

Preface

Symmetry plays an important role in superconductivity and influences many of its properties in a profound way. Ever since the discovery of the first unconventional superconductors roughly 30 years ago, the search for the symmetry of Cooper pairs has been among the most important tasks to be addressed, when studying new superconducting materials. Two symmetries are particularly important for superconductivity—time reversal and inversion symmetry. If at least one of the two is absent in the normal state already, Cooper pairing appears in non-standard forms. Ferromagnetic superconductors, lacking time reversal symmetry, form most likely pairs of electrons of the same spin, if the pairing mechanism permits. Missing inversion symmetry in so-called noncentrosymmetric crystals gives rise to mixed-parity pairing.

Non-centrosymmetric superconductors are known since a long time, but received little attention until recently. Their rise to a prominent topic of research occurred actually 2004 with the discovery of the first heavy fermion superconductor without inversion symmetry, CePt_3Si . This example was followed swiftly by the synthesis of other superconductors in similar classes, such as CeIrSi_3 and CeRhSi_3 , as well as several others also outside the heavy fermion family. These superconductors received special attention due to the expectation of unconventional pairing due to non-standard pairing mechanisms, most likely driven by magnetic fluctuations.

The symmetry properties are intriguing for many reasons connecting these unconventional superconductivity with several other modern research fields in condensed matter physics, such as multi-ferroics, spintronics or topological insulators. Many symmetry-related properties have been observed in experiment and others are predicted by theory, displaying most intriguing features of a superconducting phase.

This book provides an introduction to and an overview on many aspects of non-centrosymmetric superconductivity, written by several scientists who are most active in this field. We are most grateful to all authors for their contributions. In addition, we are very grateful to Prof. H. von Löhneysen (KIT Karlsruhe, Germany) for critically

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Introduction and Overview

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