FYS3500 Spring 2024 - Problem set 4

Topic: Feynman diagram, Standard Model

Concepts of the week

Explain these concepts: Standard Model, Feynman diagrams

Problem 1: Standard Model of Particle Physics

a) Give an overview of the Standard Model in particle physics. What does it aim to describe? How are the particles classified?

b) What are the four fundamental forces, and which groups of fermions feel which forces?

c) How do interactions between particles take place according to the Standard Model, and which are the force carrying bosons for each of the forces?

d) Watch the following video:

`https://www.youtube.com/watch?v=gkHmXhhAF2Y&list=PLUO7um7mvyatoOrFUVm4hQVX5Eupe68GS&index=1`

It's a great video, and also covers a large section of the curriculum in particle physics. So no need to understand it all at once, but it is a nice introduction to the particle-section of the course!

Problem 2: Feynman diagrams

a) What is a Feynman diagrams?

b) Explain the basic rules of how to draw Feynman diagrams, including which symbols are used for fermions, anti-fermions, gluons, spin-1 bosons, and spin-0 bosons.

c) How do we identify the virtual particles in a Feynman diagram?

d) What do we mean with the order of a Feynman diagram? Are higher-order or lower-order diagrams most probable?

e) Find the (embarassing) mistake in the Feynman diagram on the front page of Martin&Shaw 2019 (see Figure 1).

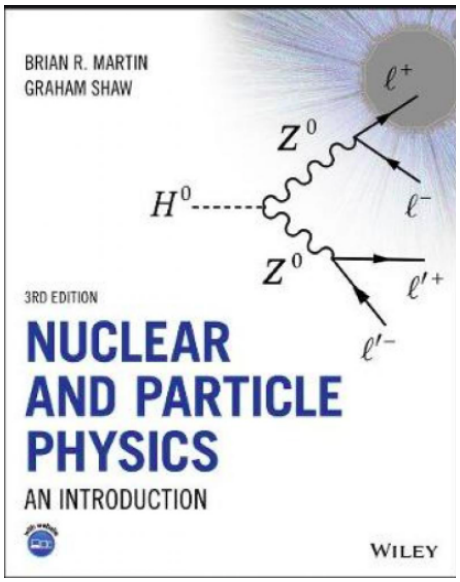

Figure 1

Problem 3: Describe Feynman diagrams

Describe what is going on in the following diagrams:
Pro tip: an online Feynman diagram creator is found here: `https://feynman.aivazis.com`

a) Figure 2

b) Figure 3

c) Figure 4

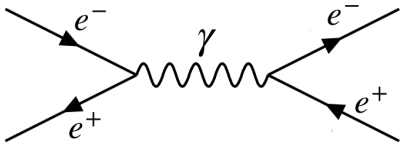

Figure 2

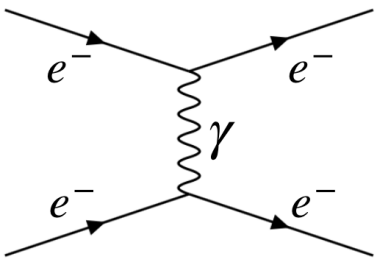

Figure 3

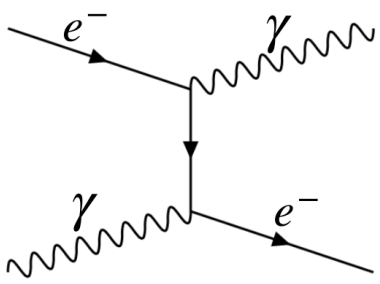

Figure 4

Problem 4: Draw Feynman diagrams

Exercise 1.10 in Martin&Shaw 2019

Problem 5: Draw Feynman diagrams

Exercise 1.11 in Martin&Shaw 2019