IMAGING JRA

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Objectives

Working within the research activity new techniques and modelling tools will be made available for a large number of users from the large communities of the nanomagnetism, engineering and generally from materials science.

First periodic report (Feb.2012 – July2013)

Activities were performed in all project tasks. A summary is shown in the table below:

Task	Work performed	Main results
18.1	New grating set is manufactured. Test experiments are performed.	The performance (visibility contrast) of the interferential gratings setup is improved.
	A magnet setup for nGI measurements of magnetic samples was manufactured.	A homogenous magnetic field up to 0.5 T is available for nGI investigations.
18.2	A prototype of high resolution neutron imaging detector was constructed.	High-resolution neutron tomography (pixel size of 6.5 μm) is provided to the user community.
	New types of scintillator screens were developed and tested.	Very thin and micro structured Gadox scintillators provide improved resolution.
18.3	A double crystal monochromator was installed at the imaging facility at HZB	Energy-selective option was provided for imaging purposes to the user community.
18.4	Several Polarized SANS measurements have been performed on various systems using different spectrometers.	Neutron PSANS measurements as a function of the applied magnetic field provide the short range correlations in carpet of Co nanowires.
	Nmag software was used to perform a micromagnetic simulations .	The 3D configuration of large arrays of nano wires can be reconstructed and visualized.
18.5	Precessionnal techniques for the study of thin films was proposed by using Time-Of-Flight method. The possibility of investigation of magnetic micro wires was studied experimentally.	Better sensitivity by studying the wavelength dependence of the neutron precessional spectroscopy can be achieved. It was proved that the precessional spectroscopy can be used for investigation of magnetic micro wires.
18.6	First imaging experiments with polarizer-analyser arrangement were performed at the BOA beam line at PSI.	The BOA beam line at PSI will be equipped with setup allowing for imaging with polarized neutrons.

DELIVERABLES

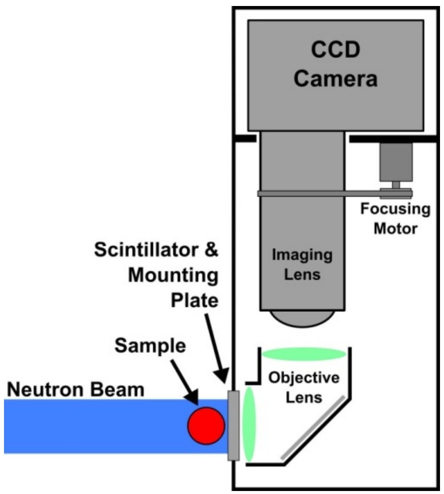
Del. no.	Deliverable name	Lead beneficiary	Nature	Delivery date from Annex I (proj month)	Actual / Forecast delivery date	Delivered Yes/ No/ Ongoing
18.1	Implementation of grating interferometry for visualization of residual stresses	6	O	36	36	Ongoing
18.2	Publication and interim report	6	R	36	36	Ongoing
18.3	Grating interferometry experiments performed with university partners	3	O	48	48	Ongoing
18.4*	**Optimization of high-resolution detector system**	**6**	**O**	**18**	**18**	**Yes/Ongoing**
18.5	Adapting of high-resolution detector system	5	O	36	36	Ongoing
18.6	**High-resolution experiments performed with university partners**	**3**	**O**	**48**	**48**	**Yes/Ongoing**
18.7	**Optimization of monochromator parameters for high wavelength resolution**	**6**	**O**	**18**	**18**	**Yes**
18.8	Bragg-edge mapping and energy-selective experiments	5	R	36	36	Ongoing
18.9	Extending the technique towards ToF-imaging	5	O	48	48	Ongoing
18.10	**Evaluation of the PASANS**	**7**	**R**	**18**	**18**	**Yes/Ongoing**
18.11	User friendly sample environment	4	R	36	36	Ongoing
18.12	User friendly platform for PASANS	2	O	48	48	Ongoing
18.13	**Evaluation of the Precessionnal spectroscopy techniques possibilities**	**7**	**R**	**18**	**18**	**Yes/Ongoing**
18.14	Precession spectroscopy measurements	7	R	36	36	Ongoing
18.15	User friendly platform for the exploitation of precession data	2	O	48	48	Ongoing
18.16	**Imaging of magnetic structures in bulk samples with high resolution**	**6**	**R**	**18**	**18**	**Yes/Ongoing**
18.17	Direct magnetic imaging experiments	5	R	36	36	Ongoing
18.18	Data processing platform	3	R	48	48	Ongoing
18.19	Wiki pages on NMI3 portal	7	R	48	48	Ongoing

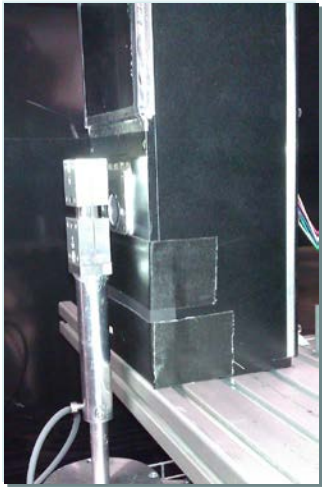
*** already delivered**

High-resolution neutron imaging

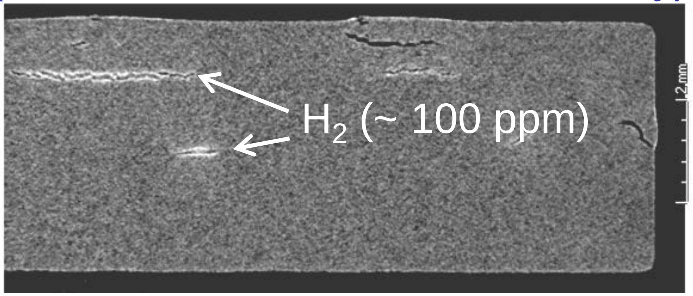
HZB

High-resolution detector was developed at HZB





Hydrogen loading of duplex stainless steel
(A. Griesche, *BAM*, Berlin, Germany)



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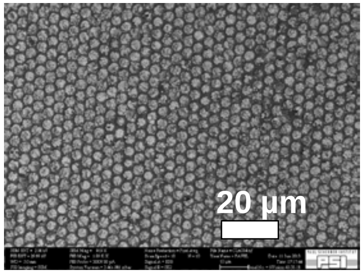
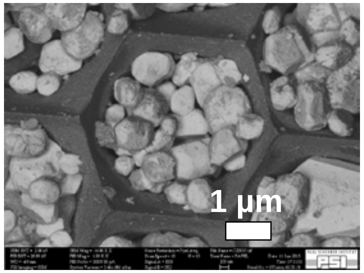
PSI





Microstructured scintillator was manufactured at PSI

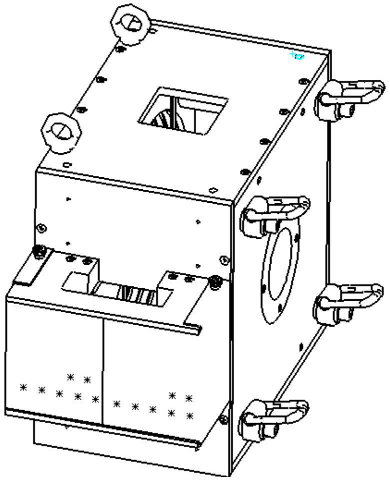
30-µm thick porous Si-membrane filled with ultrafine $Gd_2O_2S:Tb^{3+}$

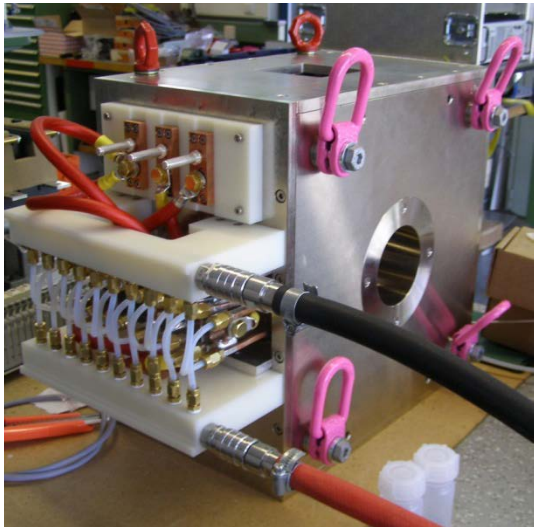
Task 2 (HZB, TUM, PSI, TUD, NPI)

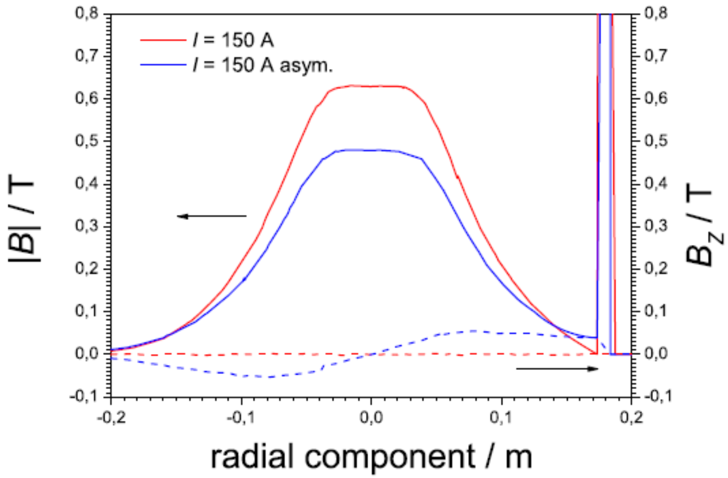
Highlights

New magnet for phase grating interferometry was designed:

- Field < 0.5 T
- Estimated field deviation: 0.5 % axial, 1.5 % radial
- 1.5 cm thick ARMCO-iron magnetic field shielding to reduce field influence on the grating setup
- Transportable: m< 200 kg, size: 238 x 376x 376 mm³
- Asymmetric operation of the coils possible







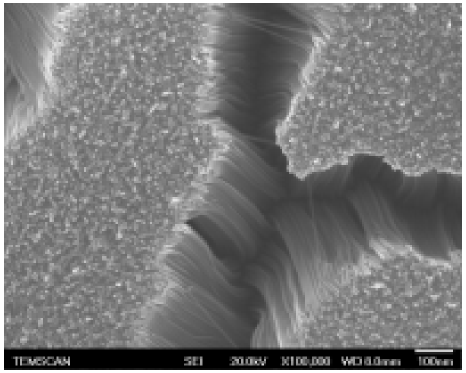
Calculated field profile of the new magnet (left) in normal and asymetric mode

Task 6 (PSI, HZB, TUM)

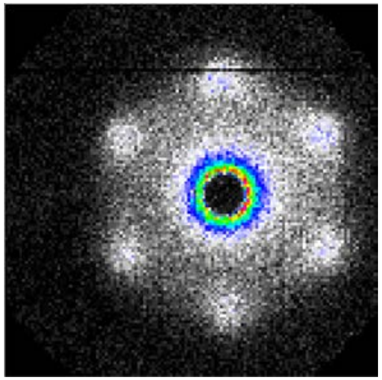
Highlights

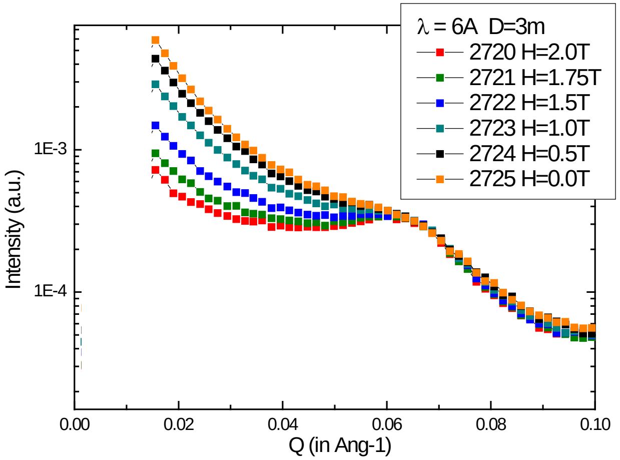
- Numerical tools for magnetic SANS scattering were developed at LLB (CEA) so as to be able to extract fine magnetic information on magnetic nanosystems

- Experimental data on several magnetic nanosystems systems were acquered
  - Arrays of ordered magnetic nanowires (nanowire carpets)
    - measurements performed on PAXY at the LLB; further measurements are planned on SANS I at FRM2



MEB image of a carpet of nanowires





SANS scattering form the carpet (2D and after circular integration). Evolution of the signal as a function of the applied field.

Task 4 (CEA, JCNS, TUD)

NPI

The JRA Imaging combines neutron experimental techniques in the direct and the reciprocal space in order to resolve structural and magnetic features on different length scales.