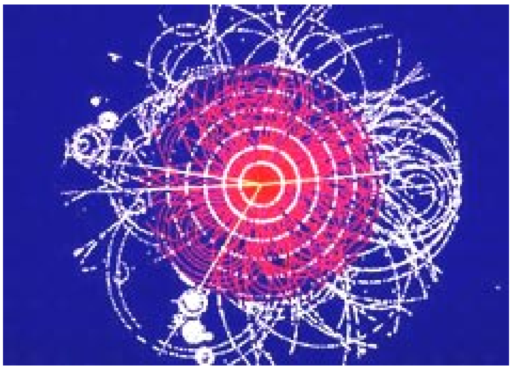
# ILC Physics: The Analysis Has Already Begun

12 February 2007



A simulation of what the decay of a Higgs particle will look like in a detector. (Image courtesy of ATLAS, CERN.)

For the proposed International Linear Collider, physicists are trying to both design the most precise calorimeter ever and still be able to afford it. A calorimeter measures the energy of particles in a detector, and is typically the single most expensive part. If you reduce its performance slightly to reduce costs, how much have you sacrificed?

One way to answer that question is to calculate the mass of the undiscovered Higgs particle. It may sound like a non sequitur, but analyzing data produced from simulated particle collisions gives a good idea of how sensitive the experiment remains to important physics.

"We are studying physics processes that are sensitive to the new detection method that the calorimeter will use," said physicist Tim Barklow. "We want to know how important it is to achieve the unprecedented precision in the calorimeter that we're attempting to achieve."

Barklow has several ways to measure the mass of the Higgs. His software starts with a list of particles identified from simulated collisions and groups the data into jets—stable particles pointed in the same direction. By adjusting the angle of each jet, within the range of error, Barklow can get a much better measurement of the Higgs mass, one that takes into account the undetected energy that neutrinos carry away from collisions.

The analysis also has to filter out background activity. For example, if the Higgs turns out to be light, say 120 GeV, physicists will have to filter out Z particles that are masquerading as Higgses. The mass of the Z is listed as 91.187 GeV, but that's only its central value. Individual Z particles can come in a variety of sizes.

A graph from one of Barklow's analyses shows the errors shrinking as calorimeter performance improves. The better performance was equivalent of a 40 percent gain in luminosity, which is like adding more collisions to your detector without improving the particle beam.

"You get a sharper peak, which means a more accurate Higgs mass, and reduced error because of better calorimeter performance. Ultimately this is money. A better calorimeter costs more, so people have to judge."

Source: by Heather Rock Woods, Stanford Linear Accelerator Center