Project Assignment 2

1. Rose-Innes, Alistair Christopher., and E. H. Rhoderick. Introduction to Superconductivity. Pergamon Press, 1994.
2. Cooper, L. (1956). Bound Electron Pairs in a Degenerate Fermi Gas. Physical Review, 104(4), pp.1189-1190.
3. J. Bardeen, L. N. Cooper, and J. R. Schrieffer. Microscopic Theory of Superconductivity. Phys. Rev., 106(1):162–164, Apr 1957.
4. “BCS Theory and Superconductivity.” *University of Florida Physics*, University of Florida, [www.phys.ufl.edu/courses/phy4523/spring12/Sample%202.pdf](http://www.phys.ufl.edu/courses/phy4523/spring12/Sample%202.pdf).

Concern: This phenomenon is heavily reliant on quantum effects. Since this class mostly covers classical E&M, is this a good topic?

4) This paper is a great summary of Bardeen, Cooper, Schrieffer (BCS) theory of superconductivity. It covers both the conceptual and mathematical aspects of this theory. This paper is a review of the theory and not the paper that released the original theory. I find this paper to be much easier to read and understand than some of the original studies. It explains the theory in much more basic language than some of the more in-depth papers that are filled with academese.

Need to know: Isotope effect. This paper mainly serves as an explanation of the concepts of the theory. It will provide a crucial part of understanding the basic concepts of superconductivity, but some of the details are not included. It covers the ideas of cooper pairs and the mathematical framework for them. Although less pertinent to the paper, it also briefly covers the experimental confirmation of the theory. One thing mentioned in other papers is the theory of the Isotope Effect which I should learn more about to get a better intuition of the mechanisms behind BCS Theory.

Question for you: How is explaining how theoretical models are constructed relevant? Isn’t the goal more to explain the model and how it works?

3) This paper is much more in depth than the previous. This paper won the 1972 Nobel prize in physics for its theory, what is referred to as BCS theory of superconductivity. It covers methods and concerns of previous explanations regarding superconductivity. This builds off of the theory of cooper pairing which is explained in reference [2]. This paper covers concerns with other theories and corrections to understandings at that time. The problem with this paper is that it uses much more academic jargon that is hard to understand if you’re no well-versed in the field. There are certainly things to learn from this paper, like the finer details of the theory and origin of conventional superconductors, but I think I should stray from relying on this too heavily. Just my thought.

This paper explains most of the deeper mathematical structure of the theory. One approximation that is makes is that it estimates the density of states at the fermi surface and uses empirical values to form the theory. I am having a hard time determining the relevance of such approximations, but it seemed note-worthy. Another important note is that this theory was sought out after a phenomenon was discovered. Many modern phenomena are theorized first and then experimentally tested but this is not true in the case of superconductors.