PHYSICS OF CONDENSED MATER

The influence of temperature on electro-magnetic properties of soft magnetic composites
supervisor: doc. RNDr. Ján Füzer, PhD. (jan.fuzer@upjs.sk)
study form: full time
Annotation: The study is oriented on investigation of the NiFe and FeSi based composite materials with inorganic or organic nonconductive binder. Part of the work is the investigation of temperature dependences of the wideband complex permeability and energy losses in prepared soft magnetic composites and determination the influence of operating temperature on magnetization processes. The aim is optimization of preparation process of soft magnetic materials with required magnetic properties at middle-frequency ac magnetic fields and in temperature interval from -50ºC to 200ºC.

Relaxation phenomena in low-dimensional and molecular magnets
supervisor: doc. RNDr. Erik Čižmár, PhD. (erik.cizmar@upjs.sk)
study form: full time
Annotation: Thesis is devoted to the experimental study of selected low-dimensional and molecular magnets with aim to study slow magnetic relaxation related to the spin-lattice relaxation processes. Spin-lattice relaxation rate represents the upper limit for spin-spin relaxation, which is a characteristic parameter (quantum coherence time) related to the application of a molecular magnet as a quantum bit. Low-dimensional magnets also represent a natural playground for the study of quantum entanglement. Analysis of EPR spectra, magnetic and thermodynamic properties at low-temperatures will be performed for determination of characteristic parameters of magnetic system and their relation to possible quantum computing applications. Studied low-dimensional magnets will be based mainly on 3d ions and organic radicals.

Interplay of the spin and lattice dimensionality in the quantum processes in the selected quantum magnets with extremely high measure of spatial anisotropy of exchange coupling.
supervisor: doc. RNDr. Alžbeta Orendáčová, DrSc. (alzbeta.orendacova@upjs.sk)
consultants: RNDr. Vladimír Tkáč, PhD., RNDr. Róbert Tarasenko, PhD,
study form: full time
Annotation: The work has experimental character focused on the understanding of microscopic origin of mechanisms responsible for the change of lattice dimensionality (phase transitions) and spin dimensionality (type of anisotropy -dipolar, exchange, crystal field,etc). Using selected compounds, various experiments will be performed including measuring of thermodynamic quantities, electron paramagnetic resonance and infrared spectroscopy. If need arises, also other quantities as heat transport, neutron diffraction and ac susceptibility will be measured. Analysis of exp. data will enable to define the character of magnetic system. When we find a proper system with high measure of spatial anisotropy of exchange coupling, the compound will serve as a toy-model system for the study of quantum processes in the dimension 0, 1 or 2. Besides standard managing of exp. methods available in our laboratories, the student is expected to learn at least one of standard program packages which enable simple DFT calculations or others like EasySpin, Fullproff , ALPS atc. With respect to actual conditions in our society, acquirement of softwer literacy is crucial for future potential job of PHD student.