **PacPidTableBasedSelector**: momentum + polar dependences
BaBar-based tables (**r24c Run 6**)
- http://mailman.fe.infn.it/superbwiki/index.php/FastSimDoc/PID_simulation#PacPid
- Next step is to produce ‘real MC’ selectors as sub-system input variables are now available (& reliable) or will soon be.
 - **Scarse manpower**; all commitments would be much appreciated
- **fDIRC developments** for barrel (Cinci.)
- **TOF** (Orsay) and **aerogel** (Nsk.) **developments** in progress

Current issues, next steps

- Many progresses since the Orsay meeting
- Main issues: manpower (too few people accumulating too much tasks)
money (SuperB co-funding urgently needed for R&D activities)
- Short- and mid-term plans quite clear:
to make progresses on barrel (priority) and forward PID in parallel
 - Barrel PID: DIRC or fDIRC? The latter design is currently favoured.
 - Forward PID: TOF or aerogel? Mechanical integration? Performances?
→ Inputs to the DGWG for final decision by the collaboration
- Very hard to give reliable timetables
→ progresses aren't smooth – more like patching what's the most urgent...

