Supersymmetry (L16)

Ben Allanach

This course provides an introduction to the use of supersymmetry in quantum field theory. Supersymmetry combines commuting and anti-commuting dynamical variables, thus relating fermions to bosons.

Physical and theoretical motivations for supersymmetry are provided. The supersymmetry algebra and representations are then introduced, followed by superfields and superspace. 4-dimensional supersymmetric Lagrangians are then discussed, along with the basics of supersymmetry breaking. The minimal supersymmetric standard model will be introduced.

Three examples sheets and examples classes will complement the course.

Prerequisites

It is necessary to have attended the Quantum Field Theory and the Symmetries, Particles and Fields courses, or be familiar with the material covered in them.

Preliminary Reading

1. The first chapters of `http://arxiv.org/abs/hep-ph/0505105`

Literature

For more advanced topics later in the course, it will helpful to have a knowledge of renormalisation, as provided by the Advanced Quantum Field Theory course. It may also be helpful (but not essential) to be familiar with the structure of The Standard Model in order to understand the final lecture on the minimal supersymmetric standard model.

Beware: most of the supersymmetry references contain errors in minus signs.

1. Supersymmetric Gauge Field Theory and String Theory, Bailin and Love, IoP Publishing (1994) has nice explanations of the physics.

2. Introduction to supersymmetry, J.D. Lykken, `hep-th/9612114`. This introduction is good for extended supersymmetry and more mathematical aspects.

3. Supersymmetry and Supergravity, Wess and Bagger, Princeton University Press (1992). Note that this terse and more mathematical book has the opposite sign of metric to the course.

4. A supersymmetry primer, S.P. Martin, `hep-ph/9709256` is detailed on phenomenological aspects, although it has the opposite sign metric to the course.

5. From Spinors to Supersymmetry, Dreiner, Haber and Martin, CUP publishing (2023) is an extensive (over 1000 pages) and definitive supersymmetry text.

Additional support

Three examples sheets will be provided, each with an associated examples class. A one-hour revision class in Easter term will be proided.