Can LHC 2016 Data answer the question:
Is Our Universe MetaStable ?

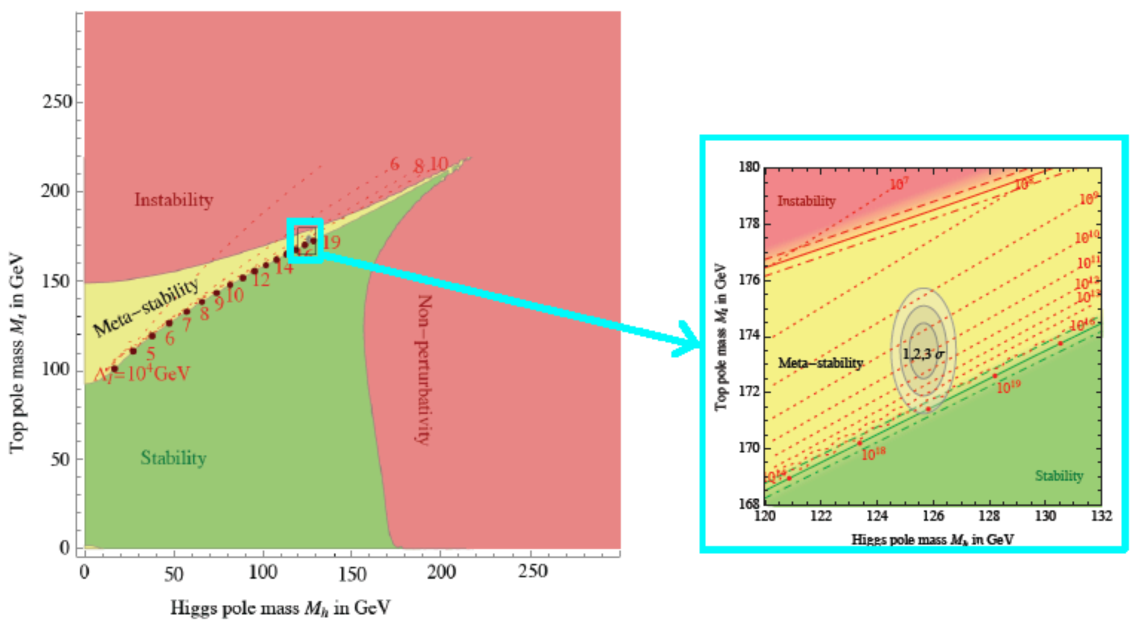
Frank Dodd (Tony) Smith, Jr. - 2013 - vixra 1309.0096

In arXiv 1307.3536 Buttazzo, Degrassi, Giardino, Giudice, Sala, Salvio, and Strumia assume a Standard Model Higgs with a single 125.66 GeV Mass State and a Standard Model Tquark with a single 173.35 GeV Mass State and conclude that Our Universe is MetaStable with a possibility that its current ElectroWeak Vacuum could decay at any time (although its probable lifetime is at least around 10^400 years). However, the LHC has seen possible indications of at least two other Higgs Mass States (around 200 GeV and 250 GeV, with small cross sections about 20% of that of single SM Higgs) that are NOT in the MetaStable Vacuum Region. For the LHC to produce enough data beyond the 25/fb now available in 2013 to show whether or not the 200 GeV and 250 GeV Higgs Mass States are real, the upgrade of the long shutdown and the 2016 run data are necessary. Only the LHC 2016 Data can answer the question: Is Our Universe MetaStable?

Can LHC 2016 Data answer the question:
Is Our Universe MetaStable ?

Frank Dodd (Tony) Smith, Jr. - 2013

In arXiv 1307.3536 Buttazzo, Degrassi, Giardino, Giudice, Sala, Salvio, and Strumia say "... from data ... of the Higgs ... and the ... [Tquark] Yukawa coupling ... we extrapolate ... SM parameters up to large energies ... Then we study the phase diagram of the Standard Model in term of high-energy parameters, finding that
the measured Higgs mass roughly corresponds to ... **vacuum metastability** ...



[image adapted from arXiv 1307.3536]

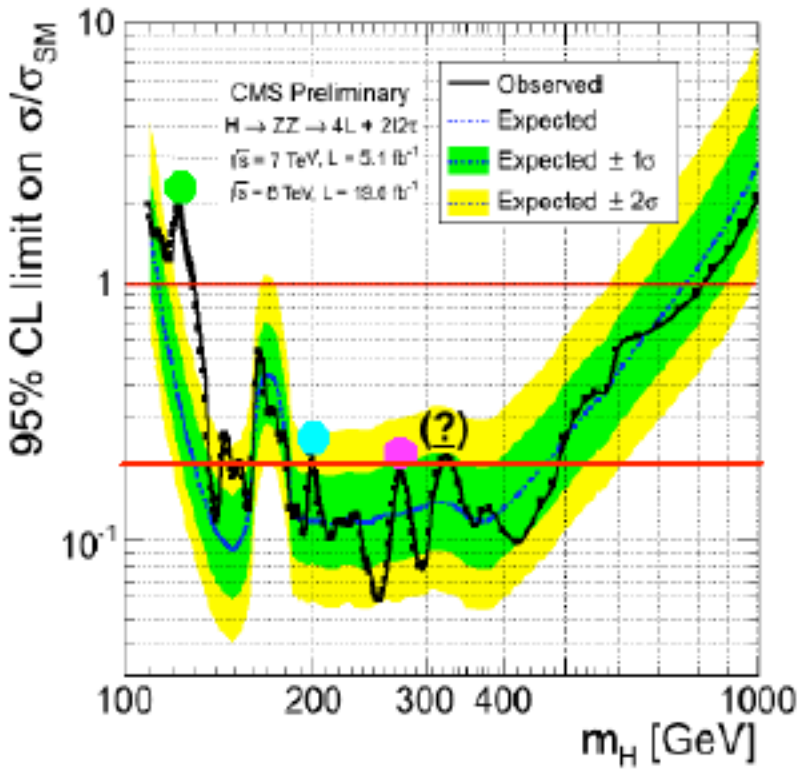
... The measured ...Higgs mass ... Mh = 125.66 +/- 0.34 GeV ... lies well within the ... window in which the SM can be extrapolated all the way up to the Planck mass Mpl
...
we adopt ... Pole mass of the [Tquark] Mt = 173.36 +/- 0.65 +/- 0.3 GeV
...
the ... values of Mh and Mt ... indicate that the SM Higgs vacuumis not the true vacuum ... and that our universe is potentially unstable ...
the instability scale ... above which the ... critical Higgs field ... potential becomes smaller than the value of the EW vacuum ... occurs at ... 10^10 - 10^12 GeV ... suggesting that the instability is reached well below the Planck mass ...
The lifetime of the electroweak vacuum, with ... future cosmology ... dominated by the cosmological constant (ΛCDM) ...[is at least about 10^400 years]..."

BUT

What if 125.66 GeV were not the only Higgs mass state ?
What if 173.35 GeV were not the only Tquark mass state ?

Has the LHC seen Higgs mass states beyond the 125.66 GeV state ?

The LHC has NOT seen any other Higgs mass state with cross section expected for a single SM Higgs, but in connection with Moriond 2013 CMS showed



a Brazil Band Plot for the High Mass Higgs to ZZ to 4l/2l2tau channel where:

top red line represents the expected cross section of a single Standard Model Higgs

lower red line represents about 20% of the expected Higgs SM cross section

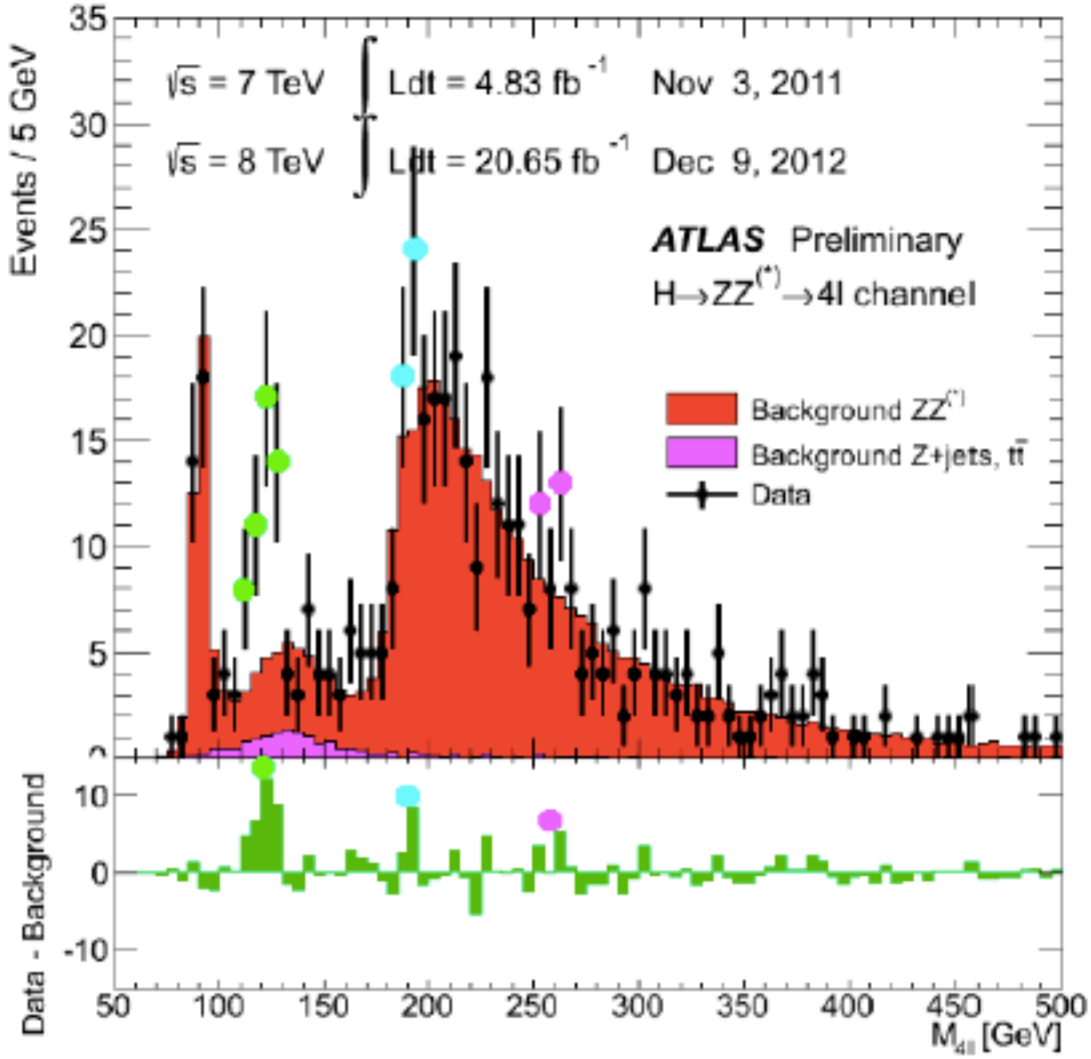
green dot peak is at the 125.66 GeV Low Mass Higgs state with SM cross section

unmarked peaks around 160 and 180 GeV may represent WW and ZZ background

cyan dot peak around 200 (+/- 20 or so) GeV may represent a Mid Mass Higgs state with about 20% of the SM cross section

magenta dot peak around 250 (+/- 20 or so) GeV may represent a High Mass Higgs state with about 20% of the SM cross section.

The (?) peak around 320 GeV may be a statistical fluctuation since it seems to have gone away in this ATLAS ZZ to 4l histogram



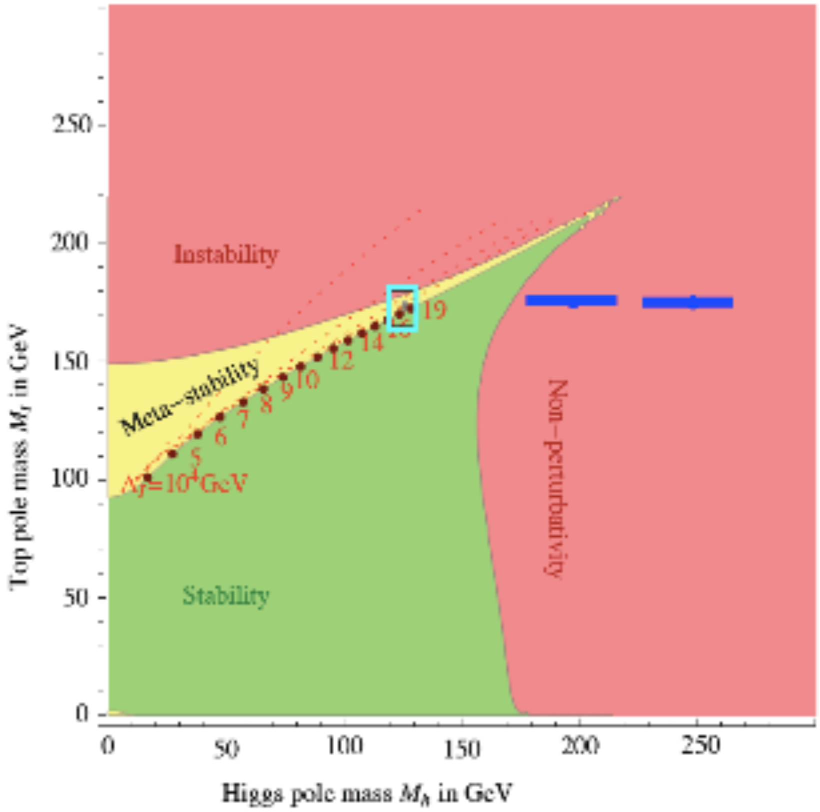
(between 300 and 350 GeV the two excess bins are adjacent to deficient bins).

It will probably be no earlier than 2016 (after the long shutdown) that the LHC will produce substantially more data than the 25/fb available at Moriond 2013 and therefore no earlier than 2016 for the green and yellow Brazil Bands to be pushed down (throughout the 170 GeV to 500 GeV region) below 10 per cent (the 10^(-1) line) of the SM cross section as is needed to show whether or not the cyan dot , magenta dot, and/ or (?) peaks are real or statistical fluctuations.

If the 200 GeV and 250 GeV Higgs Mid and High Mass states do prove to be real

and

if we continue to assume that the Tquark is a single mass state at 173.36 GeV



then we have both a MetaStable Vacuum and Non-perturbativity of Higgs.

Physically, Higgs Non-perturbativity indicates a composite Tquark condensate Higgs.

Pierre Ramond says in his book Journeys Beyond the Standard Model (Perseus Books 1999) at pages 175-176:

"... The Higgs quartic coupling has a complicated scale dependence. It evolves according to

d lambda / d t = (1 / 16 pi^2) beta_lambda

where the one loop contribution is given by

beta_lambda = 12 lambda^2 - ... - 4 H ...

The value of lambda at low energies is related [to] the physical value of the Higgs mass according to the tree level formula

m_H = v sqrt(2 lambda)

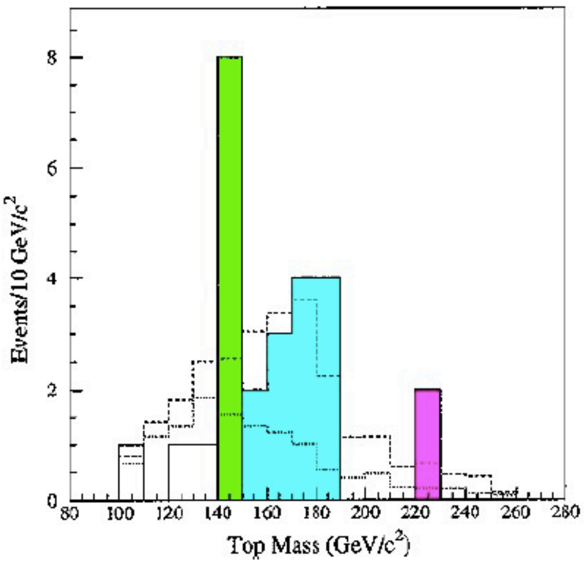
while the vacuum value is determined by the Fermi constant

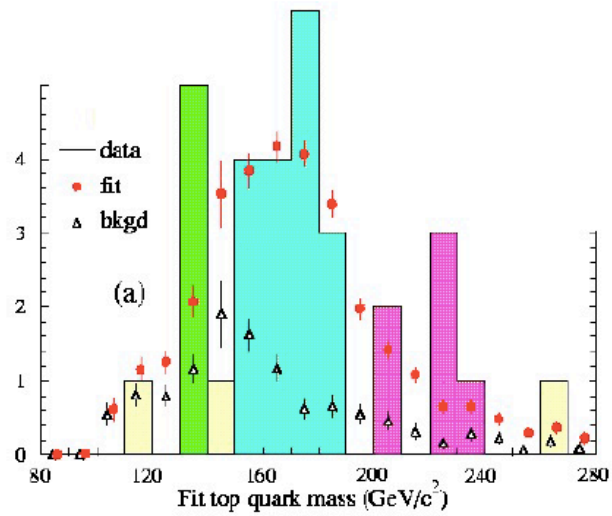
...

for a fixed vacuum value v, let us assume that the Higgs mass and therefore lambda is large. In that case, beta_lambda is dominated by the lambda^2 term, which drives the coupling towards its Landau pole at higher energies. Hence the higher the Higgs mass, the higher lambda is and the close[r] the Landau pole to experimentally accessible regions. This means that for a given (large) Higgs mass, we expect the standard model to enter a strong coupling regime at relatively low energies, losing in the process our ability to calculate ... it is natural to think that this effect is caused by new strong interactions, and that the Higgs actually is a composite ...".

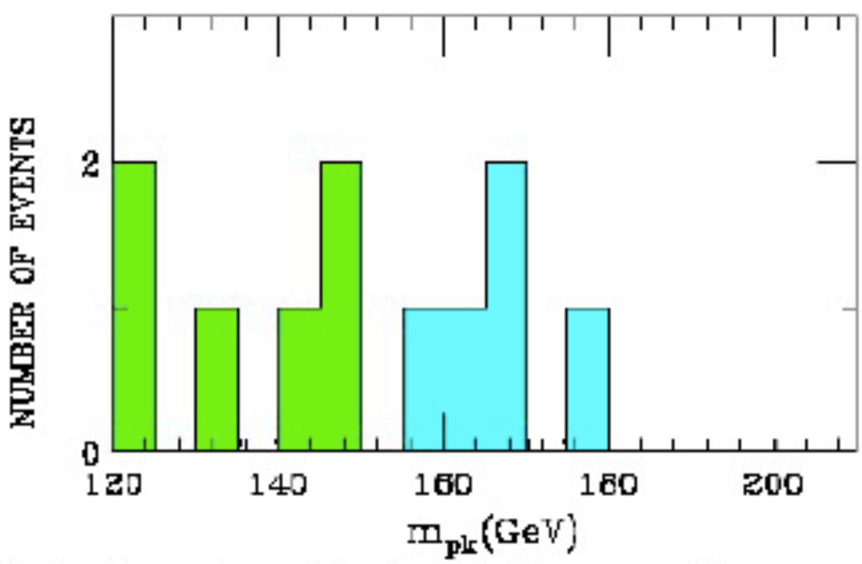
If the Higgs is really a 3-state Tquark condensate system (125.66 , 200 , 250 GeV)
then
the Tquark may also have 3 mass states (130 , 173.35 , 220 GeV)

as indicated by these 1994 CDF and 1997 D0 semileptonic histograms



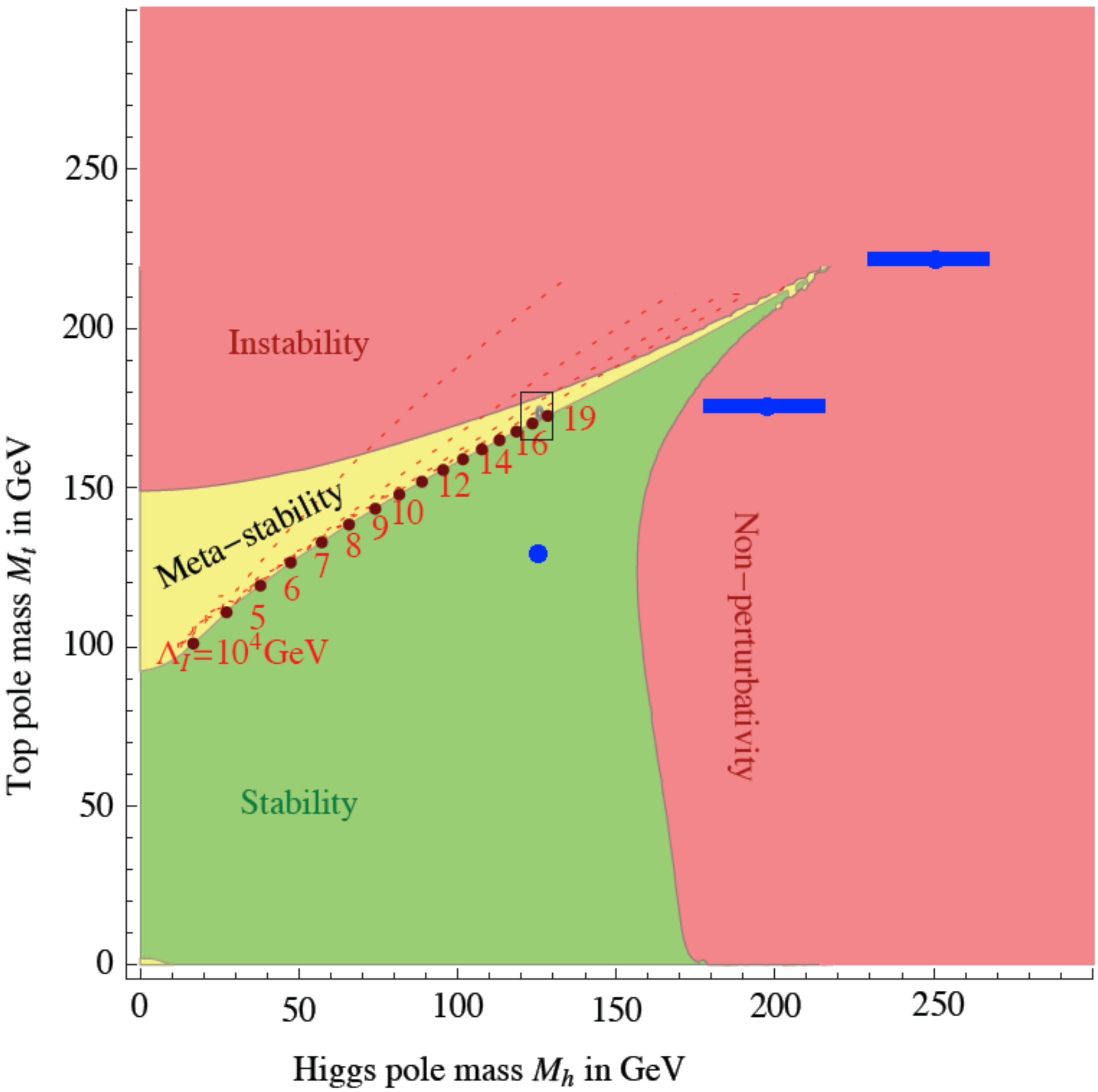


and this 1998 CDF dileptonic histogram



If you consider the Higgs-Tquark condensate system as having 3 mass states
and
if you match up the Low, Mid, and High mass states of the Higgs and Tquark
Low Mass = 125.66 GeV Higgs and 130 GeV Tquark
MId Mass = 200 GeV Higgs and 173.35 GeV Tquark
High Mass = 250 GeV Higgs and 220 GeV Tquark

then you have



No Vacuum Metastability or Instability.

A Low ground state (Mh = 125.66 Mt = 130 GeV) in the Stability Region.
A Mid state (Mh = 200 GeV Mt = 173.35 GeV) in the Non-perturbativity region.
A High state (Mh = 250 GeV Mt = 220 GeV) at the Critical Triple Point.

Two More Questions

Why does CDF 1994 semileptonic histogram show a peak in the 140 to 150 GeV bin for the Tquark mass, while E8 Physics has Tquark Ground State at 130 GeV ?

In arXiv 1209.09393 Isabella Masina says "... the [Tquark] pole mass can be easily recovered via the relation mt = mtbar(mt) + 9.6 (+2.9 -2.3) GeV ...
by doing a scheme transformation to NNLO accuracy from the running to the pole [Tquark] mass, the range mtbar(mt) = 163.3 +/- 2.7 GeV
is equivalent to mt = 173.3 +/- 2.8 GeV ...
we will link the value of the [Tquark] pole mass to the running mass via the simple relation mt = mtbar(mt) + 10 GeV ...".

What happens from 250 GeV (ElectroWeak) up to 10^19 Gev (Planck Scale) ?

Below 1 TeV energy and above 10^(-17) cm scale (LHC collision region) we see the quarks and leptons that have mass from the Higgs mechanism

Up to 10^7 TeV energy and above 10^(-24) cm scale in which ElectroWeak symmetry becomes unbroken and quarks and leptons become massless. This is a very interesting region requiring much more powerful colliders than we now have such as
a 1000 TeV Linear Muon Collider about 1000 km long costing $100 billion or so

from 10^7 TeV up to 10^16 TeV Planck energy and 10^(-24) cm down to 10^(-33) cm Planck scale the 4-dim physical spacetime merges with the 4-dim CP2 internal symmetry space to produce an Octonionic 8-dim spacetime with non-unitary processes that can produce a lot of particles (as were produced during the inflationary era).
A Fundamental Fermion particle cannot remain a single Planck-scale entity because the E8 Physics World-Line Bosonic String Theory produces Tachyons which create a cloud of particle/antiparticle pairs forming a Kerr-Newman black hole whose structure comes from the 24-dim Leech lattice part of the Monster Group
which is 2^(1+24) times the double cover of Co1, for a total order of about 10^26.
(Since a Leech lattice is based on copies of an E8 lattice and since there are 7 distinct E8 integral domain lattices there are 7 (or 8 if you include a non-integral domain E8 lattice) distinct Leech lattices, and the physical Leech lattice is a superposition of them, effectively adding a factor of 8 to the order.)
So, the volume of the Kerr-Newman Cloud is on the order of 10^27 x Planck scale, and the Kerr-Newman Cloud should contain on the order of 10^27 particle/antiparticle pairs and its size should be somewhat larger than, but roughly similar to, 10^(27/3) x 1.6 x 10^(-33) cm = roughly 10^(-24) cm
with energy about 10^10 GeV = 10^7 TeV.

In arXiv 1307.536 Buttazzo et al say "... That the critical condition for stability is ... at ... energy scale ... 10^10 - 10^12 GeV ... suggesting that the instability is reached well below the Planck mass ...". It is interesting that 10^10 GeV characterizes both the instability of our Vacuum and the Kerr-Newman Cloud created by E8 Tachyons.