MAGNETOELECTRIC INTERACTION PHENOMENA IN MULTIFERROICS AND THE ROLE OF SPACE-TIME SYMMETRY VIOLATION

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Recently, an enormous interest in multiferroics – compounds uniting two or more forms of primary ferroic ordering in one phase – is observed. Aside from technological aspects the interplay of different forms of (anti-) ferroic ordering is a rich source for exploring the fundamental science of phase control. Magnetic ferroelectrics may constitute the most interesting type of multiferroics because they may exhibit an unusually strong, so-called magnetoelectric (ME), coupling of magnetic and electric properties which is useful for controlling magnetic order with electric fields and vice versa. In my talk I will discuss the relation between space-time symmetry violation and the ME properties multiferroics. Two examples based on the nonlinear optical experiments done in our group will be given. On the one hand, space-time symmetry violation can lead to ferrotoroidicity, a fourth form of ferroic order characterized by long-range ordering of magnetic vortices inherently displaying the ME effect. On the other hand, space-time symmetry violation by the formation of magnetic spirals can lead to magnetically induced ferroelectricity with strong coupling of the spontaneous polarization to the magnetic order parameter.