

2001 LECTURES ON QUANTUM FIELDS AND STRINGS FOR MATHEMATICIANS

BENJAMIN MCKAY

REFERENCES

- [1] Pierre Deligne, Pavel Etingof, Daniel S. Freed, Lisa C. Jeffrey, David Kazhdan, John W. Morgan, David R. Morrison, and Edward Witten, editors. *Quantum fields and strings: a course for mathematicians. Vol. 1, 2*. American Mathematical Society, Providence, RI, 1999. Material from the Special Year on Quantum Field Theory held at the Institute for Advanced Study, Princeton, NJ, 1996–1997.
- [2] Richard P. Feynman. *Selected papers of Richard Feynman*, volume 27 of *World Scientific series in 20th century physics*. World Scientific, Singapore, 2000. Edited with commentary by Laurie M. Brown.
- [3] Daniel S. Freed. *Five lectures on supersymmetry*. American Mathematical Society, Providence, RI, 1999.
- [4] P. Ginsparg. Applied conformal field theory. In *Champs, cordes et phénomènes critiques (Les Houches, 1988)*, pages 1–168. North-Holland, Amsterdam, 1990.
This seems to be the bible for conformal field theory. We need to understand at least some parts of conformal field theory before going too far in string theory.
- [5] Th. Kaluza. On the problem of unity in physics. *Sitz. Preuss. Akad. Wiss.*, K1:966, 1921. Also found in English translation in [7], pp. 53–58.
The first article on Kaluza–Klein theories.
- [6] Oskar Klein. Quantentheorie und fünfdimensionale Relativitätstheorie. *Zeitschrift für Physik*, 37:895, 1926. Also found in English translation in [7], pp. 59–58.
The second article on Kaluza–Klein theories.
- [7] Lochlainn O’Raifeartaigh, editor. *The dawning of gauge theory*. Princeton University Press, Princeton, NJ, 1997. Edited and with introductory essays by Lochlainn O’Raifeartaigh.
- [8] Michael E. Peskin and Daniel V. Schroeder. *An introduction to quantum field theory*. Addison-Wesley Publishing Company Advanced Book Program, Reading, MA, 1995. Edited and with a foreword by David Pines.

Date: September 28, 2001.

Many people say this is the best book from which to learn quantum field theory.

- [9] Joseph Polchinski. Renormalization and effective Lagrangians. *Nuclear Physics B*, B231:269–295, 1984.
Proves (with rigour of a physicist, of course) via very general arguments the renormalizability of certain quantum field theories.
- [10] Joseph Polchinski. *String theory. Vol. I*. Cambridge University Press, Cambridge, 1998. An introduction to the bosonic string.
Currently the best approach to learning string theory.
- [11] Joseph Polchinski. *String theory. Vol. II*. Cambridge University Press, Cambridge, 1998. Superstring theory and beyond.
- [12] Julian Schwinger. Quantum electrodynamics. I. A covariant formulation. *Physical Rev. (2)*, 74:1439–1461, 1948. Also found in [15], pp. 36–58.
- [13] Julian Schwinger. Quantum electrodynamics. II. Vacuum polarization and self-energy. *Physical Rev. (2)*, 75:651–679, 1949. Also found in [15], pp. 59–87.
This paper was highly recommended by Alvarez in his Park City lectures.
- [14] Julian Schwinger. Quantum electrodynamics. III. The electromagnetic properties of the electron—Radiative corrections to scattering. *Physical Rev. (2)*, 76:790–817, 1949. Also found in [15], pp. 88–115.
- [15] Julian Schwinger. *A quantum legacy: seminal papers of Julian Schwinger*, volume 26 of *World Scientific series in 20th century physics*. World Scientific, Singapore, 2000. Edited with commentary by Kimball A. Milton.
- [16] Kenneth G. Wilson. Renormalization group and critical phenomena. I. Phase-space cell analysis of critical behavior. *Physical Review B*, 4(9):3184–3205, November 1971.
- [17] Kenneth G. Wilson. Renormalization group and critical phenomena. I. Renormalization group and the Kadanoff scaling picture. *Physical Review B*, 4(9):3174–3183, November 1971.
The birth of the modern theory of the renormalization group.
- [18] Kenneth G. Wilson. Renormalization group methods. *Advances in Math.*, 16:170–186, 1975.
A review of the renormalization group as applied to the problem of dilute impurities in ferromagnets.
- [19] Kenneth G. Wilson and J. Kogut. The renormalization group and the ε expansion. *Physics Reports*, 12C(2):77–199, August 1974.

A monograph explaining the renormalization group for people who don't know much physics beyond the expansion of ϕ^4 field theory into Feynman diagrams.

UNIVERSITY OF UTAH, SALT LAKE CITY, UTAH
E-mail address: `mckay@math.utah.edu`

Quantum fields and strings: a course for mathematicians. Vol. 1, 2. American Mathematical Society, Providence, RI, 1999. Material from the Special Year on Quantum Field Theory held at the Institute for Advanced Study, Princeton, NJ, 1996-1997. [2] Richard P. Feynman. Selected papers of Richard Feynman, volume 27 of World Scientific series in 20th century physics. [3] Daniel S. Freed. Five lectures on supersymmetry. American Mathematical Society, Providence, RI, 1999. [4] P. Ginsparg. Ideas from quantum field theory and string theory have had considerable impact on mathematics over the past 20 years. Advances in many different areas have been inspired by insights from physics. In 1996-97, the Institute for Advanced Study (Princeton, NJ) organized a special year-long program designed to teach mathematicians the basic physical ideas which underlie the mathematical applications. Interspersed are mathematical texts with background material and commentary on some topics covered in the lectures. These two volumes present the first truly comprehensive introduction to this field aimed at a mathematics audience.