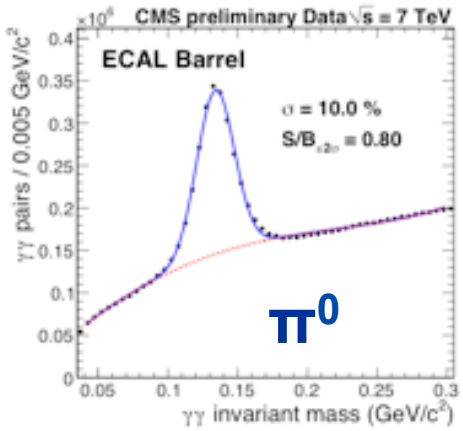
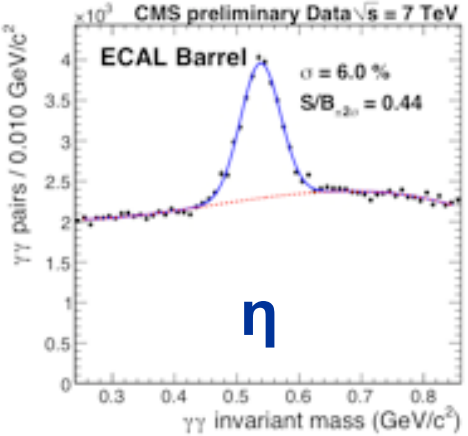
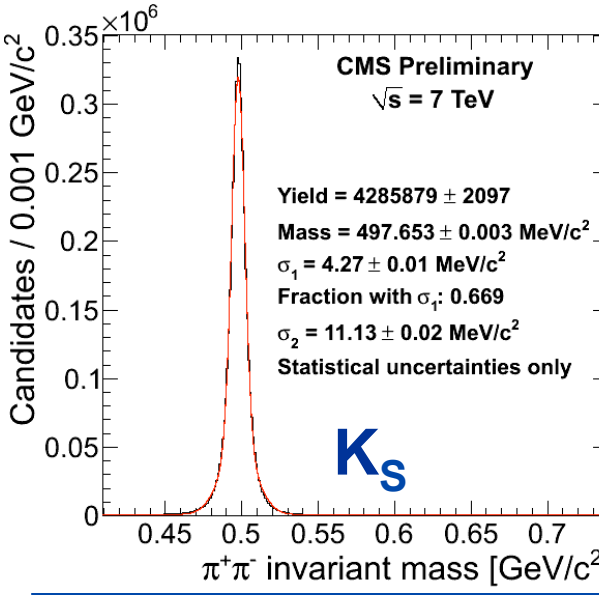
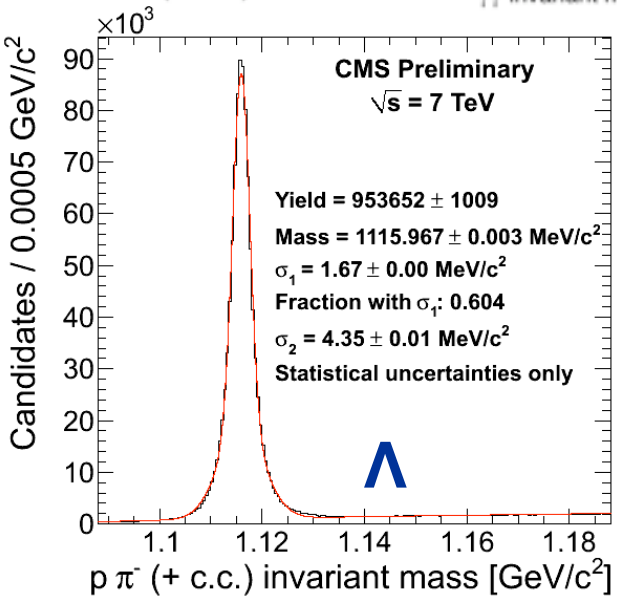
Particle Spectroscopy

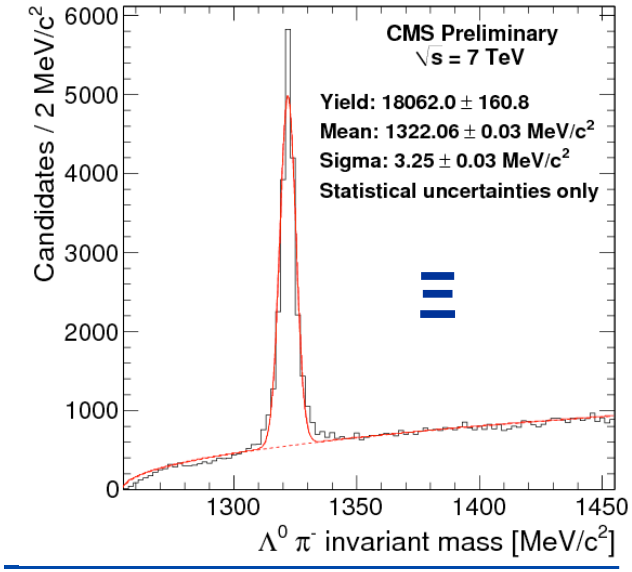
- At the turn-on of the LHC, all the excitement was on rediscovering the particles from the 1930s→1970s



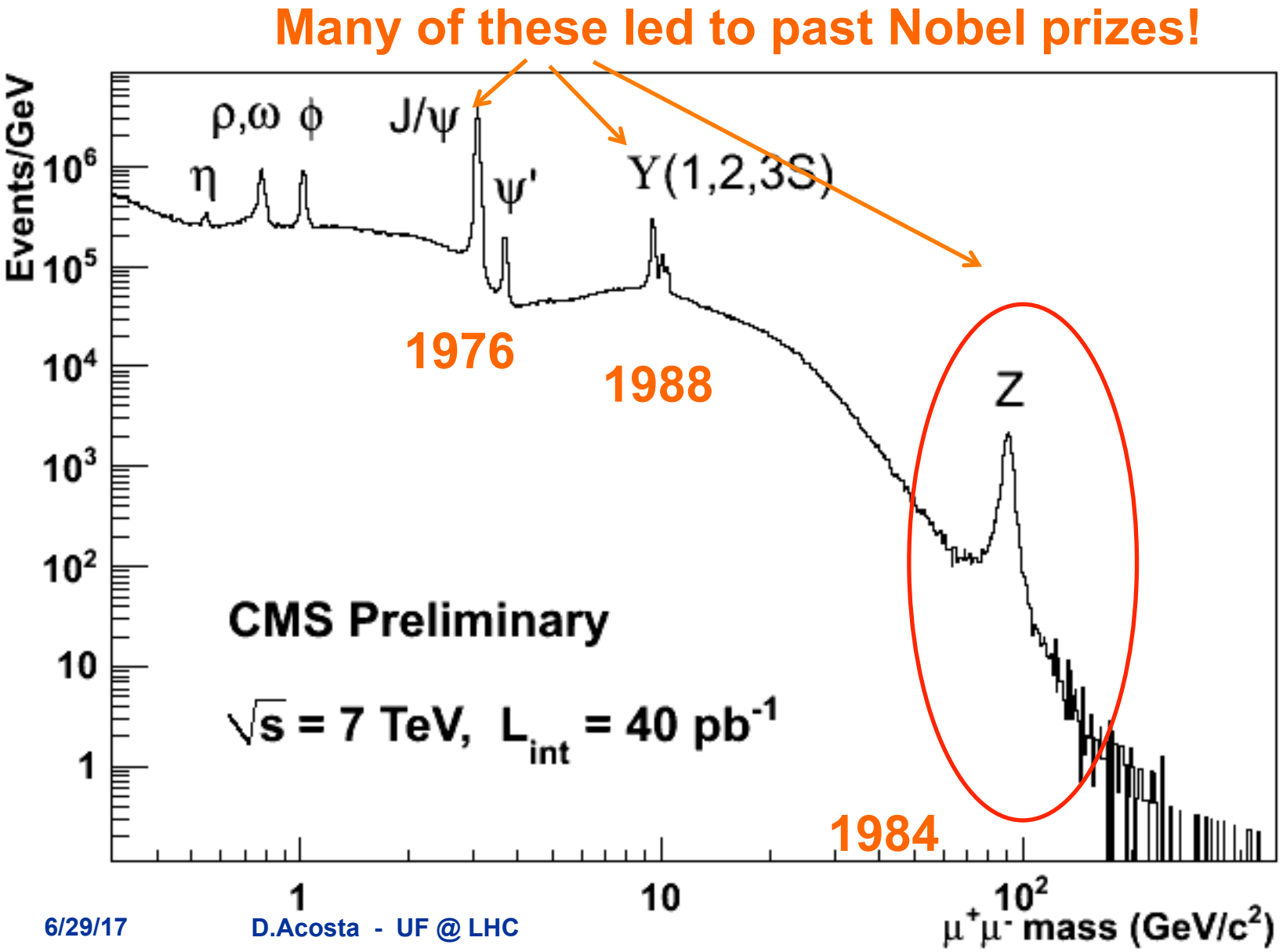




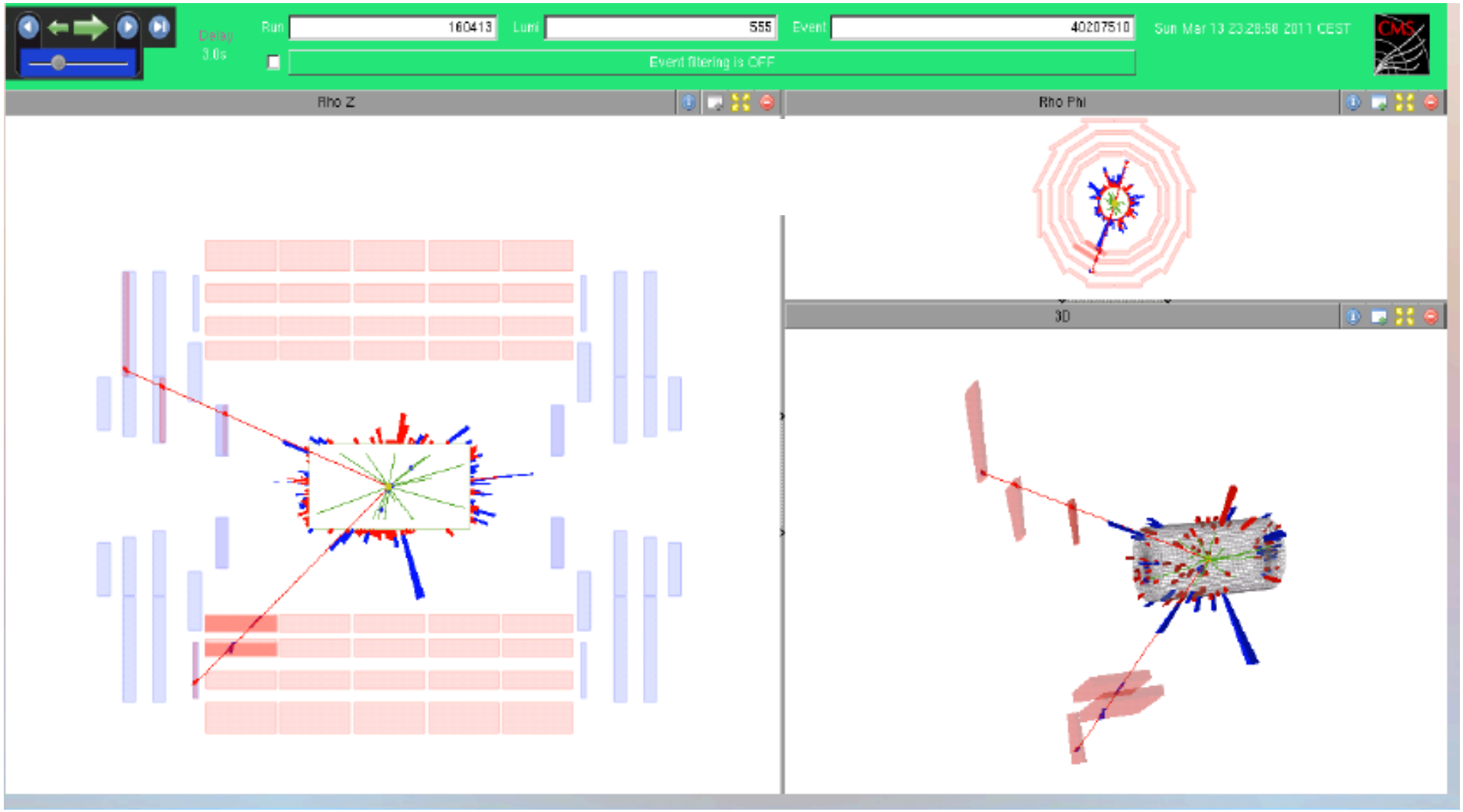




DiMuon Spectroscopy



Z boson Recorded on Sunday, after 2011 restart of the LHC



How to calculate a particle mass

- Use Einstein's special theory of relativity!
- Measure the energy and momentum of the final state particles from the decay
- Use this "Lorentz invariant" quantity
  - Difference of total squared energy and total squared momentum:

$$m^2c^4 = E^2 - p^2c^2$$

If p=0, $mc^2=E$

$$m^2c^4 = \left(E_1 + E_2\right)^2 - \left(\vec{p}_1 + \vec{p}_2\right)^2 c^2$$

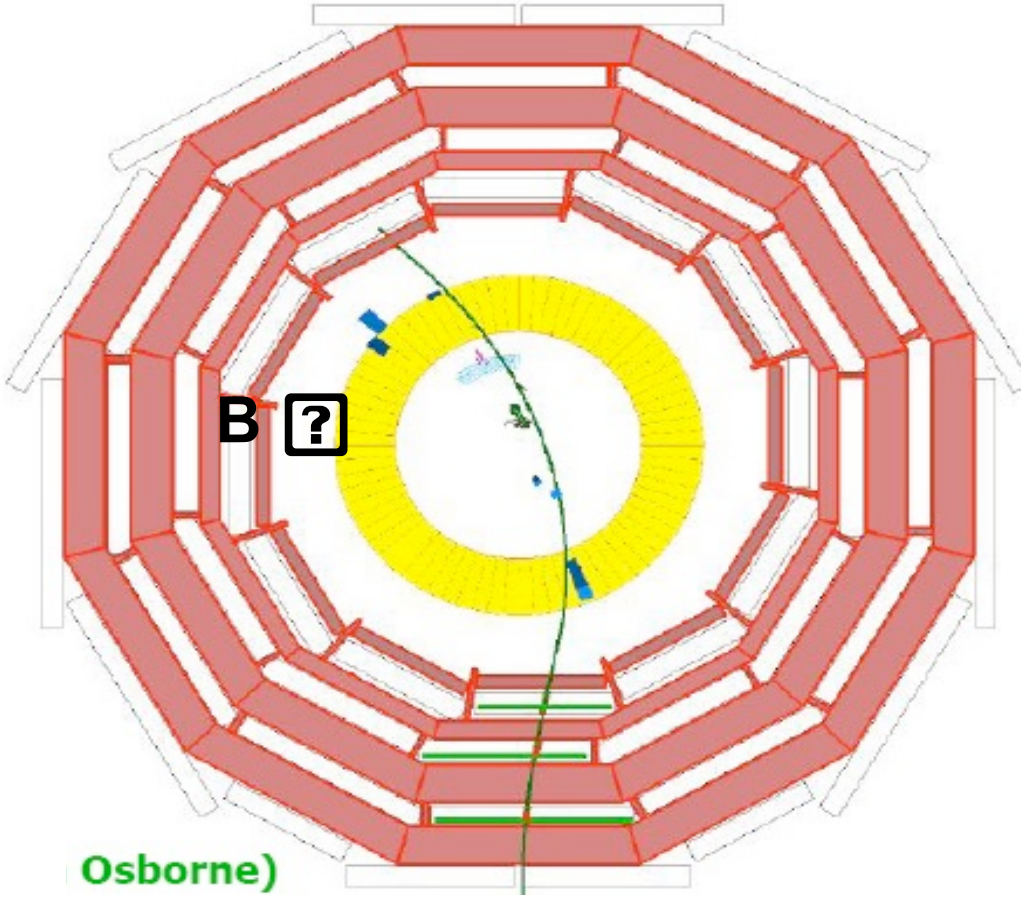
- This applies in all reference frames, even if the particle is not produced at rest in the lab
  - Mass is always mass!

Magnets

- Used to bend the trajectory of charged particles produced in collision. i.e. Determine their momenta in an experiment

Eq.1: $p = qBr$

In this case, it is a cosmic-ray muon traversing the muon detectors, calorimeters, and the silicon tracker



Life in a Magnetic Field…

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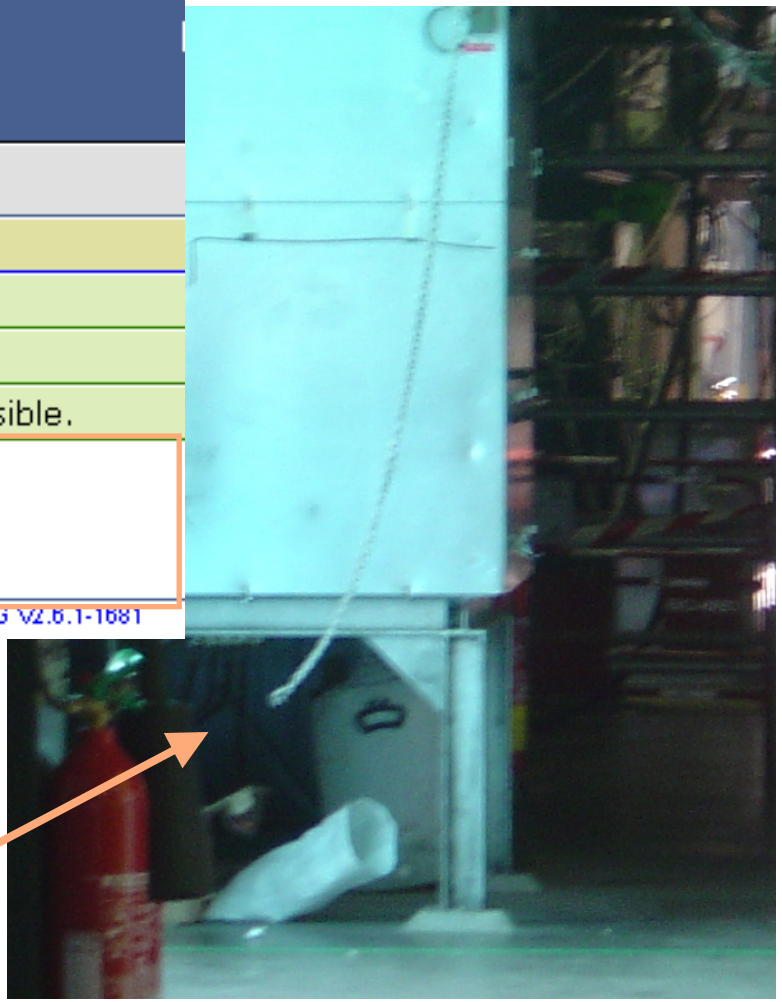
Message ID: **412**	Entry time: **Fri Aug 11 13:19:56 2006**
Author:	Austin Ball, Austin.Ball@cern.ch
Type:	
Subject:	Ramping towards 3 T. Fringe field effects visible.

Balcony barrack shielding not very effective.
Air conditioner already stopped...switched off.
60 G at RPC PS's.
Take care with opening and closing rack doors!!!

ELOG V2.6.1-1681



Chain following field line

Helium clouds…

- Fast dump of 17.5 kA (3.5T field) in 3 minutes
- 700m^3 of helium released (10 000 CHF…)

Not seen: 6mm distortion of disks with 10g force when magnet is on