

PHYS 1444 – Section 003

Lecture #1

Thursday, Aug. 25, 2011

Dr. Jaehoon Yu

- Who am I?
- How is this class organized?
- What is Physics?
- What do we want from this class?
- Brief history of physics
- Some basics ...
- Chapter 21
 - Static Electricity and Charge Conservation
 - Charges in Atom

Today's homework is homework #1, due 10pm, coming Tuesday!!

Thursday, Aug. 25, 2011



PHYS 1444-003, Fall 2011 Dr. Jaehoon Yu

Announcements

- Plea to you: Please turn off your cell-phones, pagers and computers in the class
- Reading assignment #1: Read and follow through all sections in appendix A by Tuesday, Aug. 30
 - A-1 through A-7
- There will be a quiz on this and Ch. 21 on Thursday, Sept. 1.



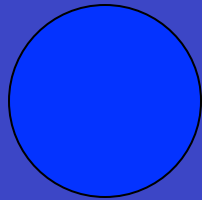
Who am I?

- 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 Particle 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
 - Forces between the constituents (gravitational, electro-magnetic, weak and strong forces)
 - Origin of Mass
 - Creation of Universe (**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
 - Why do we do with this?
 - Make our everyday lives better

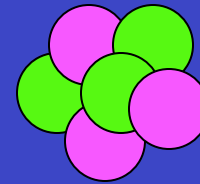


Accelerators are Powerful Microscopes.

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



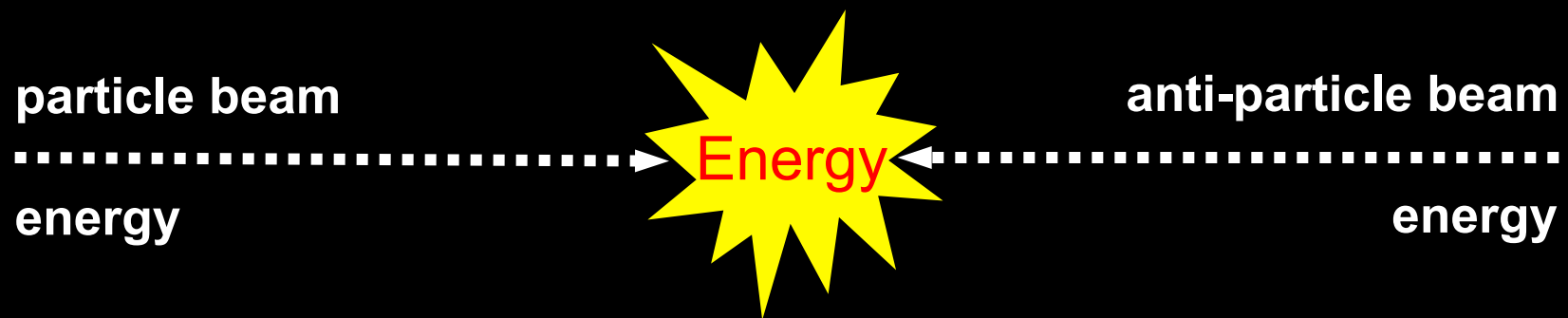
seen by
low energy beam
(poorer resolution)



seen by
high energy beam
(better resolution)

Accelerators are also **Time Machines**.

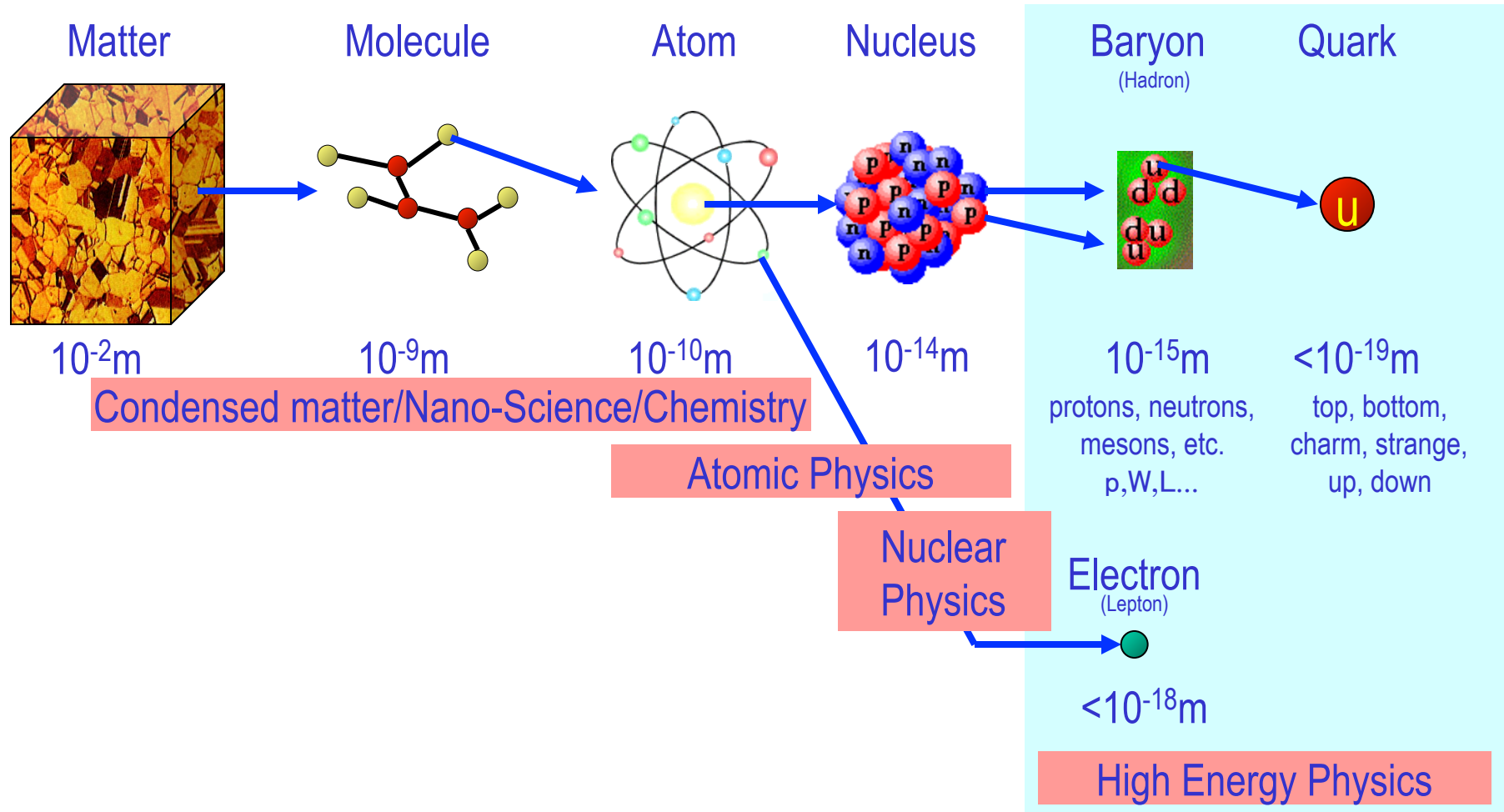
They make particles last seen
in the earliest moments of the universe.



Particle and anti-particle annihilate.

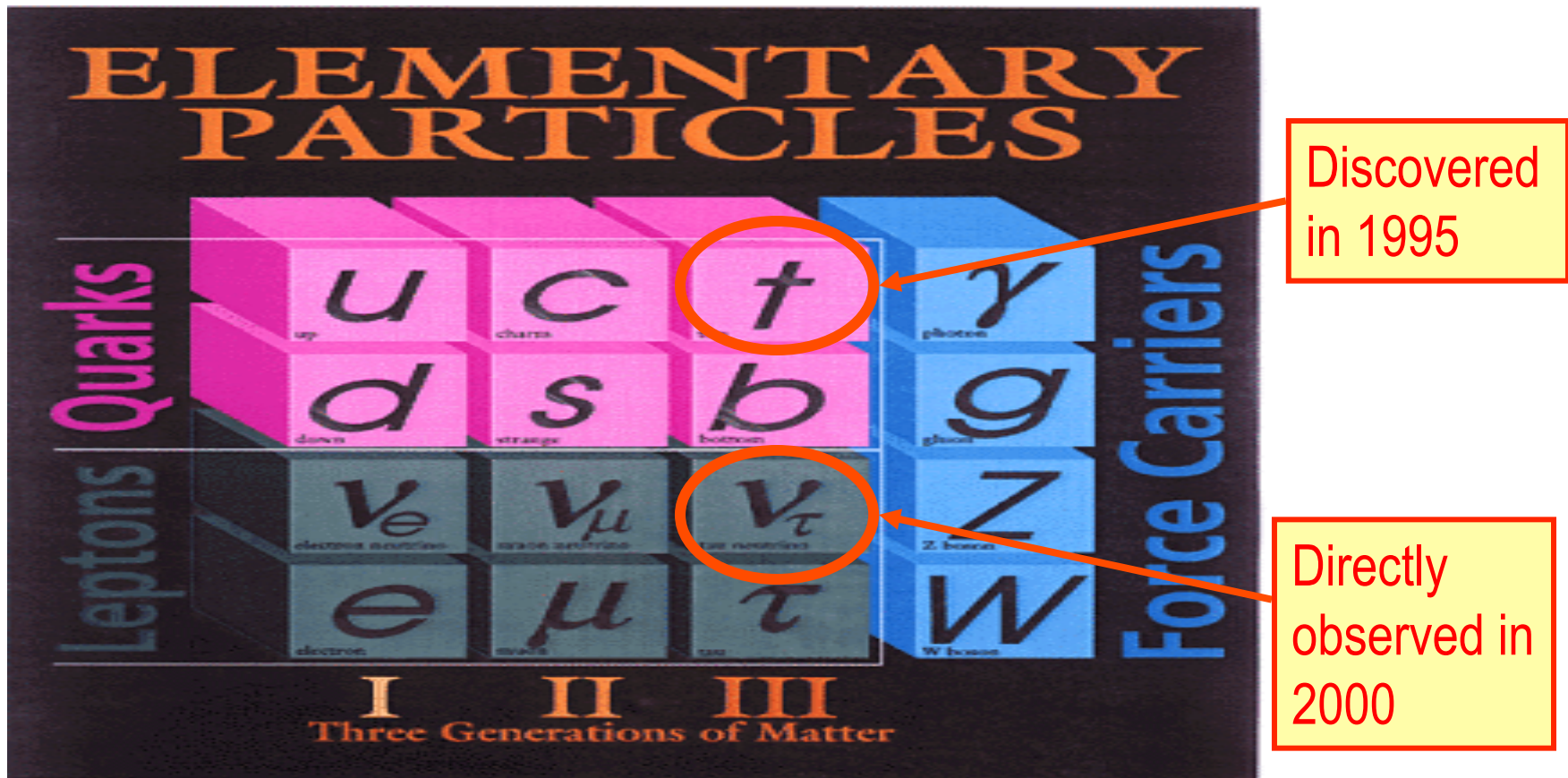
$$E = mc^2$$

Structure of Matter



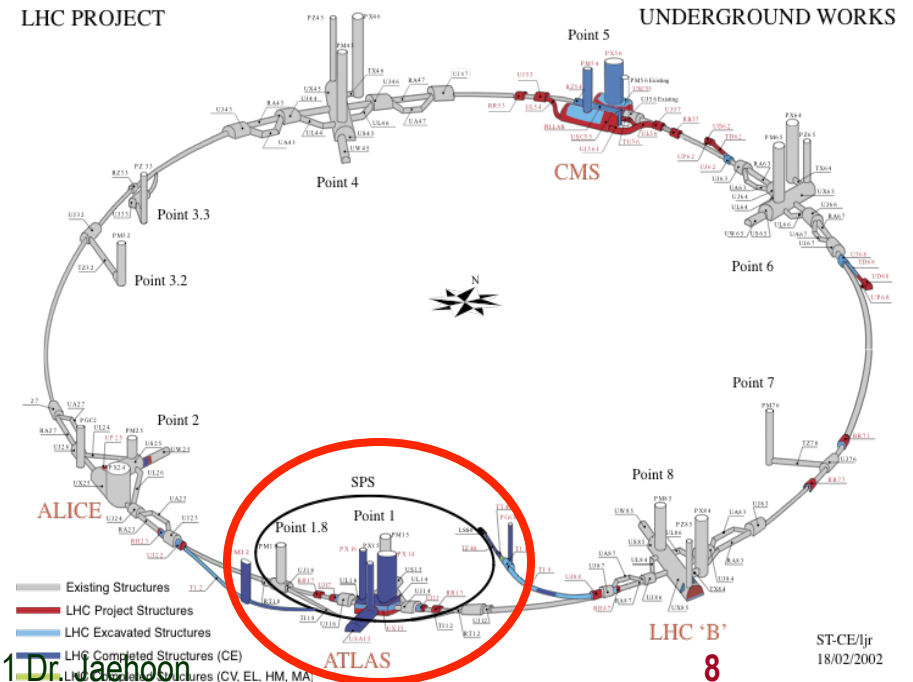
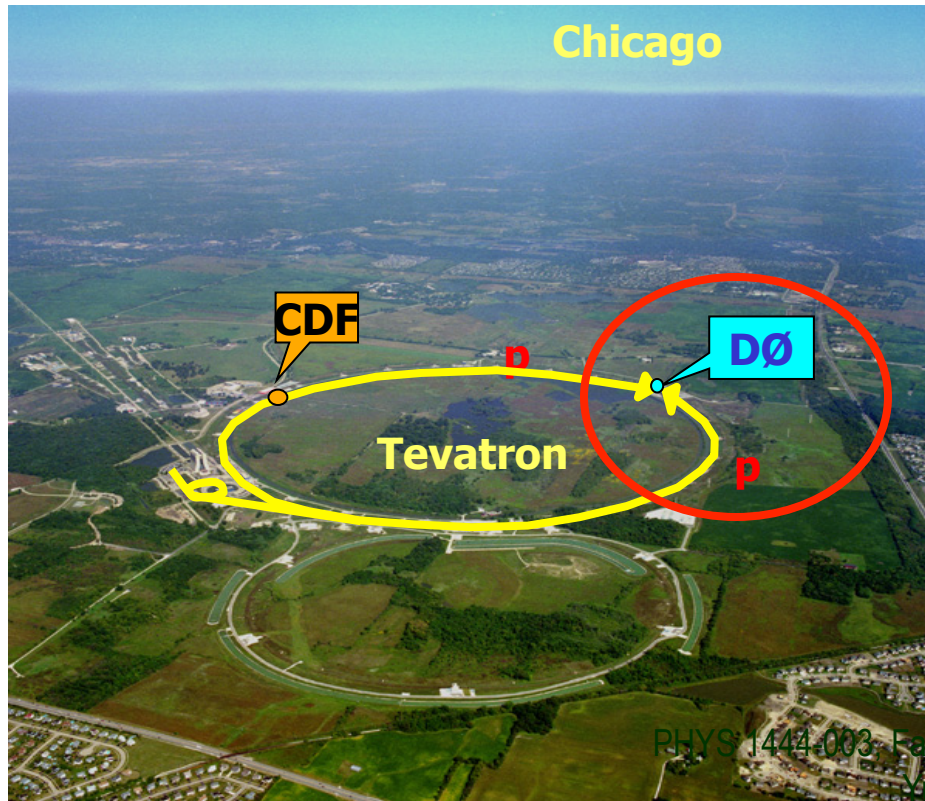
The Standard Model

- Assumes the following fundamental structure:



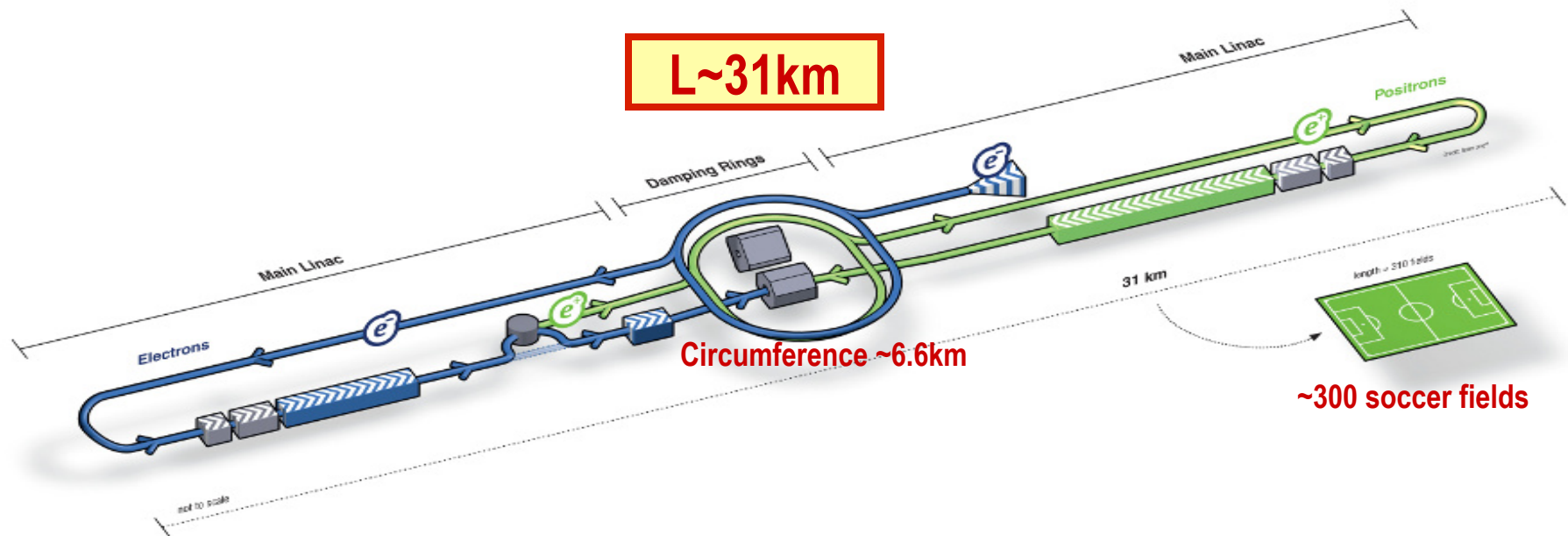
Fermilab Tevatron and LHC at CERN

- World's Highest Energy proton-anti-proton collider
 - 6km circumference
 - $E_{cm} = 1.96 \text{ TeV} (=6.3 \times 10^{-7} \text{ J/p} \rightarrow 13 \text{ M Joules on } 10^{-4} \text{ m}^2)$
 - Equivalent to the kinetic energy of a 20t truck at the speed 81mi/hr \rightarrow 130km/hr
 - $\sim 100,000$ times the energy density at ground 0 of the atom bomb dropped on Hiroshima
 - To be shut down Sept. 30, 2011**
- World's Highest Energy p-p collider
 - 27km circumference, 100m underground
 - Design $E_{cm} = 14 \text{ TeV} (=44 \times 10^{-7} \text{ J/p} \rightarrow 362 \text{ M Joules on the area less than } 10^{-4} \text{ m}^2)$
 - Equivalent to the kinetic energy of a B727 (80tons) at the speed 193mi/hr \rightarrow 312km/hr
 - $\sim 3 \text{ M}$ times the energy density at ground 0 of atom bomb dropped on Hiroshima
 - First 7TeV collisions on 3/30/10 \rightarrow The highest energy humans ever achieved!!

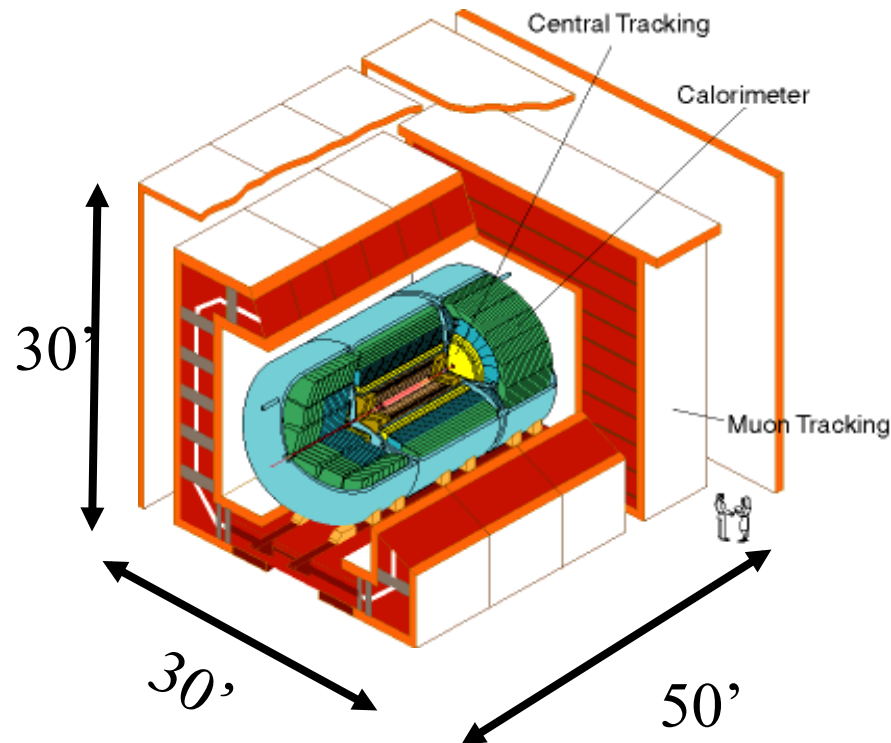


A Future Linear Collider

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



DØ Detector



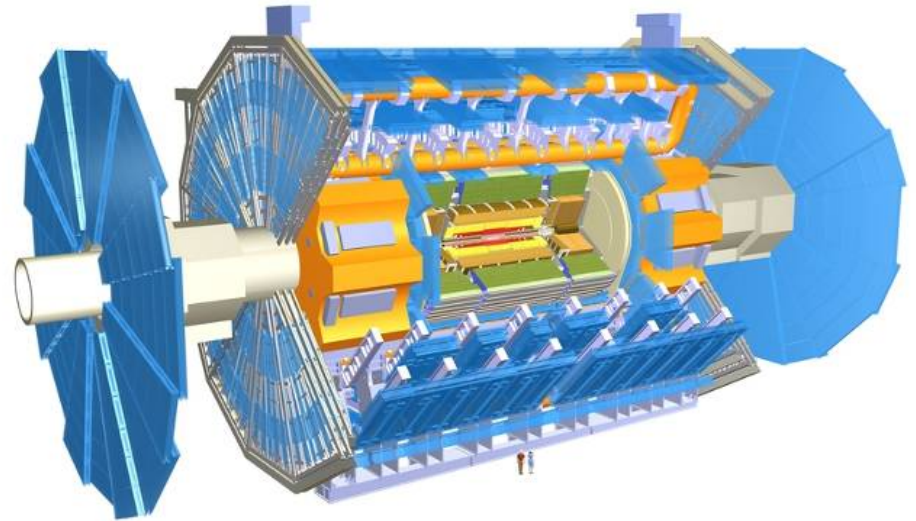
- **Weights 5000 tons and 5 story tall**
- Can inspect **3,000,000 collisions/second**
- Record **100 collisions/second**
- Records approximately **10,000,000 bytes/second**
- Records **0.5×10^{15}** (500,000,000,000,000) bytes per year (0.5 PetaBytes).

Thursday, Aug. 25, 2011



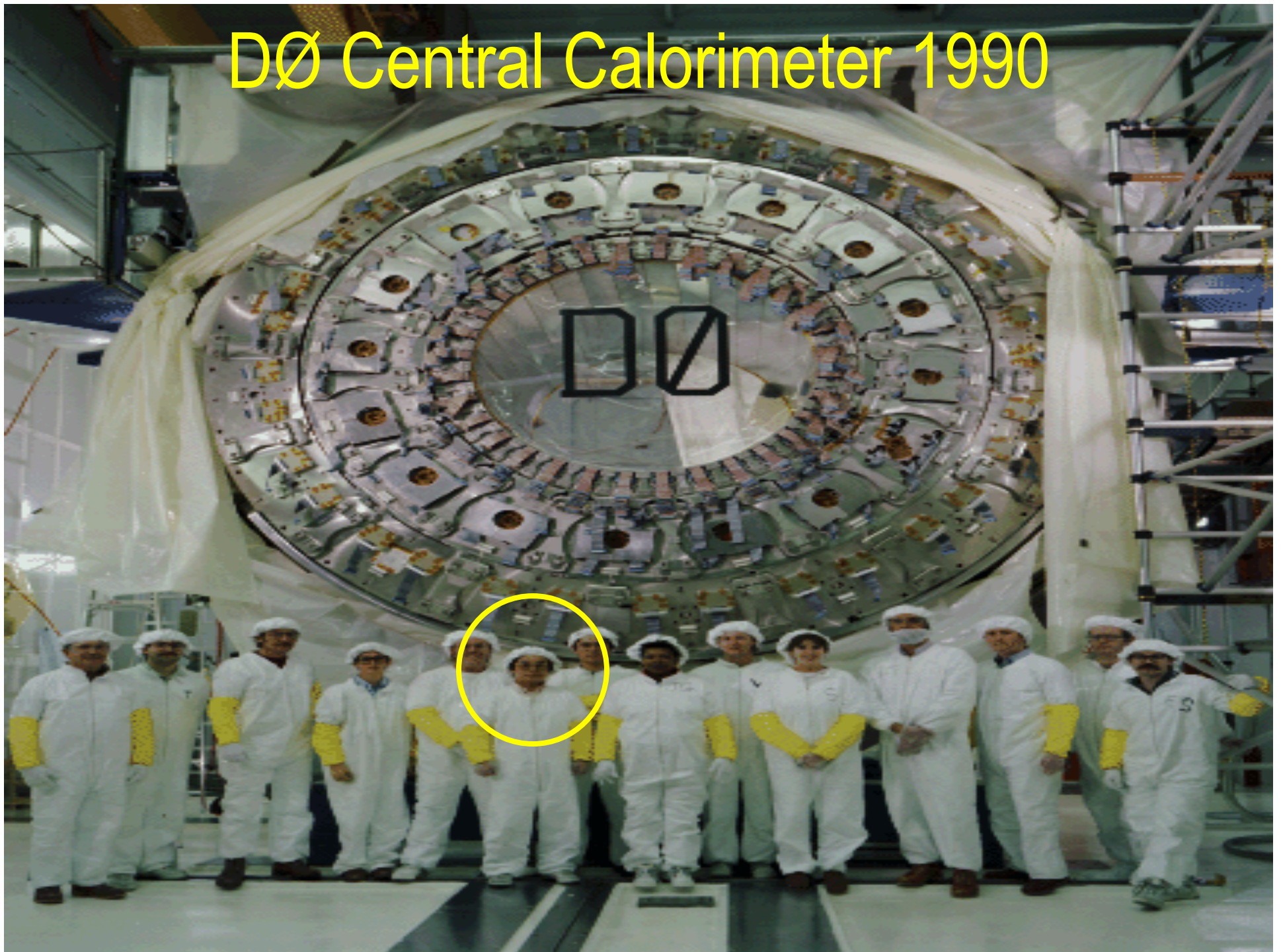
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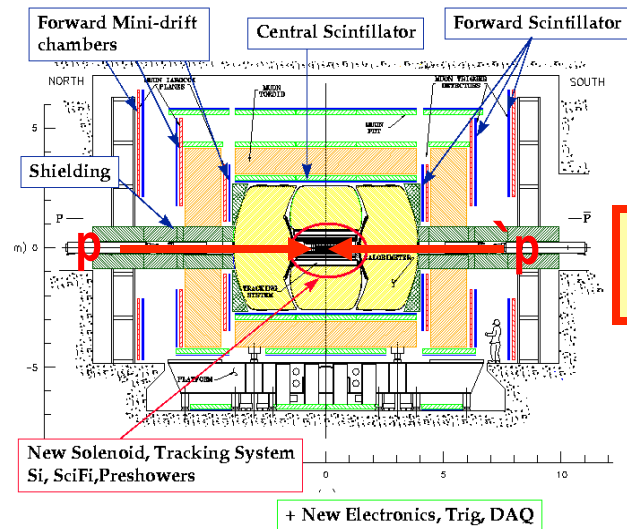
ATLAS Detector



- **Weights 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**
- Record **2×10^{15}** (2,000,000,000,000,000) bytes each year (2 PetaByte). → **200*Printed material of the US Lib. of Congress**

DØ Central Calorimeter 1990



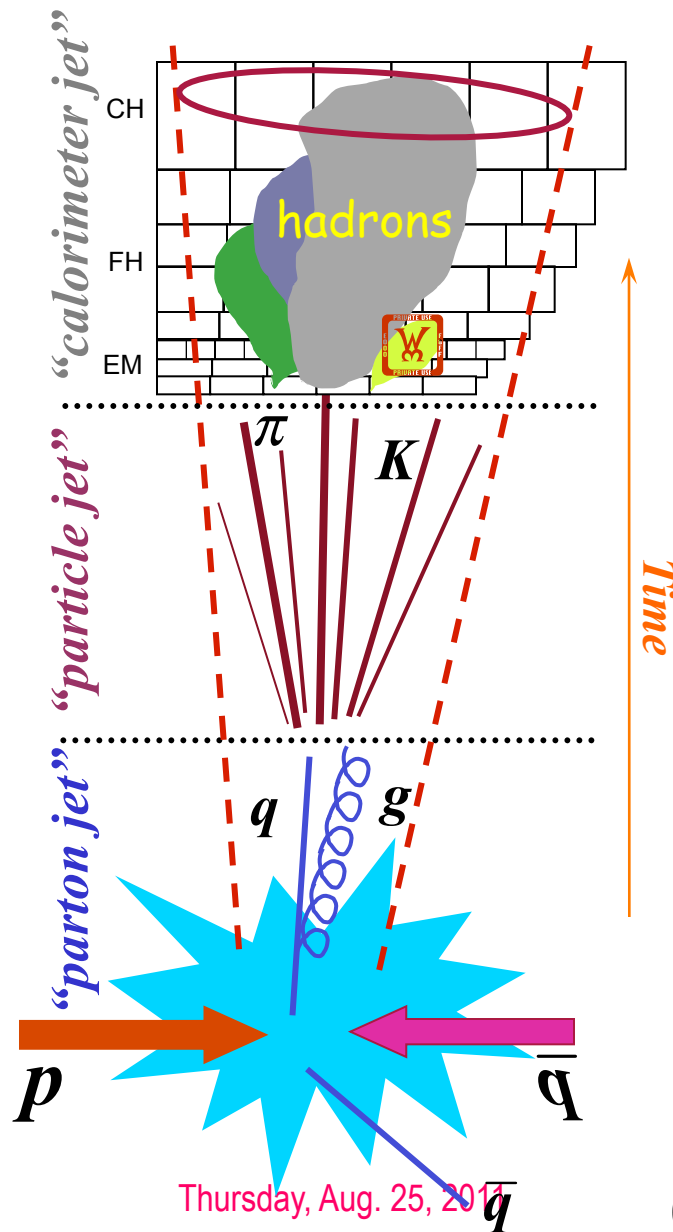


Digital data

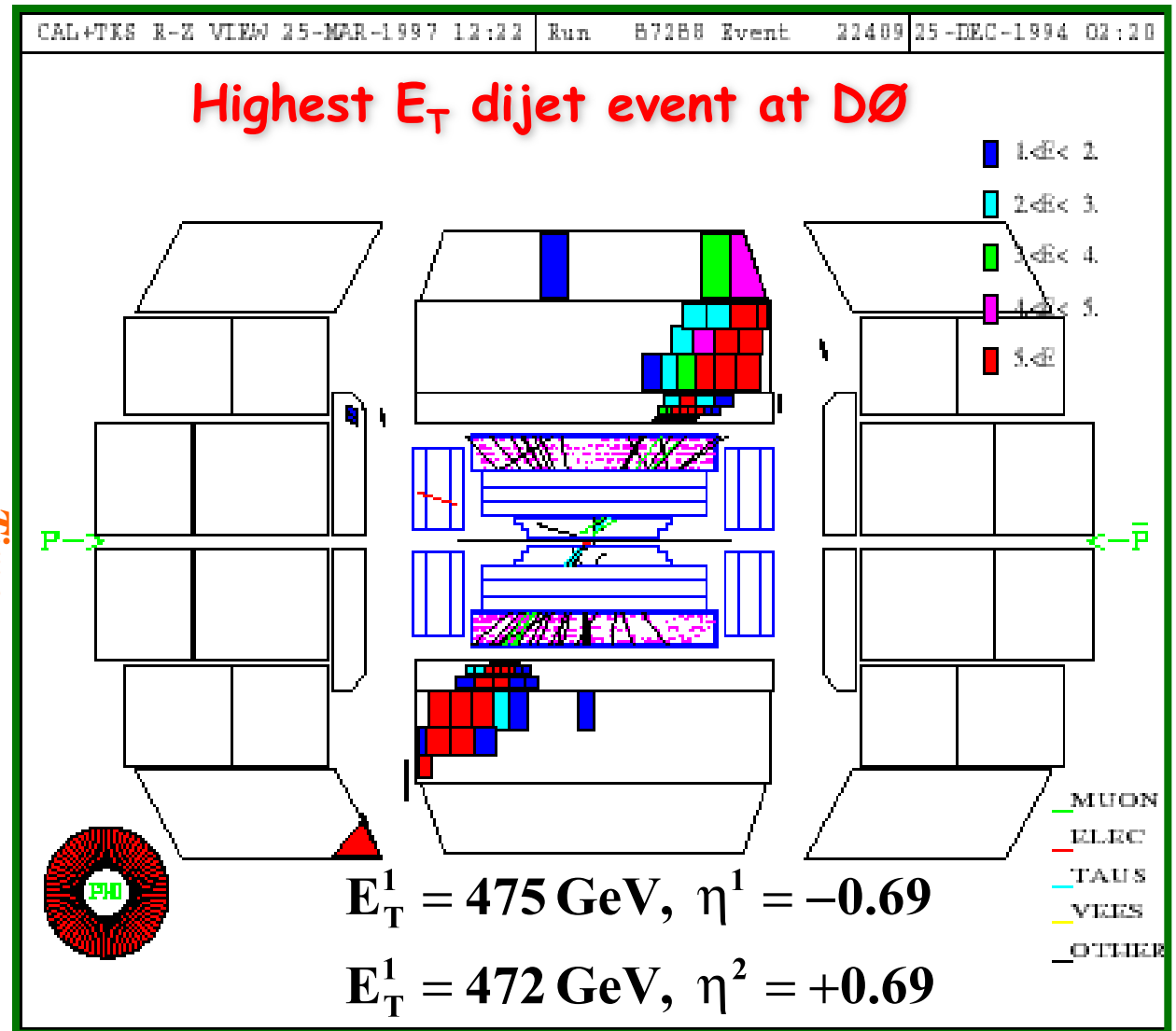


Data Reconstruction

How does an Event Look in a Collider Detector?

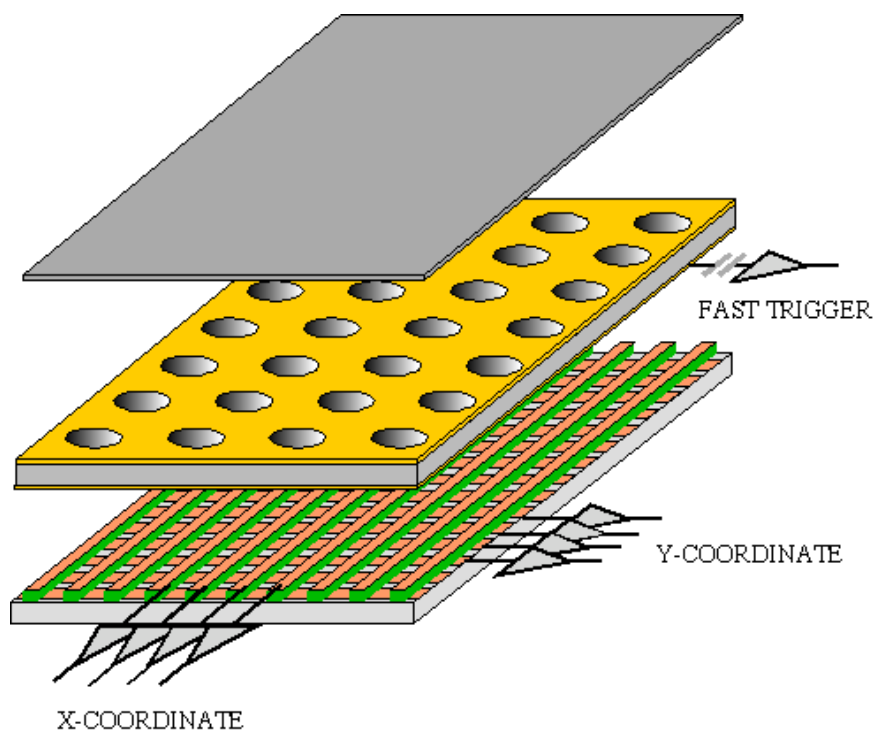


Thursday, Aug. 25, 2011

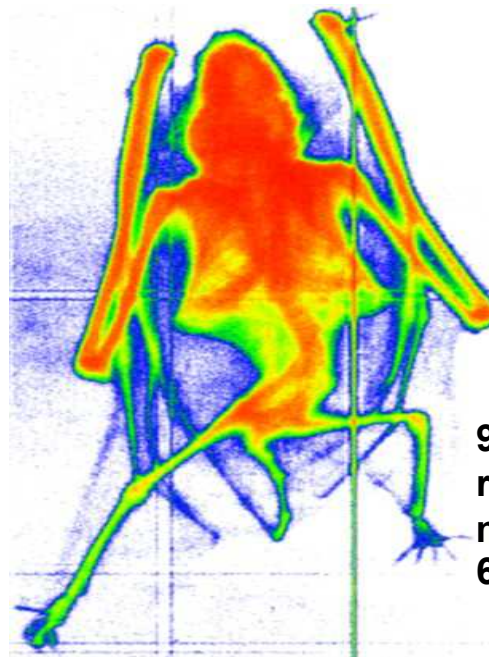


GEM Application Potential

Using the lower GEM signal, the readout can be self-triggered with energy discrimination:



FAST X-RAY IMAGING



9 keV absorption radiography of a small mammal (image size ~ 60 x 30 mm²)



A. Bressan et al,
Nucl. Instr. and Meth. A 425(1999)254
F. Sauli, *Nucl. Instr. and Meth.A* 461(2001)47

Thursday, Aug. 25, 2011



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Information & Communication Source

- 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: Make sure that your e-mail address at the time of the registration is your most favorite primary one.
 - Will send a test message this afternoon.
 - Please reply just to “me” for confirmation of the communication.
 - 3 point extra credit if done just to ME by 11pm Friday, tomorrow.
- Office Hours: 2:00 – 3:00pm, Tuesdays and Thursdays or by appointments



Evaluation Policy

- Homework: 25%
- Exams
 - Midterm and Final Comprehensive Exams (10/20 and 12/15): 19% each
 - One better of the two term Exams: 12%
 - Total of two non-comprehensive term exams (9/29 and 11/22)
 - 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%
- Extra credits: 10% of the total
 - Random attendances
 - Physics department colloquium participation
 - Strong participation in the class discussions
 - Special projects
 - Planetarium shows and Other many opportunities
- Grading will be done on a sliding scale

100%



Homework

- 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 web
 - <https://quest.cns.utexas.edu/student/courses/list>
 - Choose the course PHYS1444-003, unique number 44003
 - [Download homework #1, solve the problems and submit them online](#)
 - [Multiple unsuccessful tries will deduct points](#)
 - Roster will close Tuesday, Aug. 30
 - You need a UT e-ID: Go and apply at the URL https://idmanager.its.utexas.edu/eid_self_help/?createEID&qwicap-page-id=EA027EFF7E2DA39E if you don't have one.
- Each homework carries the same weight
- **ALL** homework grades will be used for the final grade
- Home work will constitute **25% of the total** → A good way of keeping your grades high
- Strongly encouraged to collaborate → Does not mean you can copy



Attendances and Class Style

- Attendances:
 - 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:
 - Starts Tuesday, Sept. 6
 - Important to understand physical principles through experiments
 - 15% of the grade
 - Lab syllabus is available in your assigned lab rooms.
 - Go by the lab room between 8am - 6pm M – F and pick up the syllabus
- 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. in SH 007
 - This service begins Thursday, Sept. 1
- Addition help: Supplemental Instruction: Husain Lohawala
 - 2:30 – 3:30pm, Mondays and Wednesdays in SH333

Thursday, Aug. 25, 2011



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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
 - Some will be double or triple credit (
 - Strong participation in the class discussions
 - Special projects
 - Watch the valid planetarium shows
 - Many other opportunities



Valid Planetarium Shows

- Regular running shows
 - We are Astronomers
 - Nanocam: Trip into Biodiversity
- Shows that need special arrangements
 - Black Holes
 - Ice Worlds
 - Magnificent Sun
 - Stars of the Pharaohs
 - Time Space
 - Two Small Pieces of Glass
 - SOFIA
 - Violent Universe
- 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

Thursday, Aug. 25, 2011



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Yu

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 25% 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
 - Exam's problems will be easier than homework problems but same principles!!
 - Lab 15%
 - Extra credit 10%
- I will work with you so that your efforts are properly rewarded



What do we want to learn in this class?

- Physics is everywhere around you.
- Skills to understand the fundamental principles that surrounds you in everyday lives...
- Skills to identify what laws of physics applies to what phenomena and use them appropriately
- Understand the impact of physical laws and apply them
- Learn skills to think, research and analyze observations.
- Learn skills to express observations and measurements in mathematical language
- Learn skills to express your research in systematic manner in writing
- But most importantly the confidence in your physics ability and to take on any challenges laid in front of you!!

In this course, you will learn...

- Electricity and Magnetism
- Electric and Magnetic Forces
- Electric charge and magnetic poles
- Electric and magnetic potential and energies
- Propagation of electric and magnetic fields
- Relationship between electro-magnetic forces and light
- Behaviors of light and optics
- Special relativity and quantum theories



Brief History of Physics

- AD 18th century:
 - Newton's Classical Mechanics: A theory of mechanics based on observations and measurements
- AD 19th Century:
 - Electricity, Magnetism, and Thermodynamics
- Late AD 19th and early 20th century (Modern Physics Era)
 - Einstein's theory of relativity: Generalized theory of space, time, and energy (mechanics)
 - Quantum Mechanics: Theory of atomic phenomena
- Physics has come very far, very fast, and is still progressing, yet we've got a long way to go
 - What is matter made of?
 - How do matters get mass?
 - How and why do matters interact with each other?
 - How is universe created?

