4-7-1998

The Discovery of the Top Quark

Kimberly A. Slack

Indiana University - Purdue University Fort Wayne

Follow this and additional works at: http://opus.ipfw.edu/stu_symp1998

Part of the Physics Commons

Recommended Citation

Kimberly A. Slack (1998). The Discovery of the Top Quark.
http://opus.ipfw.edu/stu_symp1998/10

This Presentation is brought to you for free and open access by the IPFW Student Research and Creative Endeavor Symposium at Opus: Research & Creativity at IPFW. It has been accepted for inclusion in 1998 IPFW Student Research and Creative Endeavor Symposium by an authorized administrator of Opus: Research & Creativity at IPFW. For more information, please contact admin@lib.ipfw.edu.
THE DISCOVERY OF THE TOP QUARK
Kimberly A. Slack
(Mark F. Masters, Assistant Professor of Physics)
Department of Physics

The top quark was discovered at Fermilab National Accelerator Laboratory in Batavia, Illinois in March of 1995. The existence of the sub atomic particle was known since 1977 when its partner, the bottom quark was discovered at CERN laboratory in Geneva. International teams of physicists searched for the top quark in vain until they realized the particle had a tremendous weight (175 GeV) and needed an appropriate accelerator to produce the high energy required to create such a particle. Fermilab accepted the challenge and created two research teams, CDF (Collision Detector at Fermilab) and D0 (pronounced D-zero).

The detector created by the CDF team is 5,000 tons and three stories high. It can record 250,000 particle collisions per second with 100,000 electronic channels. It is connected to large computers, which record massive amounts of data from collisions of protons and antiprotons. Gas filled areas located around the detector record the path of the particles post-collision. The sub atomic particles created by the collision tear electrons away from the gas molecules. The trail of electrons, referred to as jets, sends a negative charge to the electronic circuits located beneath the chamber where the path is recorded and sent to the computer for logging. The momentum of the particle can then be calculated from the path of the particle and the direction of the magnetic field inside the accelerator ring.

The particles then travel into the calorimeters filled with Argon gas, which is very dense. The gas, along with other absorbent materials, decreases the velocity of the particle causing the particle to leave behind electrons and lower energy particles. From this information, physicists can determine the energy of the particle as well as its precise path. The top quark decays rapidly into W bosons and bottom quarks. W bosons leave behind large jets from which physicists must trace in reverse to find the top quarks signature. The signature is very specific and is only visible a few time out of a million collisions. In fact, by the presentation of the discovery, the CDF had only observed 43 top quark signatures out of 50 million collisions.