Higgs-Tquark NJL 3-State System
at LHC (for Higgs) and at Fermilab (for Tquark)

Frank Dodd (Tony) Smith, Jr. - 2018

Abstract:

E8 Physics (viXra 1804.0121) views Higgs as a Nambu-Jona-Lasinio (NJL) type Truth Quark -Truth antiQuark Condensate with 3 mass states for Higgs and Truth Quark:

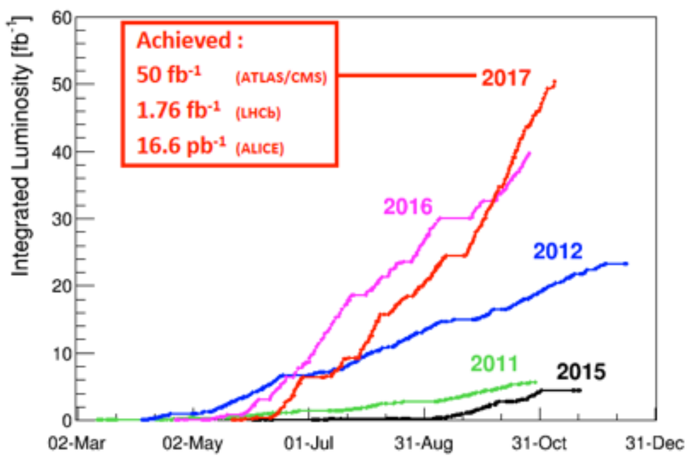
Low-mass - 125 GeV Higgs and 130 GeV Truth Quark;
Middle-mass - 200 GeV Higgs and 174 GeV Truth Quark;
High-mass - 250 GeV Higgs and 220 GeV Truth Quark.

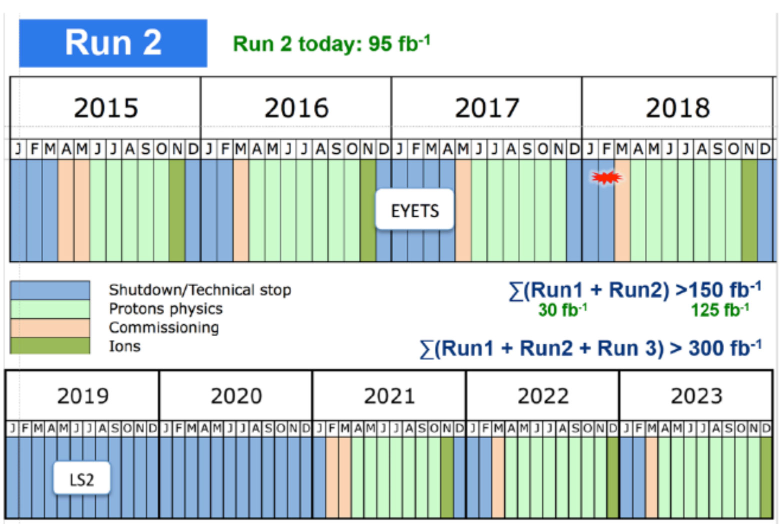
This paper is about observations of Higgs and Truth Quark mass states and data analysis such as histogram Bin Widths.

Table of Contents:

LHC Higgs and Fermilab Truth Quark Experiments

Now (2018) Fermilab is no longer doing Truth Quark Experiments
but the LHC is still doing Higgs Experiments:
On 28 Feb 2018 the 133rd LHCC Meeting - OPEN Session - presented slides:
LHC Machine Status Report - Markus Zerlauth -





LHC schedule 2018

A production year to complete Run 2

Goal ~55-60 fb^{-1}
(131 days of p-p physics)
BCMS 25ns , 13 TeV
keeping the LHC availability close to 50% (stable beams)

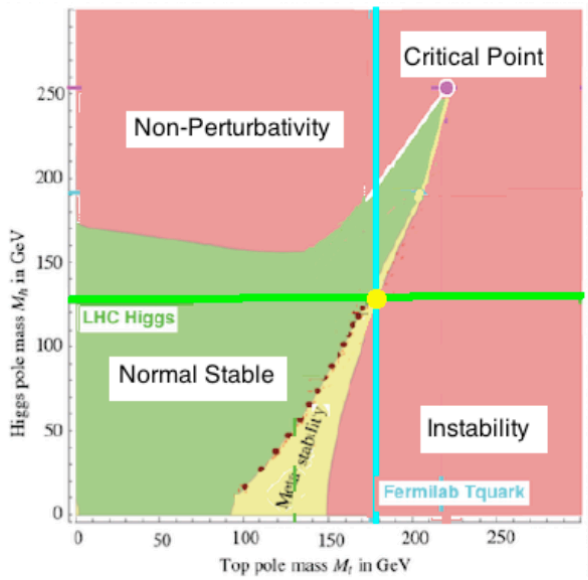
LHC and Fermilab Consensus View:

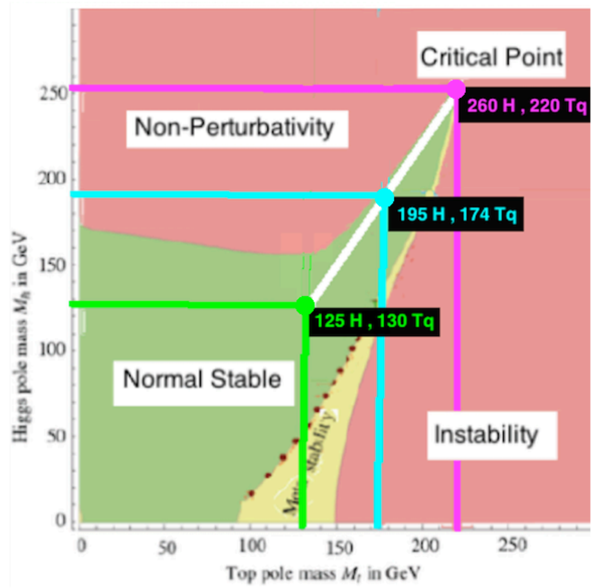
there is 1 Higgs at 125 GeV
there is 1 Truth Quark at 174 GeV

E8 Physics View: Higgs and Truth Quark = 3-Mass-State Nambu-Jona-Lasinio System:

Higgs at 125 GeV and Truth Quark at 130 GeV
Higgs at 200 GeV and Truth Quark at 174 GeV
Higgs at 250 GeV and Truth Quark at 220 GeV

Here are Higgs Mass - Truth Quark Mass Phase Diagrams with
Normal Stable Region in green
Non-Perturbative Region in upper part of red region
Vacuum Instability Region in right side of red region
Vacuum Metastable Region in yellow
Critical Point at HIggs Mass = Higgs VEV





Phase Diagram on the left shows Consensus View with one Mass State Higgs = 125 GeV and Truth Quark = 174 Gev predicting a Metastable Vacuum.

Phase Diagram on the right shows the E8 Physics View that the Higgs and Truth Quark form a 3-Mass-State Nambu-Jona-Lasinio System with

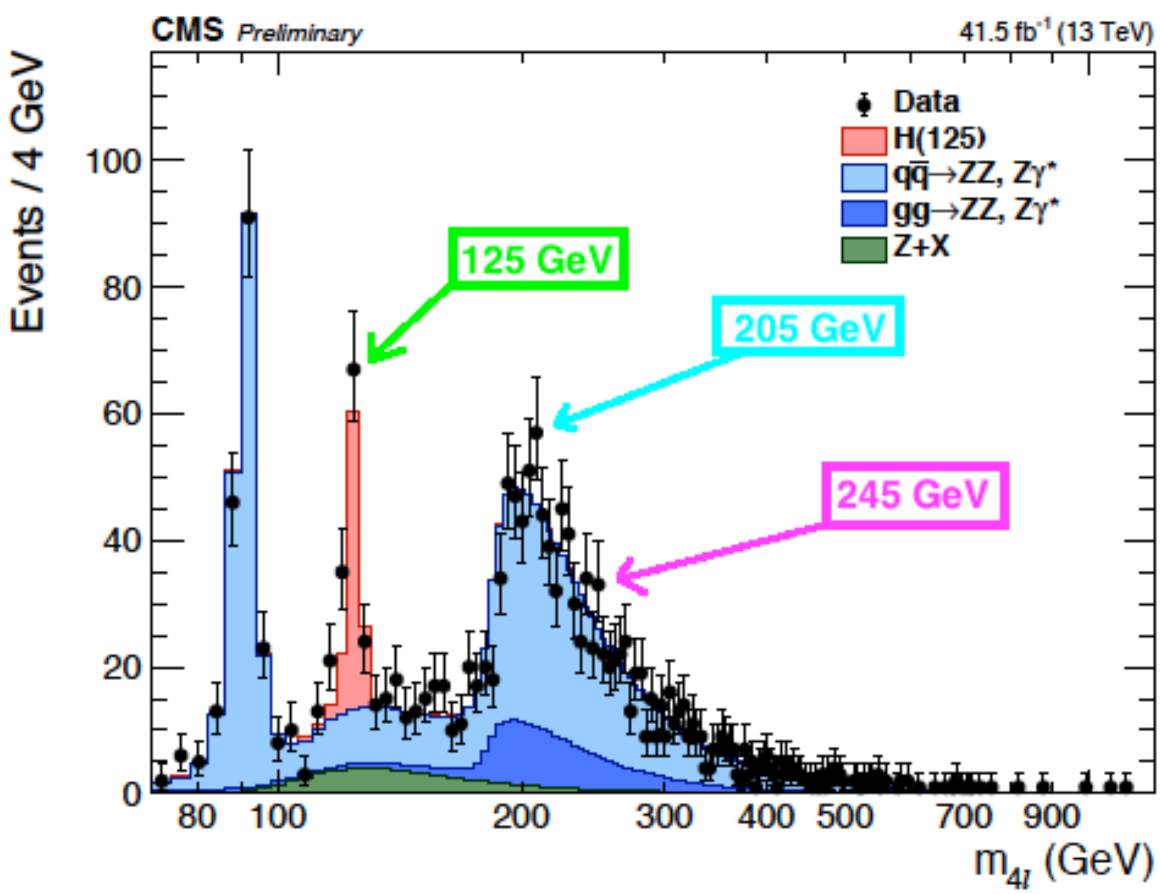
125 GeV Higgs and 130 GeV Truth Quark in the Normal Stable Region
200 GeV Higga and 174 GeV Truth Quark on Boundary of NonPerturbative Region
250 GeV Higgs and 220 GeV Truth Quark at Critical Point

Has the LHC seen 3 Higgs Mass States of E8 Physics?

Has Fermilab seen 3 Truth Quark Mass States of E8 Physics?

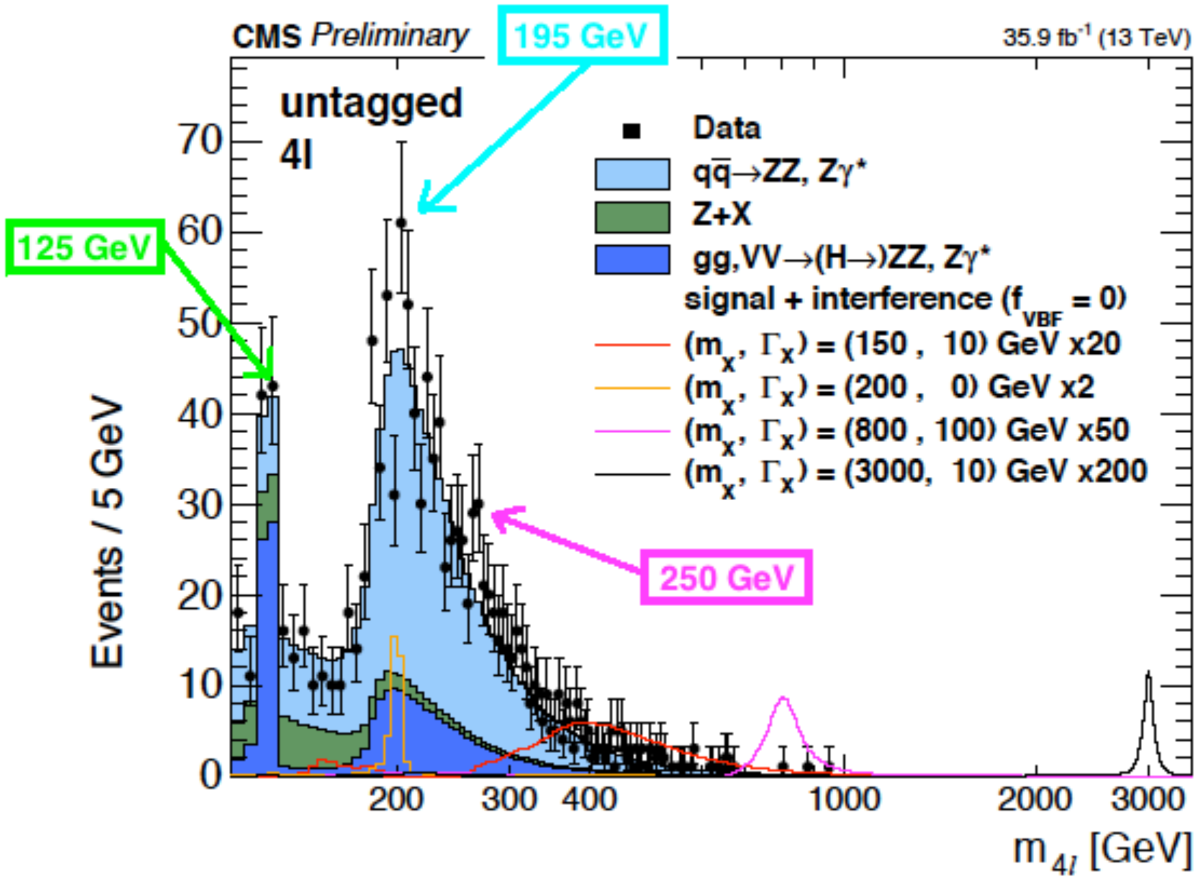
As to the LHC and 3 Higgs Mass States of E8 Physics:

On 4 June 2018 at LHCP Bologna 2018 Roberto Carlin presented
"Status and highlights from the CMS experiment".
His Slide 14 referred to CMS-PAS-HIG-18-001 dated 3 June 2018 which says
"... The **H -> ZZ -> 4l decay channel** (l = e, mu) has a large signal-to-background ratio due to the complete reconstruction of the final state decay products and excellent lepton momentum resolution ...
A data sample of proton-proton collisions at a center-of-mass energy of 13 TeV is used, corresponding to an integrated luminosity of **41.5 fb-1 recorded in 2017** by the CMS detector at the LHC. ... Figure 2 ...Distribution of the four-lepton reconstructed invariant mass m4l in the full mass range ...



...".

The 41.5 fb-1 2017 CMS histogram is very similar to its 35.9 fb-1 2016 counterpart from CMS PAS HIG-17-012 (2017/12/08) Figure 2:



CMS PAS HIG-18-001 (2018/06/03) also says "... Combination [of 2017 data] with data recorded in **2016** by ... CMS ... 13 TeV corresponding to an integrated luminosity of **35.9 fb-1** is reported ..." and is shown in the top image on the next page.

CMS used bin size 5 GeV for its 2016 data and 4 GeV for its 2017 data and for the combined 2016 + 2017 histogram (top image on next page). Tommaso Dorigo on 16 May 2011 put on his blog a post titled "Choose Bins Wisely" saying "... The only concern with too narrow bins is ...that random fluctuations might distract the user's attention from the important features of the distribution ... Let us see ... typical experimental cases ... [Case three]... Barely significant bump, small statistics ... Here I believe the narrowest binning is a bit extreme ...". Lubos Motl commented "... the main trade-off here is clear. If the bins are too wide, you lose the detailed information about the x-coordinate.

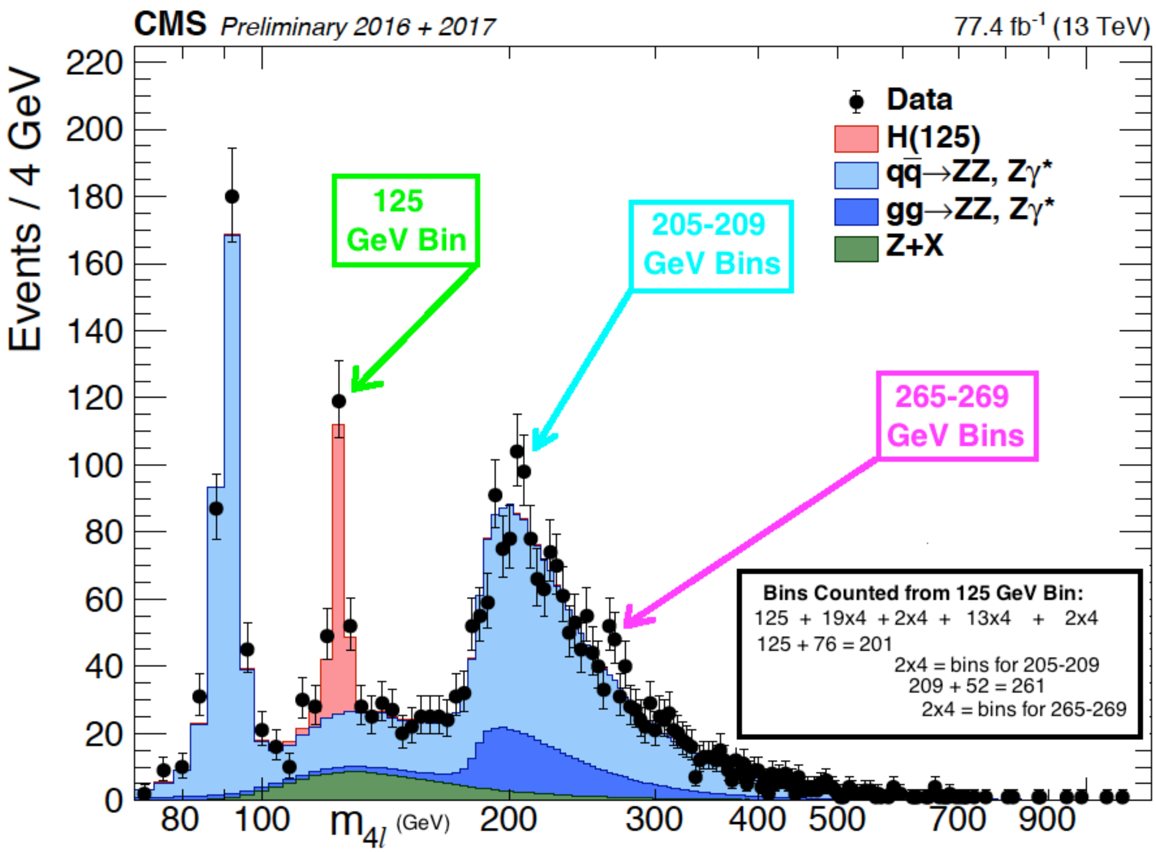
If the bins are too narrow, you lose the information about the y-coordinates - the number of events / objects in each bin becomes too fluctuating ...

It's always possible to merge bins into bigger ones ..."

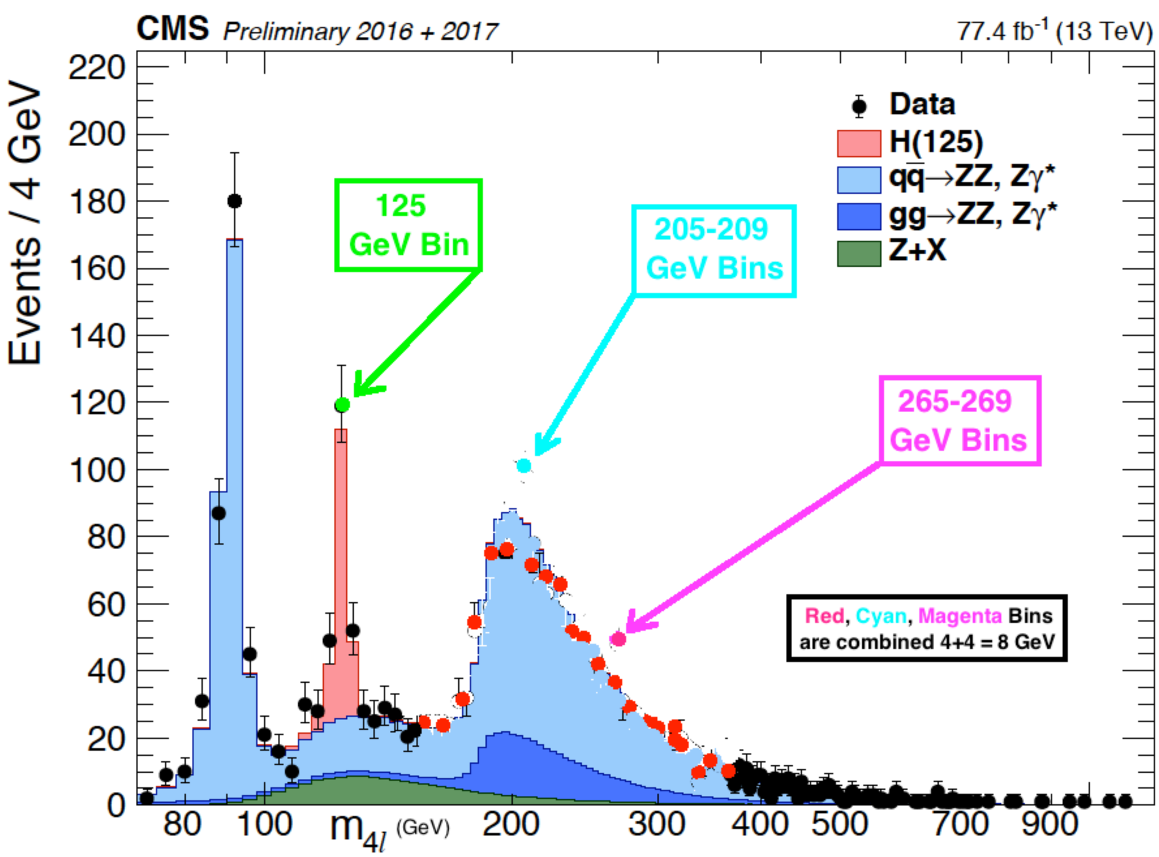
In the CMS combined histogram it seems to me that there are some large fluctuations between adjacent bins so to smooth out that noise I **merged some adjacent 4 GeV bins to get 8 GeV bins** in the combined histogram

The results of **merging some 4 GeV Bins to 8 GeV Bins** are shown in the histogram at the bottom of hte next page. Merged 8 GeV bins are colored red or cyan or magenta.

All three Higgs mass states show up more clearly using larger merged bins although the underlying data are the same.

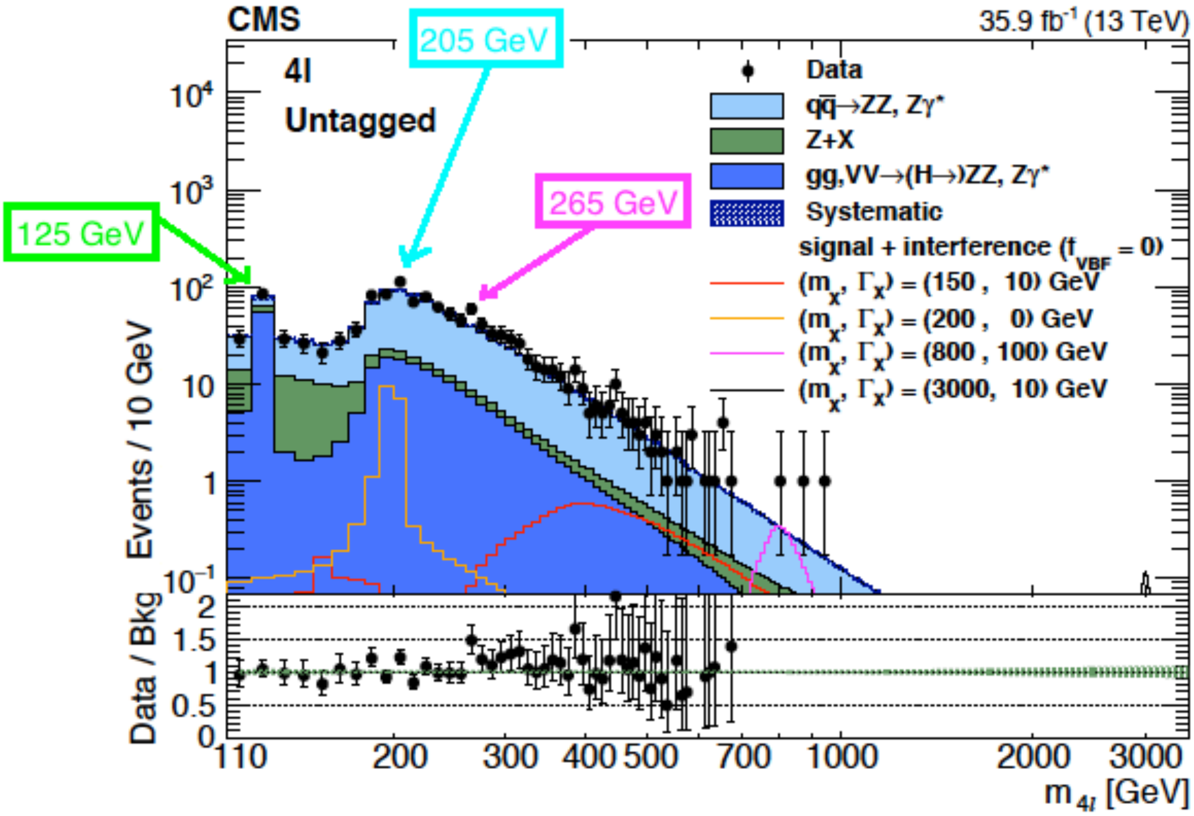


CMS Preliminary 2016 + 2017
77.4 fb-1 (13 TeV)
Events / 4 GeV
m4l (GeV)
Data
H(125)
qq̄→ZZ, Zγ*
gg→ZZ, Zγ*
Z+X
125 GeV Bin
205-209 GeV Bins
265-269 GeV Bins
Bins Counted from 125 GeV Bin:
125 + 19x4 + 2x4 + 13x4 + 2x4
125 + 76 = 201
2x4 = bins for 205-209
209 + 52 = 261
2x4 = bins for 265-269



CMS Preliminary 2016 + 2017
77.4 fb-1 (13 TeV)
Events / 4 GeV
m4l (GeV)
Data
H(125)
qq̄→ZZ, Zγ*
gg→ZZ, Zγ*
Z+X
125 GeV Bin
205-209 GeV Bins
265-269 GeV Bins
Red, Cyan, Magenta Bins are combined 4+4 = 8 GeV

The LHCP Bologna 2018 presentation “Searches for BSM Higgs Bosons ...”
by Mariarosaria D’Alfonso did not contain anything relevant to Higgs -> ZZ -> 4l
more recent than the histogram of Slide 14 based on 2016 data in arXiv 1804.01939



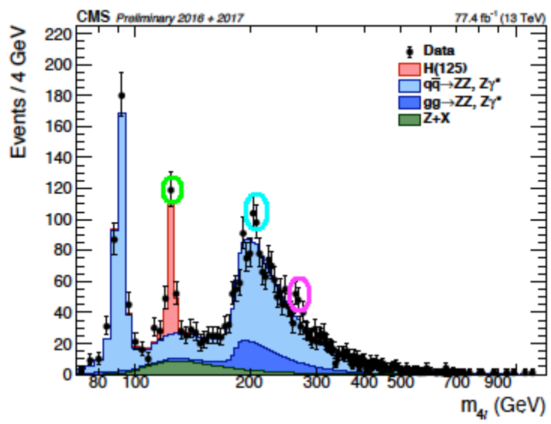
Although all three Higgs mass states are shown in the histogram,
and its 10 GeV Bin width gives a smoother background than 4 GeV or 5 Gev Bin width,
the use by CMS of a log scale for event number makes the states less obvious
than they seem in histograms with a linear scale for event number.
Despite the clarity of the presence of all three Higgs mass states, Slide 26 says
“... BSM Higgs bosons are still hiding ...”
so the official LHC opinion is that the excess peaks around 200 GeV and 250 GeV
are nothing but statistical fluctuations, which opinion may be at least in part based on
using a LEE (Look Elsewhere Effect) for the histogram range 110 GeV to 3000 GeV.
Since the Nambu - Jona-Lasinio 3-mass-state Higgs-as-TruthQuark-Condensate model
predicts Higgs mass states around 200 GeV and 250 GeV
it is wrong apply a LEE to histogram data analysis evaluating the model.
Still further, Slide 4 says “... Full coverage of a broad mX range is crucial
to maximize the sensitivity to different ... theoretical models
(higgs SM sector + scalar, doublet, triplet ...) ...” but there is no mention ...
of the Nambu - Jona-Lasinio 3-mass-state Higgs-as-TruthQuark-Condensate model
despite the fact that it is a straightforward extension of the higgs SM sector
that gives testable predictions of mass states that are observable
in the Golden Channel Higgs -> ZZ -> 4l.

The ATLAS presentation at LHCP Bologna 2018 by Kunihiro Nagano shows on Slide 15 a histogram for H -> ZZ -> 4l with 79.8 fb-1 but it is only for m4l from 80 to 170 GeV so it is not relevant for excesses around 200 GeV or 250 GeV. Slide 15 referred to ATLAS-CONF-2018-018 which is dated 4 June 2018 and said
"... The Higgs boson candidates within a mass window of 115 GeV < 4l < 130 GeV are selected ..." so it also is not relevant for excesses around 200 GeV or 250 GeV.

In Summary:

At LHCP Bologna 2018

CMS, despite indications in its combined 2016-2017 histogram of 3 Higgs mass states



considered only the 125 GeV Higgs mass state (the SM Higgs boson), saying
"... Results based on data collected in 2016 and 2017 are combined ... All results are consistent, within their uncertainties, with the expectations for the SM Higgs boson ..." and **ignoring indications of Higgs mass states around 200 GeV and 250 GeV**.

ATLAS, despite having reported in ATLAS-CONF-2017-058 for H -> ZZ -> 4l channel that 2015-2016 13 TeV data showed "... **excess ... observed ... around 240 ... GeV** ... with **local significance 3.6 sigma** ...", at Bologna and in ATLAS-CONF-2018-018 "selected ... Higgs boson candidates within a mass window of 115 GeV < 4l < 130 GeV" thus also **ignoring indications of Higgs mass states around 200 GeV and 250 GeV**.

BALONEY in Bologna

CMS-ATLAS ignoring 200 and 250 GeV Higgs mass states at LHCP Bologna 2018 is, in one of Feynman's favorite words, BALONEY

Carl Sagan proposed a Baloney Detection Kit. Among its tools are:

Encourage substantive debate on the evidence by knowledgeable proponents of all points of view ...

CMS and ATLAS refuse to discuss why they ignore
the Nambu - Jona-Lasinio 3-mass-state-Higgs-as-TruthQuark-Condensate model
and to debate it based on evidence from H -> ZZ* -> 4l channel observations

Arguments from authority carry little weight ...

CMS and ATLAS collaboration structure is based on Authority-enforced Consensus

Spin more than one hypothesis ...

CMS and ATLAS ignore the hypothesis that the 3-mass-state-Higgs might be true

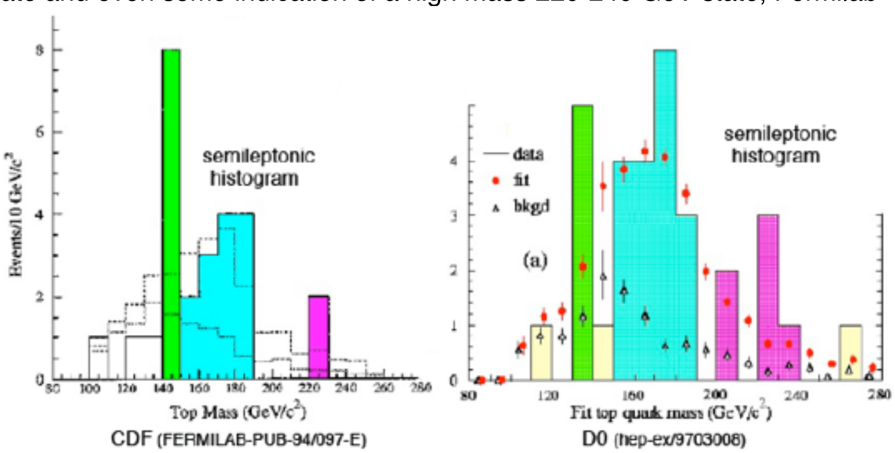
Try not to get overly attached to a hypothesis just because it's yours.

CMS and ATLAS should compare their idea of 125 GeV as the only HIggs mass state
with the alternatives including the Nambu - Jona-Lasinio 3-mass-state-Higgs

Quantify ...

Higgs mass event excesses in the H -> ZZ* -> 4l channel histograms are quantified
numerical values that can and should be compared openly and objectively

Very similar acts of BALONEY were carried out by Fermilab (CDF and D0) with respect to the 3-mass-state -Truth Quark from the 1990s to the present day. Despite CDF and D0 semileptonic histograms clearly showing, not only the Consensus 174 GeV value for Truth Quark mass, but also a low mass 130-140 GeV state and even some indication of a high mass 220-240 GeV state, Fermilab



Encourage substantive debate on the evidence ...

refused to discuss or debate models showing states other than 174 GeV

Arguments from authority carry little weight ...

used their Consensus Authority to suppress ideas other than 174 GeV

Spin more than one hypothesis ...

ignored the hypothesis that the 3-mass-state-Truth Quark might be true

Try not to get overly attached to a hypothesis just because it's yours ...

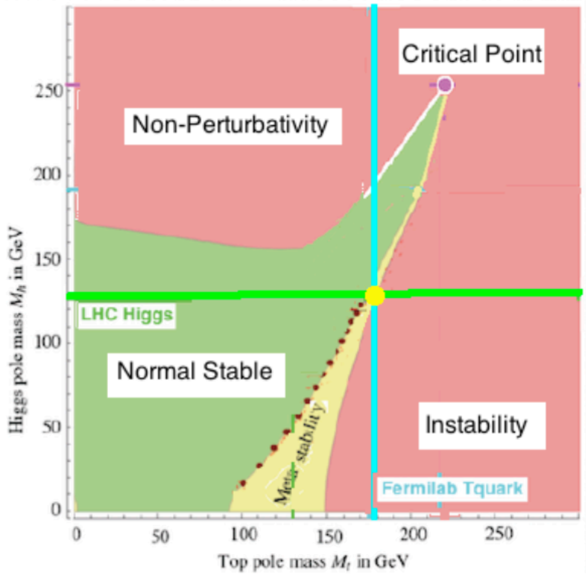
was (and still is) totally attached to its 174 GeV Consensus value

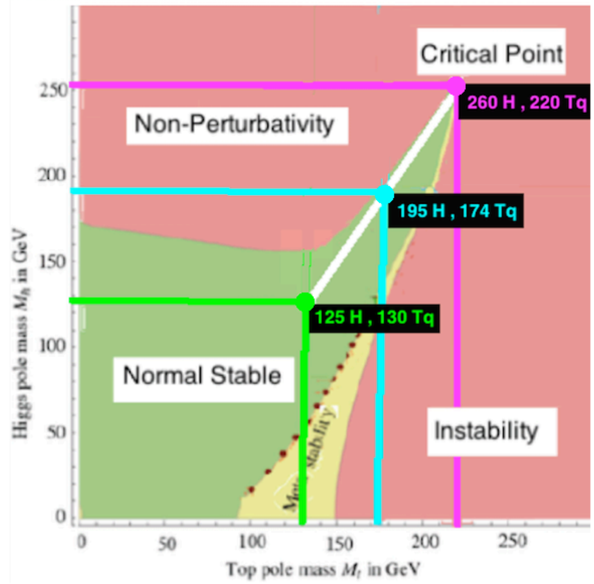
Quantify ...

the Truth Quark event histograms are quantified values that could be compared openly and objectively

(For details about the Fermilab situation, go to pages 11 ff and 29 ff)

Consensus or E8 Physics View:
What difference does it make ?





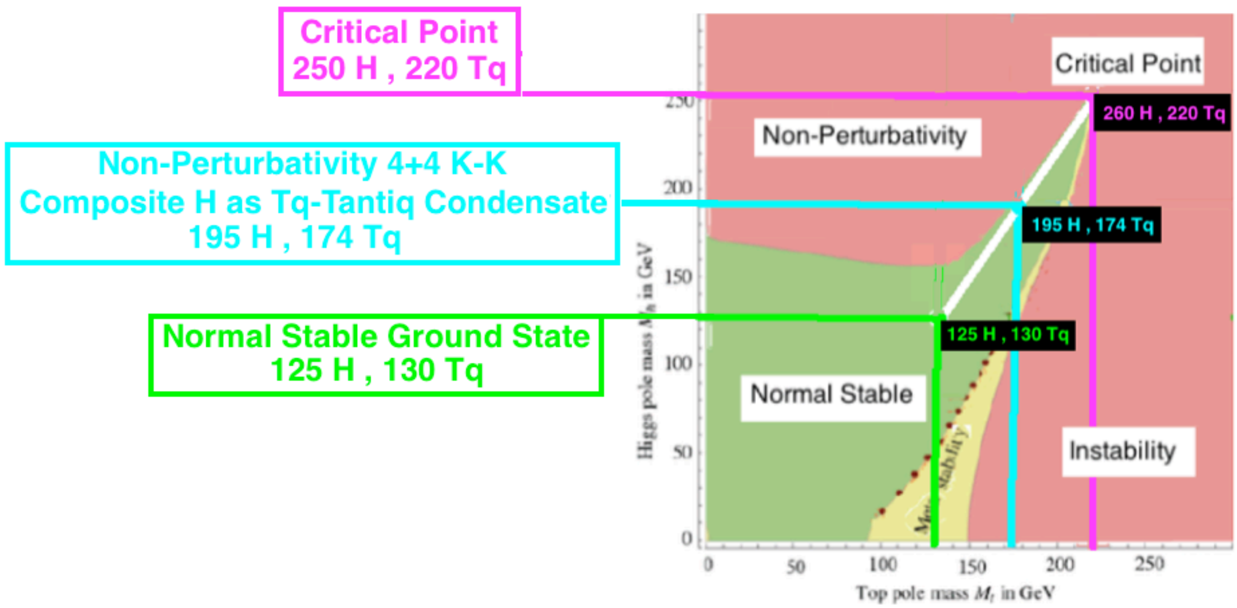
If the **Consensus View** is correct, then **Our Universe is Metastable**.

If the **Alernative View** is correct, then **we live in a Normal Stable Ground State** and there is a clear path to studying New Phenomena at Higher Energies:
at the **Non-Perturbative Boundary** the **Compositeness of NJL Higgs** is manifest as is the structure of (4+4)-dim **Kaluza-Klein Spacetime M4 x CP2**
(M4 is Minkowski and CP2 = SU(3) / SU(2)xU(1) is Internal Symmetry Space)
at and beyond the **Critical Point** the Higgs mechanism no longer gives mass to particles so we will enter a **Massless Realm** in which such things as the Kobayshi-Maskawa matrix will be radically changed, possibly becoming like the Democratic Mixing Matrix described by Marni Sheppeard.

What about the Truth Quark ?

The Fermilab and LHC Consensus View is that
there is one Truth Quark Mass State at 174 GeV
and one Higgs Mass State at 125 GeV

The E8 Physics View is that
Higgs and Truth Quark = 3-Mass-State Nambu-Jona-Lasinio System:



so even if the LHC is consistent with the E8 Physics View
the E8 Physics View would be refuted if there were not 3 Truth Quark Mass States:

Truth Quark at 130 GeV

Truth Quark at 174 GeV

Truth Quark at 220 GeV

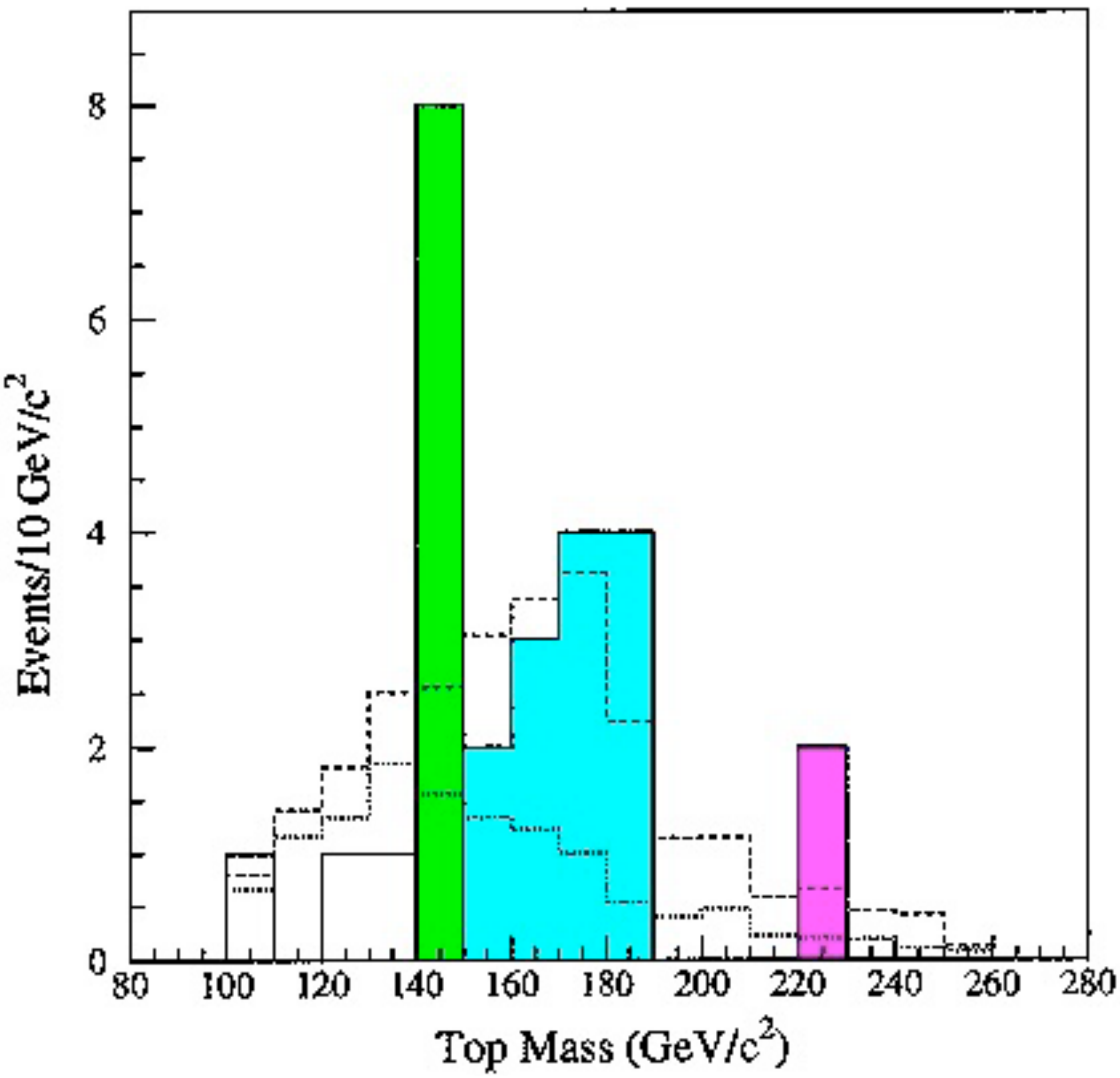
Although the Fermilab Consensus View has long been that there is
only one Truth Quark Mass State and it is 174 GeV,
my opinion is similar to my opinion about the LHC and Higgs:

there is a reasonable analysis of Fermilab data
that supports 3 Truth Quark Mass States of E8 Physics

1994 CDF observation of Truth Quark

26 April 1994 - FERMILAB-PUB-94/097E

A semileptonic histogram showed **three mass states of the Truth quark**



The green bar represents a bin in the **140-150 GeV** range consistent with the E8 Physics prediction of a Truth Quark Ground State around 130 GeV.
This peak was rejected by CDF Fermilab on the (in my opinion spurious) grounds "... We assume the mass combinations in the 140 to 150 GeV/c^2 bin represent a statistical fluctuation since their width is narrower than expected for a top signal ...".

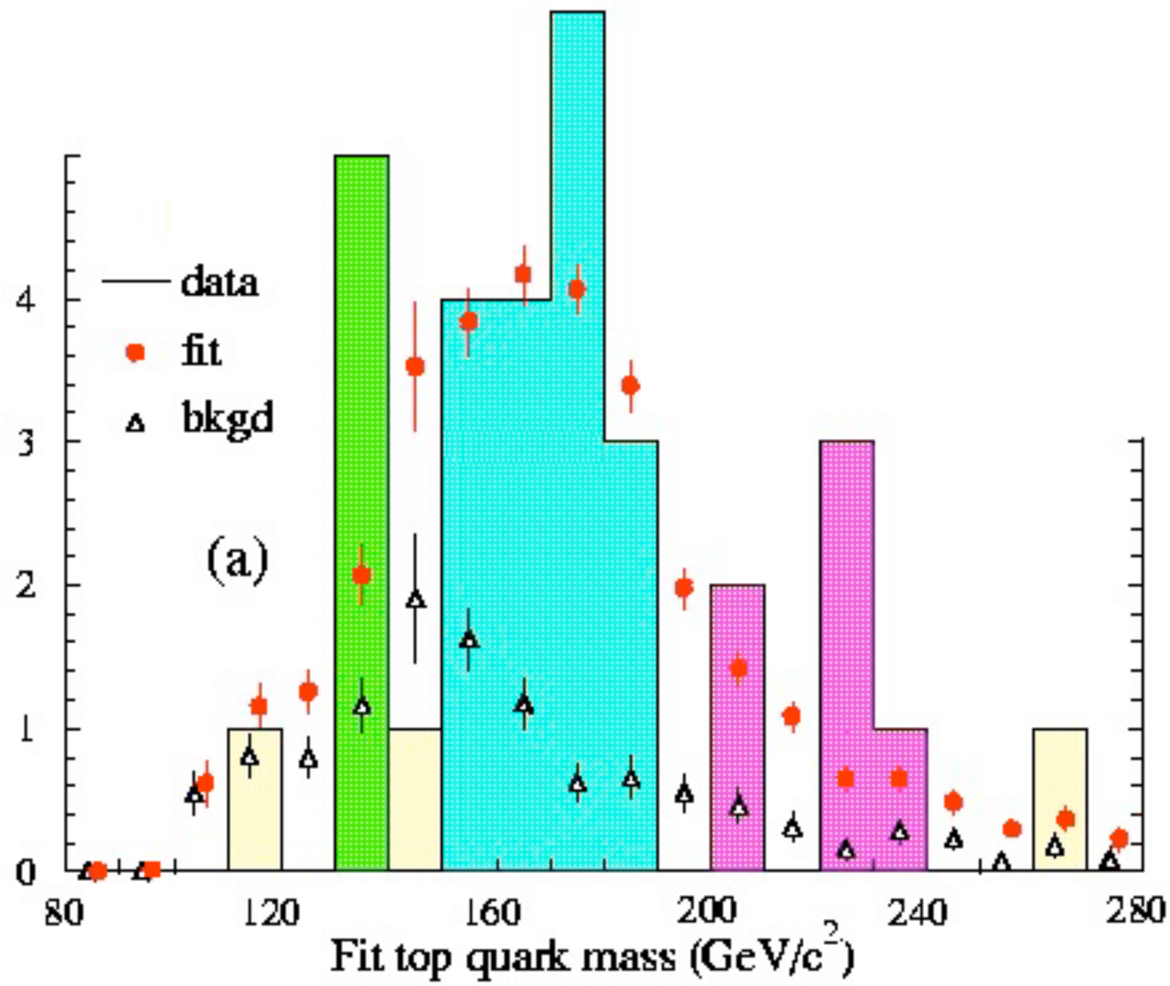
The cyan bar represents a broader peak in the **160-180 GeV** range consistent with the 174 GeV mass state of the Truth Quark that is accepted by the Consensus of the Physics Community as the one and only mass state of the Truth Quark.

The magenta bar represents a bin in the **220-230 GeV** range consistent with the E8 Physics prediction of a Truth Quark Ground State around 220 GeV.
This peak was rejected by CDF Fermilab as too small (only 2 events) to be significant.

1997 D0 observation of Truth Quark

1997 - D0 hep-ex/9703008

A semileptonic histogram also showed **three states of the Truth Quark**



Despite confirmation of the Truth Quark Ground State around 130-140 GeV by D0 Fermilab continued (and continues to the present day) to refuse to accept it.

Fermilab happily accepted the confirmation of the Truth Quark state around 174 GeV.

Despite D0 having 6 events (not just 2) for Truth Quark in the 200-240 GeV range Fermilab continued (and continues to the present day) to refuse to accept it.

In Tommaso Dorigo's blog entry "Proofread my PASCOS 2006 proceedings" 5 Sep 2007 particularly comment 11 (by me) and comment 13 (Tommaso's reply to 11):
I asked: "... With respect to the CDF figure ...[and]... the D0 figure ... **what are the odds of such large fluctuations [green peaks] showing up at the same energy level in two totally independent sets of data ?** ...".

Tommaso replied: "... It is **of the order of 4-sigma**. ...".

Observations relevant to Truth Quark mass states have been made by experiments such as (descriptions from Wikipedia):

ARGUS - a particle physics experiment at the electron-positron collider DORIS II at DESY in Hamburg - commissioned in 1982 - operated until 1992.
HERA - DESY's largest synchrotron and storage ring for electrons and positrons - began operation in 1990 - started taking data in 1992 - closed in 2007 - detectors H1 and ZEUS

FERMILAB - site of Tevatron proton-antiproton collider at Batavia, Illinois - Tevatron was completed in 1983 and closed in 2011 - detectors CDF and D0

LEP - electron-positron collider at CERN in Geneva used from 1989 until 2000

Here is a History of some Observations relevant to the Truth Quark in a Nambu-Jona-Lasinio 3-State System:

1988 - Tquark - Nir, Nuclear Physics B306 (1988) 14 -
ARGUS B-Bbar experiments set limits on the Mass of the Truth Quark, showing it to be between 43 GeV and 180 GeV, and likely to be between **83 GeV and 180 GeV**.

1992 - Low-mass Tquark - **Dalitz, Goldstein**, Phys. Lett. B 287 (1992) 225-230) -
A simple idealized procedure is proposed for the analysis of individual top-antitop quark pair production and dilepton decay events, in terms of the top quark mass. This procedure is illustrated by its application to the CDF candidate event.
If this event really represents top-antitop production and decay, then the top quark mass would be **131 +22 -11 GeV**.

1993-Low-mass Tquark- **Kondo, Chikamatsu, Kim** J. Phys. Soc. Japan 62: 1177-82 - the dilepton candidate found during the Fermilab 1988-89 run can be interpreted as from the top antitop pair

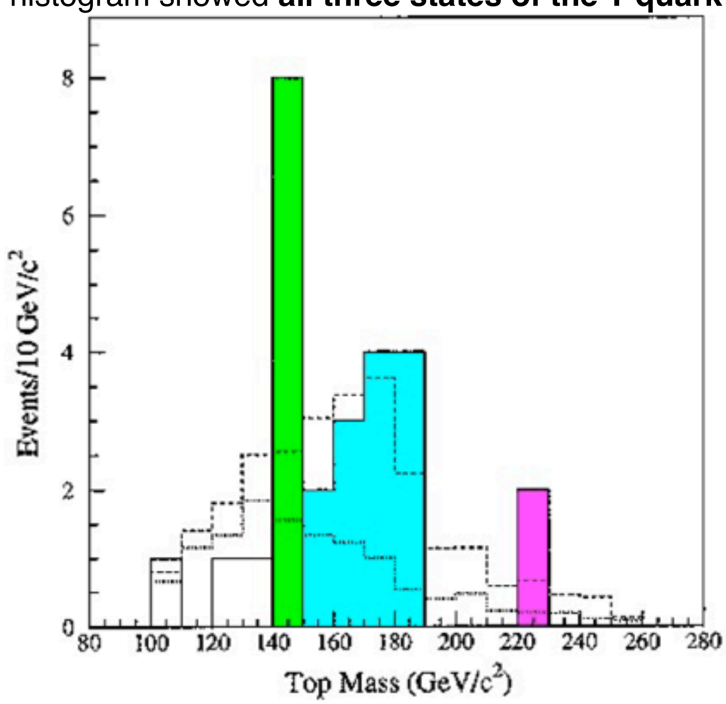
1993 - Low-mass Tquark - **Dalitz, Goldstein**, hep-ph/9308345 -
"... Now that LEP experiments have measured with high accuracy many quantities related with the electroweak interactions, these measurements can be compared with the corrected theoretical predictions in order to draw some conclusions concerning the top quark and any other particles of high mass. ... With the LEP data updated to July 1992, Ellis et al. have given the value ... $m_t = 124(27)$GeV, (2.1) using α_S $(M_Z^2) = 0.118(8)$.
...
One good ($\mu^- e^+$) candidate event has ... been published by the CDF collaboration ...

A second (μe) candidate was shown by the CDF collaboration in their report given at the November 1992 Chicago Meeting of the Division of Particles and Fields of the American Physical Society, although no measurement details were released.

It was well known at that meeting that the DO collaboration also had their first (μe) candidate. Although the integrated luminosities IL are not known to us precisely, a value of about 20 pb^{-1} for CDF (including IL=4.7 pb^{-1} from their 1989 paper) and 10 pb^{-1} for DO would appear plausible estimates, at least of the right order of magnitude. ...
On the assumption that these three (μe) candidates do stem from top-antitop production, and that the integrated luminosity up to November 1992 was about 30 pb^{-1}, the probability distribution for m_t ... peak is at **120 GeV**, the one-deviation limits being **109 and 135 GeV**. ... the peak value thus determined for m_t is not strongly dependent on our estimate for IL, nor on the number of μe events. ...".

1994 - Low-mass Tquark - 4 April - Abachi et al -
We have searched for evidence of top quark production in *pp*⁻ collisions at √*s* =1.8 TeV using the ***D*0** detector at the Fermilab Tevatron collider. ... We discuss the properties of an event for which expected backgrounds are small ... it is a dilepton e-mu event in a relatively low background region with a likelihood distribution that is maximized for a Tquark mass of about **145 GeV/c^2**.

1994 - Low, Middle, High-mass Tquark - 26 April - **FERMILAB-PUB-94/097-E** -
A semileptonic histogram showed **all three states of the T-quark**:



The green bar represents a bin in the **140-150 GeV** range containing Semileptonic events considered by me to represent the Truth Quark.
The cyan bar represents a broader peak in the **160-180 GeV** range
that includes the 174 GeV Truth Quark at the Triviality Boundary of the H-Tq System.
The magenta bar represents a bin in the **220-230 GeV** range
of the Truth Quark at the Critical Point of the Higgs - Truth Quark System.

1995 - Middle-mass Tquark - **CDF** hep-ex/9503002 -
analyzing about 50 pb-1 of data, mostly Semileptonic events
gets a T-quark mass of about **176 GeV**

1995 - Middle-mass Tquark - **D0** hep-ex/9503003 -
analyzing about 50 pb-1 of data, mostly Semileptonic events
gets a T-quark mass of about **199 GeV**

1995 - Low, Middle-mass Tquark - **Dalitz, Goldstein** hep-ph/9506232 -
analyze the recent seven L(+/-)4jet events and, in accord with CDF,
get a mass estimate of about **175 GeV** for those events.
Their analysis of e(+/-)mu(+/-)2jet events gives
a somewhat lower peak t-quark mass (about **156 GeV**).
When they consider the CDF event 45047/104393 to
be a dilepton event with both leptons hard, and combining two jets into a single jet,
they get a good fit as a t-tbar event with t-quark mass **136 (+18 -14) GeV**.

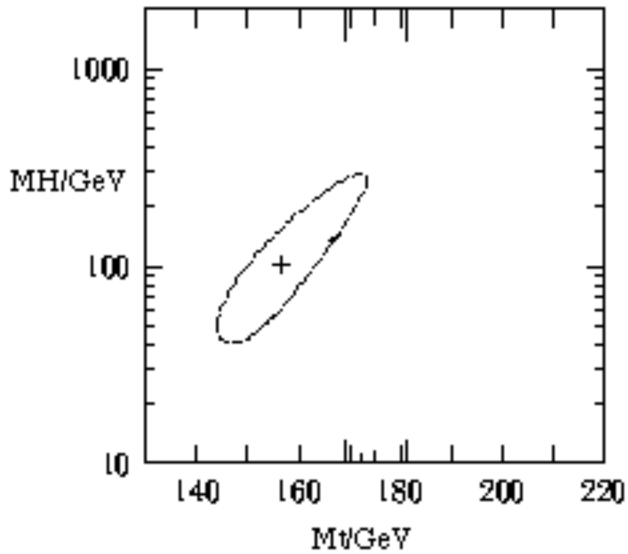
1995 - Low-mass Tquark -**Kondo** Oral History Interview by K. Staley 10 October 1995 -
the dilepton candidate found during the Fermilab 1988-89 run could be reconstructed as
decay of a top-antitop pair with top mass of around **130 GeV/c2** with a very broad error.

1996 - Low-mass Tquark - **Goldstein** hep-ph/9611314 -
Top-antitop quark pairs produced at the Tevatron have a sizeable spin correlation. That correlation feeds into the angular distribution of the decay products, particularly in the dilepton channel. Including the expected correlation in an overall analysis of a handful of actual dilepton events continues to favor a lower top mass (centered on **155 GeV**) than the single lepton events.

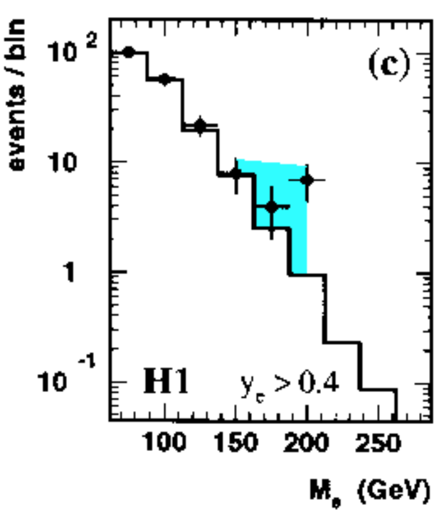
1996 - Low, Middle-mass Tquark - **Heinson** hep-ex/9601006 -
results on top quark physics from the DZero collaboration since the discovery of the top quark in March 1995 with about 50 pb^(-1) of data from 1992 to 1995:
For Semi-Leptonic Lepton + Jets events: Mt = **199 +24 -30 GeV**;
For Dilepton events: Mt = **145 +/- 32 GeV**.

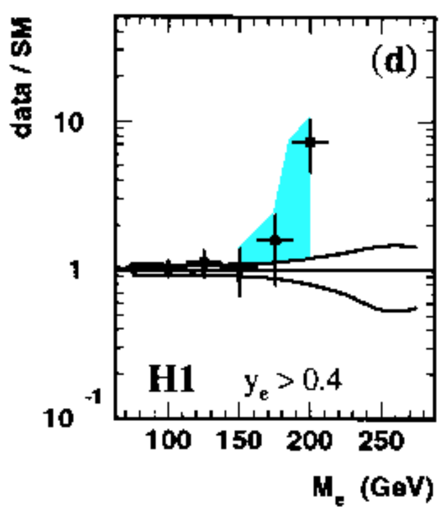
1996 - Low, Middle-mass Tquark - **Campagnari, Franklin** hep-ex/9608003 -
For Semi-Leptonic Lepton + Jets events:
CDF kinematic result: Mt = **180 +/- 12(stat) (+19/-15)(syst) GeV**;
CDF mass reconstruction result: Mt = **176 +/- 9 GeV**;
D0 mass reconstruction result: Mt = **170 +/- 18 GeV**.
For Dilepton events:
CDF kinematic result:
Mt = **159 (+24/-22)(stat) +/- 17(syst) GeV**;
D0 mass reconstruction result:
Mt = **145 +/- 25(stat) +/- 20(syst) GeV**.

1996 - Low-mass Tquark - **Dittmaier, Schildknecht**
hep-ph/9609488 -
implications of 1996 electroweak data on the Higgs and T-quark masses -
If the LEP value of the Weinberg angle s2w = 0.23200 is used,
and the SLD value s2w = 0.23165 is excluded
then, approximately, Mt = **155 GeV** and MH = **100 GeV**:

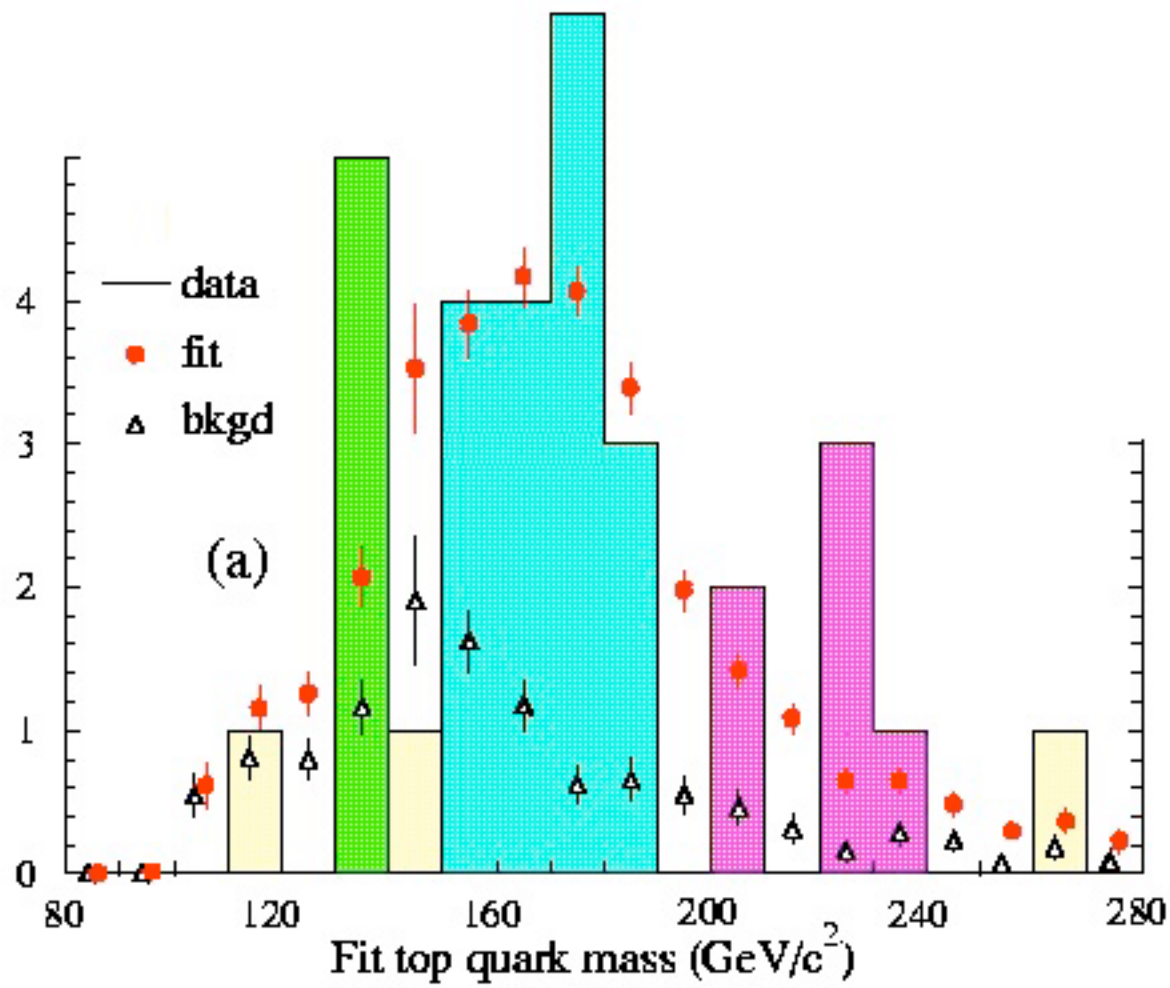


1997 - Middle-mass Tquark - **HERA H1** hep-ex/9702012 -
The following histograms show that the HERA H1 events begin to appear with unusual frequency at the **150-200 GeV** and compare the HERA H1 observed data with the 1-sigma deviation line from the standard NC DIS expected data





1997 - Low, Middle, High-mass Tquark - **D0** hep-ex/9703008 -
A semileptonic histogram showed **all three states of the T-quark**:

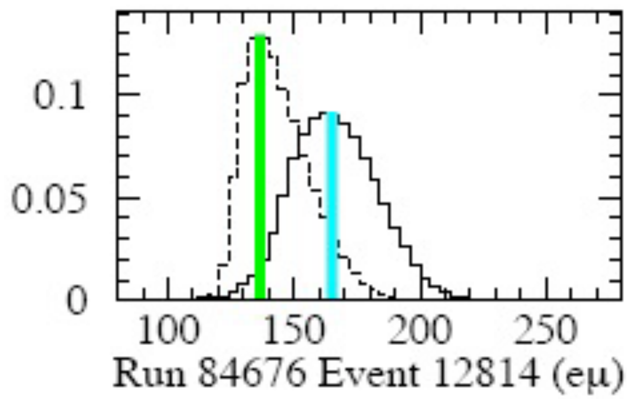


It was not only consistent with the 3 Truth Quark Mass States of E8 Physics
but also with the CDF 1994 semileptonic histogram of **FERMILAB-PUB-94/097-E**

Although Fermilab Consensus then and now was and is that the green low-mass state does not exist and is only a statistical fluctuaion, Tommaso Dorigo said that the odds of having both CDF and D0 seeing what they saw in those two histograms

are **4 -sigma**

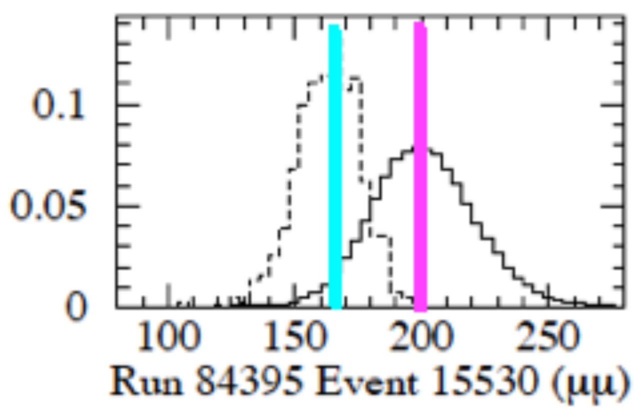
1997 - Low, Middle, High-mass Tquark - **Varnes** U. C. Berkeley Ph.D. Thesis
FERMILAB-THESIS-1997-28
https://www-d0.fnal.gov/results/publications_talks/thesis/varnes/thesis.ps
In his 1997 Ph.D. thesis Erich Ward Varnes (page 159) said:
"... distributions for the dilepton candidates. For events with more than two jets, the dashed curves show the results of considering only the two highest ET jets in the reconstruction ...



...” (colored bars added by me)

The event for all 3 jets (solid curve) seems to me to correspond to
decay of a middle (cyan) T-quark state
with one of the 3 jets corresponding to
decay from the Triviality boundary to the Normal Stable Region (green) T-quark state,
whose immediately subsequent decay corresponds to the 2-jet (dashed curve) event at the low (green) energy level.

In the Varnes thesis there is one dilepton event with 3 jets (solid curve)



that seems to me to correspond to decay of a high (magenta) T-quark state
with one of the 3 jets corresponding to
decay from the Critical Point down to the Triviality Boundary (cyan) T-quark state,
whose immediately subsequent decay corresponds to the 2-jet (dashed curve) event.

Dilepton data are described by Erich Ward Varnes in Chapter 8 of his 1997 UC Berkeley PhD thesis about D0 data at Fermilab:
"… there are six t-tbar candidate events in the dilepton final states … Three of the events contain three jets, and in these cases the results of the fits using only the leading two jets and using all combinations of three jets are given …".
There being only 6 dilepton events in Figure 8.1 of Varnes's PhD thesis

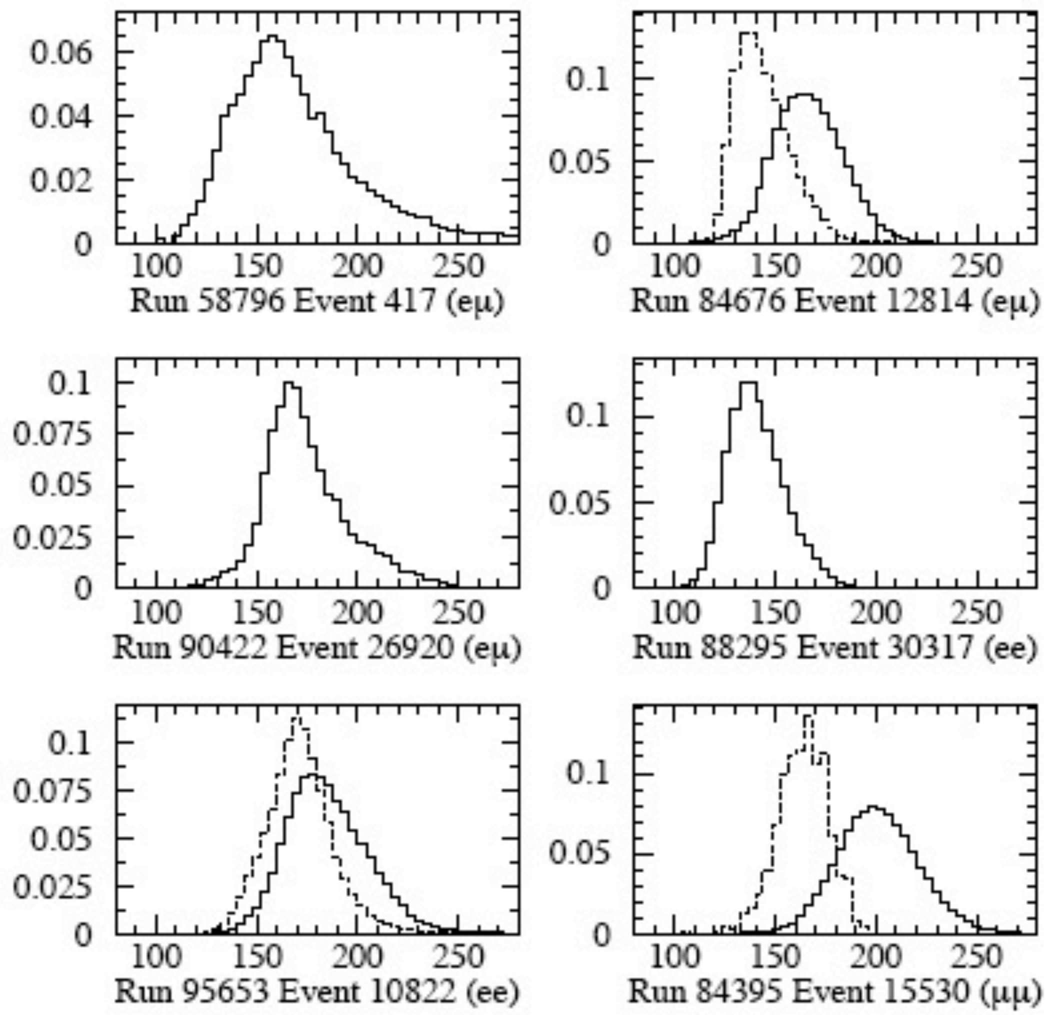


Figure 8.1: $\mathcal{W}(m_t)$ distributions for the dilepton candidates. For events with more than two jets, the dashed curves show the results of considering only the two highest E_T jets in the reconstruction.

it is reasonable to discuss each of them,
so (mass is roughly estimated by me looking at the histograms) here they are:

Run 58796 Event 417 (e mu) - 2 jets - **160 GeV**
Run 90422 Event 26920 (e mu) - 2 jets - **170 GeV**
Run 88295 Event 30317 (e e) - 2 jets - **135 GeV**

Run 84676 Event 12814 (e mu) - more than 2 jets - **165 GeV** -
highest 2 jets - **135 GeV**
Run 95653 Event 10822 (e e) - more than 2 jets - **180 GeV** - highest 2 jets - **170 GeV**
Run 84395 Event 15530 (mu mu) - more than 2 jets - **200 GeV** -
highest 2 jets - **165 GeV**

In terms of 3 Truth Quark mass states - High around 220 GeV or so -
Middle around 174 GeV or so - Low around 130-145 GeV or so - those look like:

Run 58796 Event 417 (e mu) - direct 2-jet decay of Middle
Run 90422 Event 26920 (e mu) - direct 2-jet decay of Middle
Run 88295 Event 30317 (e e) - direct 2-jet decay of Low
Run 84676 Event 12814 (e mu) - decay of Middle to Low then 2-jet decay of Low
Run 95653 Event 10822 (e e) - decay of High to Middle then 2-jet decay of MIddle
Run 84395 Event 15530 (mu mu) - decay of High to MIddle then 2-jet decay of Middle

The 1997 UC Berkeley PhD thesis of Erich Ward Varnes says:
"... the leptonic decays of the t tbar events are divided into two broad categories:
the lepton plus jets and dilepton channels.
The former has the advantage of a large branching ratio, accounting for about 30% of all t tbar decays, with the disadvantage that electroweak processes or detector misidentification of fina-state particle can mimic the t tbar signal relatiely frequently.
Conversely,
the dilepton channels have lower backgrounds, but account for only 5% of all decays.
...
The kinematic selection of dilepton events is summarized in Table 5.2 ...

	ee	$e\mu$	$\mu\mu$
Leptons	E_T> 20 GeV $\lvert\eta\rvert < 2.5$	$E_T(\mathrm{e}) > 15$ Gev, $p_T(\mu) > 15$ GeV/c $\lvert\eta(\mathrm{e})\rvert < 2.5$	$p_T(\mu) > 15$ GeV/c
Jets	≥ 2 with E_T> 20 GeV and $\lvert\eta\rvert < 2.5$		
$\not{E}_T$	> 25 GeV	$\not{E}_T$> 20 GeV $\not{E}_T{}^{\mathrm{cal}} > 10$ GeV	N/A
H_T^e	> 120 GeV	> 120 GeV	> 100 GeV

Table 5.2: Kinematic cuts for the dilepton event selection. The cut used in place of $\not{E}_T$ to reject $Z \to \mu\mu$ events is described in the text, as is the H_T^e variable. Also, the muon η cut is run-dependent, as detailed in Chapter 4.

...

In the dilepton channels, one expects the final state to consist of two charged leptons, two neutrinos, and two b jets (see Fig. 6.1)

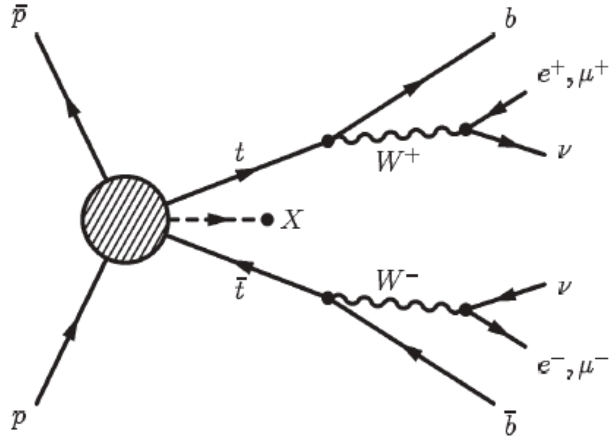
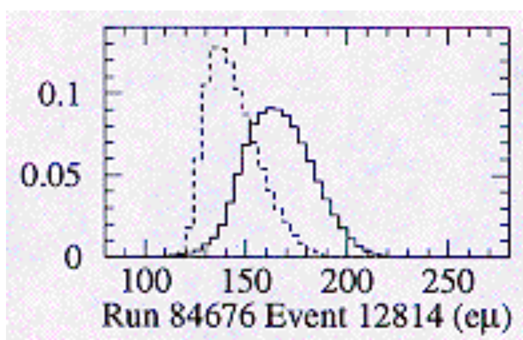


Figure 6.1: Schematic representation of $t\bar{t}$ production and decay in the dilepton channels.

so that the final state is completely specified by knowledge of the energy four-vectors of these six particles ... there are ... kinematic constraints:
The invariant mass of each lepton and neutrino pair is equal to the W mass.
The masses of the reconstructed t and tbar in the event are equal.
...
Figure 8.1: W(mt) distributions for the dilepton candidates. For events with more than two jets, the dashed curves show the results of considering only the two highest ET jets in the reconstruction ...

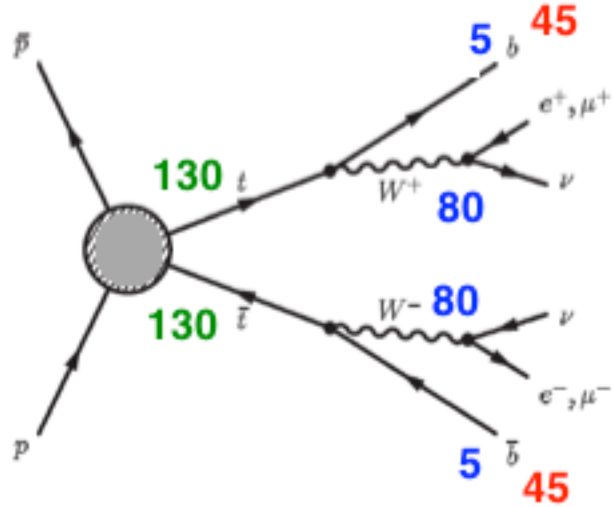


...

Run 84676 Event 12814					z vertex: -6.17 cm		
Object	E	E_x	E_y	E_z	E_T	η	ϕ
Electron	81.3	-75.4	-1.1	-30.2	74.5	-0.39	3.16
Muon	30.2	-25.2	10.6	-12.8	27.4	-0.45	2.75
$\not{E}_T$	–	62.0	5.2	–	62.3	–	0.08
Jet 1	93.8	38.0	-83.7	-15.6	91.9	-0.17	5.14
	(95.9)	(38.9)	(-85.6)	(-16.0)	(94.0)		
Jet 2	37.8	13.9	32.3	-11.2	35.2	-0.31	1.17
	(38.8)	(14.2)	(33.1)	(-11.4)	(36.0)		
Jet 3	31.4	-1.6	28.6	11.6	28.7	0.39	1.63
	(32.2)	(-1.6)	(29.3)	(11.9)	(29.4)		

...”.

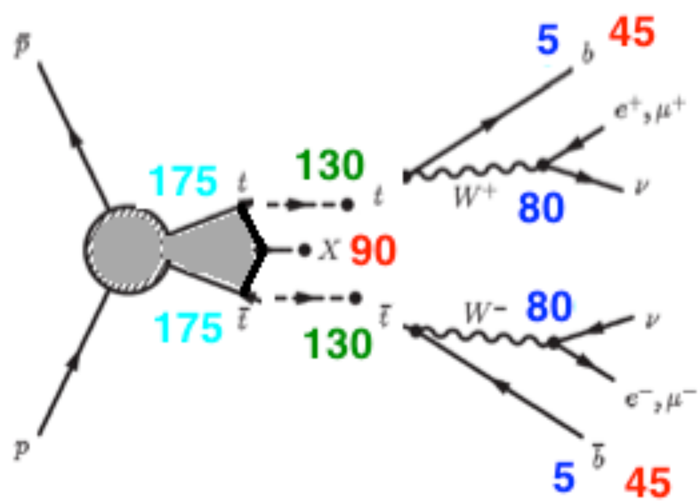
If the t and tbar are both in the 130 GeV mass state then the decay is simple with 2 jets:



and both jets are highly constrained as being related to the W - b decay process
so it is reasonable to expect that the 130 GeV decay events would fall in the narrow
width of a single 10 GeV histogram bin.

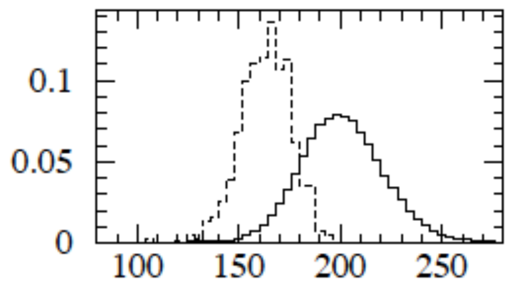
(In these two diagrams I have indicated energies only approximately for
t and tbar mass states (cyan and green) and W and b-quark (blue) and jets (red).
Actual kinematic data may vary from the idealized numbers on the diagrams,
but they should give similar physics results.)

If the t and tbar are both in the 173 GeV mass state
(as, for example, in Run 84676 Event 12814 (e mu) described above)
the decay has two stages and 3 jets:



First, the 175 GeV t and tbar both decay to the 130 GeV state, emitting a jet.
Then, the 130 GeV t and tbar decay by the simple 2-jet process.
The first jet is a process of the Higgs - T-quark condensate system of E8 Physics
and is not a W -b decay process so it is not so highly constrained
and it is reasonable to expect that the 175 GeV decay events would appear to have a
larger (on the order of 40 GeV) width.

As to t and tbar being the high T-quark mass state (around 225 GeV)
there would be a third stage for decay from 225 GeV to 175 GeV
with a fourth jet carrying around 100 GeV of decay energy.
In the Varnes thesis there is one dilepton event

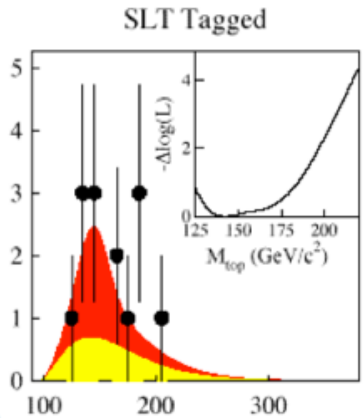


Run 84395 Event 15530 (μμ)

Run 84395 Event 15530					z vertex: 5.9 cm		
Object	E	E_x	E_y	E_z	E_T	η	ϕ
Muon 1	68.6	-63.9	12.7	-21.4	65.1	-0.32	2.94
Muon 2	34.9	-16.0	31.0	1.9	34.9	0.05	2.05
$\not{E}_T$	–	71.2	53.2	–	88.9	–	0.64
Jet 1	146.1	32.1	-98.2	-102.4	103.3	-0.88	5.03
	(153.5)	(33.8)	(-103.1)	(-107.6)	(108.5)		
Jet 2	35.1	-8.6	21.4	26.2	23.1	0.97	1.95
	(37.2)	(-9.1)	(22.7)	(27.7)	(24.5)		
Jet 3	47.1	-7.6	-16.8	43.0	18.4	1.58	4.29
	(52.3)	(-8.4)	(-18.6)	(47.8)	(20.5)		

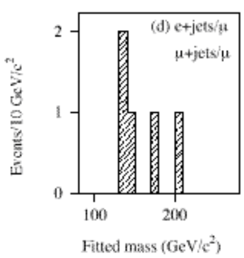
that seems me to represent that third stage of decay from 225 GeV to 175 GeV.
Since it is described as a 3-jet event and not a 4-jet event as I would have expected,
my guess is that the third and fourth jets of my model were not distinguished by the
experiment so that they appeared to be one third jet.

1998 - Low, Middle-mass Tquark - **CDF** hep-ex/9801014 -
based on lepton + 4 jet events that were either SVX tagged, SVX double tagged, or untagged ... the top quark mass is **175.9 +/- 4.8(stat.) +/- 4.9(syst.) GeV/c^2**
14 SLT tagged events with no SVX tag ... give a Tquark Mass of **142 GeV (+33, -14)**

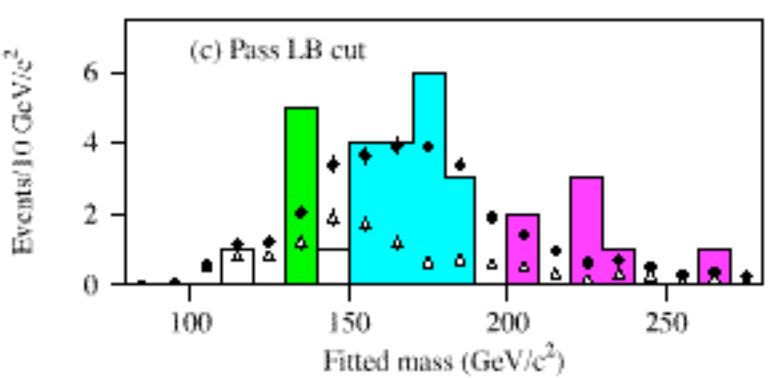


Events (10 GeV/c^2)

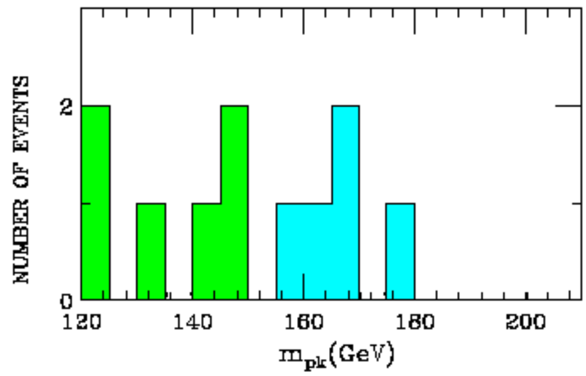
1998 - Low, Middle, High-mass Tquark - **D0** hep-ex/9801025 -
5 tagged lepton + jets give Tquark mass **130-150 GeV** for 3 of the events



of the total of 91 candidate events, 31 survived Chi-squared less than 10 cut and also survived the Low Bias selection cut, **all three Tquark states** observed:

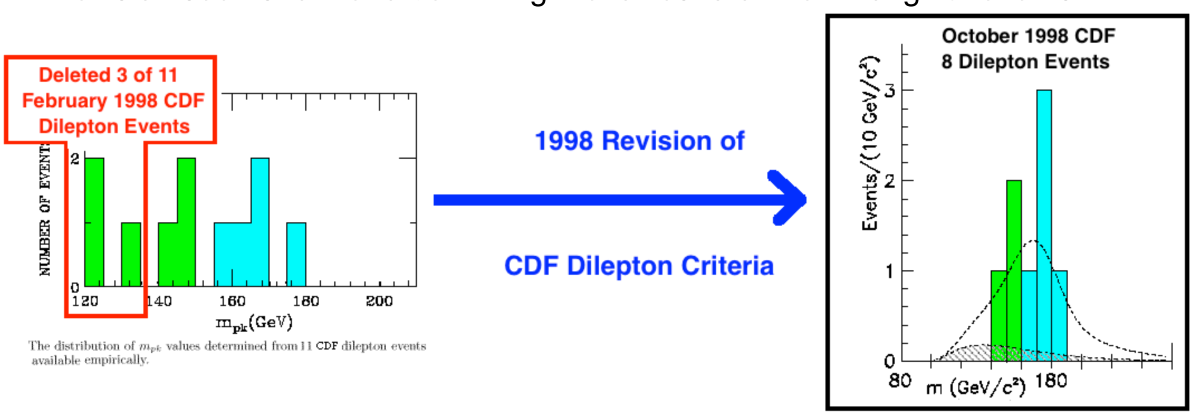


1998 - Low, Middle-mass Tquark - **Dalitz, Goldstein** hep-ph/9802249 -
11 additional CDF dilepton events which have become available since the 1997 Electron-Photon conference in Hamburg are **Low and Middle-mass Tquark states**:



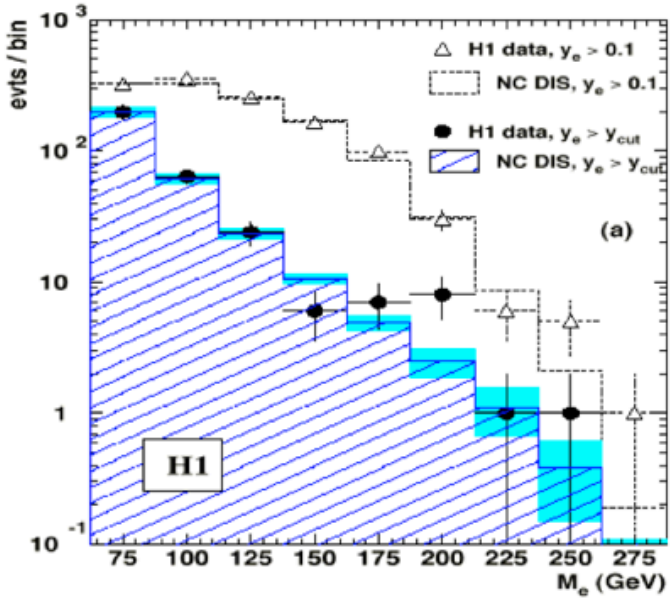
The distribution of m_{pk} values determined from 11 CDF dilepton events available empirically.

1998 - Low, Middle-mass Tquark - **CDF** hep-ex/9810029 -
CDF “present[s] a new measurement of the top quark mass ...
[that] supersedes [CDF’s] previously reported result in the dilepton channel”
which revision seems to me to be cutting the lowest 3 of the 11 original events



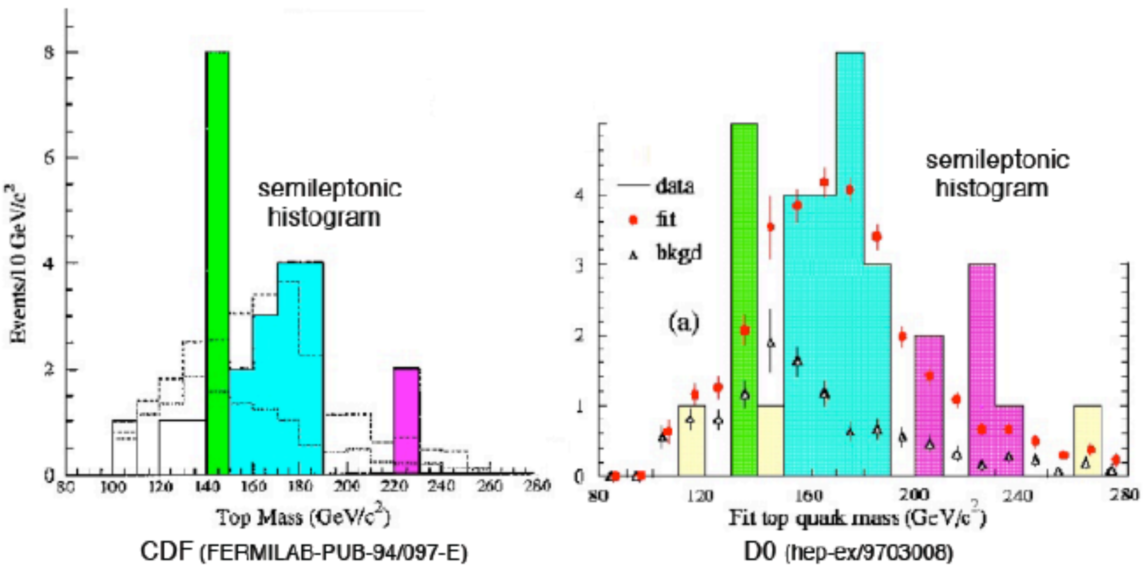
as part of a Fermilab policy of ignoring the Low-mass Tquark state.

1999 - Middle, High-mass Tquark - **HERA H1, ZEUS** hep-ex/9910012 -
The excess in the H1 data is still present at Me = **200 GeV** but has not been corroborated by the 1997 data. Also ZEUS observes an excess at Mej **> 200 GeV**



Why did Fermilab dismiss Low and High Mass Truth Quark States ?

The Truth Quark High Mass State peak in the 1994 CDF semileptonic histogram is low, only 2 events out of a total of 26, so they could be dismissed as insignificant, but the Truth Quark Low Mass State peak is not low (8 of 26 events) and should not be so easily dismissed by CDF. However, in 1994, CDF in FERMILAB-PUB-94/097-E did dismiss the Low Mass peak, saying merely "... We assume the mass combinations in the 140 to 150 GeV/c^2 bin represent a statistical fluctuation since their width is narrower than expected for a top signal. ...". I strongly disagree with CDF's "statistical fluctuation" interpretation. If it were merely a "statistical fluctuation" then it would have been highly improbable for the 1997 D0 semileptonic histogram to have shown a very similar Low Mass peak, but in fact a very similar Low Mass peak is what D0 did find in 1997:



For more detailed analysis of how Fermilab data over many years has supported the reality of three mass states of the Truth Quark, see viXra 1602.0319 .

Fermilab's dismissal of the Low Mass Truth Quark peak around 130 GeV in its own data was not only a dismissal of my hep-ph/9301210 prediction but also a dismissal of other independent theoretical predictions of Truth Quark mass:

1982 - Inoue, Kakuto, Komatsu, and Takeshita in Aspects of Grand Unified Models with Softly Broken Suypersymmetry (Prog. Theor. Phys. 68 (1982) 927) relate supersymmetry to electro-weak symmetry breaking by radiative corrections and renormalization group equations, and find that the renormalization group equations have a fixed point related to a T-quark mass of about 125 GeV.

1983 - Alvarez-Gaume, Polchinski, and Wise in Nuclear Physics B221 (1983) 495-523 : "... The renormalization group equation ... tends to attract the top quark mass towards a fixed point of about 125 GeV ...".

1984 - Ibanez and Lopez in Nuclear Physics B233 (1984) 511-544 did supergravity calculations similar to Alvarez-Gaume, Polchinski, and Wise.

1993 - Chamseddine and Frohlich in hep-ph/9307209 :
"... Connes ... non-commutative geometry [NCG] provides a geometrical interpretation of the Higgs field ... the only solutions ... occur in the narrow band ...

Higgs mass 117.3 < mH < 142.6 GeV ...
with ... corresponding top quark mass ... 146.2 < mt < 147.4 GeV ...".
Later basic NCG calculation (see arXiv 1204.0328) indicated
Tquark mass upper bound of sqrt(8/3) mW = 130 GeV .

The Renormalization Group and NCG predictions have been confirmed by the LHC 2016 run which showed not only the 125 GeV Higgs Mass State but also 3 Higgs Mass States corresponding to 3 Truth Quark Mass States including the Low Mass Truth Quark State dismissed by Fermilab.

Why would Fermilab dismiss the Low Mass Truth Quark peak in its own data, even though it had theoretical support from Renormalization Group and NCG, not to mention my isolated unconventional theory ?

To understand the hostility of Fermilab to a Low Mass Truth Quark State, you must look at the details of the process whereby Fermilab sought to discover the Truth Quark after CDF's 1988-89 run which produced a dilepton candidate event.

Kent Staley in "The Evidence for the Top Quark" (Cambridge 2004) said:
"... CDF searched for the top [quark] ... in ... the "dilepton" mode ...
CDF stopped taking data at the end of May 1989 ...
Kumi Kondo's Dynamical Likelihood Method ... would give a kinematical reconstruction of events and then calculate the likelihood of that reconstruction using the dynamics of the hypothesized decay process ... **Kondo found that ... the lone dilepton candidate found during the 1988-9 run ... could be reconstructed with his method as the decay of a top-antitop pair, with a top mass of around 130 GeV/c2** ...
Goldstein, Sliwa, and Dalitz ... were trying to apply their method to the first CDF dilepton event, the same published e-mu event from the 1988-9 run that Kondo had analyzed ...
In February 1992 ... Goldstein and Sliwa were invited to present their method ... at a meeting of the heavy flavors group (the precursor to the top group) ... **Sliwa showed ... a bump ... at a top-quark mass of about 120 GeV/c2** ...
in May 1992 ... Goldstein, Sliwa, and Dalitz ... present[ed] ... analysis of data from ... 1988-9 ...[saying]... "The plots show very clearly a well separated enhancement around Mt = 135 GeV in the accumulated probability distributions, as expected by the Monte Carlo studies" ...
The top mass estimates from the Dalitz-Goldstein-Sliwa analysis ... consistently fell into the 130-140 GeV/c2 range ...
considerably l**ower than the later estimate of 174 GeV/c2**
that appeared in CDF's paper claiming evidence for the top quark
...

Then, a very strange thing happened: ...

New Scientist, dated June 27, 1992 ... announced ... “A claim that the top quark has been found is being suppressed by scientists at the Fermilab particle physics centre ... If Dalitz turns out to be correct ... the main credit for finding the particle will go to Dalitz, a scientist outside Fermilab ...” ... Dalitz, Goldstein, and Sliwa appeared in the article as a “rival group”, the publication of whose paper CDF was “blocking”, and the author reported Goldstein saying that he was “‘quite confident’ that they have discovered the existence and the mass of the (Top) quark.”
...
An article ... in the July 24 issue of Science ... recounted how the results of the Sliwa-Goldstein-Dalitz analysis were presented to CDF ...
Goldstein and Dalitz were subsequently excluded from CDF top group meetings ...
CDF physicist... “Shochet says **CDF member Sliwa violated an unwritten code of ethics by sharing data with outsiders**.”
...
Sliwa denied that he had made substantive information about CDF’s unpublished data available to Dalitz and Goldstein
...
the unpleasant atmosphere generated by the controversy surrounding Sliwa’s work hampered progress on the Dalitz-Goldstein-Sliwa method ...
Krys really never got the time of day after [the appearance of the articles in New Scientist and Science]...[He] took it very personally, and responded very personally
...
he was “spurned by the rest of the collaboration: because he was acting singly, and not in a larger collaboration” ...”.

Tommaso Dorigo has written a book, “Anomaly”

(to be published by World on 5 Nov 2016),
that may give more details of the situation. He has blogged and commented on it over the past years (2006-2013), saying in part:
“... In **December 1988** a one-day workshop was organized in the Ramsey auditorium, the conference room at the basement floor of the Hirise, the main building of the Fermi National Accelerator Laboratory. The workshop was the first of a series of meetings that would take place in the course of the following few years, and it was specifically devoted to focused discussions on the top quark search, which was being performed independently by several groups of CDF physicists
...
one got the feeling that a well-defined strategy for the top search was missing. Indeed, back then it was not even clear to most CDF researchers that the main background to top production was constituted by events featuring a W boson together with hadronic jets produced by QCD radiation
...

Finally, the time came for the talk by Kuni Kondo. Prof. Kondo was a Japanese physicist who led a sizable group of researchers from the University of Tsukuba. In his late fifties, he was lean, not tall, with black hair combed straight above an incipient baldness; he usually dressed in black or grey suits. He was a charming and very polite person, who spoke with a soft tone of voice and smiled a lot.
It looked like nothing could ever upset him.

Kondo had devised a very complex, deep method to discriminate top quark events from the background, based on an analysis approach he had dubbed "dynamical likelihood" which would become a sophisticated standard only a decade later, but which was taken with quite a bit of scepticism at the time; in private, quite a few of his American and Italian colleagues would even make silly jokes on it. The method consisted in constructing probability distributions for the observed kinematics of the events, which could then be used to derive the likelihood that the events were more signal-like or background-like.

It is ironic to think that nowadays all the most precise measurements of the mass of the top quark rely on the method called "matrix element", which is nothing but Kondo's original idea recast in the context of a measurement of the mass rather than the discrimination of a top signal. Kondo was way ahead of his time, and like most pioneers in science he did not have an easy life getting his work appreciated and accepted, in a situation dominated by a conservative mainstream.

It is by now four in the afternoon, and Kondo finally gives a full status report of his analysis. His presentation is thorough and yet almost unintelligible by a good half of his listeners; his analysis includes highly unorthodox and yet brilliant tricks, like taking a jet from one event and mixing it in with other jets in a different event to study the behaviour of some of his selection variables for background events. His colleagues listen in an atmosphere of disbelief mixed with awe. Despite the complexity of the material and the possibility to object on a hundred of details, no questions are asked.
As **Kondo** reaches the end of his talk, he concludes with a tone of voice just a milli-decibel higher than the rest of his speech:

"And therefore", a pause, and then "I think we have discovered the top quark".

The audience remains silent.
The convener is a tall, lean guy with a sharp nose and a penetrating stare; he looks like an English gentleman from a XIXth century novel, especially thanks to his considerable aplomb. He is not impressed, and that much does show.
"Thank you very much Kuni. Is there any question ?", one, two, three, four,
"...No questions. Okay, thanks again Kuni. The next speaker is...".
In retrospect the convener's attitude and lack of consideration toward an esteemed colleague and a visitor from another country, who had brought to the experiment lots of resources and had contributed significantly to the detector construction,
sounds at least rude and unjustified.

Still, back then CDF was not a place where people would exchange courtesies and compliments (it never was, in truth): there everybody had to work hard and the only way to earn the respect of colleagues was through the good physics output of one's analysis results. If your analysis methods were not considered publishable or your results were thought fallacious, you would be considered a potential threat to the good name of the experiment, and you would suffer little short than boycott.
But the way Kondo was treated was all flowers in comparison to what other physicists would experience, along the way to the top discovery
...
[1992] I had started working on CDF ... and I remember that one of the very first articles I read was the limit on top quark production where the famous dilepton ttbar candidate was mentioned. An event that is indeed most likely the first clear top-antitop decay detected in a particle physics experiment
...
Back then, Krisztof Sliwa analyzed the ttbar candidate by CDF in the dileptonic final state with an analysis called “neutrino weighting technique” which has later become a standard, and worked with Dalitz and Goldstein on a paper which was not authorized by the CDF collaboration
…
CDF, as a collection of physicists, did feel betrayed by Chris Sliwa. I do not know how clear was the violation of internal rules of the experiment, but for sure that was the sentiment circulating those days in the corridors of the CDF trailers
...
there was this air of suspicion around in 1992
…
As if somebody had committed Heresy! ...”.

Back in the 1990s, a very bad thing had happened:

Two issues had arisen:

1 - Physics Issue - Does the 130 GeV Truth Quark Low Mass State exist
and did the Kondo and/or Sliwa-Goldstein-Dalitz Likelihood Method find it ?

2 - Bureaucratic Issue - Was Sliwa's sharing of CDF data with Goldstein and Dalitz
a serious violation of an unwritten ethical code ?

Fermilab, as a large physics collaboration with power over jobs and funding,
was in position to decide which of the issues should be pursued or suppressed.

It could have decided to pursue both issues, but it did not.

It decided to suppress the Physics Issue (and the Truth Quark Low Mass State)
so that individual outsiders (and their ideas) would go away
and only Fermilab consensus ideas would survive in the world of physics,
and the Fermilab consensus was that the one and only Tquark Mass State,
the 174 GeV Mass State, would be recognized in the world of physics.

It decided to pursue the Bureaucratic Issue because that allowed Fermilab
to use its jobs-funding power to enforce its consensus view that
the one and only Tquark Mass State was the 174 GeV Mass State.

So, instead of searching for Truth, Fermilab asserted its Power.

Regrettably, this is a common characteristic of Human Political Bureaucracies,
as is exemplified by attacks on Snowdon and Assange as criminals
for sharing Truthful Information with the public
thus deflecting attention from the True Facts to details of Criminal Prosecution
and instilling fear in others who might think about telling the Truth.

BALONEY in Bologna (page 9) indicates that LHC - CMS - ATLAS
are repeating in the 2110s
the errors of Fermilab - CDF - D0 in the 1990s
with the Higgs playing the role of the Truth Quark

The price of those errors is that
the Consensus View (page 3) will be the Only View
for the Future of Physics

and

We will never Explore 3-Mass-State NJL Higgs-Truth Quark System Experiments to see How Physics Works going Up the Energy Scale

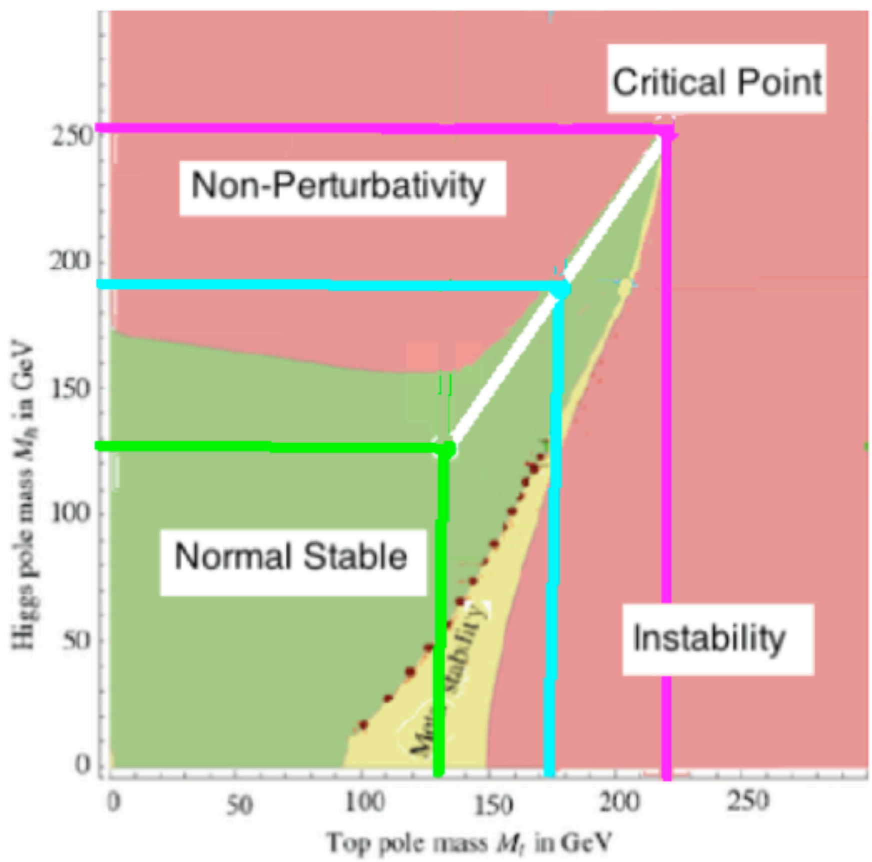
The Low-Mass States (Higgs 125 GeV, Tquark 130 GeV) are in the Normal Stable region of a Higgs Mass - Tquark Mass phase diagram.

Adding Energy moves the States up along the white line until it intersects the boundary of Normal Stability with Non-Perturbativity at which point are the Middle-Mass States (Higgs around 200 GeV, Tquark 174 GeV).

Experiments in this region should tell us a lot about Non-Perturbativity of Compositeness and 8-dim Kaluza-Klein M4 x CP2 Structure.

Adding further Energy moves up along the white line to the Critical Point at the High-Mass States (Higgs around 250 GeV, Tquark 220 GeV).

Experiments in this region should tell us about the Critical Intersection of Normal Stability, Non-Perturbativity of Compositeness and 8-dim Kaluza-Klein M4 x CP2 Structure, and Vacuum Instability.



Adding Energy beyond the Critical Point will go into the Massless Realm of Unbroken Electroweak Symmetry where the Higgs Mechanism no longer gives Mass to Particles.