




amasing


Workshop
AMASING
TU Dresden
4th June - 9th June 2012


TECHNISCHE UNIVERSITÄT DRESDEN DAAD complex nano materials DRESDEN concept




23. Dr. Denys Sheka

Dr. Denys Sheka
Chair of Mathematics and Theoretical Radiophysics
Radiophysics Faculty
National Taras Shevchenko University of Kiev
64 Vladymirska str.
01033 Kiev
UKRAINE

E-Mail: sheka@univ.net.ua

Magnetic vortices in nano-objects

The active control of nonlinear dynamical systems is a fastly developing area of condensed matter physics. Artificial nanomagnetic systems (magnetic nanoparticles and their superstructures) have acquired a significant place in physics as well as in technology. Essentially inhomogeneous states can be realized in magnetic nanoparticles. Due to nontrivial topological properties and nonlinear interactions, a problem of dynamics of inhomogeneous states in nanomagnets is a problem of non one dimensional topological solitons. Recent direct experimental observations of vortices in such systems argue that vortices can form a ground state in such nanoelements. Namely magnetic vortices provide stable bit at the scale of about 100 nm. Magnetic nanoparticles at vortex state and their structures are very promising candidates for the high density magnetic storage and high speed magnetic random access memory.

A short overview of statics and dynamics of magnetic vortices in nanomagnets will be presented. In particular, we discuss the vortex structure in nanodots of different geometries and curvatures. We consider magnetization dynamics in nanodots: linear problem of vortex-magnon interaction and nonlinear vortex dynamics. The special interest is a controlled vortex dynamics under the influence of magnetic fields and spin-polarized currents. We construct a theory of the vortex polarity switching phenomenon; we describe the mechanism of the creation of the topological singularities under the switching process. A special interest is spatially periodic vortex-antivortex structures which appear in nanomagnets under influence of spin-transfer torque. We also discuss the interplay of topological defects with curvature for out-of-surface magnetic vortices in thin spherical nanoshells: the curvature of the underlying surface leads to a coupling between the localized out-of-surface component of the vortex with its delocalized in-surface structure, i.e., polarity-chirality coupling.