STATICS AND DYNAMICS OF 3D MAGNETIZATION TEXTURES - THEORY AND SIMULATIONS

3DMATEX

The existence of 3D magnetic textures with particle-like properties (3D solitons) is known as intriguing theoretical prediction during four decades. The scientific and technological significance of the discovery of such structures can hardly be overestimated: employment of 3D solitons like Hopfions, domain walls and Bloch points can open a pass to creating magnetic storage with a high density of information recording and new spintronic devices. Only recently, with the development of computer and experimental technology, wide opportunities have arisen for their simulation and experimental observation. However, despite the successful studies of recent years, 3D magnetic textures still remain a little studied area, which makes it difficult to introduce such new materials for technological employment.

In order to bring the creation of new devices based on 3D textures closer, in the 3DMATEX project a comprehensive theoretical study of statical and dynamical properties of such magnetic systems will be performed. The priority issues to explore are:

- Create state diagrams of the 3D magnetic configurations in cylindrical nanowires;
- Describe resonant motion of 3D solitons in cylindrical geometries;
- Investigate 3D solitons inside of the cylindrical magnetic wires in ordered array and consider this structure as a versatile green magnetic storage unit with a three-dimensional architecture.
- Study Bloch point and vortex oscillation frequencies in cylindrical nanowire.

As a result, the project will answer the principal questions regarding physics and properties of stable 3D magnetization textures in confined structures: *What materials can produce non-trivial 3D magnetization textures*? *What is their topology*? *What is their dynamics*? *How we can control and determined their oscillations*? *What is detailed magnetization configuration, in particular of the Bloch-point 3D domain wall in cylindrical geometry*?

With basic knowladge about the physical properties of 3D magnetization textures developed in the project, the important step toward their technological applications will be done, towards the long-term vision of versatile green magnetic storage units with a 3D architecture, openning a new route for spintronics which promises low energy consuming computations.