Physics 612
Quantum Field Theory for Condensed Matter Physics
Tuesday and Thursday, 11:10 to 12:25PM, Room P608.

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Course Description: Many systems in nature are far too complex to analyze directly. Solving for the atomic scale behavior is simply not feasible. Despite this fact, such systems often exhibit emergent simple and striking behaviors that become more transparent after taking the continuum limit. The resulting field theory can be solved by using the same methods that were originally developed for describing fundamental fields, such as the electromagnetic field. The formalism of quantum field theory then serves the double purpose of providing a quantum mechanical description of fundamental physical fields, as well as explaining emergent behaviors of complex systems by retaining a minimum number of relevant degrees of freedom. The concepts and methods of quantum field theory have penetrated many fields of science, including high-energy physics, statistical mechanics and condensed matter physics. This course will cover the basic concepts and methods of quantum field theory with applications to condensed matter physics. Note that field theory is a very mathematical subject and sometimes requires mathematical sophistication and rigor that goes beyond the level of a typical Physics course. For this reason, it is very important to be familiarized with some basic mathematical concepts, such as functional analysis. While we will devote three lectures to second quantization, this course assumes that the students are already familiarized with this notion. The same is true for the path integral formulation of quantum mechanics for a single particle.


state path integral. Partition function of non-interacting gas.


Credit Hours: 3