L. Keller
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Background Simulations in PEP

Outline

1. History

2. Tools

3. Comparison of BaBar and PEP-N

History of Background Simulations in PEP-I and PEP-II

1. As far as I know, every PEP experiment has used the same codes to generate and track synchrotron radiation and beam-gas bremsstrahlung.

2. The tools to simulate detector response differed by experiment.

3. The BABAR collaboration spent a minimum of five man years working on detector backgrounds – before approval by the SLAC EPAC.

Useful References

1. BABAR Technical Design Report, 1995, Chapter 12.

2. Study of Beam-induced Particle Backgrounds at the LEP Detectors, Nuc. Inst. Meth. in Physics Research **A403** (1998) 205-246.

Tools

Synchrotron Radiation

QSRAD: modified by Mike Sullivan and now called SYNC_BKG - generates hits on masks and beam pipes

EGS4 (OBJEGS): hits on masks ⇒ hits in detectors (includes fluorescence and coherent scattering)

Beam-gas Bremsstrahlung (electrons and photons) and Single Coulomb Scattering

DECAY TURTLE: modified by W. Kozanecki and now called LPTURTLE - generates ray files of hits on masks and beam pipes. Ted Fieguth has written programs which take a description of the vacuum chamber as a function of S around the ring and generate an input file for LPTURTLE

GEANT: hits on masks and other apertures ⇒ hits in detectors from electromagnetic shower particles.

Radiative Bhabhas (this process limits the beam lifetime in LEP and is used for the luminosity monitor in BABAR).

BBBREM: developed for LEP by R. Kleiss and H. Burkhardt – used as a source of off-energy electrons and positrons for GEANT.

Tools (cont.)

Beam-gas Interactions near the IP, Producing Low Energy Hadrons

EPC (electro-production code): generates hadrons which can be tracked by GEANT through the detectors.

It’s possible that GEANT or FLUKA could also be used as a source code.

Comparisons with BABAR

Synchrotron Radiation (LER)

1. Design masks so no photons hit the beam pipe inside the central detector. Taper the mask surfaces so that a single bounce cannot hit the detector. Can't avoid a single bounce for photons which hit within a few microns of the mask tip.

2. The photon critical energies from the nearby dipoles and offset quads are similar to BABAR, i.e. • 5 KeV

3. The total absorbed power on nearby masks will be several kW and ~10^{19} total photons/sec with substantial numbers above 10x critical energy.

Beam-gas Bremsstrahlung (LER, HER, and VLER)

1. In BABAR, with the LER (HER) at 1 nTorr, calculated 10.6 (13.9) GeV/μsec within ±1.5 m of the IP. The PEP-N power losses should be similar and possibly higher near the forward detectors.

2. The BABAR 1.5 T axial field does a good job curling up the low energy e^- and e^+ shower particles from masks before they can hit the central tracker.

3. Probably want a Hi-Z collimator somewhere in VLER – we don't want the limiting aperture of the machine to be the experiment masks.

Radiative Bhabhas

1. The total cross section for this process is very large – 272 mb in BABAR and about 235 mb in PEP-N. However, the PEP-II luminosity is 2-3 orders of magnitude larger than in PEP-N, so this should not be a problem for a fast forward detector.

Beam-gas Electroproduction Near the IP (LER)

Conditions:

•L = 1 m
Pressure = 10 nTorr, CO
|cos •| < 0.975
P > 100 MeV/c

1. Single particle rates

Protons:	3000 hz	• 90% < 300 MeV/c
Neutrons:	1000	
$\bullet^+$, $\bullet^-$:	70	
$\bullet^0$:	150	

2. • • p • 75 hz

Summary

- Must consider all 3 rings when estimating backgrounds
- Might have to keep the forward detector elements out of the horizontal plane
- The collaboration needs to identify people to begin work on background calculations
- There is still time to modify the machine design to reduce backgrounds