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Title:

Introduction to high temperature superconductivity

Abstract:

Superconductivity was first found in mercury in 1911 by Heike Kamerlingh Onnes. About 46 years later Bardeen Cooper and Schrieffer (BCS) wrote a theory to explain this phenomenon. Today we know that most metals and alloys become superconducting at (ultra) low temperatures (milli-Kelvins to a few Kelvins). They are all conventional in the sense that they are described by the BCS theory and we therefore refer to them 'conventional' or BCS superconductors. The BCS theory consists of pairs of electrons (Cooper pairs) bound together by phonon exchange processes and forming a collective ground state.

In 1986 superconductivity was discovered by Georg Bednorz and K. Alex Müller in a ceramic material (LBCO). This material is a part of a large family known as the cuprates which exhibit transition temperatures of up to 150K. The high transition temperatures can not be explained by phonon coupling and therefore other scenarios are considered. It is widely perceived that strong correlation in the cuprates play an important role in forming the superconducting ground state. However, there is still no consensus on a single theoretical model which can describe the rich phenomenology of this family.

Many more materials have been found over the years to be superconducting. Most notable is the recent discovery of superconductivity in the iron-pnictide family (2006). This family most likely belongs to the unconventional class and adds a new ingredient into consideration - the strong magnetic moments of the iron atoms.

In this talks I will review the foundation of superconductivity theory and will discuss the phenomenology and theoretical ideas related to the cuprate and iron-pnictide superconductors.