Higgs Boson Phenomenology at the LHC

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The Standard Model

- Describes the currently accepted state of particle physics:
  - Fermions
    - Hadrons
      - Quarks
    - Leptons
  - Bosons
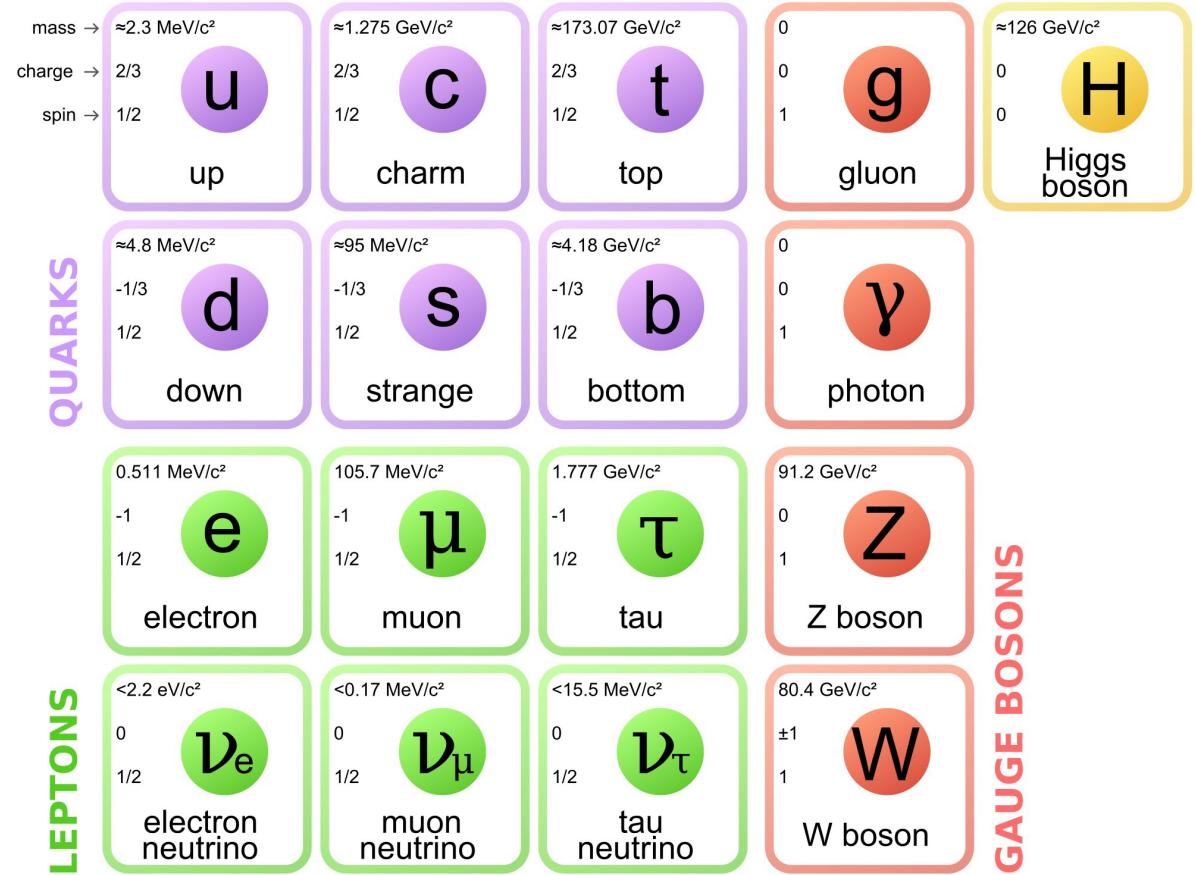
The Higgs Boson

- Theorized in 1964
  - Brout & Englert, Higgs
- Existence confirmed in 2012
  - Relatively 'new' particle
- Characterization of production and decays is a priority
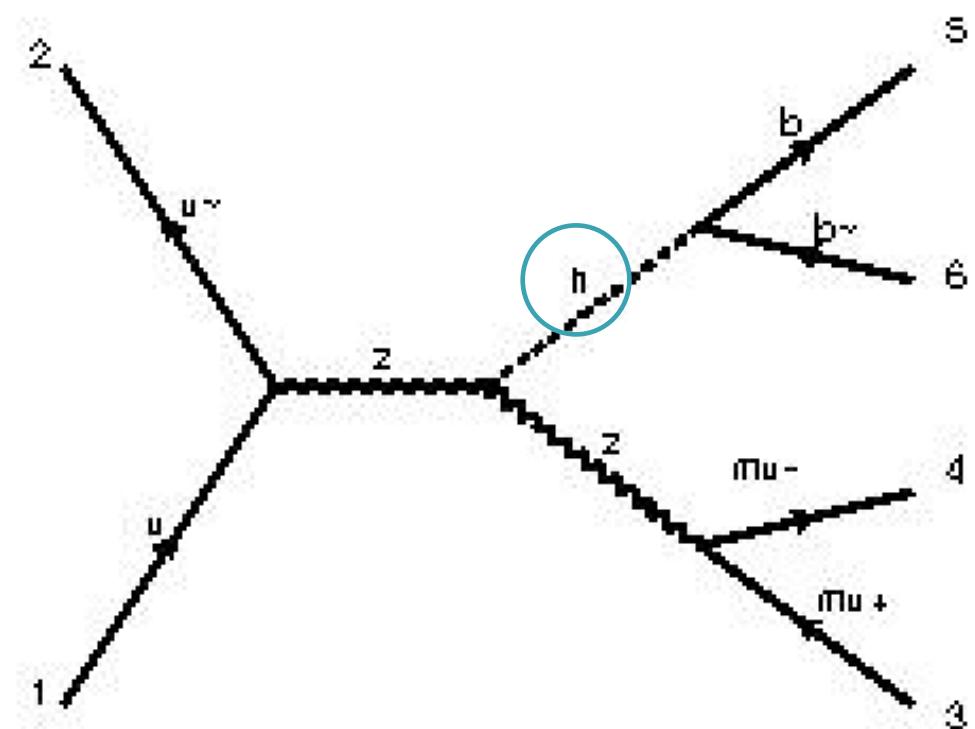
diagram 1   QCD=0, QED=4

Software: MadGraph and ROOT

MadGraph5

- Simulation software

- Can output cross sections, Feynman diagrams and more for interactions

- Can be manipulated with plugins

ROOT

- Proprietary from CERN

- Essentially a C++ distribution

- Used to pare down data from MadGraph
  - Create new, relevant plots

Research Goals

Confirming

- ATLAS experimental results:
  - p p > W h > l ν, τ+ τ-
  - p p > Z h > l+ l-, τ+ τ-

Investigating

- New physics:
  - WWH/ZZH coupling
  - h > τ τ decays

Questions?

https://home.cern/news/series/lhc-physics-ten/higgs-boson-what-makes-it-special

https://home.cern/science/physics/higgs-boson

https://www.quantumdiaries.org/wp-content/uploads/2014/03/2000px-Standard_Model_of_Elementary_Particles.svg_.jpg

Rene Brun and Fons Rademakers, ROOT - An Object Oriented Data Analysis Framework, Proceedings AIHENP'96 Workshop, Lausanne, Sep. 1996, Nucl. Inst. & Meth. in Phys. Res. A 389 (1997) 81-86.

J. Alwall et al, "The automated computation of tree-level and next-to-leading order differential cross sections, and their matching to parton shower simulations", arXiv:1405.0301 [hep-ph].