Particle Physics 1 - Fall 2021

This course is a first year course for master students in the (experimental) particle physics programme of the UvA and VU.

1 Place and Time

The course consist of 14 lectures. These take place each Monday and Wednesday morning from **9h00** to **11h00** in room **H331 at Nikhef**, Sciencepark 105, Amsterdam. A remote connection (zoom) will be provided. The lectures are followed by tutorial sessions which will be via remote connection as well. The first lecture is on Monday September 6th and the last on Wednesday October 20th.

To enter the Nikhef building via the Nikhef entrance one normally needs an electronic key. If you do not have a key, please ask for admission to the building at the reception stating that you will attend the PP1 lectures in room H331. You can also enter the building via the UvA entrance.

Course information can also be found on

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https://datanose.nl/#course[98619]
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and on this website:

http://www.nikhef.nl/~wouterh/teaching/PP1

A canvas page is in preparation.

2 Teachers

Lecturers:

- Ivo van Vulpen, room H241, ivo.van.vulpen@nikhef.nl
- Wouter Hulsbergen, room H228, w.hulsbergen@nikhef.nl
- Marcel Mark (if other teachers absent), room H229b m.merk@nikhef.nl

Assistents:

- Alice Biolchini, room H221b, a.biolchini@nikhef.nl
- Rahul Balasubramanian, H222a, r.balasubramanian@nikhef.nl

Do not hesitate to contact lecturer or assistents in between lectures.

3 Lecture notes and books

Course **lecture notes** will be handed out in the lectures, and are available online at:

https://www.nikhef.nl/~wouterh/teaching/PP1/LectureNotes.pdf

The lecture notes contain exercises, one set for each of the 14 lectures. The exercises will be discussed in the tutorial sessions.

It is strongly recommended that you get hold of a good text book to supplement the lecture notes. The recommended book is *Modern Particle Physics* by Mark Thomson.

However, there are many other good text books. These lectures were orginally based on Halzen & Martin: Quarks & Leptons: An Introductory Course in Modern Particle Physics. This book is a bit outdated (1984), still very good, but no longer in print. Besides the book by Thomson, a decent alternative is the second edition of Griffiths, "Introduction to Elementary Particles" (2008). Most people agree that Griffiths is more pleasant to read than Halzen & Martin, but that it is also a bit less formal. I myself like Aichison and Hey's "Gauge theories in particle physics, Volume 1", but this is considerably more formal. In particular, it discusses field theory, which is not part of this course.

A few text books will be on display in the first lecture, so you could decide to wait till after the first lecture before purchasing a book.

4 Contents

The course contains the following topics:

- relativistic wave equations
- scattering perturbation theory
- electromagnetic scattering of spinless particles
- the Dirac equation
- electromagnetic scattering of spin 1/2 particles
- the weak force
- local gauge invariance
- massless electroweak standard model
- the Higgs mechanism

It is assumed that you have prior knowledge of

- relativistic kinematics
- electrodynamics (Maxwell equations)
- quantum mechanics (Schrödinger equation, angular momentum)

Students that have followed a bachelor course in particle physics certainly have an advantage. Others should at least read the introductory chapter of one of the text books above.

5 Examination

Grading will be a combination of home-work exercises and an online (open-book) exam. Details will be provided in the first lecture.