PHYS 1441 – Section 002
Lecture #1

Monday, Aug. 30, 2010
Dr. Jaehoon Yu

- Who am I?
- How is this class organized?
- What do we want from this class?
- What is Physics?
- Brief history of physics
- Summary of previous classes
- On Acceleration

Today's homework is homework #1, due 9pm, Tuesday, Sept. 7!!

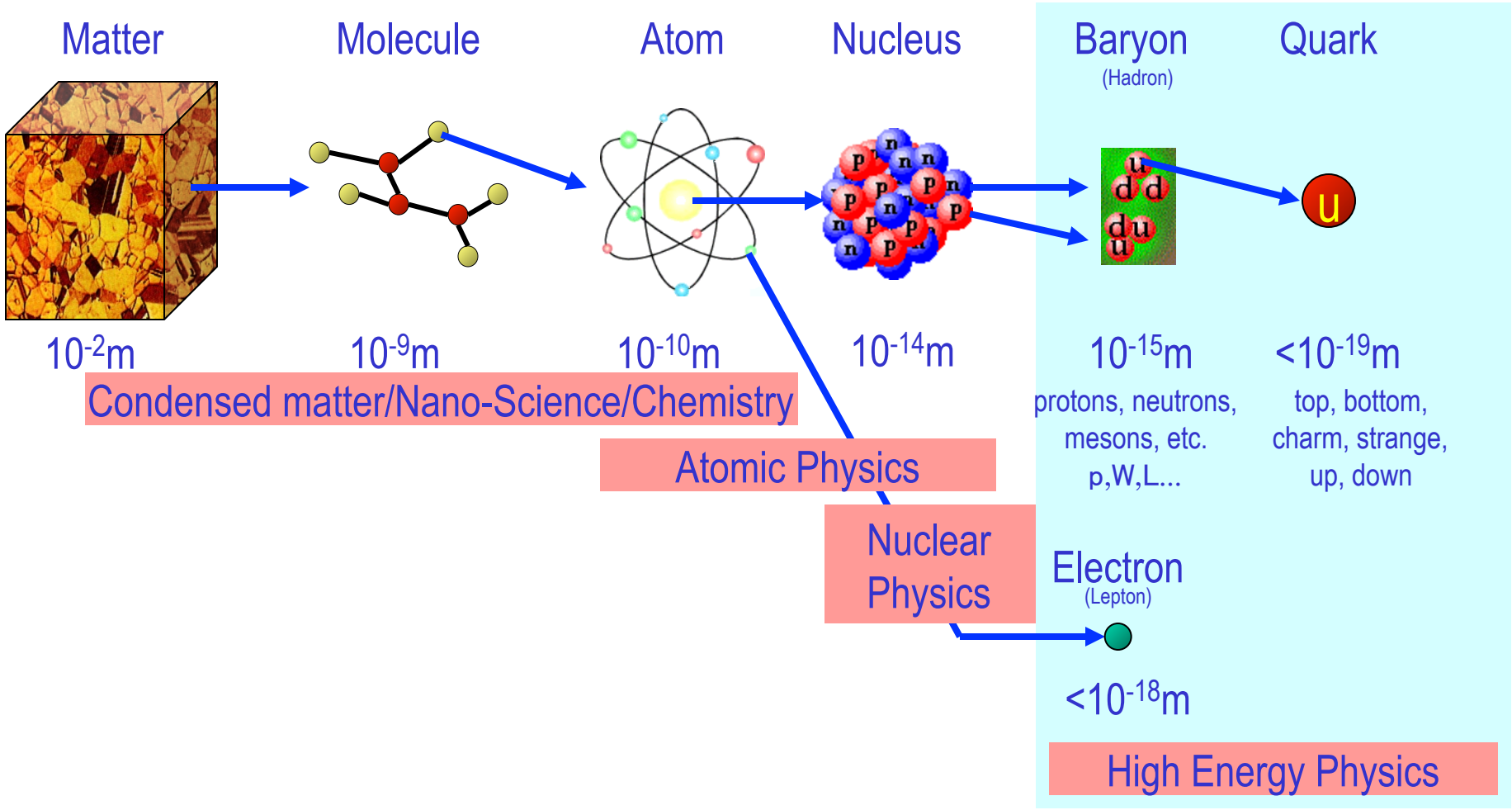
Announcements

- Reading assignment #1: Read and follow through all sections in appendices A1 – A8 by Wednesday, Sept. 8
  - There will be a quiz on Wednesday, Sept. 8, on this reading assignment and Chapter 1

Who am I?

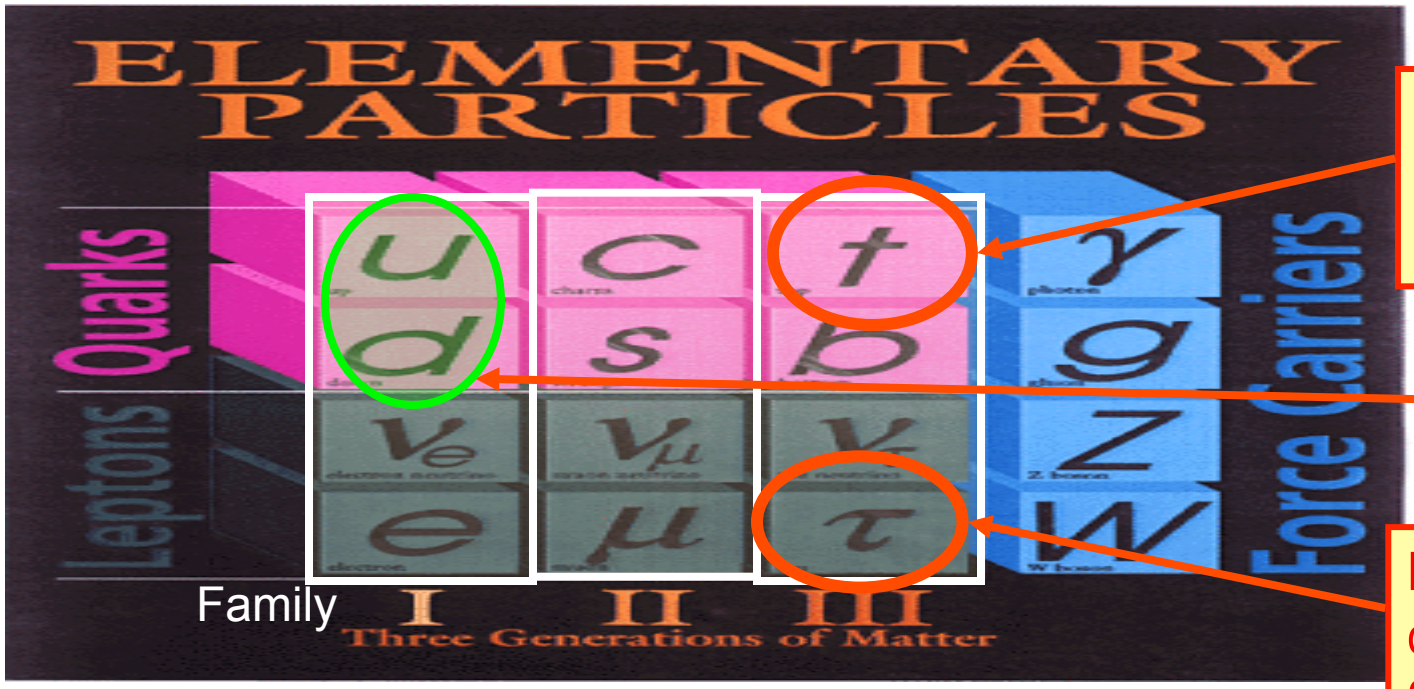
- Name: Dr. Jaehoon Yu (You can call me **Dr. Yu**)
- Office: Rm 342, Chemistry and Physics Building
- Extension: x22814, E-mail: *jaehoonyu@uta.edu*
- My profession:High Energy Physics (HEP)
  - Collide particles (protons on anti-protons or electrons on anti-electrons, positrons) at the energies equivalent to 10,000 Trillion degrees
  - To understand
    - Fundamental constituents of matter
    - Interactions or forces between the constituents
    - Origin of Mass
    - Creation of Universe (The **Big Bang** Theory)
  - A pure scientific research activity
    - Direct use of the fundamental laws we find may take longer than we want but
    - Indirect product of research contribute to every day lives; eg. WWW

Structure of Matter



The Particle Physics Standard Model

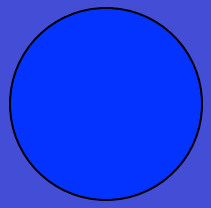
- Assumes the following fundamental structure:



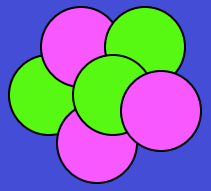
- Three families of leptons and quarks together with 12 force mediators ➔ Simple and elegant!!!

Accelerators are Powerful Microscopes.

They make high energy particle beams that allow us to see small things.



seen by
low energy beam
(poorer resolution)



seen by
high energy beam
(better resolution)

Accelerators are also Time Machines.

They make particles last seen
in the earliest moments of the universe.

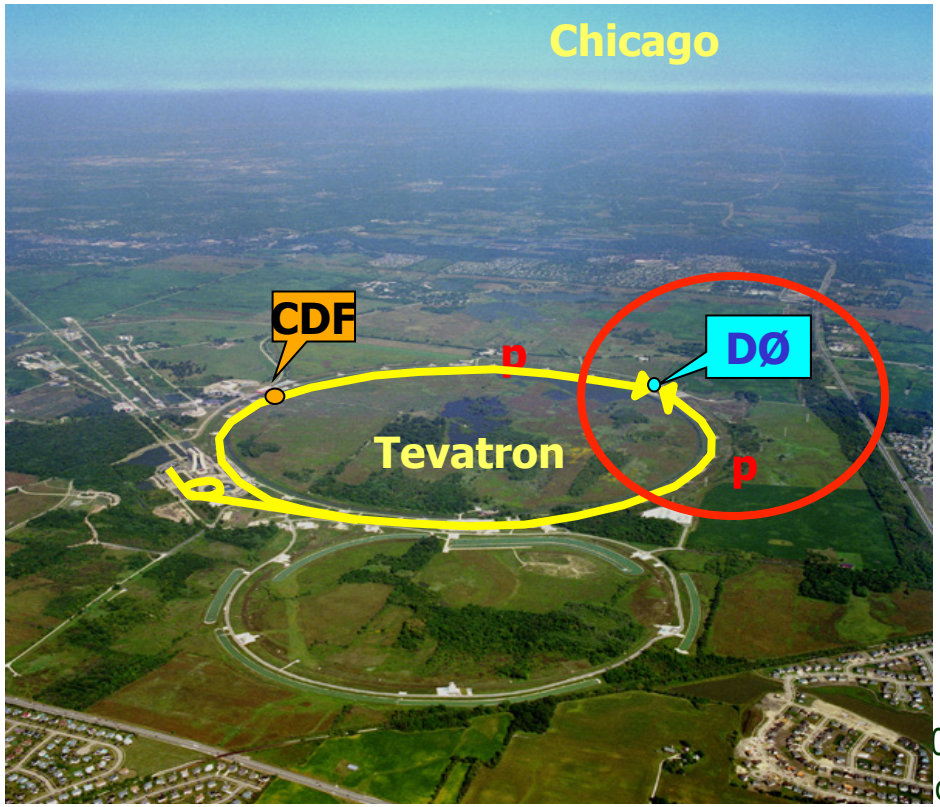
Particle and anti-particle annihilate.

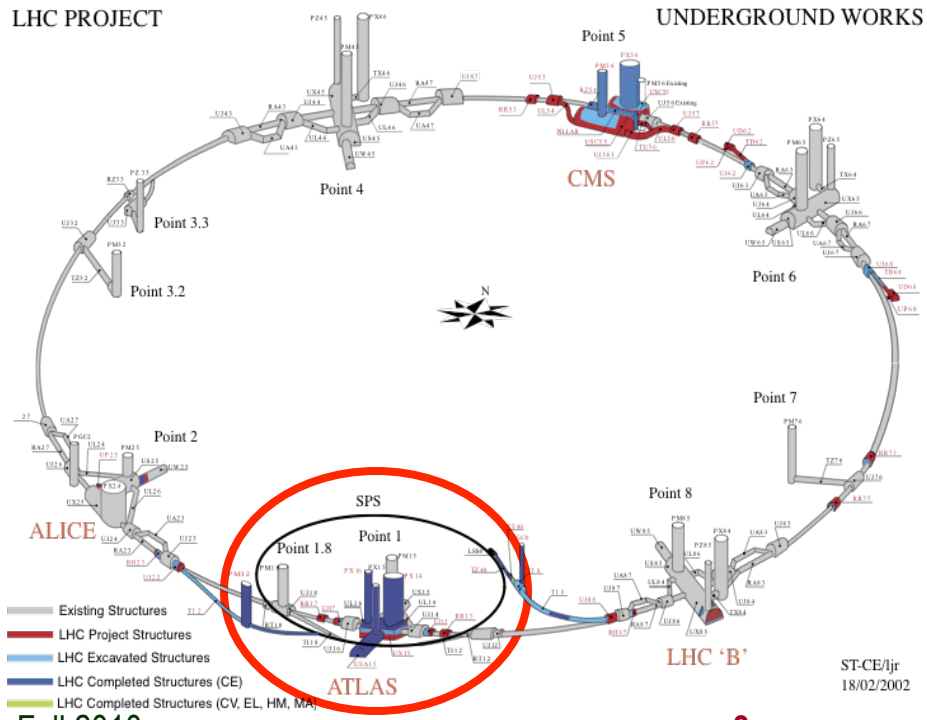
$$E = mc^2$$

Fermilab Tevatron and LHC at CERN

- Present world's Highest Energy proton-anti-proton collider
  - 4km circumference
  - E_{cm}=1.96 TeV (=6.3x10^{-7}J/p➔ 13M Joules on 10^{-4}m^2)
  - Þ Equivalent to the kinetic energy of a 20t truck at the speed 81mi/hr➔ 130km/hr

- World's Highest Energy p-p collider
  - 27km circumference, 100m underground
  - Design E_{cm}=14 TeV (=44x10^{-7}J/p➔ 300M Joules on the area less than 10^{-4}m^2)
  - ➢ Equivalent to the kinetic energy of a B727 (80tons) at the speed 312km/hr ➔ 193mi/hr
- First 7TeV collisions on 3/30/10 ➔ The highest energy humans ever achieved!!

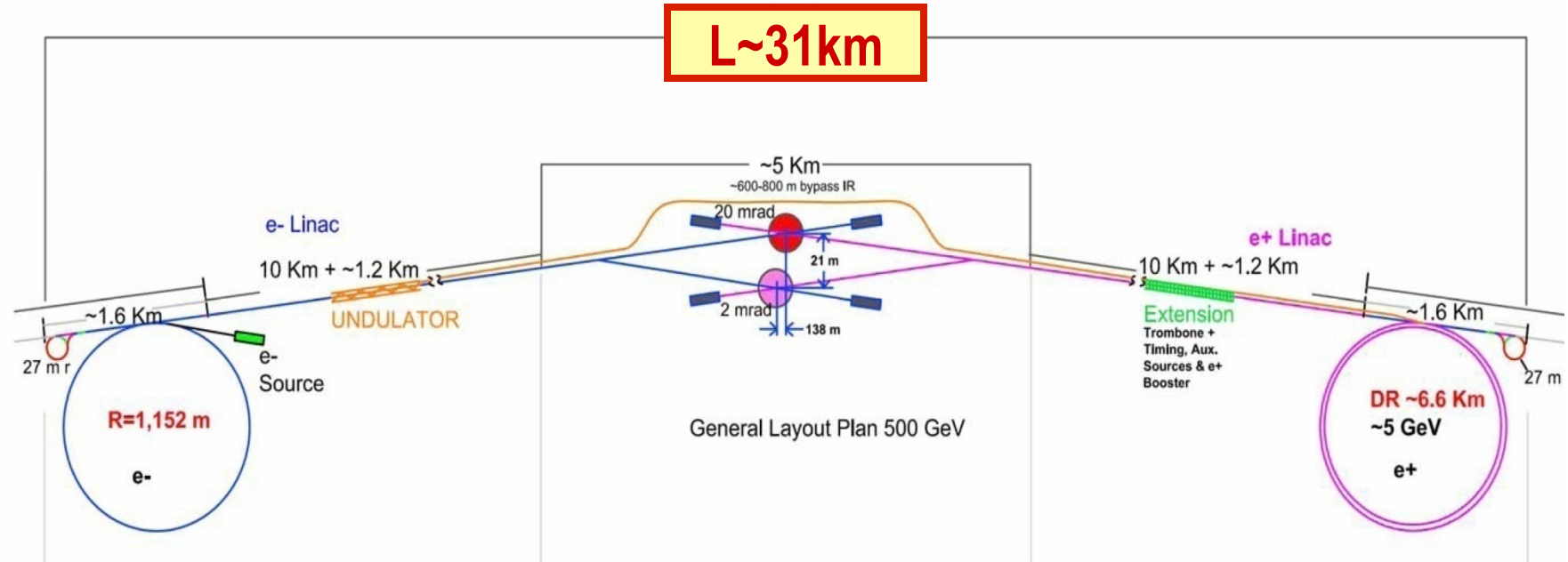




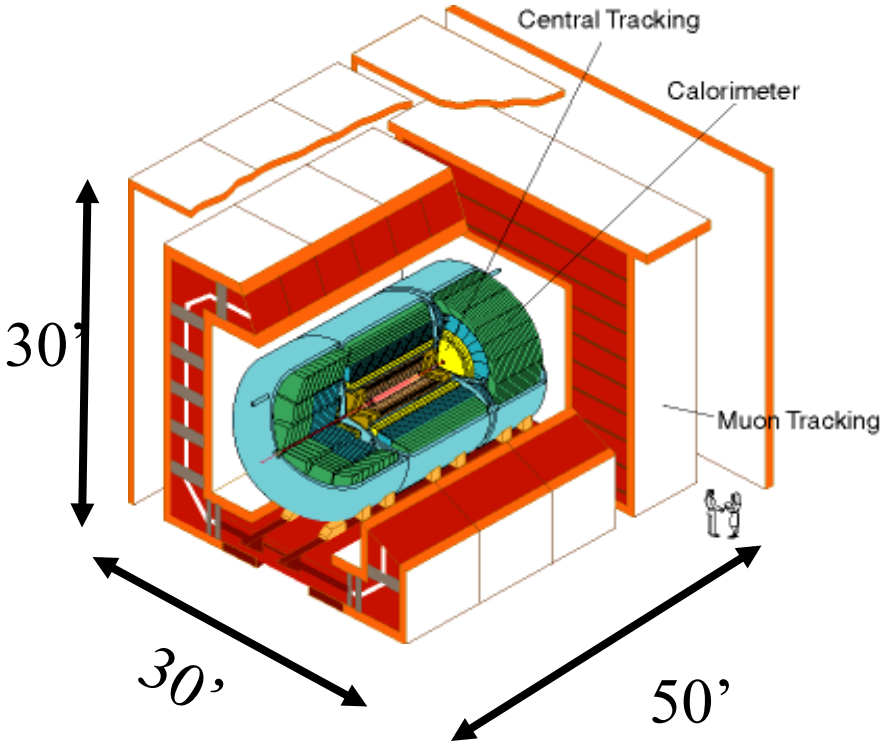
LHC @ CERN Aerial View

The International Linear Collider

- An electron-positron collider on a straight line
- CMS Energy: 0.5 – 1 TeV
- 10~15 years from now
- Takes 10 years to build the accelerator and the detector

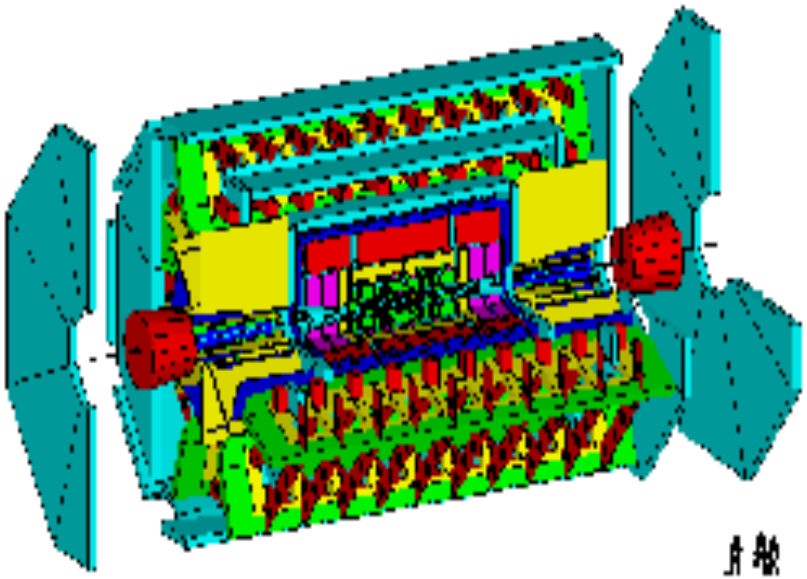


DØ Detector



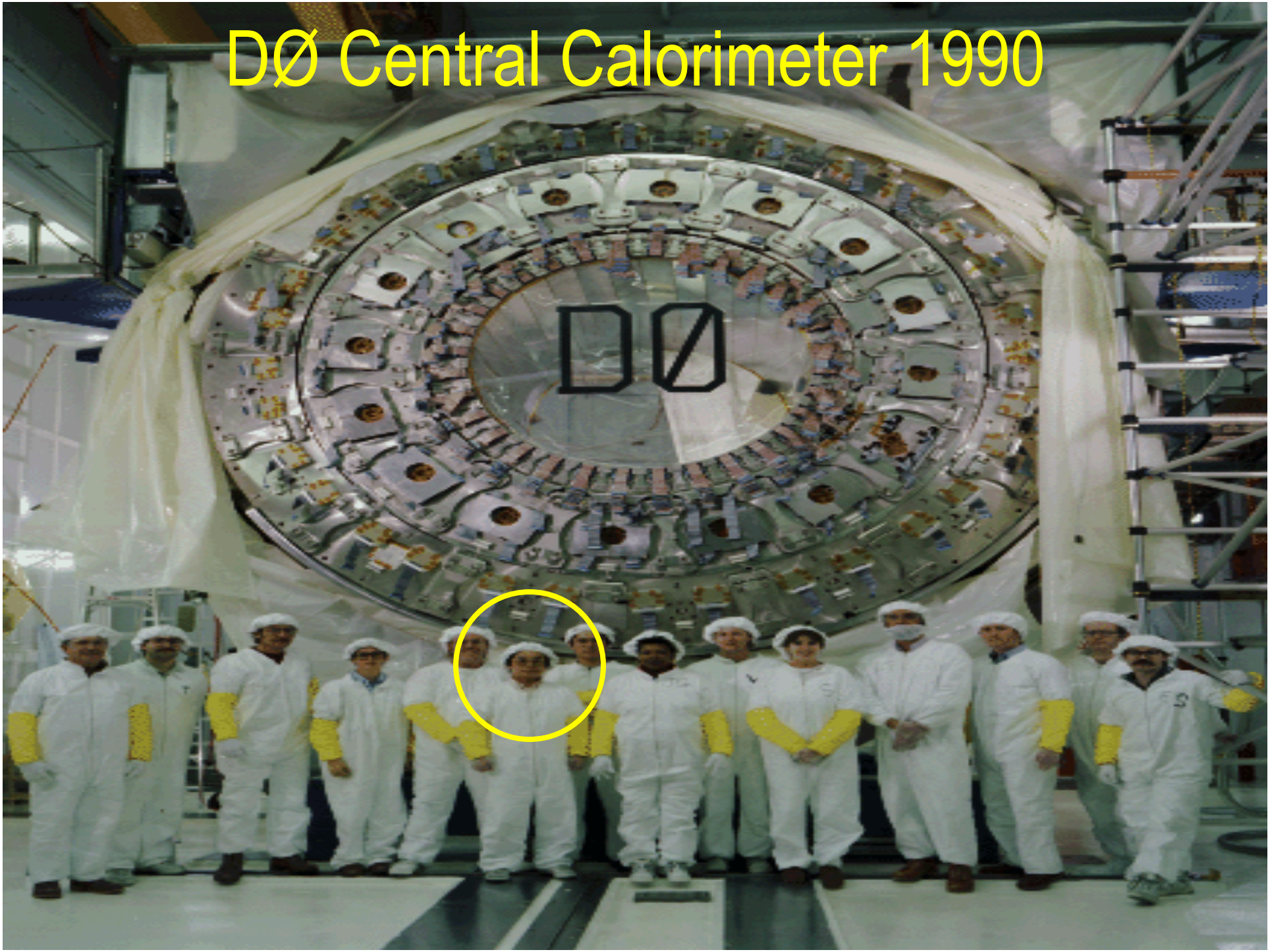
- **Weighs 5000 tons and 5 story tall**
- Can inspect **3,000,000** collisions/second
- Record **100 collisions/second**
- Records approximately **10,000,000** bytes/second
- Records **0.5×10^{15}** (500,000,000,000,000) bytes per year (0.5 PetaBytes).

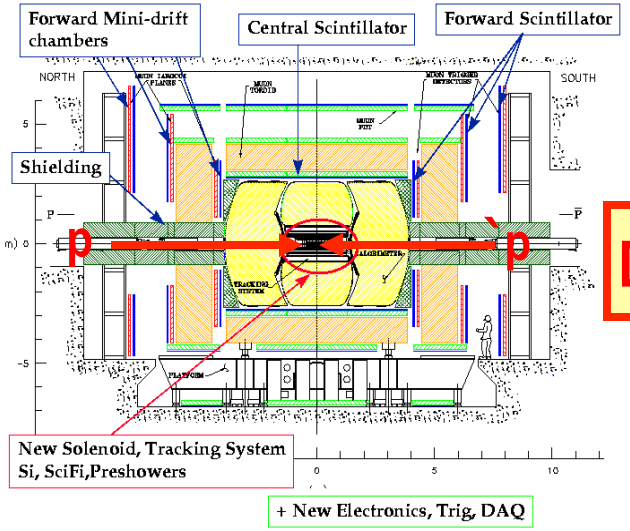
ATLAS Detector



- **Weighs 7000 tons and 10 story tall**
- Can inspect **1,000,000,000** collisions/second
- Records **200 – 400 collisions/second**
- Records approximately **350,000,000** bytes/ second
- Will record **2×10^{15}** (2,000,000,000,000,000) bytes each year (2 PetaByte).

DØ Central Calorimeter 1990

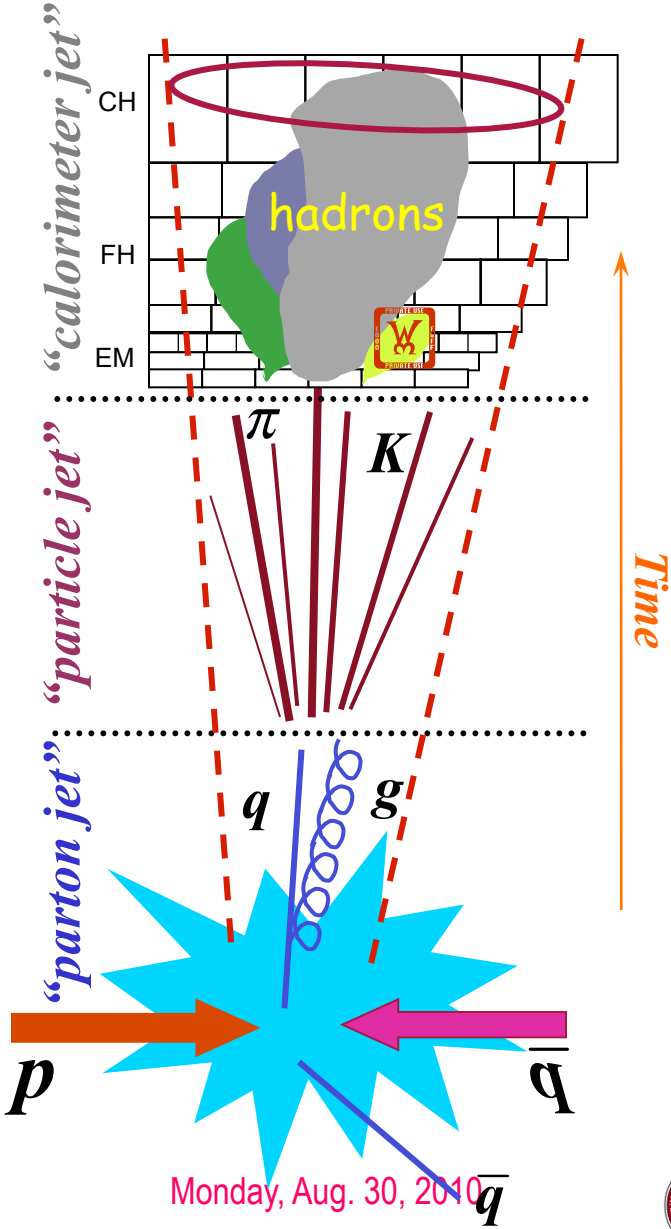


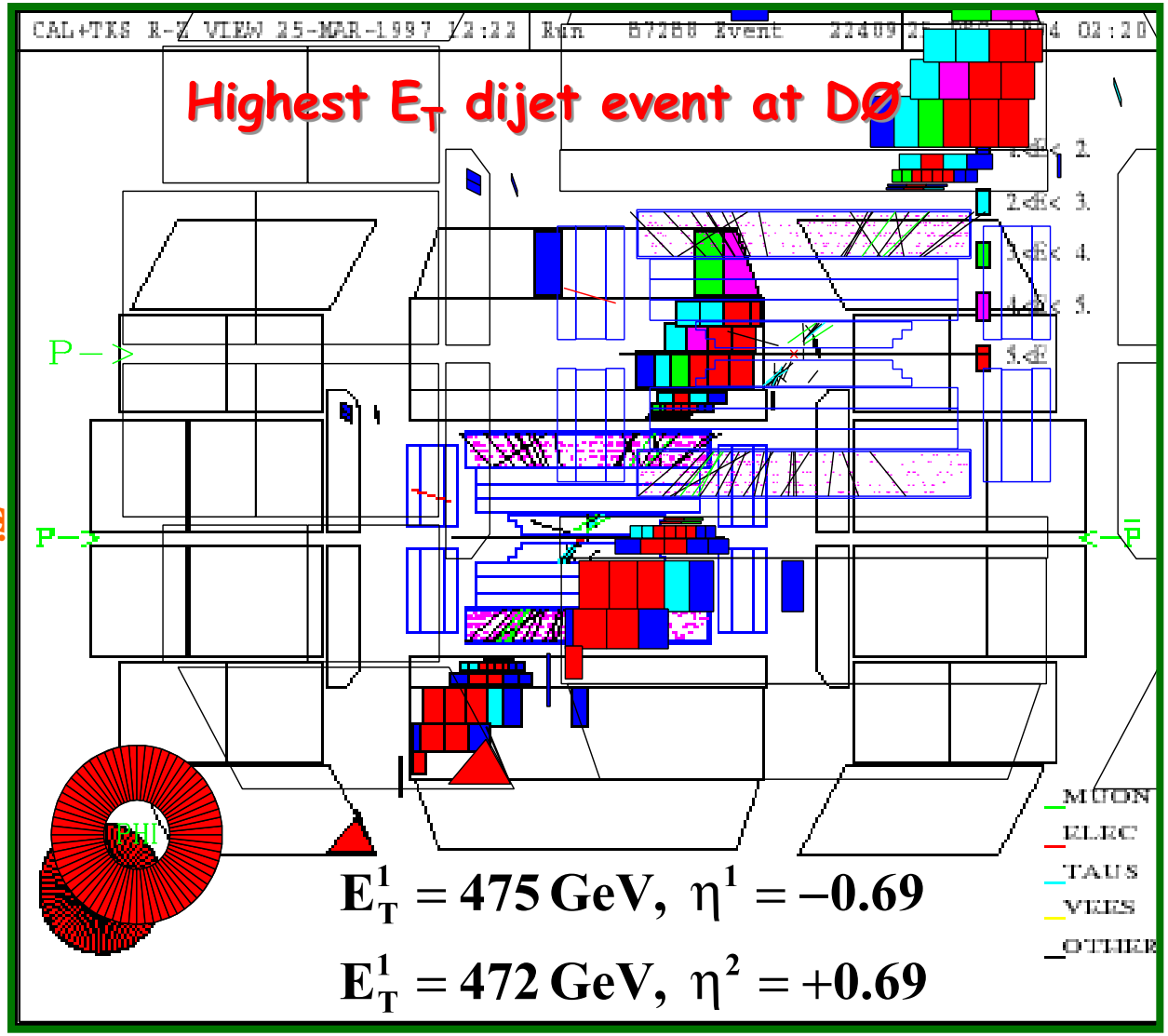


Digital data

Data Reconstruction

How does an Event Look in a Collider Detector?





Information & Communication Sources

- My web page: http://www-hep.uta.edu/~yu/
  - Contact information & Class Schedule
  - Syllabus
  - Homework
  - Holidays and Exam days
  - Evaluation Policy
  - Class Style & Communication
  - Other information
- Primary communication tool is e-mail: Register for PHYS1441-002-FALL10 e-mail distribution list as soon possible ➔ Instructions available in Class style & Communication
  - 5 points extra credit if done by this Wednesday, Sept. 1
  - 3 points extra credit if done by this Friday, Sept. 3
- Office Hours: 2:30pm – 3:30pm, Mondays and Wednesdays or by appointment

Evaluation Policy

- Homework: 30%, single largest proportion!!
- Exams
  - Final Comprehensive Exam (12/13): 25%
  - One better of the two term Exams: 20%
    - Total of two non-comprehensive term exams (9/22 and 11/3)
    - One better of the two exams will be used for the final grade
  - Missing an exam is not permissible unless pre-approved
    - No makeup test
    - You will get an F if you miss any of the exams without a prior approval
- Lab score: 15%
- Pop-quizzes: 10%

100%

- Extra credits: 10% of the total
- Grading will be done on a sliding scale

Homeworks

- Solving homework problems is the only way to comprehend class material
- An electronic homework system has been setup for you
  - Details are in the material distributed today and on the class web page
  - Student hw page link: https://quest.cns.utexas.edu/student/
  - Download homework #1 (1 problem), attempt to solve it, and submit it ➔ You will receive a 100% credit for HW#1 (Due 9pm Tuesday, Sept. 7)
  - Register as soon as possible
  - Roster will close Thursday, Sept. 2
  - Warning: You will get points deducted if you input incorrect answers
    - For multiple choice problems, you could get negative points if you try too many times
- Each homework carries the same weight
- **ALL** homework grades will be used for the final grade
- Home work will constitute **30% of the total** ➔ A good way of keeping your grades high
- Strongly encouraged to collaborate ➔ Does not mean you can copy

Attendance and Class Style

- Attendance:
  - Will be taken randomly
  - Will be used for extra credits
- Class style:
  - Lectures will be on electronic media
    - The lecture notes will be posted on the web **AFTER** each class
  - Will be mixed with traditional methods
  - Active participation through questions and discussions are **STRONGLY** encouraged ➔ Extra credit….
  - Communication between you and me is extremely important
    - If you have problems, please do not hesitate talking to me

Lab and Physics Clinic

- Physics Labs:
  - Begins Monday, Sept. 13
  - Important to understand physical principles through experiments
  - 15% of the grade
- Physics Clinic:
  - Free service
  - They provide general help on physics, including help solving homework problems
    - Do not expect solutions of the problem from them
    - Do not expect them to tell you whether your answers are correct
    - It is your responsibility to make sure that you have done everything correctly
  - 11am – 6pm, Mon – Fri and 12 – 6pm Sat.,
  - SH 007

Extra credit

- 10% addition to the total
  - Could boost a B to A, C to B or D to C
- What constitute for extra credit?
  - Random attendances
  - Physics department colloquium participation
  - Strong participation in the class discussions
  - Special projects
  - Watch the valid planetarium shows
  - Many other opportunities

Valid Planetarium Shows

- Regular running shows
  - Stars of Pharaohs
  - Wonders of the Universe
- Shows that need special arrangements
  - The Black Hole
  - Violent Universe
  - Two small pieces of glass
  - Sophia
- How to submit for extra credit?
  - Obtain the ticket stub that is signed and dated by the planetarium star lecturer of the day
  - Collect the ticket stubs
  - Tape all of them on a sheet of paper with your name and ID written on it
  - Submit the sheet at the end of the semester when asked

What can you expect from this class?

- All A's?
  - This would be really nice, wouldn't it?
  - But if it is too easy it is not fulfilling or meaningful….
- This class is not going to be a stroll in the park!!
- You will earn your grade in this class.
  - You will need to put in sufficient time and sincere efforts
  - Exams and quizzes will be tough!!
    - Sometimes problems might not look exactly like what you learned in the class
    - Just putting the right answer in free response problems does not work!
- But you have a great control of your grade in your hands
  - Homework is 30% of the total grade!!
    - Means you will have many homework problems
      - Sometimes much more than any other classes
      - Sometimes homework problems will be something that you have yet to learn in class
  - Lab 15%
  - Extra credit 10%
- I will work with you so that your efforts are properly awarded

What do we want to learn in this class?

- Physics is everywhere around you.
- Understand the fundamental principles of nature
- Identify what laws of physics applies to what phenomena and use them appropriately
- Understand the impact of such physical laws
- Learn how to research and analyze what you observe.
- Learn how to express observations and measurements in mathematical language
- Learn how to express your research in systematic manner in writing
- I don't want you to be scared of PHYSICS!!!

Most importantly, let us have a lot of FUN!!

Why do Physics?

Exp.
- To understand nature through experimental observations and measurements

Theory
- Establish limited number of fundamental laws, usually with mathematical expressions
- Predict the nature's course

⇒Theory and Experiment work hand-in-hand

⇒Theory works generally under restricted conditions

⇒Experiments verifies the theory

⇒Discrepancies between experimental measurements and theory are good for improvements

⇒Improves our everyday lives but some of these laws can take a while till we see them amongst us