Statistical Field Theory (M16)

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This course is an introduction to the renormalization group, the basis for a modern understanding of field theory. The course is primarily focussed on statistical systems such as spin models, but the connection to quantum field theory is never far from the surface.

The simplest spin system – known as the Ising model – is a constant companion throughout the course. After a description of this model, Landau's mean field theory is introduced and used as a framework to discuss the phenomology and classification of phase transitions. The extension to Landau-Ginzburg theory provides for a more complete understanding of fluctuations, and makes the connection to quantum field theory manifest.

These approaches struggle near a second order phase transition, also known as a "critical point". Here the tools of the renormalisation group become essential. Ideas such as scaling, critical exponents and anomalous dimensions are developed and applied to a number of different systems.

Pre-requisites

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. J M Yeomans, *Statistical Mechanics of Phase Transitions*, Clarendon Press (1992).
2. M Le Bellac, *Quantum and Statistical Field Theory*, Oxford University Press (1991).
3. J J Binney, N J Dowrick, A J Fisher, and M E J Newman, *The Theory of Critical Phenomena*, Oxford University Press (1992).
4. M Kardar, *Statistical Physics of Fields*, Cambridge University Press (2007).
5. D Amit and V Martín-Mayor, *Field Theory, the Renormalization Group, and Critical Phenomena*, 3rd edition, World Scientific (2005).
6. 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.