

# Renormalization Group in Statistical Mechanics

Saverio Pascazio, Prague, June 09

- A) Introduction to critical phenomena. Critical points and order parameter. Fluctuations. Qualitative description. A simple example: the Ising model. Mean field approach.
- B) Models, main ideas and basic concepts. Statistical mechanics. Block Hamiltonians and Kadanoff transformations. Ginzburg-Landau model.
- C) Landau theory. Gaussian approximation.  $T > T_c$  and  $T < T_c$ . Correlation length and its temperature dependence.
- D) Scaling hypothesis. Scale transformations. The renormalization group. Definition, philosophy and motivation.
- E) Fixed points. Critical exponents. Critical region. Free energy. Relevant, irrelevant and marginal fields. The role of dimension.

## Textbooks

S.-K. Ma, Modern theory of critical phenomena, Addison-Wesley, 1982.

M. Le Bellac, “Des phénomènes critiques aux champs de jauge” (Savoirs Actuels, InterEditions/Editions du CNRS, 1990).

Notes and personal calculations, available at  
<http://www.ba.infn.it/~pascazio>