June 21, 1999
BaBar Collaboration meeting,
SLAC.

Speaker: J. Va'vra

DIRC
Topics covered in this talk

a) DIRC installation progress,
b) Quartz bar box construction,
c) Some construction Q.C. issues,
d) Initial operational experience.
5 bar boxes are installed.
Installation was very smooth.
Installation of bar boxes

- It was very important to install four lower boxes because the PEP II beam line does not have to be disturbed for installation of all remaining boxes.

- Tests of “on-beam line” installation are under way in IR-12 to study any possible interference issues.

- Installation off all remaining boxes is scheduled for the Fall down period.

- Probably one should assume rate of 1 bar box per day.
SOB leak rate measurement (P. Bourgeois and J. Va’vra):

SOB leak checking in IR1 - April 6-8, 1999

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J.V., 4.8.1999

SOB vessel temperature
PM socket temperature
Diff.pressure
Rel.humidity
Series5

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Bar production

- Boeing initial difficulties (bar chipping near edges during lapping step) has been solved.

- Present rate of production:
  
  64 bars every 2-3 weeks.
Bar production

Delivery rate:

Acceptance rate:
Bar Quality Issues

- Optical quality is good.

- Mechanical quality is steadily improving. This shows up in much easier way to put bars together in the bar box (starting with bar box #6).

- Yield: 98-99% (last ~100 bars).
Bar Boxes

- 7 bar boxes complete at this point. (this includes a prototype bar box in slot #11).

- 5 bar boxes are installed in the BaBar (this includes a prototype bar box in slot #11).

- 2 bar boxes are in storage.

- The bar box #8 is on the gluing fixture (will be finished by June 30).

- Assembly of one bar box takes ~3 calendar weeks start to finish.
People and institutions directly involved in bar and bar box production

- **SLAC**: Contact with Boeing Co., bar delivery, R&D issues, Q.C. issues, bar-to-bar gluing, bar-to-wedge gluing, bar box construction, bar box installation, clean room construction.


- **LBL**: Bar box engineering, gluing fixtures, wedge-to-window gluing, bar box construction, engineering of the bar box installation fixtures, bar box installation.

R&D topics, which were addressed:

1. Quartz transmission (DIRC notes #18, #40, #54, #122).
2. Internal reflection coefficient (#18, #40, #54, #122).
3. Quartz pollution and its effect on the reflection coefficient.
4. Reflectivity of mirrors (#122).
5. Reflectivity of shims, bar support buttons.
6. Gluing methodology of quartz bars, wedges and window.
7. Radiation damage of quartz (#18 and #39).
8. Radiation damage of optical glues (#39).
10. Mechanical strength of optical glues.
11. Uniformity of quartz refraction index (lobes) (#87).
12. Cleaning methodology of quartz.
13. Quartz bar scintillation.
15. Water pollution by various materials (#55).
16. Quartz handling in clean room.
Quartz bar Q.C.
Quartz edge damage

Method invented by M. Convery:

Bad and good bar edge:

- Using the pixel information from the CCD camera, the method is able to quantify the extent of bar edge damage. It also measures bar angles, which complements another, more simple, method developed by J. Cohen-Tanugi.
DIRC quartz bar transmission and reflection coefficient setup:

Measurements of Joe Schwiening ( DIRC note #122):

Boeing bars
DIRC Reflection coefficient = f(wavelength) setup:

Measurements of J.Va’vra:

1-Refl. Coeff. = f(Wavelength)  

- Data (Boeing bar #114)
- Scalar theory assuming the surface polished to 15A rms
- Scalar theory assuming the surface polished to 10A rms
- Scalar theory assuming the surface polished to 5A rms
Quartz surface pollution studies:

Measurement of J. Schwiening, J. Cohen-Tanugi and J. Va’vra:
Bars on the gluing fixtures:

Wedges:
Gluing bars to bars:

Gluing wedges to window:
Gluing mirrors to bar ends:

Measurement of J. Va’vra (DIRC note #122):

Analysis of cosmic ray data (Ch. Yeche): Reflectivity is 92.1%.
Loading bars into the bar box:

Typical bar width distribution (variation has to be taken out by shims):
Inserting shims between bars:

Spreadsheet calculating gaps between the bars (DIRC note #122):

<table>
<thead>
<tr>
<th>BAR NUMBERING</th>
<th>TOP VIEW - wedges point down</th>
<th>Wedges</th>
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</thead>
<tbody>
<tr>
<td>Bar #12, BaBar #36</td>
<td></td>
<td></td>
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<tr>
<td>Bar #11, BaBar #37</td>
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<td></td>
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<tr>
<td>Bar #10, BaBar #38</td>
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<td>Bar #9, BaBar #39</td>
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<td>Bar #8, BaBar #40</td>
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<td>Bar #7, BaBar #41</td>
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<td>Bar #6, BaBar #42</td>
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<td>Bar #5, BaBar #43</td>
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<td>Bar #4, BaBar #44</td>
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<td>Bar #3, BaBar #45</td>
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<td>Bar #2, BaBar #46</td>
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<tr>
<td>Bar #1, BaBar #47</td>
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<table>
<thead>
<tr>
<th>TOP VIEW</th>
<th>Wedges</th>
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</thead>
<tbody>
<tr>
<td>310 (rotated)</td>
<td>308</td>
</tr>
<tr>
<td>0.0067</td>
<td>0.0060</td>
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<tr>
<td>303</td>
<td>304</td>
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<tr>
<td>0.0069</td>
<td>0.0069</td>
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<tr>
<td>311</td>
<td>312</td>
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<tr>
<td>0.0061</td>
<td>0.0064</td>
</tr>
<tr>
<td>0.0066</td>
<td>0.0060</td>
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<tr>
<td>315</td>
<td>316</td>
</tr>
<tr>
<td>0.0069</td>
<td>0.0064</td>
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<td>319</td>
<td>320</td>
</tr>
<tr>
<td>0.0077</td>
<td>0.0064</td>
</tr>
<tr>
<td>324 (rotated)</td>
<td>325</td>
</tr>
<tr>
<td>0.0069</td>
<td>0.0065</td>
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<tr>
<td>331</td>
<td>332</td>
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<td>0.0060</td>
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<td>0.0064</td>
<td>0.0061</td>
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<tr>
<td>351</td>
<td>352</td>
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</table>

Shift on fixture: subtract 0.001"
Final inspection of the bars after the bar box is finished:

Image of 12 bars in bar box #1 (BaBar slot #5) —J.Va’vra and S.Spanier:
Number of photoelectrons per bar

Analysis of cosmic rays by Lydia Roos and Christophe Yeche:

- Average number is \(~30\) per bar.
DIRC Water system:

DIRC water dump valve:

- Dump valve controlled by electronics and a system of humidity sensors designed by S. Telnov and R. Kadel.
Measuerements of J.Va’vra:

Absolute transmission through 1m of water

<table>
<thead>
<tr>
<th>Sample</th>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>2.22.99</td>
<td>Final water system (internal best water) - 16.8MOhms</td>
</tr>
<tr>
<td>#2</td>
<td>4.23.99</td>
<td>SOB water return - 14hours recirculating - return water resistance 5.8MOhms</td>
</tr>
<tr>
<td>#3</td>
<td>4.30.99</td>
<td>SOB water return - 8days recirculating - return water resistance 6.8MOhms</td>
</tr>
<tr>
<td>#4</td>
<td>5.7.99</td>
<td>SOB water return - 15days recirculating - return water resistance 7.2MOhms</td>
</tr>
<tr>
<td>#5</td>
<td>5.14.99</td>
<td>SOB water return - 22days recirculating - return water resistance 7.8MOhms @25.8degC</td>
</tr>
<tr>
<td>#6</td>
<td>5.17.99</td>
<td>Ref. water Final water system (internal best water) - 12.3MOhms @26.3degC</td>
</tr>
<tr>
<td>#7</td>
<td>5.21.99</td>
<td>SOB water return - 26days recirculating - return water resistance 7.39MOhms @26.3degC</td>
</tr>
<tr>
<td>#8</td>
<td>6.11.99</td>
<td>SOB water return - 48days recirculating - return water resistance 7.49MOhms</td>
</tr>
<tr>
<td>#9</td>
<td>16.16.99</td>
<td>SOB water return - 53days recirculating - return water resistance 7.23MOhms</td>
</tr>
</tbody>
</table>
Electronics:
(A. Hoecker and G. Wormser)

- 16 dead + noisy channels out of which:
  1 PMt is physically missing
  2 PMts are used by the machine
  4 belong to a noisy analog chip
  (we will replace it one of these days)
  the remaining true dead + noisy PMts

- very comparable to number given at the last collaboration meeting.

Calibration:
(V. Shelkov, D. Brown and M. Zito)

- \( t_0 \) calibration works at a rate of 1.2kHz, which a total time per calibration of \(~2-3\text{min.}\)

- Introduced a timing offset into the LED flushing for each sector to reduce a light cross-talk, which introduces a bias in \( t_0 \).

Slow monitoring:
(G. Vasileiadis)

- slow control works
First experience with PEP II.

Cosmic ray trigger:

PEP II in a wrong tune:
Truncations of DIRC data due to heavy load of hits: (solved by V. Shelkov and D. Brown)

Install lead shielding as a test:

• However, PEP II improved dramatically at the same time.
Data taking mode:
- HER 71mA, LER 244mA, full field,
- colliding, gate: 2µs, trigger: 0x403ffff

Average occupancy per sector (run 5938):
(Taken from the Fast monitor written by Stefan Spanier)

Note: ignore sector 5 occupancy (hot channel)
Under these running conditions we see a clear signal in the Cherenkov single photon distribution (runs 5375 & 5354)

Cuts: momentum : > 2.5 GeV/c  
Time window : +- 1000ns (i.e. very wide)

Preliminary analysis of Ch. Yeche:

- How do we scale this performance to full current in PEPII?
Each sector has a PMt connected to a scaler (run 5938):
(Analysed by Stefan Spanier)

![Graph showing scaler rate vs. LER current]

Dead time limit is ~200 kHz per PM tube:

- This would be reached in sector #0 for ~1.6 A in LER.
- However, after sector #0 gets a bar box, the rate doubles.
- Correcting for acceptance, we get another factor of two.

**Conclusion (based on run 5938):**

- To run at a 2 A in LER, DIRC will need additional shielding.

(Probably in the plug area around the LER beam pipe)
Timing capability of DIRC.

Single PM timing resolution:

Analysis of Stefan Spanier (run 5938):
Conclusions

. DIRC works.

. We know how to build it.

. To run DIRC at full PEP II currents, we will probably need additional shielding, unless, the machine improves further.