

Supersymmetry (L24)

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Supersymmetry is a peculiar symmetry that relates fermions and bosons. This course will start with an introduction to supersymmetric quantum field theories, explaining how one can realise supersymmetry with a carefully curated collection of fields and interactions. We do this by introducing the concept of superspace, a generalisation of Minkowski space that includes new anti-commuting dimensions.

The magic of supersymmetry is that it often allows us to make exact statements about quantum field theories, statements that hold even when the coupling is strong and usual perturbative methods fail to work. This means that supersymmetric theories provide a collection of solvable toy models in which we can understand what kinds of things can happen in a quantum field theory. Furthermore, the solutions to supersymmetric theories have close connections to many modern developments in geometry and topology. In the second part of this course, we will study the supersymmetric version of QCD. This will give us a handle on a number of interesting phenomena, such as confinement and chiral symmetry breaking, that are also known to arise in non-supersymmetric theories.

Prerequisites

You should be comfortable with Quantum Field Theory from Michaelmas term and much of AQFT from Lent, including path integrals, non-Abelian gauge theories and beta functions. We will start by studying representations of the supersymmetry algebra and some familiarity with Lie algebras will be helpful. The latter part of the course involves understanding how quantum field theories look at different length scales and some familiarity with Wilsonian RG, whether from Statistical Field Theory or AQFT, will be useful.

Literature

1. Wess and Bagger, *Supersymmetry and Supergravity*, Princeton University Press
2. John Terning, *Modern Supersymmetry: Dynamics and Duality*, Oxford University Press

Further resources can be downloaded from the course website:

<http://www.damtp.cam.ac.uk/user/tong/susy.html>.

Additional support

Four examples sheets will be provided and four associated examples classes will be given. There will be a one-hour revision class in the Easter Term.