Wednesday Posters
Abstracts

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Fano effect vs. induced superconductivity in T-shaped double quantum dots

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I will present some preliminary results concerning a double quantum dot device with three electrodes: one superconducting and two made of normal or ferromagnetic metal. I consider the T-shaped configuration, in which only one dot is directly coupled to the normal leads, and focus on a superconductor proximity effects. In the absence of superconductor, the ferromagnetic contacts induce so-called exchange field, splitting the levels of the interacting quantum dots. It leads to the spin-dependent Fano anti-resonance in the conductance of the system expressed as a function of gate voltages. Consequently, gate-controlled spin filtering effect occurs at low temperatures. In the poster, I will show the influence of the superconducting lead on this effect, on the basis of numerical renormalization group calculations.

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Local magnetic measurements of permanent current paths in a natural graphite crystal

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A recently reported transition in the electrical resistance of different natural graphite samples suggests the existence of superconductivity at room temperature [1]. To check whether dissipationless electrical currents are responsible for the trapped magnetic flux inferred from electrical resistance measurements, we localized them using magnetic force microscopy on a natural graphite sample in remanent state after applying a magnetic field.
The obtained evidence indicates that at room temperature a permanent current flows at the border of the trapped flux region. The current path vanishes at the same transition temperature $T_c \simeq 370$ K as the one obtained from electrical resistance measurements on the same sample. The overall results support the existence of room-temperature superconductivity at certain regions in the graphite structure and show that the used method is suitable to localize the superconducting regions.
[1] Precker et al., New J. of Physics 18, 113041, 2016, DOI: 10.1088/1367-2630/18/11/113041

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Inertia-Free Thermally Driven Domain-Wall Motion in Antiferromagnets

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Induced domain wall motion is the key to an efficient and fast control of magnetic nanostructures. Due to their complex spin structures leading to higher spin dynamics than in ferromagnets, antiferromagnets are promising candidates as materials for future devices.
Domain-wall motion in antiferromagnets triggered by thermally induced magnonic spin currents is studied theoretically. It is shown by numerical calculations based on a classical spin model that

the wall moves towards the hotter regions, as in ferromagnets. However, for larger driving forces the so-called Walker breakdown - which usually speeds down the wall - is missing. This is due to the fact that the wall is not tilted during its motion. For the same reason antiferromagnetic walls have no inertia and, hence, no acceleration phase leading to higher effective mobility (Phys. Rev. Lett. 117, 107201).
The effect is not restricted to temperature gradients but also applies to other driving mechanisms in antiferromagnets featuring staggered torques, like Néel spin-orbit torques. These torques allow for much higher velocities revealing a kind of relativistic limit when the wall velocity approaches the magnon velocity of the system.

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Ferromagnetic phase transition in Li2-xCoxAE2N2 (AE = Ca, Sr)

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Li3-xFexN is one of the scarce rare-earth free hard magnets and shows a huge magnetic anisotropy and the highest known coercivity field with a value of more than 11 T! These properties are attributed to the unquenched orbital moment of iron, enabled by the perfect linear, twofold coordination of iron between nitrogen [1]. In order to investigate the necessity as well as sufficiency of this geometrical motive, we investigated similar compounds [2]. Among those are (Li2-xCox)Ca2N2 and (Li2-xCox)Sr2N2. Isothermal and temperature dependent magnetization measurements were performed at temperatures of T = 2 K - 300 K and applied magnetic fields of up to $\mu_0 H$ = 7 T. We observe comparatively large coercivity fields. The Hysteresis vanishes at 76 K for (Li2-xCox)Ca2N2 and 43 K for (Li2-xCox)Ca2N2, respectively, and is clearly reflected in the temperature dependence of the magnetization. We conclude that the structural motive of a transition metal in linear coordination with only two neighbours, allows to predict materials with unusually stable magnetic properties.
[1] A. Jesche et al. Nat. Commun. 5:3333. doi: 10.1038/ncomms4333 (2014) [2] P. Höhn, T. J. B. et al. Inorganics 4, 42 (2016)

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Manipulation of magnetic systems by thermal gradients

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The investigation and control of domains and domain walls in magnetic materials plays a crucial role for a deeper understanding in magnetic thin films and in the development of future spintronic devices. Lately the interaction between heat transport, charge and spin degrees of freedom has been attracting considerable attention.
In this project we are investigating the influences of thermal gradients in magnetic systems by different means. One method uses a frequency doubled cw-Nd:YAG which is focused onto a sample, thus creating a locally controlled thermal gradient. The other method is direct laser interference patterning (DLIP) [1]. For DLIP we split up a nanosecond pulse into a number of beams which are overlapped again on the sample surface, hence creating a periodic temperature pattern. One material type in study are amorphous TbFe thin films with an out of plane magnetization. By controlling the extent of the gradient one can for example manipulate magnetic domain walls [2] or induce a phase change from out of plane magnetization to in plane. Since the change of magnetization direction happens due to a crystallization process one can tailor a

crystalline structure of choice in an otherwise amorphous matrix. Preliminary experiments indicate, that those structures in turn might be of interest as magnonic crystals.

[1] STAERK, M., et al. (2015). "Controlling the magnetic structure of Co/Pd thin films by direct laser interference patterning." Nanotechnology 26(20): 205302.
[2] HINZKE, D. and U. NOWAK (2011). "Domain Wall Motion by the Magnonic Spin Seebeck Effect." Physical Review Letters 107(2).

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Ultrafast Magnetic Imaging with Circularly Polarized High Harmonics

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The recently demonstrated generation of circularly polarized extreme ultraviolet (XUV) radiation from high-harmonic light sources [1,2] in combination with lensless imaging techniques opens a new and powerful route for the spatially-resolved study of ultrafast magnetization dynamics [3]. Integrating the in-line production of a bi-circular field [4] in a recent implementation of high-harmonic-based coherent diffractive imaging [5] allows us to generate bright circularly polarized harmonics in the 25-70 eV photon energy range. Using the circularly polarized high harmonic pulses, magnetic imaging via x-ray magnetic circular dichroism (XMCD) at the M-absorption edges of Co, Ni, Mn and Fe becomes possible.

Here, we demonstrate the first nanoscale magnetic imaging with high harmonic radiation employing Fourier transform holography [6] at the cobalt M edge. Our experiment opens the path for imaging of ultrafast magnetization dynamics and chiral phenomena with nanometer spatial resolution, high temporal resolution down to the attosecond time scale combined with element-specificity.

[1] O. Kfir et al., Nature Photonics 9, 99-105 (2015)
[2] D. Hickstein et al., Nature Photonics 9, 743-750 (2015)
[3] S. Mathias et al., JESRP 189, 164-170 (2013)
[4] O. Kfir et al., Appl. Phys. Lett. 108, 211106 (2016)
[5] S. Zayko et al., Optics Express 23, 19911-19921 (2015)
[6] S. Eisebitt et al. Nature 432, 885–888 (2004).

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Ferromagnetic nanoparticles of Ising spin-1 with a Rubik's cube structure: Monte Carlo simulations

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Using Monte Carlo simulations, magnetic properties of the ferromagnetic nanoparticles of Ising spin-1 are investigated in the framework of the Ising model. The system is considered to have a Rubik's cube structure composed of nanocubes having an equivalent exchange coupling, while, between adjacent nanocubes, the exchange coupling is assumed to vary. Both, size effects and system parameters influence on phase diagrams of the nanosystem are studied. Thus, magnetic properties of the system such as the critical temperature,the magnetization and the coercive field are computed.

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Ultrafast demagnetization dynamics in non-collinear magnetic multilayers

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Non-collinear magnetic multilayers are ideal sample systems to study optically excited spin currents in magnetic materials. In the ground state, these samples consist of an out-of-plane magnetized layer and an in-plane magnetized layer that are separated by a non-magnetic spacer layer [1, 2]. Using external magnetic fields, the magnetic configuration of the ground state can be changed to a collinear state in which the magnetizations of both magnetic films are either in-plane or out-of-plane. This allows us to gain insight into the role of the relative magnetization between different magnetic materials on the femtosecond dynamics of optically excited spin currents.

In this presentation, we focus on non-collinear multilayers containing Pd/Co layers and NiFe as magnetic materials separated by different non-magnetic materials. Optical excitation of the upper magnetic layer by fs laser pluses creates spin currents that are subsequently injected into the spacer layer. We vary the thickness and material of the spacer to influence the magnitude of the spin currents that are transmitted by the spacer layer and subsequently injected into the second magnetic layer. The ultrafast magnetization dynamics of each layer is monitored by using an all optical method based on the time-resolved magneto-optical Kerr effect. This becomes possible by exploiting the complex nature of the Kerr response [3]. This approach allows us to follow the evolution of magnetization of optically excited trilayer films and thereby to understand the role of ultrafast spin currents for the fs-demagnetization dynamics in magnetic layered structure with different arrangement of magnetizations.

[1] A. J. Schellekens et al, Nature Comm. 5, 4333 (2014)

[2] G-M. Choi et al, Nature Comm. 5, 4334 (2014)

[3] J. Hamrle et al, Phys. Rev. B 66, 224423 (2002)

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Magnetic Properties of the Nanolaminated Mn_2GaC MAX Phase

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We study the magnetic properties of a new magnetic Mn_2GaC MAX phase [1]. It is the first synthesized ternary compound with Mn as an exclusive element [2]. The sample is a heteroepitaxial thin film with a atomically laminated structure. Ferromagnetic resonance measurements show an easy axis of magnetization in the film plane [3].

We estimated a magnetocrystalline anisotropy energy density (MAE) of -40 ± 10 kJ/m^3. The negative sign indicates that the MAE favors an in-plane direction of the magnetization. Vibrating sample magnetometry (VSM) shows competing ferromagnetic (FM) and antiferromagnetic (AFM) interactions with a saturation magnetization M_S = 0.3 μB per Mn atom at T = 100 K (assuming that all spin polarization is located at the Mn atoms). With increasing temperature Mn_2GaC undergoes a first-order magnetic phase transition from a FM to an AFM state at T = 214 K.

[1] M. W. Barsoum, Prog. Solid State Chem. 28 (2000), 201.

[2] A. S. Ingason et al., Mater. Res. Lett. 2 (2014), 89-93.

[3] R. Salikhov et al., Mater. Res. Lett. 3 (2015), 156.

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Propagation of spin wave under time dependent magnetic fields

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The spin-wave dispersion relation strongly depends on the effective magnetic field acting on the magnetic moments. In order to investigate how spin waves behave if the magnetic field changes in time during their propagation, we applied pulsed magnetic fields changing on the nanosecond time scale.
Spin waves were excited in a NiFe micro stripe. A static bias magnetic field and a time dependent pulse field were applied to the stripe. The spin-wave intensity was measured by time-resolved Brillouin light scattering microscopy. We observed a frequency shift of spin waves at the rising edge of the pulse field. The change in frequency can be understood by the shift of the dispersion relation induced by the pulse field. We succeeded to manipulate the spin-wave frequency during their propagation by temporally inhomogeneous magnetic fields.

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Fe-Layer Induced Ferromagnetism in Polycrystalline Pd: An *In-Situ* Polarised Neutron Reflectometry Study

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Magnetic data storage systems are based on thin magnetic layers and heterostructures. For improving the functionality of existing devices and to develop new ones, a deep understanding of the properties of these layers and the coupling between them is essential. In this context not only the classic room temperature ferromagnets are of interest but also elements which can be polarised, like Pd, in which induced magnetism is observed when it is brought into contact with Fe. To monitor the structural and magnetic properties during the deposition process, in-situ polarised neutron reflectometry is used as a novel analysis technique.
The evolution of the magnetism in polycrystalline Pd/Fe/Pd thin film systems during growth will be presented. For Fe-layer thicknesses of only 4.1 Å, deposited onto an initial Pd layer, a high induced magnetic moment of approximately 1µB per unit cell was found in the Pd at the interface whereas the magnetic moment of the Fe is small compared to its bulk value. With more Pd deposited on top of the Fe layer, the magnetic moment of Fe increases while the induced magnetism in Pd decreases. An induced magnetisation of Pd was observed for a region of 7.5 Å on both sides of the Fe layer with a magnetic moment which decreases with increasing distance to the Fe/Pd interface. Additional TEM measurements show that the interfaces between Fe/Pd are sharp and it can be excluded that the magnetisation results from inter-diffusion or Fe clusters at the interface.

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Ultrafast imprinting of topologically protected magnetic textures via pulsed electrons

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The magnetic field associated with a picosecond intense electron pulse is shown to switch locally the magnetization of extended films and nanostructures and to ignite locally spin waves excitations. Also, topologically protected magnetic textures such as skyrmions can be imprinted swiftly in a sample with a residual Dzyaloshinskii-Moriya spin-orbital coupling. Characteristics of the created excitations such as the topological charge or the width of the magnon spectrum can be steered via the duration and the strength of the electron pulses. The study points to a possible way for a spatiotemporally controlled generation of magnetic and skyrmionic excitations.

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[2] I. Tudosa, C. Stamm, A.B. Kashuba, F. King, H.C. Siegmann, J. Stöhr, G.
Ju, B. Lu, and D. Weller. "The ultimate speed of magnetic switching in granular recording media", Nature 428, 831 (2004).
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Chebotkevich, A.V. Sadovnikov, S.A. Nikitov, Y. J. Kim, I. H. Cha, and Y. K.
Kim. " Spontaneous nucleation and topological stabilization of skyrmions in magnetic nanodisks with the interfacial Dzyaloshinskii–Moriya interaction", J. Magn. Magn. Mater. (2017)

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Magnetic Damping of sputter deposited, exchange coupled bilayers: Py|Fe

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We report on magnetic damping, α, of exchange coupled, polycrystalline Py|Fe bilayers, prepared by sputter deposition on an amorphous 3nm Ta seed layer. FMR measurements are performed on varying thicknesses of the individual Py and Fe layers while keeping the total bilayer structure at a fixed thickness of 6 nm. For structures where Fe is grown on top of Py, we observe a linear decrease in magnetic damping with an increasing ratio of Fe to Py, the lowest value occurs at Py(1.5nm)|Fe(4.5nm) at α = 4.7x10-3. The measured damping has a contribution arising from spin pumping into Ta; this can be estimated and subtracted away from the total damping to find the intrinsic damping of the structure, for Py(1.5nm)|Fe(4.5nm) this is α = 3.9x10-3. One can estimate damping for an equivalent single-crystal structure by averaging the single-crystal damping parameters for Py, ~5x10-3 , and Fe[1], ~2 x10-3, weighted by their respected magnetic moment, see bottom line in figure. The zero frequency offset measured by FMR of Py|Fe is low, ~1-2 Oe, indicating that the exchange coupling averages out the contribution from the anisotropy fields due to the polycrystalline nature of the sample. However, if Fe is grown first, followed by Py, the magnetic damping of the entire structure is greatly enhanced, α ~ 9x10-3 for Fe(3nm)|Py(3nm), as well as an increase of the zero frequency offset, ~ 15 Oe. X-ray confirm an improved texture of Fe if Py is used as an under-layer, suggesting a correlation between sample texture and magnetic damping. Furthermore, SQUID measurements show a linear increase in saturation magnetization with increasing ratio of Fe, up to 1460 emu/cm3 for the Py(1.5nm)|Fe(4.5nm). In conclusion, we present an easy to manufacture magnetic structure, requiring simple layer by layer deposition without any annealing processes. The low magnetic damping and variable saturation magnetization make it a good candidate for further studies in spintronics.

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Structure, magnetic properties and R2-relaxivity of magnetite-gold nanodumbbells

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At the present time dumbbell-like magnetite-gold nanoparticles (NPs) are of great interest for biomedical application due to their physical-chemical properties. The feature of magnetite-gold nanodumbbells is the presence of two types of surfaces, which allows their double functionalization, for example, covering magnetite NPs with a biocompatible polymer shell and introduction of vector molecules on the surface of gold NPs, and usage for magnetic resonance imaging (MRI) as tumor-selective contrast agents.
It has been established in literature that the growth of magnetite-gold nanodumbbells proceeds through the mechanism of heterogeneous nucleation of magnetite NPs on gold NPs [1], which occurs during the thermal decomposition of iron pentacarbonyl in high-boiling solvents. The properties of the obtained NPs can be controlled by adjusting of synthetic parameters.
In this work we obtained magnetite-gold nanodumbbells with the size: 1) 10±1 / 4±1 nm, 2) 15±3 / 6±1 nm, 3) 19±3 / 6±1 nm, 4) 26±7 / 9±2 nm (magnetite / gold), according to the transmission electron microscopy data. In all samples two phases were detected by X-ray analysis: magnetite and gold. The saturation magnetization, normalized to the weight of magnetite, and the coercive force, measured in magnetic field 20 kOe, enhanced with increase of the magnetite NPs size and were equal to 46, 62, 51, 76 emu/g and 20, 14, 32, 92 Oe for samples 1, 2, 3 and 4, respectively. All samples were covered with a biocompatible polymer coating (the derivative of polyethylene glycol and phospholipid) transferring them to the aqueous phase before the MRI-relaxivity measurement. The values of the R2-relaxivity 202, 227, 266 and 233 mmol-1·s-1 were obtained for samples 1, 2, 3 and 4, respectively.
Therefore, in this work structure and magnetic properties of magnetite-gold dumbbell-like NPs were investigated. It was also found that they can be potentially used as MRI contrast agents due to their high values of R2-relaxivity which exceeded the values of commercial contrast agents (Feridex, Resovist).
This work was supported by Ministry of Education and Science of the Russian Federation (14.607.21.0132, RFMEFI60715X0132).
[1] C. Wang, C. Xu, H. Zeng, S. Sun, Adv. Mater. 21, 3045–3052 (2009)

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Influence of Growth Temperature on Stoichiometry and Verwey Transition of Magnetite Thin Films

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The ferrimagnetic inverse spinel magnetite (Fe_3O_4) is a highly interesting material for spintronics. One of the characteristic phenomena of magnetite is a pronounced metal – insulator transition which is known as the Verwey transition (T_V=120 K). The Verwey transition is drastically influenced by the stoichiometry of Fe_3O_4 because electron hoping between Fe^{2+} and Fe^{3+} octahedral sites is suppressed for nonstoichiometric ratios.

In the present work, magnetite thin films are grown epitaxial on $SrTiO_3$ (001) substrate via pulsed laser deposition with different growth temperature (Tgrowth= 200 °C-700 °C). The surface morphology of films is characterized by AFM and XRR. It is found that the roughness decreases dramatically with decreasing of T_{growth}, and very flat surfaces with RMS≤0.4 nm are obtained for T_{growth}≤400 °C. The crystallinity of films is examined by XRD showing that all films are grown epitaxially on the $SrTiO_3$ substrate, but with significant variation of the lattice constant with T_{growth}. We find films growth with film T_{growth}=400 °C matching the bulk lattice constant coop=8.3875Å. By magnetic characterization (SQUID), it is found that Fe_3O_4 samples prepared with decreasing growth temperature show a shift towards lower Verwey transition temperatures (T_V≈110K) which gives indication for variations of oxygen content dependent on T_{growth}. By HAXPES and XMCD, we find that the film with T_{growth}=400 °C are chemically and magnetically comparable to the bulk material.

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Epitaxially Grown NiMnGa Thin Films: the Impact of Growth Conditions and Low Temperature Post-annealing on Microstructure and Magnetic Configuration

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Ferromagnetic shape memory alloys (FSMA) such as NiMnGa show a strong coupling between magnetic and structural degrees of freedom, thus giving rise to an evident correlation between magnetic, thermal and mechanical characteristics. This unique behavior has opened a new window to develop smart devices with sensing and actuation capabilities [1]. In particular, FSMA thin films are of special interest due to possible integration in micro and nano-systems. Growth conditions play an important role in the microstructure of NiMnGa thin films and consequently influence their magneto-structural properties such as magnetic field induced strain (MFIS). The ability to control the microstructure and magnetic characteristics of these films at different length scales is of particular interest for the optimization of shape memory effect and MFIS applications. The opportunity to induce large strains by engineering NiMnGa microstructure using stress and magnetic field will lead to the development of novel sensors and contact-free actuators with fast response [2]. By varying the temperature, NiMnGa encounters phase transformation between cubic austenite and tetragonal (or monoclinic or orthorhombic) martensite. The martensitic phase in NiMnGa thin films consists of both or one of the differently oriented areas in which the magnetic easy axis is whether solely parallel (Y zone) or alternatively parallel perpendicular (X zone) to the substrate plane. The orientation of X zone variants is 45° tilted from the substrate edges while in Y zone it is parallel to substrate edges. It seems that in high amount of substrate constraint the X zone orientation is selected by the material. Different arrangement of these zones affects the magneto-structural characteristics and consequently the magnetic properties of these films [3].
In the present study NiMnGa films (10-800nm) were directly grown on MgO (100) at 200-400°C using RF sputtering technique. The deposition rate was varied from 38.3 to 73.3Å/min. Microstructures of the thin films were determined using AFM and XRD. Magnetic configuration and behavior of the samples, martensitic transformation and Curie temperature were studied by MFM, AGFM and SQUID techniques. In the next step we performed post-annealing procedure (350°C, 1h, in 4.0×10^{-8} mbar) for the same samples.
Dependence of growth parameters and microstructure of martensitic NiMnGa films were successfully investigated before and after post-annealing process. We found that the film roughness is increased in low growth temperature and low deposition rate. Crystallinity and

ordering of the martensitic X zone are largely affected by the film thickness. The results for post-annealed films are notable as we were able to achieve different microstructures in 200nm films including Y zone. In the hysteresis curves of post-annealed 200nm films, jump-like kinks were detected. The jumps follow two different regimes, which can be then called X-zone regime and Y-zone regime.

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Ultrafast laser pulse switching the magnetization of FePt nanoparticles deterministically for data storage application

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FePt granular medium is a special material of interest for application in magnetic data storage. Writing on these nanoparticular medium with optical angular momentum was reported [1] although the mechanism remained unclear. In our work [2] we study experimentally and theoretically the all optical switching of FePt and show that the magnetization switching is a stochastic process. A complete multiscale model was developed which allowed us to optimize the number of laser shots needed to switch the magnetization of high anisotropy FePt nanoparticles. We have predicted that only angular momentum induced by Inverse Faraday Effect (IFE) can do the deterministic switching with only one pulse by choosing the desired circular polarization of the laser output. Our latest experiments prove that that there is a strong dependence of IFE on the photon energy and prove that it is indeed possible to switch the magnetization deterministically using one laser pulse.

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Investigating the chemical and magnetic properties of individual goethite nanoparticles

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Antiferromagnetic materials play an important role in modern spintronics devices such as spin valves and magnetic random access memories [1,2]. Bulk Goethite (α-FeOOH) is antiferromagnetic at room temperature [3]. Synthetic polycrystalline goethite nanoparticles are dispersed from solution on silicon substrates. X-ray magnetic linear dichroism spectromicroscopy

[4] is combined with scanning electron microscopy to correlated the magnetism and morphology of the very same individual nanoparticles [5]. Studying the temperature dependent linear dichroism of the goethite nanoparticles gives insight in the magnetic order at room temperature.

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Electronic and magnetic properties of new Be-substituted langasite $La_3Ga_3Ge_2BeO_{14}$

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Owing to their functional properties such as piezoelectricity, multiferocity, ferroelectricity, dielectricity and their use in telecommunication, langasites have received much attention over the last two decades. Langasites contitute an important class of nanomaterials with numerous potential applications.
In the current work we reused ab-initio calculations within wien2k code to assess the magnetic behavior of $La_3Ga_3Ge_2BeO_{14}$. Based on the density of state, we found out that this compound exhibits a magnetic behavior which is not in agreement with the experiments results.

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Quantitative Imaging of Magnetic Nanostructures Using Magneto Optical Indicator Film Techniques

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The magneto-optical indicator film (MOIF) technique is a versatile tool for imaging magnetic domain structures. A quantitative interpretation of the measured contrast in terms of stray field data is possible after calibrating the sensor signal in homogene-ous purely perpendicular magnetic fields. Optimized sensor films combined with cor-rection schemes to compensate the influence of the finite sensor thickness allow to measure perpendicular stray field components with a spatial resolution down to the sub-micrometer scale [1].
However, present calibration schemes neglect in-plane stray field components. Therefore, a quantitative analysis of stray field data above micropatterned magnetic materials creates additional difficulties, since the closure of the flux lines leads to a rapidly spatially varying direction of the magnetic field. To understand the sensor re-sponse on such arbitrary stray fields the full anisotropy tensor and the magnetic his-tory of the sensor material have to be known. I will present results on the FMR based analysis of sensor materials. But, even if the sensor response function is understood, the inversion from contrast to stray field in general is not unique. Conditions which allow a reconstruction of the magnetic field and the underlying domain pattern will be discussed.

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A tool for detecting complex magnetic configurations

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In bulk samples, the chiral magnet MnSi shows a so called A-phase in a small temperature-magnetic field range were a stable skyrmion lattice is present. With decreasing the dimensionality this A-phase expands and the “skyrmion state” becomes more stable. One way to study this A-phase has been through measurements of the Hall effect where the topological part (topological hall effect) shows evidence of the existence of the skyrmion phase in bulk and thin film MnSi [1,2,3,5,6].
We use the thermoelectric voltage due to the ANE as a tool to detect the magnetization reversal [4,7,9], using this effect it can be observe the different magnetization changes (or different phases) that arise by varying the magnetic field and the temperature in a MnSi thin film nanowire. A temperature gradient is generated by a platinum microheater placed next to the MnSi nanowire. The thermoelectric voltage generated in the wire allows us to detect the average magnetization state of the wire without applying a current.
The thermoelectric measurements are compared to Hall measurements and SQUID measurements that were made from the same fabricated film.

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Study on the demagnetization dynamics in doped FePt alloys on ultrashort timescales

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The intrinsic properties of ferromagnetic materials are determined by the exchange coupling between the individual atoms and magnetic moments of the system. While this coupling can be directly investigated in elementary ferromagnets by the overall magnetization of the material, element specific techniques have to be employed for magnetic alloys. However, the latter materials are particularly interesting for future applications as the magnetic coupling in alloys can be tuned by magnetic impurities. Here, we investigate ultrafast demagnetization dynamics of FePt alloys doped with Mn and Ni impurities on the characteristic timescale of the exchange interaction of a few femtoseconds. To disentangle the element specific magnetic response of each element, we record the optically induced Kerr response using fs-XUV radiation in the energy

range of the M-absorption edges in transversal geometry (TMOKE). [1]. We find a clear dependence of the transient TMOKE response on the absorption energy. The spectroscopic signature attributed to Fe reveals the typical demagnetization behavior for both dopants Mn and Ni. Most interestingly, however, the TMOKE response in the spectral range of the dopant shows an early response in case of Mn, which is absent for Ni.
Our findings are discussed in the light of a purely optically induced spin transfer from the FePt sublattice into the Mn dopant lattice which is coupled antiparallel to the host material. Our results clearly support earlier investigations revealing that the exchange interaction between different sub-lattices can result an element specific demagnetization dynamics on ultrashort timescales [2,3].

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