EMC Background Simulation

Steven Robertson

McGill
Context

- **EMC background simulation used for background studies** during detector commissioning and initial startup phases
- **Very little actual data available to validate studies**
- **Primary issues were:**
  - Locating and characterizing background “sources” (apertures, background types)
  - Characterizing beam background effects (rates, distribution patterns etc)
  - Disentangling effects of electronics noise, calibration issues, hot towers etc
  - Determining a reasonable digi energy threshold for EMC operation
  - Radiation dose
Background simulation

- Based on TURTLE ray simulation of Brem and Coulomb lost particle backgrounds (T. Fieguth)
  - Primary particles interacting with machine apertures within +/-8m of the IP are considered background sources
  - Allows determination of original particle source and type, as well as impact point

- Background candidates then tracked by GEANT3 (bbsim) detector simulation
  - Some known issues!
    - Detector model
    - Some discrepancies between IR models used by TURTLE and bbsim
    - Hadronic interactions?

- GEANT simulation modeled the IR out to the end of Q5 magnets
Background simulation
**Background sources**

- When a beam background particle interacts in the EMC, record the location of the initial (GEANT/TURTLE) “hit” in the beampipe
  - Weight according to known pressure profile in IR and around the ring
  - Categorize backgrounds according to type

**HER initial hit position**

**LER initial hit position**
Background sources (cont)

- Estimate pressure-zone contributions to the EMC occupancy rate
  - F.O.M. is number of digits above your favourite energy threshold
  - Give feedback to PEP-II
  - Zone 8 is the total rate

400mA HER, Best Guess pressure

800mA LER, Best Guess pressure
Occupancy rate predictions

- Use beam current dependence of pressure profile to extrapolate background rates as a function of currents
  - Once we had actual data from dedicated beam backgrounds then the simulation became less important, but still useful:

![Graphs showing Emc digi multiplicity (E>5MeV)]
Energy and angular distributions

- Background simulation also correctly predicted (qualitatively!) the characteristic energy and angular distributions of backgrounds

Digi energy distribution

Digi phi distribution

EMC crystal energy (GeV)
Radiation dose

- Total radiation dose rate can be estimated from flux rate of backgrounds
  - Assume some reasonable pressure profile and beam currents
  - Reproduces observed doses reasonably well

- Simulation predicted that LER backgrounds irradiate the endcap from the upstream (LER) side, leading to a sheltered region in the forward barrel
Problems (future improvements?)

- Most predictions from simulation were qualitative
- Issue of IR modeling discrepancy between GEANT and TURTLE made it difficult to trust predictions
- Many interesting effects in data were not well modeled (or modeled at all)
  - Material model/shielding
  - Beam-wall/inelastic interactions
  - No rad-fet/leakage current simulation
  - Injection backgrounds (also Touschek for SuperBaBar)?
  - No modeling of “Lumi” contribution (thought to be zero-angle radiative Bhabhas)
- Need updated TURTLE ray deck and GEANT4 simulation of IR well past Q2

September 23, 2003  
Steven H. Robertson,  
McGill University