Probing the Superconducting State of Sr_2RuO_4 with Strains: New Perspectives on an Old Puzzle

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Sr_2RuO_4 has fascinated physicists for over 30 years as a leading candidate for unconventional superconductivity, a state of matter where electrons pair up in unusual ways not explained by conventional theories [1]. Despite intense study, the exact nature of its superconducting state remains elusive. At the heart of the debate lies the symmetry of the order parameter, which describes how electrons pair in the superconducting phase [2].

Recent experiments applying uniaxial strain have added new insights but also deepened the mystery. In particular, the smooth variation of the superconducting transition temperature (T_c) under certain strain directions suggests a simple, one-component order parameter [3]. On the other hand, ultrasound measurements detecting sudden changes in the elastic moduli of Sr_2RuO_4 point toward a more complex, two-component scenario [4, 5].

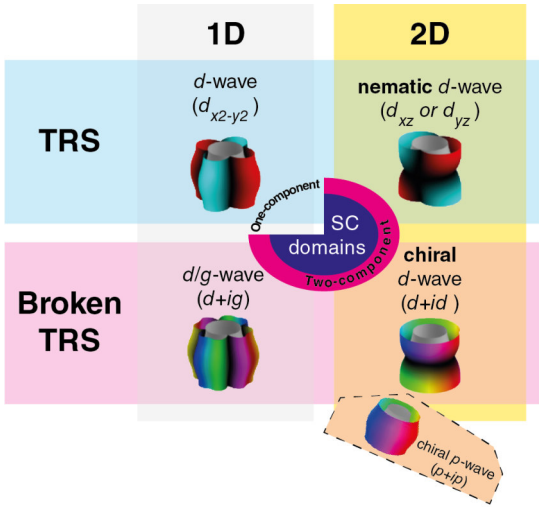

Figure: Proposed superconducting symmetries of Sr_2RuO_4. [2]

In this talk, I will first give an overview of Sr_2RuO_4 and the long-standing puzzle surrounding its superconductivity. I will then introduce our recent experimental developments involving both uniaxial and shear strains in Sr_2RuO_4 crystals and measuring changes in T_c using sensitive magnetic techniques [6]. Our findings offer a fresh angle on the problem and help test the competing theories of the superconducting state. This approach highlights the broader potential of strain as a powerful and versatile tool for tuning and controlling the electronic properties of quantum materials.

References

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