

1 Unconventional electronic states in reduced dimensions (tentative)

1. Conventional phases of matter. The concept of phase transitions.
2. The Landau theory of phase transitions.
3. Aharonov-Bohm effect. Dirac monopole and Dirac string.
4. The adiabatic evolution. Berry connection, Berry phase, and Berry curvature.
5. Chern number. Berry phase on the Brillouin zone.
6. The integer quantum Hall effect: phenomenology. Landau levels in the Landau gauge.
7. Landau levels in the symmetric gauge. The role of disorder. Edge states.
8. The Laughlin argument and the TKKN quantization of the transverse conductivity.
9. Lattice models. A simple example: the SSH model.
10. The Kitaev model for a p-wave superconductor. Majorana fermions.
11. The Peierls substitution. Hofstadter butterfly.
12. The Haldane model: two ways of gapping the Dirac points.
13. The Haldane model: Berry phase and edge states.
14. The time-reversal symmetry. Kramers degeneracy. Symmetry-protected topological states.
15. The Kane-Mele model and the Z_2 topological insulators.
16. The fractional quantum Hall effect: phenomenology.
17. The Laughlin wave function. Mapping to a classical partition function.
18. Haldane pseudo-potentials. Exact diagonalizations.
19. Excitations. Fractionalization of the electron charge.
20. Fractionalization of spin: the Kitaev model on the honeycomb lattice.
21. The toric code.
22. The concept of anyons and topological order.
23. The flux attachment. The Wigner-Jordan transformation.
24. The Jain theory of composite electrons.