

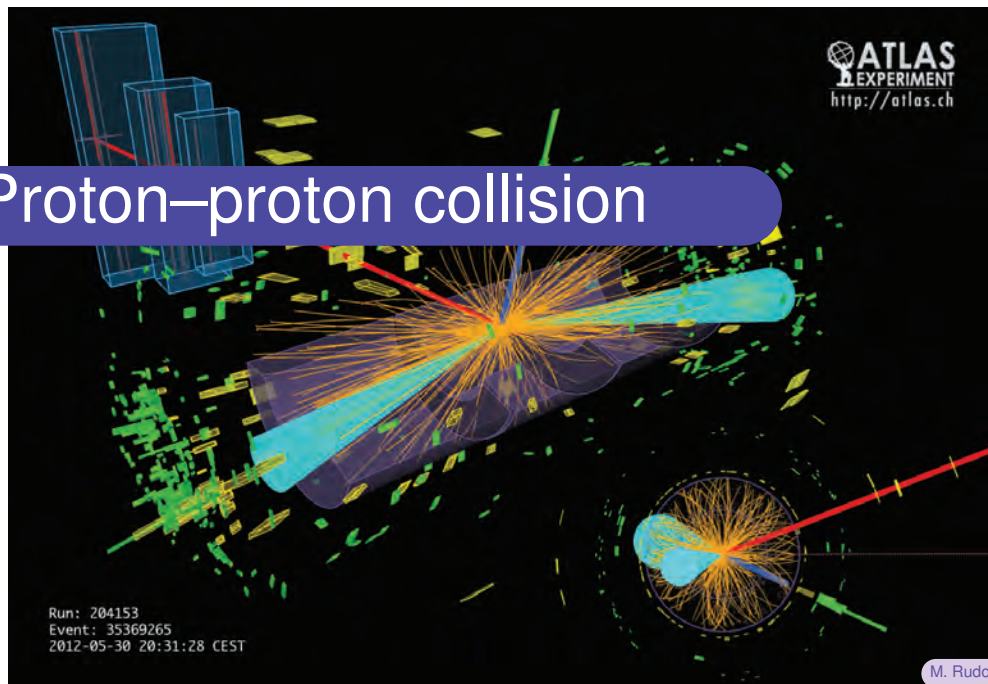
Detectors and data

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August 15, 2019

Proton–proton collision



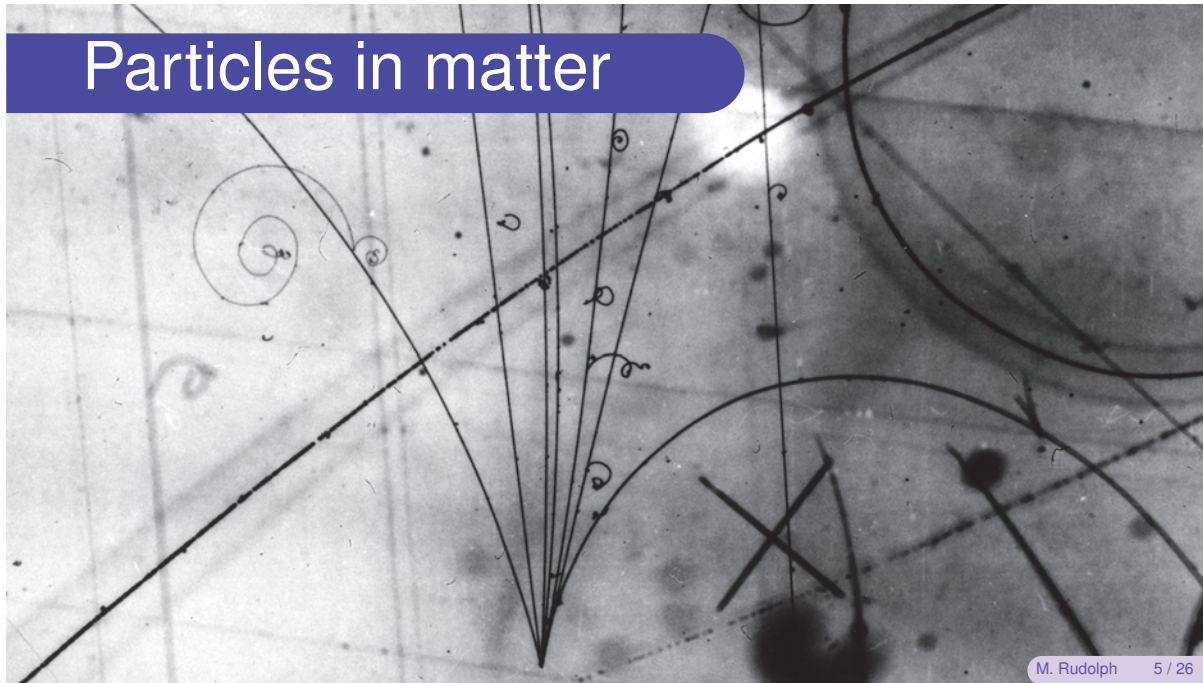
Can you see a Higgs?



What we actually measure

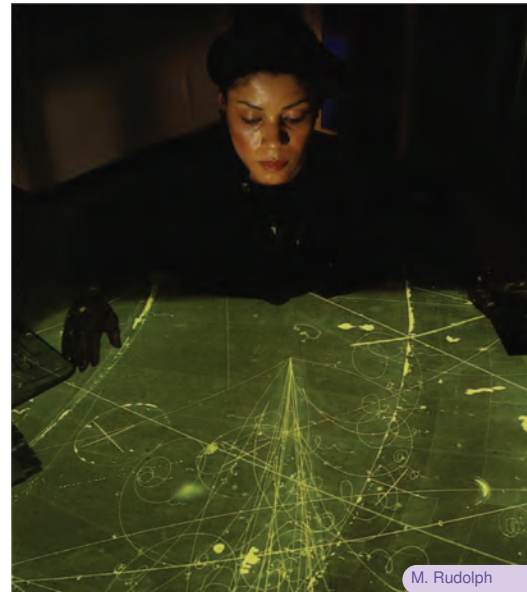
- Want to know the **momentum** and **identity** of these particles:
 - Electrons
 - Muons
 - Photons
 - Hadrons:
 - Protons and neutrons
 - Pions (lightest meson)
 - Kaons (meson with a strange quark)
- These are all “stable” (at least over 10s of nanoseconds)
- Want to measure as many as possible in each collision

Particles in matter



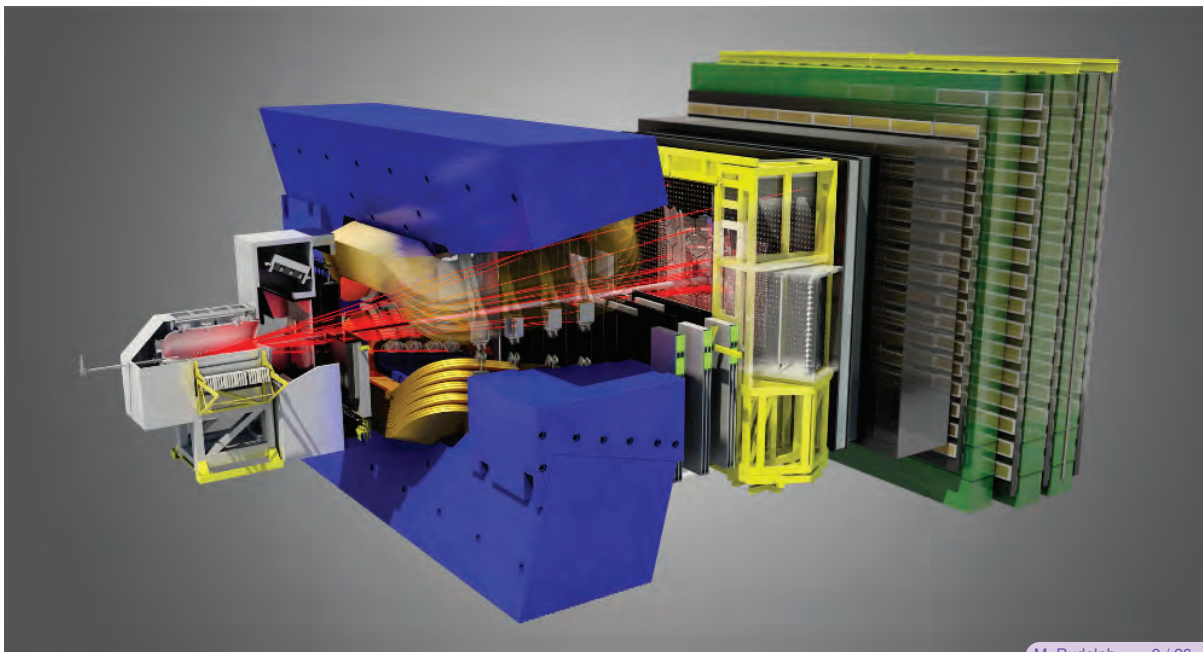
Recording data

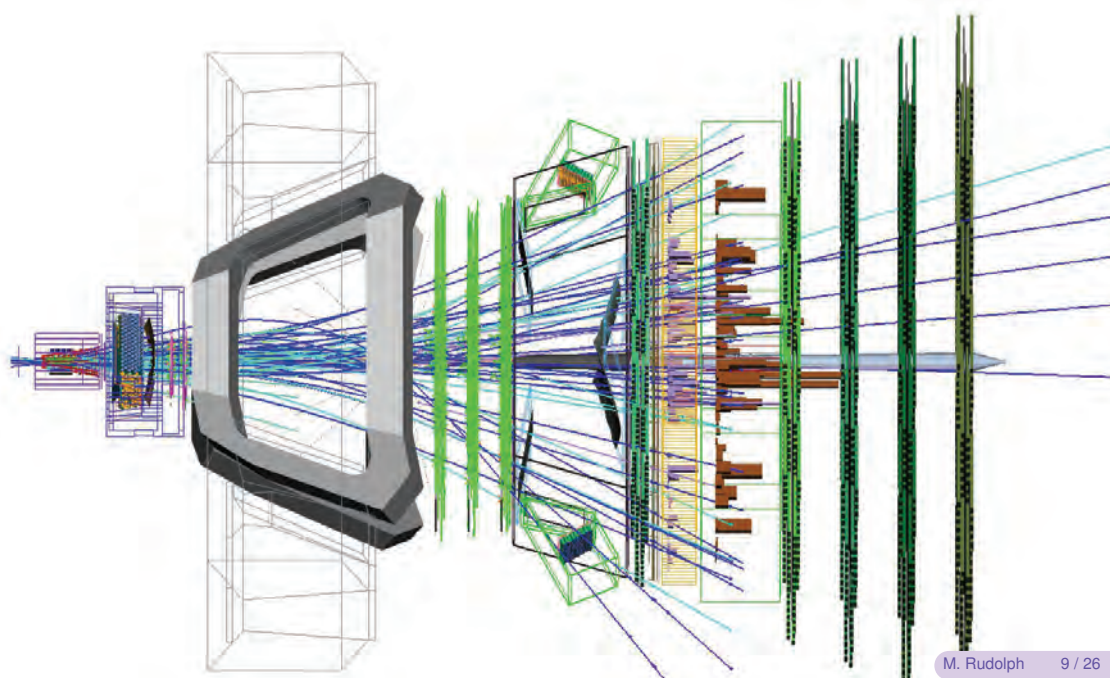
- Used to literally take a picture of the interaction!



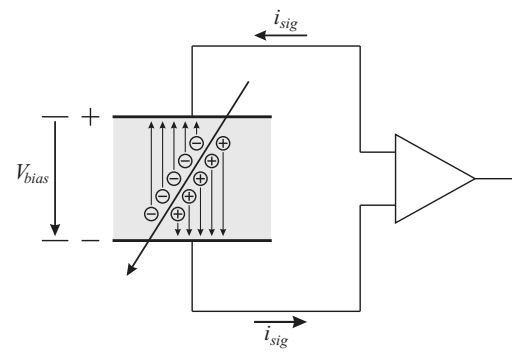


LHCb

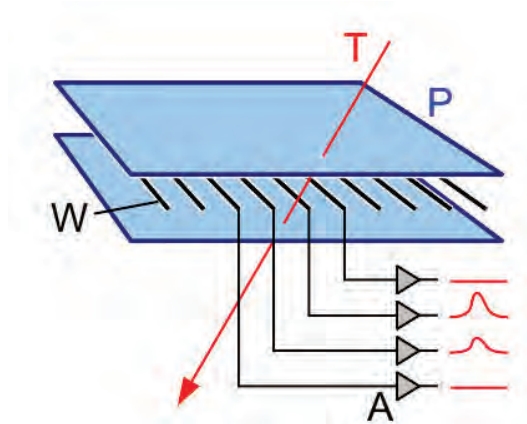




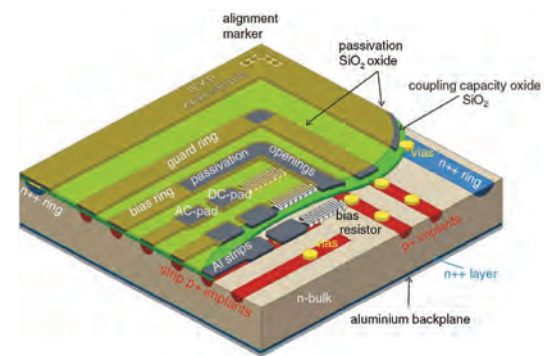
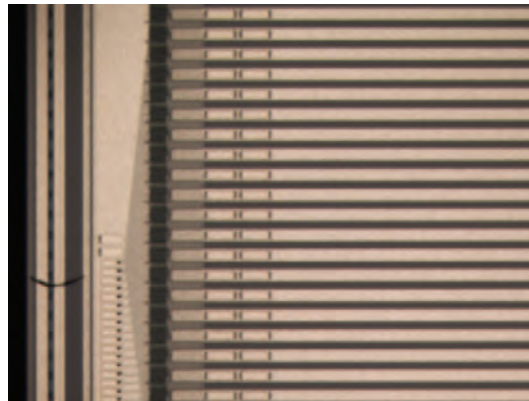
Position detectors



Multiple wires

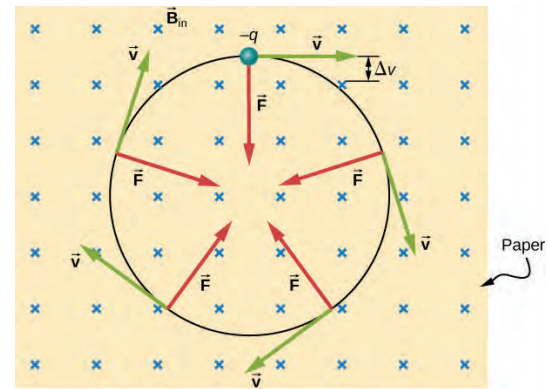


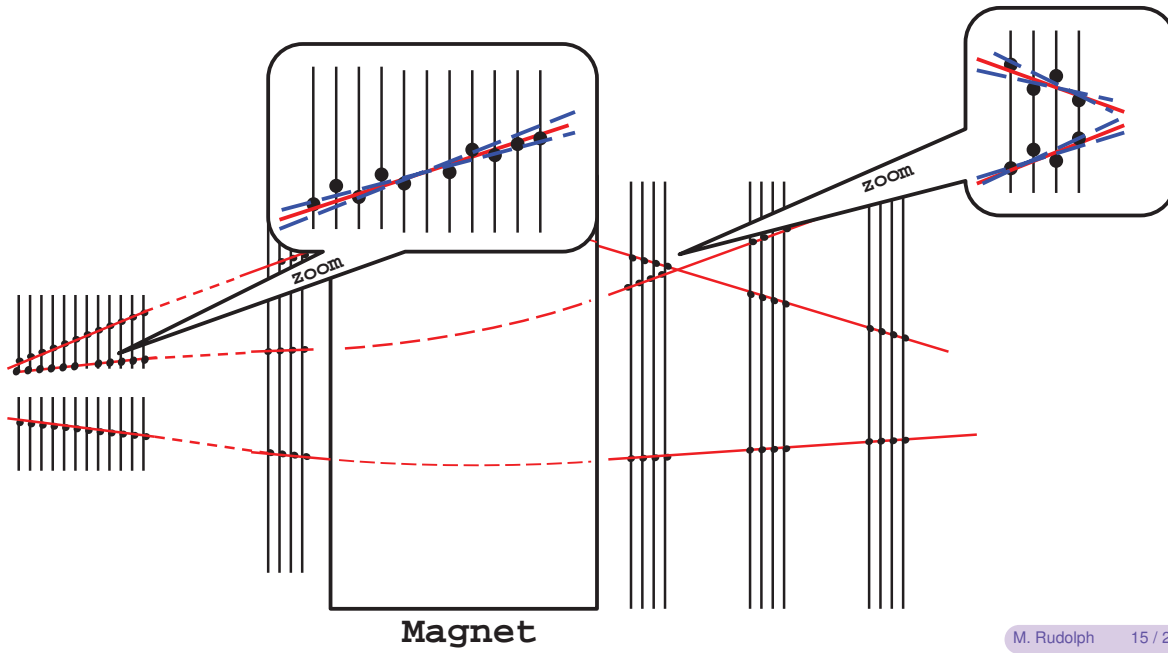
Silicon sensors



Magnetic bending

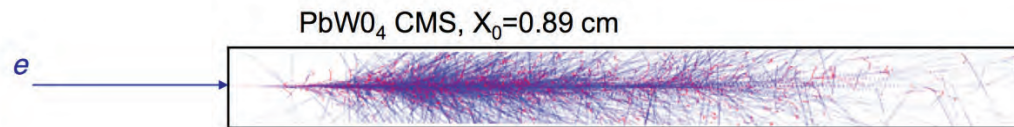
$$\rho = qrB$$





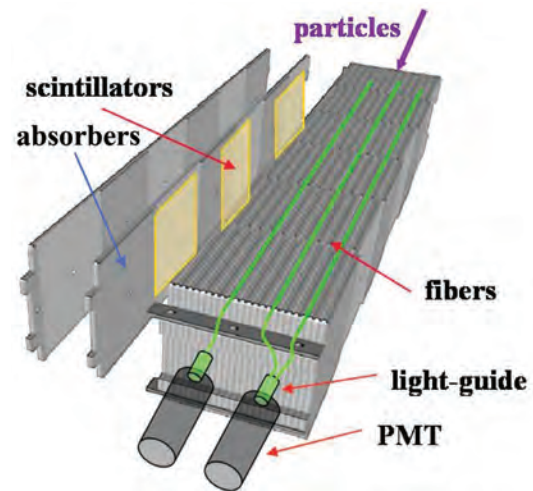
Calorimeters

- Try to **absorb** the particle and measure its energy
- Particles passing through PbWO_4 emit **scintillation light**



LHCb Hadronic calorimeter

- Often simply use metal as an absorber
- Intersperse with a scintillator to measure “samples” of the shower

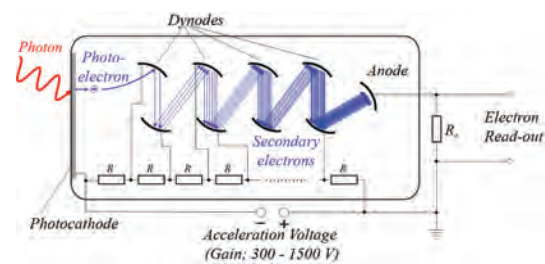


MINOS

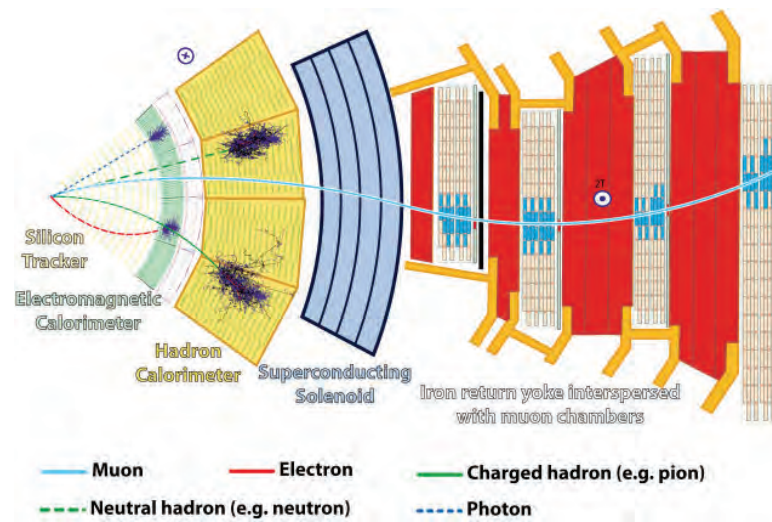


Photon collection

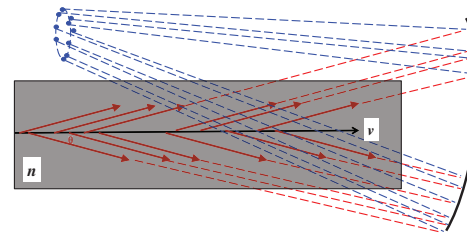
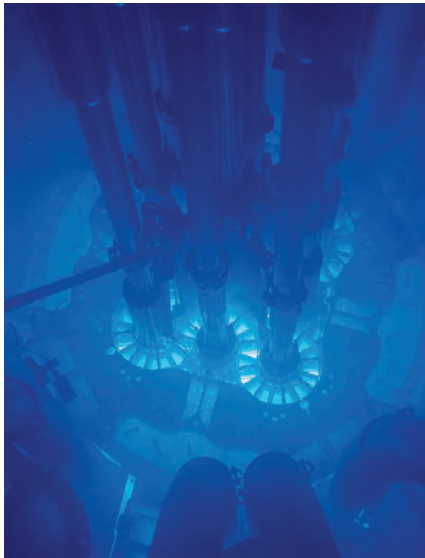
Photomultiplier tubes



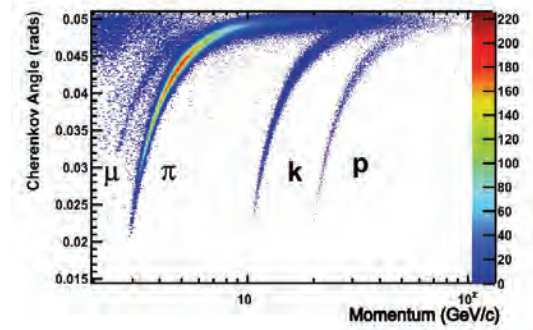
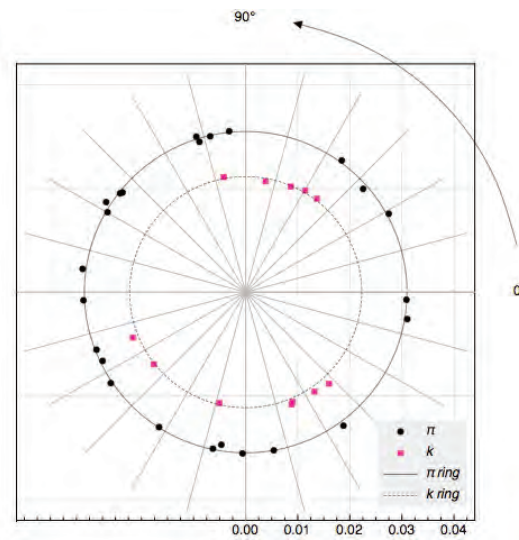
CMS slice

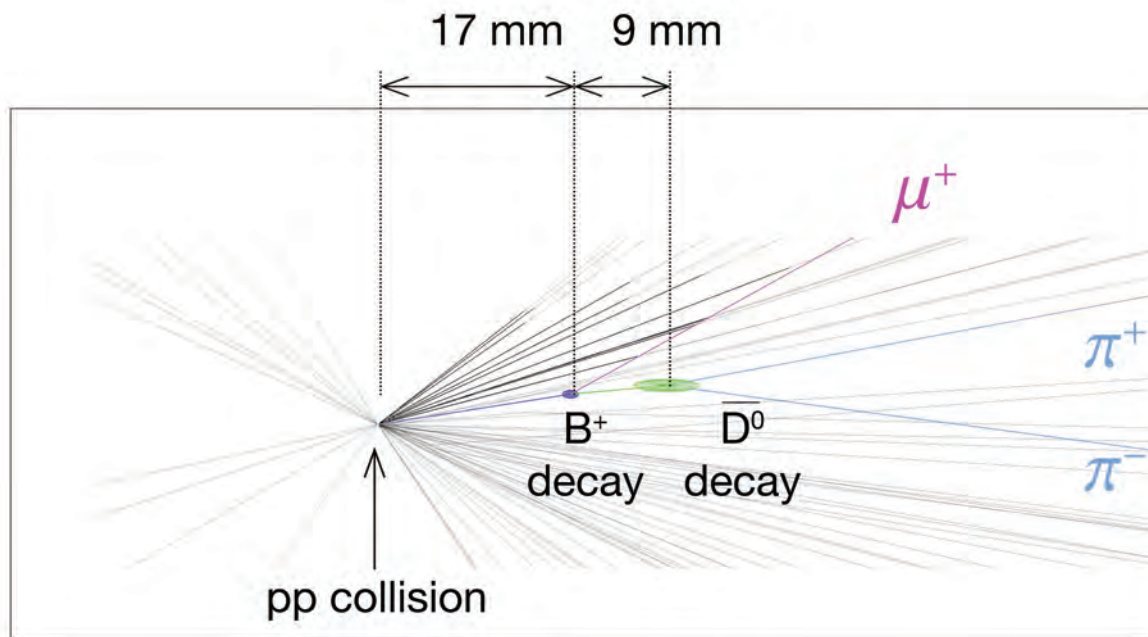


Cherenkov light



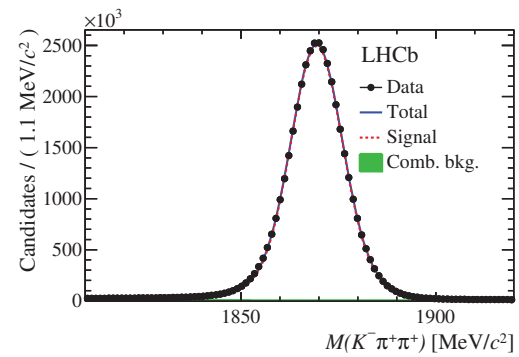
Measure the angle



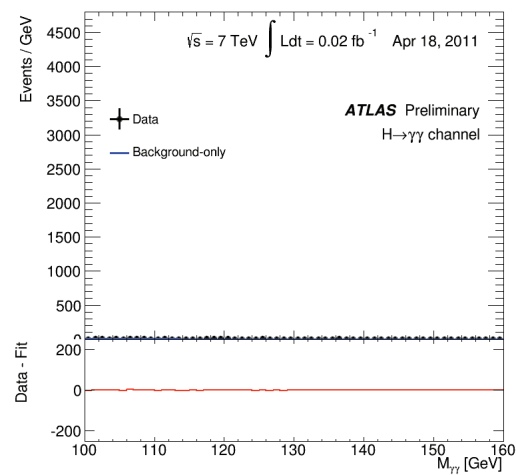


Putting the pieces together

- Measure many decays and use the data to measure some property: rates, angular distributions, etc.



Visualizing an experiment





Questions?