

Modèle standard des interactions fondamentales

Lecturers

Laura LOPEZ HONOREZ (Coordinator) and Thomas HAMBYE

Course mnemonic

PHYS-F422

ECTS credits

5 credits

Language(s) of instruction

French

Course period

Second term

Course content

- Particles and Antiparticles (reminder and notation) -- CP symmetry - Gauge Interactions -- Framework of the Electroweak interactions $SU(2)_L \times U(1)$ - Discussion of Empirical input - Spontaneous symmetry breaking -- The Brout-Englert-Higgs Model - On-Shell Equivalence of the Brout-Englert (renormalizable) and the Higgs (unitary) approaches - W and Z bosons - masses, properties - Predictions vs Inputs of the Standard Model - Quarks and Strong Interactions - $SU(3)$ - Chiral symmetry breaking and the Pion - Quarks and weak Interactions (Cabibbo-Kobayashi-Maskawa Mixing, absence of flavour changing neutral currents) -- Indirect (radiative corrections) constraints on the Standard Model parameters - CP violation vs gauge interactions: the quark/scalar sector - Anomalies: towards the quantization of charge (if time allows) More advanced chapters: --- The nature of neutrino: Dirac, Majorana particles, mass matrix and CP violation, --- Matter-antimatter asymmetry in the Universe --- Simple variants of the Standard Model, which are real challenges for LHC, (and possible sources of Dark Matter)

Objectives (and/or specific learning outcomes)

- Presentation of Particle Physics and Fundamental interactions at a state of the art level (arguably our most achieved theory in physics) - At the end of the course, the students should be up to date in the field, and capable to understand the cutting-edge developments, notably the search for the Brout-Englert-Higgs boson at CERN, - The course will also provide

an indication of possible alternatives to the minimal model, with important implications for future experiments. - It also provides a detailed discussion of neutrino physics, with its current challenges - It provides a fundamental understanding of issues surrounding matter-antimatter asymmetry, including the "defeat of antimatter" in our Universe -

Teaching method and learning activities

Blackboard course Exercise sessions The examination will also involve a prepared topic chosen by the student

References, bibliography and recommended reading

will be provided during the course

Other information

Contact(s)

Prof. Jean-Marie Frere Directeur, service de Physique theorique, CP 225 phone +32 2 650 55 71 frere@ulb.ac.be <http://homepages.ulb.ac.be/~frere> <http://www.ulb.ac.be/sciences/physst/>

Building N, level 7, office 2N7-114, Campus Plaine, Blvd du Triomphe B-1050 Bruxelles

Evaluation method(s)

Other

Evaluation method(s) (additional information)

Oral examination requesting - sound knowledge of the core of the course - detailed discussion of a topic selected by the student (prepared question)

Programmes

Programmes proposing this course at the faculty of Sciences

MA-PHYS | **Master in Physics** | finalité Research/unit 1 and finalité Teaching/unit 1