

PHYSICS 683, QUANTUM HALL LECTURES: BOOKS

Christopher Henley, spring 2006

In this list, books with “*” are (or were) available in the LASSP research library on the 5th floor of Clark. The REQUIRED text is

Steven Girvin,

“The Quantum Hall Effect: Novel Excitations and Broken Symmetries”,

in *Topological Aspects of Low Dimensional Systems*,

ed. A. Comtet, T. Jolicoeur, S. Ouvry, and F. David.

(Springer-Verlag/Les Editions de Physique, 2000). [Lectures from the Les Houches summer school, 1998.] Book in Math Library, QC20.7.T65 E26x 1998 (not on reserve).

Article available online via www.arxiv.org, paper cond-mat/9907002. This corresponds fairly well to the level and content of my lectures. The differences are that i) These lectures omit the important topics of fractional statistics (anyons), edge currents, and composite fermions. ii) Girvin’s sections 1.10-1.12 on quantum Hall ferromagnets, skyrmions, and double-layer ferromagnets go into much more detail than I want to or can.

The other main books are

*Richard E. Prange and Steven M. Girvin, eds, *The Quantum Hall Effect* (2nd ed.)

(Springer-Verlag, 1990); QC612.H3 Q1 1990.

Ten integrated review chapters are pedagogical reviews of the basic phenomena of the integer and quantized Hall effects, as discovered in the 1980s. Now a bit dated.

Sankar Das Sarma and Aron Pinczuk, eds, *Perspectives in Quantum Hall Effects*

(John Wiley & Sons, 1997); QC612 H3 P46x 1997.

– Same format as, and sequel to, Prange and Girvin. This covers the elaborations developed in the 1990s. Read Prange and Girvin first, before you try this one.

Advanced solid-state texts with a chapter on QHE

The QHE is the last chapter in each of these textbooks. They are aimed around the level of Physics 636 (Solid State II).

Philip L. Taylor and Olle Heinonen,

A Quantum Approach to Condensed Matter Physics (2002)

Chapter 10, quantized Hall effect, is one of the recent additions in a renovation of the original 1970 text. This book, slanted towards non-specialists, deserves to be better known: overall clear writing, not too many equations, and good choice of the most important points. Author Heinonen did research on QHE during 1983-2002.

*Patrik Fazekas *Lecture Notes on Electron Correlation and Magnetism*
(World Scientific, 1999)

Chapter 12, “Quantum Hall effect” – The main text is (I consider) the best up-to-date text on magnetism, centered on the Hubbard model; the QHE chapter goes into considerable detail, though

Philip W. Phillips *Advanced Solid State Physics*
(Westview Press/Perseus Books, 2002) QC176 .P46x 2002

Chapter 14, “Quantum Hall Effect”. Not as complete as the others, perhaps, but has a modern flavor.

Field-theory texts

Quantized Hall effect has probably been the richest playground of field theory as applied to real solid-state systems. I am not going to teach condensed-matter field theory, but it may be helpful if you want to go deeper, and particularly if you have to read some of the theory papers.

Eduardo Fradkin, *Field theories of condensed matter systems*
(Addison-Wesley, 1991) QC611.98.H54 F73x 1991

– Good general view of condensed matter field-theory models. Maybe beyond our level.

*Xiao-Gang Wen, *Quantum Field Theory of Many-Body Systems – from the Origin of Sound to an Origin of Light and Electrons*
(Oxford University Press, c2004) NOT CU LIBRARY

This book is certainly beyond our level. As the title shows, it gets far out indeed! But authoritative text for the concept of “topological order”, originally formulated by Wen for the QHE, and closely related to fractional charge/statistics.

Naoto Nagaosa, *Quantum field theory in condensed matter physics*
(Springer-Verlag, 1999) QC174.45 .N27x 1999

Chapter 6 (the final one), “Quantum Hall Liquid and the Chern-Simons Gauge Field”. I haven’t read this thin text, but it is one of the main ones out there. Its more advanced sequel, *Quantum Field theory in strongly correlated electron systems*, also has a section 5.3 (final section!), “Gauge theory of quantum Hall liquids.”

Other review or pedagogical articles

List to be handed out.