The Discovery of the Top Quark

Alex Baker

Top Quark Discovery

- Fermilab and Tevatron
- Prediction
- Production
- Decay
- Discovery

Fermilab

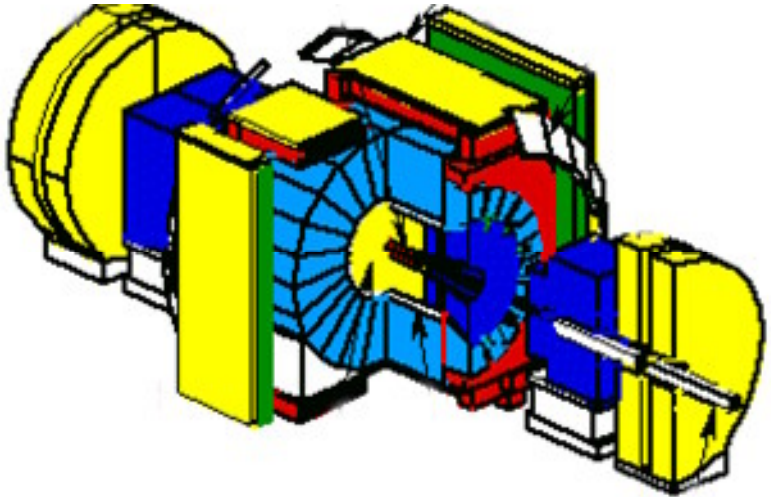
- The Fermi National Accelerator Laboratory
- Established in 1967.
- Collider experiments.
- Fixed target experiments.
- Neutrino experiments

Fermilab

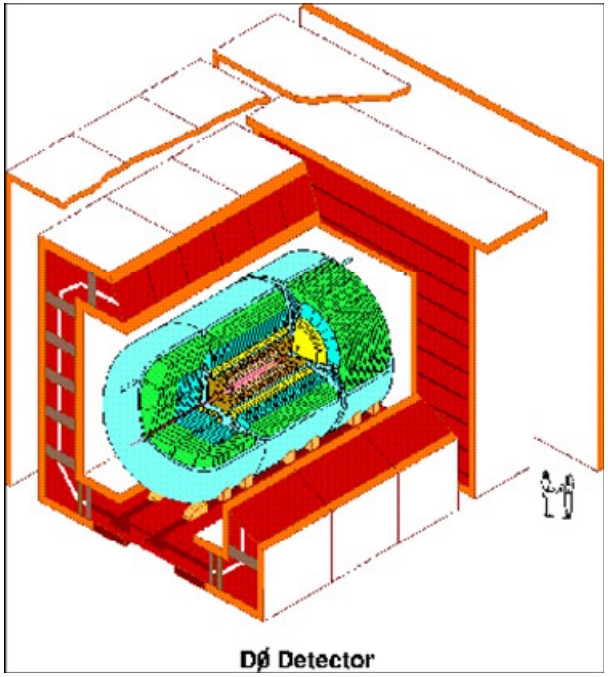
Tevatron

- Proton - Anti-proton Collider
- CMS energy 1.96 TeV
- Worlds highest energy collider (until LHC)
- First SC magnets in an accelerator
- Two experiments, CDF and D0

CDF and D0



CDF

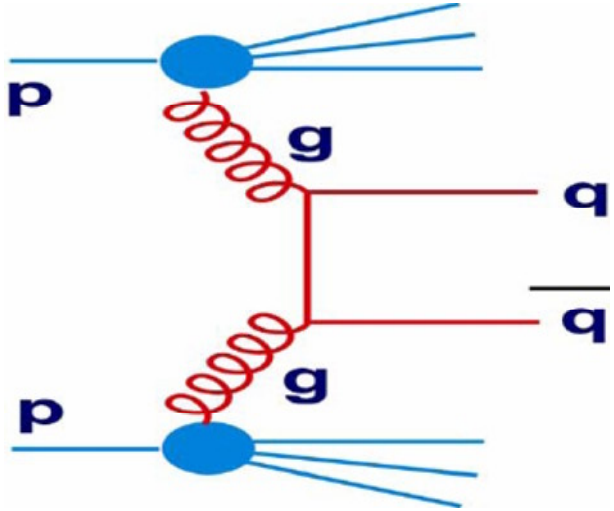


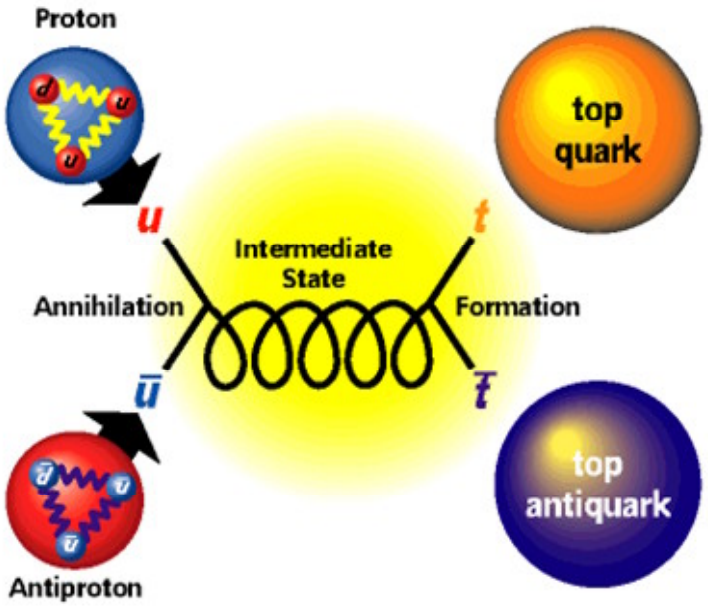
D0

Top Quark Predictions

- The Quark Model, 1964.
- Quark observation at SLAC in 1968.
- b Quark discovery,1977.
- Top Quark mass estimations of 145 – 185 GeV/c^2.

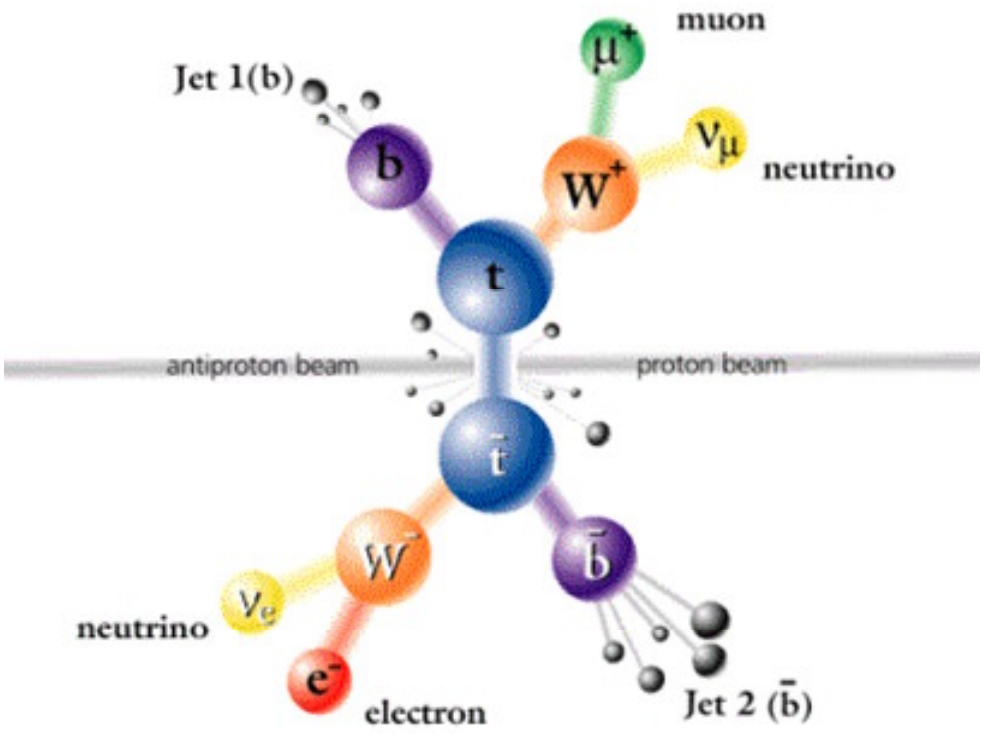
Top Quark Production





Top Quark Decay

- Predict t → W + d/s/b
- Find t → Wb (~99% BR)
- W then decays to a lepton and neutrino or a quark anti-quark pair.



Top Quark Decay

This gives three possible decay methods

- 6 jet decay
- 4 jet, 1 lepton, 1 neutrino decay
- 2 jet, 2 lepton, 2 neutrino decay

Top Quark Discovery

- First seen by CDF and D0 in 1994
- Discovery of top quark officially announced in march 1995
- Only around 10-20 top pairs seen in each experiment before announcement

Top Quark Discovery

- CDF Results: 176±8 (stat)±10(syst)GeV/c^2

  4.8σ signal

- D0 Result: 199 + 19/-21 (stat)

  ±22(syst)GeV/c^2

  4.6σ signal

Conclusion

- Tevatron still operating, expected to close in 2010, after LHC begins operation

- Top quark mass now measured to $172.6 \pm 1.4\ \mathrm{GeV}/c^2$

Further Information

Try Wikipedia.

Questions?