Statistical Field Theory (M16)

Prof. C. E. Thomas

This course introduces the renormalization group, focusing on statistical systems such as spin models with further connections to quantum field theory.

After presenting the Ising Model, Landau's mean field theory is introduced and used to describe phase transitions. The extension to the Landau-Ginzburg theory reveals broader aspects of fluctuations whilst consolidating connections to quantum field theory. At second order phase transitions, also known as 'critical points', renormalisation group methods play a starring role. Ideas such as scaling, critical exponents and anomalous dimensions are developed and applied to a number of different systems, including those with continuous symmetries.

Prerequisites

Background knowledge of statistical mechanics at an undergraduate level is essential. This course complements the Quantum Field Theory and Advanced Quantum Field Theory courses.

Literature

1. N Goldenfeld, *Lectures on Phase Transitions and the Renormalization Group*, Addison-Wesley 1992.
2. M Kardar, *Statistical Physics of Fields*, Cambridge University Press 2007.
3. J Cardy, *Scaling and Renormalisation in Statistical Physics*, Cambridge University Press 1996.
4. J M Yeomans, *Statistical Mechanics of Phase Transitions*, Clarendon Press 1992.
5. M Le Bellac, *Quantum and Statistical Field Theory*, Oxford University Press 1991.
6. J J Binney, N J Dowrick, A J Fisher, and M E J Newman, *The Theory of Critical Phenomena*, Oxford University Press 1992.
7. D Amit and V Martin-Mayor, *Field Theory, the Renormalization Group, and Critical Phenomena*, 3rd edition, World Scientific 2005.
8. L D Landau and E M Lifshitz, *Statistical Physics*, Pergamon Press 1996.

Additional support

Three examples sheets will be provided and three associated examples classes will be given. There will be a revision class in Easter Term.