Physics 598 PTD
Physics of two-dimensionsal systems
Fall 2009

Time:	MW 4:00–5:20
Place	144 Loomis Lab of Physics (LLP)
Instructor:	Tony Leggett
Office:	2113 Engineering Sciences Building (ESB)
Office Hour:	Thursday 2:00
TA:	Victor Vakaryuk, 4119 ESB [office hour: Wednesday 2:00]

TOPICS: The course will concentrate on those aspects of the physics of 2 D systems that have no obvious analogs in 3 D. (e.g. absence of long-range order, the quantum Hall effect, the (supposed) universality of localization). It will emphasize the comparison of theory and experiment, particularly in areas where there is currently substantial discrepancy.

A tentative lecture schedule for the first half of the course is attached; a schedule for the second half will be distributed later.

BOOKS: I have not found a single book that adequately covers all the material of the course, though there are some that give excellent treatments of particular topics (see below). A useful if somewhat "random" reference for the general subject of (one- and) two-dimensional systems is section E of the journal *Physica*, which was introduced in 1997 specifically to cover this area.

Other suggestions:

D. J. Thouless, in P.C.W. Davies (ed.), *The New Physics*, Cambridge University Press, 1989, 530 N 422

J. Wosnitza, Fermi Surfaces of low-dimensional organic metals and superconductors, Springer Tracts in Modern Physics, v. 134 508ER38

Y. Imry, *Introduction to Mesoscopic Physics*, 2nd ed. (Oxford University Press, 2002). As the name implies, this book covers a wider area than 1- and 2-D systems, but it is quite useful for its treatment of weak localization (where, however, it ignores the developments of the last few years). 537.6 Im 8i2002.

S. Girvin and R.E. Prange (eds.) The Quantum Hall Effect, 2nd ed. (Springer, Berlin 1990). A very useful collection of reviews on various aspects of both the integral and the fractional effects.537.6Q R51990 (Res)

ASSESSMENT: assuming departmental approval, by homework assignments and a project.

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Tentative lecture syllabus for first half of course

Lecture	Date	Topic
1	M 24 Aug	General introduction:what is special about two dimensions?
2	W 26 Aug	Some important experimental systems
3	M 31 Aug	Experimental systems (cont.): Single-particle quantum mechanics in two dimensions
4	W 2 Sept	Weak localization I: General considerations, one-parameter scaling
5	W 9 Sept	Weak localization II: Quantitative treatment
6	M 14 Sept	Weak localization III: The effects of spin
7	W 16 Sept	Weak localization IV: Interaction effects, the pre-1995 experimental situation
8	M 21 Sept	Ginzburg-Landau theory
9	W 23 Sept	Long-range order in 2D systems
10	M 28 Sept	The Kosterlitz-Thouless transition
11	W 30 Sept	Dynamics of superfluid films: The superconducting analogy
12	M 5 Oct	The experimental situation: 2D magnetism
13	W 7 Oct	The experimental situation: Superconducting films
14	M 12 Oct	The experimental situation: Si MOSFETs
15	W 14 Oct	Some aspects of two-dimensionality in the cuprates