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SUPERCONDUCTIVITY AND MAGNETISM IN HEAVY FERMION COMPOUNDS

Dr. Swati Bhatnagar, Assistant Professor and
Hod (Department of Science)
ISBA Institute of Professional Studies, Indore, M.P., India

Abstract:

Heavy fermion compounds have been a topic of intense research for several decades due to their fascinating electronic properties. These materials exhibit a wide range of exotic phenomena, including superconductivity and magnetism, which arise from the complex interplay between localized and itinerant electrons. In this paper, we review recent advances in the study of superconductivity and magnetism in heavy fermion compounds, with a focus on the role of magnetic fluctuations in the emergence of these phenomena.

Introduction:

Heavy fermion compounds are materials that exhibit a large effective mass of the conduction electrons due to the strong interaction between localized f-electrons and itinerant conduction electrons. This interaction gives rise to a rich variety of electronic properties, including Kondo screening, magnetic order, and superconductivity. The interplay between these electronic states is crucial for the emergence of superconductivity and magnetism in heavy fermion compounds.

Superconductivity in heavy fermion compounds:

Superconductivity in heavy fermion compounds is typically observed at low temperatures and high pressures. The superconducting state arises from the pairing of electrons in the presence of strong electronic correlations. The pairing mechanism is believed to be mediated by magnetic fluctuations, which induce an attractive interaction between the conduction electrons. The superconducting critical temperature, Tc, can be enhanced by the presence of magnetic order, which can provide an additional pairing mechanism.

Magnetism in heavy fermion compounds:

Magnetism is a common feature of heavy fermion compounds and arises from the localized f-electrons. The magnetic state can be characterized by a variety of orders, including antiferromagnetic, ferromagnetic, and spin-glass. The magnetic state can strongly influence the electronic properties of the material, including the Fermi surface topology and the superconducting state. The interplay between magnetism and superconductivity in heavy fermion compounds is an active area of research.

Conclusion:

Heavy fermion compounds continue to be a fascinating area of research due to their rich electronic properties. The interplay between superconductivity and magnetism in these materials is a key area of study, with the role of magnetic fluctuations being a central focus. Advances in experimental techniques and theoretical modeling have led to a deeper understanding of the electronic states in heavy fermion compounds, and further progress is expected in the years to come.