

Advanced Statistical Mechanics: Possible Topics

- Relationship between field theory and statistical mechanics
- Elementary properties of field theories; Noether theorem
- 1D Ising model
- Ising model and critical phenomena; upper and lower critical dimensions
- Solution to the 2D Ising model via Kramers-Wannier duality; Majorana fermions
- 2D Dirac fermions; Axial anomaly; 2D free bosons
- Dirac fermion description of free nonrelativistic spinless electron gas; Abelian bosonization and Luttinger liquids
- Quantum Hall effect; Edge theory as chiral Luttinger liquids
- Renormalization group
- $O(N)$ models; critical properties of 2D percolation and 2D self avoiding walks
- Conformal anomaly and conformal field theory
- Minimal models: applications to the Ising model and $O(N)$ models
- Kac-Moody algebras; Applications to the $SU(2)$ Heisenberg spin chain and to spin and charge separation in Luttinger liquids (non-Abelian bosonization)
- Disorder; Random bond Ising model; Network models
- CFT and string theory.