

Supersymmetry (L16)

Professor Ben Allanach

This course provides an introduction to the use of supersymmetry in 3+1 dimensional quantum field theory. Supersymmetry combines commuting and anti-commuting dynamical variables, thus relating fermions to bosons.

Physical and theoretical motivations for supersymmetry are provided. We shall then review spinor representations of the Lorentz algebra. Supersymmetry algebra and supersymmetric representations are then introduced, followed by superfields and superspace. 4-dimensional globally supersymmetric Lagrangians (including supersymmetric gauge theories) are then discussed, along with the basics of supersymmetry breaking. Supergravity is very briefly reviewed. The minimal supersymmetric standard model is given as an example.

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. For more advanced topics later in the course, it will be helpful to have a knowledge of renormalisation, as provided by the Advanced Quantum Field Theory course or by the Statistical Field Theory course. The material from the Standard Model course may be useful (but not essential) for understanding the last lecture on the minimal supersymmetric standard model.

Literature

Beware: most supersymmetry references contain errors in minus signs and these are no exception:

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 and three associated examples classes will be given. There will be a one-hour revision class in the Easter Term.