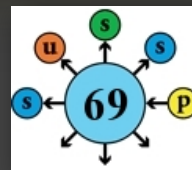


Lynn Marx
The University of Manchester

The HIGG STORY



69th Scottish Universities Summer School in Physics, St Andrews, August 2012

or finding the last piece of the Standard Model puzzle¹

Some things have mass (like you) and some don't (like light). Why is that? and where does mass come from?

1960 The underlying answer lies in something called Spontaneous Symmetry Breaking which is mostly very technical but let's give credit where credit is due...



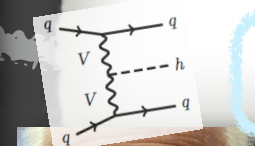
1964 3 papers are published by Englert & Brout, Higgs and Guralnik & Hagen & Kibble to further tackle the mass question: Particles gain mass by interacting with a new particle



Imagine Einstein walking into a room of physicists. Everybody will want to talk to him, making it harder for him to move - he has acquired mass



1966 "The Recipe Book" Peter Higgs calculates how this new particle, now known as the Higgs boson, interacts with other particles



How about a massive scalar (spin=0) particle?



1967/8 "Bringing it all together"

Using this Higgs mechanism, Glashow, Weinberg & Salam combine the electromagnetic and weak force into what is known as the Standard Model

This mechanism could also give mass to fundamental particles like electrons & muons



1971/2 "Cleaning pesky ∞"

This model works very well but sometimes predictions are infinitely large, so 't Hooft & Veltman come up with a solution known as renormalization



Particle Discoveries (needed for the puzzle)

1974 CHARM QUARK (SLAC, BNL)

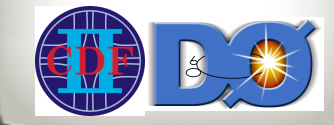
1977 BOTTOM QUARK (Fermilab)

1978 GLUON (DESY)

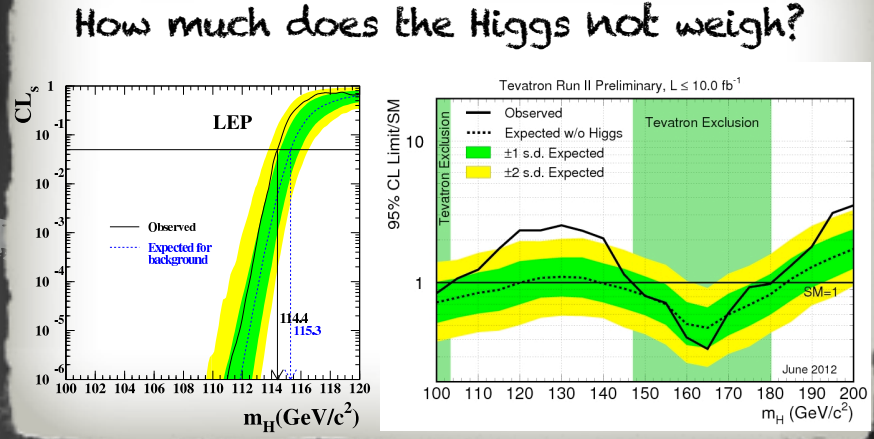
1983 W BOSON Z BOSON (UA1, UA2)



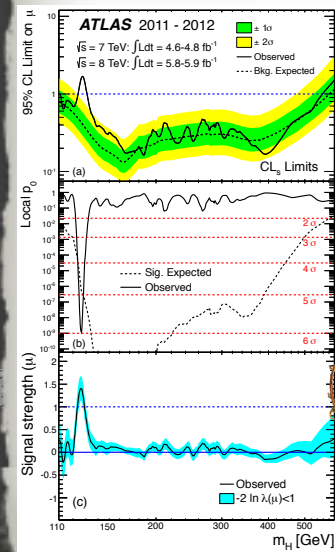
1995 discovery expected to interact the strongest with the Higgs as it is the heaviest



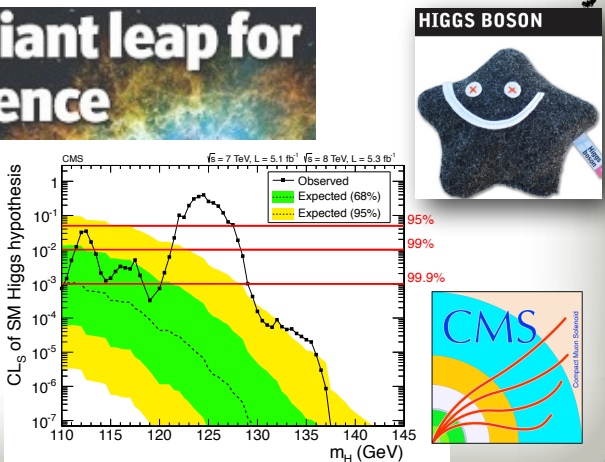
2000-2011 LEP & Tevatron results



2012 Discovery of (something) Higgs (-like) at the LHC with mass = 126 GeV and more than 99.999% certainty



A giant leap for science



Future
Does this particle behave like Higgs predicted? If not, is there New Physics? Supersymmetry? Extra dimensions?

1) greatly inspired by <http://arxiv.org/abs/1201.6045>