PFA Event Reconstruction

The true test of future detector models will be their ability to provide sufficient data for precise reconstruction of interesting physics channels. To test this it is necessary to have a full analysis toolchain, from the generation of physics events, to simulation, to analysis and reconstruction. A large amount of work was done on this for the ILC project, which used ccal02, a dual readout calorimeter with fine depth segmentation, very similar to the Muon Collider Detector proposal. While the next version of mcd00 is being developed it will be instructive to work with the datasets and reconstruction tools developed for ccal02, which can then be used on and serve as a basis of comparison for mcd.

For more information, see this March 2012 talk by Hans Wenzel

CCAL02 Introduction

The SLIC Dual Read out Tutorial has the information needed to get started with CCAL02. This page will focus on work with the datasets

- panpyZZnunubaruds-0-1000.slcio
- W_0_100.slcio
- W_100_200.slcio

which can be found in the **/ilc/ild/wenzel/ccal02/slcio_combined** directory of the Fermilab DetSim machine (you need a Fermilab Kerberos principal for SSH access to this machine).

The first dataset has the decay of a pair of Z bosons into a pair of neutrinos and a pair of quarks (u + ubar, d + dbar, or s + sbar). The second two have a single W boson, generated with 0-100 or 100-200 GeV kinetic energy respectively, decaying into two quark jets.

The reconstruction will attempt to use particle flow algorithm techniques to reconstruct the W or Z mass in these datasets. This is interesting because distinguishing the W and Z can help find and measure the Higgs and other particles, which is challenging due to their natural mass width and small mass difference (W mass mean ~= 80 GeV vs Z mass mean ~= 91 GeV).

Running the Analysis

To set up the framework, it will be necessary to follow the instructions here, being sure to install the lcsim, GeomConverter and lcsim-contrib packages as well as JAS3 with the listed plugins.

The lcsim-contrib package contains a folder named SteveMagill (which should be located somewhere like ~/netbeans/lcsim-contrib/src/main/java/org/lcsim /contrib/SteveMagill/), whose efforts on ccal02 and assistance have made this possible. This analysis will use the drivers found here, though you will have to make a few minor modifications.

One of the drivers used requires a DigiSim steering file, attached here . Download the steering file and edit line 21 of the PFACSClusdMJetDriver.java to point to your copy of the file, eg.

```
String dsteer = ("/home/aconway/work/steer/CCAL002M50.steer");
```

In addition, it may be necessary to download the ccal02 detector description and place it into your ~/.lcsim/cache directory (or wherever JAS3 stores these detector files on your operating system), as the file pulled by JAS3 when analyzing ccal02 data may be incomplete, preventing the analysis from running. In some environments (Windows, in particular), JAS may automatically pull this broken file into the cache, overwriting the correct version. If this happens, it may be necessary to disable your Internet connection when starting any analysis.

To run the analysis, run JAS3 and load the file PFADRSelect.java from the SteveMagill folder using **File -> Load...** and open the panpyZZnunubaruds.slcio file using either **File -> Open...** or **File -> Open Data Source...** The analysis should begin to run and create many plots, which we will get to later. It will take a long time to complete, but it should only be necessary to process a few hundred events for most purposes. To stop the analysis before it is finished, hit the square button next to the one used to start it.