

Adding Backgrounds



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Introduction

- In order to specify the requirements placed on the accelerator and detectors by the desire to undertake precision physics measurements, we need a good understanding of the full set of systematics.
- Backgrounds can play a crucial role.
 - Underlying physics processes.
 - Machine backgrounds.
 - Detector noise and inefficiencies.
- Would like to overlay background processes on signal events.

Underlying Physics Processes

- Dominant background due to $\gamma\gamma \rightarrow$ hadrons resulting from beam- and brems-strahlung photons.
- Extensively studied at LEP II, particularly by OPAL.
- Event generators usually considered:
 - PHOJET
 - PYTHIA
 - HERWIG

$\gamma\gamma$ Generators

- Latest version of PYTHIA includes improved support for $\gamma\gamma$ processes.
 - Will use as default unless objections.
 - Does as well as PHOJET at LEP II.
 - PHOJET needs PYTHIA fragmentation.
- PYTHIA allows event-by-event specification of cms energy.
- Use CIRCE to provide input γ spectrum.

Overlaying $\gamma\gamma$ Events in Fast MC

- Use HADES package for fast MC
 - Developed by D. Schulte for CLIC studies.
 - Also being used for TESLA simulations.
 - Generate $\gamma\gamma$ events and store event information in unformatted files.
 - Run PYTHIA for signal generation, then select a background event and add it to the PYTHIA event common block.
 - Can select on background event rate and particle p_T , theta.

Overlaying $\gamma\gamma$ Events in Full MC

- Generate $\gamma\gamma$ events using PYTHIA.
- Process events through full simulation.
- Merge with fully simulated signal events.
 - Variable number of events to add.
- SIOMerge combines MC particle heirarchy, tracker and calorimeter hits.
 - Renumbers MC particles, etc.
 - Does not yet account for time offsets in time-sensitive detectors (e.g. TPC).

Machine Backgrounds

- T. Maruyama and L. Keller simulating machine backgrounds (e^+e^- pairs and muons, respectively)
 - See talk in parallel session II
- Files of particles impinging on detector elements are written out.
- Run through full simulation → sio files.
- Use SIOMerge to add appropriate number of bunches to signal events.

Detector Issues

- Currently don't merge tracker hits.
 - Need to digitize signals or simulate.
 - Axial Si μ strips
 - "ghosts" from forward stereo disks
 - Need to assign appropriate errors to merged hits.
- Don't simulate detector inefficiencies.
- Don't add detector noise.
 - Both fairly straightforward.

Summary

- PYTHIA+CIRCE for $\gamma\gamma \rightarrow$ hadrons.
- Very nice simulations from BDS group
 - Providing both pairs and muon backgrounds.
- Tools available to overlay backgrounds.
 - $\gamma\gamma$ events in both fast and full MC.
 - Machine backgrounds for sio events.
- Need to conduct physics analyses to judge relative importance of various background sources.