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Band structure of magnetic materials

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This lecture will explore the relationship between electronic band structure and the emergence of magnetism in materials, with a particular emphasis on van der Waals magnetic compounds. We begin with a review of fundamental band theory, employing simplified models to build intuition about electronic states in solids. This is followed by an introduction to modern electronic structure methods used to calculate band structures, along with a brief overview of how theoretical predictions can be validated against experimental observations. The lecture will then focus on the connection between magnetic ordering and band structure. We examine various types of magnetic order - including ferromagnetism, antiferromagnetism, and ferrimagnetism - and how these give rise to characteristic features such as spin splitting and band asymmetries in both metals and insulators. Finally, we introduce the concept of altermagnetism, a property of a recently identified class of magnetic materials that exhibit spin-split electronic structures despite possessing zero net magnetization. This emerging property provides new opportunities for the design and understanding of quantum materials and spintronic applications.

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