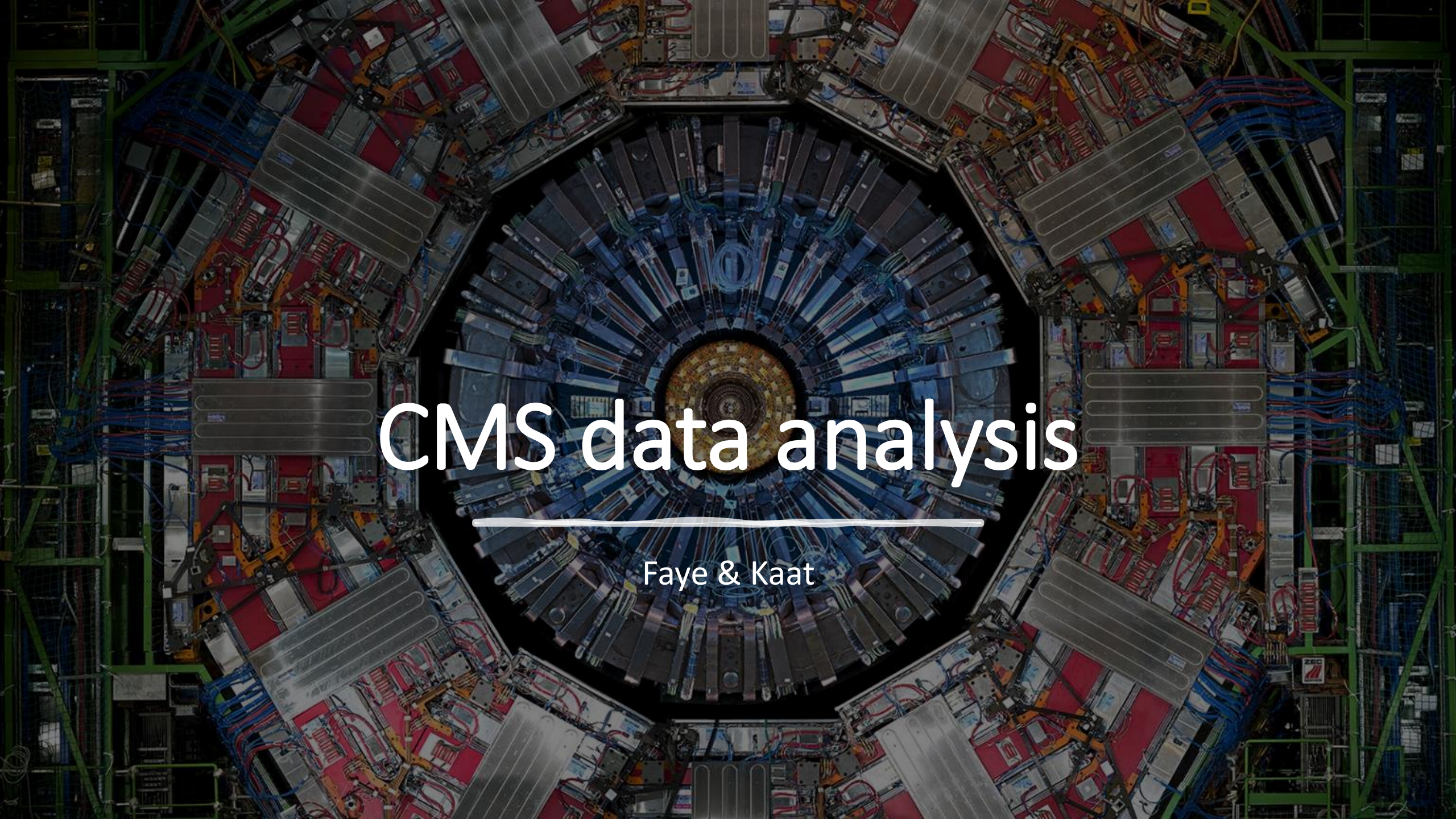


# CMS data analysis

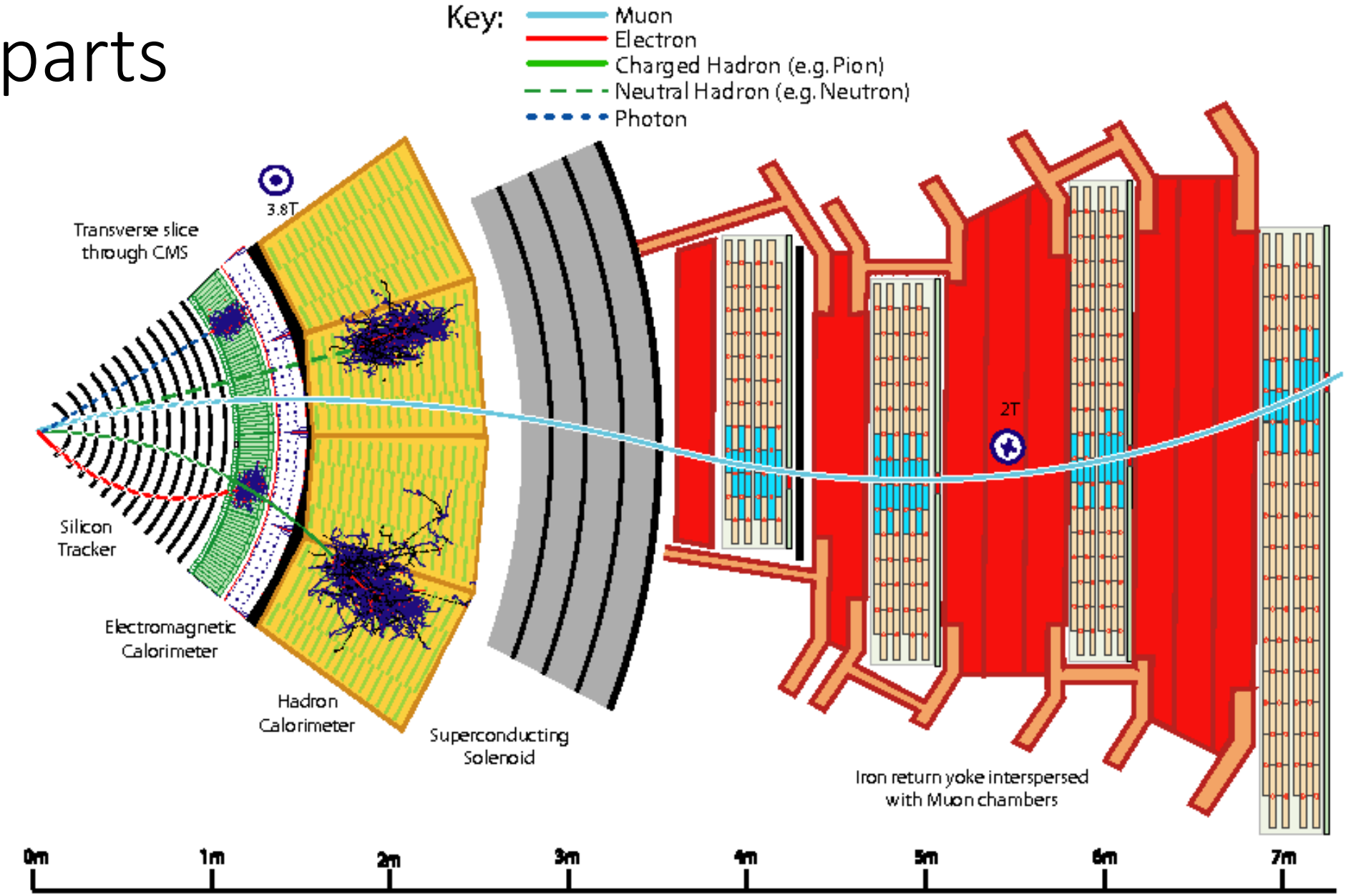
Faye & Kaat

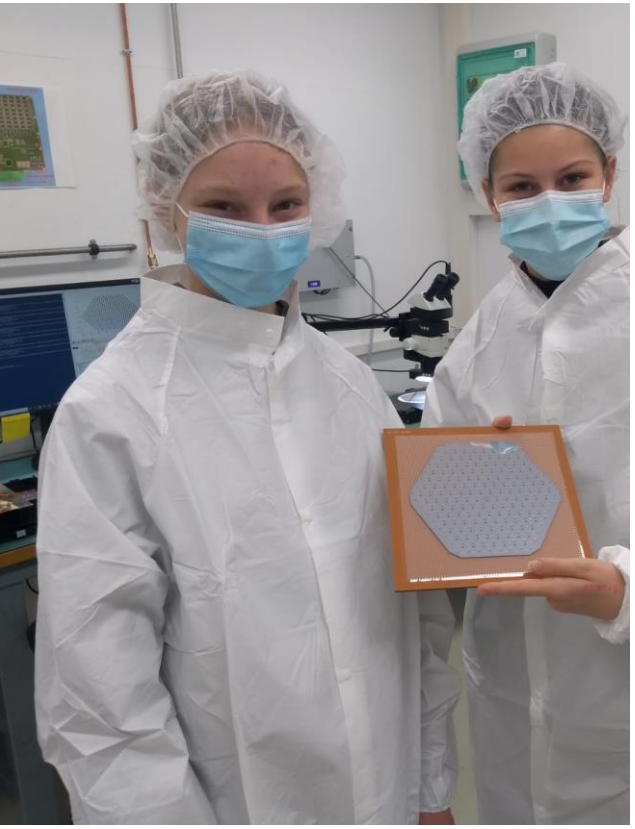

HMC-3
PAKISTAN
YE4 SECTOR

# What did we do?

- Supervisors and their work
- CMS:
  - New parts
  - Test beam
  - Data

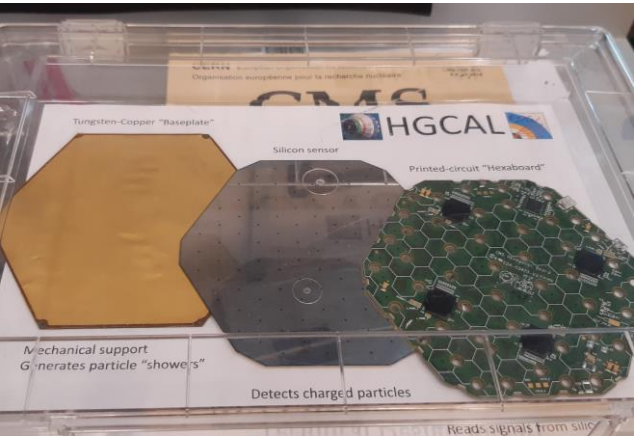
# CMS parts

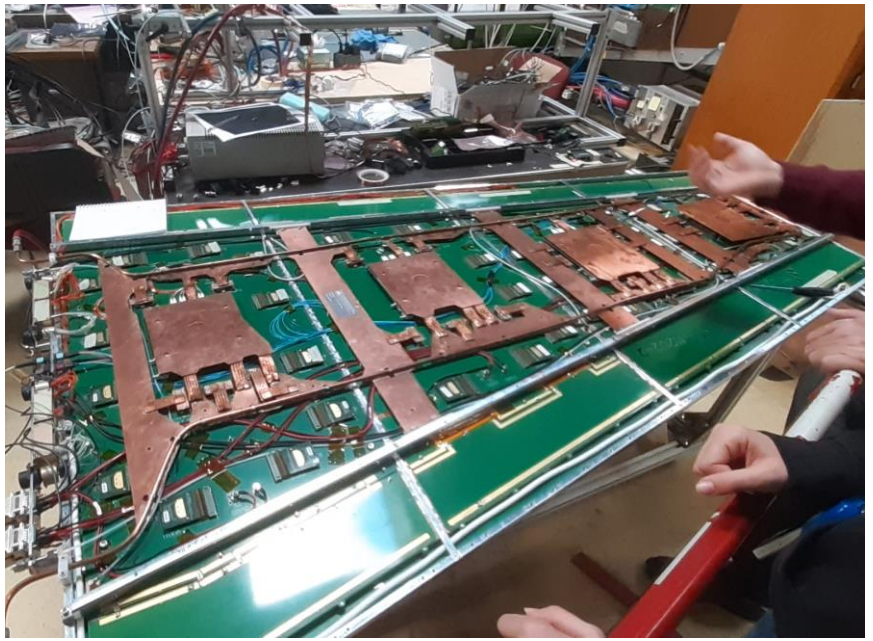

Key:
Muon
Electron
Charged Hadron (e.g. Pion)
Neutral Hadron (e.g. Neutron)
Photon
3.8T
Transverse slice through CMS
Silicon Tracker
Electromagnetic Calorimeter
Hadron Calorimeter
Superconducting Solenoid
2T
Iron return yoke interspersed with Muon chambers
0m
1m
2m
3m
4m
5m
6m
7m

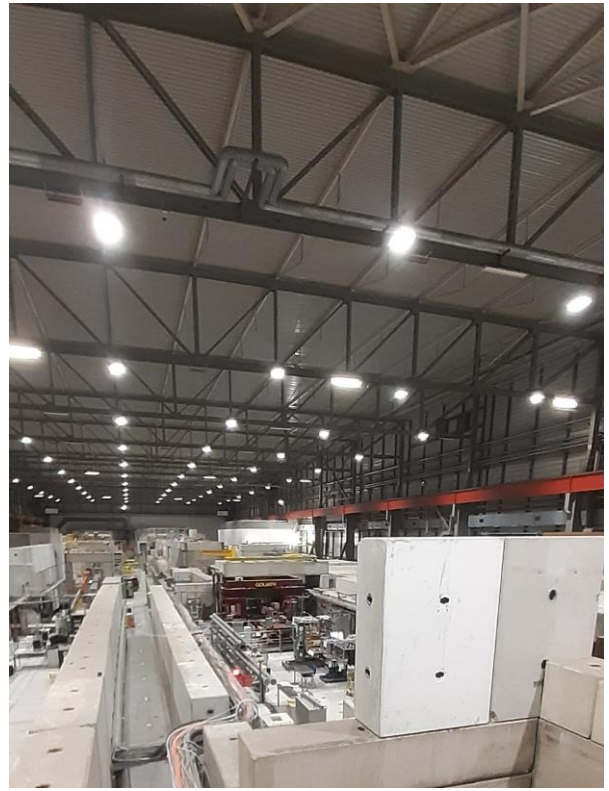



# New parts

- Clean room
- Workshop

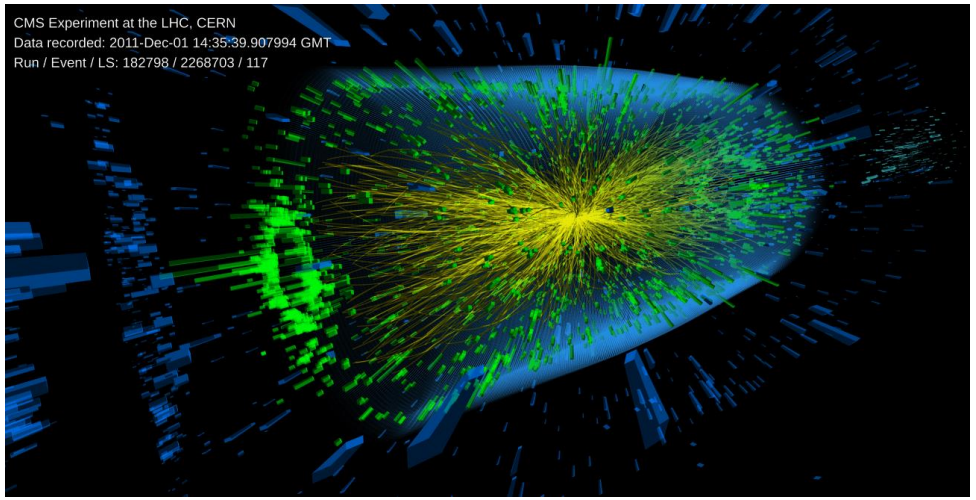


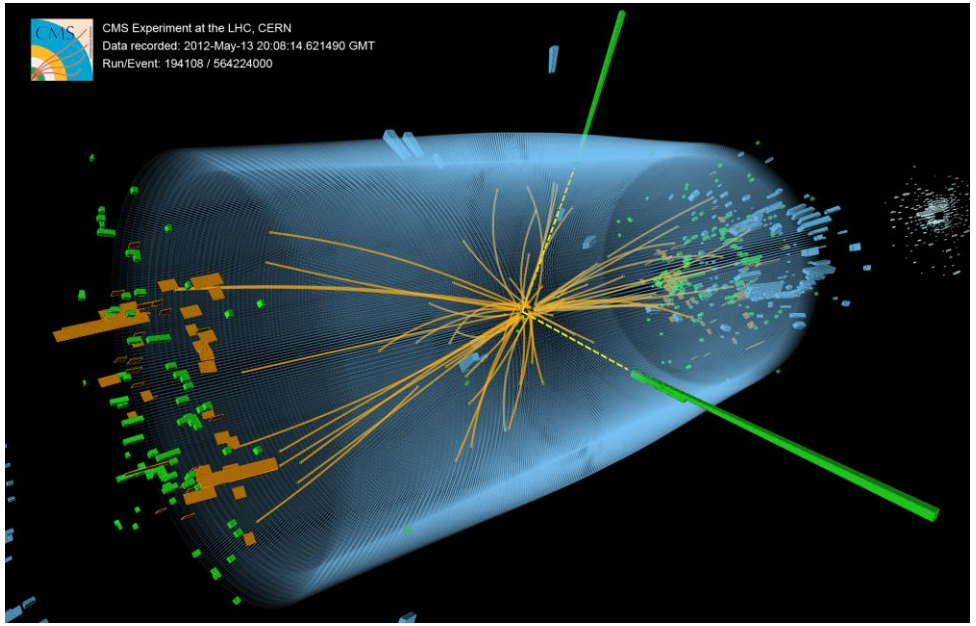





# Test beam


# Data

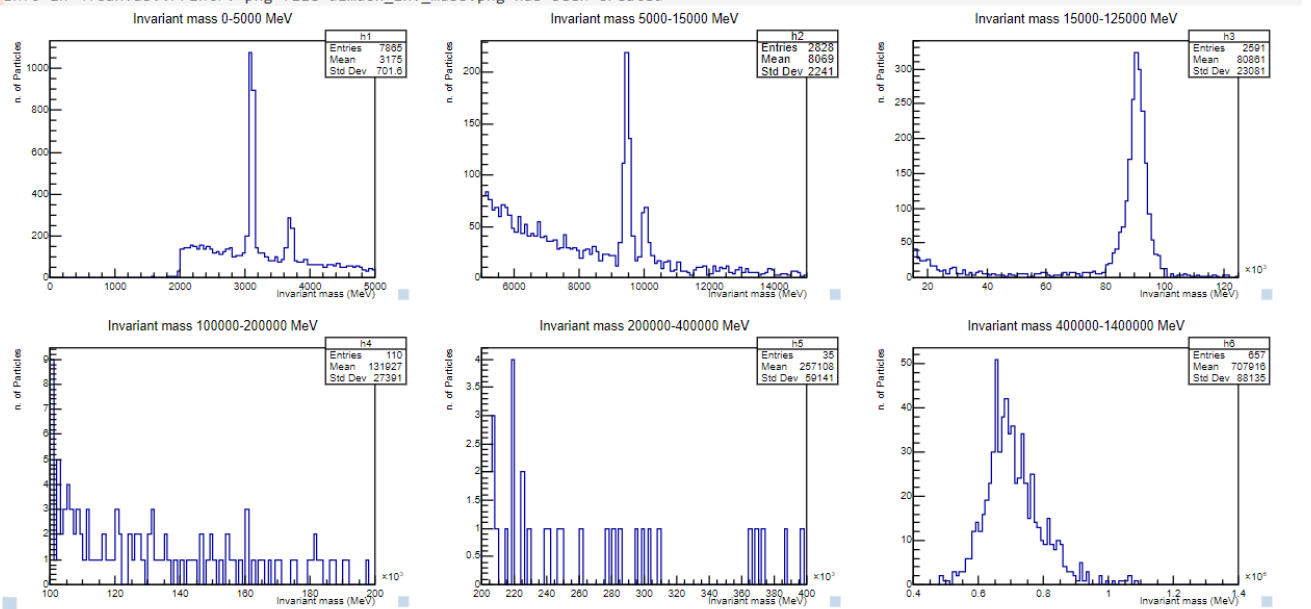


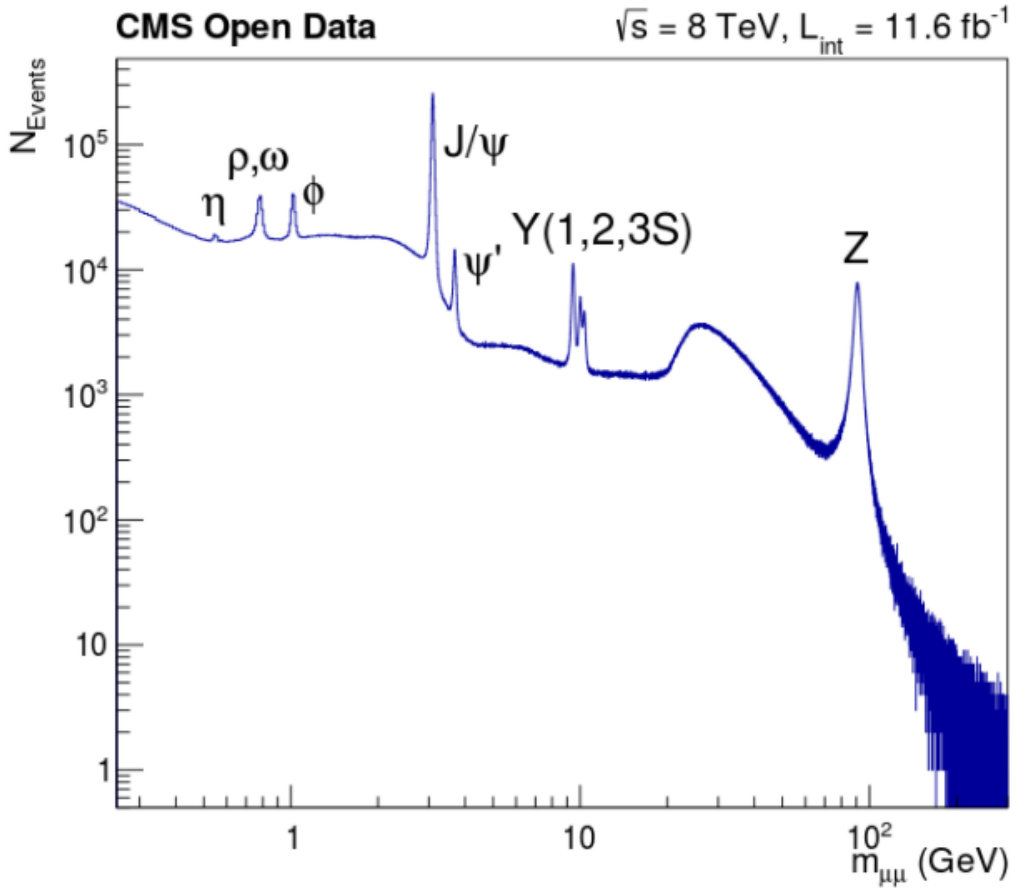

In [10]:
```
def draw_all_m(h1, h2, h3, h4, h5, h6, c):

    c.cd(1)
    h1.GetXaxis().SetTitle("Invariant mass (MeV)")
    h1.GetYaxis().SetTitle("n. of Particles")
    h1.Draw()
    c.Update()

    c.cd(2)
    h2.GetXaxis().SetTitle("Invariant mass (MeV)")
    h2.GetYaxis().SetTitle("n. of Particles")
    h2.Draw()
    c.Update()

    c.cd(3)
    h3.GetXaxis().SetTitle("Invariant mass (MeV)")
    h3.GetYaxis().SetTitle("n. of Particles")
    h3.Draw()
    c.Update()

    c.cd(4)
    h4.GetXaxis().SetTitle("Invariant mass (MeV)")
    h4.GetYaxis().SetTitle("n. of Particles")
    h4.Draw()
    c.Update()

    c.cd(5)
    h5.GetXaxis().SetTitle("Invariant mass (MeV)")
    h5.GetYaxis().SetTitle("n. of Particles")
    h5.Draw()
    c.Update()

    c.cd(6)
    h6.GetXaxis().SetTitle("Invariant mass (MeV)")
    h6.GetYaxis().SetTitle("n. of Particles")
    h6.Draw()
    c.Update()

    c.cd()
    c.Update()
    c.Draw()
```

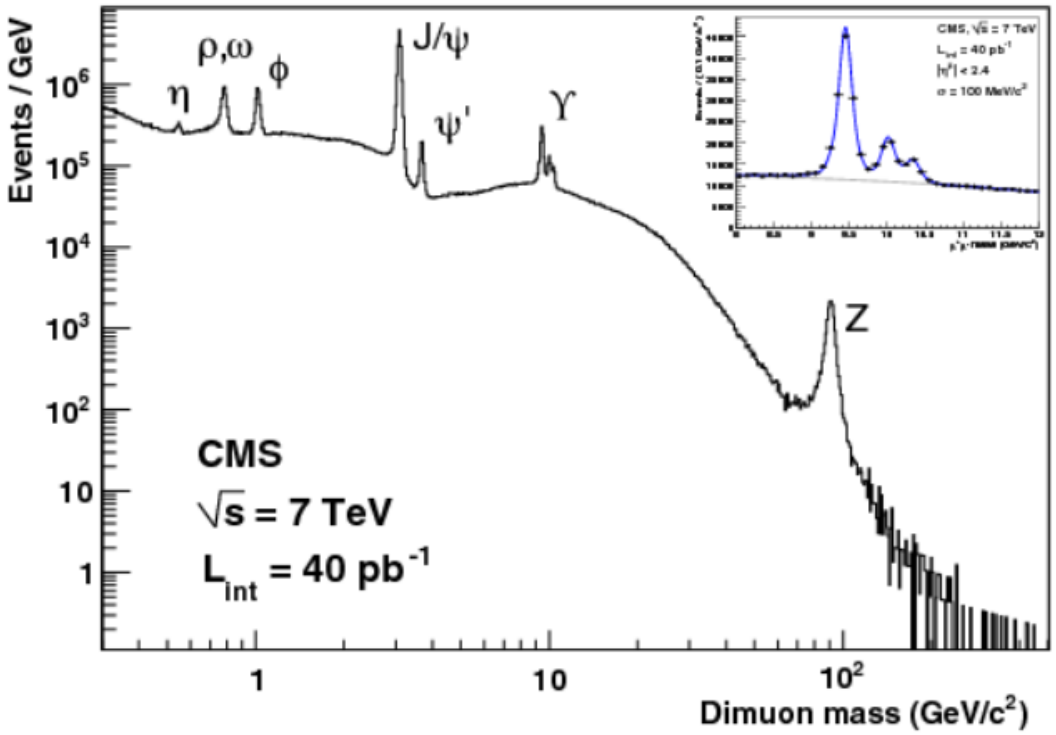
In [11]:
```
c_dm = ROOT.TCanvas("c_dm","for dimuon spectra",1000,500)
c_dm.Divide(3,2)

h1 = ROOT.TH1F("h1", "Invariant mass 0-5000 MeV",100,0,5000)
h2 = ROOT.TH1F("h2", "Invariant mass 5000-15000 MeV",100,5000,15000)
h3 = ROOT.TH1F("h3", "Invariant mass 15000-125000 MeV",100,15000,125000)
h4 = ROOT.TH1F("h4", "Invariant mass 100000-200000 MeV",100,100000,200000)
h5 = ROOT.TH1F("h5", "Invariant mass 200000-400000 MeV",100,200000,400000)
h6 = ROOT.TH1F("h6", "Invariant mass 400000-1400000 MeV",100,400000,1400000)

for event in tree:
    dimuon = (tree.NMUO==2 and tree.KFMUO[0]*tree.KFMUO[1]<0)
    if dimuon:
        E2 = (tree.EEMUO[0]+tree.EEMUO[1])**2
        px2 = (tree.PXMUO[0]+tree.PXMUO[1])**2
        py2 = (tree.PYMUO[0]+tree.PYMUO[1])**2
        pz2 = (tree.PZMUO[0]+tree.PZMUO[1])**2

        m = sqrt(E2 - px2 - py2 - pz2)

        if m<5000:
            h1.Fill(m)
        elif m<15000:
            h2.Fill(m)
        elif m<125000:
            h3.Fill(m)

        if m<100000:
            pass
        elif m<200000:
            h4.Fill(m)
        elif m<400000:
            h5.Fill(m)
        elif m<=1400000:
            h6.Fill(m)

draw_all_m(h1, h2, h3, h4, h5, h6, c_dm)

c_dm.SaveAs("dimuon_inv_mass.png")
```

```
Info in <TCanvas::Print>: png file dimuon_inv_mass.png has been created
```




There appear to be peaks around 3.1 GeV, 3.7, 9.5, 10, 90, and 680 GeV

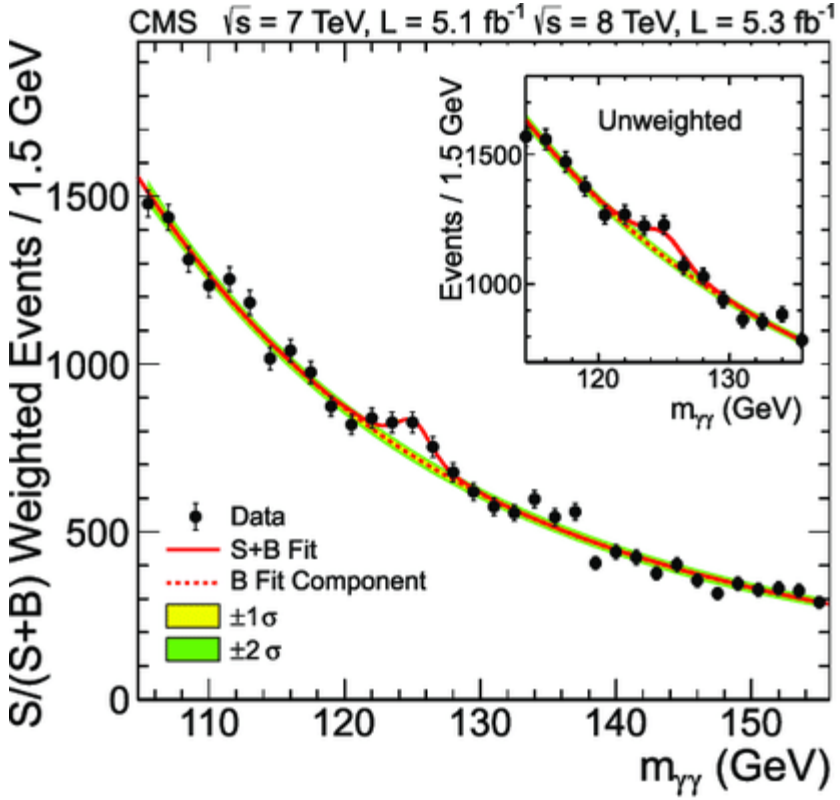


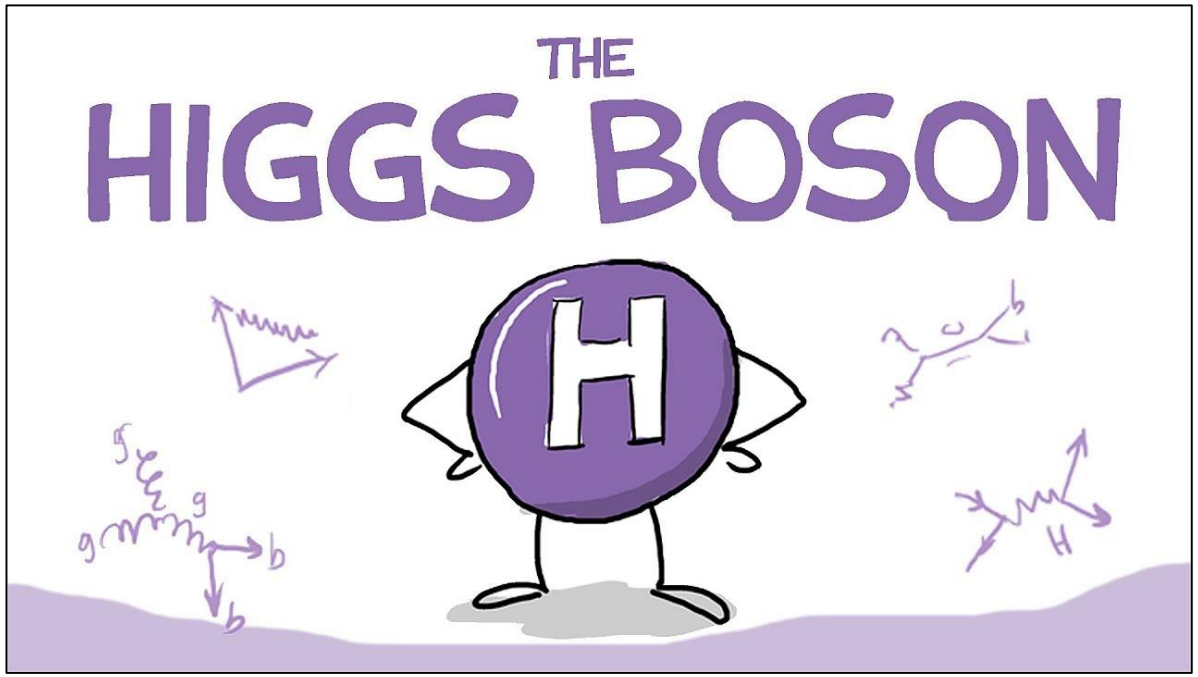




Take into account:
Conservation of momentum and energy
Relativity theory and fourvectors

# Why analyse data?

- New particles
- Understand the universe



THE END