

# Physics beyond the standard model

## Titulaires

Thomas HAMBYE (Coordonnateur) et Michel TYTGAT

## Mnémonique du cours

PHYS-F469

## Crédits ECTS

5 crédits

## Langue(s) d'enseignement

Anglais

## Période du cours

Premier quadrimestre

## Campus

Plaine

## Contenu du cours

This course is shared between ULB (Pr Michel Tytgat) and VUB (Pr Steven Lowette) and therefore will be given in English.

The topics to be covered include:

- > Effective vs renormalizable quantum field theory
- > A recap of the Standard Model
- > Chiral and scale anomalies
- > Grand Unification Theories
- > Neutrino masses and mixing
- > Strong CP problem
- > Contemporary anomalies: lepton universality,  $g-2$  of the muon, flavor physics, dark matter problem,...
- > Experimental aspects of searches for BSM physics, including supersymmetric particles

## Objectifs (et/ou acquis d'apprentissages spécifiques)

To grasp the meaning of effective field theories and renormalizability; to clarify the underlying structure of the Standard Model; to appreciate its shortcomings and understand why the community is looking for physics beyond the Standard Model; to develop skills in QFT, the use of symmetries in physics and experimental analysis.

## Pré-requis et co-requis

### Cours co-requis

PHYS-F410 | Quantum field theory I | 5 crédits

## Connaissances et compétences pré-requis

It is strongly recommended to have taken the following courses (or equivalent):

PHYS F 410 : théorie quantique des champs I

PHYS F 422 : Modèle Standard des interactions fondamentales

Some topics will be easier to grasp if you have taken or are taking in parallel the followings:

PHYS F 440 : théorie quantique des champs II

PHYS F 415 Cosmologie

For experimental aspects, the relevant courses are

PHYS F 416 : Physique des particules

## Méthodes d'enseignement et activités d'apprentissages

2 hours of lectures (black board and/or slides); 2 hours of exercises (in practice, 90' + 90').

There will be no specific homework beyond the exercises.

## Références, bibliographie et lectures recommandées

An Introduction To Quantum Field Theory de Michael E. Peskin et Daniel V. Schroeder for basics of QFT

Quantum Field Theory and the Standard Model de Matthew D. Schwartz for some specific aspects of QFT

Gauge Theory of Elementary Particle Physics de Ta-Pei Cheng et Ling-Fong Li for more BSM aspects

Supplementary material will be provided if necessary

## Autres renseignements

### Lieu(x) d'enseignement

Plaine

### Contact(s)

michel.tytgat AT ulb.be

steven.lowette AT vub.be

## Méthode(s) d'évaluation

Autre

### Méthode(s) d'évaluation (complément)

The exam will be oral and will take place in January 2023 (1st session). It will be based on the material presented during the

lectures. The students will be invited to deepen a specific topic of their choice.

### Construction de la note (en ce compris, la pondération des notes partielles)

The note is based on the oral exam.

### Langue(s) d'évaluation principale(s)

Anglais

### Autre(s) langue(s) d'évaluation éventuelle(s)

Anglais et Français

## Programmes

### Programmes proposant ce cours à la faculté des Sciences

MA-PHYS | **Master en sciences physiques** | finalité Approfondie/bloc 2 et finalité Didactique/bloc 2

