Report on BELLE-BABAR
Background Task force

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LAL Orsay
The BELLE-BABAR background task force

- Following the Hawaii meeting in January 2004, BELLE and BABAR management decided to form a small task force to look into background issues with the aim of mutual help by exchanging experience about background fighting, better understand the various sources, compare tools for background modelling, and so on.

- Junji Haba (co chair) Witold Kozanecki (co chair)
- Shoji Uno (DCH, EMC) Steve Robertson (EMC)
- Masanori Yamauchi Markus Cristianzani (DCH)
- Karim Trabelsi (Simu) Giovanni Calderini (SVT)
- Osamu Tajima (SVT) Guy Wormser
- Toru.Tsuboyama
- Hitoshi Yamamoto

- Monthly meetings: 3 held so far
## The Background Comparison

- Many background sources but few in common!

<table>
<thead>
<tr>
<th></th>
<th>BABAR</th>
<th>BELLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Synchrotron Radiation</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Beam Gas</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Touschek</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Bhabba debris</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>HER-LER cross term</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Beam-beam</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outgassing</td>
<td></td>
<td>XX</td>
</tr>
</tbody>
</table>
Extract Two-types BG Separately

Energy spectrum

Energy deposition

Radiation dose

Energy spectrum of SVD

Particle-BG

SR

#cluster/keV/event

energy (keV)
Azimuthal Distribution of SR

- Single-Bunch 15 mA (trigger-timing is adjusted)
- Total 0.8 A w/ 1284 bunch (random timing)
- Hard-SR simulation

**Simulation:** 58 kRad/yr

**66 kRad/yr** at HER 1.1A

**42 kRad/yr** at HER 1.1A

*Only above threshold 10 keV*

*Simulation complements below threshold*
Azimuthal Distribution of Particle BG

FWD

BWD

H E R  0 . 8  A

L E R  1 . 5  A

88 kRad/yr at HER 1.1A

86 kRad/yr at LER 1.6A

Simulation

106 kRad/yr

42 kRad/yr
Study of Touschek Effect

- Smaller beam-size (larger density) → larger background

**If no Touschek**

- Single beam run
- Collision run

 Beam-size is different for collision

Touschek contribution
- < 20 % at collision
- ~ 50 % at single beam
- 31 % in simulation

Touschek contribution must be corrected
Azimuthal Distribution of Particle BG

with correction of Touschek

HER 0.8 A

LER 1.5 A

88 kRad/yr at HER 1.1A

44

106 kRad/yr

42 kRad/yr

36 kRad/yr

at LER 1.6A

simulation

simulation

8 8 kR a d / y r

1 0 6 k R a d / y r
Radiation Dose at SVD 1st layer

$\phi \sim 0 \text{ deg}$ $\phi \sim 180 \text{ deg}$

- Total
- SR
- Particle-BG (HER, e-)
- Particle-BG (LER, e+)

Measured BG is consistent with Simulation
Extrapolated Occ. $\leftrightarrow$ single beam runs

At Maximum Currents (HER 1.1A, LER 1.6A)

<table>
<thead>
<tr>
<th></th>
<th>Outer-direction</th>
<th>Inner-direction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>~ 0 degree</td>
<td>~ 180 degree</td>
</tr>
<tr>
<td>Particle-BG (LER)</td>
<td>3 %</td>
<td>2 %</td>
</tr>
<tr>
<td>Particle-BG (HER)</td>
<td>7 %</td>
<td>5 %</td>
</tr>
<tr>
<td>SR-BG</td>
<td>2 %</td>
<td>4 %</td>
</tr>
<tr>
<td><strong>Total (single beam)</strong></td>
<td><strong>12 %</strong></td>
<td><strong>11 %</strong></td>
</tr>
</tbody>
</table>

**Collision (Dec2003)** ~12 % ~11 %

Indication of Low Beam-beam effects
Luminosity Dependences

we put the scintillation detector 12x12cm^2

Its bkg has strong correlation with luminosity

( next page)
The background templates

- One of the goal of the task force is to provide QUANTITATIVE comparisons of BELLE and BABAR background, hence the templates
- Initial goal: the fudge factors (Translate BELLE quantities in BABAR units) for SVT, DCH, EMC
- The fudge factor depend on:
  - Definition of the measurement
  - Geometry of the sensor
  - Time resolution of the sensor
  - Trigger definition
  - Sensor gain/efficiency
### SVT

<table>
<thead>
<tr>
<th></th>
<th>BABAR</th>
<th>BELLE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1st layer Geometry</strong></td>
<td></td>
<td>cm</td>
</tr>
<tr>
<td>Nb of sectors</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Minimum Radius</td>
<td>3.3</td>
<td>2</td>
</tr>
<tr>
<td>Maximum Radius</td>
<td>3.8</td>
<td>2.7</td>
</tr>
<tr>
<td>Phi Strips Width</td>
<td>50 microns</td>
<td>0.005</td>
</tr>
<tr>
<td>Phi Strips Length</td>
<td>8.2</td>
<td>7.68</td>
</tr>
<tr>
<td>Z strip width</td>
<td>100 microns</td>
<td>0.0075</td>
</tr>
<tr>
<td>Z strip length</td>
<td>4</td>
<td>2.56</td>
</tr>
<tr>
<td>Surface used to integrate the dose</td>
<td>PIN diode</td>
<td>whole DSSD</td>
</tr>
<tr>
<td>Average radius</td>
<td>3.3</td>
<td>2.3</td>
</tr>
<tr>
<td>Area</td>
<td>1 cm²</td>
<td>7.68 x 2.56</td>
</tr>
</tbody>
</table>
SVT Fudge factor

- Occupancy Fudge Factor
  - Same width but not same solid angle since radius is not the same
  - Different length for Phi strips
  - Different integrating time

- To convert BELLE numbers to BABAR units:
  \[ K = \left(\frac{2}{3.3}\right)^2 \times \left(\frac{8.2}{7.68}\right) \times \left(\frac{1}{1.2}\right) = 0.33 \]
DCH Fudge factor

- Fudge factor for current: Gain*Volume
  - \( K = \frac{5.2}{5} \times \frac{40000}{20000} = 2.08 \)

- Fudge factor for Cell:CellxSize*Integrating time*Length
  - \( K = 0.77 \times 5 \times \frac{2.76}{2.2} = 5 \)

- But GAS gain and current do not agree at all! BABAR and BELLE are drawing about the same current at 10**34, while occupancies differ by at factor 10 (fudge factor included)
EMC fudge factor

- Fudge factor = Integrating time = 1 microsecond for both expts
- Single crystals above 1 MeV:
  - BELLE 620/160/150 sum 930
    (Is electronic noise removed? If not, please do so)
  - BABAR 400/275 sum 675
- Numbers of CLUSTERS of 20 MeV, 100 MeV
  BELLE 10/3
  BABAR 3,7/1
  Check Cluster definition
- BABAR Dose information yet to be filled in (~1 krad but a large part is Injection)
Comparison of SVT occupancies as function of single beam currents

**HER single beam-SVT**

**LER Single Beam-SVT**

BELLE Numbers are translated in BABAR units
DCH Comparison - Beam Gas and Lumi

HER single Beam DCH Occ.

LER Single Beam

Total DCH Occupancy

BELLE Numbers are translated in BABAR units

LER assumed = 1.5 HER
LUMI = 2.66 HER**2
# Background comparison at $10^{**34}$

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<tr>
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</thead>
<tbody>
<tr>
<td>SVT (Occ in %)</td>
<td>12 (W)/ 3 (E)</td>
<td>2,3</td>
</tr>
<tr>
<td>DCH (Occ in %)</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>EMC (1 MeV Digi</td>
<td>400</td>
<td>620 (?)</td>
</tr>
<tr>
<td>20 MeV clusters)</td>
<td>3,7</td>
<td>10</td>
</tr>
</tbody>
</table>
Simulation Tools

- BELLE and BABAR use TURTLE for rays transport
- BELLE uses GEANT3, BABAR Geant4 for detector description
- BELLE transmit all rays to GEANT, BABAR only rays that hit aperture
- Touschek effects not yet simulated in both experiments
- BELLE does not have a Bhabba generator
- BELLE has a powerful ONLINE SR simulation
Particle Background Simulation

Belle
Conclusion

• The BELLE-BABAR task force is functioning well
• The background sources are almost orthogonal, beam gas in common.
• Almost ready to have accurate quantitative comparisons
• Can share the work on advanced simulation (Touschek, Bhabbas)
• Could think together of the background at the next machine (Sum of all seen ?)