Statistical Field Theory (M16)

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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.