

Prize Talk

PRV I Tue 13:15 HSZ 01

Seeing is believing: Nonlinear optics on ferroic materials —
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For millennia, ferromagnetism was the only form of ferroic order known to humankind. Now, however, a large variety of magnetic, electrical and mechanical types of ferroic phenomena is discussed. All of these all have one property in common: The ferroic ordering breaks the symmetry of the host material. Nonlinear optical processes are very sensitive to these symmetry changes. Even its simplest representative, doubling of the frequency of the light or "second harmonic generation" (SHG), therefore couples to the ferroic order parameter and accesses important features of the ferroic state that are often inaccessible to non-optical

techniques. Novel ferroic states like ferrotoroidicity as a spontaneous order of magnetic whirls can thus be probed. Ultrafast processes can be resolved — how fast can a magnetic state be switched? In particular, the coexistence of different types of ferroic order in a material can be imaged by SHG. Thus, SHG became an invaluable tool for resolving the magnetoelectric coupling of domains in multiferroics as materials uniting magnetic and ferroelectric order. In my talk I will give an overview of the most important milestones in the classification of (multi-)ferroic materials by nonlinear optics. I will discuss basic questions such as the search for yet unknown types of ferroic order and correlations. I will also address highly application-relevant issues such as the use of SHG for tracking the emergence of ferroic order in thin films in-situ, during the growth process. A not-too-serious concept for "magnetoelectric teleportation" will conclude the lecture.