Symmetry analysis of multiferroic domain structures

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Any ferroic domain structure (DS) results from dissymmetrization (reduction of symmetry) at a ferroic phase transition. It is, therefore, not surprising that the symmetry analysis can yield basic relations governing DS properties. These deductions are definite and exact – their validity does not depend on any model or approximation – and are particularly useful in complicated DS's associated with large dissymetrizations , which is the case of multiferroics.

Some results of symmetric analysis of DS in multiferroic boracites and manganites will illustrate derivation of possible domain states (interior structures of domains), their basic classification (ferroelastic, ferroelectric, ferromagnetic and others), their hierarchy (some ferroelastic domain states may contain several ferroelectric domain states, each of which may further be compatible with several ferromagnetic or antiferromagnetic domain states, etc.), observability of different domain states and possible switching by external fields (in particular, switching of magnetic domain states by electric field and vice versa).

Multiferroics open also new possibilities for domain engineering. An example will demonstrate what possible domain configurations are, in principle, accessible by external magnetic, electric and mechanical fields. Averaged tensor properties of these engineered domain structures indicate how various material coefficients could be modified by such procedures.