Z+b

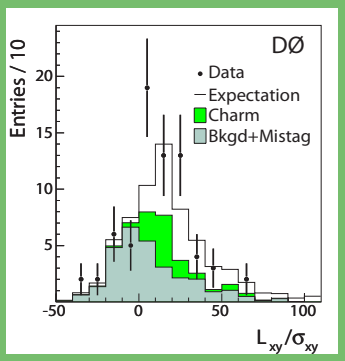
Finding the haystack

Understanding the nature of mass is of utmost importance in light of the strong evidence that neutrino is massive and that most of the mass of the universe are things we cannot yet explain.

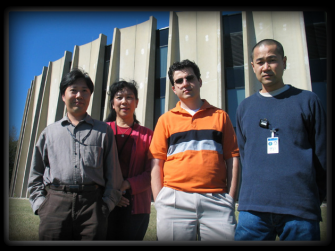
In the Standard Model of particle physics, masses of "fundamental" particles (such as quarks, electrons, muons etc.) are given by the Higgs boson. Higgs boson is a massive particle and the more a particle wants to interact with the Higgs, the more massive it becomes by dragging the Higgs bosons around it (think of carrying extra shopping bags). Higgs boson provides a nice solution to why the weak force, which is one of the four forces of nature, is so weak. Originally massless particles (W and Z bosons) which mediate weak force, like to couple to the Higgs boson thereby becoming massive. By uncertainty principle, the range of influence of massive W/Z becomes very small. Weak force is needed to remain weak for the stability of matter, formation of stars and even earth, responsible for providing the heat in the earth.

At the Tevatron, there are a few ways to produce this Higgs as a "real" particle. The degree of coupling to a particle is synonymous with the probability of being observed together. And Z boson is one of the heavier fundamental particles, so it is one of the ways to look for the Higgs that can accompany it.

The Higgs particle is expected to decay into a pair of b quark and anti-b quark since it is one of the more massive quarks and are easily identifiable. Still, production of a real Higgs boson is expected to be quite rare.



There are contributions which may look like Higgs production, but are backgrounds. One such background is Z boson produced together with b quarks. Understanding the backgrounds will eventually allow us to search for anything that stands out. (It's like trying to carry on a conversation in a noisy bar. The voice of your friend has characteristics that are different from noise.) DZero has made the first measurement of Z+b production in a hadron collider environment. White part of the graph shows the expected contribution from Z+b from theory, and data matches better with theory that includes Z+b. This is an exciting measurement and an important first step in looking for the Higgs.



People who worked on the analysis (from left to right):

Suyong Choi	UC Riverside
Qizhong Li	Fermilab
Yildirim Mutaf	SUNY, Stony Brook
Kazu Hanagaki	Fermilab