Софийски университет „Св. Климент Охридски“
Физически факултет

ФАКУЛТЕТЕН СЕМИНАР

петък, 17 юли 2015 г., 14:15 часа, зала А315

Avadh Saxena

Los Alamos National Lab, New Mexico, USA

Topological Excitations in Functional Materials

A variety of stable topological excitations such as domain walls and vortices are ubiquitous in condensed matter as well as high energy physics and are responsible for many emergent phenomena. Recently a new mesoscopic spin texture called skyrmion was discovered experimentally in certain conducting and insulating magnets. It has been observed in multiferroic materials as well. It is now believed to exist in Bose-Einstein condensates, 2D electron gases, superconductors, nematic liquid crystals among other systems. This topological excitation was originally proposed by Tony Skyrme in 1958 in a nonlinear field theory of baryons. In the temperature-magnetic field phase diagram of chiral magnets, skyrmions form a triangular lattice in the low temperature and intermediate magnetic field region (in thin films). In metallic magnets, skyrmions can be driven by a spin polarized current. The threshold current density to depin skyrmions is 4 to 5 orders of magnitudes weaker than that for magnetic domain walls. The low depinning current makes skyrmions extremely promising for applications in spintronics, such as information storage. I will first attempt to summarize the experiments and present a comparative overview on domains, vortices and skyrmions. Then I will discuss the dynamical phase transitions for skyrmions and show that they can be created and destroyed dynamically by current. In magneto-electric insulators they can be moved by a magnon current. When easy plane magnetic anisotropy is increased there is a topological charge fractionalization resulting in merons. Next, I will discuss the emergent magnetic monopoles. Finally I will compare skyrmions with other topological objects such as vortices in type II superconductors and domain walls.