Introduction to Honors 135

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Today

- Outline of the physics
- Administrative notes
  - Roadmap for the course
  - Syllabus
- Particle Fever clip

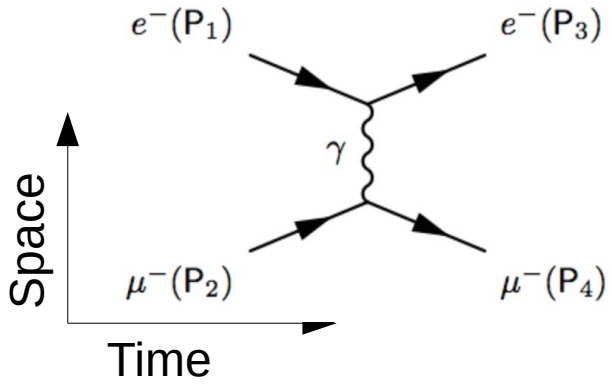
Physics Questions

What is matter?

- Structure of matter:
  - Molecules
  - Atoms
  - Proton, Neutron, Electron
  - Quarks, Gluons
- Matter is made up of ***particles***. A particle cannot be broken down into something smaller.
- It is the task of particle physics to discover, sort, and understand these particles.

What is a force?

- A force is the way one particle interacts with another
- Forces:
  - **Electromagnetism**: what you feel when you push on the table
  - **Strong force**: what keeps protons bound in the nucleus
  - **Weak force**: causes particle decays, neutrinos...
  - **Gravity**: keeps planets together
- A force is conveyed by a **force carrier**



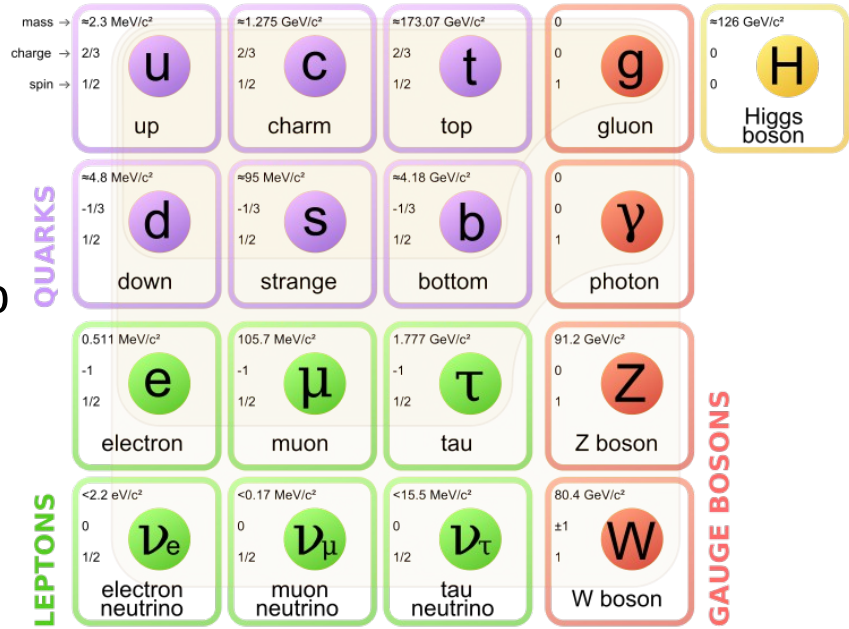
In *Compton Scattering* two like charged particles (e and μ) bounce off each other.

As they do so, they share a **photon** between them. The photon carries the force!

http://www-pnp.physics.ox.ac.uk/~barra/teaching/feynman.pdf

Okay, what particles *do* exist?

- The Standard Model of Particle Physics
- **Quarks** make up protons
  - Up, Down, Strange, Charm, Top, Bottom
- **Leptons** electrons and neutrinos
  - Electron, Muon, Tau
  - Electron Neutrino, Muon Neutrino, Tau Neutrino
- **Bosons** carry the forces
  - Photon
  - Gluon
  - W, Z bosons
  - Higgs boson
- No gravity? Dark matter?



http://en.wikipedia.org/wiki/Standard_Model#mediaviewer/File:Standard_Model_of_Elementary_Particles.svg

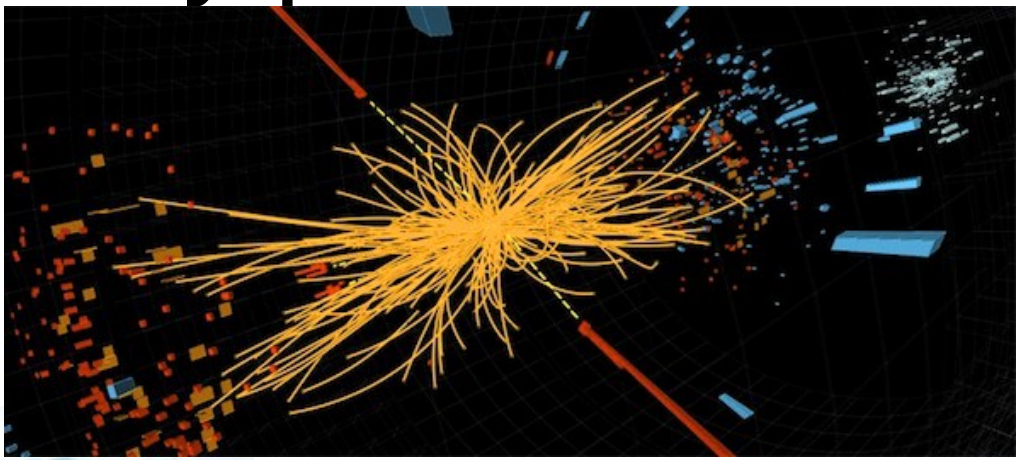
How do we study particles?

- Historically:

http://en.wikipedia.org/wiki/Cyclotron#mediaviewer/File:1937-French-cyclotron.j

How do we study particles?

- Today:



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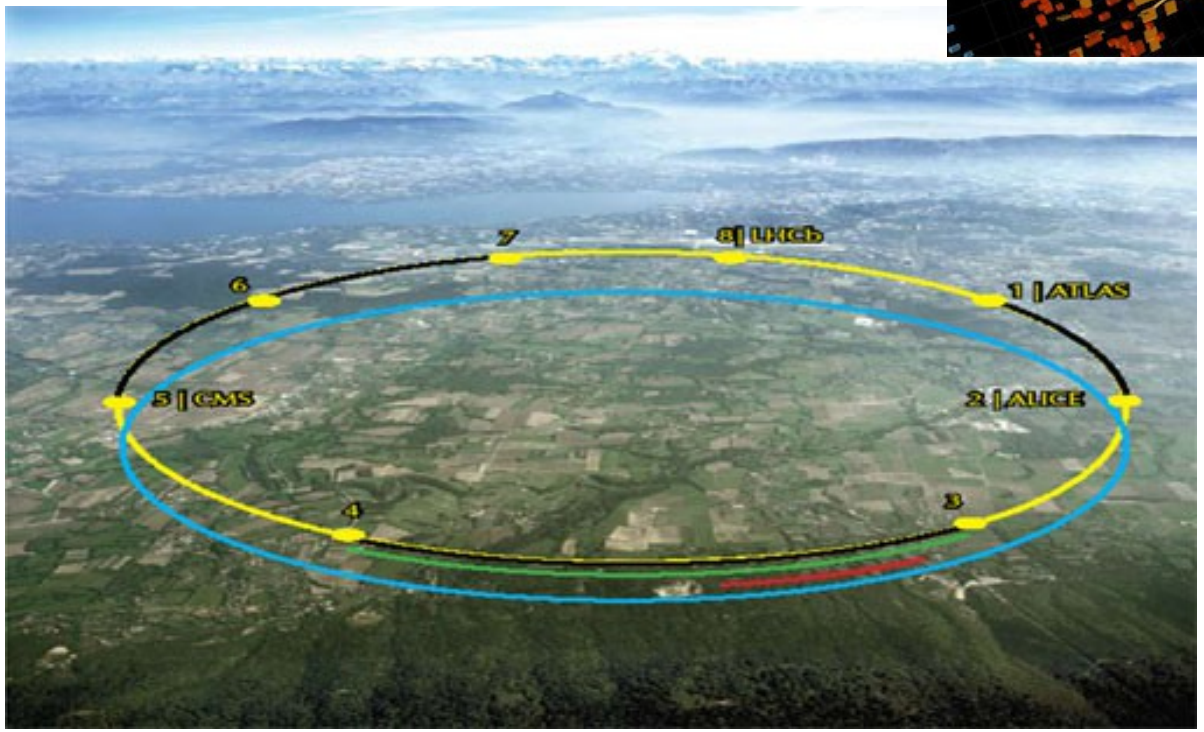
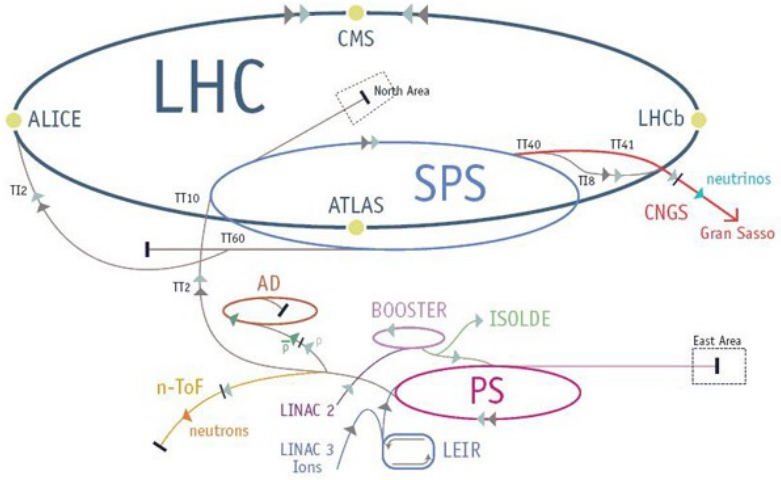


https://atlas-service-enews.web.cern.ch/atlas-service-enews/2009/images_09/lhc-update-a_511.jpg



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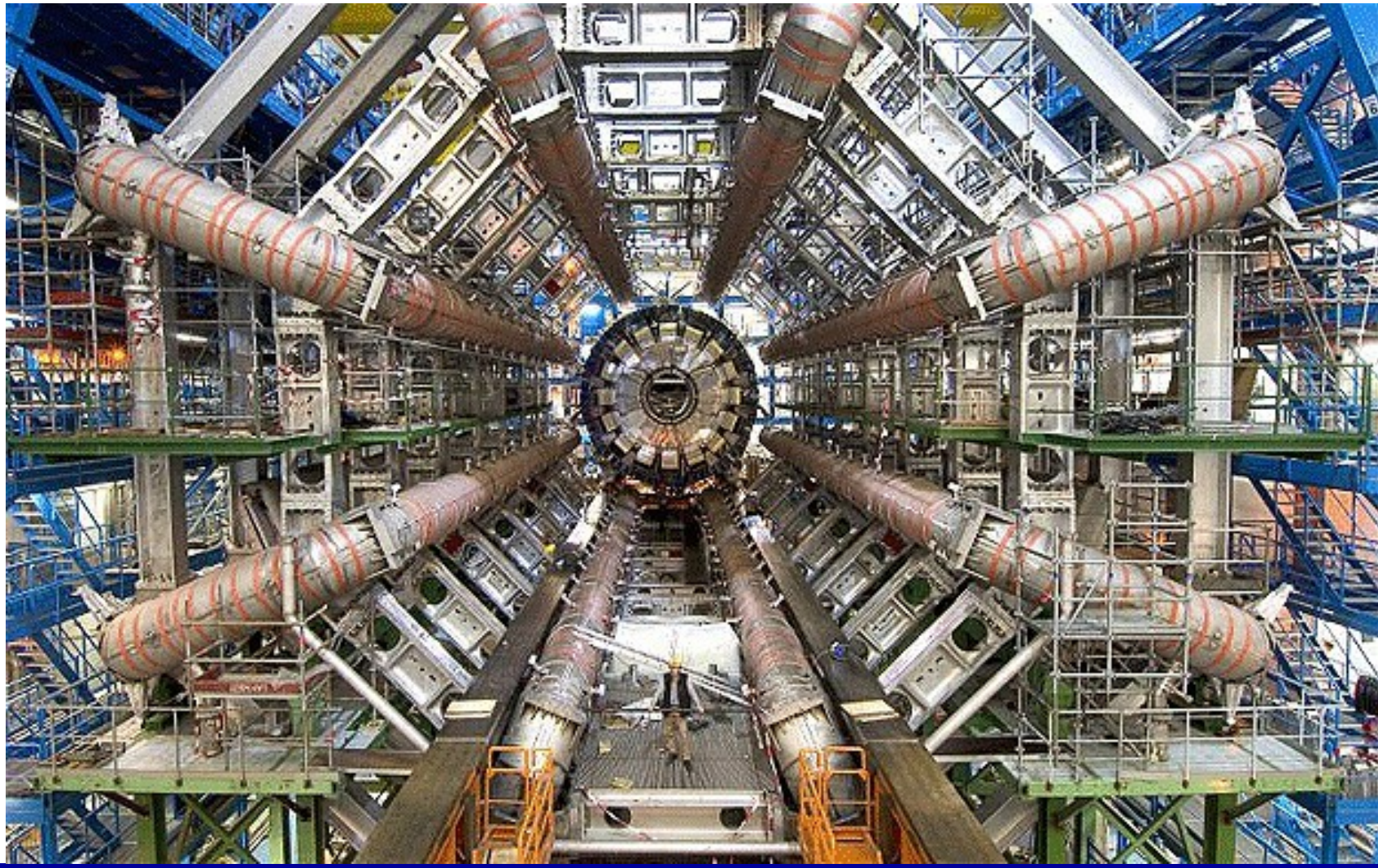

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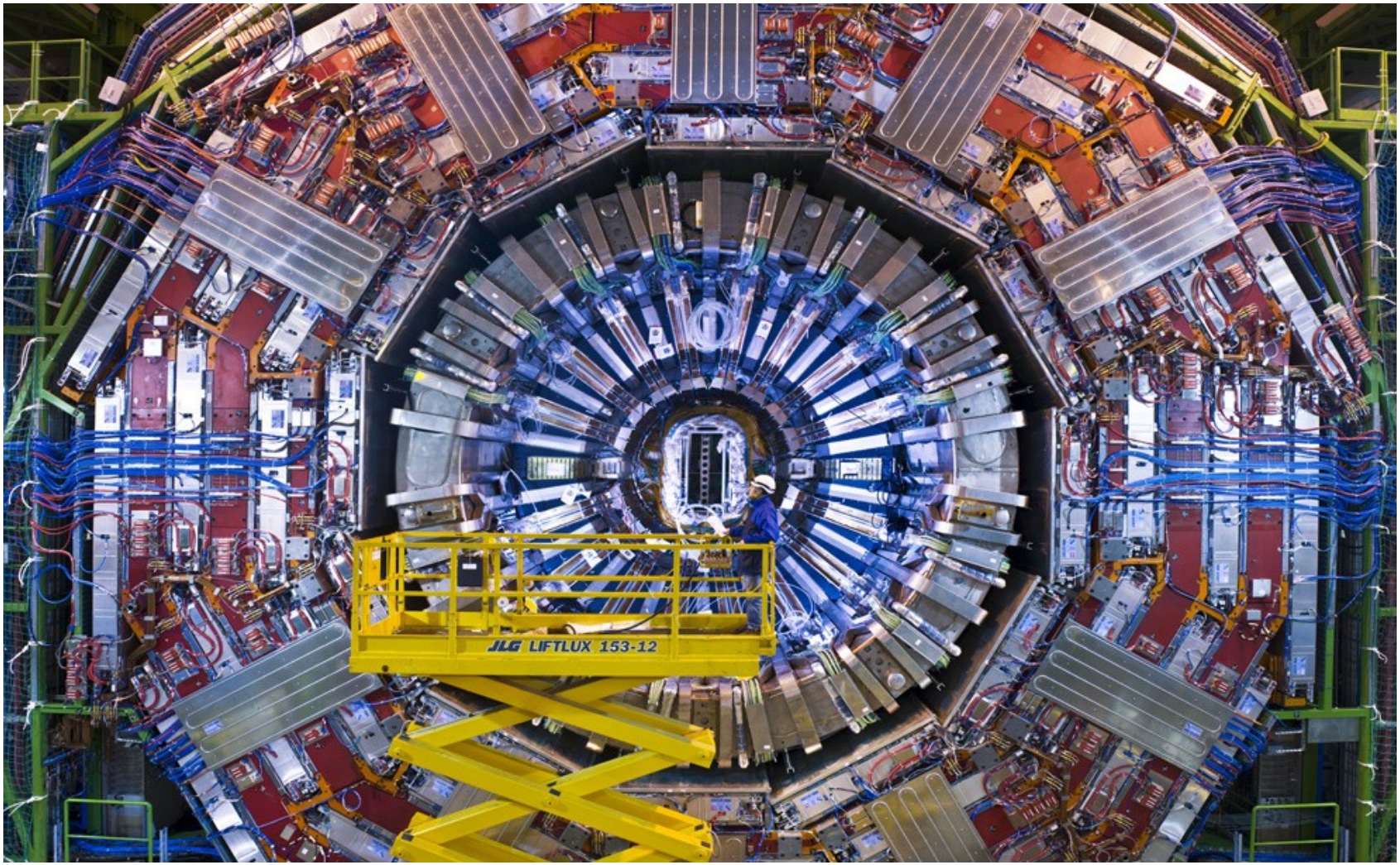

http://cache.boston.com/universal/site_graphics/blogs/bigpicture/lhc_08_01/lhc17.jpg

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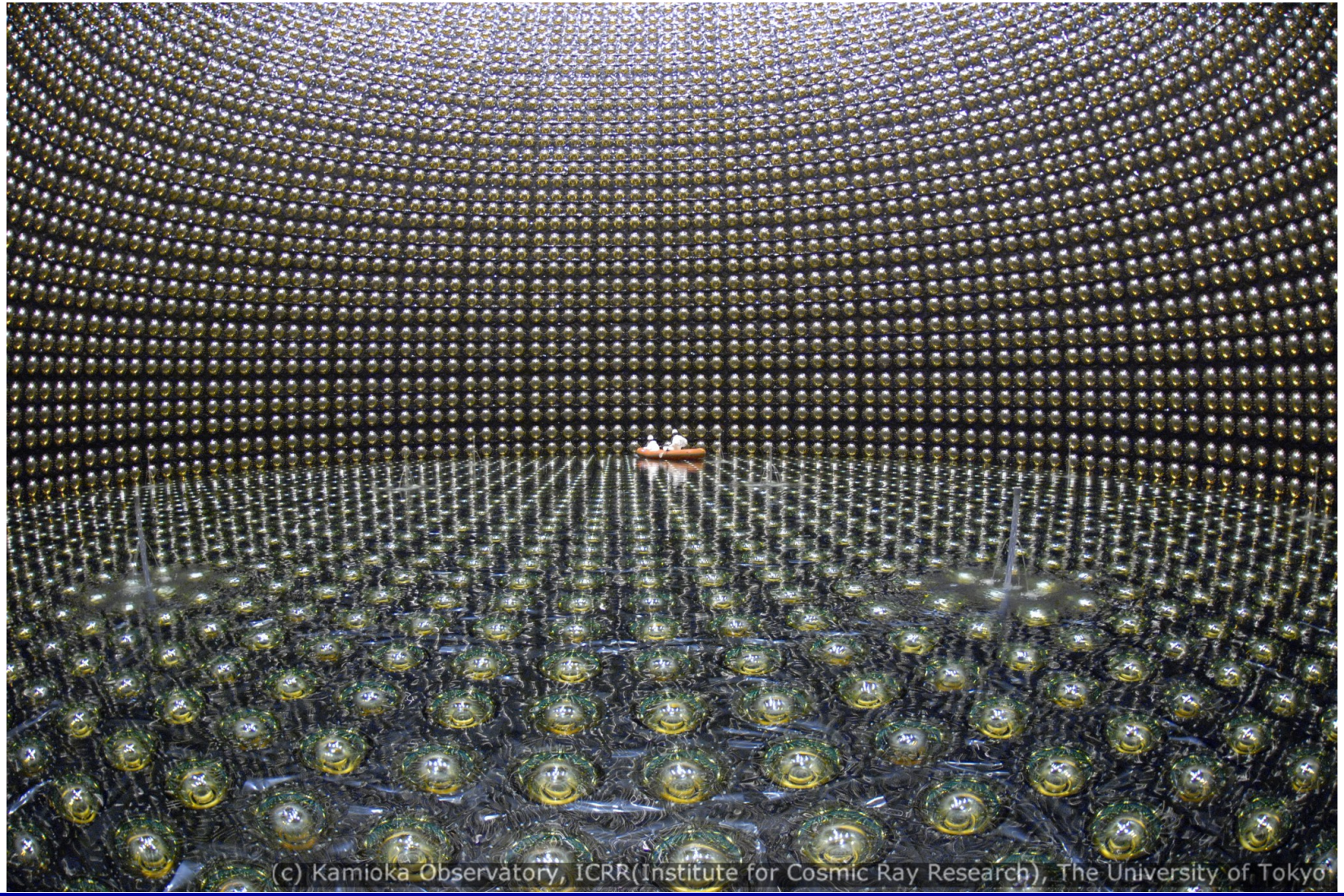


http://cache.boston.com/universal/site_graphics/blogs/bigpicture/lhc_08_01/lhc17.jpg

What are the big mysteries?

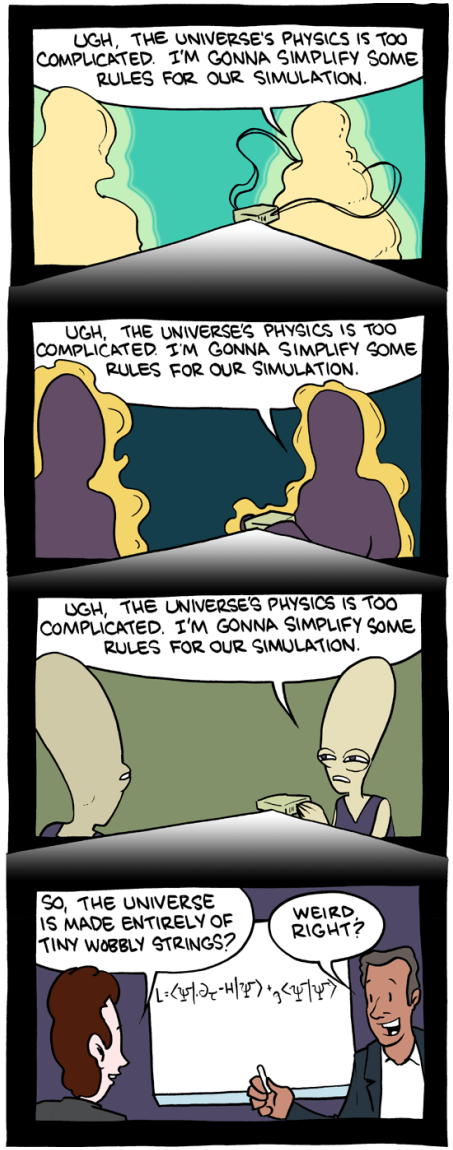
- What is dark matter?
- What is dark energy?
- What particles exist? Super Symmetry?
- How does gravity work?
- Neutrino mass?

- (These are the questions that the course will *not* answer)

Administrative Notes

Course schedule

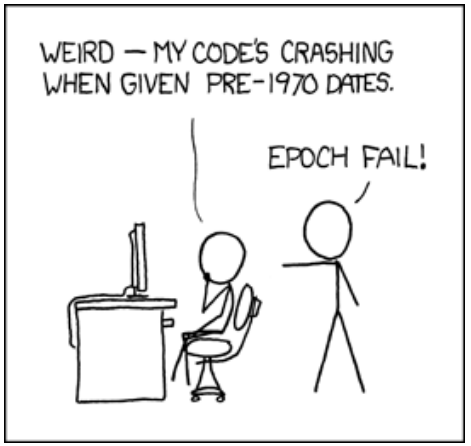
- Week 1: Introduction
- Week 2: Particle physics history
- Week 3: Methods of detection
- Week 4: Accelerators
- Week 5: Modern experiments
- Week 6: Fermilab trip
- Week 7: DAQ and analysis
- Week 8: Theory and future experiments
- Week 9: Final Topics



smbc comics

Syllabus expectations

- Course website: honors135.hg8i.com
  - Slides, lecture notes, syllabus
- Attendance
  - I expect you to attend class
- Participation
  - Participate in discussion
  - Assignments?
- Grading:
  - Attendance + Participation = Grade
  - Grade is credit/no credit



You can't fail
http://xkcd.com/376/

Fermilab Trip

- October 13-14
- Leave 8am, return 4pm
- Outside Chicago
- Paid for by physics department
- See:
  - SeaQuest experiment
  - Neutrino experiments
  - Tevatron, D0
  - Fermilab campus

Fermilab

Particle Fever