

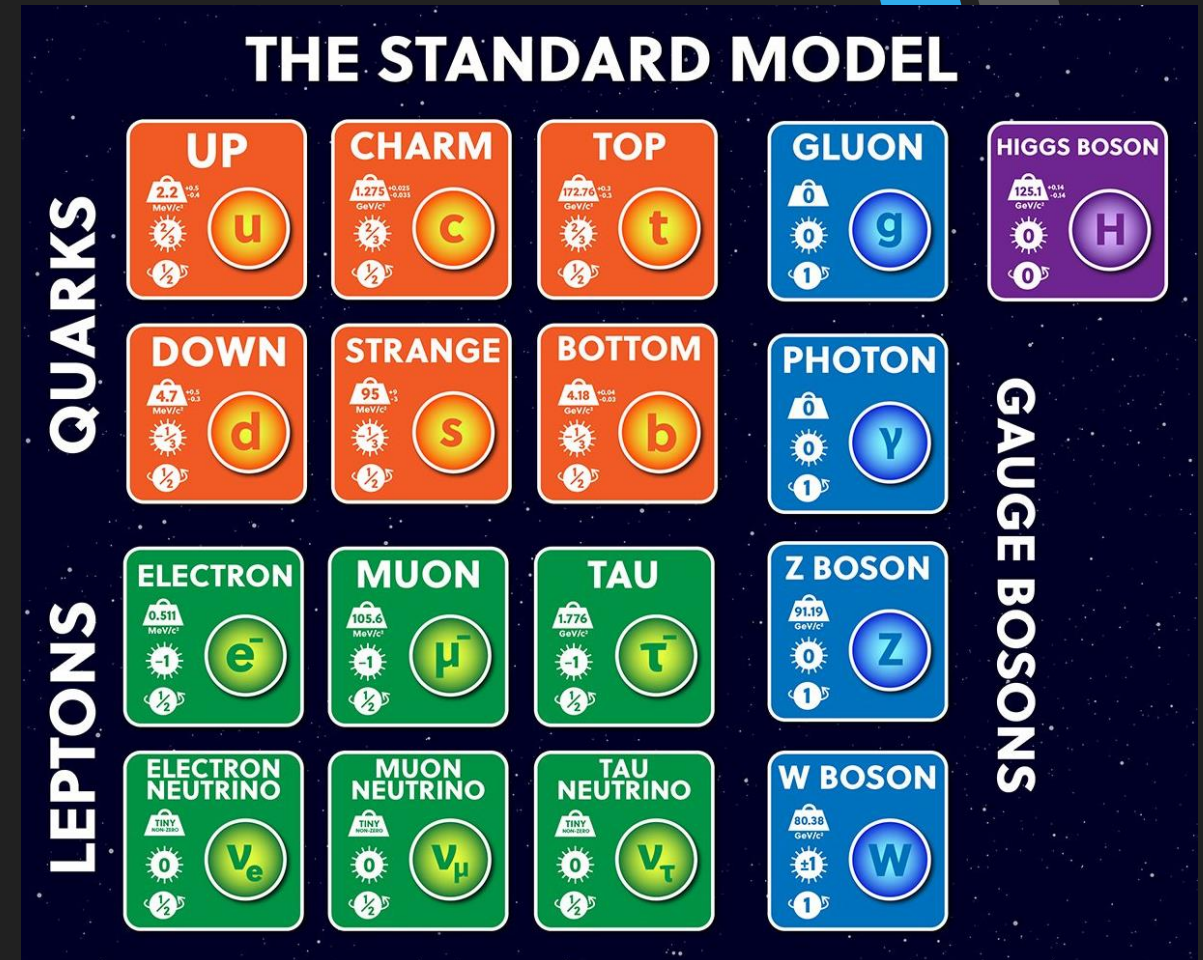


# Search for Charming Top Events

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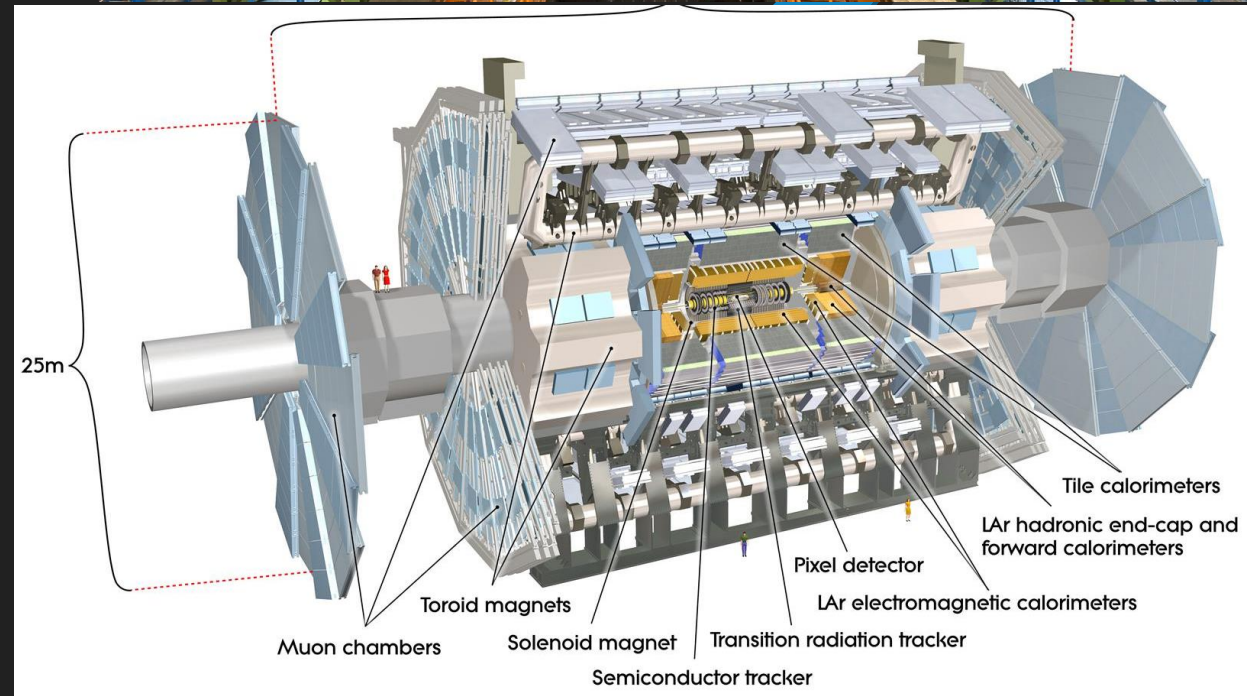
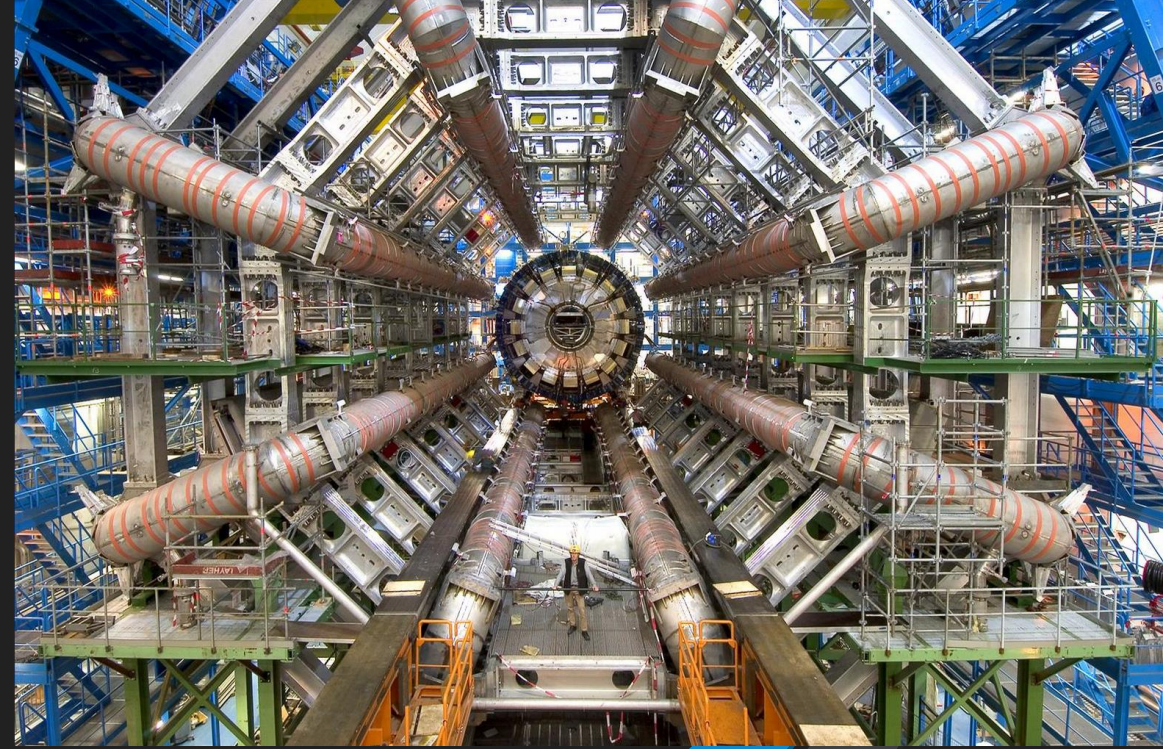
# Standard Model

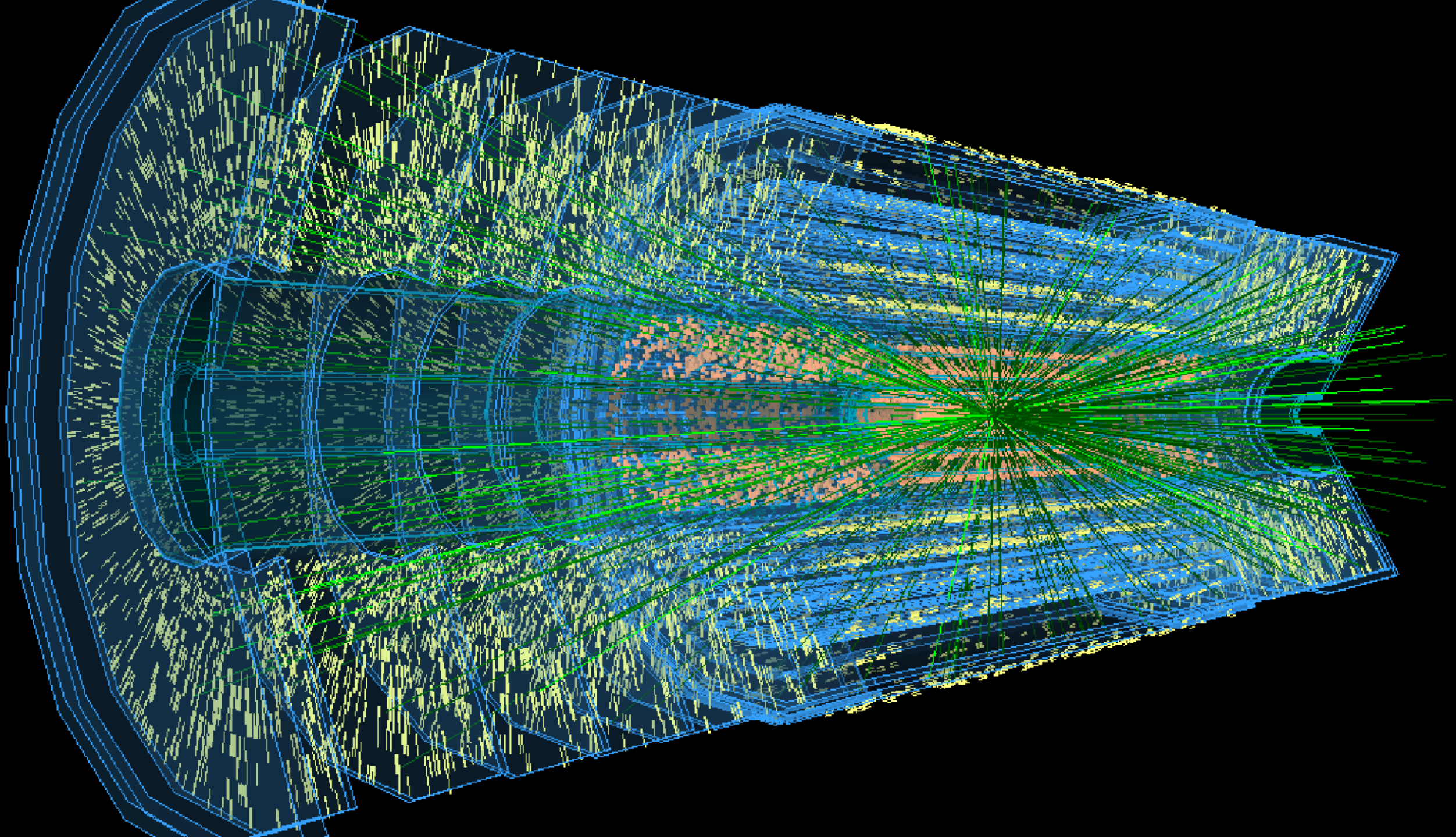
- Quarks & Leptons are matter particles
- Bosons are force carrying particles
- Interactions between mass particles can be thought of as an exchange of a boson
- Forces carried include strong, weak, and electromagnetic forces (so far)
- SM falls short in several explanations, so we are always probing for new physics



# LHC & ATLAS

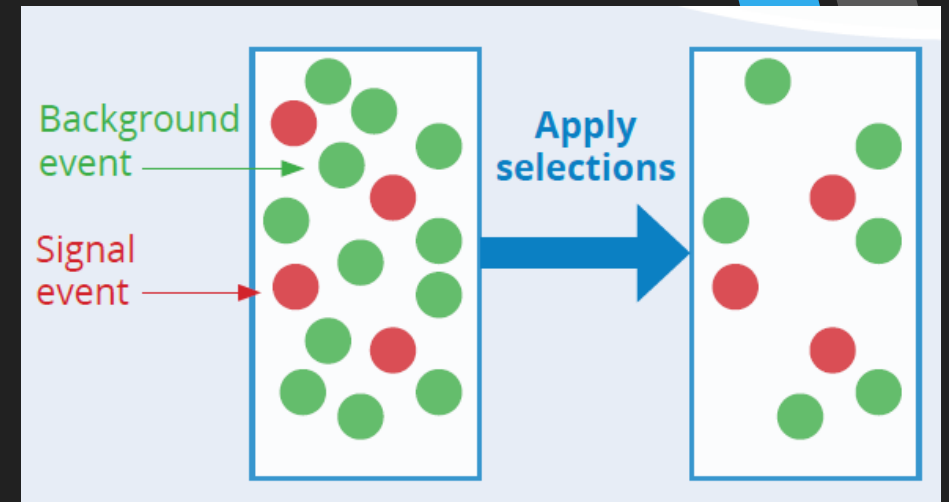
- Large Hadron Collider at CERN operates at 13.6 TeV, highest in world
- Testing of SM physics by accelerating protons or heavy ions at each other at extremely high energies
- Collisions take place in a detector known as ATLAS
- 40 million proton-proton collisions per second
- Provides massive data sets to analyze particle physics interactions





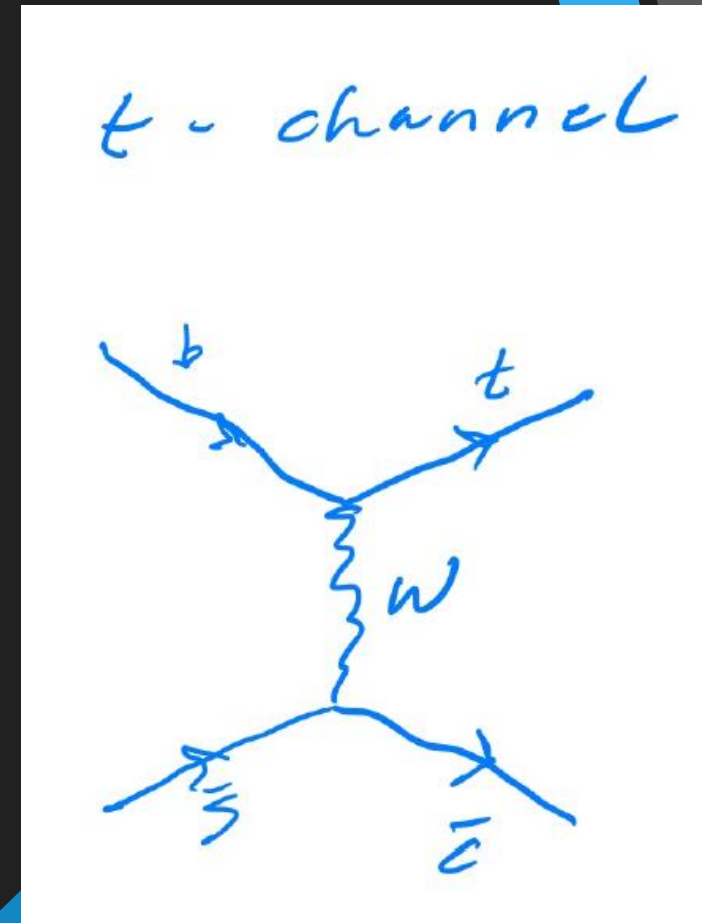
# Important Ideas

- Cross Section - probability that two particles will collide and interact in a certain way. Dependent on particle type and energy
- Integrated luminosity is size of data set
- Total events = integrated luminosity \* cross section
- High significance is desired to tell us with confidence we have the signal we want
- Significance is  $S/\sqrt{B}$  where  $S$  is number of signal events and  $B$  is the number of background events



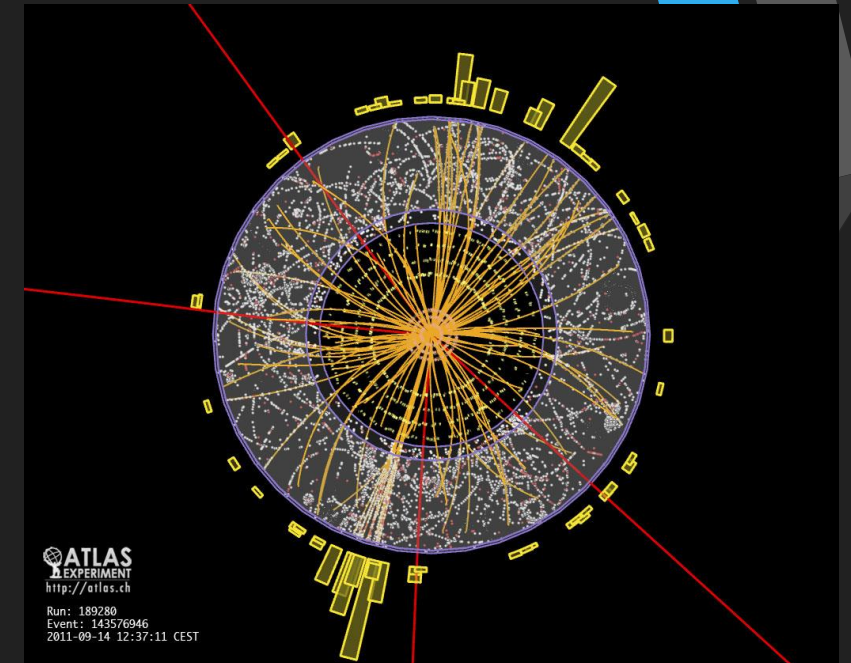
# Research Goals

- Observation of proton-proton  $\rightarrow$  top + charm has never been measured before
- Massive data sets require methods to separate signal from background
- Determine selection criteria to be able to make significant measurement
- Good significance requires good discriminating variables
- Agreement strengthens SM, disagreement could point to unknown physics



# What Am I Learning?

- Making histograms to determine necessary discriminating variables
- Statistical analysis methods to determine significance of measurements
- Implementing Boosted Decision Trees to improve signal to noise ratio
- Look for significance of observation of single top + charm event



# References

- Dr. Abbott
- The Particle Adventure
- ATLAS Cheat Sheets
- <https://atlas.cern/updates/press-statement/atlas-experiment-presents-latest-higgs-search-status>
- [http://opendata.atlas.cern/books/current/get-started/\\_book/GLOSSARY.html](http://opendata.atlas.cern/books/current/get-started/_book/GLOSSARY.html)
- [https://www.nsf.gov/news/news\\_images.jsp?cntn\\_id=296456&org=NSF](https://www.nsf.gov/news/news_images.jsp?cntn_id=296456&org=NSF)