

ASP 2018 LHC Data Measurement for High School Learners

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



NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY



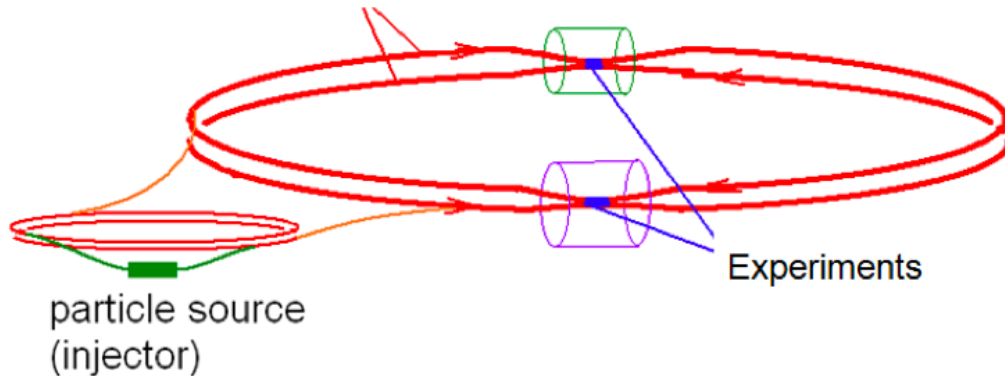
African School of Fundamental
Physics and Applications

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)

beams accelerated in large rings
(27 km circumference at CERN)

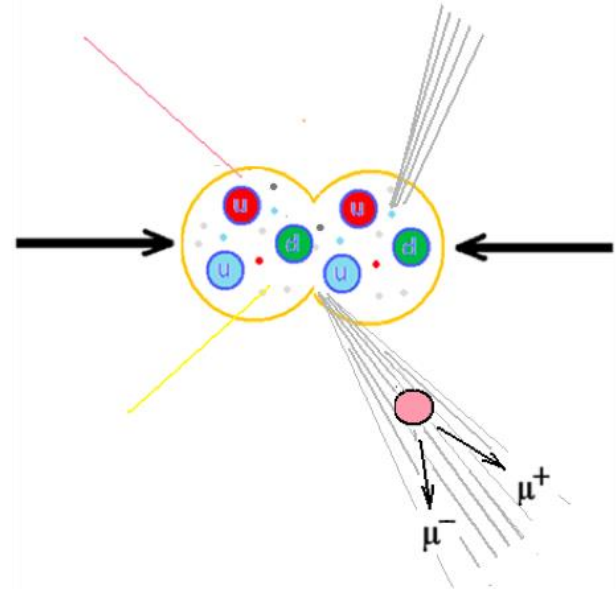


What is the LHC and what happens there?

When protons collide...

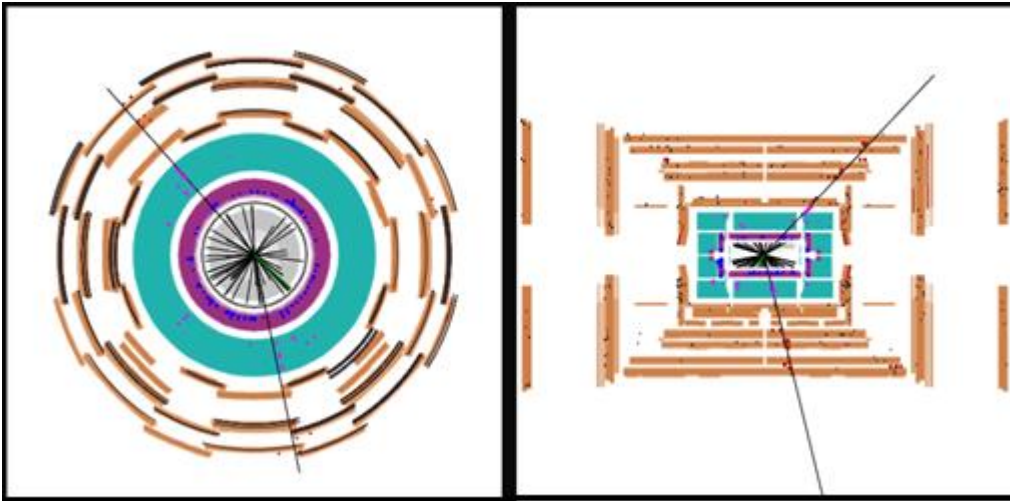
- Many particles are produced due to $E=mc^2$ (13 TeV \rightarrow particles)
- Most are known processes: background
- What we are looking for:
 - Relatively massive particles produced (like Z boson!)
 - We never see these – they decay promptly
 - We see *decay products* like muon and anti-muon
 - A muon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

ELECTRON DISCOVERED: 1897	MUON DISCOVERED: 1937	TAU DISCOVERED: 1975
		
MATTER PARTICLE	MATTER PARTICLE	MATTER PARTICLE
Mass: 0.511 MeV/c ²	Mass: 106 MeV/c ²	Mass: 1777 MeV/c ²
Electric Charge: -1	Electric Charge: -1	Electric Charge: -1
Strong Charges: -	Strong Charges: -	Strong Charges: -
Weak Charge: -1/2	Weak Charge: -1/2	Weak Charge: -1/2
Lifetime: unlimited	Lifetime: 2.2 · 10 ⁻⁶ s	Lifetime: 2.9 · 10 ⁻¹³ s

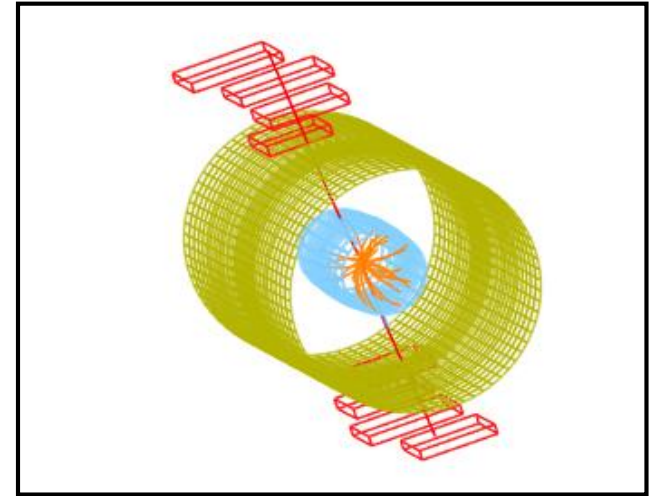


Dimuons look like one of these

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

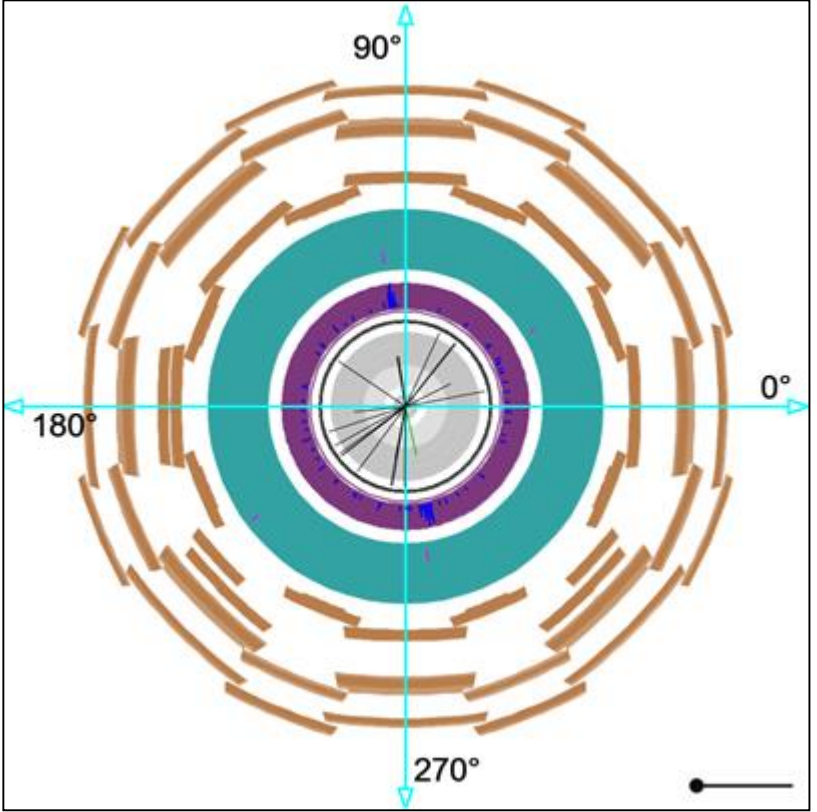
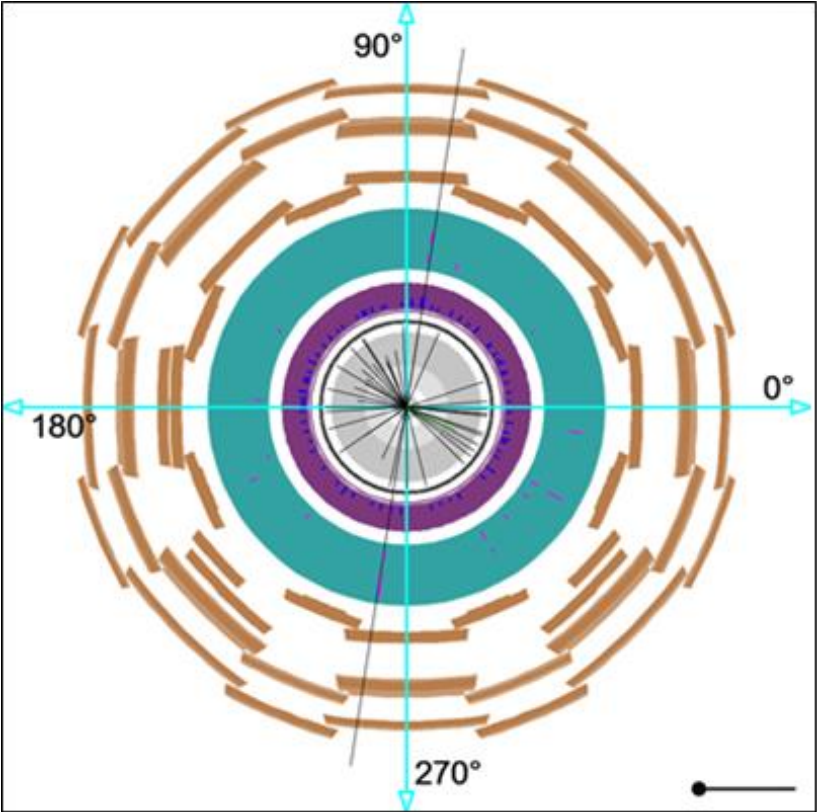


Dimuon in ATLAS

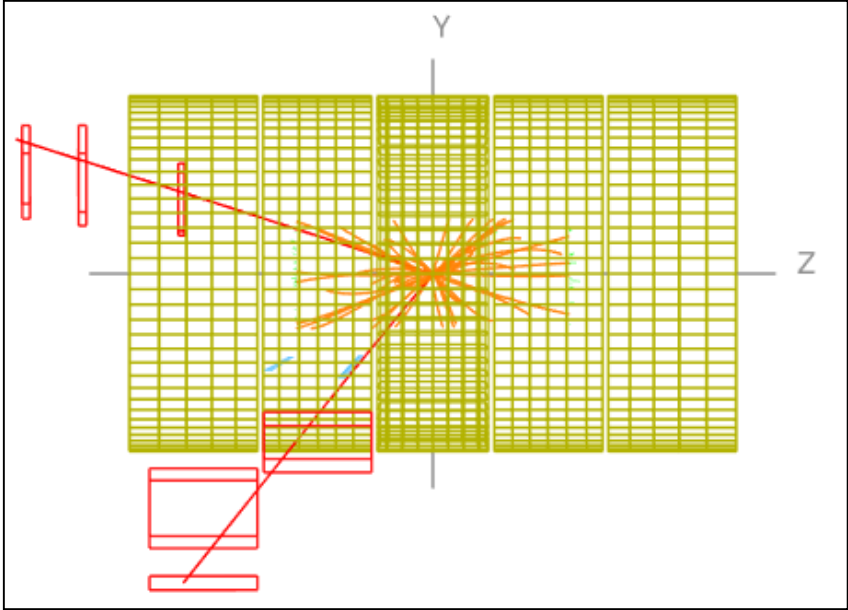
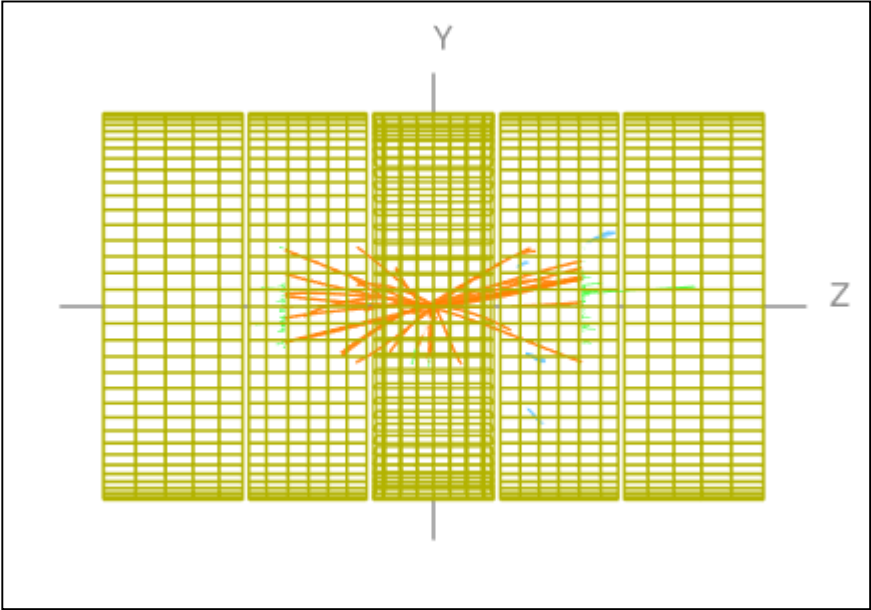


Dimuon in CMS - muons coded red

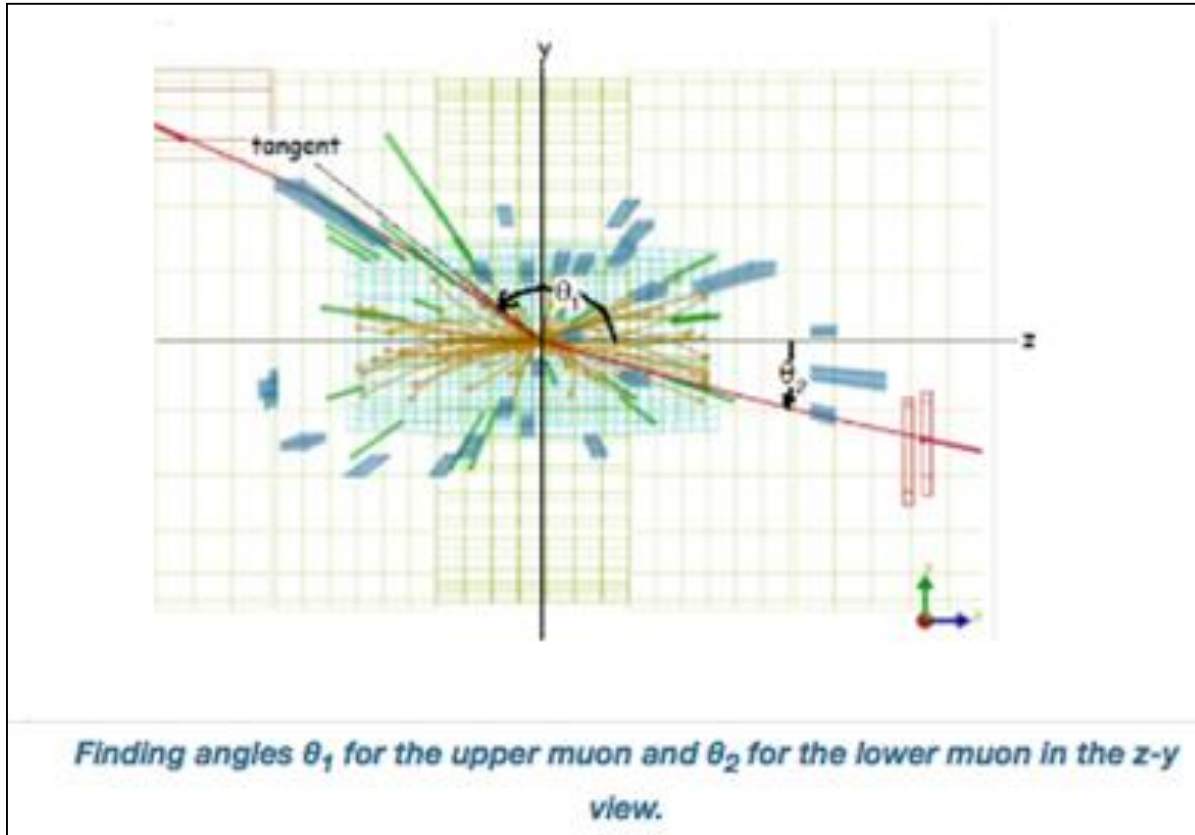
Dimuon or background? (ATLAS)



Dimuon or background? (CMS)



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

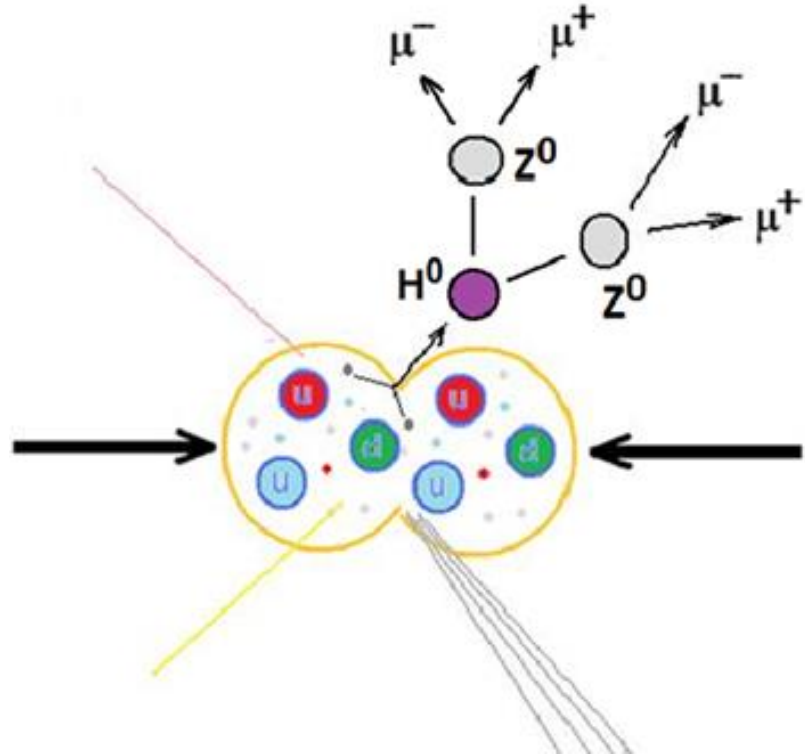


- Use your protractor to measure from the +z axis to each muon track.
- Use the smallest angle from +z to the track.
- Keep it positive!
- Find the nearest angle in the tally sheet and place a tick mark for each.

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!

