Term Paper Guidelines
PHYS 798I
Fall 2012
Prof. Steven Anlage

Format: Follow the format of Physical Review A/B/E articles for references, sections, figures, etc. Include an abstract, introductory section (including a brief outline of the paper), and conclusions. This paper may pass as your "scholarly paper" requirement for the Ph.D. program. The paper should be typed and double spaced, 12 pt type or larger. Style and clarity are important in all writing; have a friend proof-read your paper. Please have a native English speaker read and correct the paper. Figures can and should be used, but figures taken from other sources should be referenced. Please include a descriptive figure caption in your own words for all figures. I also prefer to have the figures integrated into the text, rather than collected together in a Figure section at the end of the paper. Don't forget to spell check the paper! The length of the paper should be somewhere between 10 and 20 pages.

Plagiarism: You must not steal other people's work. Verbatim copying of passages from other papers, published or unpublished or transparent paraphrasing of other work, is forbidden. You may use the results of other papers, but they must be referenced.

Content: Write an overview of your topic which can be read and understood by the other students in the class. Define terms, avoid the use of jargon, and put things in a logical order. This paper should introduce an intelligent newcomer to the topic. An exhaustive listing of all references in the field, or a repetitive unenlightening summary (in 2004, Smith made wiffnium, with a T_c of 102 K. In 2005, Jones made woofnium, with a T_c of 103 K, etc.) is <u>not</u> desirable. <u>An understandable discussion of key ideas, simple calculations and estimates, and anything else which indicates that you understand something about superconductivity and can explain it to beginning researchers in the field is desirable</u>.

It is also important to focus the paper and <u>go into quantitative detail</u> on at least one or two aspects of the subject. For example, one should not simply mention a stream of results without any further discussion. <u>Something should be discussed in depth, with quantitative and detailed analysis presented</u>. Also avoid the use of qualitative statements such as "superconducting XYZ devices are clearly superior to normal metal XYZ devices." Give numbers and quantitative justification for all claims. Don't hesitate to introduce equations which illustrate the physics behind your arguments. If you write a paper on an experimental topic, be sure to include a discussion of theory relevant to the experiment. If you write on a theoretical topic, be sure to discuss experimental consequences of the theory.

Please give me three choices of topics in writing by mid-October (anlage@umd.edu). To broaden your horizons a bit, choose paper topics that are not directly related to your research. I will assign topics no later than the end of October. Only one person should write on each topic, so please have more than one choice. If you want to write about a topic not on the list, please discuss it with me.

Please e-mail your paper by 21 November, 2012. A copy will be returned to you with comments, to be rewritten and returned on 5 December, 2012. The 5 December version will be graded.

<u>Possible Topics</u>

Vortex Glass - Vortex Liquid - Vortex solid phase transitions
Exotic vortex phases - Bose glass, hexatic phase, etc.
Critical behavior of superconductors (heat capacity, thermal expansion, penetration depth, etc.)
p-wave and d-wave pairing in superconductors and superfluids
SQUID ground state wavefunction pairing symmetry experiments
Spin-charge separation, Charge fractionalization, Visons
Spin fluctuation pairing mechanism in HTS and pnictide superconductors
Andreev reflection, bound states at surfaces of d-wave superconductors
Time-reversal symmetry breaking states in superconductors
Nonlinear Meissner Effect

Pseudogap phenomenon in HTS - stripe phase
Neutron spectroscopy of collective modes in HTS
The Electron-Phonon mechanism in HTS (including the isotope effect)
Coexistence of antiferromagnetism and superconductivity in HTS and other superconductors
Coexistence of ferromagnetic and superconducting order
S/F/S Josephson junctions, spin-triplet proximity effect
The Proximity Effect, superconductor/ferromagnet proximity coupling
C_{60} superconductors, field-effect in C_{60} films
Superconductivity in carbon nanotubes and graphene
Superconductivity and topological insulators
Nano-scale superconductivity, proximity effect
MgB_2 superconducting properties and/or applications
Leggett mode in multi-band superconductors
Kosterlitz-Thouless transition in superconducting thin films
Quasi-1D superconducting films grown on carbon nanotubes
Hubbard model and HTS pairing mechanism
SO(5) theory of antiferromagnetism and HTS
Superconducting X-ray detectors
Mesoscopic superconductors - Andreev scattering, Andreev billiards
Infrared and Optical properties of superconductors - The sum rule in HTS
Rotating superconductors and the London moment
The Bernoulli Effect in superconductors
Electric Field Effect in superconductors
High Field (>30 T) properties of HTS. Fulde-Ferrell-Larkin-Ovchinikov State
HTS and MgB_2 Wire production
HTS Tape coating methods (Rabits, IBAD, etc.)
Vortex imaging techniques (neutrons, magnetic force microscopes, SQUID microscopes, etc.)
Classical superconducting computers
Quantum superconducting computers
Superconducting kinetic inductance single-photon detectors
Transition edge sensors
NMR measurements in superconductors
Ultrasonic attenuation in unconventional superconductors
Magnetic and non-Magnetic impurities in HTS
Angle-Resolved Photoemission spectroscopy (ARPES) of the Fermi surface and energy gap in HTS
High-field quantum oscillation measurements in cuprates and other superconductors
STM and tunneling spectroscopy of superconductors
Marginal Fermi Liquid theory of HTS
Organic superconductors
Transport properties of HTS with $H > H_{c2}$
Hall Effect in LTS and HTS
Nernst Effect above T_c in the pseudogap region
Fluctuation diamagnetism above T_c in the pseudogap region
Theory of and Evidence for a Quantum Critical Point in the HTS phase diagram
Room temperature superconductivity – where is it? What would it look like? Do we already have it?
Practical utility of room temperature superconductors
Extremely low-level measurements using SQUIDs
Superconductivity in the presence of spin imbalance
Superconducting experiments and detectors operating in orbit.
Superconductivity in the gravity-Probe B experiment

Some Previous Term Paper Titles:
Transport Properties of the Electron-doped Superconducting Cuprates
Superconductors for Wireless Applications
Imaging Techniques for Vortices in Superconductors

Scanning Tunneling Microscopy and Scanning Tunneling Spectroscopy on Superconductors
Extremely Low-Level Measurements Using DC SQUID
Report on Rapid Single Flux Quantum (RSFQ) Logic
Proximity Effects of Superconductors
Infrared and Optical Properties of Superconductors
Extremely Low Level Measurements Using SQUIDs
Kosterlitz-Thouless Transition in Two-Dimensional Superconductors
Manifestations of the Casimir effect in superconductors

Superconductors in Rotation
Superconductors in the presence of weak inertial and gravitational fields
The pseudogap of the angle resolved photoemission spectroscopy and the resonating valence bond model in high temperature superconductors
Thermally-Driven Melting of the Vortex Lattice
Quantum phase transition: in cuprate superconductors
High-T_c Superconductors and the Hubbard Model
Models for the proximity effect
Chaos and Nonlinear Dynamics in Josephson Junctions
Vortex Imaging Techniques
Magnetic Levitation with Superconductors
Andreev Reflection