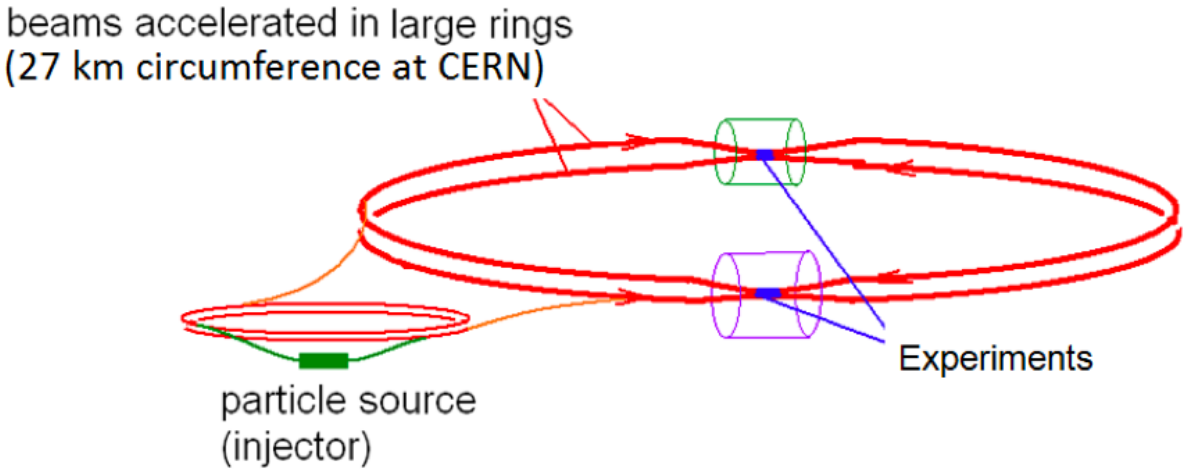
ASP 2018 LHC Data Measurement for High School Learners

Learn more at http://tiny.cc/w2d2-18.

What is the LHC and what happens there?

LHC=Large Hadron Collider

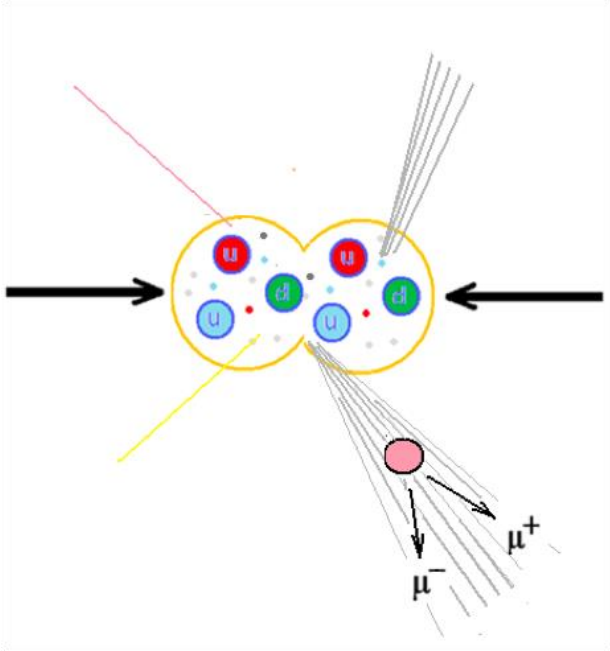
- ~100 m underground near Geneva, collides protons
- Most energetic accelerator in the world (currently 13 TeV)



What is the LHC and what happens there?

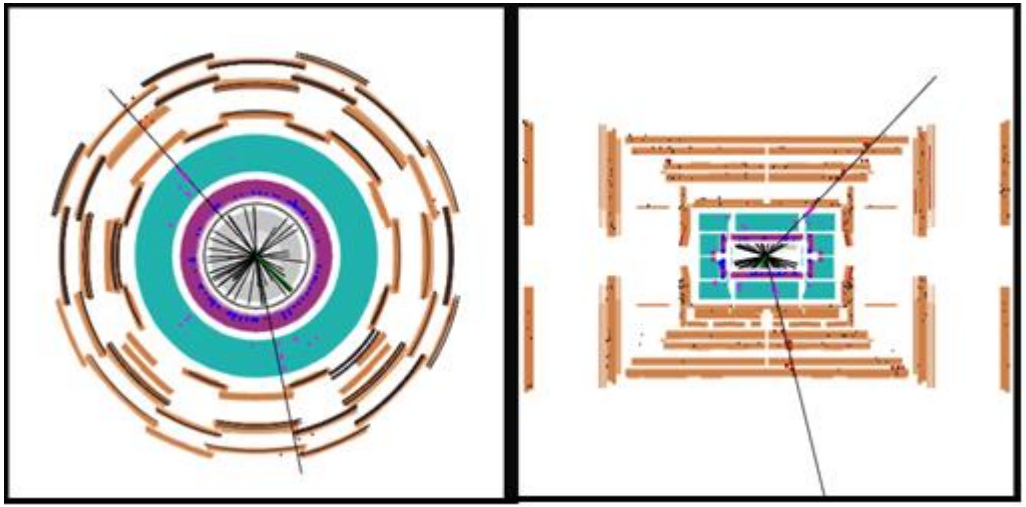
When protons collide...

- Many particles are produced due to $E=mc^2$ (13 TeV → particles)
- Most are known processes: background
- What we are looking for:
  - Relatively massive particles produced (like Z boson!)
  - We never see these – they decay promptly
  - We see *decay products* like muon and anti-muon
  - A muon is the heavier cousin of the electron

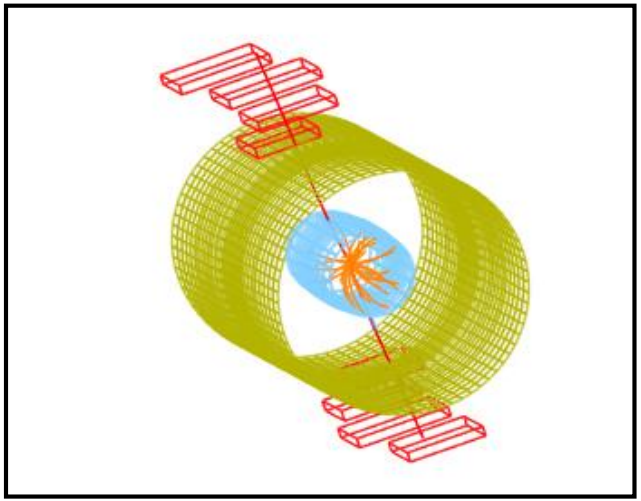


Dimuons look like one of these

- 2 long tracks
- Any other things in event are background - ignore
- If not 2 muons in event, entire event is background - ignore

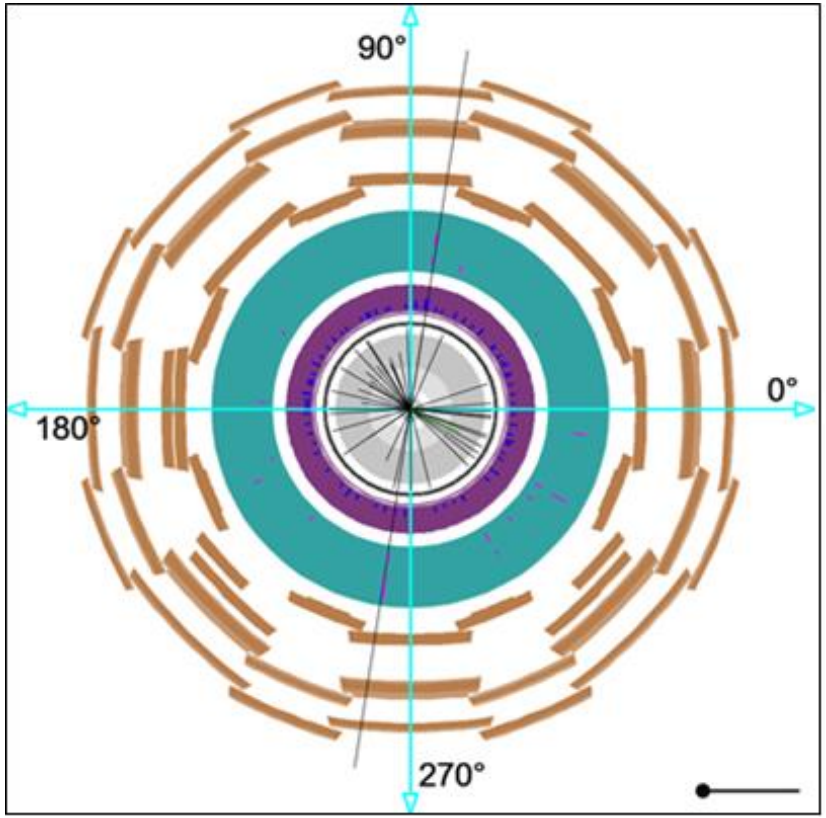


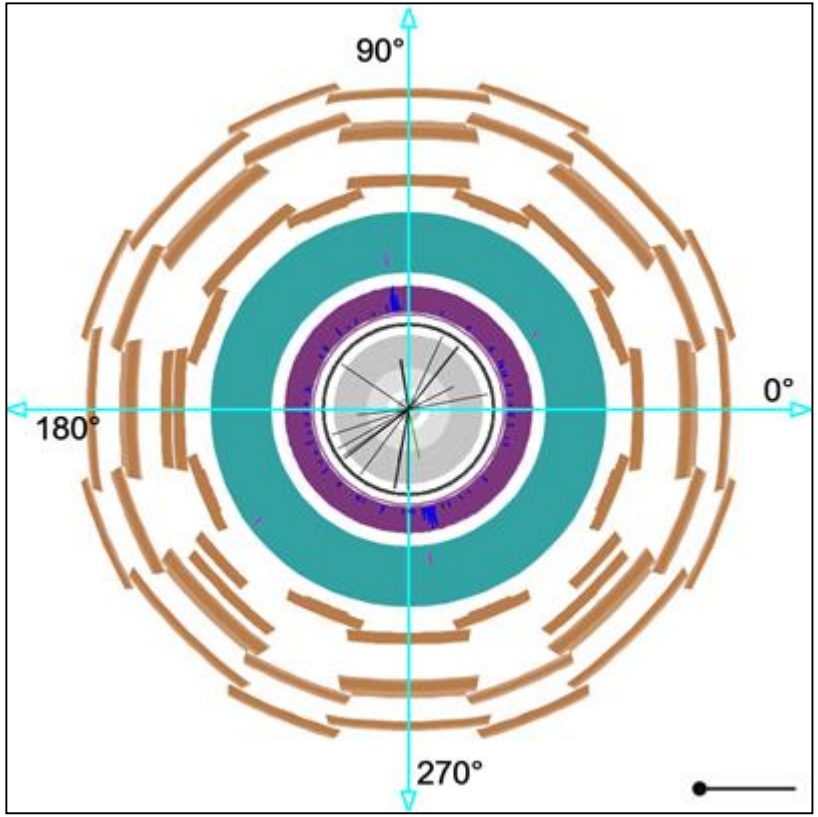
Dimuon in ATLAS



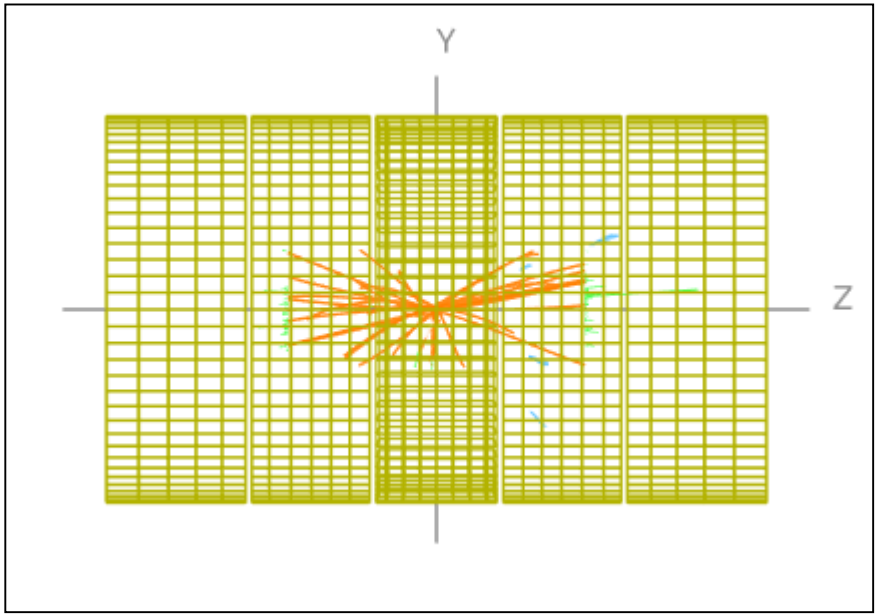
Dimuon in CMS - muons coded red

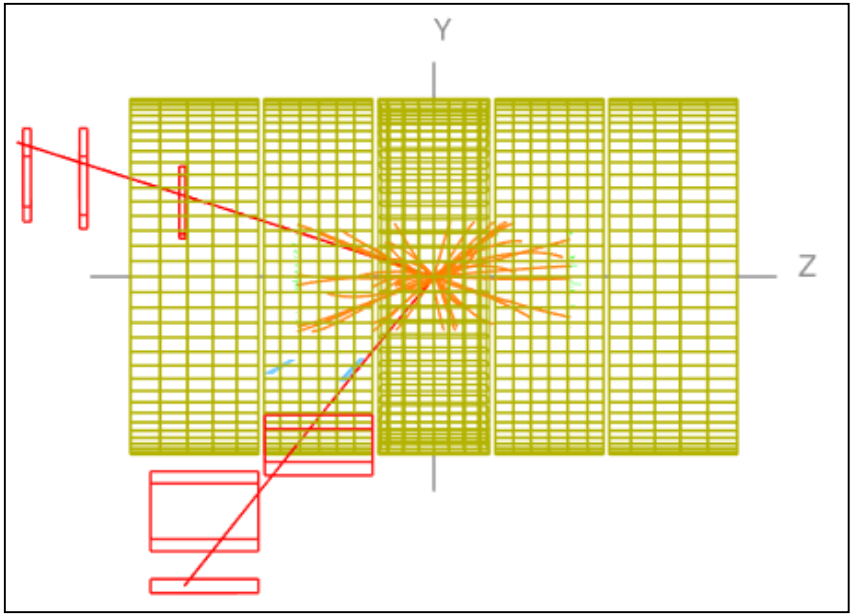
Dimuon or background? (ATLAS)



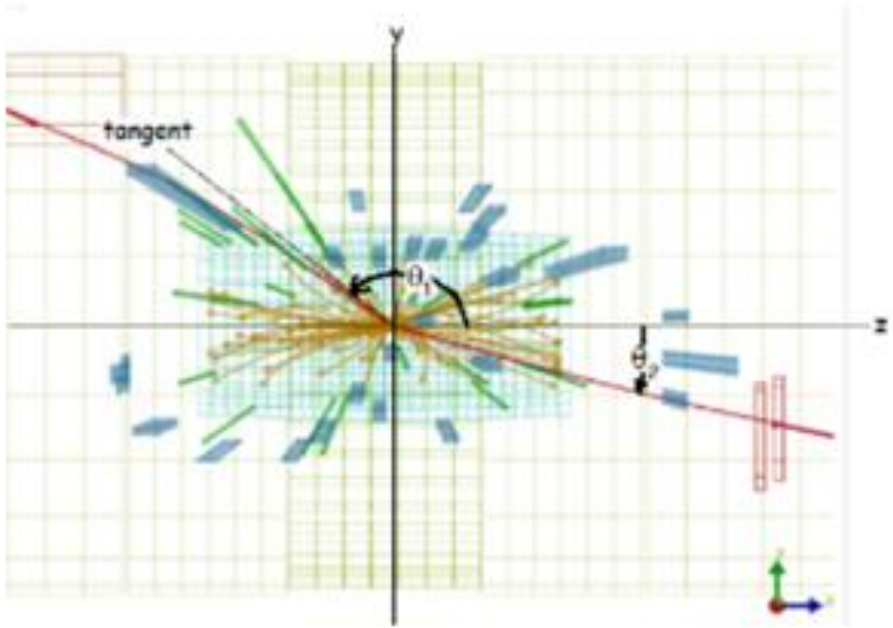


Dimuon or background? (CMS)





Ready? Make use of event display sheets, protractor, and tally sheet.



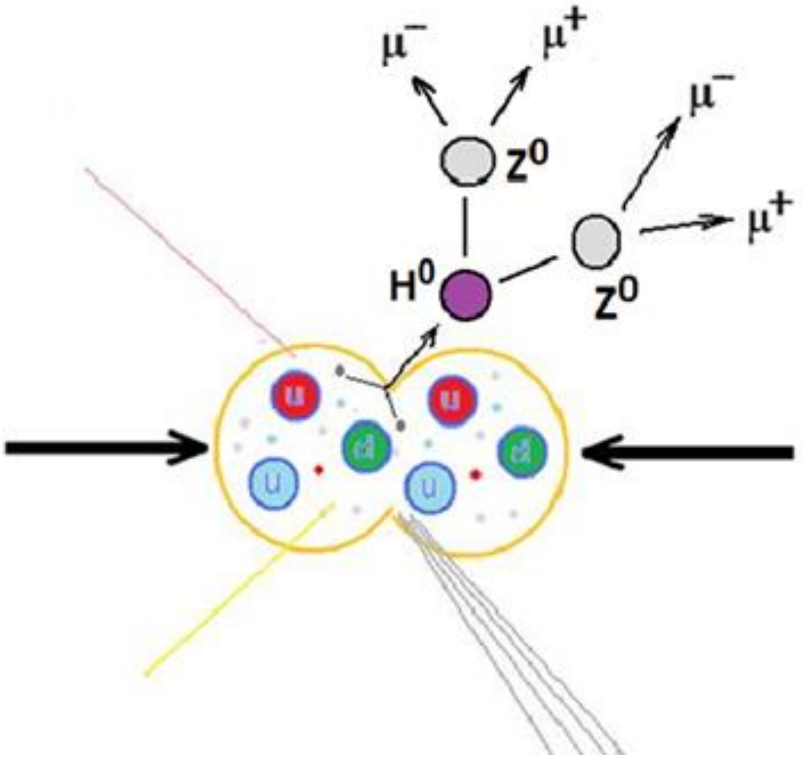
Finding angles θ_1 for the upper muon and θ_2 for the lower muon in the z-y view.

- Use your protractor to measure from the +z axis to each muon track.
- Use the smallest angle from +z to the track.
- Keep it positive!
- Find the nearest angle in the tally sheet and place a tick mark for each.

One more thing…

The Higgs boson was discovered by CMS and ATLAS and announced on July 4, 2012.

If you see 4 muons, it might just be from a Higgs boson!



Ready?

- Partners – work in groups at your tables
- We will give you ATLAS or CMS events.
- Fill out tally sheet.
- Make a class histogram!
- Ask questions!