First Beam at Large Hadron Collider

Particle beams were transported around the 17 mile ring in both directions.
The Universe is Made of Particles

- Investigating the particles reveals the fundamental structure of the Universe and matter within it.
TONIGHT’S PROGRAM

• What are some highlights of particle physics history?

• What is the purpose of the
  Large Hadron Collider? - G. Kribs

• How do we do experiments at the LHC? - E. Torrence

• What are the unanswered questions from the audience?
1897 - J.J. Thomson - Electron
J.J. Thomson, Speaking in 1934

Could anything at first sight seem more impractical than a body which is so small that its mass is an insignificant fraction of the mass of an atom of hydrogen? -- which itself is so small that a crowd of these atoms equal in number to the population of the whole world would be too small to have been detected by any means then known to science.


Credit: American Institute of Physics
1932 - Discovery of Anti-Matter
1969 - Quarks discovered (inside atomic nucleus) Stanford
1995 - Top Quark Discovered at Fermilab

Creation of massive matter

\( E=mc^2 \)
Building Blocks of Nature

Elementary Particles

Quarks: u, c, t, d, s, b

Leptons: \( \nu_e, \nu_\mu, \nu_\tau, e^-, \mu^-, \tau^- \)

Force Carriers:

Anti-Quarks:

Anti-Leptons:

Three Generations of Matter

September 12, 2008

Large Hadron Collider - J. Brau
Next Energy Frontier

• Terascale
  Energy = 1,000,000,000,000 electron-volts
  – Equivalent to trillions of household batteries
  – Controlled voltage of tens of thousands of lightning bolts

• Scientific Goals at Terascale
  – Origin of Mass
  – Symmetries of Forces
  – Dark Matter
The Large Hadron Collider (LHC)

**Largest** machine in the world

**Fastest** racetrack on the planet

**Emptier** than space in the Solar System

**Hottest spots** in the galaxy, but even **colder** than outer space

**Biggest** and **most sophisticated** detectors ever built

**Most powerful** supercomputer system in the world
The Large Hadron Collider (LHC)

- 17 mile circumference
- 9300 Magnets
  - 1600 Superconducting (−456°F)
- Collision energy
  - 14,000,000,000,000 eVolts
- Energy in beams
  - 362 MegaJoules
    - 747 Jumbo Jet on take-off
  - 10,000 MJ in magnets
- Particle Collision rate
  - 600,000,000/second
From kilo-electron-volts to the Terascale

1897
Discovery of the Electron

2008 +
Discovery of ???????
Now, Two Experts on the LHC

• Physics Goals of the LHC
  – Graham Kribs
    UO Assistant Professor of Physics

• Experiments at the LHC
  – Eric Torrence
    UO Associate Professor of Physics

• Then - Questions and Discussion