

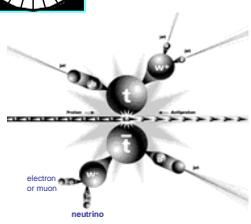


Search for top quark in lepton + jets final state



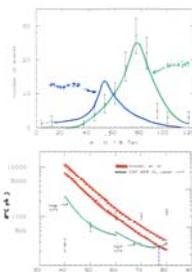
1988-89 - The search begins.....

1992....The first few pb⁻¹ of the "1992 - 1993 Run"



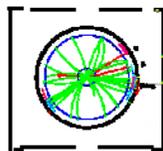
For the relatively low top masses accessible with 4.4 pb⁻¹, the lepton-neutrino effective mass is LESS than that of the W.

John Walsh fits the transverse mass distribution (with much help from Pekka Sinervo) and sets a lower limit of 77 GeV

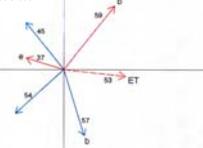


The early running led to observation of a spectacular μe event and two "golden" 4 jet events....

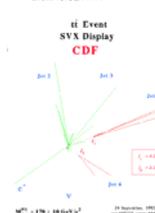
Event 41540/17085



Event 41301/45902



Event 40758/44414



An obvious question was whether these events were consistent with top and whether they were each consistent with a top quark of the same mass.

There followed intensive study of these events, first with "hand" calculations, then with fitting programs

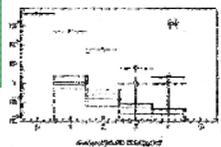


Some hand calculations of the mass of event 41301/45902 by Guillaume Unal

At Penn we focused on the search for top events where one W decays to an electron (or muon) and a neutrino and the other W decays to a quark anti-quark pair... i.e. "lepton + jets"

February 18, 1993

Things start to come together...



Status of search on 1m 10 pb⁻¹:
- Two b-tagged events
- First "bottoms up" Method 2 background calculations
- Estimated yield to 3 & 4 jet bins is 0.22 events
- Rate approximately consistent with $M_t = 150-170$ GeV.

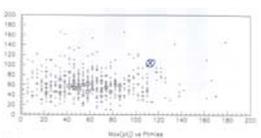
concludes that Top excluded for $M_t < M_{W} = 77$ GeV @ 95% CL.

As more data accumulates many studies are underway on event selection and b-tagging.

The μe event is also found to be consistent with the same mass range.

The μe event was a bit problematic - the missing E, and leading jet energy were on "the edge" of what one expected for top

Early studies of b-tag efficiency by Guillaume and Gerry Houk
- Their work's distinct b-tag algorithms being investigated by various groups.

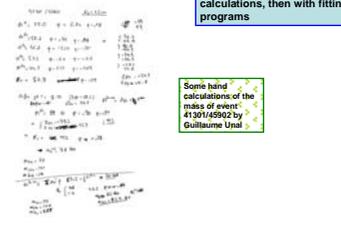


Still 1992 - November

Table with 3 columns: Particle, Energy, E/F. Rows for Electron, Neutrino, Jet1, Jet2, Jet3, Jet4.

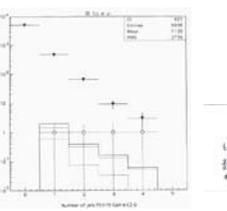
Brian Harnal fits the two 4-jet events using Minuit. Both events were consistent with the same top mass.

The jet energy scale at this time is not fully understood.



March 18, 1993

Refinement of selection cuts, bgnd calculations. 11.5 pb⁻¹ Still no muon events with tagged jets.



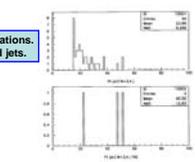
Penn and Michigan both release updated notes on their analyses.



May 1993

Various kinematic studies, such as one at left, show b-tagged events do not look like background.

A CDF note appears with a common selection criteria for all the groups working on lepton + jets.



I have made the plot to see if the tagged event at $M_t = 173$ GeV are kin. different from $M_t = 160$ GeV, with the same 4 and 2 jet top and have the same than $M_t = 160$ GeV

Summer 1993

Systematic studies proceed on background calculations, acceptance, b-tagging efficiencies and fake tagging rates.

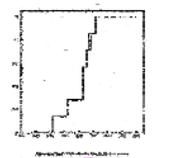
It has not been recognized that one of the most critical issues in our search for top is the reliability of our determination of the background.

A detailed comparison of background calculations via "Method 2" (using several variations) and "Method 1" is presented and compared to data.



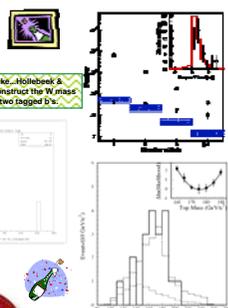
Brian Harnal fits the 4-jet event using Minuit. $M_t = 4$ is a bit conservative. Since it is probably not useful to histogram 8 events, the "optimal" will be whatever.

Rohan did produce a plot of the "cumulative mass distribution (below). It shows very clearly a mass in the region of 170 - 180 GeV. The USC group produced a similar mass analysis, using the program SQUAW.



February 1995

On February 24th, CDF submits Top Discovery paper to PRL



Using on the case, Hollebeck & Wilkinson reproduce the W masses for events with two tagged jets.

January - February 1995

The challenge now is to convince the entire collaboration of the discovery...very quickly.

There were some lively discussions in the top group between the proponents of JETVTX and SECVTX.



Meetings are held every week. It is standing room only in the top floor copier/meeting room. The meetings last 4-5 hours, coffee and donuts during the morning are mandatory.

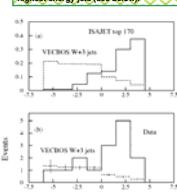
CDF Top Meeting

Fall 1994

With the beginning of Run 1b, data is rapidly accumulated. By Dec 1994-Jan 1995, it is clear to the top group that there is sufficient signal for a "discovery paper."

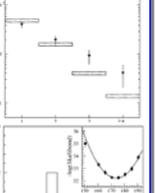
While there are a few refinements with respect to the "Observation paper", the main change is a new, improved B-tagging algorithm, SECVTX.

There is additional strong evidence for top, not in the PRL. A "kinematic analysis by Martin Collett and collaborators, shows strong evidence for top based on the energy of the 2nd and 3rd highest energy jets (see below).



April 1994

Evidence for Top PRL



With the signals in lepton + jets (b-tagged), lepton + jets (soft lepton tag), and di-leptons, it is decided to publish the results.

A great deal of work goes into calculating the statistical significance, and worrying about "anomalies" (such as an apparent excess of tagged Z + jet events).

The "Evidence for top" PRL is released in April 1994.



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