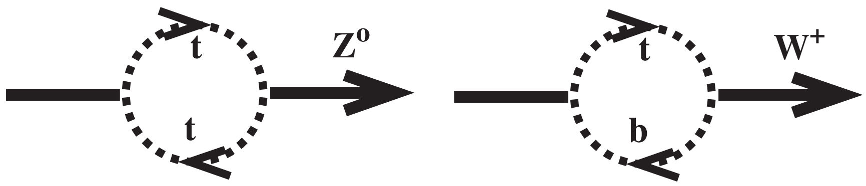
Why MUST the Top Quark Exist?

If top doesn't exist, the Standard Model crumples

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

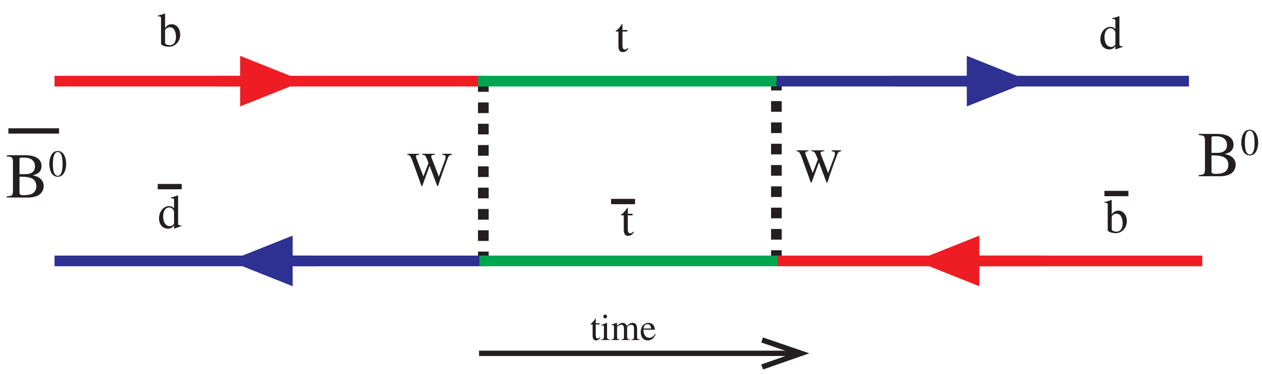


  - Measurements of the Z boson require

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

- 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



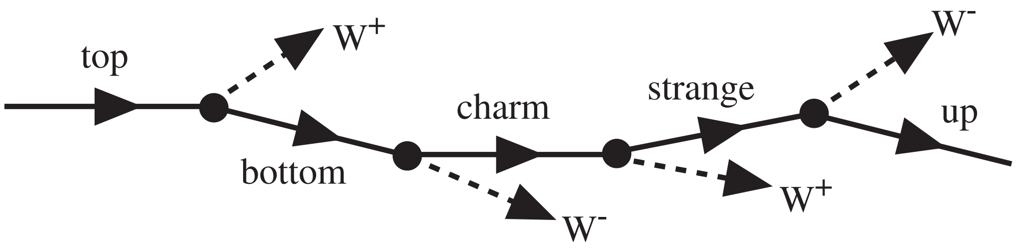
Why are Heavy Quarks Hard to Find?

Hard to produce

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

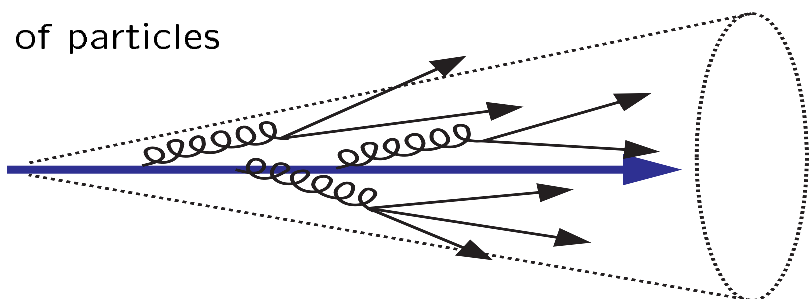
They Decay!

- 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

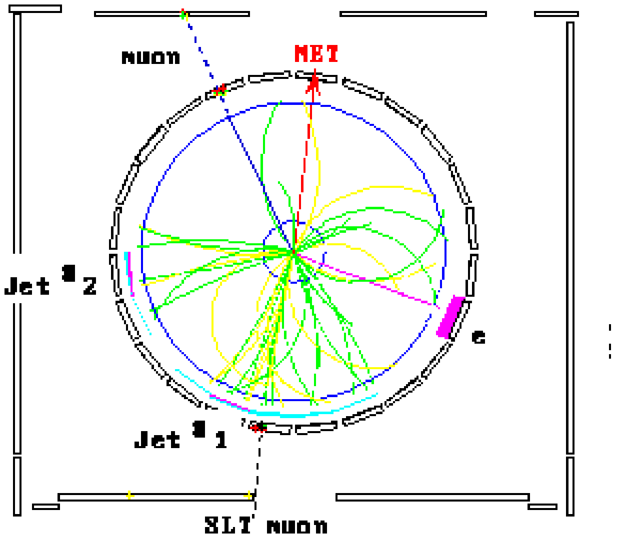
- Quarks are "not allowed" to appear unescorted in public
- Have to "dress" themselves up around other quarks
- Result in "jets" of particles



Dilepton Top Quark Search

$t\bar{t}$ decaying into 2 leptons create unique signature

- Two charged leptons from $W^{\pm}$ decay
- Imbalance in total energy due to undetected neutrinos
- Two jets from bottom quarks



We observe a total of 6 candidate events

- Observe 1 $\mu^{+}\mu^{-}$ event and 5 $e\mu$ events
- Expect 1.3 ± 0.3 events from background

Probability of background fluctuation is 3.3×10^{-3}

b Quark Tagging in W+Jet Events

Applied these tagging techniques to W+jet events

Sample	SVX bkg	SVX tags	SLT bkg	SLT tags
W+$\geq$ 3 jet	6.7 ± 2.1	**27**	15.4 ± 2.3	**23**

- Probability of background fluctuation is 1×10^{-6}
- Agrees well with expected rate from $t\bar{t}$ production