PHYS 3446 – Lecture #1

Wednesday, Jan. 19, 2005

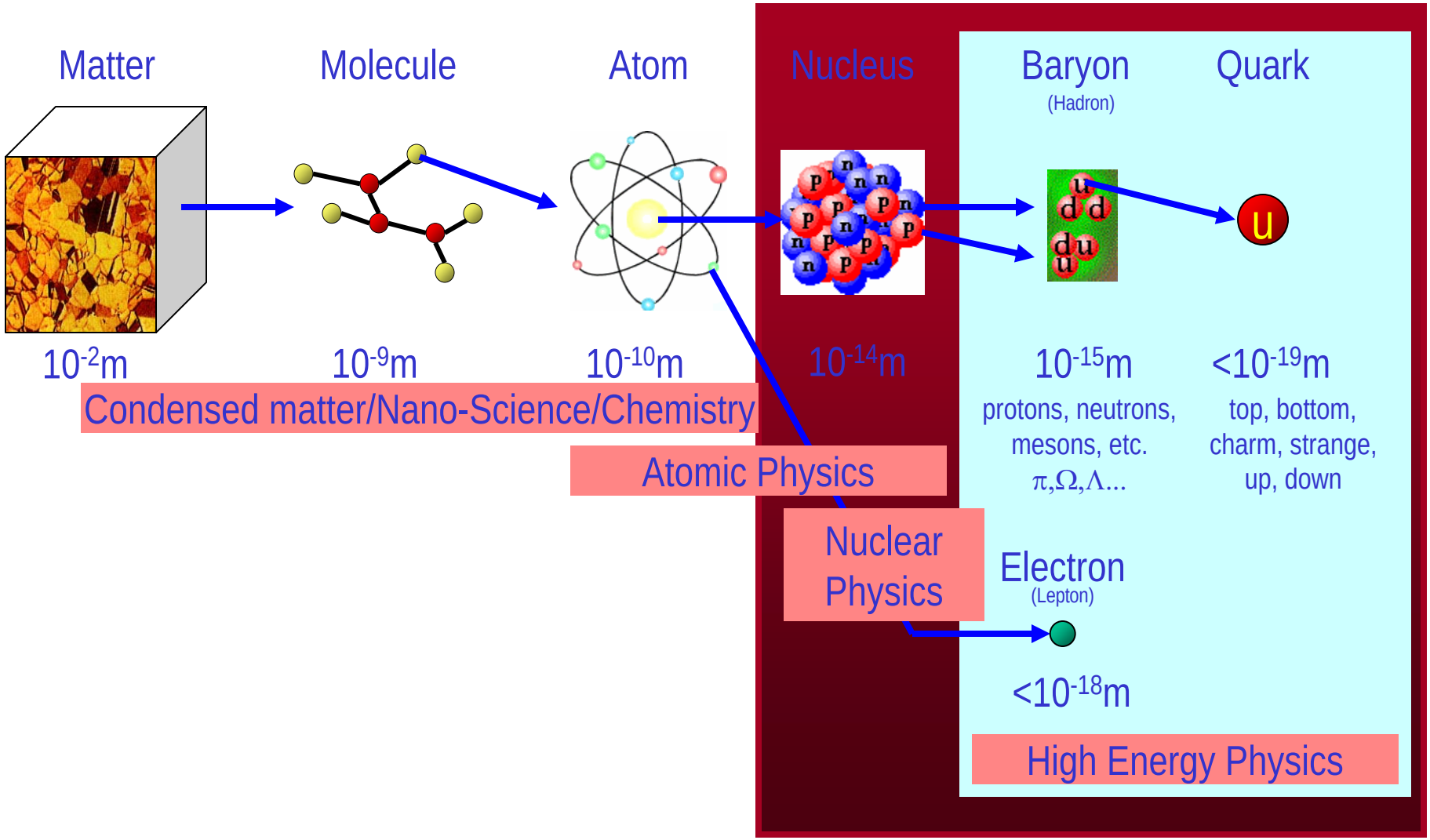
Dr. Jae Yu

1. Who am I?
2. Class time and location
3. Information and communication sources
4. Class specifications and style
5. Class plans
   - Syllabus
   - Semester projects
6. Lab
7. Evaluation Policy

Who am I?

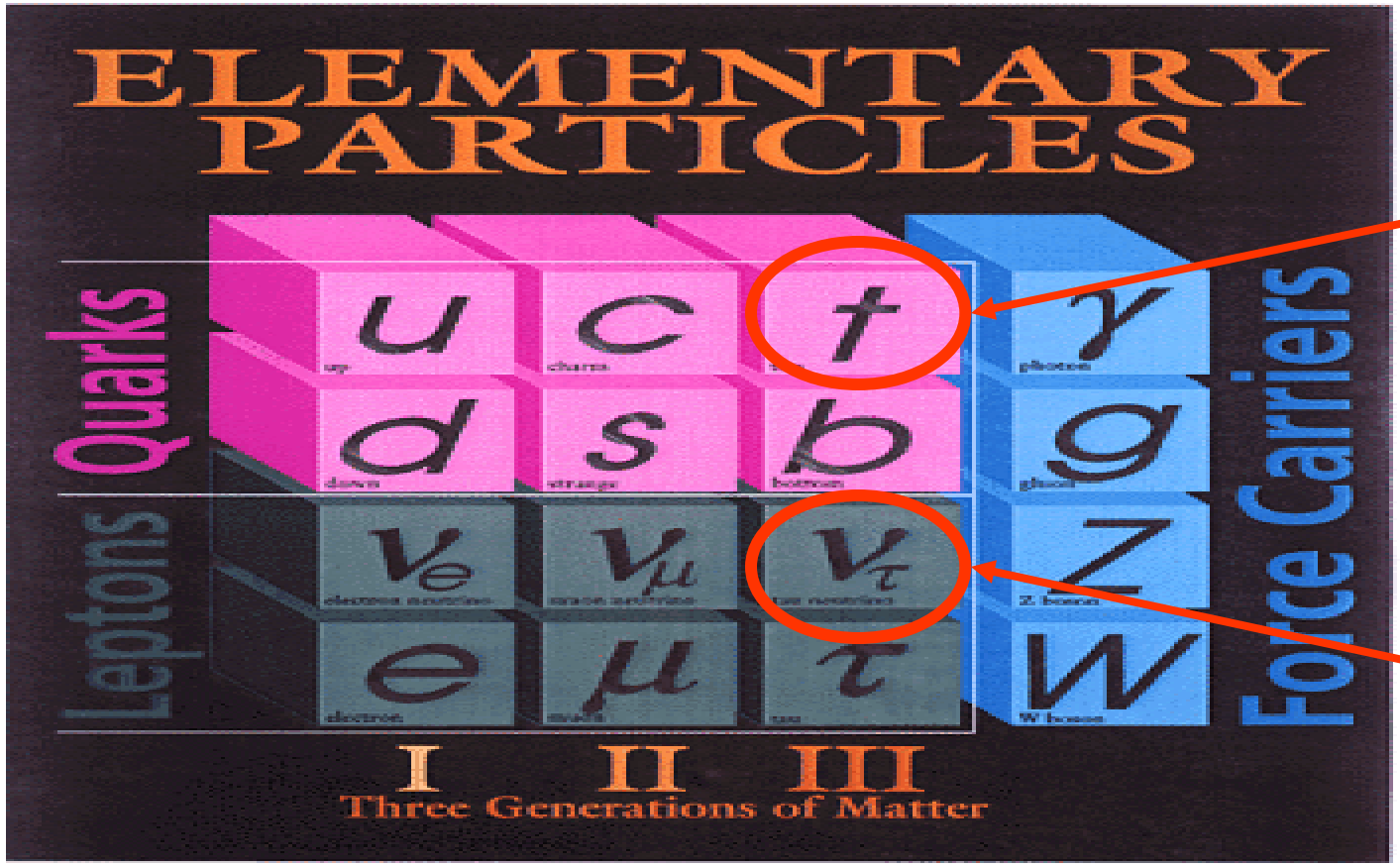
- Name: Dr. Jaehoon Yu (You can call me Dr. Yu)
- Office: Rm 242A, Science Hall
- Extension: x22814, E-mail: *jaehoonyu@uta.edu*
- My profession:High Energy Physics (HEP)
  - Collide particles (protons on anti-protons or electrons on anti-electrons, positrons) at the energies equivalent to 10,000 Trillion degrees
  - To understand
    - Fundamental constituents of matter
    - Interactions or forces between the constituents
    - Origin of Mass
    - Creation of Universe (**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 Standard Model

- Assumes the following fundamental structure:



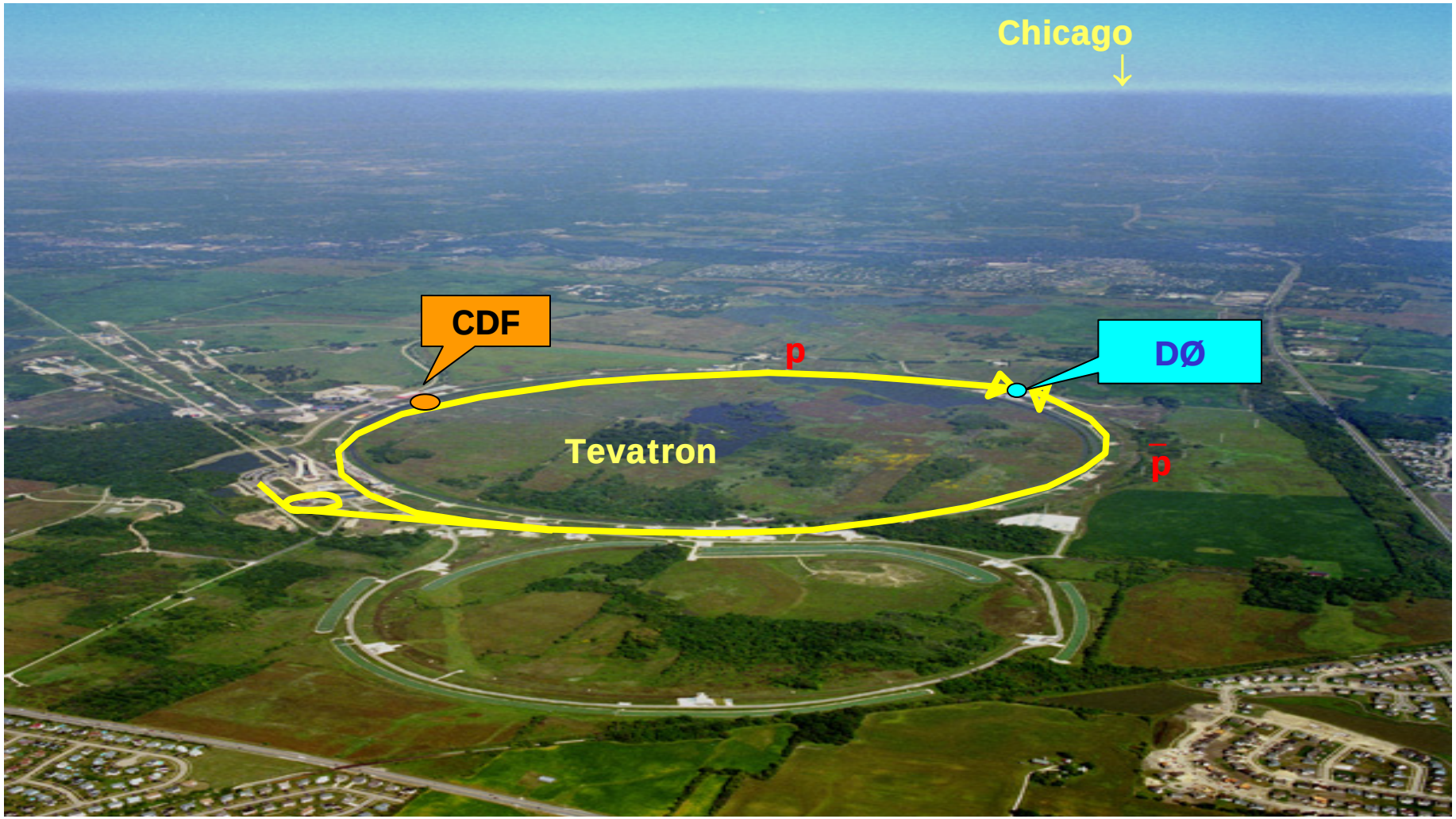
Discovered in 1995

Directly observed in 2000

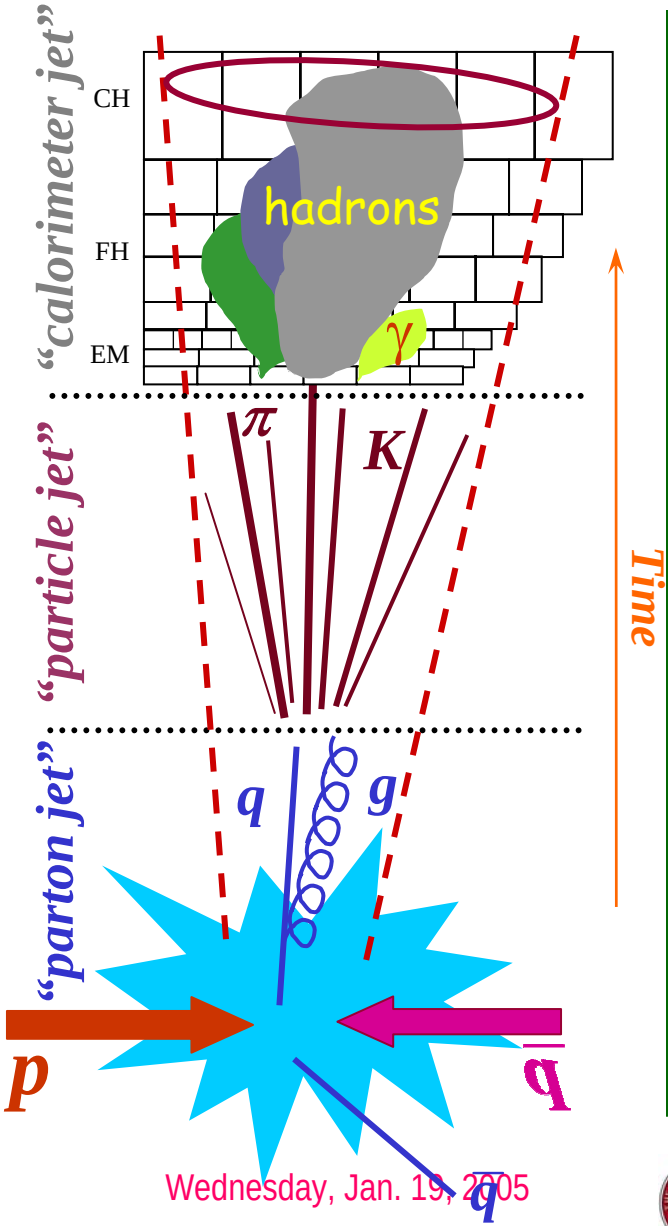
DØ Experiment at Fermilab Tevatron

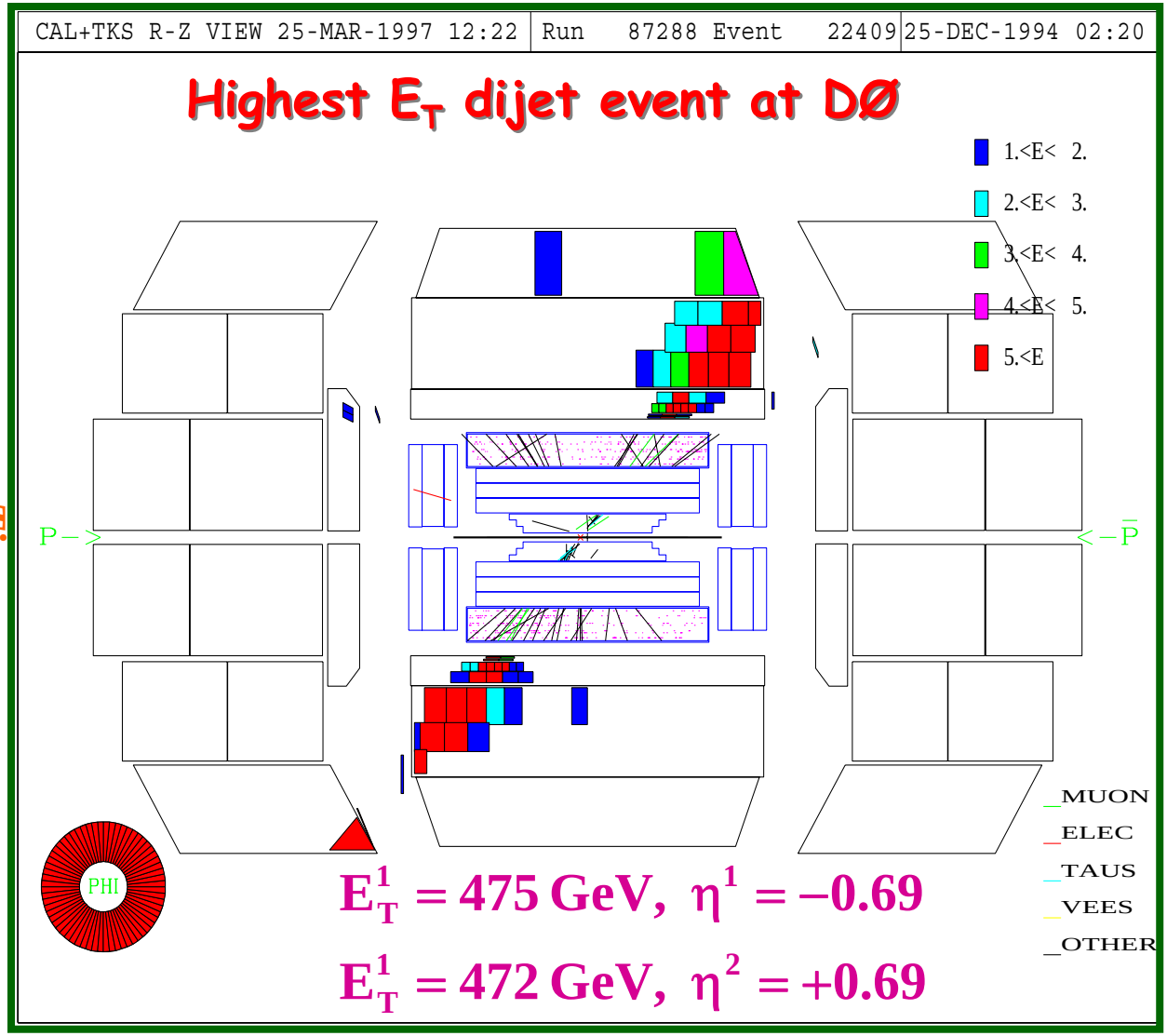
- World's Highest Energy proton-anti-proton collider
  - E_{cm}=1.96 TeV (=6.3x10^{-7}J/p➔ 13M Joules on $10^{-6}m^2$)

⇒Equivalent to the kinetic energy of a 20t truck at a speed 80 mi/hr



How does an Event Look in a Collider Detector?





Class Time and Location

- Current: 1:00 – 2:20pm, Mon & Wed, SH 125
- Proposal: 1:00 – 2:20pm, Mon & Wed, SH 200

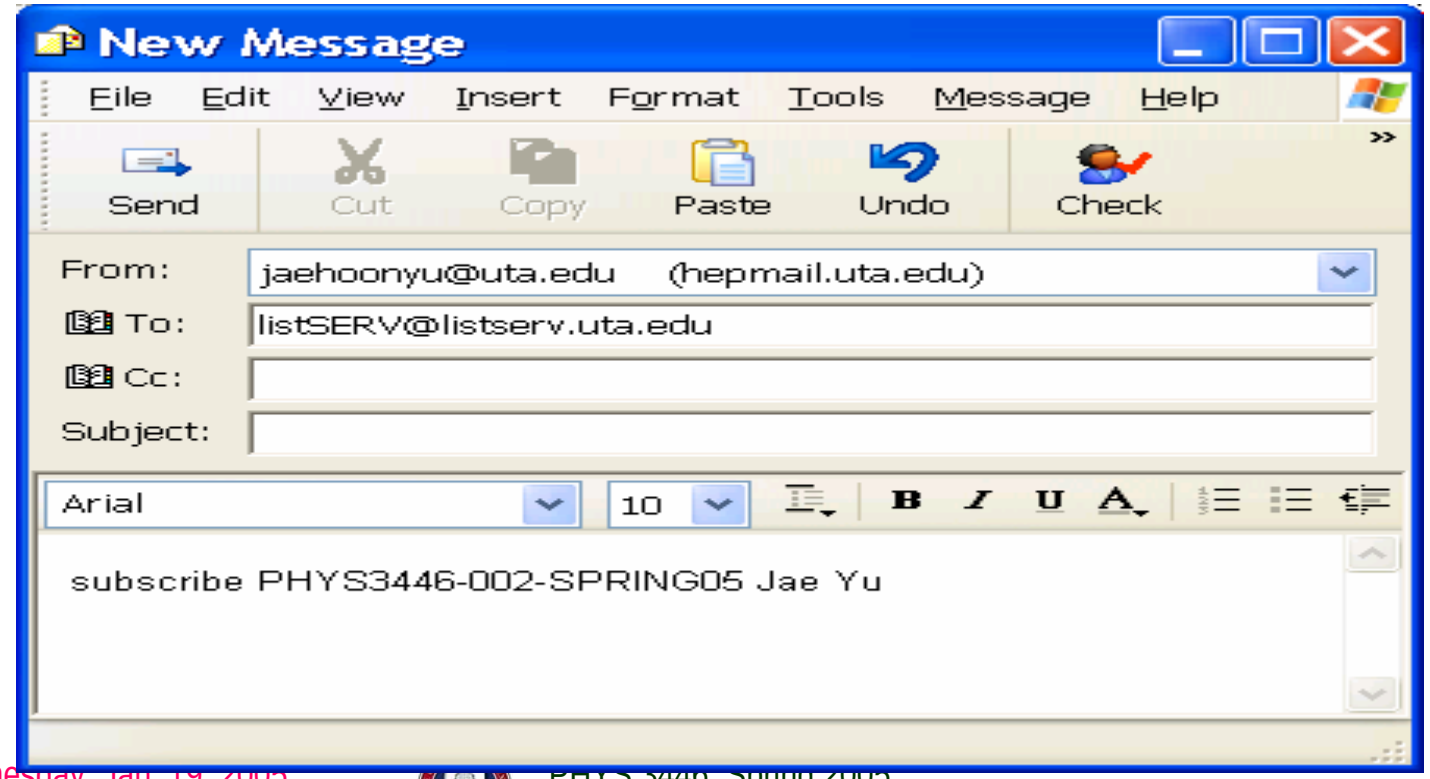
Information & Communication Source

- 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: Register for PHYS3446-002-SPRING05 e-mail distribution list as soon possible ➔ Instruction available in Class style & Communication
  - 5 points extra credit if done by next Monday, Jan. 24
  - 3 points extra credit if done by next Wednesday, Jan. 26
- Office Hours: 2:30 – 3:30pm, Mondays and Wednesdays or by appointments

How to subscribe to the e-mail list?

•Log onto your most favorite e-mail account that you read all the time.
•Send e-mail to listserv@listserv.uta.edu without subject and with the following in the body:
Subscribe phys3446-002-fall05 YourFirstName YourLastName

The e-mail should look as follows (note that there are no spaces in the list name):



Class Specification

- Text Books
  - Das and Ferbel, “Introduction to Nuclear and Particle Physics”
  - R. Fernow, “Introduction to Experimental Particle Physics”
- Reading Assignments
  - Not just based on the books
  - We will use published papers as well
  - Extra credit on class participations and attendances up to 10%
- Homework Assignments:
  - There will be homework problems randomly assigned throughout the semester
- Two Written Term Exams (15% each)
- Semester DØ Data Analysis Projects and Presentations (20%+10%)

Syllabus

- Nuclear Physics (~1/3 of the semester)
  - Nuclear Phenomenology
  - Nuclear Models
  - Nuclear Radiation
- High Energy Experimental Techniques
  - Particle energy deposit in matter
  - Particle detector techniques and detectors
  - Accelerators
- HEP Phenomenology
  - Elementary particle interactions
  - Symmetries
  - Discrete Transformations
  - CP violations
  - The Standard Model

Syllabus

- Neutrinos
  - Neutrinos and proton structure functions
  - $\sin^2\theta_W$ measurements and its impact to Higgs
  - Neutrino Oscillation
- Electroweak Symmetry Breaking
  - Standard Model EWSB formalism & Higgs
  - Minimal Super-symmstric Extension of Standard Model
  - Other EWSB Theories (SUSY) & Other Types of Higgs
  - Strategy for Higgs search
- New Phenomena
  - SUSY Formalism and available models
  - Large Extra-dimension
  - Search strategy
- Will be mixed with appropriate experimental techniques

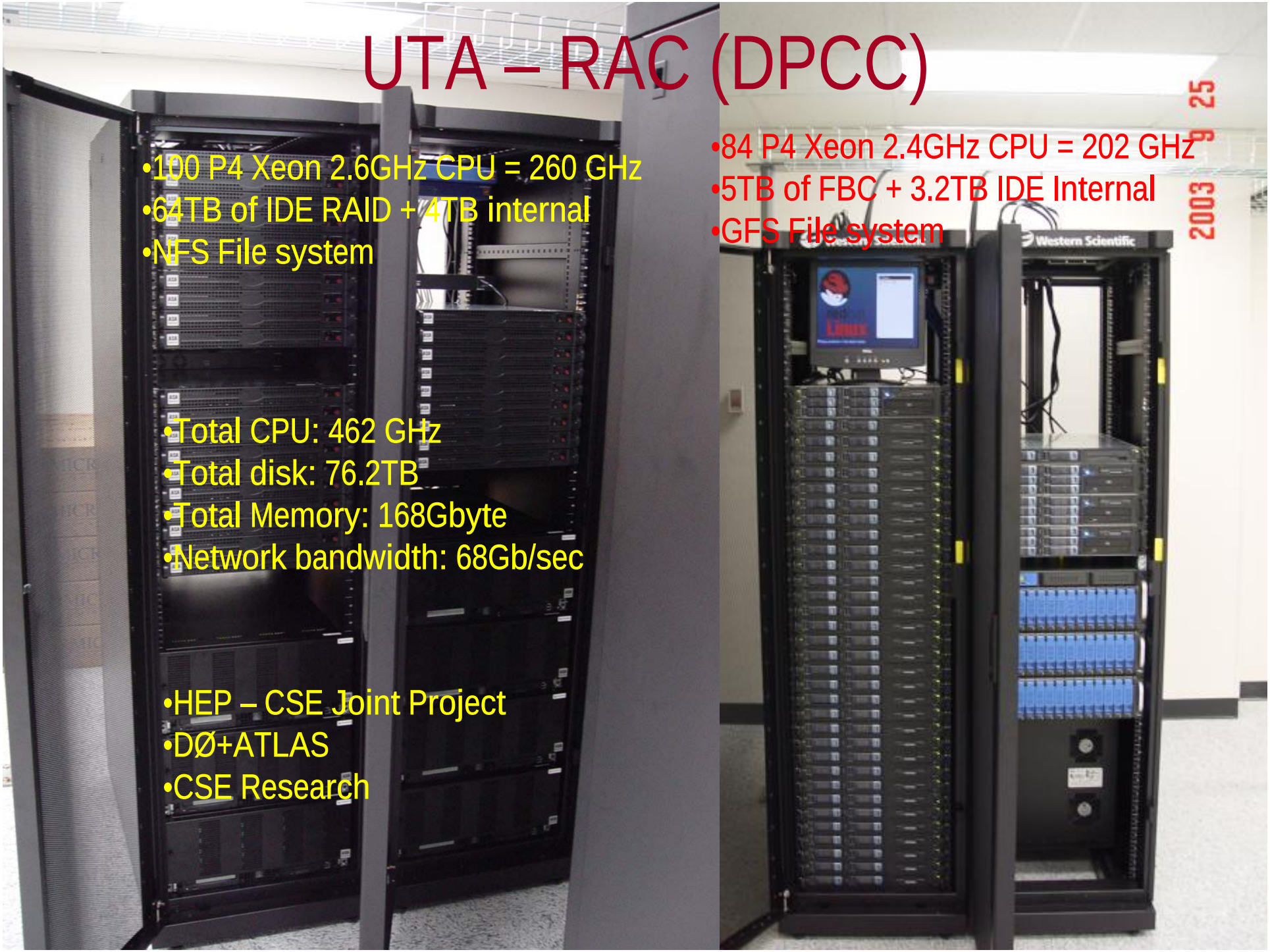
Attendances and Class Style

- 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….

Semester Projects

- DØ Data Analysis
  - 23 million pre-selected events each of
    - Electron + X
    - Muon + X
  - Need to setup DØ Data Analysis using root
- Must obtain a computer account to get access to the pre-processed root files of DØ data
  - Send e-mail to mcguigan@cse.uta.edu with PHYS3446 as the title and your full name and last four digits of your ID
- Consists of
  - A 5 - 7 page report each (must become a UTA-HEP note): 20% of the total
  - A 10 minute power point presentation each: 10% of the total
- Topics
  - Kinematic characteristics of decay product of W and Z bosons
  - Composed quantities of W and Z: transverse and invariant masses

UTA – RAC (DPCC)



- 100 P4 Xeon 2.6GHz CPU = 260 GHz
- 64TB of IDE RAID + 4TB internal
- NFS File system

- Total CPU: 462 GHz
- Total disk: 76.2TB
- Total Memory: 168Gbyte
- Network bandwidth: 68Gb/sec

- HEP – CSE Joint Project
- DØ+ATLAS
- CSE Research

- 84 P4 Xeon 2.4GHz CPU = 202 GHz
- 5TB of FBC + 3.2TB IDE Internal
- GFS File system

Events with W/Z Bosons

- Most the signal events you are interested in involve
  - high P_T leptons (e, μ and τ)
  - Neutrinos → Missing E_T
  - Jets → especially jets from heavy quarks
- Requires
  - Producing kinematic variable distributions
    - Electron and Muon E_T spectra
    - Missing E_T spectra
    - Construction of Masses (Transverse and Invariant masses of W and Z you collect)
    - Subtraction of backgrounds
    - Error estimate (stat. and syst.)

Events with W/Z Bosons

- Number of candidate events before and after background subtraction
- Computation of cross section
- Comparisons to other measurements
- Conclusions with your own interpretations

- CERN W and Z measurement paper will be available on the class web page for your reading
- You can use SLAC Spires preprint servers to obtain copies of useful papers:
  - http://www.slac.stanford.edu/spires/index.shtml

Laboratory

- Location: Room 008 in basement
- Time: 1:00 – 3:50pm, Fridays
- Instructor: Hyeonjin Kim
- Requirements: Radiation safety training
- A few measurements throughout the semester
  - Lab can be accessed in times other than regular lab
- Lab reports are due one week after each measurement
  - The report will be peer reviewed by someone out of your team
  - Review comments are due the week after ➔ Will be reflected into the lab grade
- Lab score will be 15% of the total

Evaluation Policy

- Two Term Exams: 15 % each ➔ 30%
- Lab Score: 15%
- Final Semester project paper: 20%
- 10 minute Project oral presentation: 10%
- Homework: 15%
- Quizzes: 10%
- Extra Credit: 10%