

Physics 583
Spring Semester 2009, Academic Year 2008/2009
List of Suggested Term Papers

Professor Eduardo Fradkin

1. The Coleman-Weinberg Mechanism, Fluctuation Induced First Order Transitions and the Superconductor Phase Transition.
Reference: S. Coleman and E. Weinberg, *Phys. Rev.* **D7**, 1888 (1973); B. Halperin, T. Lubensky and S-K. Ma, *Phys. Rev.Lett.* **32**, 292 (1974).
2. Renormalization Group study of the 2D Sine Gordon Theory.
Reference: D. Amit, Y. Goldschmidt and G. Grinstein, *J. Phys.* **A13**, 585 (1980).
3. QCD in the limit of a large number of colors, $N_c \rightarrow \infty$.
Reference: E. Witten, *Nuc. Phys.* **B160**, 57 (1979); S. Coleman, *Aspects of Symmetry*, Chapter 8.
4. Field Theory for the Localization Transition.
Reference: P. W. Andreson, E. Abrahams, D. C. Licciardello and T. V. Ramakrishnan (The Gang of Four), *Phys. Rev. Lett.* **42**, 673 (1979); F. Wegner, *Phys. Rev.* **B19**, 783 (1979) ; A. McKane and M. Stone, *Ann. Phys.* **131**, 36 (1981); S. Hikami, *Phys. Rev.* **24**, 2671 (1981).
5. Field Theory models of Polyacetylene.
Reference: R. Jackiw and J. R. Schrieffer, *Nucl. Phys.* **B190** [FS3], 253 (1981); W. P. Su, J. R. Schrieffer and A. J. Heeger, *Phys. Rev.* **B22**, 2099 (1980); H. Takayama, Y. Lin-Liu and K. Maki, *Phys. Rev.* **B21**, 2388 (1980); D. K. Campbell and A. R. Bishop, *Phys. Rev.* **B24**, 4859 (1981); E. Fradkin and J. E. Hirsch, *Phys. Rev.* **B27**, 1680 (1983).
6. Conformal Field Theory and two-dimensional Critical Phenomena.
Reference: A. A. Belavin, A. M. Polyakov and A. B. Zamolodchikov, *Nucl. Phys.* **B241**, 333 (1984); D. Friedan, Z. Qiu and S. Shenker, *Phys. Rev. Lett.* **52**, 1575 (1984); J. Cardy, *Nucl. Phys.* **B270**[FS16], 186 (1986) .
7. Non-linear Sigma models and quantum spin chains.
Reference: F. D. M. Haldane, *Phys. Lett.* **A93**, 464 (1983); *Phys. Rev. Lett.* **50**, 1153 (1983).
8. Deconfinement transition of QCD at finite temperature.
Reference: A. M. Polyakov, *Phys. Lett.* **B72**, 477 (1978); L. Susskind, *Phys. Rev.* **D20**, 2610 (1979); D. Gross, R. Pisarski and L. Yaffe, *Rev. Mod. Phys.* **53**, 43 (1981)
9. Confinement and lattice Gauge Theory.
Reference: K. G. Wilson, *Phys. Rev.* **D10**, 2455 (1974); J. Kogut and L. Susskind, *Phys. Rev.* **D11**, 395 (1975); J. Kogut, *Rev. Mod. Phys.* **51**, 659 (1979).
10. Macroscopic Quantum Coherence: the Caldeira-Leggett model.
Reference: A. Caldeira and A. J. Leggett, *Physica* **A121**, 587 (1983); *Ann. Phys. (NY)* **149**, 374 (1983) ; A. J. Leggett, S. Chakravarty, M. P. A. Fisher, A. Dorsey and W. Zwerger, *Rev. Mod. Phys.* **59**, 1 (1987).
11. Field Theory approaches to the Quantum Hall Effect.
Reference: S. C. Zhang, T. Hansson and S. Kivelson, *Phys. Rev. Lett.* **62**, 82 (1989) ; A. Lopez and E. Fradkin, *Phys. Rev.* **B44**, 5246 (1991); S. C. Zhang, *Int. J. Mod. Phys.* **62**, 25 (1992).
12. Gauge Theories, Chern-Simons actions and the Theory of Knots.
Reference: E. Witten, *Comm. Math. Phys.* **121**, 351 (1989);
13. Semiclassical theory of Solitons.
Reference: R. Rajaraman, *Solitons and Instantons*, North-Holland.
14. Renormalization Group approach to Fermi Liquids.
Reference: R. Shankar, *Rev. Mod. Phys.* **66**, 129 (1994).

15. QED in two space-time dimensions.
Reference: J. Schwinger, *Phys. Rev.* **128**, 2425 (1962); J. Kogut, A. Casher and L. Susskind, *Phys. Rev.* **D10**, 732 (1974).
16. Decay of the False Vacuum.
Reference: S. Coleman, *Aspects of Symmetry*, Chapter 7.
17. Fermi and Bose Relativistic Strings.
Reference: M. B.Green, J. Schwartz and E.Witten, *Supertstring Theory*; A. M. Polyakov and others in *Fields Strings and Critical Phenomena*, Les Houches Session XLIX (1988), E. Brezin and J. Zinn Justin , Elsevier (1989); D. Friedan in *Recent Advances in Field Theory*, Les Houches Session XXXIX (1982), J. Zuber and R. Stora (1984); A. M. Polyakov , *Gauge Fields and Strings*, Harwood (1987); J. Polchinski, *String Theory*, Cambridge University Press (1998).
18. Bosonization in 1+1-dimensional field theories.
Reference: D. C. Mattis and E. Lieb, *J. Math. Phys.* **6**, 304 (1965); S. Coleman, *Phys. Rev.* **D11**, 2088 (1975); S. Mandelstam, *Phys. Rev.* **D11**, 3026 (1975); F. D. M. Haldane, *J. Phys. C* **14**, 2585 (1981).
19. Non-Abelian Bosonization.
Reference: E. Witten, *Comm. Math. Phys.* **92**, 455 (1984).
20. Path Integrals and Bosonization.
Reference: A. M. Polyakov and P. B. Wiegmann, *Phys. Lett.* **B131**, 121 (1983); A. M. Polyakov in *Fields Strings and Critical Phenomena*, Les Houches Session XLIX (1988), E. Brezin and J. Zinn Justin , Elsevier (1989); R. Gamboa Saravi, M. A. Muschietti, F. A. Schaposnik and J. E. Solomin, *Ann. Phys. (NY)* **157**, 360 (1984); C. M. Naon, *Phys. Rev.* **D31**, 2035 (1985); M. Stone, *Nucl. Phys.* **B327**, 399 (1989).
21. Duality in Field Theory.
Reference: N. Seiberg and E. Witten, *Nucl. Phys.* **B426**, 19 (1994); *Nucl. Phys.* **B431**, 484 (1994); E. Verlinde, *Nucl. Phys.* **B455**, 211 (1995).
22. The Maldacena Conjecture.
Reference: J. Maldacena , *Int. Jour. Theor. Phys.* , **38**, 1113 (1999); *Phys. Rev. Lett.* **80**, 4859 (1998); D. J. Gross, H. Ooguri, *Phys. Rev.* **D58**, 106002 (1998); N. Drukker, D. J. Gross, H. Ooguri, *Phys. Rev.* **D60**, 125006 (1999); O. Aharony, S. SĜubser, J. Maldacena, H. Ooguri, Y. Oz, *JHEP* 9812 (1998) 026, hep-th/9812046.
23. Black Holes and String Theory.
A. Strominger, C. Vafa, *Phys. Lett.* **B379**, 99 (1996); G. Horowitz, A. Strominger, *Phys. Rev. Lett.* **77**, 2368 (1996); C. G. Callan, J. M. Maldacena, *Nucl. Phys.* **B472**, 591 (1996); J.M. Maldacena, PhD Thesis, hep-th/9607235.
24. Boundary Conformal Field Theory.
Reference: S. Ghoshal and A. B. Zamolodchikov, *Int. J. Mod. Phys.* **A9**, 3841 (1994); C. Callan, I. Klebanov, A. W. W. Ludwig and J. Maldacena, *Nucl. Phys.* **B422**, 417 (1994).
25. Field Theory of the Kondo Problem.
Reference: P. W. Anderson, *J. Phys.* **C3**, 2436 (1970); P. W. Anderson, G. Yuval and D. R. Hamann, *Phys. Rev.* **B1**, 4464 (1970); N. Read and D. Newns, *J. Phys.* **C16**, 3273 (1983); I. Affleck and A. W. W. Ludwig, *Nucl. Phys.* **B352**, 849 (1991).
26. Bosonization of Fermi Liquids and Coherent States
Reference: A. H. Castro Neto and Eduardo Fradkin, *Phys. Rev.* **B49**, 10877 (1994); *Phys. Rev.* **B51**, 4084 (1995); A. Houghton and J. B. Marston, *Phys. Rev.* **B48**, 7790 (1993).