Introduction to Multiferroics

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Multiferroics are materials with a coexistence of magnetic and ferroelectric order. Although their discovery dates from the 1950's, they have seen an impressive revival in the past 15 years, mainly driven by the possibility of an efficient route for the control of magnetism by electric fields. In recent years, key discoveries in theory, synthesis and characterization techniques have boosted the field. In this lecture, I will present the different mechanisms of multiferroicity, such as lone-pair, geometric, charge-ordering and spin-driven effects. I will put a particular emphasis on the archetype compound $BiFeO_3$ and its relevance to different fields, including ferroelectricity, spintronics and topology. The spatial and time-scales for these properties will also be discussed to better illustrate the great potential of these materials.