ZERNIKE INSTITUTE COLLOQUIUM

Thursday, October 6th, 2011

16:00h, Lecture Hall: 5111.0080 **Coffee and cakes from 15:30h**

Multiferroic Vortices and Graph Theory

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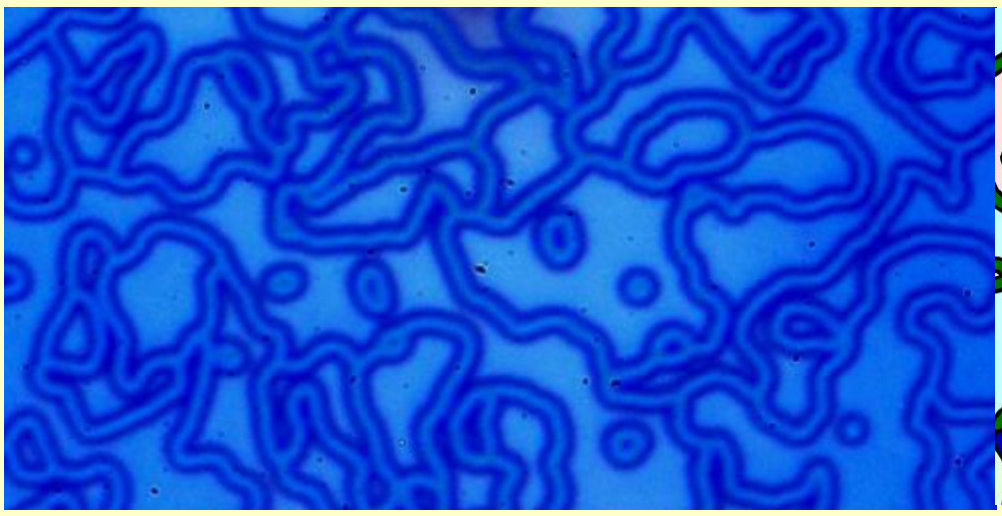
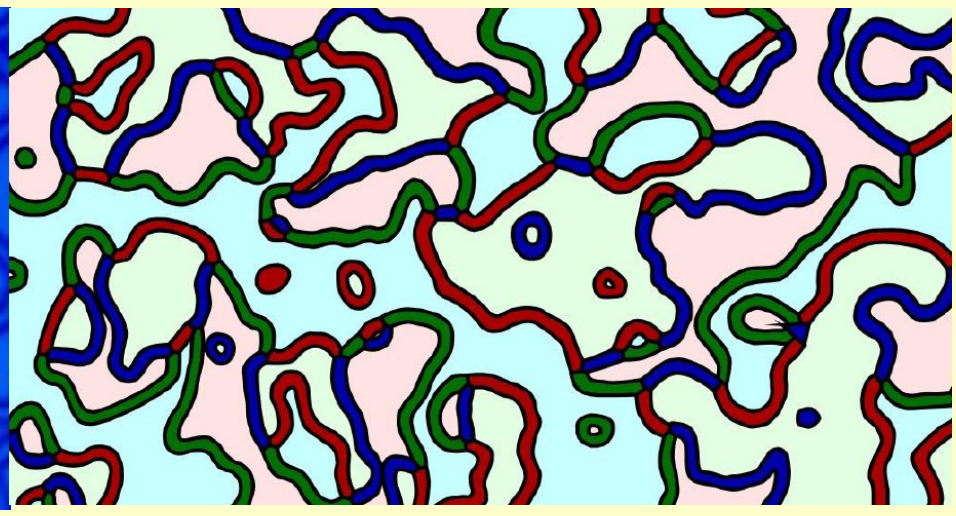
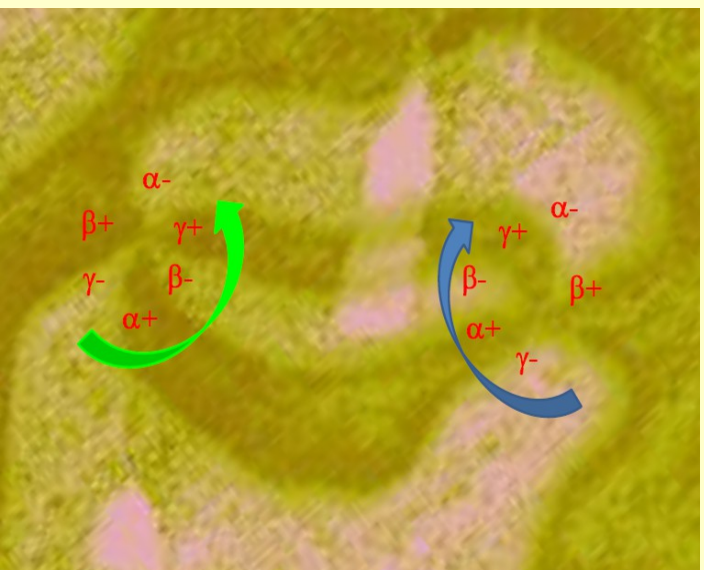
The fascinating concept of topological defects permeates ubiquitously our understanding of the early-stage universe, hurricanes, quantum matters such as superfluids and superconductors, and also technological materials such as liquid crystals and magnets. Large-scale spatial configurations of these topological defects have been investigated only in a limited degree. Exceptions include the cases of supercurrent vortices or liquid crystals, but they tend to exhibit either trivial or rather-irregular configurations.





Hexagonal REMnO3 (RE= rare earths) with RE=Ho-Lu, Y, and Sc, is an improper ferroelectric where the size mismatch between RE and Mn induces a trimerization-type structural phase transition, and this structural transition leads to three structural domains, each of which can support two directions of ferroelectric polarization. We reported that domains in h-REMnO3 meet in cloverleaf arrangements that cycle through all six domain configurations, Occurring in pairs, the cloverleafs can be viewed as vortices and antivortices, in which the cycle of domain configurations is reversed. Vortices and antivortices are topological defects: even in a strong electric field they won't annihilate.



Recently we have found intriguing, but seemingly irregular configurations of a zoo of topological vortices and antivortices in h-REMnO3. These configurations can be neatly analyzed in terms of graph theory and this graph theoretical analysis reflects the nature of self-organized criticality in complexity phenomena as well as the condensation and eventual annihilation processes of topological vortex-antivortex pairs.

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