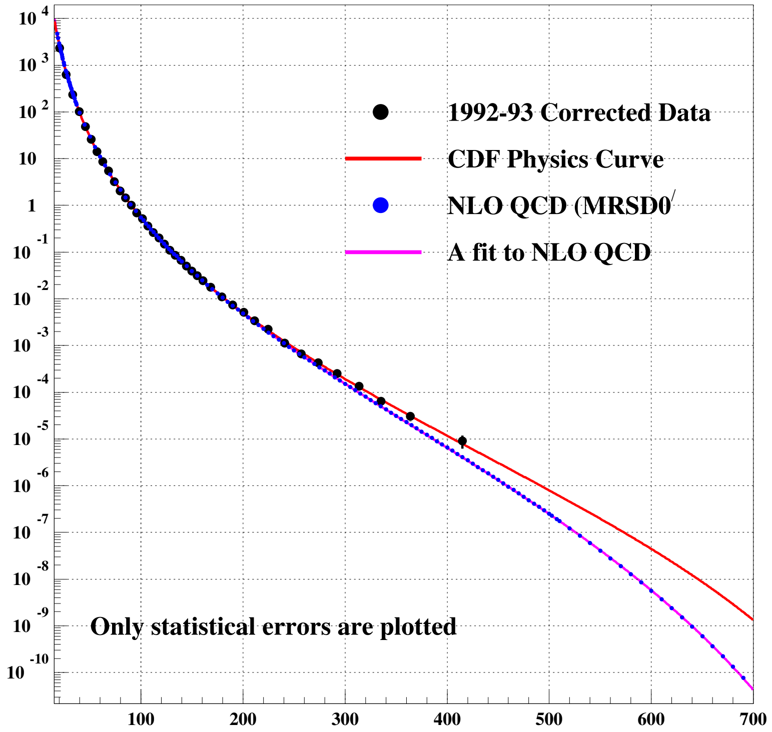
Highest Energy Data

Typically look at energy distribution of “jets” produced in these collisions

- Compare with predictions that assume point quarks

Comparison of Corrected Data and NLO QCD

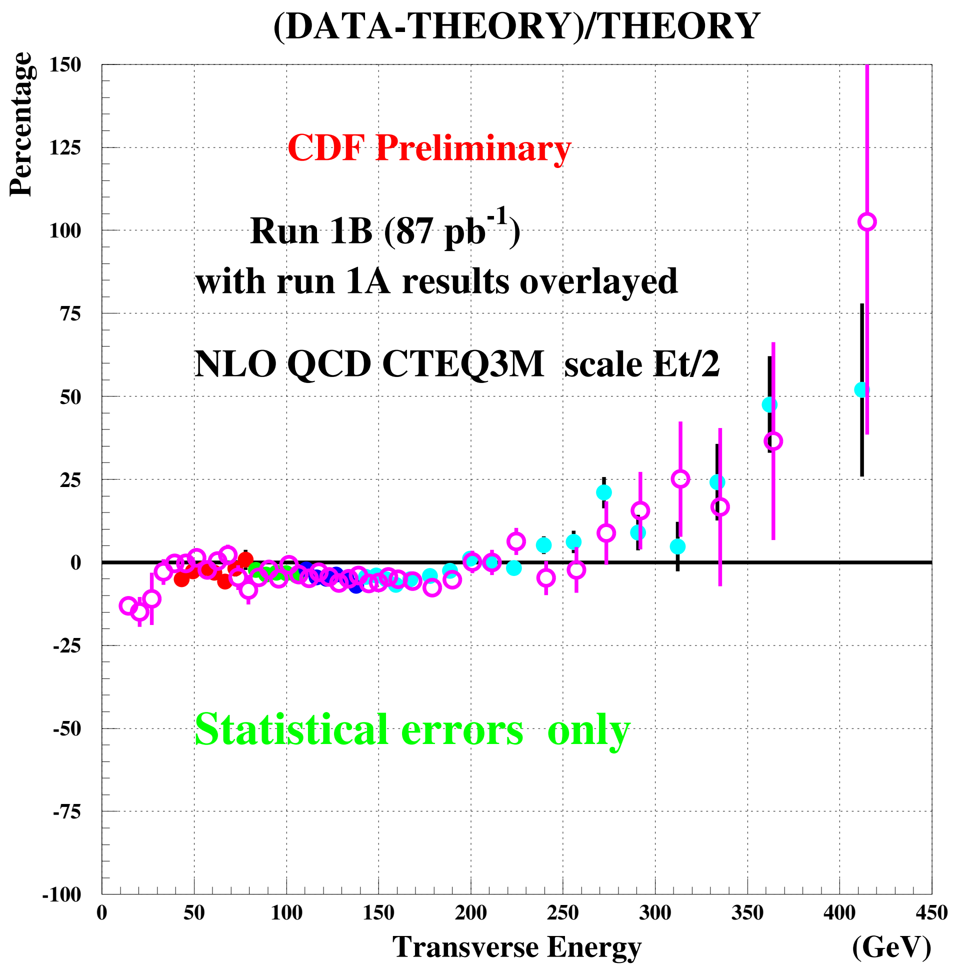


Physics Curve is well behaved beyond data
Parameterization also fits well to NLO QCD

High Energy Data

The high E_T tail does show an excess

- Best seen when comparing relative difference



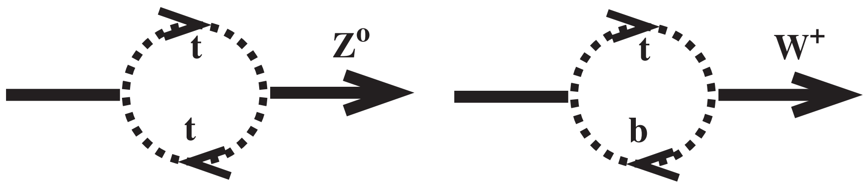
One sees a small discrepancy

- Looks suspicious, but not conclusive
- Implies quark is smaller than $\sim 10^{-17}$ m

Why MUST the Top Quark Exist?

If top doesn't exist, the Standard Model crumples

- Masses of the $W^{\pm}$ and Z° bosons cannot be explained



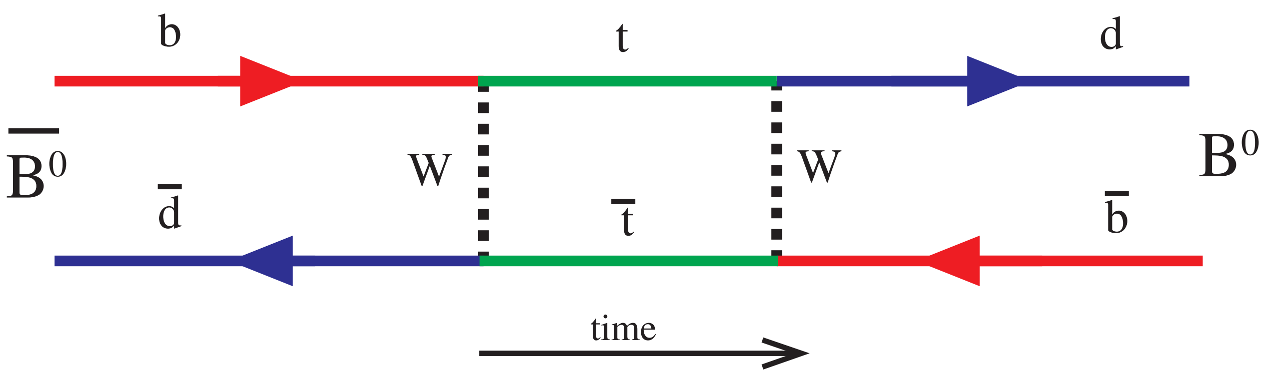
  - Measurements of the Z boson require

$$M_{top} = 166^{+17+19}_{-19-22}\ \mathrm{GeV/c^2}$$

- Behaviour of the bottom quark implies that it must have a partner

  - Weak force predicts asymmetry in $e^+e^- \to b\bar{b}$

- B meson "mixing" could not occur



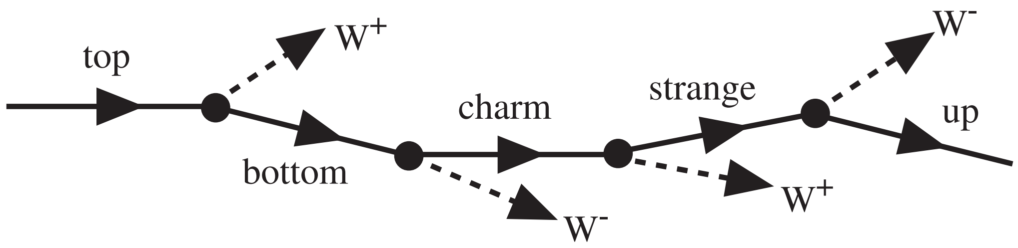
Why are Heavy Quarks Hard to Find?

Hard to produce

- Must sift through lots of matter-antimatter collisions
- Happens about 1 in every billion collisions?

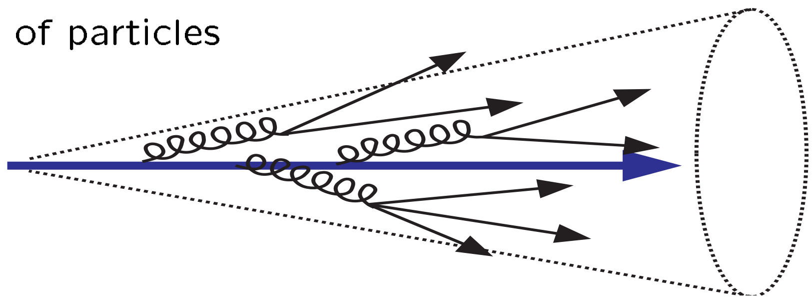
They Decay!

- A top quark decays via the weak force into a bottom quark
- The bottom quark then decays into lighter quarks



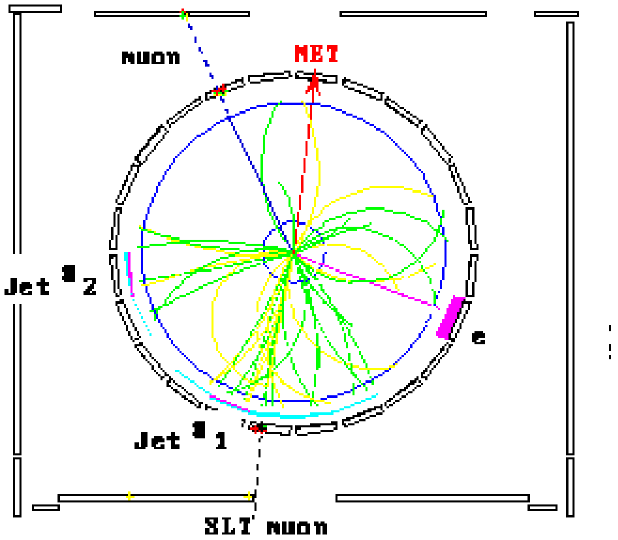
Ya can't see free quarks

- Quarks are "not allowed" to appear unescorted in public
- Have to "dress" themselves up around other quarks
- Result in "jets" of particles



Now Have the Evidence...

In about 10 billion collisions, find about 50 events



We observe about the right number of different types

- Observe 1 $\mu^+\mu^-$ event and 5 $e\mu$ events
- Expect 1.3 ± 0.3 events from background
- Observe ~ 40 events with $W + \geq 3$ jets

Probability of background looking like this is $< 10^{-6}$