Forward PID in SuperB

November 27th 2009

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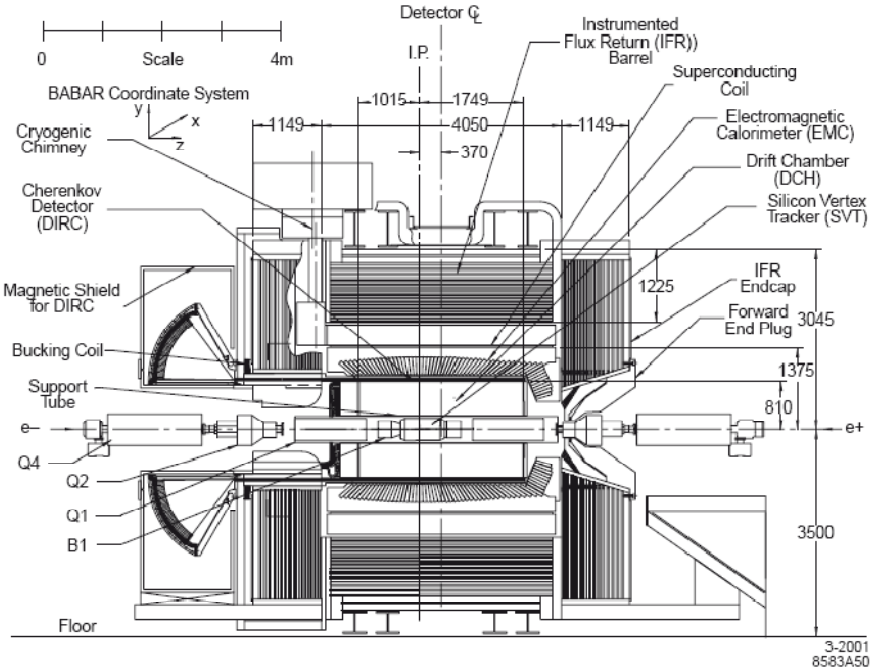
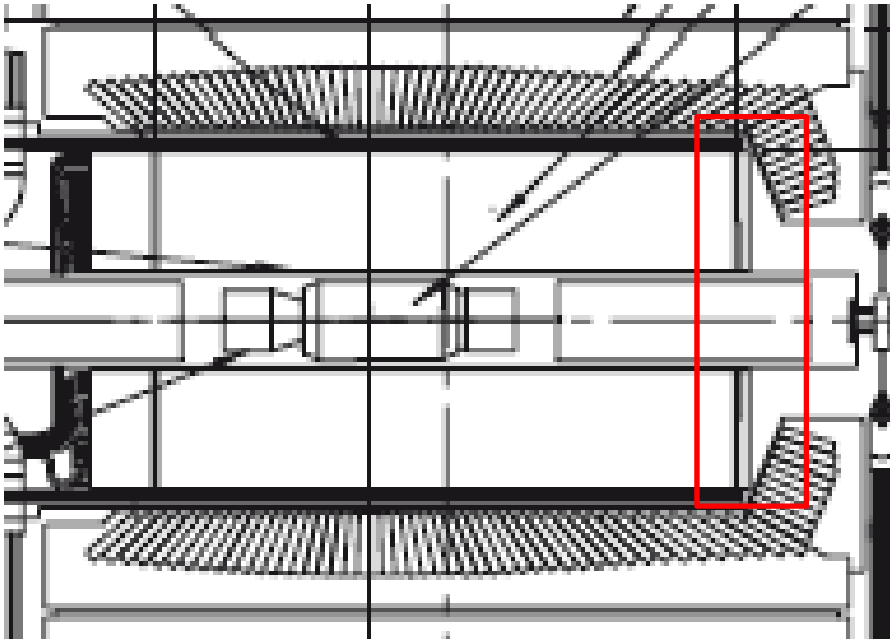
- BaBar vs. SuperB
- Constraints
- Designs of ‘Time of Flight’ detectors
- Goal of today’s meeting

BaBar

- No PID (charged particles identification, e.g. K/π separation) system on the forward side of the detector

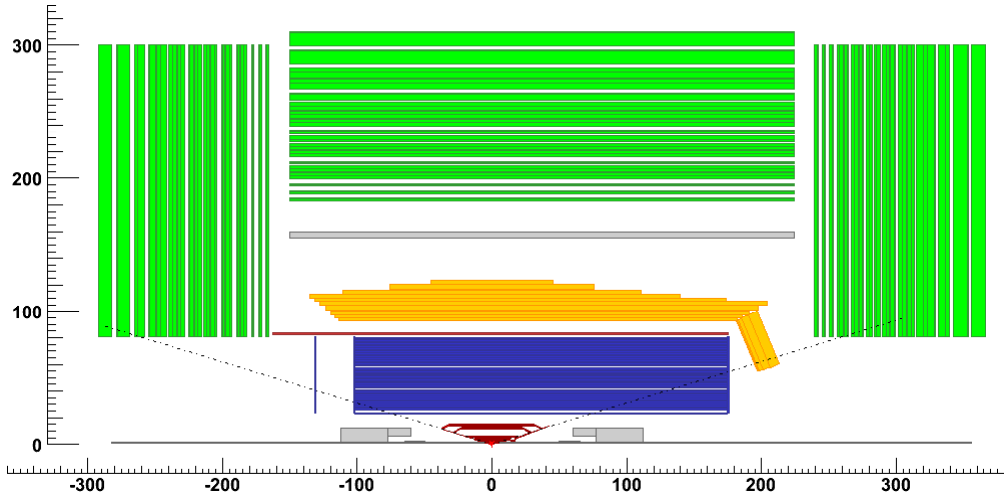




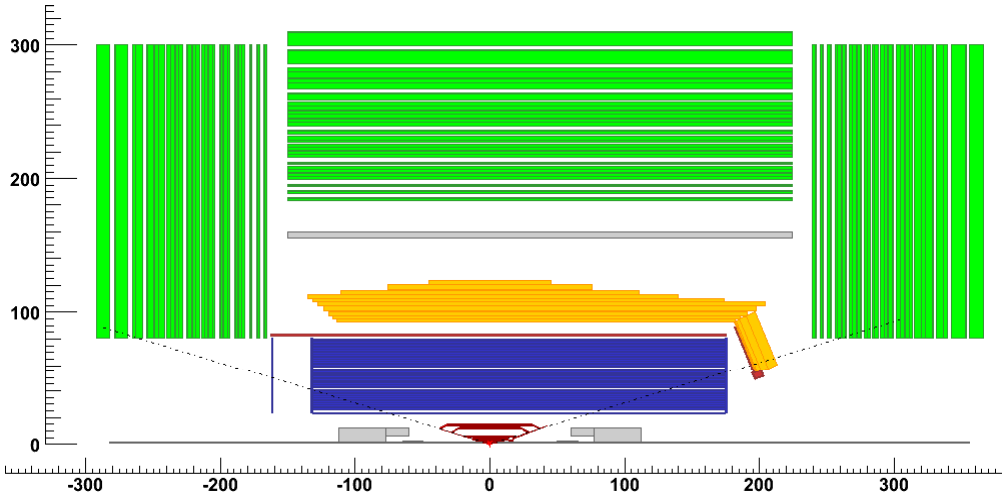
⇒ source of unefficiencies in PID: boost, Breco, etc.

SuperB

- BaBar-like configuration:



- BaBar-like configuration + forward PID detector:



Constraints

- Not much free space between DCH and forward EMC

- Material in front of the EMC $\Rightarrow$ degradation of the calorimeter performances

$\Rightarrow$ If we want a detector, it must be thin and as close as possible to the forward EMC

- Time Of Flight (TOF) technology
  - track momentum p = f(mass, speed) measured in tracking system

  - TOF: speed = distance (known) / time (measured)

  $\Rightarrow$ mass can be estimated
  $\Rightarrow$ particle can be identified ($m_\pi < m_K$)

Jerry Va'Vra designs

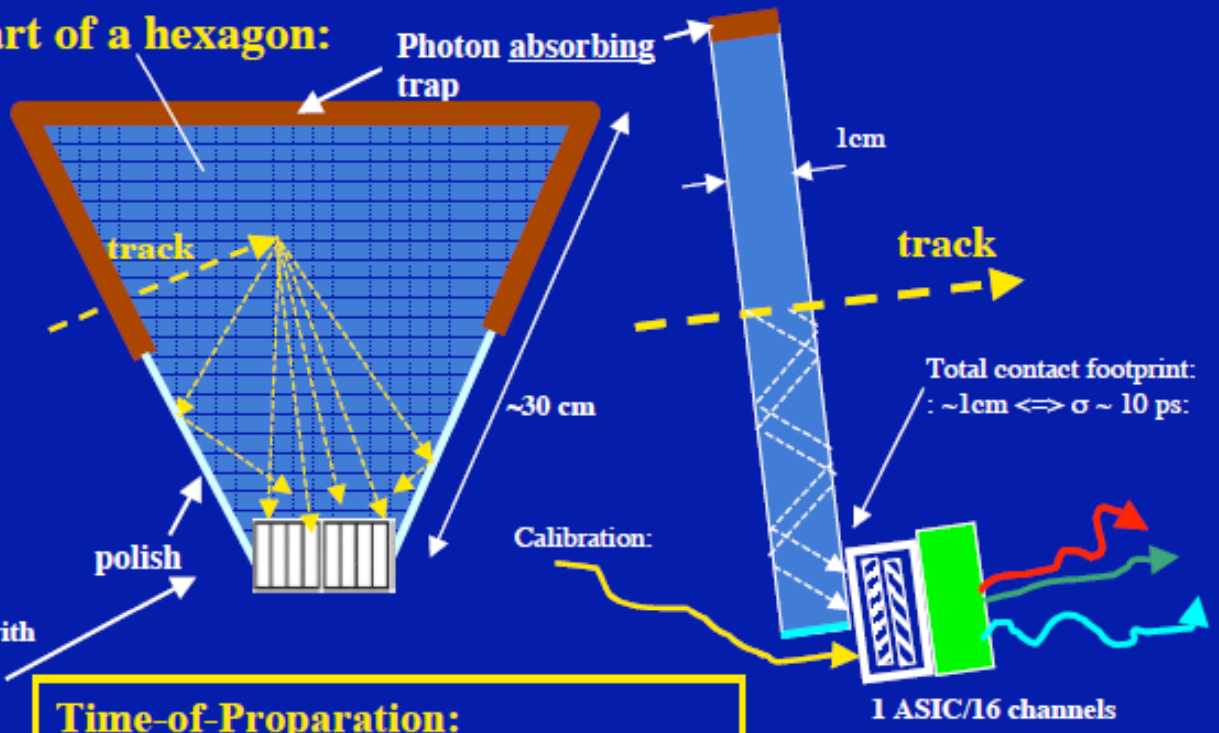
- 'DIRC-like' TOF detector
- 'Pixilated' TOF detector

- Other potential design: a RICH
  $\rightarrow$ Probably too thick, studies less advanced than ours

"DIRC-like" TOF detector

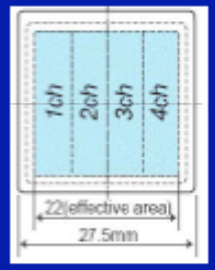
J.V., http://www.slac.stanford.edu/~jjv/activity/Vavra_Forward_TOF_geometry.pdf, Perugia, June 2009

- Not all photons are of "equal" quality. Some we want to throw away because they are affected by the chromatic broadening.
- We do not want photons to rattle around for too long
- This design requires a high gain operation to detect single photons



Hamamatsu MCP-PMT (SL-10) with strips and a protection foil:

ϕ 10 μm holes



Time-of-Proparation:

$TOP(\Phi, \theta_c, \lambda) = [L_{photon\ path})]/[v_g(\lambda)]$

A direct photon is accepted only if:

$TOP_i^{measured} - TOP_i^{expected} < Cut$

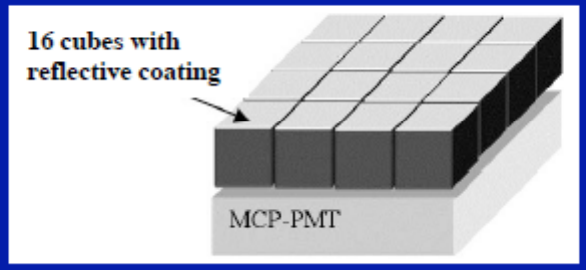
Even 3 photons will do as long as they are "good" photons

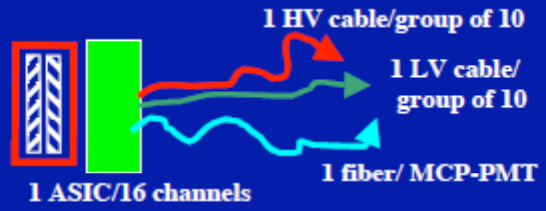
"Pixilated" TOF counter running at low gain

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} ~ 50 cm (θ ~ 15-16°)
r_{max} ~ 80 cm (θ ~ 25°)
Δr ~ 30 cm
Total area: ~12,300 cm^2
Req.pos. accuracy: ~0.5 mm
Hang it off EMC support ?
~$3k/MCP-PMT ?
~1.35 M$ - total detectors

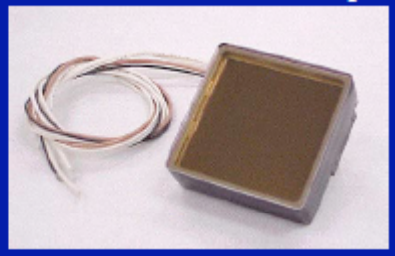
Quartz cubes radiators:





Total cable plant:
- 450 fibers
- 50 HV & LV cables

Photonis MCP-PMT with 64 pixels



Arguments for it:
- very low gain of ~2x10^4.
- smaller aging rate ?
- good results in beam
- use all photons
- less complicated analysis

Arguments against it:
- more channels.
- Not sure that we can get cables out

Outlook; goal of today's meeting

- Orsay currently focusing on the 'DIRC-like' TOF detector
  - Less material than the other solution
  - Simple and elegant detector
- SuperB situation not frozen
  - Completely new detector (no BaBar experience)
    $\Rightarrow$ several studies ongoing in parallel:
    fast and full simulations, electronics, PMTs, mechanics, etc.
  - No decision yet on whether or not to build a forward PID detector
- Can a forward 'DIRC-like' TOF detector be installed in front of the forward EMC calorimeter?
- Agenda
  - Before lunch: EMC & PID presentations
  - After lunch: Open discussion between engineers
  - Summary & prospects to close the meeting
- Indico webpage: http://indico.lal.in2p3.fr/conferenceDisplay.py?confId=926