LHC – Summary and Perspectives

What do we know so far – what are the next steps?

LHC + Experiments:
spectacular start-up in 2010

p-p collisions at $\sqrt{s}$ = 7 TeV:
30 March - 4 Nov 2010
Pb-Pb collisions at $\sqrt{s}$ = 2.76TeV/N:
7 Nov - 6 Dec 2010

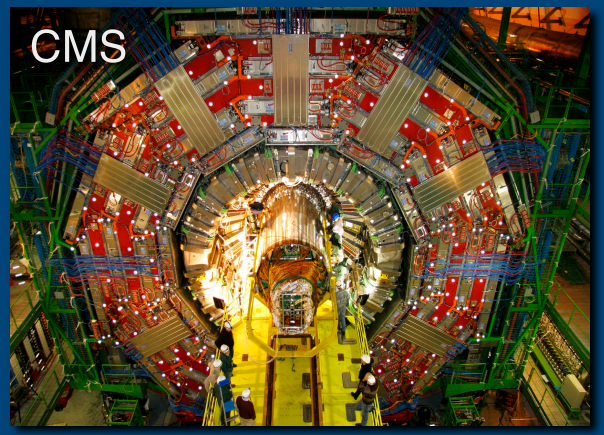
Excellent performances of LHC and experiments in 2010

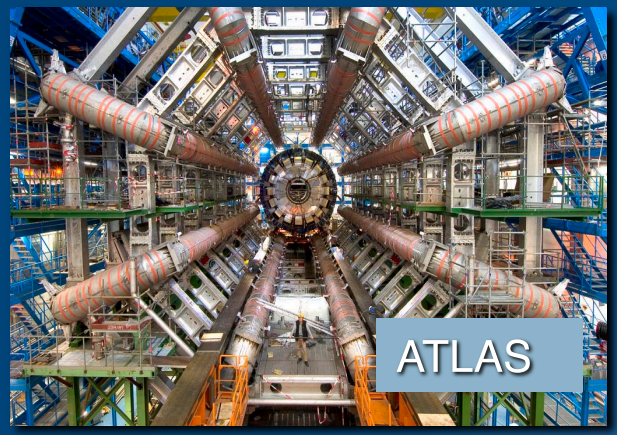
see talks on results from ATLAS, CMS, LHCb and ALICE

F. Pauss / CERN

LHC Experiments → complementary

Specialised detector to study b-quarks → CPV



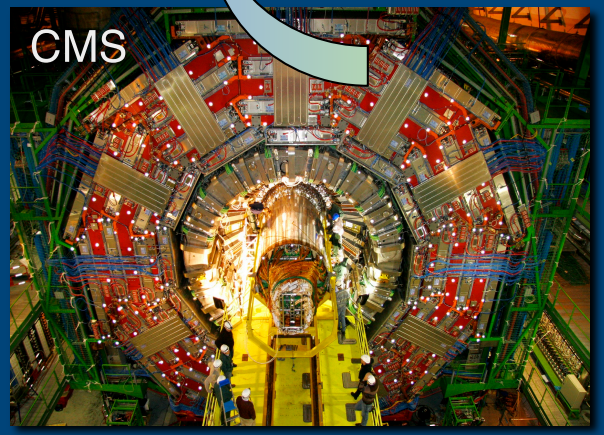


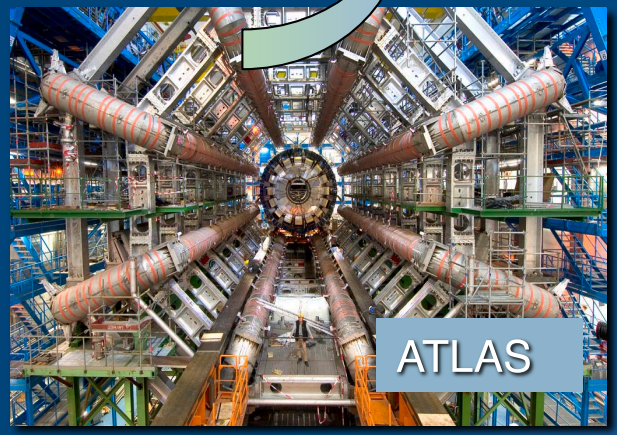
General purpose detectors

Specialised detector to study heavy ion collisions

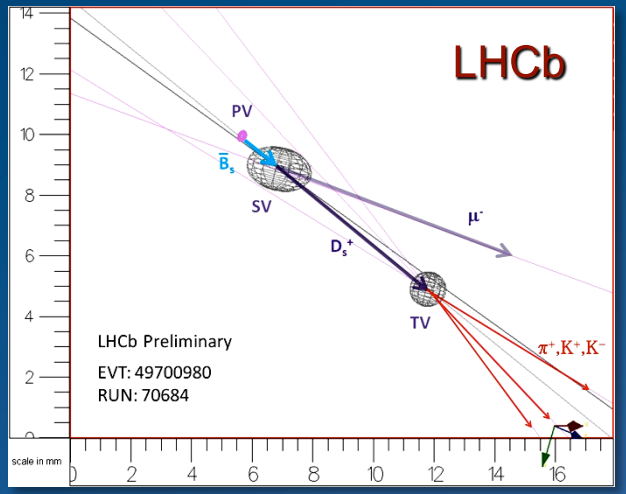
LHC Experiments → complementary

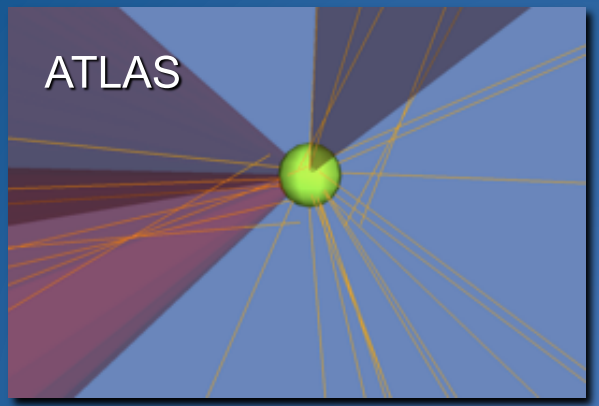
Overlap in physics reach





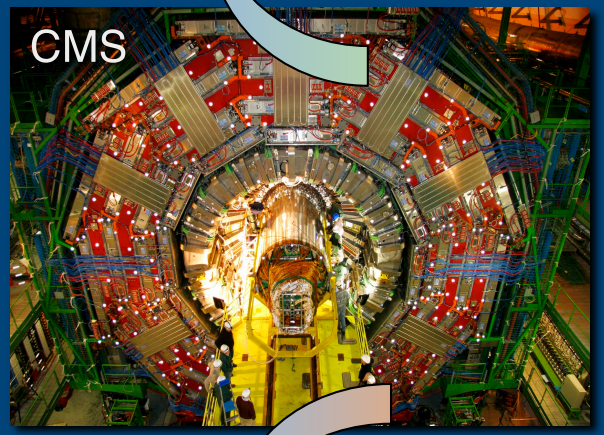
Key feature: reconstruct secondary vertex

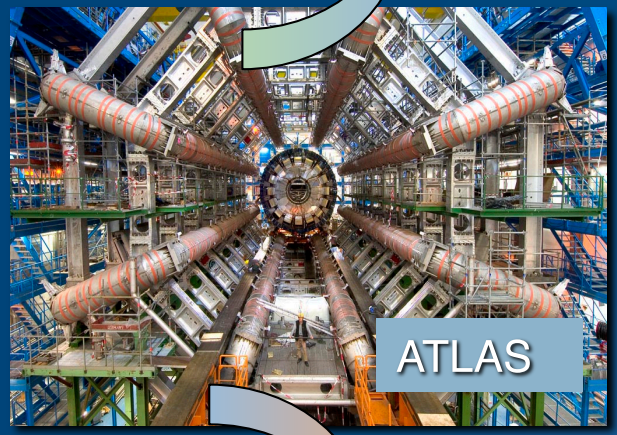




LHC Experiments → complementary

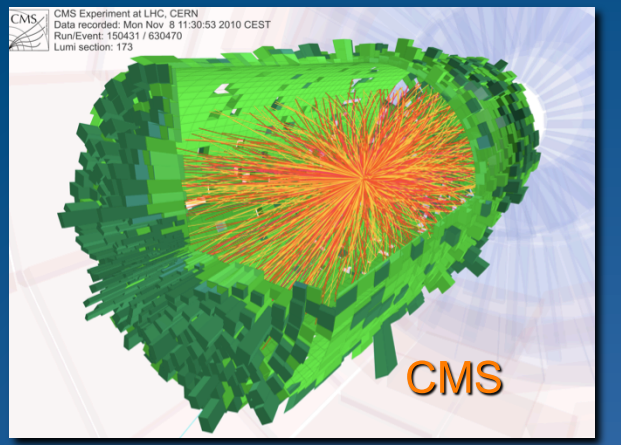
Overlap in physics reach

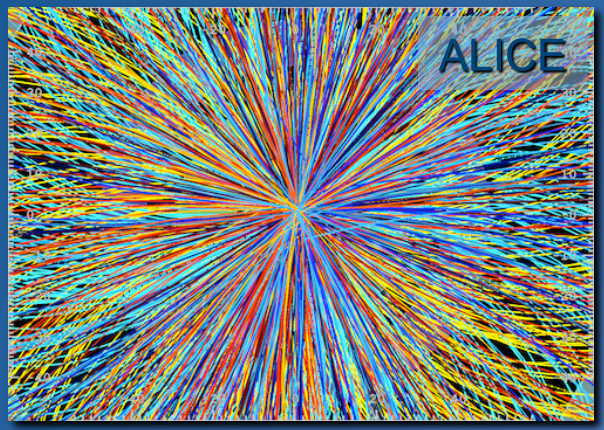


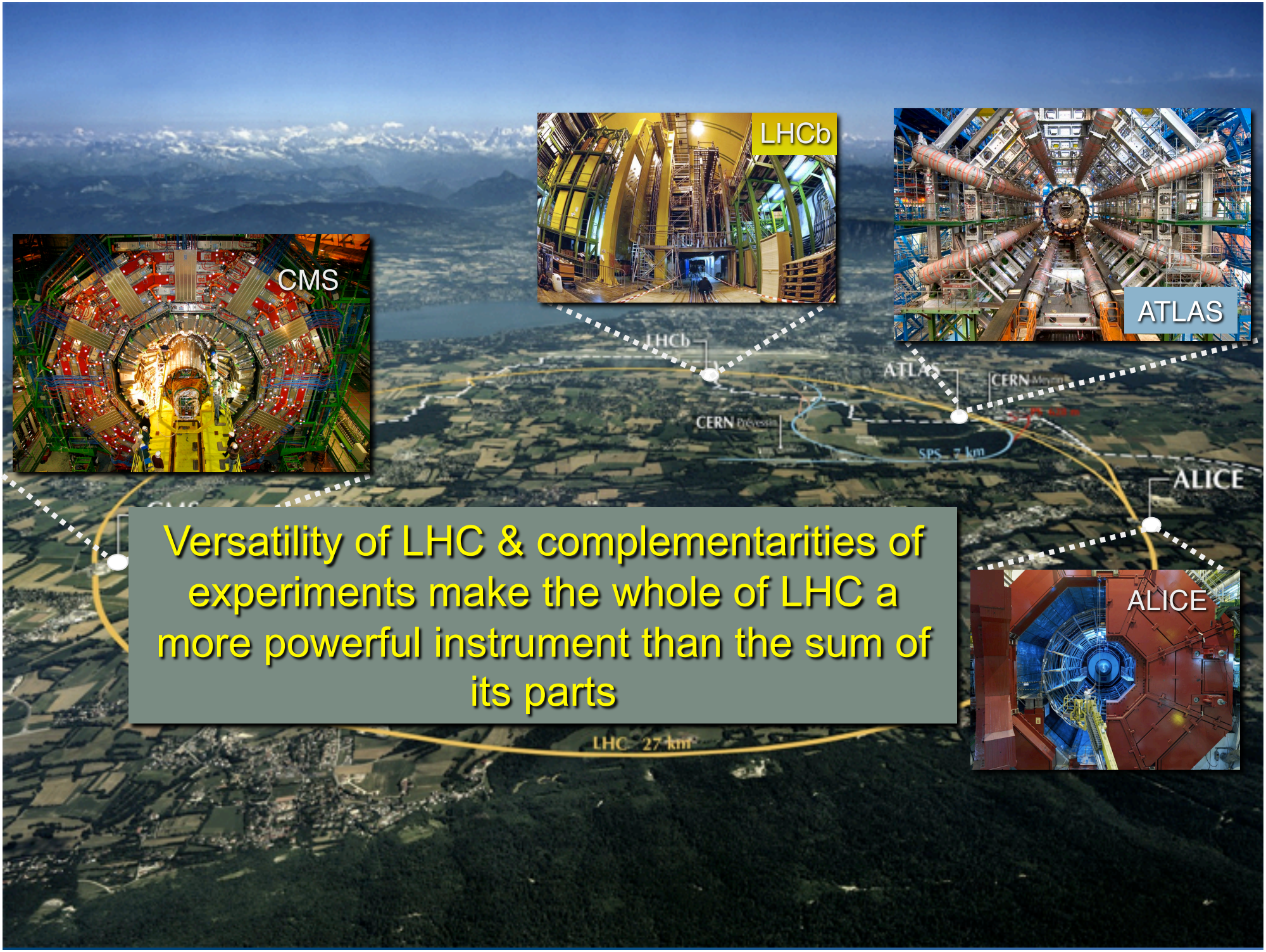


Overlap in physics reach

Key feature: reconstruct > 20'000 charged tracks in one event

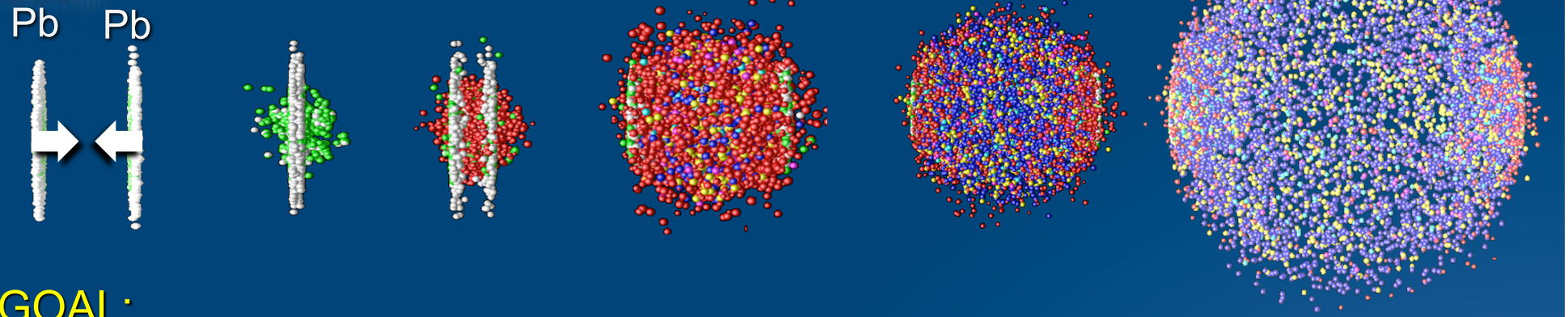






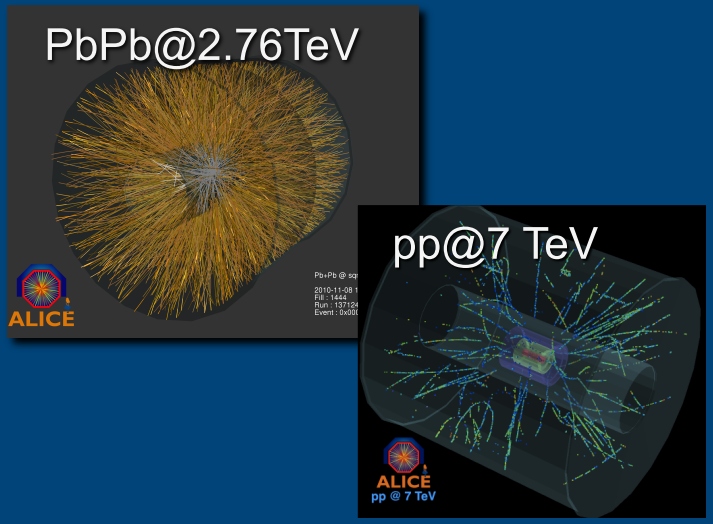
Versatility of LHC & complementarities of experiments make the whole of LHC a more powerful instrument than the sum of its parts

Heavy Ion Collisions (Pb – Pb)



GOAL:

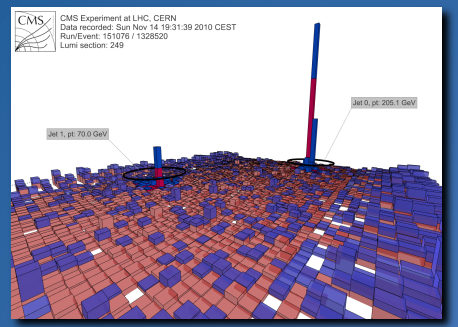
- Study the 'primordial' state of matter in the early Universe (~10^{-6} sec after BB)
- At increasing temperature & energy density → new state of matter: QGP
- Study strong interaction sector (QCD) of the Standard Model



Interesting results presented (going beyond RHIC):

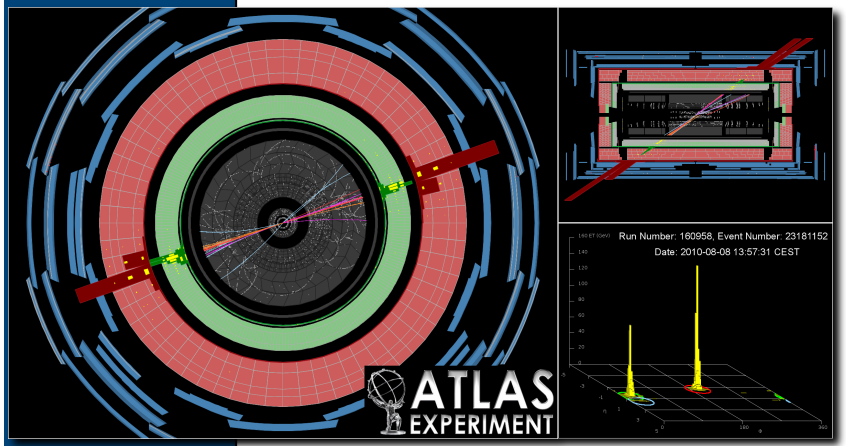
- QGP behaves like a liquid
- Jet quenching
- …

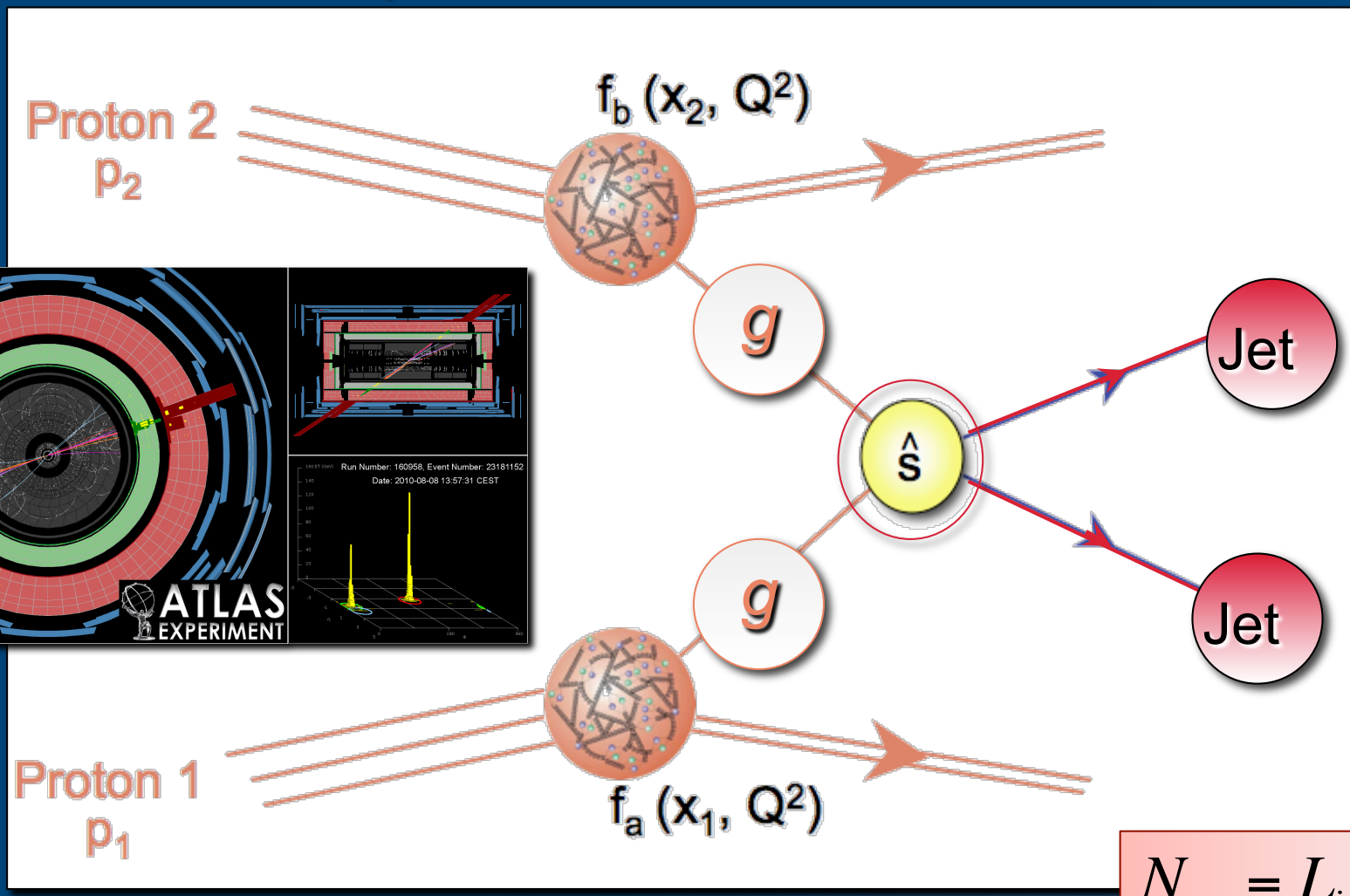
→ There is plenty of exciting physics ahead!



Proton-Proton Collisions

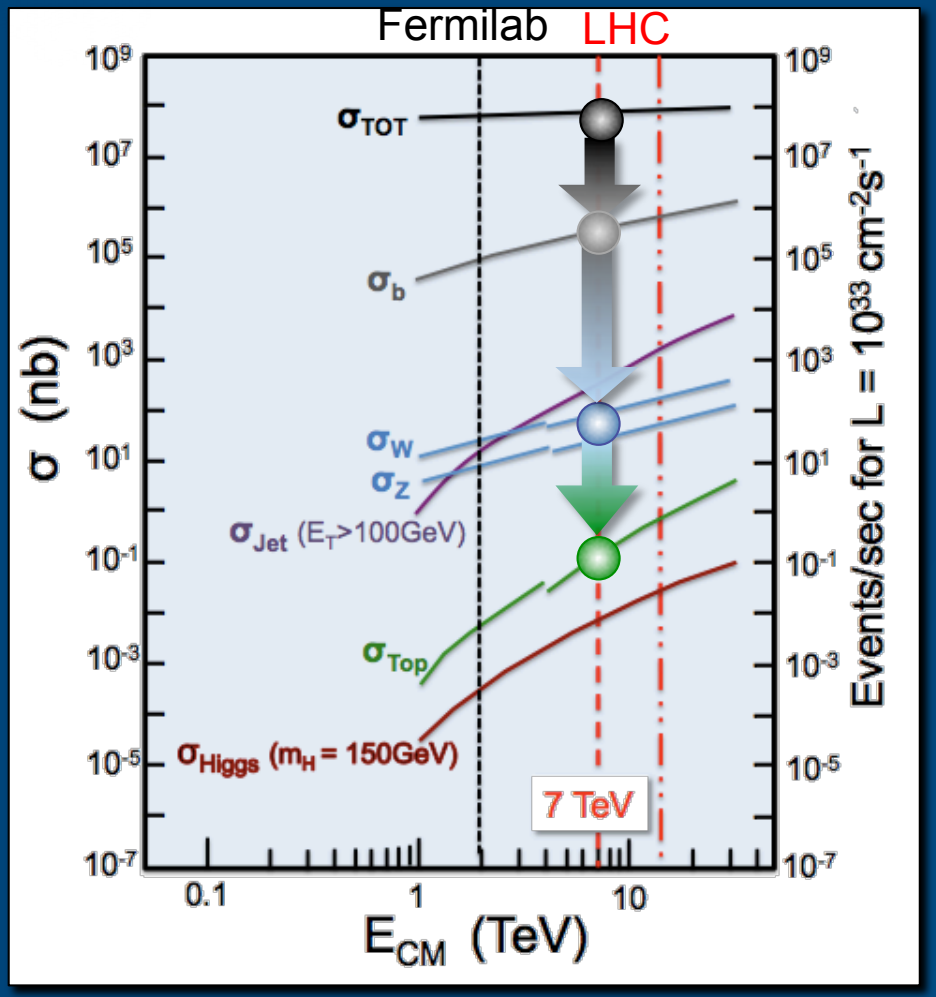
The basic process

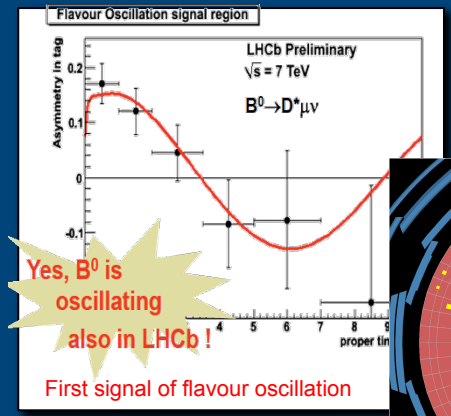


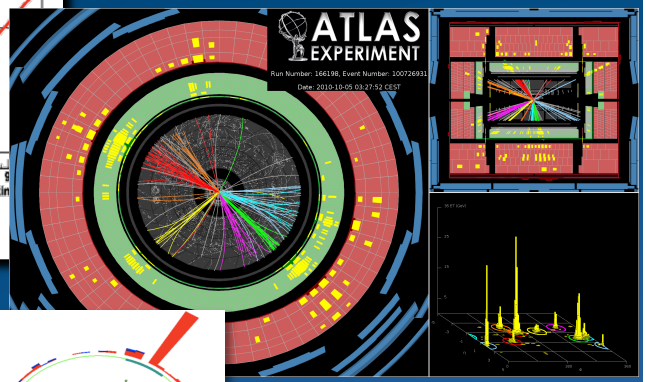


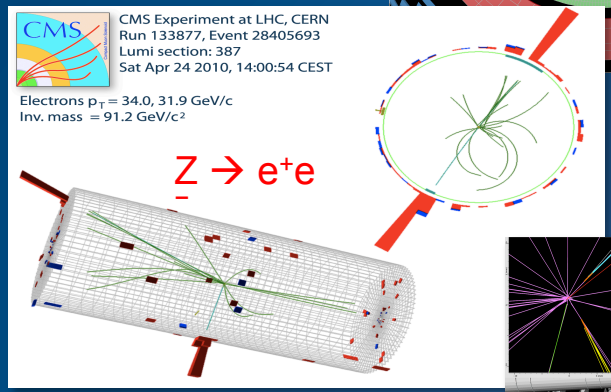
$$N_{ev} = L_{\text{int}} \times \sigma$$

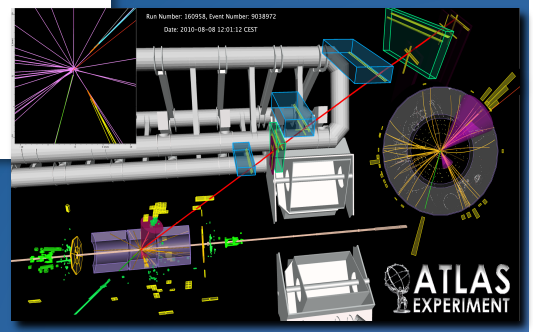
Proton-Proton Collisions





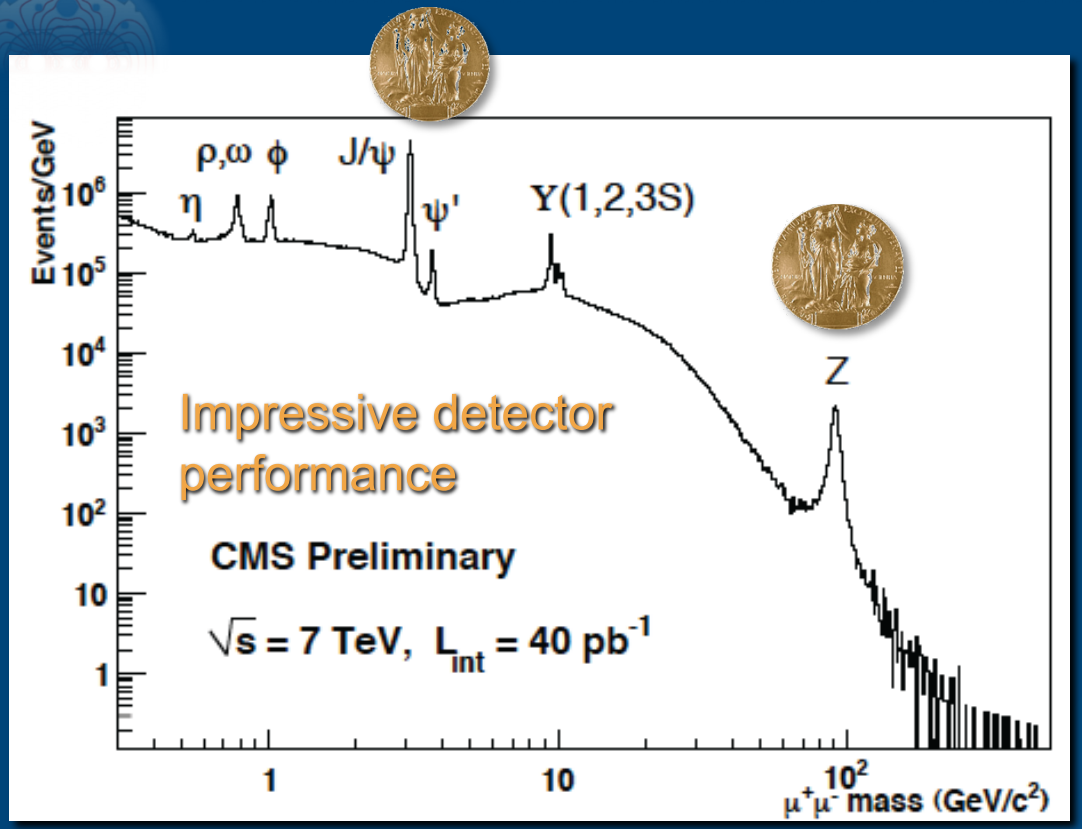






→ "re-discovered" Standard Model → excellent agreement!

Excellent performances → next steps

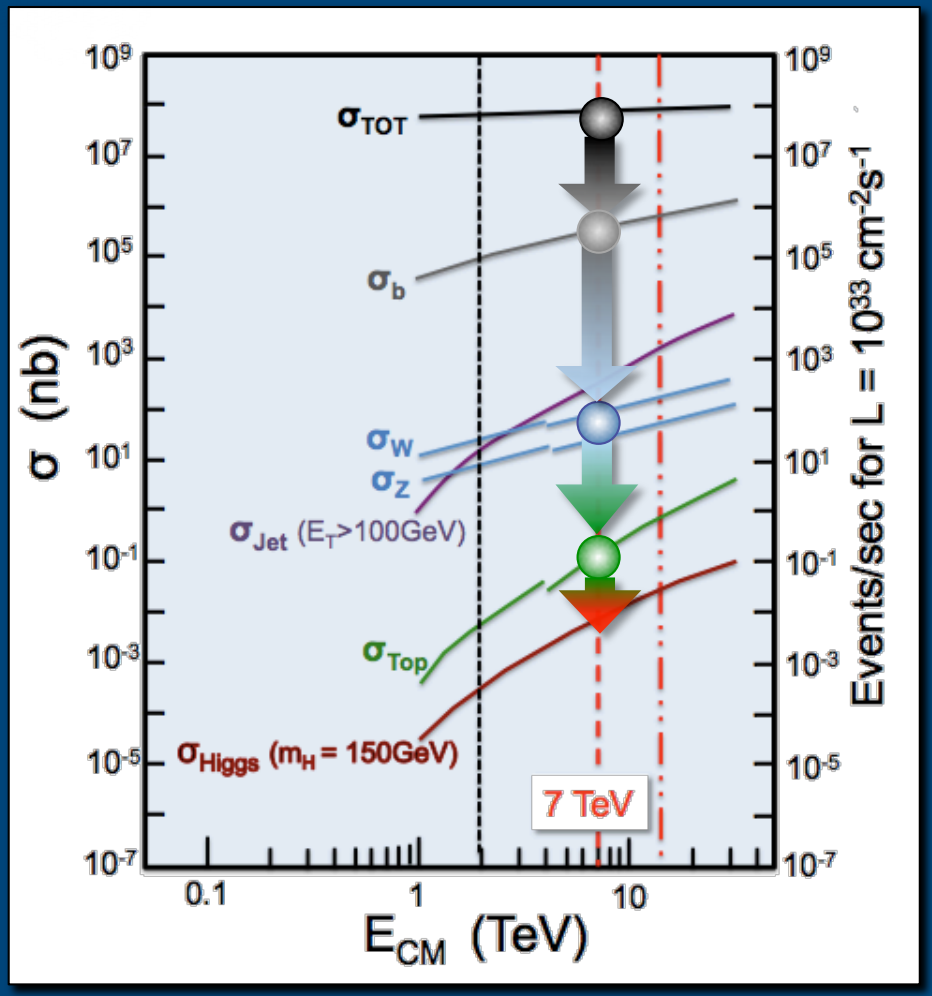


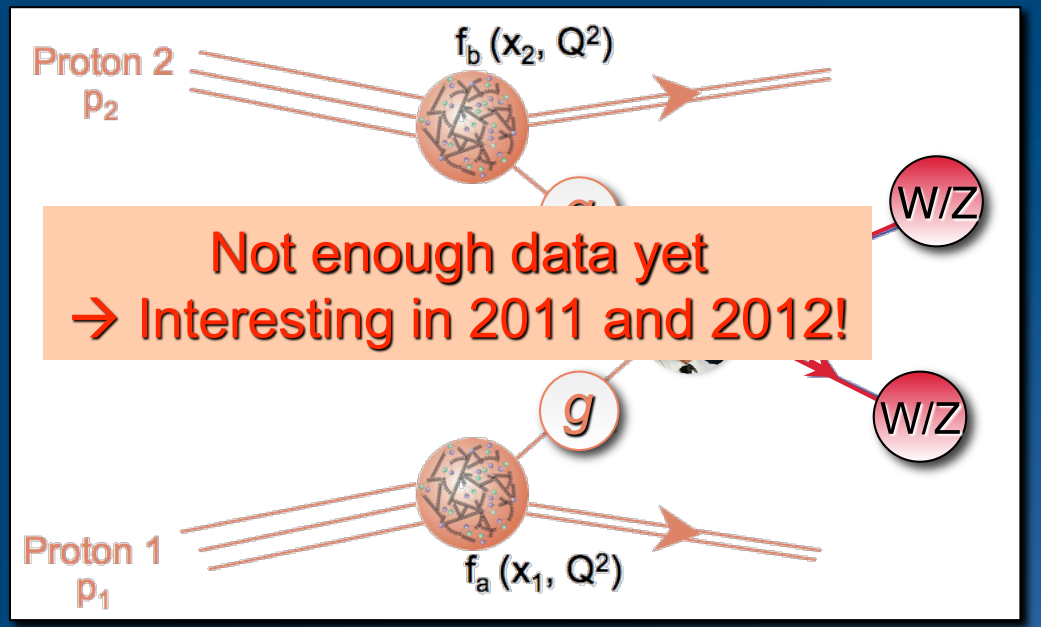
- Experiments demonstrated readiness in the exploitation of the 7 TeV p-p and 2.76 TeV Pb-Pb data;
- analyses proceeded very rapidly;
- Experiments have about completed their journey through the Standard Model … and have started to take us into uncharted territories …

Operate LHC in 2011 and 2012:

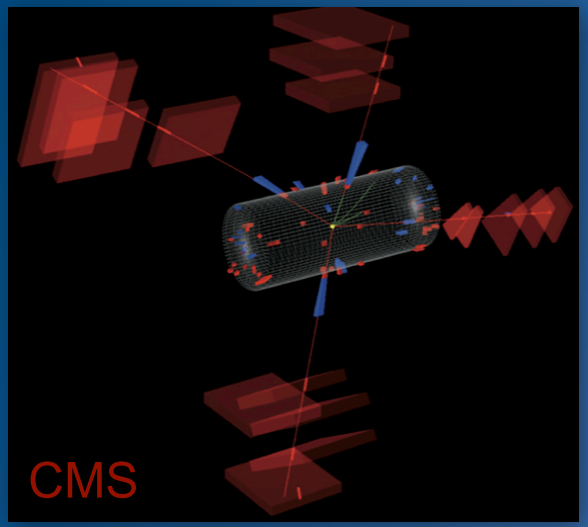
- 2011: E_{cm} = 7 TeV, expect L_{int} = 1 fb^{-1} (baseline): increase by factor of ~20
- 2012: maybe E_{cm} > 7 TeV, L_{int} possible increase by factor of ~ 2
- 2013/2014: shut down (≥ 15 months) to prepare LHC for 14 TeV operation

The 2011 and 2012 run …



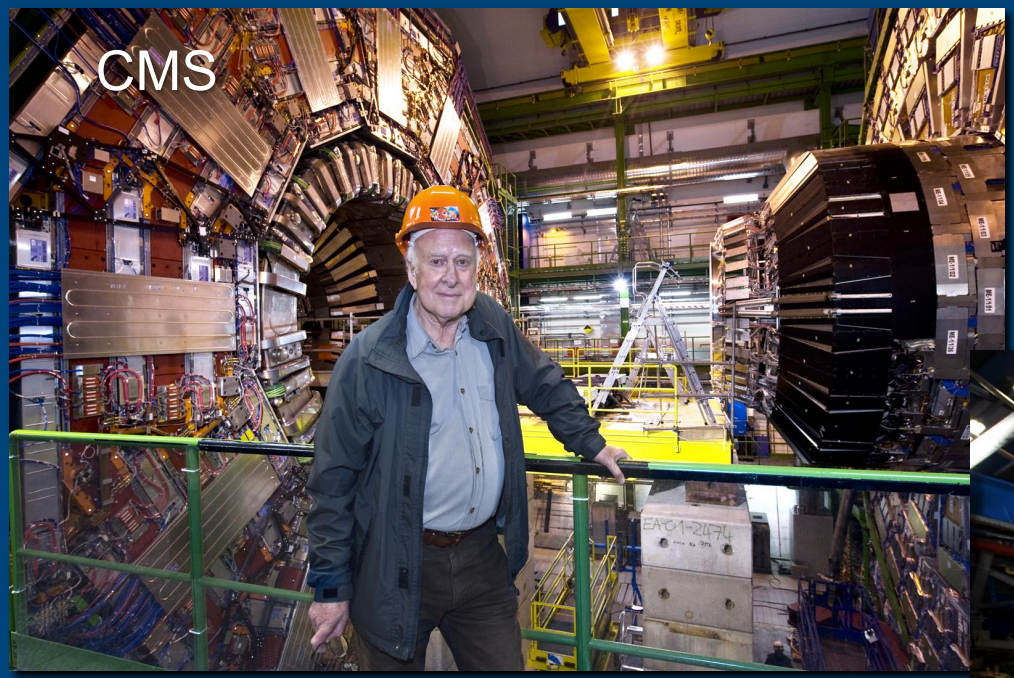


Not enough data yet
→ Interesting in 2011 and 2012!



$m_{4\mu}$=201 GeV

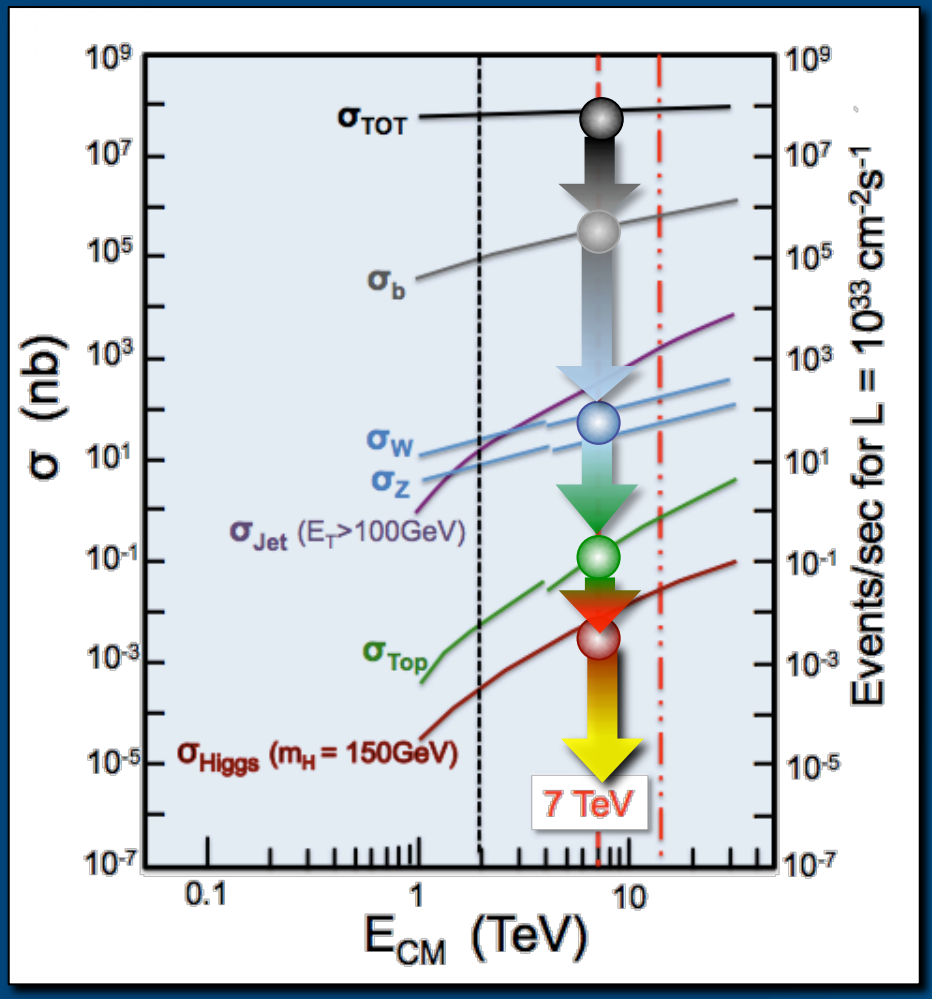
First “Higgs Event” …..



…. observed jointly in
CMS and ATLAS ….
(April 2008)

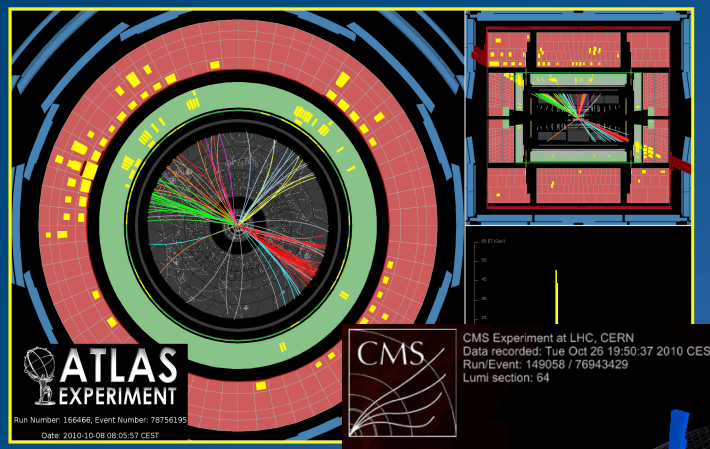
“Not only Peter Higgs”:
Important contributions also from
Brout & Englert
Guralnik, Hagen, Kibble

The 2011 and 2012 run …

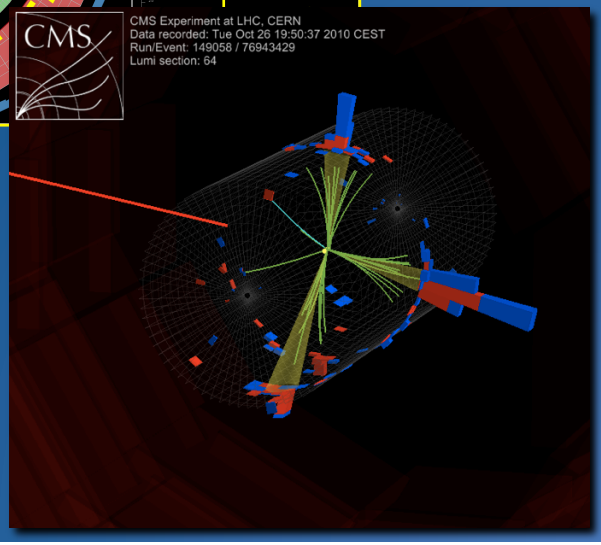


Search for physics beyond SM

- Discovering new particles
- Making precise measurements of properties of known particles/forces: e.g. LHCb: $B_s \rightarrow \mu^+\mu^-$

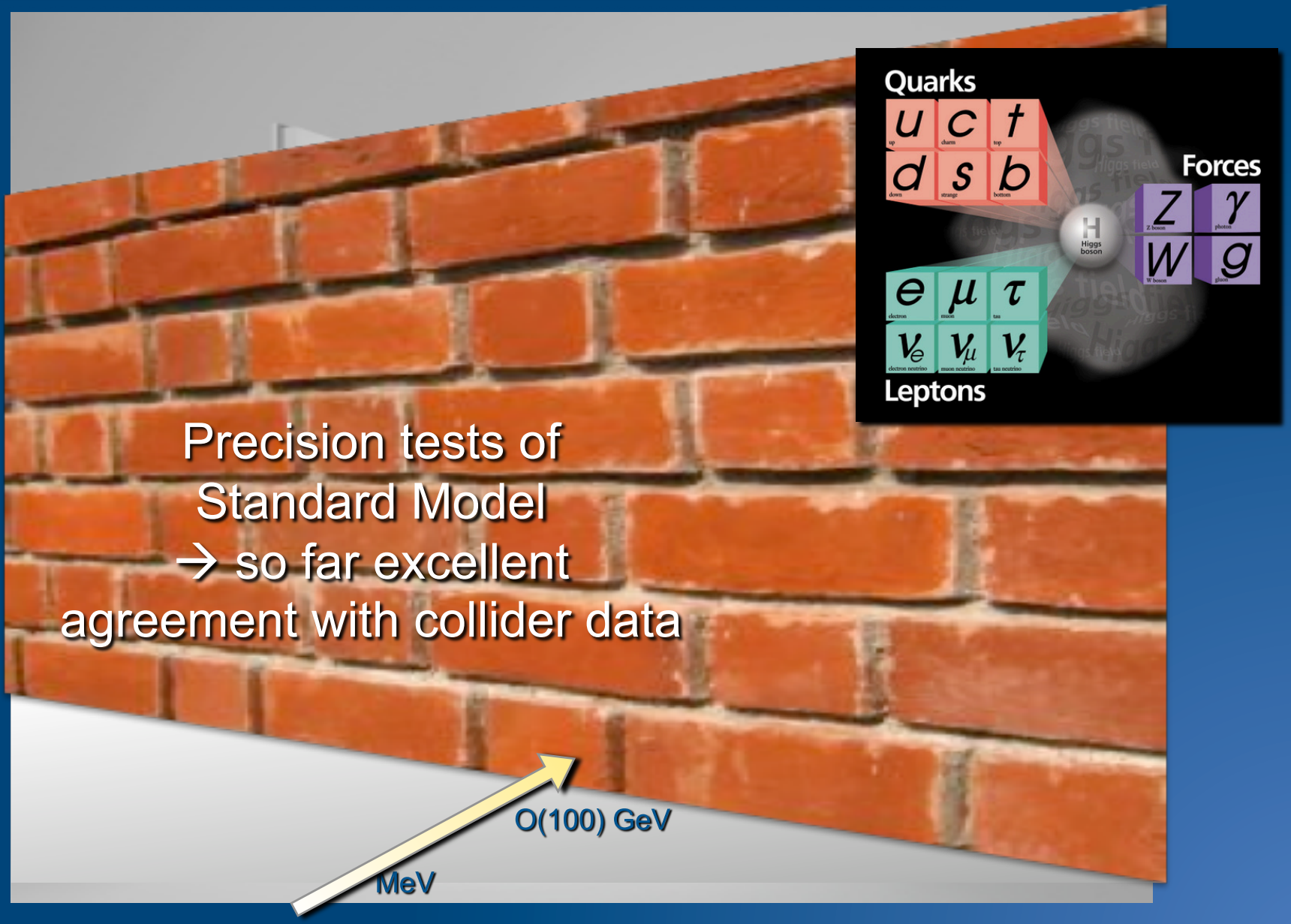


Highest mass di-jet event (3.7 TeV)



→ Will enter new territory !

My (personal) view of the LHC



My (personal) view of the LHC

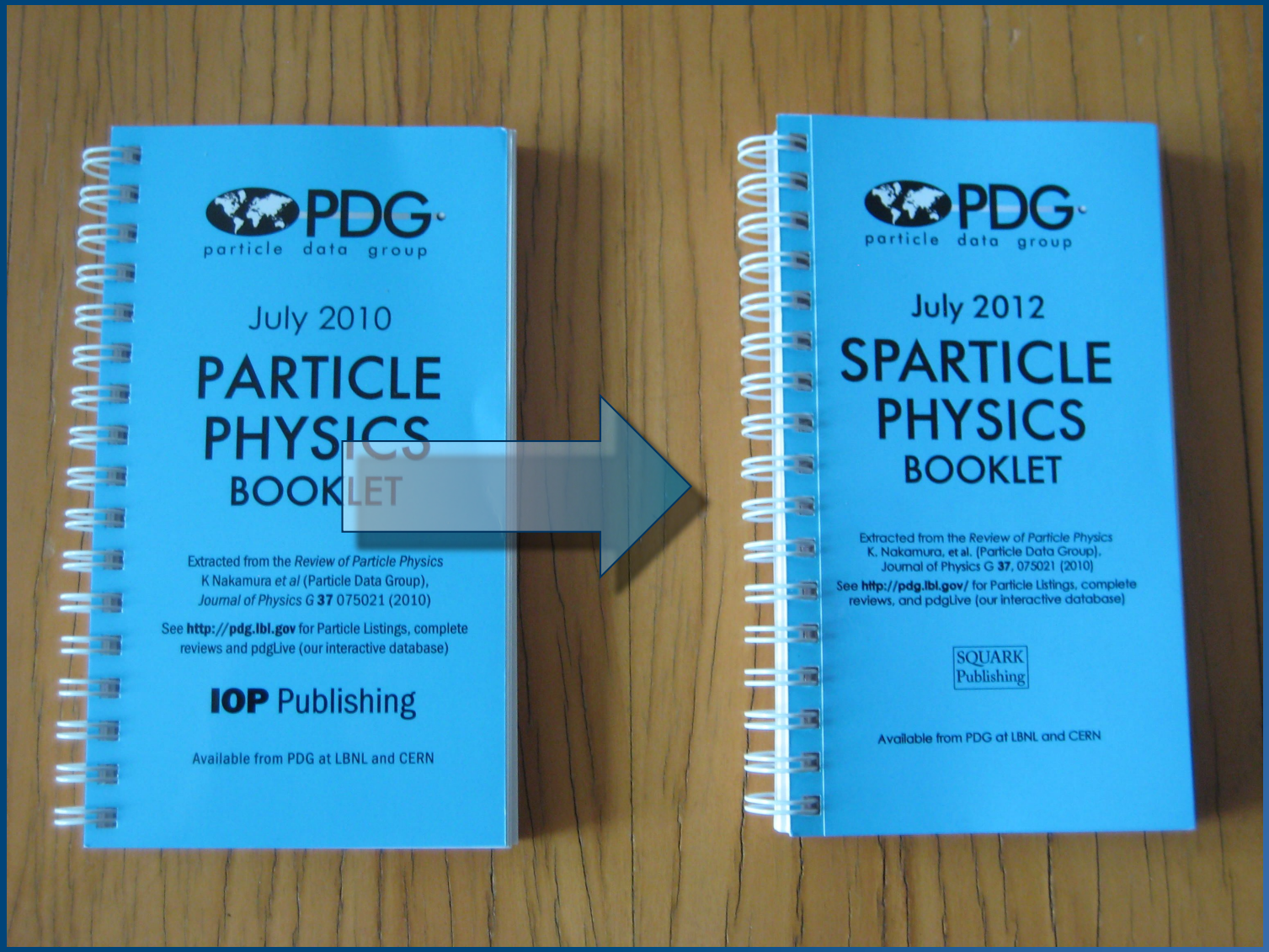
New Landscape of Physics?

Extra Dimensions ?

Supersymmetry ?

Higgs Field ?

So hopefully…




Very exciting years are ahead of us!
LHCb
ATLAS
CERN
CERN
SPS 7 km
SUISSE
FRANCE
CMS
ALICE
LHC 27 km