

# 3-State Higgs-Tquark System

by Frank Dodd (Tony) Smith, Jr.

Abstract:

The 8-dimensional Kaluza-Klein spacetime of my E8 physics model, with the Higgs as a Tquark condensate, produces a Higgs-Tquark system with 3 states:  
low mass (Tquark mass consistent with the 120-160 GeV/c<sup>2</sup> CDF Wjj 2011 bump)  
mid mass (Tquark mass consistent with conventional Tquark mass)  
high mass (Tquark mass around 218 GeV/c<sup>2</sup>)

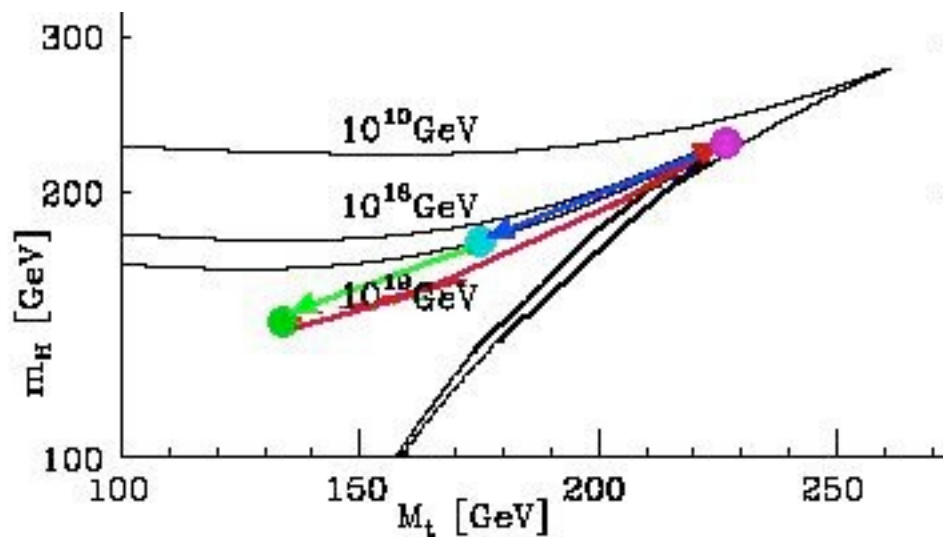
The three predicted Higgs mass states (around 146, 182 and 239 GeV/c<sup>2</sup>) should be verified or refuted by LHC by the end of 2012, if not earlier.

Some implications for the future of large-collaboration physics beyond 2012 are briefly discussed, inevitably intermeshed with the future of the global financial/political system.

(References are included in the body of the paper and in linked material.)

## 3-State Higgs-Tquark System

**My E8 physics model** has 3 states (green, cyan, magenta) for the Higgs-Tquark system:

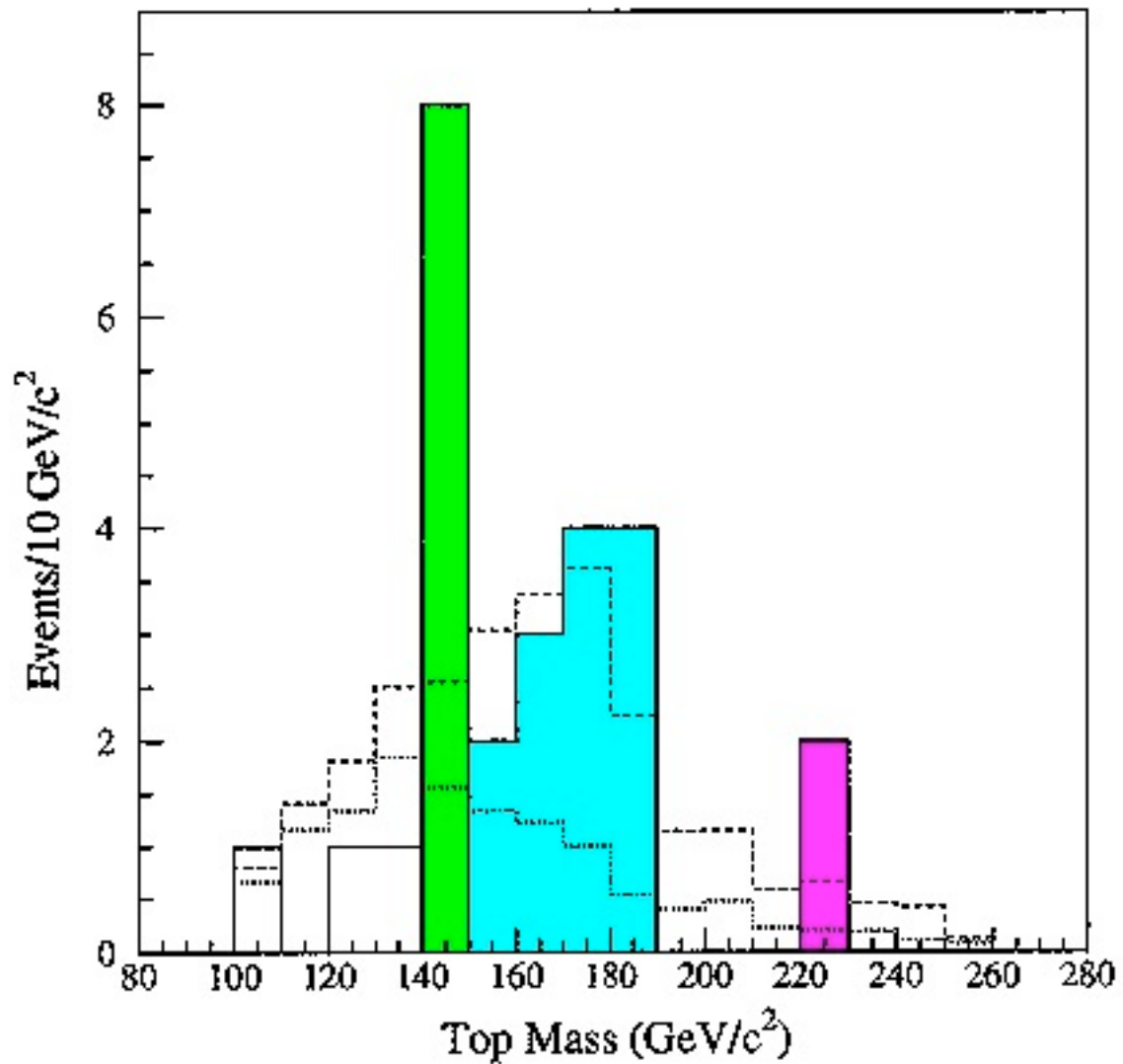


The low state (green) is in the usual stable-vacuum no-triviality space-time region.

The middle state (cyan) is on the Triviality boundary where the Higgs is composite T-Tbar condensate in 8-dim Kaluza-Klein spacetime with high-energy cut-off scale at the Planck energy  $10^{19}$  GeV which is the lowest of the three Triviality boundary upper bound curves.

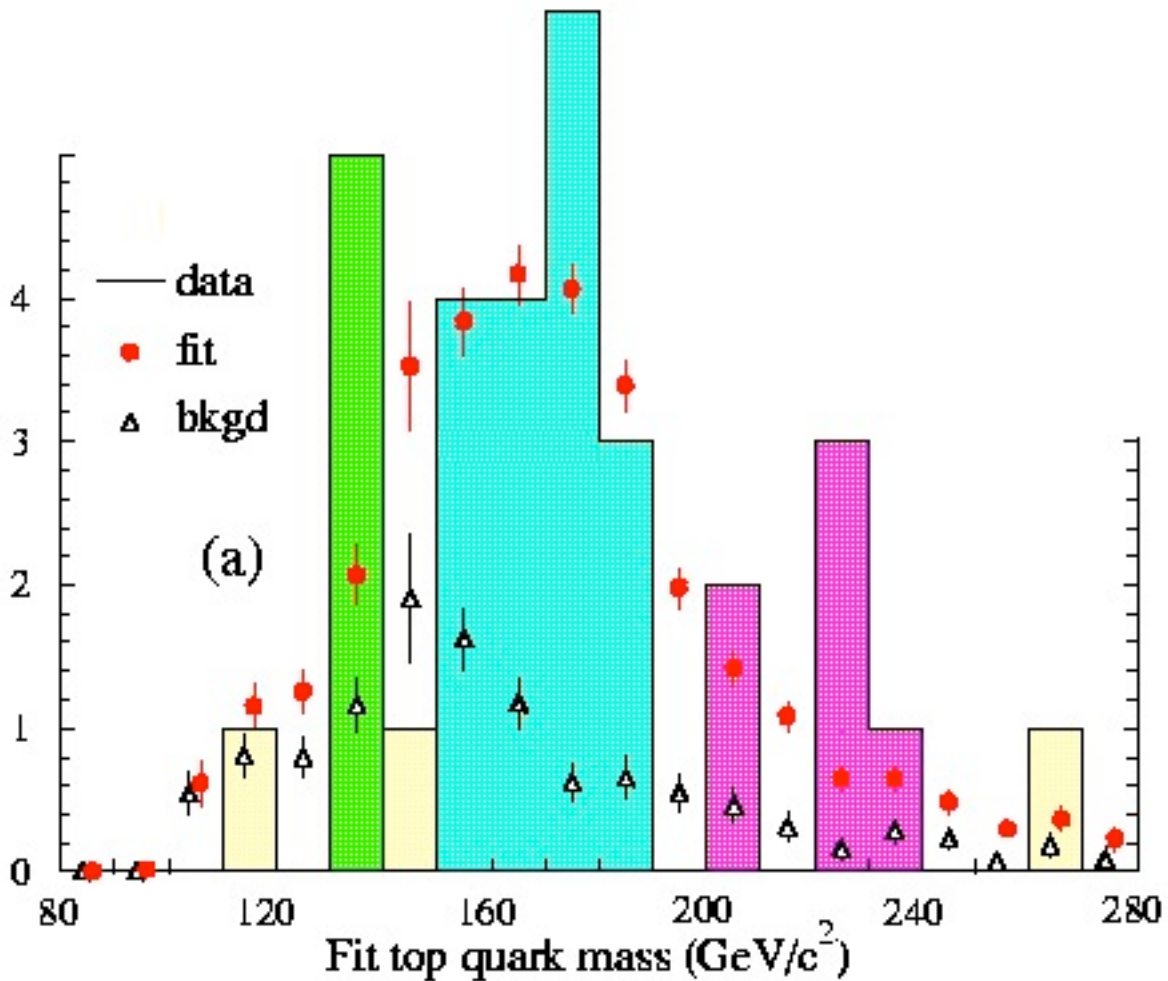
The high state (magenta) is at the critical point where the Triviality boundary (upper bound curves) intersects the vacuum stability boundary (right-side bound curves).

In 1994 a semileptonic histogram from CDF



seems to me to show all three states of the T-quark.

In 1997 a semileptonic histogram from D0



also seems to me to show all three states of the T-quark.

**The fact that the low (green) state showed up in both independent detectors indicates a significance of 4 sigma.**

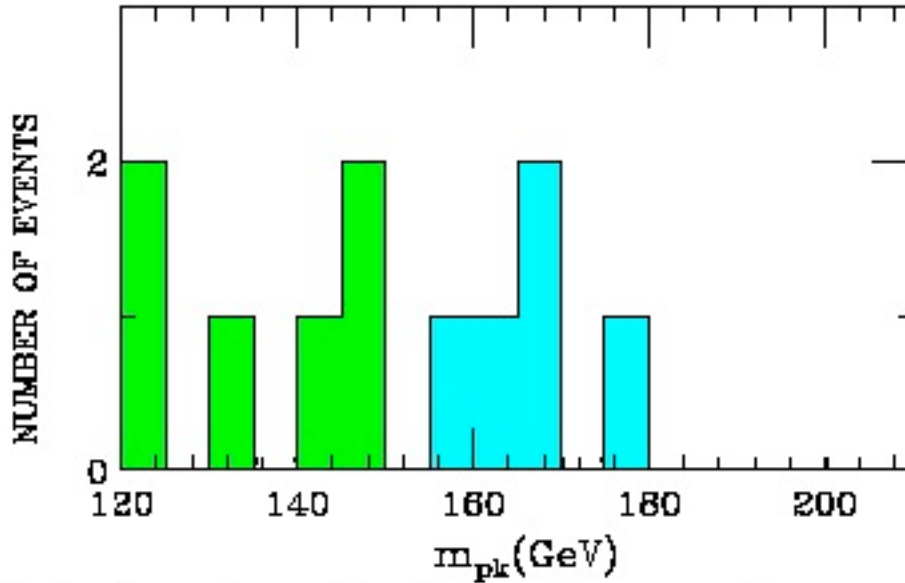
Some object that the low (green) state peak should be as wide as the peak for the middle (cyan) state,

but

my opinion is that the middle (cyan) state should be wide because it is on the Triviality boundary where the composite nature of the Higgs as T-Tbar condensate becomes manifest and

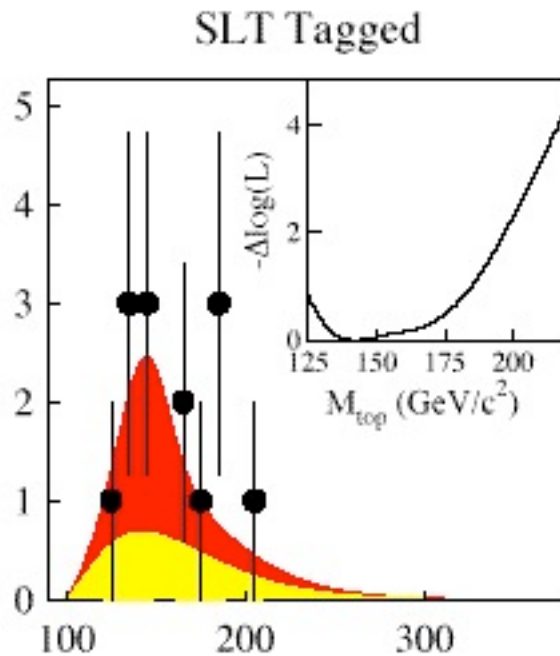
the low (green) state should be narrow because it is in the usual non-trivial region where the T-quark acts more nearly as a single individual particle.

In 1998 a dilepton histogram from CDF seems to me to show both the low (green) state and the middle (cyan) state of the T-quark:

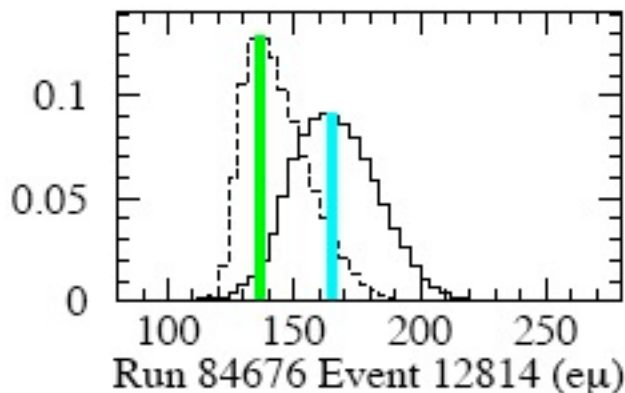


The distribution of  $m_{pk}$  values determined from 11 CDF dilepton events available empirically.

In 1998 an analysis of 14 SLT tagged lepton + 4 jet events by CDF showed a T-quark mass of 142 GeV (+33,-14) that seems to me to be consistent with the low (green) state of the T-quark:



In 1997 the Ph.D. thesis of Erich Ward Varnes (Varnes-fermilab-thesis-1997-28) at 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 ...



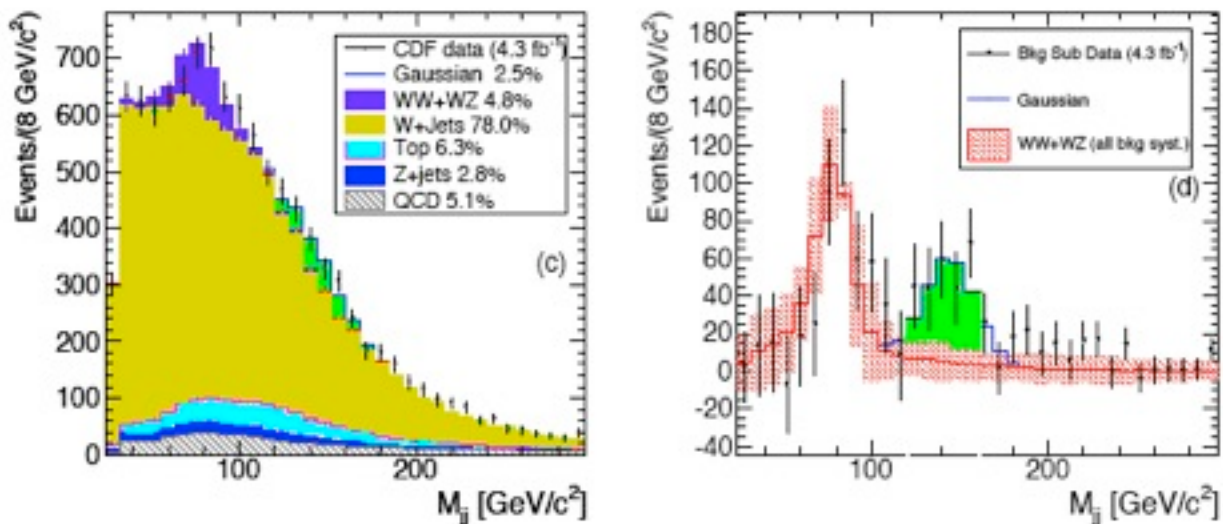
..." (colored bars added by me)

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 down to the low (green) T-quark state, whose immediately subsequent decay is corresponds to the 2-jet (dashed curve) event at the low (green) energy level.

**After 1998 until very recently Fermilab focussed its attention on detailed analysis of the middle (cyan) T-quark state, getting much valuable detailed information about it but not producing much information about the low or high states.**

**In 2010** the thesis of Viviana Cavaliere (FERMILAB-THESIS-2010-51) said: "... We present the measurement of the WW and WZ production cross section in p pbar collisions at sqrt(s) = 1.96 TeV, in a final state consisting of an electron or muon, neutrino and jets. ... **for the [ 120 , 160 ] GeV/c2 mass range ... an excess is observed ... corresponding to a significance of 3.3 sigma ...**".

Those results are also presented by her Fermilab collaboration CDF in arXiv 1104.0699 which says "... the invariant mass distribution of jet pairs produced in association with a W boson using data ... which correspond to an integrated luminosity of 4.3 fb-1 ... [some image colors altered and green added by me]...



... has an excess in the 120-160 GeV/c2 mass range which is not described by current theoretical predictions ...".

**The 120-160 GeV/c2 excess may be Low Mass Truth Quark SingleT events:** The events corresponding to the middle (cyan) state of the T-quark are shown in the left chart as being part of the background, and after subtracting the background (including the middle (cyan) state) the right chart shows a Gaussian corresponding to events in the 120-160 GeV /c2 range of the low (green) state of the T-quark. In arxiv 1104.0699 **CDF** said "... we estimate a **cross section** times the particle branching ratio into dijets **of the order of 4 pb.** ...". In Fermilab-Pub-11/267-E **D0** said "... The best fit value ... yields a **cross section of ... 0.82 ( +0.83 -0.82 ) pb ...**".

**Those cross sections are roughly consistent with the conventional singleT cross section of 2.90 pb** (see arxiv 1104.4087 by Plehn and Takeuchi).

An objection to Tquark as cause of the excess was raised by Giovanni Punzi in slides 31 and 33 of his 2011 Blois Rencontres presentation where he said said: "... could this be top background [ arXiv: 1104.4087, arXiv: 1104.3790] ... the answer is NO - this cannot possibly be top background - there is no significant tagged component ...".

However,

As to b-tagging, the CDF update on the Wjj bump said:

"... b-tagging in the excess region ... No significant enhancement of b-tagged events is observed in

the "excess" region compared to the sideband regions. ... This highlights that ... the excess is not

due to an under-estimated t-tbar content since in these events at least one of the jets should give rise

to a b-quark in the "excess" region" ...",

so

while lack of tagging might be an argument against t-tbar causing the excess, my position is that singleT might cause the excess.

As to b-tagging for singleT, Sullivan and Menon in arxiv 1104.3790 said:

"... one may wonder whether there is a large excess in the 2 b-tag CDF dijet invariant mass. CDF

has measured that signal in an analysis to search for Higgs production in WH to Wbbbar. There are

two reasons we do not expect to see a large excess in that study. First, the deficit in Wbb from tchannel

single-top is almost perfectly cancelled by the excess in the s-channel single-top contribution. The basic cuts in the Higgs analysis are almost identical to the single-top-quark

analysis, and so there is no contamination from processes with additional jets.

Furthermore, in the

CDF Higgs analysis, they normalize their background subtraction to data. Hence, any residual

excess should be removed. ...".



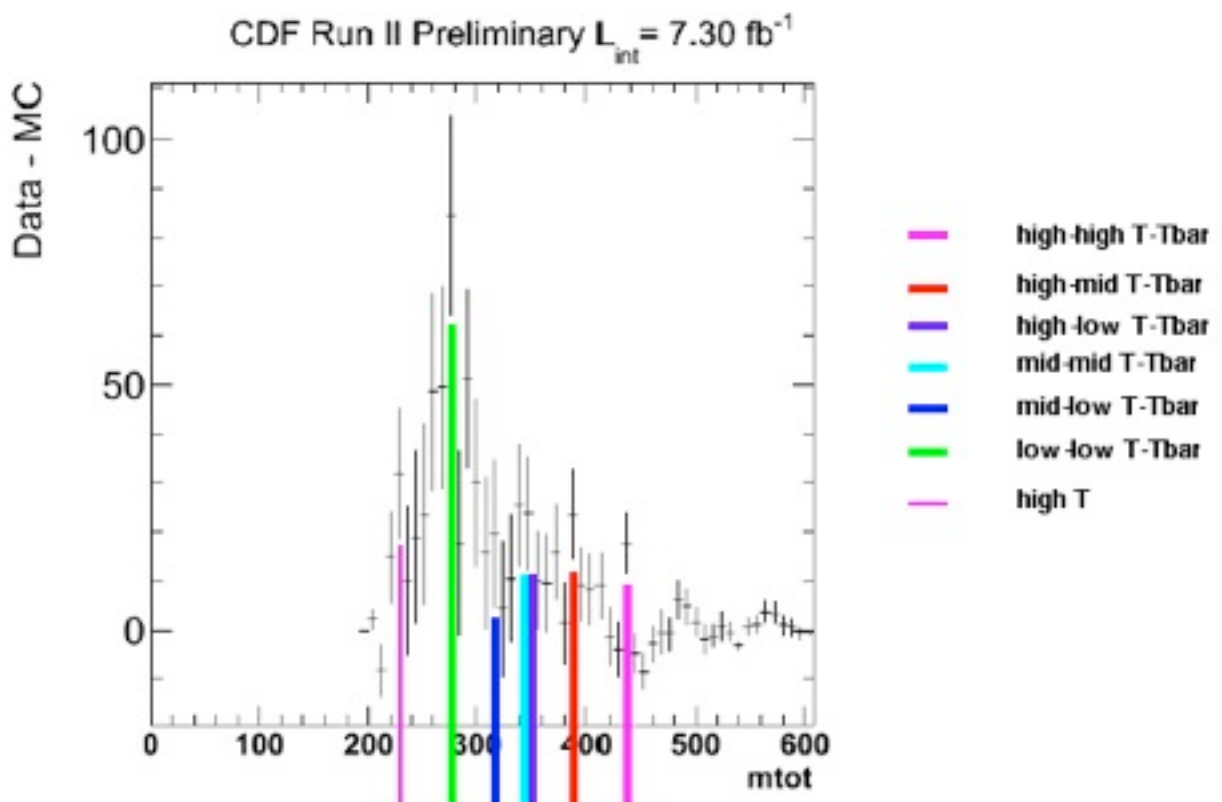
## What about T-Tbar Events ?

My view is:

most of the T-Tbar events were included in the Tquark background by CDF in arxiv 1104.0699

but

a few such events may have been faintly seen in a kinematic distribution plot shown in a link on a CDF note released 2 June 2011 of the mass of jj+lv (jets, lepton, neutrino) in the 115 to 175 GeV region of  $M_{jj}$  (colored bars and their description added by me):



The relative lowness of the mid-mid T-Tbar and mid-low T-Tbar peaks may be due to CDF inclusion of the mid T in background.

## What about the 3 Higgs states?

The Higgs has not yet been observed, but Tommaso Dorigo said in his blog entry 31 Jan 2011:

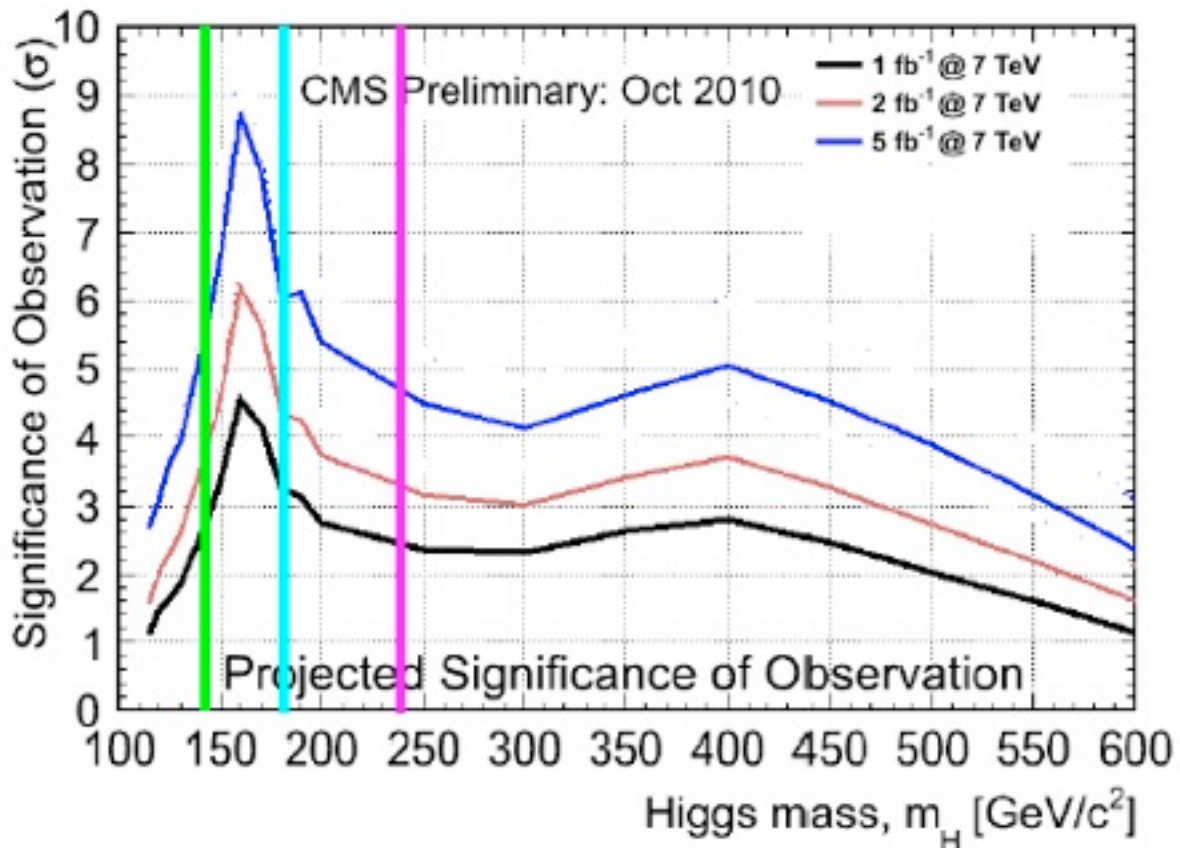
### "The LHC Will Run At 7 TeV in 2011 and 2012"

"... the Tevatron will finally shut down at the end of 2011 ...

LHC will continue to run through 2012, increasing as much as possible the instantaneous luminosity of the beams. This means that while at the end of 2011 CMS and ATLAS might still only have one inverse femtobarn of collisions to play with, by the end of 2012 it is reasonable to expect at least a factor of 5 more data. ...

then ...[in]... 2013 ... a long shutdown ... to allow the retro-fitting of LHC with systems which will prevent future incidents such as the one of September 2008 ...

The graph below ...



[ I have altered the graph by omitting irrelevant material and adding three vertical lines at the Higgs masses for the three states in my physics model. The cyan line also corresponds to the Higgs mass predicted in hep-ph/0311165 by Hashimoto, Tanabashi, and Yamawaki in the context of an 8-dim Kaluza-Klein Higgs-as-T-condensate model. ]

... shows the number of standard deviations equivalent to the observable ... Standard Model Higgs boson ... signals that may be obtained by a combination of sensitive search channels by CMS. The curves show the median sensitivity, i.e. they show the minimum significance achievable 50% of the time. Different curves refer to ... different integrated luminosities. As you clearly see, 50% chances of a 3-sigma or larger evidence for the Higgs boson exist in a wide range of masses, even with the 7 TeV running and 5 inverse femtobarns ( the full blue line -a reasonable estimate for 2012!). And bear in mind that this is CMS only: a combination with ATLAS would typically make a 3-sigma signal become a 4-sigma one, roughly. If it were real! ...".

Therefore,

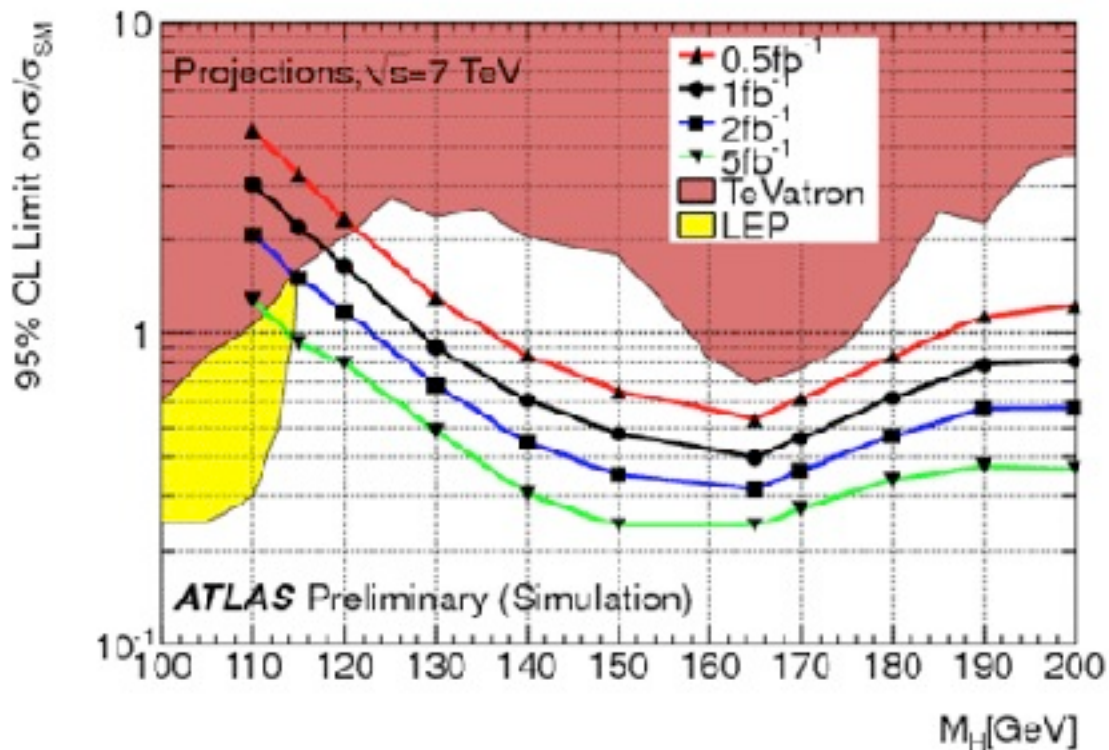
**by the end of 2012 the LHC should have 5/fb  
and so Verify (to 5 sigma for low and mid states) my Higgs  
boson predictions.**

Even earlier,

**by the EPS-HEP conference in Grenoble 21-27 July 2011**

**the LHC should have 1/fb**

(image from viXra log blog entry on 13 June 2011)



and so **Refute** (at 95% CL)

or

**See Evidence For** (at 2 or 3 sigma)

**my Higgs boson predictions.**

# What is Beyond 2012?

If, by the end of 2012, the LHC sees nothing beyond the Standard Model (with or without my predicted 3-stage Higgs-Tquark-Condensate system),  
i.e., sees no SuperSymmetry or other Exotic New Physics,  
then:

If Europe (outside Germany) and the USA are suffering financial collapse,  
the LHC repair/maintenance year 2013 might become the LHC ShutDown Year.

If Fermilab might be then already be ShutDown,

**the End of 2012 might see the End of Large-Collaboration Collider Physics  
and**

**the Beginning of an Era in which the Fundamental Laws of Physics**

i.e., the Standard Model plus Gravity

(perhaps unified as in my E8 physics model)

are understood so well that we can devote our energy to

**Engineering a Better World, on Earth and Beyond**

by centrally-directed programs such as

**Safe Nuclear Energy for Desalted Sea Water, Hydrogen Fuel, Electricity**

**Worldwide Network of Rapid Rail**

**Worldwide New Towns in poor rural areas**

**Free Basic Education and Medical Care**

**Basic Research into controlling Cold Fusion and Dark Energy**

i.e., effectively following the Real-Growth-Oriented Ideas of China,  
which, being governed by descendants of the revolutionary PLA who understand the standards of military realism, the utility of productive manufacturing, and the value of all the people who are its citizens,  
is printing trillions of yuan each year and investing them at zero interest in projects such as mega-cities and high-speed rail serving all the country.



The timetable for such construction is until about 2020.

Some USA economists are pessimistic about China's Real-Growth-Oriented ideas, such as Nouriel Roubini of New York University, who said (Al Jazeera 18 April 2011):

“... China is rife with overinvestment in physical capital, infrastructure, and property. To a visitor, this is evident in sleek but empty airports and bullet trains ... highways ... thousands of colossal new central and provincial government buildings, ghost towns, and brand-new aluminum smelters ... overcapacity will lead inevitably to serious deflationary pressures, starting with the manufacturing and real-estate sectors. Eventually, most likely after 2013, China will suffer ... a financial crisis and/or a long period of slow growth ... once further fixed-investment growth becomes impossible ...”.

What Roubini and his fellow USA apologists do not understand is that **when Siberia, Kazakhstan, Central Asia, the Middle East, and Africa see the Chinese bullet trains, highways, buildings, etc.,**



**China’s capacity in 2020 will not be “overcapacity” but will be used to become the World’s Building Contractor**





As to what might become of the thousands of highly-trained workers in the Large-Collaboration Physics Colliders that might all be ShutDown by 2013.

the Experimenters who built and ran the Machines are Excellent Engineers and can be constructive participants in an Era of Centrally-Directed-Real-Growth Engineering.

On the other hand,  
the Theorists who are Highly-Trained in Unrealistic Exotica-Beyond-the-Standard-Model such as Superstring Theory may find that their brains (a la Vroomfondel and Majikthise of HHGG)  
"... must be too highly trained ..." for anything other than

Unrealistic Physics Exotica

or

the Financial-Derivative-Based Pyramid Casino run by the Big Five Bank holding companies JPMorganChase, Bank of America, Citigroup, GoldmanSachs, and MorganStanley who in 2010 held \$300 trillion in Derivatives against only \$8 trillion in real assets,  
and so were only able to keep their Casino afloat by directing the USA government (effectively bought and controlled by them) to print trillions of dollars each year and give them at zero interest to the Big Five Banks,  
thus debasing the USA dollar and sucking all credit out of the productive sectors of the USA system.