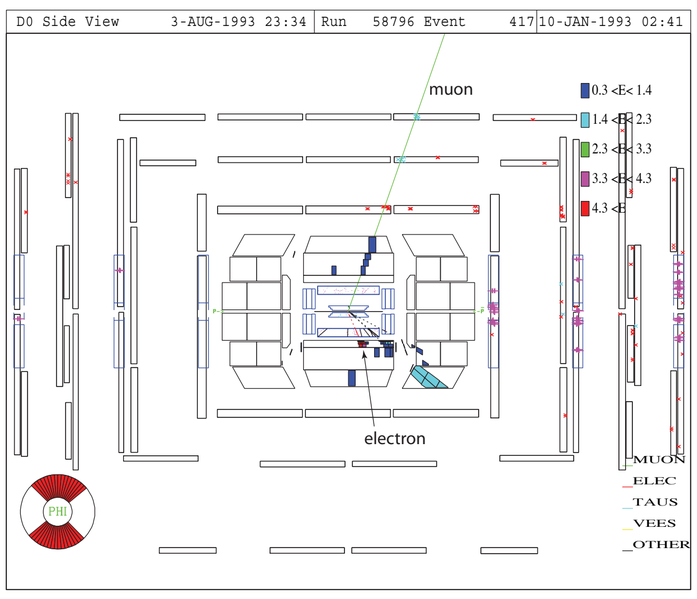
DØ Event 417

The Gold Plated Top Event*

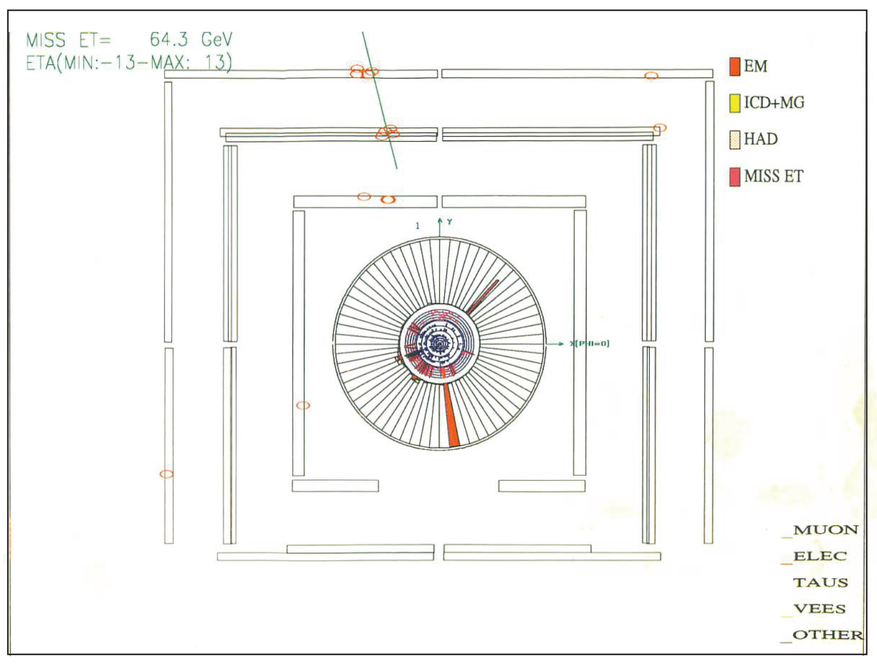
Finding a "Golden" Event

In 1993, while scanning the express stream, Boaz Klima found event 417, which had an very high E_T electron, a high p_T muon, 3 jets and large missing E_T, making it an outstanding candidate for a top event, since expected backgrounds are small.



Event has Spurious A Layer Hits

Event 417 failed the original top selection because spurious muon A-layer hits gave the muon track very low momentum. This can be seen in the end view (below). Other aspects of this event were checked by many experts to see that all other systems worked properly.



Muon Track Hits

Dave Hedin blew up the view of the muon hits to about 10 feet. He measured the track with meter sticks on his basement floor at home. He also redid the alignment. He calculated the momentum with and without the A layer hits. The fit with the A layer needed large multiple scatters in the calorimeter and magnet iron and had low probability.

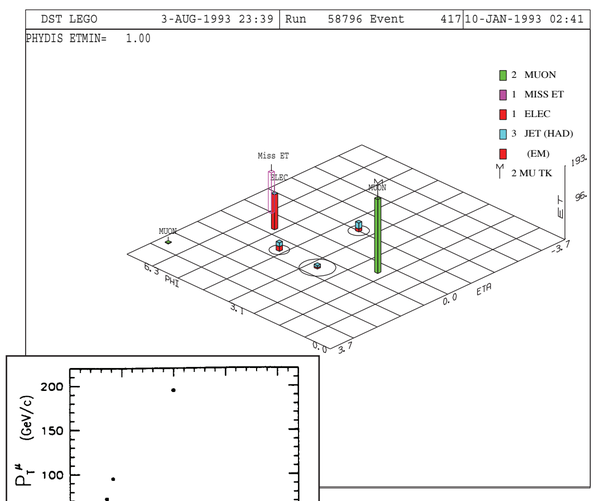
Muon

Daria Zieminska and Dave Hedin exchanged ~30 e-mail messages on the fits for this track to determine the muon momentum more precisely. Using fits by hand and prototype computer code they determined the muon momentum to be greater than 100 GeV/c .

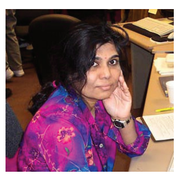
Kinematic Parameters of Event 417

$E_T^e = 98.8 \pm 1.6$ GeV
$p_T^\mu = 195$ GeV/c
(>40 GeV/c at 95% CL)
$E_T^{j1} = 24.9 \pm 4.3$ GeV
$E_T^{j2} = 22.3 \pm 5.6$ GeV
$E_T^{j3} = 6.7 \pm 3.6$ GeV
Missing E_T = 102 GeV

This event survived the final Run 1 cuts, since it has such high momentum and missing E_T.



Background Probabilities



Suman Beri, Puspha Bhat, Jim Cochran, and Harrison Prosper were among those who worked on calculating the probabilities for this event to be produced by various background processes. The probability was 10 to 1 that this event was top. Event 417, which was the world's first observed top event, was presented at conferences in 1993.

Top Quark Mass from Event 417

Ulrich Heintz, Raja, and Mark Strovink worked on a likelihood calculation, based on a method inspired by Dalitz, Goldstein, and Kondo, which determined that the event was consistent with top masses of 100-200 GeV/c^2. The likelihood was maximized at mass(top) =145 GeV/c^2. Later, Harrison Prosper calculated the top mass for event 417 using a new kinematic method. He estimated that the mass(top) =163 $\pm$ 36 GeV/c^2.

Publication

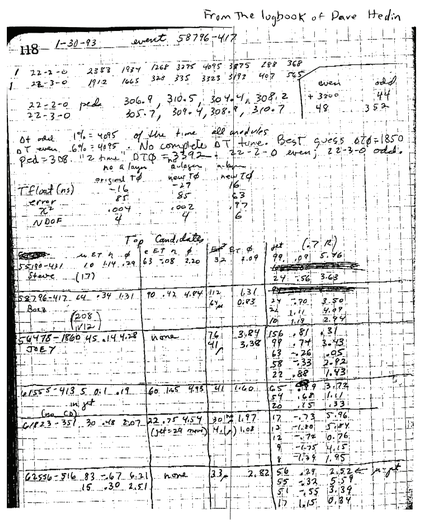
The parameters of Event 417 and likelihood mass determination was submitted for publication at the end of 1993 and appeared in a PRL article entitled "Search for the Top Quark" in April, 1994. This event also survived later, tighter cuts, and was included in the final DØ Run I dilepton results, published in 1998.

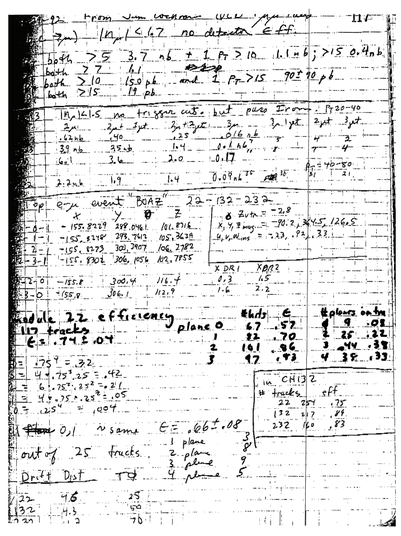
Note: This is a personal view of finding and interpreting aspects of the most spectacular top candidate event in DØ. The full task of assembling and analyzing the complete top quark sample required the dedicated talents of a much broader group of people.
Sharon Hagopian

Sample Logbook Pages:

(First two pages from the logbook of Dave Hedin and last three pages are from the logbook of Harrison Prosper.)

From the logbook of Dave Hedin





From the logbook of Harrison Prosper