Field Theory in Condensed Matter Physics

Prof. J. Cardy – Hilary Term 2002

This 16-lecture course is intended as an introduction to some of the various applications of field theory methods in theoretical condensed matter physics. A basic knowledge of the Feynman path integral formulation of simple quantum field theories, of Feynman diagrams, and of the elements of renormalisation (as discussed in the Michaelmas 2001 Field Theory course) will be assumed.

It is hoped that the the following topics will be covered, as time allows:

1. Connection between euclidean QFT and critical behaviour in classical statistical mechanics.
2. Field-theoretic renormalisation group approach to classical critical behaviour and the ϵ-expansion.
3. Relation to more general RG schemes: Wilson's method, and real space renormalisation.
4. The two-dimensional XY model.
5. Bosonisation in 1+1 dimensions.
6. Finite-size scaling and quantum critical behaviour.
7. Dynamic critical behaviour at finite temperature.
8. Non-equilibrium critical behaviour.

A notable omission will be any detailed discussion of quantum magnetism, since this will be covered in a special course to be given by Dr. Andrew Green in Trinity Term.

The lectures will be on Mondays and Tuesdays, 11-12 am, in the Fisher Room of the Denys Wilkinson Building (formerly NAPL).

References: Secs. 1 & 2 are mainly review material from last term's Field Theory course. A good (but expensive) general reference is *Quantum Field Theory* by K. Huang (Wiley). Secs. 3, 4, 6 and part of 7 are all covered in my book *Scaling and Renormalization in Statistical Physics* (CUP, 1996, £24.95.). I plan to circulate notes covering Sec. 5, and Secs. 7, 8.

Problem Sets: There will be two sets of Problems, one handed out about halfway through the term and the other at the end (due after the Easter vacation.) The solutions will be discussed in Problem Classes (times to be arranged.)