DIRC Background Status

Part I

Updates and

Background Scaling

J. Va’vra and T. Hadig
DIRC main source of background: Radiative Bhabhas striking Q4 magnet inboard flange

- Source discovered empirically with a Geiger counter.
- Shielding erected step-by-step slowly building empirically a proof that things are improving.
- Carsten proved later, with a Turtle program, that a major source of DIRC background is the radiative Bhabhas striking Q4 inboard flange, which is too small.
Background Estimate and Reality

Thomas Hadig

Carsten estimated in Feb 2002:
\[ R = 13 \text{kHz/A I(HER)} + 18 \text{kHz/A I(LER)} + 10 \text{kHz/(10}^{33}/\text{cm}^2/\text{s}) L \]

Comparison to average scaler rates in March and April 2003:
All in all: good agreement but some dependency on running conditions and position in DIRC SOB.
DIRC background projections and PMT aging
J. Va’vra, 2003

- **Input:** HER, LER and LUMI projections of John Seeman (2003)
- C. Hast’s 2002 analysis was done after a massive DIRC shielding was put in place, and therefore it predicts lower scaler rates. Based on this analysis, DIRC should be OK until 2006, and beyond. (due to shielding and TDC upgrade)
- However, all this does not include the trickle injection running conditions, and any possible difficulty related to running with large beam currents.
- **Without any shielding** we would have ~1 MHz per PMT by 2007.
- However, it looks like, if ETL Co. data are correct, that the total dynode gain will not drop by more than 40% after ~10 years of running, given the present shielding and the Seeman 2003 prediction.
DIRC Background Limitations

• Before TDC upgrade (till summer 2002):
  TDC deadtime of about 5% at 250kHz

• After TDC upgrade (since summer 2002):
  TDC deadtime estimated to be 5% at 2.5MHz
  ADC deadtime estimated to be 5% at 1MHz

• Small number of Out-of-order errors at high rates
  fixed by changing DFB firmware
  (Dominique, Chris, Philippe in summer 2003)

• Tiny number of errors remain in stress tests (Chris)

Other limits:

• Maximal number of hits shipped
  currently we stop after 5000 to 6000 hits, mark event as corrupted.

• Readout time and volume (see Chris’ talk)

Offline: Tight timing cut, bkg has small effect on final data quality.
However, there are still hot spots around BaBar

J. Va’vra, June 2003

- Radioactive hot spots correlate with the regions where the beam is large, according to Witold.
- Forward LER side (LER going in):
  a) ~12m from IP near downstream collimator
  b) ~25m from IP near upstream collimator
- Forward HER side (HER going out):
  a) ~7m from IP near Q5 exit
  b) ~3-4m from IP near coupling of backward raft to the central tube
- Backward LER side (LER going out):
  a) ~14m from IP near QDCX2 magnet
  b) ~27m from IP near QFCX1 magnet
  c) ~7m from IP at the exit side of Q5
  d) ~3-4m from IP near coupling of backward raft to the central tube
- Backward HER side (HER going in): quiet
- **A suggestion:**
  Move both LER collimators from the forward side to the downstream side of Babar.
Energy spectrum of a general background
J. Va’vra, November 2000

- A typical background around PEP-II consists of a few MeV photons.
- The spectrum shape is independent of how the CsI detectors is oriented relative to DIRC, or if there is a 1” thick lead shutter in or out. This means the whole cave is filled with this type of background.
- Hard to shield - one needs a lot of lead. This was successfully done over past few years, which enabled DIRC to operate without a glitch as far as the background.
- The detector was calibrated with a Na$^{22}$ source (0.511 and 1.27 MeV gammas).
New updates in BaBar background display

• Increase readout frequency in Run 4:
  CsI: 0.5 sec (was every 2 sec)
  Quartz: 0.5 sec (was every 2 sec)
  DIRC scalers: 2 sec (was 10 sec)
  DIRC HV PS current: 0.5 sec
  PMT outside DIRC: 0.5 sec
  RPC: 2 sec (was 10 sec)
  EMC diodes: 0.5 sec
  Diamond detectors: 1 sec (was 2.5 sec)
  SVT diodes: 2.5 sec (was 2.5 sec)

• Run 4: Based on a large radioactivity measurements with a hand-held Geiger counter, two CsI detectors (CsI 29 & 30) were placed on the backward side on the outgoing LER beam.

• CsI #29 is only ~10 meters from BaBar. We may want to put some lead shielding to block this source.

• Two CsI crystals replaced on LER in Forward direction.

• Three crystals recalibrated.

• Two new CsI crystals placed on LER exiting from Babar near the very radioactive hot spots.

9/23/2003
Geometry of some detectors used in this study
(some changes after 2003 run)
Run 4 - how we are doing?

- A huge background in Quartz_HER and new CsI #29 and #30 in the outgoing LER from BaBar. A real effect! May want to put some shielding next to entrance to QDCX2 magnet on LER.
Conclusion

- Background estimate still applicable.
- ... will this be true for trickle injection?
- If projection is valid, no problem for DIRC till 2010.
- More hot spots found, need to add shielding.
- Improved monitoring with new sensors and faster readout.
- ... more in second talk ... stay tuned!