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THERMODYNAMIC PROPERTIES OF HEAVY FERMION SUPERCONDUCTORS

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2016

A thesis submitted in Partial fulfillment of the requirement for the award of the degree of Master of Science in physics of Masinde Muliro University of Science and technology.

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Declarations

Declaration by the candidate

This thesis is my original work prepared with no other than the indicated sources and support and has not been presented anywhere for a degree or any other award in any other university.

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Declaration by the Supervisors

This thesis has been submitted for examination with our approval as the University Supervisors

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ABSTRACT

Heavy fermion superconductors are metallic materials with very large electronic effective mass, 100 or more times larger than the bare electronic mass, arising from antiferromagnetic interaction between conduction electrons and the local magnetic moments residing on a sub-lattice of atoms in the metal. Although many different heavy-fermion superconductors have been found, theoretical studies are still insufficient to bring out an understanding of the specific superconducting properties. The thermodynamic properties of Heavy Fermion Systems have been studied using the Bogoliubov-Valatin transformations approach. In this research a singlet and triplet pairing is studied as s-wave superconductivity. An effective Hamiltonian for the singlet and triplet pairing is developed in terms of the fermionic creation and annihilation operators. The specific heat and entropy of the system were determined and consequently analyzed. The total energy of the system is found to increase with increase in temperature of the system. The jump in specific heat capacity suggests a phase-like transition at temperature of about 5.2K.The Heavy Fermion Systems show a large value of specific heat of about 4.8×10^{-23} J/K at T_C. Such precise measurements of heavy fermion formation are not only required for understanding of the electronic excitations close to quantum phase transitions but are also critical to identifying the source of unconventional superconductivity. The entropy is continuous at $T = T_C$ showing the phase transition is continuous, hence not of first order. Entropy of the system was found to decreases with temperature as is conventionally the case.