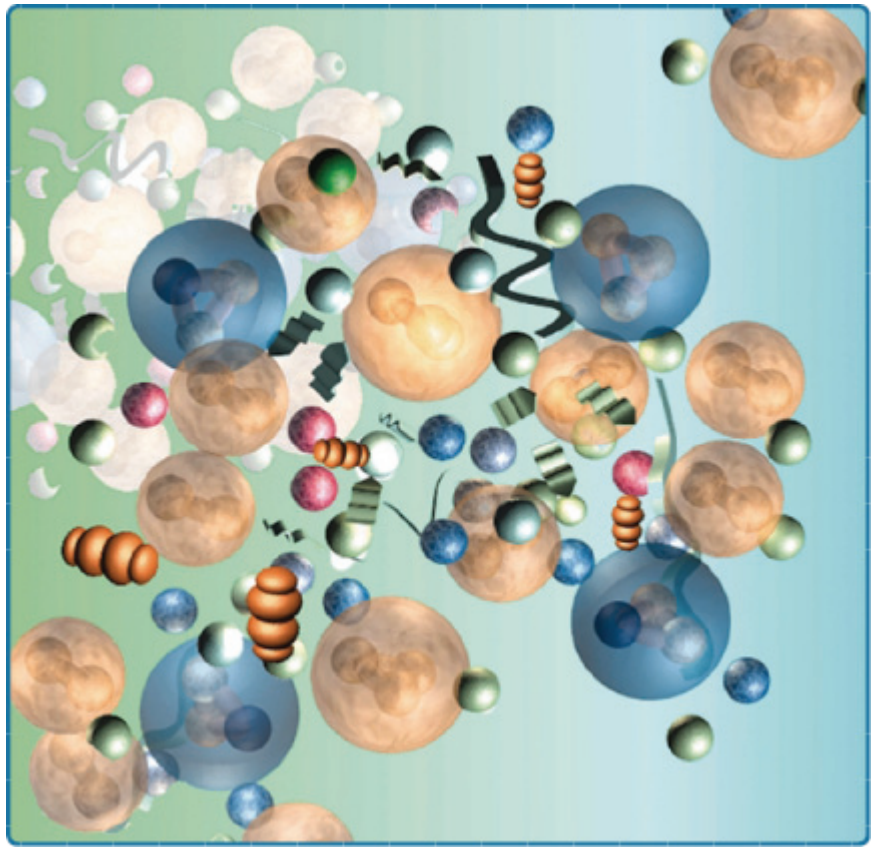
# Particle Physics

FYS225
FKF050

http://www.hep.lu.se/courses/fys225-fkf050/



LUND UNIVERSITY


***Division of Experimental High Energy Physics (www.hep.lu.se)***

***Lecturers:***

***Oxana Smirnova***
***Vincent Hedberg***
***Sakar Osman***

*and invited experimental teams leaders*


***Introductory notes, January 23, 2006***

# Introductory meeting, 24.01.2006

1. Purpose of the course
2. Required knowledge
3. Course plan
4. Lecture schedule
5. FYS225 or FKF050?
6. Projects (seminars, only LU students)
7. Course literature
8. CERN summer student programme

# 1. Purpose of the course

- Particle physics is the most fundamental of experimental natural sciences
- The purpose of the course of to give basic knowledge about elementary particles and their interactions
- The course has an experimental perspective:
  - what are the variables and quantities that can be experimentally measured
  - what kind of measurement devices are needed
  - what are the current experimental questions
- Elementary particles are experimentally investigated using detectors at particle accelerators, and also in cosmic ray experiments, therefore invited talks giving overviews of such experimental activities are included

# 2. Required knowledge

- **Basic knowledge of four-vectors, relativistic kinematics, quantum mechanics**
  - **Check e.g. the "Notes on particle kinematics, cross-sections etc. " at the course Web page**

# 3. Course plan

- Three 2-hour lectures a week (one per textbook chapter)
- Hand-in exercises: see the course schedule
  - hand in either at the lecture or leave in the box in the cupboard at the end of corridor C3
- Exercises are explained in 3 problem solving sessions
- Few presentations about current research activities at the Division

# 4. Lecture schedule

- Check the course homepage for eventual updates

| | | | | |
|---|---|---|---|---|
| Tue 2006-01-24 | 15:15 | C366 | Chapter 1: Basic concepts | O.Smirnova |
| Thu 2006-01-26 | 10:15 | C366 | Chapter 2: Leptons, quarks and hadrons | O.Smirnova |
| Fri 2006-01-27 | 10:15 | C366 | Chapter 3: Experimental methods | O.Smirnova |
| Tue 2006-01-31 | 15:15 | C366 | Chapter 4: Space-time symmetries<br>Leave in exercises Ch.1-3 | O.Smirnova |
| Thu 2006-02-02 | 10:15 | C366 | Problems: Ch. 1-3 | S.Osman |
| Fri 2006-02-03 | 10:15 | C366 | Chapter 5: Quantum numbers and excited states | O.Smirnova |
| Tue 2006-02-07 | 15:15 | C366 | Chapter 6: Quark states and colour<br>Leave in exercises Ch.4-5 | O.Smirnova |
| Thu 2006-02-09 | 10:15 | C366 | Heavy ion experiments | TBC |
| Fri 2006-02-10 | 10:15 | C366 | Problems: Ch. 4-5 | S.Osman |
| Tue 2006-02-14 | 15:15 | C366 | Chapter 7: QCD, jets and gluons | V.Hedberg |
| Thu 2006-02-16 | 10:15 | C366 | Chapter 8: Weak interactions, W+ and Z0<br>Leave in exercises Ch.6-7 | V.Hedberg |
| Fri 2006-02-17 | 10:15 | C366 | Chapter 9: Electroweak unification | V.Hedberg |
| Tue 2006-02-21 | 15:15 | C366 | Chapter 10: Charge conjugation and parity<br>Leave in exercises Ch.8-9 | V.Hedberg |
| Thu 2006-02-23 | 10:15 | C366 | Chapter 11: Beyond the Standard Model | V.Hedberg |
| Fri 2006-02-24 | 10:15 | C366 | Student seminars | – |
| Tue 2006-02-28 | 15:15 | C366 | Student seminars<br>Leave in exercises Ch.10-11 | – |
| Thu 2006-03-02 | 10:15 | C366 | Problems: Ch. 6-11 | S.Osman |
| Fri 2006-03-03 | 10:15 | C366 | ATLAS, H1 experiments | TBD |

# 5. FYS225 or FKF050?

- LU/N-faculty students: FYS225 5p
  - project work on a selected topic, presented at a dedicated seminar (ca 20 min).
- LTH students: FKF050 3p
  - NOTE THAT THERE IS A POSSIBILITY TO ENROLL IN FYS225 to make the 5p course
- All: written examination (4 hours) and exercises (problems)
- 5p course FYS225: points for the final grade:
  - Exam: 6 complex questions, 50% of the final points.
  - Exercises: 10% of the final points. Exercises are evaluated by the teacher and points are awarded accordingly.
  - Project work: 40% of the final points. The contents of the work will be evaluated based on the given presentations.
- 3p course FKF050: points for the final grade:
  - Exam: 6 complex questions, 85% of the final points
  - Exercises: 15% of the final points. Exercises are evaluated and points are awarded accordingly.

# 6. Suggested seminar topics

- **Seminars are scheduled for February 24 and/or 28**
- **LU students are asked to pick any of the subjects:**
  - **Discovery of J/$\psi$**
  - **Discovery of top quark**
  - **Discovery of W- and Z-bosons**
  - **Discovery of neutrino oscillations**
  - **Discovery of CP violation**
  - **Discovery of pentaquarks**
  - **Search for the Higgs boson**
  - **Dark matter**
  - **Dark energy**
  - ***Own topics are welcomed***

# 7. Course literature

- B.R. Martin & G. Shaw, "Particle Physics" (2nd edition), 1997, publ. John Wiley & Sons Ltd
- Course homepage contains links to previous courses and video-recorded lectures, see
  http://www.hep.lu.se/courses/fys225-fkf050/
- Other related information at the Division's homepage:
  http://www.hep.lu.se/education.html

# 8. CERN Summer Student programme

- A unique opportunity to enjoy a summer in Switzerland, learning bleeding-edge science and technology and meeting new friends from all over the world
- Google "CERN Summer Student", or go directly to
  http://humanresources.web.cern.ch/HumanResources/external/recruitment/Students/students.asp
- 2-3 months of training at CERN: work in a research group, lectures, student sessions, visits to experiments, workshops,…
- Possibility to make a diploma work

# 8. CERN Summer Student programme

- Applications deadline: January 31, 2006
- Eligibility:
  - Undergraduate students of physics, engineering or computing
  - CERN member state nationality
  - At least 3 years of university studies
  - No previous work at CERN
  - Good knowledge of English
- Electronic application submission; 2 recommendation letters are required