FARICH prototype status


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FARICH for SuperB

- Expansion gap ~180 mm
- 312 Photonis XP85012 MCP PMTs
- 3-layer focusing aerogel $n_{\text{max}}=1.07$, 40mm thickness
- NaF 5mm thickness

Material budget ($X/X_0$)

<table>
<thead>
<tr>
<th>Material</th>
<th>%</th>
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<tbody>
<tr>
<td>Aerogel</td>
<td>4%</td>
</tr>
<tr>
<td>NaF</td>
<td>4%</td>
</tr>
<tr>
<td>MCP PMT</td>
<td>10%</td>
</tr>
<tr>
<td>Support, electronics, etc</td>
<td>8%</td>
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<tr>
<td><strong>Total</strong></td>
<td>26%</td>
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Read-out geometry

- 12 phi-sectors
- 26 PMTs per sector
- Total of 312 PMTs
- 19'968 channels

- FE ASIC and SCATS TDC as in DIRC
- Got in contact with Cristophe and Vanessa on DIRC electronics
- FEE seems to fit in 5 cm behind PMTs
- Design and integration is wanted
FARICH performance

Aerogel + NaF

- excellent PID level: $\pi/K$ better than $8\sigma$ (MC) for momenta $0.6-4$ GeV/c
- background is well under control
- less than 10% QE drop is expected in 5 SuperB years
- cost 3.4 M€

For details see the talk in Elba’10
FARICH prototype

- Box is designed for radiator-PD distance 50–700 mm
- 32 MRS-APDs (SiPMs) as photon detectors
- Custom made discriminator boards
- CAEN V1190B 64-ch multi-hit TDC
- Two focusing aerogel tiles for SuperB are ready to be tested, 2-4 more are expected in October.
Prototype's read-out

- 4x8 SiPMs
- 2x16ch Discriminator boards
- CAEN TDC V1190B
- VME controller

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Prototype's status

- SiPMs are tested for amplification, noise rate
- TDC readout with SiPMs and discriminators is tested
- Measurements with a laser diode are ongoing
- The prototype will be moved to the beam in October
- Beam tests October-February
Test beam facility at VEPP-4M, Novosibirsk
Electron and tagged photon beams

Design parameters

<table>
<thead>
<tr>
<th></th>
<th>Electrons</th>
<th>Gammas</th>
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<tbody>
<tr>
<td>Energy, GeV</td>
<td>0.5–3.0</td>
<td>0.05–3.0</td>
</tr>
<tr>
<td>ΔE/E, %</td>
<td>0.3–0.5</td>
<td>≈1</td>
</tr>
<tr>
<td>Intensity, Hz*</td>
<td>10–100</td>
<td>≈1000</td>
</tr>
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</table>

* With converter in the beam halo

Installation of the components is finishing in October
First results on the electron beam

- Several runs with NaI calorimeter and 3 scintillation counters in place were taken in July this year
- We worked with Bremsstrahlung gammas from beam-gas interaction in VEPP-4M: \( E_e = 2.5 \text{ GeV}, I_e = 3-10 \text{ mA} \)
- Gammas hit 1 \( X_0 \) thick lead target to produce \( e^+e^- \)
- Magnet current was tuned to 1 GeV and 1.4 GeV electron energy
- 1x1 cm\(^2\) trigger area in front of NaI (10x10cm\(^2\), 20\(X_0\))

![Nal amplitude spectrum](image)

Event rate: 0.02 – 0.04 Hz/mA as expected

Moving converter in the beam halo is foreseen to increase intensity. Beam-beam interactions will also work.
Conclusion and outlook

- The Forward PID system based on FARICH with an excellent performance is proposed. Background rate is under control. Aging of MCP PMTs is minor.
- Electron beam is obtained
- Beam tests with the FARICH prototype scheduled for October–February. Runs after February 2011 can be provided if needed.
- Still need FARICH electronics design
Occupancy (NaF+Aerogel)
Background consideration

- **Pile-up noise**
  Time resolution <1ns
  Occupancy: $6 \text{p.e.}/20000 \text{ch} = 3 \cdot 10^{-4}$ → less than one background hit within area of the rings – negligible for the ring reconstruction.

- **MCP PMT aging**
  Gain: $10^5$
  Integrated anode charge:
  $6 \cdot 200 \cdot 10^6 \cdot 10^5 \cdot 3 \cdot 10^7 \cdot 1.6 \cdot 10^{-19} / (312 \cdot 5.3^2) = 0.07 \text{C/cm}^2/\text{year}$
  P. Krizan et al. poster at RICH2010:
  10% QE drop at 400mC/cm$^2$ (25μm version) ~6 years of SuperB Aging tests of 10μm version are ongoing (P.Krizan)

- **MCP PMT gain stability**
  Time between collisions: 5ns
  Rate: $6 \cdot 200 \cdot 10^6 / (312 \cdot 5.3^2) = 140 \text{kHz/cm}^2$ – no gain drop.
Photonis MCP PMT

XP85012

- Chevron MCP configuration
- 8x8 anode pads with 6.5mm pitch
- Bialkali photocathode, QE(400nm)=29%
- Gain ~ $5 \cdot 10^5$
- 25μm pores, need 10μm to work in 1.5T field with gain ≥ $10^5$
- MCP open area ratio ~70%
- Size □59 mm
- Effective area fraction 81%
- excellent timing ~40ps single photon

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