Research report 2016

PhD students

In 2016 ESS supported the following PhD (and master) students in their studies relevant for neutron scattering:

<table>
<thead>
<tr>
<th>Name</th>
<th>University/Company</th>
<th>Topic</th>
<th>Start</th>
<th>ESS co-supervisor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marcella Cabrera Berg</td>
<td>Copenhagen (NBI)</td>
<td>Dental Cement</td>
<td>2014-10-01</td>
<td>H. Bordallo</td>
</tr>
<tr>
<td>Alberto Cereser</td>
<td>DTU Copenhagen</td>
<td>3DND Methodology</td>
<td>2013-02-15</td>
<td>M. Strobl</td>
</tr>
<tr>
<td>Robin Delhom</td>
<td>ILL, Grenoble, France</td>
<td>Isolation and structural characterization of natural deuterated lipids and oils from microorganisms</td>
<td>2014-10-13</td>
<td>H. Wacklin</td>
</tr>
<tr>
<td>Yashika Bansal</td>
<td>Bergen, Norway</td>
<td>High spatial resolution silicon-based neutron detectors</td>
<td>2014-04-01</td>
<td>K. Kanaki</td>
</tr>
<tr>
<td>Anna Fedrigo</td>
<td>Copenhagen (NBI), ICNR, Italy</td>
<td>Application of neutron techniques to cultural heritage artefacts</td>
<td>2013-03-19</td>
<td>M. Strobl</td>
</tr>
<tr>
<td>Malgorzata Molin</td>
<td>DTU Copenhagen</td>
<td>In-Situ Neutron Imaging of Solid Oxide Fuel Cells</td>
<td>2013-01-01</td>
<td>M. Strobl</td>
</tr>
<tr>
<td>Francesco Manzoni</td>
<td>Lund University</td>
<td>Neutron protein crystallography</td>
<td>2012-10-15</td>
<td>E. Oksanen</td>
</tr>
<tr>
<td>Nazia S. Nazer</td>
<td>IFE, Norway</td>
<td>HIBAT-project</td>
<td>2014-01-01</td>
<td>P. Henry</td>
</tr>
<tr>
<td>Adrian Sanchez Fernandez</td>
<td>Bath, UK</td>
<td>Self Assembly in Deep Eutectic Solvents</td>
<td>2014-08-01</td>
<td>A. Jackson</td>
</tr>
<tr>
<td>Julius Scherzinger</td>
<td>Lund University</td>
<td>Neutron detection techniques</td>
<td>2012-02-01</td>
<td>R. Hall-Wilton</td>
</tr>
</tbody>
</table>
Conference sponsoring 2016

Nordic workshop on scattering from soft matter, Uppsala 20-21 January 2016
ERICE International School of Neutron Science and Instrumentation, Erice, Sicily, April 1st - 9th 2016
7th International Meeting "Photosynthesis and Hydrogen Energy Research for Sustainability - 2016", June 19 to 25, 2016 in Pushchino, Moscow Region, Russia, organized by the Russian Academy of Sciences

Science Day 2016

The Science Day took place on June 16, 2016 at the castle of Bjärsjölagård. For the program please see attachment.
<table>
<thead>
<tr>
<th>Time</th>
<th>Topic</th>
<th>Speaker</th>
</tr>
</thead>
<tbody>
<tr>
<td>08:00</td>
<td>Bus ride from Lund C</td>
<td></td>
</tr>
<tr>
<td>09:00-09:20</td>
<td>WELCOME COFFEE</td>
<td></td>
</tr>
<tr>
<td>09:20-09:40</td>
<td>Opening talk</td>
<td>Andreas Schreyer</td>
</tr>
<tr>
<td>09:40-10:00</td>
<td>SFT state</td>
<td>Arno Hiess</td>
</tr>
<tr>
<td></td>
<td>Changes on confinement of intracellular water lead to changes on thermal properties of breast cancer cells</td>
<td>Heloisa Bordallo</td>
</tr>
<tr>
<td>10:00-10:15</td>
<td>Aiming at high-resolution crystal structures of the ionotropic glutamate receptor GluA2</td>
<td>Saara Kaisa Laulumaa</td>
</tr>
<tr>
<td>10:15-10:30</td>
<td>Coupling between creep and redox behaviour in Ni-YSZ observed in-situ by energy resolved neutron imaging</td>
<td>Malgorzata Makowska</td>
</tr>
<tr>
<td>10:30-10:45</td>
<td></td>
<td></td>
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<tr>
<td>10:45-11:10</td>
<td>COFFEE</td>
<td></td>
</tr>
<tr>
<td>11:10-11:40</td>
<td>Life science at MAX IV</td>
<td>Uwe Müller</td>
</tr>
<tr>
<td>11:40-11:55</td>
<td>Influence of headgroup-solvent interaction on micellization in deep eutectic solvents</td>
<td>Adrian Sanchez Fernandez</td>
</tr>
<tr>
<td>11:55-12:10</td>
<td>Developing strategies for perdeuteration of macromolecules in yeast</td>
<td>Katarina Koruza</td>
</tr>
<tr>
<td>12:10-12:25</td>
<td>Biodeuteration and Crystal Production for Neutron Diffraction Studies</td>
<td>Vinardas Kelpsas</td>
</tr>
<tr>
<td>12:25-14:00</td>
<td>LUNCH</td>
<td></td>
</tr>
<tr>
<td>14:00-14:30</td>
<td>Imaging and Spectroscopy of Low Dimensional Structures: From Microns to Ångströms and from Hours to Attoseconds</td>
<td>Anders Mikkelsen</td>
</tr>
<tr>
<td>14:30-14:45</td>
<td>Decomposition of the Bragg glass in a type-II superconductor</td>
<td>Rasmus Toft-Petersen</td>
</tr>
<tr>
<td>14:45-15:00</td>
<td>Neutron crystallography and theoretical studies on Galectin 3</td>
<td>Francesco Manzoni</td>
</tr>
<tr>
<td>15:00-15:15</td>
<td>and integration support at the ESS Testbeamline</td>
<td>Robin Woracek</td>
</tr>
<tr>
<td>15:15-15:30</td>
<td>3D neutron diffraction - up and running</td>
<td>Alberto Cereser</td>
</tr>
<tr>
<td>15:30-16:30</td>
<td>Mingle</td>
<td></td>
</tr>
<tr>
<td>17:00</td>
<td>Bus departs from Bjärsjölagård to Lund C</td>
<td></td>
</tr>
<tr>
<td>Date</td>
<td>Speaker</td>
<td>Title</td>
</tr>
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<td>-------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>20 January</td>
<td>Tõnu Pullerits</td>
<td>From light absorption to separated charges: from fundamentals towards applications</td>
</tr>
<tr>
<td>21 January</td>
<td>Niina Jalarvo</td>
<td>Towards better understanding of atomic-scale ion migration processes in solid oxides</td>
</tr>
<tr>
<td>27 January</td>
<td>Zoe Fisher</td>
<td>Deuteration and macromolecular crystallization (DEMAX): status and future plans</td>
</tr>
<tr>
<td>3 February</td>
<td>Robin Woracek</td>
<td>First Results From The ESS-Testbeamline at Helmholtz Zentrum Berlin</td>
</tr>
<tr>
<td>10 February</td>
<td>Dr. Aldo Zenoni</td>
<td>EXPERIMENTAL STUDY OF MATERIAL RADIATION DAMAGE FOR THE SPES FACILITY</td>
</tr>
<tr>
<td>24 February</td>
<td>Anders Pettersson</td>
<td>SAD – Mechatronics and Software Integration (MESI)</td>
</tr>
<tr>
<td>2 March</td>
<td>Ann Terry</td>
<td>The girl in the spider’s web</td>
</tr>
<tr>
<td>9 March</td>
<td>Harald Schneider</td>
<td>FLUCO – Sample Environment for soft matter research</td>
</tr>
<tr>
<td>23 March</td>
<td>Alex Holmes</td>
<td>Temperature and Field sample environment at ESS</td>
</tr>
<tr>
<td>6 April</td>
<td>Martin Valldor</td>
<td>Novel transition metal compounds with dual anioncoordinations, inducing magnetic anisotropy and crystal field diversity.</td>
</tr>
<tr>
<td>13 April</td>
<td>Dr. Patrick Huber</td>
<td>Soft Matter in Hard Confinement: Thermodynamics, Microscopic Structure, Diffusion and Flow in Nanoporous Media</td>
</tr>
<tr>
<td>27 April</td>
<td>Malcolm Guthrie</td>
<td>High pressure at ESS</td>
</tr>
<tr>
<td>11 May</td>
<td>Jeroen Plomp TU Delft</td>
<td>Larmor labelling meets neutron imaging</td>
</tr>
<tr>
<td>18 May</td>
<td>Wolfgang Knecht LU</td>
<td>The Lund Protein Production Platform LP3</td>
</tr>
<tr>
<td>25 May</td>
<td>Marie-Sousai APPAVOU</td>
<td>Influence of pressure on proteins structure and dynamics investigated by neutron scattering</td>
</tr>
<tr>
<td>15 June</td>
<td>Je-Geun Park</td>
<td>A view on structure and spin dynamics of multiferroic BiFeO3</td>
</tr>
<tr>
<td>30 June</td>
<td>Mark Bird</td>
<td>Development of Magnets &gt;25 T for Neutron-Scattering</td>
</tr>
<tr>
<td>Date</td>
<td>Name</td>
<td>Title</td>
</tr>
<tr>
<td>------------</td>
<td>-----------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>7 July</td>
<td>Torsten Soldner</td>
<td>A cold neutron beam facility for Particle Physics at the ESS Confinement and entropic effects on the phase diagram of electrolyte: the case of water confined in Nafion membrane</td>
</tr>
<tr>
<td>25 August</td>
<td>Marie Plazanet</td>
<td>Research with very cold and ultra-cold neutrons accelerating structures at the Institut Laue Langevin in Grenoble</td>
</tr>
<tr>
<td>30 August</td>
<td>Peter Geltenbort</td>
<td>Standardized communication protocol for sample environment – SINE2020 work package 7.1</td>
</tr>
<tr>
<td>31 August</td>
<td>Erik Dahlbäck</td>
<td>Complex Magnetism in Manganite Heterostructures Probed with Polarized Neutrons Structural basis for sensitivity to molecular oxygen of oxidases and fluorescent proteins investigated by high-pressure crystallography</td>
</tr>
<tr>
<td>30 November</td>
<td>Artur Glavic</td>
<td></td>
</tr>
<tr>
<td>7 December</td>
<td>Benedicte Lafumat</td>
<td></td>
</tr>
</tbody>
</table>
SFT Engineering Material, Geosciences, Archeology and Heritage Conservation

Publications


- M. Markowska, L. Theil-Kuhn, H. L. Frandsen, E. M. Lauridsen, S. De Angelis, L. N. Cleemann, M. Morgano, P. Trtik, M. Strobl
Coupling between creep and redox behavior in nickel - yttria stabilized zirconia observed in-situ by monochromatic neutron imaging
Journal of Power Sources, Volume 340, 1 February 2017, Pages 167–175

- Anna Fedrigo & Markus Strobl & Alan R. Williams & Kim Lefmann & Poul Erik Lindelof & Lars Jørgensen & Peter Pentz & Dominik Bausenwein & Burkard Schillinger & Anton Kovyakh & Francesco Grazzi
Neutron imaging study of ‘pattern-welded’ swords from the Viking Age

- J Šaroun, J Fenske, M Rouijaa, P Beran, J Navrátil, P Lukáš, A Schreyer and M Strobl
Neutron optics concept for the materials engineering diffractometer at the ESS

- J Fenske, M Rouijaa, J Šaroun, R Kampmann, P Staron, G Nowak, J Pilch, P Beran2, P Šittner, P Strunz, H-G Brokmeier, V Ryukhtin, L Kadeřávek, M Strobl, M Müller, P Lukáš and A Schreyer
BEER – The Beamline for European Materials Engineering Research

- R. Woracek, T. Hoffmann, M. Bullat, M. Sales, K. Habicht, K. Andersen, M. Strobl
The testbeamline of the European Spallation Source – instrumentation development and wavelength frame multiplication

In-situ time-of-flight neutron imaging of NiO-YSZ reduction under influence of stress

Wavelength-Independent Constant Period Spin-Echo Modulated Small Angle Neutron Scattering
Accelerated creep in solid oxide fuel cell anode supports during reduction

- Anna Fedrigo, Daniele Colognesi, Mads Bertelsen, Monika Hartl, Kim Lefmann, Pascale Deen, Markus Strobl, Francesco Grazzi, and Marco Zoppi
VESPA: the vibrational spectrometer for ESS
Review of Scientific Instruments, in the press

- Anton S. Tremsin, Małgorzata G. Makowska, Didier Perrodin, Tetiana Shalapska, Ivan V. Khodyuk, Pavel Trtik, Pierre Boillat, Sven C. Vogel, Adrian S. Losko, Markus Strobl, L. Theil Kuhn, Gregory A. Bizarri and Edith D. Bourret-Courchesne
In situ diagnostics of the crystal-growth process through neutron imaging: application to scintillators

- M. Strobl, B. Betz, R. P. Harti, A. Hilger, N. Kardjilov, I. Manke, C. Gruenzweig
Wavelength dispersive dark-field contrast: micrometer structure resolution in neutron imaging with gratings

- M. Trapp, R. Steitz, M. Kreuzer, M. Strobl, M. Rose, R. Dahint
BioRef II – neutron reflectometry with relaxed resolution for fast, kinetic measurements at HZB

- Anna Fedrigo, Francesco Grazzi, Alan R. Williams, […], Markus Strobl
Extraction of archaeological information from metallic artefacts—A neutron diffraction study on Viking swords

- R. P. Harti, C. Kottler, J. Valsecchi, M. Strobl, […], C. Grünzweig
Visibility simulation of realistic grating interferometers including grating geometries and energy spectra
Optics Express 25(2) (2017)

- R. P. Harti, M. Strobl, B. Betz, K. Jefimovs, M. Kagias, C. Gruenzweig
Sub-pixel correlation length neutron imaging: Spatially resolved scattering information of microstructures on a macroscopic scale
Scientific Reports 7:44588 (2017) | DOI: 10.1038/srep44588
Book chapters

PhD thesis
Anna Fedrigo accomplished, Sept 2016
Alberto Cereser accomplished, Sept 2016
Malgorzata Makowska accomplished, Mar 2016
Morten Sales accomplished, June 2016
Nazia Nazer (submitted, April 2017)

Invited talks
R. Woracek FRM2/TUM seminar, May 2016
R. Woracek German Conference on Neutron Scattering, Kiel, Germany, September 2016
M. Strobl PNcmi conference, Freising, July 2016
M. Strobl ECAART conference, Jyväskylä, Finland, July 2016
M. Strobl B-MRS, Campinas, Brazil, Sept. 2016
M. Strobl SNS TS2 expert meeting, Oakridge, TN, April 2016
M. Strobl C-SNS expert meeting, China, Oct. 2016
M. Strobl DTU, CANS advisory meeting, Nov. 2016
M. Strobl KTH, Big Data Expert meeting

Comittes
M. Strobl PSI SAC
M. Strobl JPARC, NSPRC, PEC
M. Strobl ISIS, FAP7
M. Strobl ILL, SC College 1
M. Strobl ICTMS, Sweden, organizing committee
M. Strobl ITMNR, China, Program committee
M. Strobl Neuwave, GB, Program committee

Conferences
M. Strobl, A. Fedrigo, M. Sales, A. Cereser, M. Makowska and R. Woracek Neuwave Abingdon (ISIS), June 2016
R. Woracek 3D-Material Science conference in St. Charles, IL, USA; July 2016
M. Strobl ITMNR, China, September 2016
M. Strobl PNcmi conference, Freising, July 2016
M. Strobl ECAART conference, Jyväskylä, Finland, July 2016
M. Strobl B-MRS, Campinas, Brazil, September 2016
M. Strobl Neutrons in Energy Research, Bordeaux, May 2016
Teaching
M. Strobl LTH Imaging school
M. Strobl LU/KU/DTU summer school
M. Strobl ISIS neutron school
M. Strobl Neutron Imaging school of ITMNR in Peking

Funding
4 InterReg projects (3xDTU,MU)
Bir2Gain project (LU, MAX4, Swerea, Jenkertore)
PhD project Engineering materials characterization (LU)
EU Infrastructure, CZ, 4 postdocs for SFT related WPs (M. Strobl WP leader)
Sine2020 Image analyses software (6 months A. Fedrigo)

Industry relations
- Project funding granted BIR2Gain project to familiarize Swedish metallic industry with large scale facilities (MAX4 & ESS) together with LTH, MAX4, Swerea and Jenkertore; workshop organized 1&2 Juni 2017
- Intro to ESS potential for Finnish mining industry
- Industry contacts and beamtime preparations through DTU Industry Portal
- Swedish Mettalisc Material Industry meeting, ESS presentation and workshop

Website – no progress and update since intern Hermanni Heimonen left (Aug. 15)

SFT members 2016
A. Fedrigo
A. Kusmin
A. Cereser
M. Makowska
M. Sales
M. Lacatusu
N. Nazer
T. Maimaitiyili
R. Woracek
E. Guerin
S. Hall
H. N. Bordallo
P. Beran
J. Fenske
P. Bentley
R. Hall-Wilton
L. Zanini
M. Strobl
1) Papers 2016 (Soft/life members):


Tsapatsaris N, Lechner RE, Markó M, BordalloHN. “Conceptual design of the


2) Students

Not directly supported, co-supervised by ESS staff, working on neutron projects:

1) Katarina Koruza (Lund University, SE) – project title: Perdeuteration of biological molecules (Zoe Fisher)
2) Rohit Kumar (with Derek Logan, LU). (Esko Oksanen)
3) Octav Caldaru (with Ulf Ryde, LU) (Esko Oksanen)

Supported by ESS:

1) Adrian Sanchez-Fernandez (Bath University, UK) (Andrew Jackson)
2) Robin Delhom (Grenoble University, FR) – project title: Isolation and structural characterization of deuterated lipids and oils from microorganisms (Hanna Wacklin)
3) Francesco Manzoni (sadly passed away March 2017) – (Esko Oksanen, with Derek Logan and Ulf Ryde (both LU)).

3) Events, sponsorship

Funded by Interreg/MAX4ESSFUN: Synchrotron and neutron scattering in biomaterials and soft matter, 26-28 October 2016 in Malmö, Sweden.

Neutrons and Food conference – May 2016, Lund Sweden

MAX4ESSFUN research day, 7 October 2016, Elite Ideon Hotel, Lund, Sweden.

The Sixth Annual Niels Bohr International Academy Workshop on ESS Science (NBIA6), 7-8 November 2016 in Lund, Sweden. 
https://indico.nbi.ku.dk/conferenceDisplay.py?confId=930

Protein Science Day 2016 – Astronomihuset, LU (co-sponsored by ESS, LU, MAX lab)
4) General text for Soft/Life

We are always updating our website information and are now 23 members and counting:

https://europeanspallationsource.se/page/soft-condensed-matter-life-science

There have been numerous research activities by us, our partners, collaborators, and members, as can be seen in the publication list and grant activities.

The DEMAX partnership with LP3/LU is now formalized and running. DEMAX moved over to LU in Summer 2016. DEMAX also completed a major milestone in the in-kind with University of Bergen, Norway (picture below). DEMAX is also working to recruit a shared technical resource with the LP3/LU for biodeuteration & crystallization developmental activities for ESS.
5) Grants involving ESS staff as PI or co-PI

Vetenskapsrådet: A New Method to Model the Dynamic Structure Factor by Molecular Dynamics Simulations, PI Jan Swenson, Chalmers University, Co-PIs: Heloisa N. Bordallo (NBI/KU), Thomas H. Rod (DMSC/ESS) and Anders Markvardsen (ISIS)

Interreg/MAX4ESSFUN: Neutron studies of new drug leads for the inhibition of cancer-related human carbonic anhydrase IX. PI & co-PI – Wolfgang Knecht (LU), Zoe Fisher (ESS/LU), Katarina Koruza (student)

Co-PI Esko Oksanen (ESS/LU), Supervisor Poul Nissen (AU, Denmark), Marlene Sørensen (student, AU).

Co-PI Esko Oksanen (ESS/LU), Supervisor Claes von Wachenfeldt (LU), Vinardas Kelpsas (Student, LU).

Co-PI Esko Oksanen (ESS/LU), Supervisor Per Kjellbom (LU), Yonathan Sonntag (student, LU).

Crafoord: Neutron studies of new drug leads for the inhibition of cancer-related human carbonic anhydrase IX. PI, Co-PI: Wolfgang Knecht (LU), Zoe Fisher (ESS/LU), Katarina Koruza (LU)


Knut och Alice Wallenberg Stifftelse (DECREC) - PI is Mikael Akke (LU), co-PI Esko Oksanen (ESS/LU)


iNEXT (10M€) JRA2 Membrane protein enabling technologies (47k€ ESS).

VR Röntgen-Ångström grant 2015-06099 “Non-equilibrium thermodynamics of biology studied by time resolved small angle X-ray and neutron scattering”, 9.6 MSEK, 2016-2019, PI: Gergely Katona, Gothenburg University. (979200 SEK ESS)

VR Neutron Scattering project grant 2016-06963 “Organization of mitochondrial
membranes under oxidative stress: Implications for their active role in regulation of apoptosis“, 5.06 MSEK 2017-2020, PI: Gerhard Gröbner, Umeå University.


LU Science faculty project grant for research with neutrons and synchrotron radiation “Neutron and X-ray diffraction studies of biological lipid mixtures”, 100 000 SEK 2015-2016, PI: Hanna Wacklin, LU Physical Chemistry, Co-PI Wolfgang Knecht, LU Biology

SINE2020 WP5 & WP6

The SINE2020 grant is well underway on two work packages (WP5 Deuteration & WP6 Crystallogenesis) involving our SFT members. This work is highly collaborative and involves many of our partners including ILL, ISIS, and MLZ. In this regard we have welcomed a new hire, Anna Leung. She has joined the Science Directorate and is working as a deuteration chemist on the SINE2020 grant (WP5).
Science Focus Team Activity 2016:
Chemistry of Materials, Magnetic and Electronic Phenomena

Coordinator: Alex Holmes (alexander.holmes@esss.se)

The science focus team of the ESS for physics and chemistry is approximately 20 people strong, with scientific interests ranging from the chemistry of batteries, high pressure physics to Quantum Monte Carlo simulations for the theoretical determination neutron scattering profiles focussed on emergent behaviour. We have strong links with Copenhagen University, Niels Bohr Institute, Chalmers University and the Technical University of Denmark.

The Interreg and Nordforsk programmes for bi and trilateral collaborations in the region focussed on science linked to neutron and x-ray scattering are under way. These proposals allow groups to develop small research projects with universities in the Nordic region to educate PhD and post doctoral students and thereby enlarge the community. A number of projects involving SFT members have been supported under the MAX4ESSFUN programme. Six projects worth a total of 47 million NOK have been awarded to neutron related research activities under the Nordforsk scheme. One of these grants, worth 7 million NOK, will fund Ph.D. students who will study magnetic frustration under the extreme conditions of high pressure at mK temperatures. It involves Pascale Deen from ESS in collaboration with researchers at Institute for Energy Technology, IFE (Oslo) and the universities of Stockholm, Lund, Copenhagen and Oslo.

SFT Members:


Selected publications:

1. Altoe, MAS; Michels, L; dos Santos, BC; Droppa, R; Grassi, G; Ribeiro, L; Knudsen, KD; Bordallo, HN; Fossum, JO; da Silva, GI, “Continuous water adsorption states promoted by Ni^{2+} confined in a synthetic smectite”, Applied Clay Science, 123, 83-91 (2016)
2. Chang, J; Blackburn, E; Ivashko, O; Holmes, AT; Christensen, NB; Hucker, M; Liang, R; Bonn, DA; Hardy, WN; Rutt, U; Zimmermann, M; Forgan, EM; Hayden, SM, “Magnetic field controlled charge density wave coupling in underdoped YBa_2Cu_3O_{6+x}”, Nature Communications 7, 11494 (2016)
3. Scherb, T; Kimber, SAJ; Stephan, C; Henry, PF; Schumacher, G; Escolastico, S; Serra, JM; Seeger, J; Just, J; Hill, AH; Banhart, J, “Nanoscale order in the frustrated mixed conductor La_{5.6}WO_{12-d}”, J. Appl. Cryst. 49, 997-1008 (2016).
5. Nazer, NS; Yartys, VA; Azib, T; Latroche, M; Cuevas, F; Forseth, S; Vie, PJS; Denys, RV; Sorby, MH; Hauback, BC; Arnberg, L; Henry, PF, “In operando neutron diffraction
study of a commercial graphite/(Ni, Mn, Co) oxide-based multi-component lithium ion battery”, Journal of Power Sources \textbf{326}:93-103 (2016)

6. Zheng, HY; Li, K; Cody, GD; Tulk, CA; Dong, X; Gao, GY; Molaison, JJ; Liu, ZX; Feygenson, M; Yang, WG; Ivanov, IN; Basile, L; Idrobo, JC; Guthrie, M; Mao, HK, “Polymerization of Acetonitrile via a Hydrogen Transfer Reaction from CH3 to CN under Extreme Conditions”, Angewandte Chemie-International Edition: \textbf{55} 12040-12044 (2016)
Three different instruments for particle and nuclear physics have been identified at ESS in the past years:
- the cold beam line: ANNI,
- a beam UCN source,
- the neutron-antineutron experiment: NNBAR.

Recently the NNBAR collaboration has presented a new project called HIBEAM “High Intensity Baryon extraction and measurement”

This project has its own physics program with several different measurements that can be performed (search for mirror neutrons, measurements of weak nucleon-nucleon interactions) but it also is foreseen as a prototype for the full NNBAR experiment.

Today, all three instruments and HIBEAM are pushed by specific consortia. For ANNI, a design is available and a full ESS instrument proposal was submitted jointly by scientists from different universities and labs. For the other two instruments detailed designs are not yet finalized but letters of intent (LoI) with preliminary gain factors were submitted.

A Scientific and Technical Advisory Panel (STAP) for fundamental physics has been established to advise and later to review the instrument proposal and letters of intent.

Past Meeting and Seminars

On 8th July 2016 the “Strategy Workshop on Fundamental Physics at ESS“ has been held at ESS where, with more than 20 participants, cold neutron physics, NNBAR and UCNs were discussed. The main aim of this meeting was to prepare for successful particle physics projects at the ESS in the future. During the workshop the status and prospects of all three instruments were presented. In addition to that the ESS Director of Science Andreas Schreyer pointed out that at this stage “fundamental and particle physics” is missing completely from the portfolio of instruments, but expressed the clear vision that this should be changed. In conjunction with the strategic meeting Torsten Soldner gave a seminar at ESS “A cold neutron beam facility for Particle Physics at the ESS”.

At the end of August 2016 during the fourth workshop of the NNBAR collaboration a mini-symposium for fundamental physics has been held at ESS. During this symposium Peter Geltenbort from ILL gave the seminar: “Research with very cold and ultra-cold neutrons at the Institut Laue Langevin in Grenoble”. Bastian Mürkisch from TUM gave a seminar too on “Neutron Decay”.

On 22th February 2017 Nobel Prize Art McDonald visited the ESS site. After his visit a meeting with him, the ESS management and a scientific team has been held to discuss the possibilities for fundamental physics at ESS.

On 16th March 2017 a seminar from David Milstead about the HIBEAM project (“HIBEAM at ESS”) has been given at ESS. After the seminar there has been a meeting with the ESS Director of Science and a scientific team to discuss the possibility of the project.
Future Meeting and Seminars

There will be a seminar on 19th July by Vince Cianciolo from SNS on “Fundamental Physics at the Oak Ridge Spallation Neutron Source”.

A workshop between the ANNI collaboration and HIBeam is foreseen for this autumn to discuss a common strategy for the next round of ESS proposal.

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