Seminar: Hard Condensed Matter Theory

JOHANNES GUTENBERG UNIVERSITÄT MAINZ

Room: Galilei Raum, 01-128 (Staudinger Weg 9)
Time: Januar 23th, 2018 at 14:00

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Topological excitations in nano-scale ferroelectrics

Formation of unusual textures of polarization is imminent for nano-scale ferroelectric samples, films, rods, and granules, where the depolarization surface effects play the crucial role. The topologically protected stability of such textures is coming from polarization vorticity, provided by condition of absence of the energetically-unfavorable depolarization charge. Polarization domains that alternate the surface charge distribution, first proposed by Landau and Kittel in contents of ferromagnetism can be formed in ferroelectric thin films as an effective mechanism to confine the depolarization field to the near-surface layer and diminish the depolarization energy. However, their existence have long been considered as barely possible until the direct theoretical predictions and experimental evidences thin oxide-based superlattices. Very recently we have demonstrated that the effective capacitance of ferroelectric layers with domains is negative. This effect is explained by the opposite orientation of the depolarizing field with respect to the field-induced averaged polarization. This phenomenon is currently considered as the platform for realization of the dissipation-free high performance nano-circuits. Moreover, in sub-THz region the resonance plasmonic effect can be induced by oscillating domain walls and can be suitable for design of the ultra-small low-energy THz chips. Multi-vortex and skyrmion states can be formed inside ferroelectric cylindrical nano-dots and nanorods to reduce the depolarization energy. We study the stability of such states and demonstrate that the topological class of the most stable topological excitations can be driven by the geometrical and electrical parameters of the system, external field and temperature. We target the multi-domain and topological excitations in FE nanodots as a platform for multivalued logic units, breaking ground for neuromorphic computing.

All interested are cordially welcome!

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