Annual Report 2006

Department of Physics



DEPARTMENT OF PHYSICS, NTNU

Høgskoleringen 5, 7491 Trondheim, Norway

Phone: +47 73593478 Fax: +47 73597710 E-mail: postmottak@phys.ntnu.no

Head of Department: Professor Berit J. Kjeldstad Deputy Head of Department: Professor Kåre Olaussen Head of Administration: Cand.scient Sylvi Vefsnmo

Departmental Council: Elected members:

Representing the permanent scientific staff

Representing the temporary scientific staff Representing the technical/administrative staff Representing the students of the department

Appointed external member:

Professor Randi Holmestad Professor Catharina Davies Professor Alex Hansen Professor Mikael Lindgren Post doc Anh Kiet Nguyen Head Engineer Oddbjørn Grandum Student Ole Martin Tranvåg Solås Student Mariann Suh Jøssang

Research Manager Jostein Mårdalen (chair) SINTEF Materials and Chemistry

Professor Lisa Lorentzen, NTNU, Department of Mathematical Sciences

COVER PAGE

Tumour grown in a transparent window chamber on a mouse

Supplementary text: Imaging in vivo is an important tool to monitor uptake and distribution of drugs in tissue. The image is obtained with a confocal laser scanning microscope. Red/pink represents the blood vessels. Blue represents the drug administered and is present both inside and outside the vessels. The collagen network (green) signal is acquired with second harmonic generation – a nonlinear optical effect. Collagen is known to represent a transport barrier for the delivery of drugs to tumour cells.

Photo: Division of Biophysics (Arne Erikson)

DEPARTMENT OF PHYSICS

http://www.ntnu.no/fysikk

CONTENTS

DEPARTMENT OF PHYSICSpage 1
Synopsis of Events
Staff
Accounts
Awards
Special Events
RESEARCH
Division of Applied Physics and Didactic Physics
Division of Biophysics and Medical Technology
Division of Complex Materials
Division of Condensed Matter Physics
Division of Theoretical Physics
Publications in Refereed Journals and Books
Conferences, other Talks, Reports and Books
Physics Presentations through Media
Co-operating Institutions
EDUCATIONpage 46
Subjects and Student Attendance
Theses - Graduate Studies
Theses - Doctoral Studies
PARTICIPATION IN COMMITTEES
Evaluation Committees; International, National, University and Departmental Committees; Arrangement Committees
FRIDAY AFTERNOON LECTURESpage 55

Edited by: Eli Monsøy, Arne Mikkelsen, Sylvi Vefsnmo og Berit Kjeldstad

The Annual report is also available on the internet address: <u>http://www.ntnu.no/fysikk/arsrapporter</u>

SYNOPSIS OF EVENTS

Department of Physics is among the largest departments at NTNU, with 38 permanent scientific staff, 24 technical/administrative staff, 27 researchers/postdocs and 57 PhD students.

Although the number of faculty members is lower than ever since the merging of two physics departments in 2000, the scientific production with respect to the number of scientific papers in peer reviewed journals is larger than ever. Fortyone percent of published papers appeared in wellknown so-called level II journals. The number of external scientific projects as well as the economy related to the external activities reached new maxima in year 2006. It is gratifying to notify that this is not affecting the quality of the scientific publication rate.

Two of our PhD students (Jo Smiseth and Eivind Smørgrav) were awarded the Exxon Mobil prize for *excellent PhD work*. Another PhD student (Marit Sletmoen) won the prize for *best PhD thesis at the faculty*. In August, two of our Professors, Arne Brataas and Asle Sudbø, started as group leaders at the Centre of Advanced Study at the Norwegian Academy of Science and Letters, a basic research institution where *outstanding researchers* from Norway and abroad are invited to spend a year.

High research activity goes in parallel with an overall high teaching activity for the staff of the department. The number of ECT credits produced is kept high, and even increased in this year. It is promising to see that courses in physics are popular among students and regarded as useful. The number of international students on short time exchange studies has increased, particularly the number of Erasmus students. There are still free places on our international Master programs. The increased interest for Physics courses among international students might be related to an increasing number of courses that we offer in English. The majority of students from abroad come from Germany and France.

The new five year Master Program in Nanotechnology has gained much interest while the five year Master Program in Physics and Mathematics remains very popular. The two year Master Program in Physics has still open places. One future goal will be to recruit more students to this program. The award *best technology candidate from our faculty* was won by physics student Cecilie Russøy. The department has a continuous activity to promote science, particular physics. The Physics Trail attracted a number of 1200 twelve year old children, doing hands on experiments at the campus for one day, as well a Researchers' Night, with a number of 600 seventeen year old teenagers visiting the university for one night, are the most pronounced activities. Many dedicated teachers of the permanent staff have given popular talks, participated in TV or radio programs and other promoting activities.

The Department of Physics, in cooperation with SINTEF, is involved in two so-called Gemini Centres: the 'PV and Solar Cell Materials Centre' which was officially opened in year 2006 and the new establishment of the 'Transmission Electron Microscopy Centre'.

In May one of our professors, previous Rector of NTNU, Eivind Hiis Hauge, was decorated by the King for his service to the University. Our physics colleague from Technical University of Delft, Professor Hans Moij, received his honorary doctors degree at our university.

The NTNU's Lars Onsager Professorship for 2006 was awarded professor John R. Klauder, Departments of Physics and Mathematics, University of Florida, who collaborated with scientists at the department for about six months.

A number of senior staff members have retired over the last few years, and the last ones were professor Ole Johan Løkberg, assoc. professor. Bård Tøtdal and prof. Helge Skullerud. The department is in the midst of a generation change, and almost 20 persons have been interviewed for five new vacancies, to be filled in 2007. A most challenging task is to recruit women in future positions to fulfil NTNU's goals for gender equality in professor positions.

The department started its strategy process, following up NTNU's strategy for international excellence in 2020. Some of the future challenges will be to increase external funding, particularly from the European Union. The competition to recruit good students will continue with even more strength on providing good, high quality study programs.

Trondheim, May 2007

Berit Kjeldstad

STAFF

Head of Department: Professor Berit Kjeldstad

Deputy Head of Department: Professor Kåre Olaussen

PERMANENT STAFF

SCIENTIFIC STAFF

Professors

Jens O. Andersen, Anne Borg, Arne Brataas, Catharina Davies, Arnljot Elgsæter, Jon Otto Fossum, Alex Hansen, Eivind Hiis Hauge, Randi Holmestad, Ola Hunderi, Johan S. Høye, Anders Johnsson, Michael Kachelriess, Berit Kjeldstad, Mikael Lindgren, Tore Lindmo, Ole J. Løkberg, Thor Bernt Melø, Arne Mikkelsen, Frode Mo, Jan Myrheim, Kalbe Razi Naqvi, Kåre Olaussen, Steinar Raaen, Emil J. Samuelsen, Bo-Sture Skagerstam, Helge R. Skullerud, Bjørn Torger Stokke, Asle Sudbø, Arne Valberg.

Associate professors

Berit Bungum, Morten Kildemo, Tore H. Løvaas, Pawel Sikorski, Knut Arne Strand, Jon A. Støvneng, Bård Tøtdal, Erik Wahlstrøm, Turid Worren, Ingjald Øverbø.

Adjunct professors

Kenneth Dahl Knudsen, Einar Rofstad, Arne Skretting, Roger Sollie, John Walmsley, Tor Wøhni.

TECHNICAL AND ADMINISTRATIVE STAFF

Head of Administration Sylvi Vefsnmo

Administrative staff

Margit C.Hagen, Snorre Hansen, Inger Kosberg, Inger J. Lian, Eli Monsøy, Tove G. Stavø.

Technical staff

Irene Aspli, Lars Berntzen, Ole Tore Buset (substitute), Rolf Dahl, Knut R. Gjervan, Oddbjørn Grandum, Tor Jakobsen, Dagfinn Johnsen, Aphirak Juthajan (substitute), Erling Kristiansen, Lise Kvalø, Per Magne Lillebekken, Heimir Magnusson, Arne Moholdt, Jon Ramlo, Inge Sandaunet, Edrun Andrea Schnell, Bertil O. Staven, Kristin Grendstad Sæterbø.

TEMPORARY STAFF

Post doc/research scientist

Trine Højberg Andersen, Egor Babaev, Jon Are Beukes, Øyvind Borck, Ahmed Gmira, Antonius Helvoort, Daniel Huertas-Hernando, Joakim Hove, Morten Kildemo, Dionne Klein, Joachim Mathiesen, Gjertrud Maurstad, Yves Meheust, Boris Minaev, Anh Kiet Nguyen, Stine Nalum Næss, Sverre Vegard Pettersen, Ståle Ramstad, Albert Reiner, Bjørn Skjetne, Pradhan Srutarshi, Hao Sun, Mathieu Taillefumier, Ingunn Tufto, Rene Vissers, Per Erik Vullum, Roland Wittje, Xiaofeng Yu.

Senior staff

Johannes Falnes, Per C. Hemmer, Kristian Fossheim, Hans Kolbenstvedt, Jørgen Løvseth, Kjell Mork, Haakon Olsen, R. Svein Sigmond, Ivar Svare, Sigmund Waldenstrøm.

Doctoral students

Christian Andresen, Asadollah Bagheri, Jan Øystein Haavig Bakke, Binod Kumar Bhattarai, Håvard Huru Bergene, Kjetil Børkje, Aktor Chikukwa, Eskil Kulseth Dahl, Roya Dehghan, Live Eikenes, Arne Erikson, Tom Richard Evensen, Davi de Miranda Fonseca, Jørn Foros, Eirik Glimsdal, Martin S. Grønsleth, Henning Frydenlund Hansen, Håkon Kortner Hasting, Håvard Haugen, Hans Kristian Helgesen, Mari Juel, Steinar Kragset, Jacob Rune Linder, Yun Liu, Lars Løseth, Hanne Mehli, Devi Dhavraj Meena, Samsun Mohamad, Åsmund Fløystad Monsen, Jan Petter Morten, Florian Mumm, Kenate Nemera Nigussa, Heidi Nordmark, Kanak Parmar, Amutha Ramachandran, Thomas Ramstad, Ole Christen Reistad, Nina Kristine Reitan, Terje Røsten, Magne Saxegaard, Stein Olav Skrøvseth, Roman Shchelushkin, Hans Joakim Skadsem, Marit Sletmoen, Marius Aase Solberg, Bjarte Gees Bokn Solheim, Frantz Stabo-Eeg, Rune Strandberg, Aksel Straume, Ingeborg-Helene Svenum, Ragnhild Sæterli, Sven Tierney, Sedsel Fretheim Thomassen, Henrik Tollefsen, Wakshum M. Tucho, Glenn Tørå, Lars Erik Walle.

ACCOUNTS 2006

Government University funding

Amount kNOK

50 687

Projects financed by the Research Council of Norway	Project manager	Amount kNOK
Structural, electronic and optical properties of atomic overlayers on surfaces	Anne Borg	233
FUNMAT, post.doc.	Anne Borg	301
FUNMAT, Stipendiat	Anne Borg	489
Fysikkåret 2005	Anne Borg	81
Quantum Transport in Nanoscale Systems	Arne Brataas	19
Transport of spin and charge in semiconductors	Arne Brataas	586
Fundamentals of Nanoscale systems	Arne Brataas	1 198
Fundamentals of Condensed Matter	Arne Brataas	3 212
Intravital microscopy and MRI	Catharina Davies	493
Nanostructured Soft and Complexe Materials	Alex Hansen	4 044
Experimental investigations	Jon Otto Fossum	33
Structure and Dynamics of Soft and Complex Nanomaterials	Jon Otto Fossum	742
SUP Complex	Jon Otto Fossum	345
IPP, Interconnected Physical Phenomena	Jon Otto Fossum	309
Stipendiat, H.H. Bergene	Alex Hansen	18
Two-Phase Flow	Alex Hansen	342
Petromax	Alex Hansen	638
The Role of Damage in Fracture Dynamics	Alex Hansen	260
Fracture-Failure Phenomena in Disordered Media	Alex Hansen	587
Mapping of residual oil between wells	Alex Hansen	145
Micro- and nanostructure, materials development	Randi Holmestad	1 356
FUNMAT, Stipendiat	Randi Holmestad	513
Studies of the electronic structure of materials at the nanoscale	Randi Holmestad	260
Kimdanningskontroll for optimaliserte egenskaper	Randi Holmestad	11
Light Metal Surface Science	Ola Hunderi	44
Dendritic nanoporous materials with multifunctionality	Mikael Lindgren	1 882
Forskningssamarbeid Norge - Tyskland	Mikael Lindgren	31
Heat treatment fundamentals	Randi Holmestad	2 955
Electromagnetic fields and biological effects	Anders Johnsson	380
Factors controlling UV radiation in Norway	Berit Kjeldstad	395
Material fluxes from the Russian Rivers Ob and Yenisey	Berit Kjeldstad	38
Travel support SNBL/ESRF	Frode Mo	212
Structure Studies og ferroic materials under non-ambient conditions	Frode Mo	622
Mesoscale structures	Bjørn T. Stokke	86
Polymer gel signal transducers	Bjørn T. Stokke	497
Structure Formations and Properties of Polyelectrolyte Complexes	Bjørn T. Stokke	697
FRIBIOMOL, Activation of Toll-like receptors	Bjørn T. Stokke	650
Advanced Biological materials	Bjørn T. Stokke	103
Quantum Transport in Nanoscale Systems	Asle Sudbø	428
IKT-oxides	Asle Sudbø	11 349
Point Contact Investigations	Erik Wahlstrøm	134
ATEMIC	John Walmsley	117
Thin-film III-V semiconductors	Turid Worren	536
PhD, Rune Strandberg	Turid Worren	501
Småforsk	Several	685
	Sum	38 560

Contribution from other financial sources		
Projects financed by the Research Council of Norway	Project manager	Amount kNOK
EU	Valberg / Kjeldstad / Brataas	40
Kosmische Strahlung als Probe für Teilchenphysikjenseits des Standartmodels	Michael Kachelriess	152
Statoil	Alex Hansen / Anders Johnsson	183
VISTA	Alex Hansen	87
Photocure ASA	Anders Johnsson	25
FOI, Totalforsvarets foskningsinstitutt	Mikael Lindgren	180
Utvärdering av NKS/B	Tore Lindmo	43
NUFU	Jørgen Løvseth / Turid Worren	1 168
Hydro	Randi Holmestad	1 250
Elkem	Randi Holmestad	250
SINTEF	Strand / Raaen / Holmestad	7
Statens Strålevern	Tor Wøhni / Berit Kjeldstad	108
IFE	Anders Johnsson / Sylvi Vefsnmo	515
Naturfag i praksis / Evina	Per Morten Kind	149
Telenor ASA	Anders Johnsson	35
	Sum	4 192
Total external financing in 2006		42 751



AWARDS



Marit Sletmoen received the award for the best PhD thesis at the Faculty of Natural Sciences and Technology, the academic year 2005/2006. In her thesis, Marit Sletmoen presented research on the ultrastructure of biological macromolecules and their interactions.





Our physics colleague from Delft, Professor Hans Moij, received his honorary doctors degree, doctor honoris causa.

In May 2006 Professor Eivind Hiis Hauge (previous Rector of NTNU) was decorated by the King for his services to the University.



Jo Smiseth and Eivind Smørgrav were awarded the Exxon Mobil prize for excellent PhD work.

SPECIAL EVENTS

New Research Group at the Centre for Advanced Study (CAS)



Professors Asle Sudbø and Arne Brataas.

Gemini Centre PV Solar Cell Materials

On September 11th 2006 The Minister of Trade and Industry, Odd Eriksen, officially opened the Gemini Centre "PV Solar Cell Materials". A Gemini Centre is a revitalization of the close collaboration between NTNU and SINTEF that started in 2003, and this Gemini Centre was the 16th to be opened. The participants in the centre are Departments of Materials Technology and Department of Physics NTNU and SINTEF Materials and Chemistry. The purpose of the centre is to strengthen the competence in the area of solar cell materials, with the aim to make solar electricity cheaper and to support the growing Norwegian solar cell industry. Professors Asle Sudbø and Arne Brataas. are new group leaders at CAS within spin and transport in nanostructures for the academic year 2006/2007. They will investigate the novel and intriguing phenomena that occurs in nanoscale systems. By a combined broad experience in nanoscale systems as well semiconductors. normal as metals. high-temperature ferromagnets. lowand superconductors, and exotic new metals and insulators, a rich research environment for top-rate research will be created. They will develop improved theoretical methods for describing transport and other phenomena, and plan to use these methods to increase our understanding of experiments



Silicon for solar cells: Harsharn Thatgar explains to Minister of Trade and Industry Odd Eriksen how silicon is purified. Silicon of purity 99.8% costs ca $1\ell/kg$, and purified to 99,9999%, suitable for solar cells, the price is increased to ca ℓ 250/kg.

President Unni Steinsmo (SINTEF) congratulates Professor Randi Holmestad (NTNU) and Senior Scientist John Walmsley (SINTEF) at the new Gemini Centre, April 2006. Photo taken by Geir Otto Johansen.

SINTEF and NTNU have established a Gemini Centre in Transmission Electron Microscopy A Gemini Centre is a formalised (TEM). collaboration between SINTEF and NTNU which include common strategy processes and coordination of research. This centre is an outcome of the good working relationship between SINTEF Materials and Chemistry, SINTEF Synthesis and Properties and the TEM group in the Division of Condensed Matter Physics. Research done at the atomic level of materials is and will be important in nanotechnology. TEM is an indispensible tool in development of new materials. The new Gemini Centre is working to get a new aberration-corrected TEM to Trondheim and Norway.

Gemini Centre TEM Transmission Electron Microscopy

RESEARCH

DIVISION OF APPLIED PHYSICS AND DIDACTIC PHYSICS

Staff

Assoc. Professor Berit Bungum Assoc. Professor Morten Kildemo Professor Berit Kjeldstad Professor Mikael Lindgren Professor Helge Skullerud Assoc. Professor Tore Løvaas Assoc. Professor Tore Løvaas Assoc. Professor Knut Arne Strand Assoc. Professor Turid Worren Professor Emeritus Johannes Falnes Professor Emeritus Ole Johan Løkberg Assoc. Professor Emeritus Jørgen Løvseth Professor Emeritus R. Svein Sigmond

Guests

Sverre V. Pettersen (Scientist) Roland Wittje (Postdoc) Boris Minaev (Visiting Scientist)

Overview

The Division of Applied Physics and Didactic Physics consists of several teams carrying out research within the fields of *electron and ion physics, energy and environmental physics, experimental optics, physics education ("didactic physics").*

Interfaces between fluid phases existing in oil and gas reservoirs are studied by light scattering (*Strand*) with the purpose of improving condensate and oil reservoir management and production. Both model systems and samples from actual gas and oil fields are studied under reservoir conditions (studies can be performed at pressure up to 700 bar and temperature up to 180 °C.)

In electron and ion physics one studies the electrical breakdown in fluids and gases (*Løvaas, Sigmond*) and transport of ionized gases (*Skullerud*). The experimental optics group (*Lindgren, Kildemo*) carries out studies of photo-physical properties of molecular systems in biology and materials sciences. Research in the group also involves work on video holography and optical coherence tomography (*Løkberg*).

In energy and environmental physics the processes affecting transmission of ultraviolet radiation to the surface, particularly the importance of aerosols and clouds, are being studied (*Kjeldstad*), as well as renewable energy sources such as wind and ocean waves (*Falnes, Løvseth*). Research conducted on solar cells (*Worren*) is presented in more detail below.

Research in physics education (*Bungum*) involves work on curriculum development in physics and technology education, in a contemporary as well as in a historical



Figure 1. Teachers attending course in space technology at Andøya Rocket Range.

perspective. A PhD study carried out in the group investigates the effects of in-service courses in space technology, in terms of the nature and extent of teachers' realisation of content knowledge gained from the courses in their teaching.

Example of research carried out in 2006

Third generation solar cells

(Turid Worren, Sedsel Fretheim Thomassen, Rune Strandberg)

The solar cell physics group consisted in 2006 of two PhD students, one scientist and an associate professor, in addition to two master students. The research focus is on the so-called **third generation solar cells**.

Motivation

The global power consumption is increasing rapidly. For solar electricity to become a significant energy source, the cost per power unit produced must be reduced. One way to achieve this is to reduce costs of the current commercial solar cell technologies (first and second generation), but a more viable strategy will be to increase the conversion efficiency by introducing new concepts. The commercial solar cells for terrestrial energy supply are so-called single junction cells, which have an upper theoretical limit for the efficiency of 41% (for fully concentrated sun light).

To increase the efficiency limit beyond 41%, several new solar cell concepts, so-called **third generation** (**3GEN**) **solar cells**, have been proposed, having maximum theoretical efficiencies near 87%. One of these new concepts is the so-called multi-junction cell, where the tandem cell is a special case with two junctions. Three-junction cells have been realised using various III-V semiconductors, and the record efficiency, from 2005, is near 40%. One limitation in the performance of these multi-junction cells is the need for current matching. Equal amounts of photo-current must be generated in each junction. Since the spectral contents of the solar radiation varies with time, this current matching is a challenge and the junction producing the smallest current will limit the overall performance. The development of a cost-effective technology for III-V multi-junction solar cells remains a challenge.

An alternative to the multi-junction cells is the socalled intermediate-band (IB) solar cells, where (half-filled) intermediate energy bands within the band gap of the host/matrix semiconductor are introduced by the use of nanomaterials or quantum confined structures. By choosing the appropriate combination of matrix and embedded material compositions, and ensuring that confinement provides quantization effects, a structure with several decoupled energy bands can be created. If optical or "hot" phonon transitions are the dominant mechanism for charge transfer between these bands, similar and even larger efficiencies than for the multi-junction cells can be achieved. The major advantage of IB cells over multijunction cells is that similar efficiencies can be achieved with inherently simpler structures. This indicates a potential for lower fabrication costs. Furthermore, the current matching limitation is less severe. The intermediate-band materials are, however, also challenging to fabricate, and a strong effort on fundamental materials research is essential in order to develop industrially viable solutions.

The research focus of the solar cell physics group at NTNU is on third generation solar cells based on quantum dots. Through experimental and theoretical work we aim at establishing a fundamental understanding of the growth process of these nanomaterials, of how the properties of the materials depend on the fabrication process, and of how these properties affect the solar cell efficiency. This fundamental knowledge will not only enable the research and fabrication on intermediate band solar cells, but will also define a baseline for research into other proposed designs for high efficiency solar cells such as hot carrier cells and up/down conversion of photons. Both of these alternative routes to high efficiencies are proposed realised using nanoparticles or quantum dots.

Current activities

At present the research focus is on model systems, where we use molecular beam epitaxy (MBE) to fabricate samples made from III-V semiconductors. For these experiments we have a close collaboration with Prof. Bjørn-Ove Fimland at the Department of Electronics and Telecommunication, NTNU and Shumin Wang of Chalmers University of Technology. The aim is to verify the potential of quantum dot based intermediate band solar cells, and to investigate how these should be manufactured to get close to the ideal intermediate band solar cell. The samples are characterised using atomic force mictroscopy (AFM) transmisson electron microscope (TEM) (in collaboration with Prof. Randi Holmestad) and photoluminescence (PL) (in collaboration with Chalmers/Linkoping/NTNU).

To achieve high absorption of infrared radiation a high volume density of quantum dots is needed. In practice this means several quantum dot layers of high crystal quality. One of the main challenges in growing multiple layers is to optimize the barrier layer separating the quantum dot layers. The quantum dot layers should be electronically coupled, which requires a rather thin barrier, but still have high crystal quality, which requires a rather thick barrier. One proposal to achieve a thin barrier with high crystal quality is to anneal each barrier during growth.

In our latest experiments we introduced up to five InAs quantum dot layers in a GaAs/Al_{0.35}Ga_{0.65}As matrix. The materials and growth parameters are chosen to match the band gap parameters of an optimized threeband intermediate band solar cell. The effective band gap for the quantum dots should be 1.24 eV [M. A. Green, A. S. Brown, and R. P. Corkish, Physica E 14, 121 (2002)]. We compared three- and five layer samples with and without annealing of the barrier layers. The samples are characterized by PL and AFM.

Figure 2 shows the quantum dot PL spectra for the 3 and 5 layer samples (with no barrier annealing). The PL intensity increases as the number of quantum dot layers increases, as expected. The PL peak is centred around 1.21 eV for both samples, not far from the optimum value of 1.24 eV.



Figure 2. Room temperature PL of the 3 (black) and 5 (red) quantum dot layers without annealing.

Figure 3 show two 5 layer samples with and without annealing. The PL intensity of the annealed sample is lower than for the un-annealed sample. The PL peak for the sample without annealing is 1.21 eV while it is increased to 1.23 eV for the annealed sample, i.e. towards the optimum value.



Figure 3. Room temperature PL of the 5 layer samples with (blue) and without (red) annealing.

These results indicate that the quantum dots are affected by annealing. TEM measurements will be used to investigate how annealing affects the composition, density and size of the quantum dots.

Figure 4 shows an AFM image of a one layer InAs quantum dot structure taken one hour after growth. The total quantum dot density is high, in the order 10^{11} cm⁻², and consists of some large dots and a high number of small dots. Typical size (diameter x height) of a large dot is 60 x 10 nm and of a small dot 30 x 2 nm. For a practical solar cell which should absorb over a wide range of wavelengths, a narrow size distribution is not needed.



Figure 4. AFM image of InAs quantum dots in AlGaAs.

In addition to the MBE samples, we will manufacture quantum dot samples using pulsed laser deposition (PLD). A PLD facility is under construction, and will be operational in spring 2007. The advantage with PLD over MBE is that there is no limitation (in principle) to what kind of materials can be fabricated. For the PLD experiments, we focus on silicon based materials at first.

DIVISION OF BIOPHYSICS AND MEDICAL TECHNOLOGY

Staff

Professor Catharina de Lange Davies Professor Anders Johnsson Professor Tore Lindmo Professor Thor Bernt Melø Professor Kalbe Razi Naqvi Assoc. Professor Pawel T. Sikorski Professor Bjørn Torger Stokke Professor Bjørn Torger Stokke Professor II Einar Rofstad Professor II Einar Rofstad Professor II Arne Skretting Professor II Tor Wøhni

Guests

Dionne Klein (Postdoc) Gjertrud Maurstad (Postdoc) Gunnhild Oftedal (Scientist) Ståle Ramstad (Scientist) Marit Sletmoen (Postdoc) Ingunn Tufto (Postdoc)

Overview

The research within the division for Biophysics and medical technology can conveniently be grouped into three main activities although they are closely related. Biopolymers and bionanotechnology: Studies of physical properties and organisation of biological molecules and their utilisation in bionanotechnological *Medical technology*: Optically devices. based molecular and functional imaging to study properties and processes of molecules in cells and tissue. Biosystems: Photobiophysics, including spectroscopic and kinetic studies of biologically important molecules, photoinduced destruction of cells and bacteria. biophysics of vision. Studies of electromagnetic field exposures from different electric devices. Studies of plant growth and its interaction with gravity (space-related research). A brief overview is given below, and parts of one on-going project are presented in more detail.

Survey of research activities

Biopolymers and bionanotechnology

Biopolymers mesoscale structural organization and interactions

(B. T. Stokke, D Klein, G. Maurstad, M. Sletmoen, S. Tierney)

The projects comprise several aspects of biopolymer organization and function. We investigate polyelectrolyte complexation of biopolymers (DNAchitosan, xanthan-chitosan) focusing on studies of structures (toroid, rodlike, globular, structural metastability), stability and competition. Beta-glucan structures and interactions with polynucleotides and single-molecule interactions between mannuronan C-5 epimerases and alginates are studied. Among many techniques used, dynamic force spectroscopy is especially essential.

Responsive hydrogels as biological sensors is a new area of considerable interest and we also study the activation of toll-like receptors by force microscopy.

Finally investigations are carried out on the influence of chain stiffness on structure build up in polyelectrolyte multilayers.

Bionanotechnology

(*P. Sikorski, F. Mumm*) Se detailed project presentation below.

Medical technology

Transport of macromolecules in tumour tissue

(C. de Lange Davies, T. Lindmo, I. Tufto, L. Eikenes, N.Reitan, A. Eriksen)

A prerequisite for successful cancer therapy is that the therapeutic agent reaches its target. Novel cancer therapeutic agents such as DNA vectors, liposomes, and proteins are large molecules, and the tumour uptake of these agents is generally too low for successful therapy. The high interstitial fluid pressure and the extracellular matrix are potent barriers to the delivery of therapeutic macromolecules. Diffusion thus becomes the main transport mechanism. The therapeutic molecules have to diffuse through the extracellular matrix which consists of a structural network of collagen embedded in a gel of glycosaminoglycans.

In 2006 we have focused on characterization of the structural collagen network and measurements of diffusion in tumor tissue. Diffusion was measured using fluorescence recovery after photobleaching based on scanning two-photon laser or using fluorescence correlation spectroscopy. Disintegration of the collagen network was found to increase the diffusion more efficiently than disintegration of the gel of glycosaminoglycans.

Characterization of vulnerable plaques by multiphoton microscopy

(C. de Lange Davies)

Coronary heart disease due to atherosclerotic plaque leads to myocardial infarction and plaque should be detected at an early stage. Using two-photon excitation microscopy, the collagen rich plaque was detected by the second harmonic signal whereas the elastin in healthy vessel walls was detected by its autofluorescence. The collagen/elastin ratio may be used to detect the plaque.

Functional optical coherence tomography (OCT) (*T. Lindmo*)

This project was outlined in the Annual Report for 2003. Several papers were published in 2006, and the project is now continued in the optics group at SINTEF.

Biosystems

Plant growth reactions in weightlessness.

(A. Johnsson, B. Solheim)

This project focuses on the influence of gravity on growth of plants at the physiological, cellular and genetic level. In 2006 the work has concentrated on preparatory studies in collaboration with the Plant BioCentre at the Department of Biology. Oscillatory growth processes are abundant in plants and show a wide range of period times. The interaction of gravity with these growth processes will be studied in weightlessness in an experiment on the International Space Station (ISS). The overall experiment, denoted MULTIGEN-1, is a long term experiment and aims at studying seed-to-seed development of this plant species under weightlessness. The experiment is planned to be launched in year 2007.

Photoinduced reactions in cells.

(A.Johnsson, T.B. Melø, S. Ramstad)

Photosensitization reactions are studied in various cell types. In 2006 the interest has been focused on the bladder cancer cell line AY-27. Photoreactions leading to cell destruction after addition of photosensitizers are investigated by different techniques. An ultimate goal is to understand reactions that make it possible to treat bladder cancer by selective photodestruction of the cancerous cells. Another cell type of interest in the project is the skin bacterium, *Propionibacterium acnes*, partly responsible for the common acne disease.

Biological effects of electromagnetic fields

(A. Johnsson, G. Oftedal, A. Straume)

The project concentrates on questions around exposure to weak electromagnetic fields in the low frequency and the radiofrequency regions. Possible health effects of electromagnetic fields are the basic objectives of mapping of mainly 50 Hz magnetic fields in town areas, low frequency fields magnetic measurements around mobile phones and other electric devices. Radio frequency exposure (mobile phone frequencies) of mobile phone users reporting headaches as a symptom has been carried out in a double blind provocation study in collaboration with the Department of Neurology at the University Hospital. The results have been accepted for publication in 2007.

Photophysics of important pigment systems (*K.R. Naqvi, T.B. Melø*)

The research on carotenoids focussed on two different aspects. One dealt with the mechanisms and pathways of energy transfer in two carotenoid-pyropheophorbide dyads, serving as model antenna systems; the dyads contain carbonyl carotenoids peridinin and fucoxanthin, which display a remarkable dependence of their excited state lifetime on the polarity of the medium. The second project dealt with electron and energy transfer involving natural and artificial watersoluble carotenoids.

The kinetics of the phosphorescence of singlet oxygen photosensitized by the carotenoidless reaction centre of Rhodobacter sphaeroides R26.1 was investigated, and compared with the decay of the triplet state of the donor, the so-called special pair, which is believed to have insufficient energy to sensitize the formation of singlet oxygen. These experiments have shed much light on the generation and deactivation of singlet oxygen in the purple bacterial reaction centre. In another project involving singlet oxygen, we compared the singlet oxygen qunching ability of the thione analogues canthaxanthin, of echinenone and rhodoxanthin.

Noting that there was a great dearth of room temperature spectra of radical cations of polycyclic arenes, we decided to develop a method for obtaining such spectra and the associated molar absorption coefficients. The method makes use of electron transfer from the arene to tetranitromethane.

Biophysics of vision

(A. Valberg)

Signatures of mango- and parvocellular pathways

(A. Valberg and H. Sun, visiting scientist) Psychophysical experiments at the Department of Physics were compared to neurophysiological experiments at the State University of New York (Dr. B. Lee) in order to define signatures of chromatic and luminance signals in the parvo- and magnocellular pathways.

Age-related macular degeneration (AMD)

(A. Valberg, P. Fosse)

Within the framework of a Concerted Action initiated by the European Union, a collaboration between four international research groups has dealt with possibilities of early diagnosis of age-related macular degeneration (AMD). Α videographic visual stimulation system, VIGRA, developed in our group was used to evaluate contrast sensitivity and colour vision of persons suffering from AMD. This was a collaboration with Tambartun National Resource Centre for the Visually Handicapped. This result points to the possibility that tests of colour vision may help in the early diagnosis of the disease.

The VIGRA system has further been used in *Tests of the spectral proximity model of defective colour vision* (Dischler and Valberg). Other clinical colour vision tests (Ishihara, Farnsworth 100 Hue, Farnsworth D15 and H16 tests) often fail in classifying a visual defect correctly. Measurements were compared with DNA analysis to investigate the spectral proximity model stating that polymorphism in L- and M-pigment genes and a shift of λ_{max} of maximum cone absorptions leads to anomalous red-green colour discrimination.

A long-range neural effect

(A. Valberg, T. Otte, L. Spillmann)

In collaborative efforts it was demonstrated that the afterimage resulting from a strong foveal light flash can be made to pulsate by luminance modulation of a surround annulus as far as 8 degrees away. Afterimage pulsation persists even if all artefacts due to pupil size, stray light and simultaneous contrast are ruled out. This suggests an origin in a *long-range neural process* acting from the remote surround.

Example of research carried out in 2006

Characterisation and applications of biopolymer based nanotubes

(F. Mumm, P. Sikorski)

For living organisms, fabrication of complex 3D structures on the nm length scale is a common task. Utilisation of precisely designed and fabricated nanostructures is essential for all living organisms. Complex structures can be manufactured from variety of materials, e.g. proteins (microtubules, actin and collagen filaments, viruses), polysaccharides (chitin and cellulose whiskers) and through controlled biomineralisation, from inorganic materials like silica and calcium carbonate. These nanostructures can have a whole range of properties, tailored for the specific function that they have within a living organism. The structures can be soft and flexible, some can be dynamically de-assembled/re-assembled.



Figure 1: Colourful appearance of sea mouse hairs and spines when illuminated with white light at 90° angle.

We work on the isolation and application of biopolymer nanotubes produced by the bristle worm *Aphrodita Aculeate* (Sea Mouse). This marine worm produces two types of elongated structures: hairs with

a diameter of approximately 10 μ m (blue and green in Figure 1) and spines with diameter of approximately 1mm (dark red in Figure 1). Neither is made of solid polymer; both contain instead thousands of nano-channels (diameter 100 nm for hairs and about 200 nm for spines). This internal structure also results in a unique colourful appearance of the hairs and spines (see Figure 1). Larger spines also contain a central hollow core (diameter approx. 1 mm) and in this case, the walls that are built of an array of nanochannels (see Figure 2).



Figure 2: Optical and SEM micrographs of biopolymer sea mouse spines.

Nanochannels run parallel to the thread axis and are several mm long. Considering that the internal diameter of a individual channel is only 200 nm and the length can be up to 10 mm, this gives an aspect ratio of 1:50000.

Recent experiments show that nanochannel arrays from thicker spines can be chemically dissociated into individual channels or small channel arrays. In initial flow experiments, arrays of nanochannels were embedded in a PDMS polymer matrix and the diffusion in the nanochannels was observed using confocal laser scanning microscopy (see Figure 3).



Figure 3: Diffusion of fluorescein in water-filled channels

DIVISION OF COMPLEX MATERIALS

Staff

Professor Arnljot Elgsæter Professor Jon Otto Fossum Professor Alex Hansen Professor Arne Mikkelsen Professor Frode Mo Professor Steinar Raaen Professor Bo Sture Skagerstam

Guests

Jon Are Beukes (Postdoc / Scientist) Ahmed Gmira (Postdoc / Scientist.) Yves Meheust (Postdoc) Stine Nalum Næss (Postdoc) Srutrashi Pradhan (Postdoc) Bjørn Skjetne (Postdoc) Xiaofeng Yu (Postdoc)

Overview

The research is focused on the *Physics of Soft and Complex Materials* including *Biological Physics*. The phenomena studied include: structure and dynamics of nanostructured surface alloys; structurals phase transitions in ferroic compounds, clay containing systems and biopolymers; spontaneous and guided selfassembly of nanoparticles; diffusion properties in nanoporous media; folding and conformational dynamics of proteins and other biopolymers; anomalous diffusion processes; mechanical properties of rough surfaces; brittle fracture; mechanical properties of granular media; multiphase flow in porous media.

The research comprises the use of experimental methods, computer simulations and theoretical methods.

The *home laboratories* of the division contain facilities for: solid state surfaces in ultrahigh vacuum; wide- and small-angle X-ray scattering; static and dynamic light scattering; light microscopy; atomic force microscopy; preparation of soft aqueous samples for transmission electron microscopy; measurements of static and dynamic viscoelastic properties of soft materials (rheology); micro- and nano-calorimetry; thermogravimetry; studies of dynamic electro-optic properties of soft materials; isolation and purification of nanoparticles including biopolymers. Some members of the section are also regular users of the synchrotron facilities in Grenoble, France; Sao Paulo, Brazil; Pohang, South Korea.

The *computer simulation methods* include Brownian dynamics, Monte Carlo and deterministic particle dynamics methods.

The *theoretical studies* are mainly on condensed matter physics theory and statistical physics.

Survey of research activities

Experimental and theoretical studies of the dynamics and structure of nanoparticles and polymers

(A. Elgsæter and A. Mikkelsen)

Our work within the physics of various polymer systems consists of three closely integrated parts: I) Development of the necessary formal theoretical basis for describing the nanoscale dynamics using realistic macromolecule models. II) Development of the required numerical algorithms to carry out numerical Brownian dynamics simulation of macromolecule dynamics. III) Experimental studies of macromolecule dynamics using methods such as static and dynamic light scattering, nanocalorimetry, electron microscopy and electrically induced transient birefringence. A primary goal here is a deeper understanding of the interplay between functions and structural dynamics.

Experimental investigations of soft and complex
materials:From nano to macro.(J.O.Fossum)

For several years, the research group has focused on basic understanding of problems within soft and complex materials, in particular physical phenomena in soft matter using synthetic nano-layered silicates (clays) as the physical complex model system. Main physical phenomena studied in these systems include flow and diffusion processes, intercalalation processes, spontaneous self-assembly into liquid crystalline phases in systems of nano-platelets, and guided selfassembly into electrorheological and magnetorheological smart material properties. Important experimental methods applied include standard microscopy, as well as AFM and STM; rheology in external applied fields (magnetic or electric); visible light scattering; wide- and small-angle X-ray scattering; synchrotron X-ray scattering (at ESRF, LNLS in Brazil, PAL in South Korea and other sources); neutron scattering (at IFE, Kjeller).

Brittle fracture, mechanical properties of granular media, two-phase flow in porous media, econophysics

(A. Hansen)

The main research interests for 2006 have been concentrated on brittle fracture and on two-phase flow in porous media, in addition to granular flow problems. We have also initiated an activity on econophysics. The fracture project is described in detail below. The twophase flow problems concern the further development of a pore-scale flow simulator which will use lattice Boltzmann techniques to resolve the interface dynamics at junctions where the two phases meet. The granular flow problems are connected to the gravitational motion of charged grains. This is a technologically important problem occurring e.g. in the three-dimensional printing process. We are at present studying certain network topologies using Boltzmann methods. This study goes under the heading of econophysics.

Crystallographic studies of materials structure and properties.

(F. Mo)

Ferroic materials: A major part of the work has been devoted to studies of epitaxial thin films, and in particular to improving existing experimental procedures and optimizing the instrumentation. Ferroelectric PbTiO₃-films of thickness \sim 5 - 57 nm have been studied, also under electric fields up to 2.5 kV/cm, by the use of a specially designed sample cell allowing control of temperature, relative humidity and equipped with capacitors for the application of DC-fields. Targets for the studies are atomic/molecular structure, domain structure and dynamics, and their dependence on nanosize and electric field.

Polymer structure: A study of several related ethylene copolymers with the aim to understand the influence of various polymer variables on properties such as: crystallinity and crystallite size, thermal expansion, behaviour at melting and recrystallization, has been completed. A manuscript has been submitted.

X-ray induced damage in molecules: Combined timeresolved X-ray diffraction and Raman-studies of the nature and evolution of X-ray induced radiation damage in a small organic S-containing model compound. The results are presumably relevant also for bio-macromolecules for which radiation damage is a serious problem. A manuscript is under preparation.

Properties of nanostructured surfaces

(S. Raaen)

Electronic and structural properties of nanostructured surfaces are studied by X-ray photoelectron (XPS), spectroscopy ultraviolet photoelectron spectroscopy (UPS), photoemission electron microscopy (PEEM), low energy electron diffraction (LEED, and temperature programmed desorption (TPD). In recent years the focus has been on growth and properties of rare earth/transition metal based surface alloys, e.g. Ce, Sm and Tm on Pt, Pd and Rh. Adsorption of simple gases has shown adsorption properties may be dramatically altered on such systems. Some progress has recently been made in analyzing TPD-data by the use of Monte Carlo simulations. Presently, we are also studying the properties of a new form of carbon, namely carbon nano-cones, which show some interesting gas adsorption properties.

Collective Effects and self-organized critically in traffic flows

(Bo-Sture Skagerstam)

We have focused our attention on large-time statistical properties of traffic flows (work done in collaboration with A. Hansen). In this study has use been made of the so-called Hurst exponent to classify the large-time properties of traffic flows and properties of stochastic differential equations. In particular a generalized version of the fluctuation dissipation theorem could be used to describe the scaling behaviour of the statistical fluctuations of the sound-noise generated by the traffic flows. We have also studied various collective effects of atoms interacting with one and the same microcavity radiation field (cavity electrodynamics). The effect of e.g. detection efficiencies has been taken into account in great detail. Noise-properties of statistical mixtures in quantum optics have also been studied and it has been shown that minimal-dispersion can be obtained only for pure quantum states. A research project on the human eve as a quantum-mechanical detector of photons has also been initiated. We now believe that we have a predictive model for the response of the human eye on low intensity (quantum) light.

Example of research carried out in 2006

Electric polarisation and chain formation of nanolayered particles

(J.O. Fossum, Y. Méheust, K.P.S. Parmar, K.D. Knudsen, and D.M. Fonseca)

(Published in Scientific Highlights 2006 of the European Synchrotron Radiation Facility, ESRF.)

When certain colloidal suspensions of electrically polarisable particles in insulating fluids are subjected to an external electric field, usually of the order of 1 kV/mm, the particles become polarised, and subsequent dipolar interactions are responsible for aggregating a series of interlinked particles that form chains and columns parallel to the applied field. This structuring occurs within seconds, and disappears almost instantly when the field is removed. The structuring coincides with a drastic change in rheological properties (viscosity, yield stress, shear modulus, etc.) of the suspensions, which is why such fluids are sometimes called electro-rheological fluids (ERs). The mechanical behaviour of such suspensions is readily controllable by means of the external electric field, which has stimulated a great deal of scientific interest both in academic and industrial areas. Based on the ER effect, several possible industrial applications have been proposed, including "smart" devices such as clutches, brakes, damping devices, actuators, fuel injection valves, hydraulic valves, bearing dampers, seismic damping frame structures etc. Furthermore, it has been suggested that ER fluids could be used as and in photonic crystals, light shutters, mechanical polishers, displays, ink jet printers etc.



Fig. 1:

a) Optical microscope image of ER chain formation in a cell of 1 mm electrode gap with an electrical field applied in the horizontal direction.

b) Sketch of the reported X-ray scattering experiments. The magnified area sketches a single nano-layered clay particle inside a dipolar chain and the attached arrow indicates the direction of the dipole moment induced by the external electric field. A corresponding diffractogram is shown in Figure 2.

Here we report structural studies of ER phenomena in systems consisting of nanolayered clay particles suspended in oil. Our optical microscopy observations show that suspensions in silicone oil of nanolayered smectite (swelling) clay particles, either synthetic or natural, undergo, when submitted to a strong external electric field, a fast and extended chain-like structuring characteristic of ER behaviour (Figure 1). This structuring results from interaction between induced electric dipoles of polarised clay particles.

The present synchrotron wide-angle X-ray scattering (WAXS) experiments were performed at the Swiss-Norwegian Beamline BM01A (SNBL), where diffractograms were recorded using a 2D Mar345 detector. These WAXS experiments provide about the preferred direction information of polarisation for individual clay particles, as well as information about the orientational distributions of polarised clay particles within the aggregated ER chain structures. Each individual clay particle is a stack of "nano-cards", and thus a ring of Bragg powder scattering from randomly oriented clay particles in suspension is observed in zero applied electrical field, whereas anisotropic oriented powder scattering is observed above the ER triggering field of about 1 kV/mm (Figure 2).

The reported experiments show that the clay particles polarise along their silica sheets, *i.e.* along the "easiest" direction for moving intercalated ions and water. A change in the platelet separation inside the clay nanolayered particles also indicates that intercalated ions and water molecules play a central role in their electrical polarisation. The resulting induced dipole is attached structurally to the clay particle, and this causes clay particles to reorient and interact, resulting in the observed macroscopic structuring.

Therefore, the macroscopic properties of the reported ER clay suspensions could, in principle, be tuned by controlling the nature and quantity of the intercalated species, at the nanoscale. This creates an opportunity for novel ways of producing guided self-assembled nanostructures for implementation into nanocomposite materials design, as well as for use in connection with nanostructured templates.



Fig. 2:

a) 2D Mar345 detector diffractogram from ERoriented clay in silicon oil suspension. The broad dark ring is the scattering from the silicon oil. The narrow anisotropic (001) Bragg peak is the 1 nanometre layer stack scattering summed from the suspended clay particles when an external electric field is applied as sketched in Figure 1.

b) Azimutal representation of diffractograms of the type shown in the upper panel; scattering from ER structured chains formed in 4 different kinds of smectite clays are shown. Theoretical orientational fits are also included.

DIVISION OF CONDENSED MATTER PHYSICS

Staff

Professor Anne Borg Professor Randi Holmestad Professor Ola Hunderi Professor Emil J. Samuelsen Assoc. Professor Bård Tøtdal (Jan – June) Assoc. Professor Erik Wahlström Professor II John Walmsley Professor Emeritus Ivar Svare Professor Emeritus Kristian Fossheim

Guests

Trine Andersen (Postdoc) Ton van Helvoort (Postdoc) Rene Vissers (Postdoc) Per Erik Vullum (Postdoc)

Survey of research activities

The research activities include topics both in experimental and theoretical condensed matter physics. The members of the division work with a variety of experimental techniques, including synchrotron radiation, for studying physical properties of materials and material structures.

Transmission electron microscopy (TEM)

(R. Holmestad, J.Walmsley)

The year 2006 marked the retirement of Bård Tøtdal after 35 years in the group, during which he helped many postgraduate and undergraduate students, and worked closely with many colleagues in the University. His contribution to the group has been highly valued and his presence will be missed greatly.

The activities in the TEM research group include nanoscale structure studies within materials physics and the connection to macroscopic properties.

In 2006 projects have included:

- Alloy development, nucleation of precipitates in aluminium alloys; structure determination of metastable, hardening phases, experimentally and by modeling
- Materials for hydrogen storage (alanates)
- Micro- and nanostructure studies of functional perovskite materials; ferroelastic sintered materials, ferroelectric thin films and one-dimensional structures
- Analysis of alloy nanoparticles and support in catalyst materials
- Multicrystalline silicon solar cell materials
- Palladium membranes for hydrogen separation
- Segregation processes in aluminium alloys
- Metal dusting corrosion in industrial materials

NTNU and SINTEF emphasized the importance of TEM through the establishment of a TEM Gemini Centre in 2006. The Gemini Centre formalized a well functioning and fruitful collaboration between the partners, and aims at strengthening the strategic collaboration to meet common future challenges.

Nanomagnetics

(E. Wahlström)

The nanomagnetics group develops experimental methods for preparing and characterizing devices with spin dependent electronic properties. During the last year work has been done mainly along two lines: on the one hand adapting scanning microprobe techniques for local injection of current into devices, and on the other starting to prepare novel materials with nanometer size elements.



Figure 1. I-R curve indicating current induced magnetization reversal from an ellipse-shaped (450nm x 150nm) spin valve structure.

Recent studies have been focused on laterally resolved probing of current induced magnetization reversal of CPP-GMR spin-valve structures (Cu/Co/Cu/Py/Cu, lateral dimensions down to 50 nm). In ring elements the magnetoresistance was probed as a function of the lateral position of the contact, the applied field and the sense current. Magnetisation reversal was observed; both as induced by changing the magnetic field and the sense current. The field induced reversals are interpreted as a consecutive rotation of the onion states of the two magnetic layers. The current induced offsets and the current induced magnetisation reversal can be interpreted as induced by a combination of the spin torque and the Øerstedt field of the injected current. In particular the behaviour of the onset in the vicinity of the onion state domain wall boundaries display large shifts and large sensitivity to the sense current.

Surface theory

(Ø. Borck, I.-H. Svenum, and A. Borg)

The adsorption of methanol on NiAl(110) and Ni3Al(111) has been investigated using high resolution photoemission spectroscopy (PES) and

density functional theory (DFT) calculations. The experiments were performed at beamline D1011 of the Upon methanol MAX-lab synchrotron source. exposure, the PES experiments show that methanol and methoxy are adsorbed on both surfaces at 120 K in the first monolayer. Higher coverages only result in additional methanol adsorption. Upon heating in ultra high vacuum to 200 K, predominantly methoxy remains on the surface. DFT calculations were performed to determine the adsorption sites and to provide insight into the interactions between the adsorbates and the surfaces. These calculations show that methanol molecules adsorb in the Al on-top site on both surfaces. The molecule is rather weakly bound to the surface with an adsorption energy of approximately 0.4 eV. Methoxy is strongly bound to both the NiAl(110) and Ni3Al(111) surfaces (~ 2.7 eV). On NiAl(110), we find that the preferred adsorption site for methoxy is an Al-Al bridge site, while on Ni3Al(111) the adsorption site is an fcc-type hollow site with one nearest-neighbour Al atom two nearestneighbour Ni atoms.

In collaboration with Elsebeth Schröder, Chalmers University of Technology, we have also used DFT to investigate the adsorption of small, organic molecules (methanol, methylamine, and phenol) on the Al2O3(0001), Cr2O3(0001), and graphite(0001) surfaces.

Propagation of low frequency electromagnetic waves

(O. Hunderi, L. Løseth)

"Modelling of Controlled Source Electromagnetic Data" treats modelling of electromagnetic fields from controlled sources in geophysical applications. The focus is on modelling the marine CSEM (controlled source electromagnetic) method in planarly layered media. The recent introduction of SeaBed Logging (SBL) as an application of the marine CSEM method for direct hydrocarbon identification, has resulted in increased survey activity, and expanded as well as renewed the interest for investigating electromagnetic field propagation in the subsurface of the earth. Even if electromagnetic field propagation in layered media is a rather mature research subject, the current development of the CSEM and SBL methods demands reinvestigations and new theoretical insights. Optimal survey planning and solid interpretation rely on a thorough understanding of the signal propagation in the subsurface.

Polymeric and molecular organic semi-conductors (*E. J. Samuelsen*)

The research activity on organic semi-conducting polymers has been continued, although at a modest level. A series of small angle x-ray scattering studies (SAXS) using our new instrumentation Nanostar, on various alkyl-substituted polythiophenes $[C_4SH-R]_n$, $R = C_6H_{13}$ (hexyl), C_8H_{17} (octyl), $C_{10}H_{21}$ (decyl), and $C_{12}H_{25}$ (dodecyl), revealed an interesting different behaviour of the dodecyl material from the others. The chain stacking lattice parameter *a* was found to increase through the series

between 16.7 Å for the hexyl to 26.2 Å for the dodecyl, in agreement with previous observations, but the dodecyl showed an additional strong signal at very low angles, corresponding to a long-period repetition of length 160 Å. The long-period signal was looked for but could not be found for the other materials using our own SAXS instrument The materials were subsequently studied with better resolution at the SAXS instrumentation in Risø, which confirmed the long-period signal for dodecyl, and which also opened for possible very weak small angle signals even for some of the other polymers.

A possible explanation for the long-period might be chain folding, a phenomenon which has been shown to occur in some poly-alkyl-thiophenes as monolayers on graphite.



Figure 2. SAXS pattern of heat-treated poly dodecylthiophene

Example of research carried out in 2006

Hardening precipitates in Al alloys studied by APT and STEM

(H.S. Hasting, J.C. Walmsley, A.T.J. Helvoort and R. Holmestad)

Microstructure and precipitation phases in age hardenable Al-Mg-Si and Al-Mg-Si-Cu alloys have been studied by atom probe tomography (APT) and annular dark field scanning transmission electron microscopy (ADF-STEM). Both techniques give chemical information at a sub-nanometer scale, and they are recently developed techniques not established for standard investigations of the relevant alloys. APT experiments are performed as part of an ongoing collaboration with CNRS/Université de Rouen, France.

The main precipitate hardening phase in Al-Mg-Si alloys is the β " phase, whose composition has been investigated by APT, quantitative electron diffraction and ab-initio density functional calculations. A significant level of Al is found in the precipitates and the Mg:Si-ratio is significantly higher than 1. Chemical analysis by APT suggests a substitution of Si by Al in the structure of the well known Mg5Si6-model of β ". These experimental results are confirmed by ab-initio calculations, as the Mg5Al2Si4 composition is found to have an even lower formation enthalpy than Mg5Si6. Furthermore, quantitative electron diffraction analysis, used to establish the original Mg5Si6-structure, are in addition found not to contradict the new composition. Figure 3 illustrates results from APT experiments on one particular precipitate.



Figure 3. a) 3D reconstructed volume with β " precipitate, b) same precipitate identified by cluster identification c) *Erosion profile with matrix/precipitate interface indicated.*

Precipitates formed at peak hardness and over-aged conditions in Al-Mg-Si-Cu alloys are investigated by Z-contrast ADF-STEM. Cu-containing atomic columns in precipitates were imaged by atomic number contrast along [100] matrix direction. The technique has been used qualitatively, as Z-contrast shows a remarkable capability in imaging distinct patterns of Cu-containing atomic columns in the different phases. The method complements and aids interpretation of conventional high-resolution TEM images and nano beam diffraction observations. Figure 4 shows several precipitate types in the over-aged condition. The contribute to results obtained an improved understanding of the crystallography of the precursor and details of the structural transformation taking place during the precipitation process.

The work was funded by a SUP (Micro and nanostructural materials development) and KMB (Heat treatment fundamentals). The latter was sponsored by Hydro Al.



Figure 4. Precipitates found in matrix in the overaged condition: (a) HREM image of Q'-phase, (b) Z-contrast image of Q'-phase (c) Z-contrast of precursor-phase aligning in Al < 100>, (d) Zcontrast of mixed phase with elements of both precursor and Q'-phase.

DIVISION OF THEORETICAL PHYSICS

Staff

Professor Jens Oluf Andersen Professor Arne Brataas Professor Eivind Hiis Hauge Professor Johan S. Høye **Professor Michael Kachelriess** Professor Jan Myrheim Professor Kåre Olaussen Professor Asle Sudbø Assoc. Professor Jon Andreas Støvneng Assoc. Professor Ingjald Øverbø Professor II Roger Sollie Professor Emeritus Per Chr. Hemmer Professor Emeritus Kjell Mork Professor Emeritus Hans Kolbenstvedt Professor Emeritus Haakon A. Olsen Assoc. Professor Emeritus Sigmund Waldenstrøm

Guests

Dr. Tommy Øvergård (Scientist) Dr. Dag Østvang (Scientist)

Overview

Research is mainly carried out within the broad fields of *Condensed Matter Physics*, *Statistical Physics*, *Quantum Physic and Astro-particle physics*. These contain several subfields with a large variety of topics for research. A brief overview is given. For the year 2006 we have given a more extended description of two research topics: "Easy-plane quantum antiferromagnets" by A. Sudbø and "Entanglement in quantum mechanics" by J. Myrheim of K. Olaussen. Asle Sudbø and Arne Brataas have been at the Center for Advanced Studies in Oslo during the fall semester.

Survey of research activities

Unification of HRT (Hierarchical Reference Theory) SCOZA (Self-consistent Ornstein-Zernike and Approximation) have been further studied. Both theories have turned out to be very accurate for fluids also in the critical region. Now these theories are combined by requiring consistency between the energy, and free energy, compressibility routes to thermodynamics. In this way two free parameters imbedded in the pair correlation function can be determined. We have developed general equations and applied them to a more simple class of models that can be solved exactly. These models are the MSM (mean spherical model) and and a generalization of it, the GMSM, that we introduced (J. S. Høye and A. Reiner).

The SCOZA was used for further studies of fluids with realistic interaction like the Lennard-Jones interaction. We have shown how a soft molecular core can be replaced by an effective temperature-dependent hard core in a consistent way (J. S. Høye and A. Reiner).

The thermal behavior of the Casimir force between metallic plates is further studied. Up to a certain temperature the Casimir force decreases with increasing temperature. This may be counterintuitive and has been heavily debated by claims that this will break the third law of thermodynamics. We show the opposite. (J. S. Høye, I. Brevik, J. B. Aarseth, K. Milton, S. Ellingsen).

Fundamentals of nano-scale systems: The future of nano-electronics will require a combination of in different expertise fields bv integrating semiconductors and normal metals with magnetic and superconducting materials. Our group explores spin and charge flow in such nanostructures. We aim to develop improved theoretical methods for describing transport phenomena, and other physical effects, and use these methods to increase our understanding of experiments. We study the properties of novel systems, pure or hybrid, containing ferromagnets, normal metals, semiconductors, and superconductors. Among current projects are 1) current induced our magnetization excitations, 2) two-dimensional "Dirac fermions" in graphene, a two-dimensional form of graphite, 3) spin flow into superconductors, 4) transport in magnetic semiconductors, 5) fluctuations and dissipation in ferromagnets, 6) Berry phase and its connection to the spin Hall effect and the anomalous Hall effect. We published 11 papers in 2006, of which 2 in Physical Review Letters, 7 in the Physical Review B, and 1 in Physics Report. (A. Brataas, A.K. Nguven, D. Huertas-Hernando, M. Taillefumier, J. Foros, J.P. Morten, R. Shchelushkin, H.J. Skadsem and H. Haugen).

In the past year, we have been focusing primarily on Josephson tunnelling in heterostructures of novel and unconventional ferromagnetic spin-triplet superconductors, thermal fluctuations of vortex matter in trapped Bose-Einstein condensates, and the character of a putative quantum phase transition from a Neel state to a valence bond solid state in easy-plane quantum antiferromagnets. The results are published in three papers in Physical Review Letters: (M. S. Grønsleth, J. Linder, J.-M. Børven, and A. Sudbø, Phys. Rev. Lett., 97, 147002 (2006). S. Kragset, E. Babaev, and A. Sudbø, Phys. Rev. Lett., 97, 170403 (2006). S. Kragset, E. Smørgrav, J. Hove, F. S. Nogueira, and A. Sudbø, Phys. Rev. Lett., 97, 247201 (2006).

Entanglement in mixed quantum states is studied from a geometric point of view (*J. Myrheim, J. M. Leinaas, E. Ovrum*).

Density functional calculations have been used to determine vibrational spectra of triphenyl based compounds and ions (Ph₃CCl, Ph₃CCH₃, Ph₃C⁺) as

well as aluminum based reaction partners (e.g. $Al_2Cl_2(CH_3)_4$). These systems are of interest in connection with homogeneous catalysis of olefin polymerization. Calculated frequencies were compared with experiments, and assignment of the observed IR bands was done by investigation of the calculated normal modes. (*J. A. Støvneng, O. K. Eide*, submitted to Vibrational Spectroscopy).

Using the 1/N expansion, we have studied the influence of quantum instantons on the thermodynamics of the CP^{N-1} model in 1+1 dimensions. We have done this by calculating the pressure to next-to-leading order in 1/N, without quantum instanton contributions. The fact that the CP¹ model is equivalent to the O(3) nonlinear sigma model, allows for a comparison to the full pressure up to $1/N^2$ corrections for N=3. Assuming validity of the 1/N expansion for the CP¹ model makes it possible to argue that the pressure for intermediate temperatures is dominated by the effects of quantum instantons. (*J. O Andersen, D. Boer, H. J. Warringa,* Phys. Rev. D, 74, 045028 2006).

The focus of our research was the physics of ultrahigh energies cosmic rays (UHECR). Two of the main results obtained were the prediction of a "second dip" as a signature of UHE proton interactions with cosmic microwave background radiation and the suggestion of the Compton-Getting effect as a tool to study extragalactic cosmic rays. We argued also that angular anisotropies of UHECRs on medium scales compatible with the expectation from Large Scale Structures in the Universe have been already observed. Other studies include the discussions of deflections of UHECRs in the Galactic magnetic field and of the consistency of the observed energy spectrum of UHECRs with the one predicted by Fermi shock acceleration (V. Berezinsky, A. Gazizov, M. Kachelriess, D. Semikoz, P. Serpico and *M. Teshima*). The status of superheavy dark matter was reviewed and the main predictions of this model were up-dated for the Pierre Auger Observatory (R. Aloisio, V. Berezinsky and M. Kachelriess).

The production of high energy neutrinos in astrophysical sources with weak magnetic fields, but large interaction depths was investigated (*M.Kachelriess and R.Tomàs*).

Size distributions of damage avalanches during failure processes are typically power laws. For fiber bundles and other systems it is demonstrated that the power law changes near complete breakdown, and we propose to use such changes as a signal for imminent system failure (*P.C. Hemmer, A. Hansen and S. Pradhan*).

Examples of research carried out in 2006

Easy-plane quantum antiferromagnets (A. Sudbø)

Quantum phase transitions in Mott insulators do not fit easily into the Landau-Ginzburg-Wilson paradigm. A recently proposed alternative to it is the so-called deconfined quantum criticality scenario providing a new paradigm for quantum phase transitions. In this context it has recently been proposed that a secondorder phase transition would occur in a twodimensional spin1/2 quantum antiferromagnet in the deep easy-plane limit, from a Neel state to a valence bond solid. A check of this conjecture is important for understanding the phase structure of Mott insulators. To this end, we have performed large-scale Monte Carlo simulations on an effective gauge theory for this system, including a Berry-phase term that projects out the S=1/2 sector. The result is a first order phase transition, thus contradicting the conjecture. However, while we do not find criticality in the model system, we do find deconfinement in the sense that the instantons of an a priori compact gauge field governing the spinfluctuations are suppressed by a Berry-phase term that projects out the correct S=1/2 spin sector. The result is an emergent noncompact gauge field, equivalently an emergent photon. This corresponds to an emergence of spinons rather than magnons as long-lived spinexcitations at the phase transition. (S. Kragset, E. Smørgrav, J. Hove, F. S. Nogueira, and A. Sudbø, Phys. Rev. Lett., 97, 247201 (2006)).



Figure 1. Histograms of the action of an effective gauge theory model of an easy-plane quantum antiferromagnet with a compact gauge field (top) and a non-compact gauge field (bottom). The clear double peak structure illustrates the coexistence of two degenerate phases at the phase transition, which is the hallmark of a first-order phase transition.

Entanglement in quantum mechanics

In quantum mechanics it is possible to have stronger correlations between spatially separated systems than what is possible in classical physics. Schrödinger introduced in 1936 the name entanglement for such correlations. Entanglement can be regarded as a physical resource that can be used for example in quantum computing, or to double the information content in a message by so called superdense coding. How to measure entanglement quantitatively is still an active area of research.

The concept of entanglement is less well understood for mixed quantum states than for pure states. Mixed states are classified as either separable or entangled. The separability problem, i.e. deciding which class a given mixed state belongs to, has been shown to be computationally hard in general, although the so called Peres criterion is a simple necessary condition for separability. Even in the very simple case of a composite system consisting of two three-level quantum systems, no simple sufficient condition for separability is known. In a collaboration between Jan Myrheim at NTNU and Jon Magne Leinaas and his PhD student Eirik Ovrum in Oslo, it has been a goal to understand better how to measure entanglement in the lowest dimensional cases.



Figure 2. A two dimensional section through the 80 dimensional space of mixed states for two three-level systems. The set of separable states is labelled S. The regions B and E both contain entangled states. The states in B are entangled but satisfy the Peres condition, such states are said to have bound entanglement.

Another line of investigations concerns the entanglement between systems with very many degrees of freedom. In a model studied by Stein Olav Skrøvseth it was found that a pure state in a large universe may actually look like a thermal state when only a small subset of the total system is accessible to an observer, and that almost all initial states tend to evolve unitarily towards such an apparent thermal state. This is a result which we on even days tend to think is obvious, and on odd days impossible.

PUBLICATIONS IN REFEREED JOURNALS AND BOOKS

Alnes, Håvard; Ravndal, Finn; Olaussen, Kåre; Wehus, Ingunn Kathrine. Electromagnetic Casimir energy with extra dimensions. *Physical Review D, Particles and fields* 2006;74

Aloisio, Roberto; Berezinsky, Venya; Kachelriess, Michael. On the status of superheavy dark matter. *Physical Review D, Particles and fields* 2006;74

Amundsen, Lasse; Løseth, Lars Ole; Mittet, Rune; Ellingsrud, Svein; Ursin, Bjørn. Decomposition of electromagnetic fields into upgoing and downgoing components. *Geophysics* 2006;71(5):G211-G223

Andersen, Jens Oluf; Boer, Daniel; Warringa, Harmen J. Effects of quantum instantons on the thermodynamics of the CP(N-1) model. *Physical Review D, Particles and fields* 2006;74(4)

Andersen, Odd Jan; Løvseth, Jørgen. The Froya database and maritime boundary layer description. *Marine Structures* 2006

Arstad, Bjørnar; Venvik, Hilde Johnsen; Klette, Hallgeir; Walmsley, John; Tucho, Wakshum Mekonnen; Holmestad, Randi; Holmen, Anders; Bredesen, Rune. Studies of self-supported 1,6 μm Pd/23 wt.% Ag membranes during and after hydrogen production in a catalytic membrane reactor. *Catalysis Today* 2006;118:63-72

Bakke, Jan Øystein Haavig; Hansen, Alex; Kertész, János. Failures and avalanches in complex networks. *Europhysics letters* 2006;76(4):717-723

Berezinsky, Veniamin S.; Gazizov, Askhat; Kachelriess, Michael. Second dip as a signature of ultrahigh energy proton interactions with cosmic microwave background radiation. *Physical Review Letters* 2006;92

Bhattarai, Binod Kumar; Kjeldstad, Berit Johanne; Bagheri, Asadollah; Thorseth, Trond Morten. Aerosol climatology in Kathmandu using Sun Photometry. I: *Remote Sensing 2006*. Bellingham, USA: SPIE - International Society for Optical Engineering 2006: 11 s.

Bjarte-Larsson, Torkel; Falnes, Johannes. Laboratory experiment on heaving body with hydraulic power take-off and latching control. *Ocean Engineering* 2006;33(7):447-477 **Bjarte-Larsson, Torkel; Falnes, Johannes; Moan, Torgeir**. Comparison of results from timedomain simulations and model tests of a waterpumping wave-power unit. *Proceeding of The Sixteenth International Offshore and Polar engineering Conference* 2006:416-422

Borck, Øyvind; Schröder, Elsebeth. Adsorption of methanol and methoxy on the alpha-Cr2O3(0001) surface. *Journal of Physics-Condensed Matter* 2006;18(48):10751-10763

Borck, Øyvind; Schröder, Elsebeth. Firstprinciples study of the adsorption of methanol at the alpha-Al2O3(0001) surface. *Journal of Physics-Condensed Matter* 2006;18(1):1-12

Brataas, Arne; Bauer, GEW; Kelly, P.J. Noncollinear magnetoelectronics. *Physics Reports -Review Section of Physics Letters* 2006;427:157-255

Brataas, Arne; Tserkovnyak, Y; Bauer, GEW. Current-induced macrospin versus spin-wave excitations in spin-valves. *Physical Review B* 2006;73(014408)

Bu, H; Næss, Stine Nalum; Beheshti, N; Zhu, KZ; Elgsaeter, Arnljot; Kjoniksen, AL; Nystrom, B. Characterization of thermally sensitive interactions in aqueous mixtures of hydrophobically modified hydroxyethylcellulose and cyclodextrins. *Langmuir: the ACS Journal of Surfaces and Colloids* 2006;22:9023-9029

Bu, HT; Kjoniksen, AL; Elgsaeter, Arnljot; Nystrom, B. Interaction of unmodified and hydrophobically modified alginate with sodium dodecyl sulfate in dilute aqueous solution -Calorimetric, rheological, and turbidity studies. *Colloids and Surfaces A, Physicochemical and Engineering Aspects* 2006;278

Bungum, Berit. Transferring and transforming technology education: A study of Norwegian teachers' perceptions of ideas from Design & Technology. *International journal of technology and design education* 2006;16(1):31-52

Bungum, Berit. Teknologi og design i nye læreplaner i Norge: Hvilken vinkling har fagområdet fått i naturfagplanen? *NorDiNa* 2006(4):28-39

Bungum, Berit; Rossing, Nils Kristian.

Teknologi: Vi bygger elektroniske sensorer. Naturfag : tidsskrift for Nasjonalt nettverk for naturfag 2006;1:12-16 **Børkje, Kjetil; Sudbø, Asle**. Tunneling between noncentrosymmetric superconductors with significant spin-orbit splitting studied theoretically within a two-band treatment. *Physical Review B* 2006;74

Camarda, Massimo; Siringo, Fabio; Pucci, Renato; Sudbø, Asle; Hove, Joakim. Methods to determine the Hausdorff dimension of vortex loops in the three-dimensional XY model. *Physical Review B* 2006;74

Chakarova-Käck, Svetla D.; Borck, Øyvind; Schröder, Elsebeth; Lundqvist, Bengt I. Adsorption of phenol on graphite(0001) and alpha-Al2O3(0001): Nature of van der Waals bonds from first-principles calculations. *Physical Review B* 2006;74(15)

Cuamba, B.A.; Chenene, M.L.; Mahumane, G.; Quissico, E.; Vasco, E.; Løvseth, Jørgen; O'Keefe, P. Energy Resources Assessment in Mozambique. *Journal of Energy in Southern Africa* 2006;17(4)

Dischler, Eirik Øverland; Valberg, Arne. Comparing chromatic detection ellipses of colourdeficient subjects with standard colour vision tests. *Perception* 2006;35 Suppl: 186-187

Djupesland, Per G; Skretting, Arne. Breath actuated device improves delivery to target sites beyond the nasal valve. *The Laryngoscope* 2006;116

Donangelo, Raul; Jensen, Mogens H; Simonsen, Ingve; Sneppen, Kim. Synchronization Model for Stock Market Asymmetry. *Journal of Statistical Mechanics: Theory and Experiment* 2006

Draget, Kurt Ingar; Skjåk-Bræk, Gudmund; Stokke, Bjørn Torger. Similarities and differences between alginic acid gels and ionically crosslinked alginate gels. *Food Hydrocolloids* 2006;20:170-175

Elgsæter, Arnljot; Foss, Bente Jeanette; Li, B.; Sliwka, Hans-Richard; Partali, Vassilia; Melø, Thor Bernt; Naqvi, Kalbe Razi; Næss, Stine Nalum. Hydrophilic carotenoids: Surface properties and aggregation of crocin as a biosurfactant. *Helvetica Chimica Acta* 2006;89

Erostyák, J; Jávorfi, T; Buzády, A; Naqvi, Kalbe Razi; Garab, G. Comparative study of integrating cavity absorption meters. *Journal of Biochemical and Biophysical Methods* 2006;69(1-2):189-196 **Falnes, Johannes**. Discussion. *International Journal of Offshore and Polar Engineering* 2006;16

Falnes, Johannes; Bjarte-Larsson, Torkel. Theoretical and experimental investigation of wave energy conversion by a phase-controlled heaving body. *Journal of Engineering for the Maritime Environment (Part M)* 2006;220(4):175-183

Fossheim, Kristian. Vortex Matter in Nanostructured Superconductors, Vortex IV Closing remarks. *Physica C - Superconductivity and Its Applications* 2006;XI-XIII:437-438

Fossum, Jon Otto. Inferring orientation distributions in anisotropic powders of nanolayered crystallites from a single two-dimensional WAXS image. *Journal of applied crystallography* 2006;39:661

Fossum, Jon Otto. Using synchrotron X-ray scattering to study the diffusion of water in a weakly-hydrated clay sample. *Clay Science* 2006;12 Suppl 2:66-71

Garmo, Øyvind Aaberg; Naqvi, Kalbe Razi; Røyset, Oddvar; Steinnes, Eiliv. Estimation of diffusive boundary layer thickness in studies involving diffusive gradients in thin films. *Analytical and Bioanalytical Chemistry* 2006;386(7-8):2233-2237

Giskeødegård, Nils Håvard; Blaijev, O.; Hubin, A.; Terryn, H.; Hunderi, Ola; Nisancioglu, Kemal. Properties of oxide formed on aluminium in aqueous acetate buffer. *Materials Science Forum* 2006;519-521:717-722

Grønsleth, Martin; Linder, Jacob; Sudbø, Asle; Børven, Jon-Mattis. Interplay between ferromagnetism and superconductivity in tunneling currents. *Physical Review Letters* 2006;97

Hansen, Henning F.; Andresen, Christian Andre. Nettverk - Hvilke nettverk tilhører du? *Fra fysikkens verden* 2006(4):95-98

Hansteen, Fredrik; Kimel, Aleksei V.; Kirilyuk, Andrei; Rasing, Theo. Nonthermal ultrafast optical control of the magnetization in garnet films. *Physical Review B* 2006

Hasting, Håkon Stokka; Walmsley, John C; Marioara, Calin D; Van Helvoort, Antonius; Holmestad, Randi; Danoix, Frederic; Lefebvre, Williams. Characterisation of early precipitation stages in 6xxx series aluminium alloys. *Institute of Physics Conference Series* 2006;26:99-102 Hasting, Håkon Stokka; Walmsley, John; Van Helvoort, Antonius; Marioara, Calin D; Andersen, Sigmund; Holmestad, Randi. Zcontrast imaging of the arrangement of Cuprecipitates in 6xxx-series aluminium alloys. *Philosophical Magazine Letters* 2006;86(9):589-597

Helbing, Dirk; Johansson, Anders; Mathiesen, Joachim; Jensen, Mogens; Hansen, Alex. Analytical approach to continuous and intermittent bottleneck flows. *Physical Review Letters* 2006;97

Horn, Svein Jarle; Sikorski, Pawel; Cederkvist, Jannicke B.; Vaaje-Kolstad, Gustav; Sørlie, Morten; Synstad, Bjørnar; Vriend, Gert; Vårum, Kjell Morten; Eijsink, Vincent G.H. Costs and benefits of processivity in enzymatic degradation of recalcitrant polysaccharides. *Proceedings of the National Academy of Sciences of the United States of America*, 2006;103(48):18089-18094

Horn, Svein Jarle; Sørbotten, Audun; Synstad, Bjørnar; Sikorski, Pawel ; Sørlie, Morten; Vårum, Kjell Morten; Eijsink, Vincent G.H. Endo/exo mechanism and processivity of family 18 chitinases produced by Serratia marcescens. *FEBS Journal* 2006;273:491-503

Hove, Joakim; Sudbø, Asle. Hove and Sudbø reply. *Physical Review Letters* 2006;96

Huertas-Hernando, Daniel; Guinea, Fransisco; Brataas, Arne. Spin-orbit coupling in curved graphene, fullerenes, nanotubes, and nanotube caps. *Physical Review B* 2006;74(155426)

Hunderi, Ola; Friis, Jesper; Marthinsen, Knut; Ryum, Nils. Grain size correlation during normal grain growth in one dimension. *Scripta Materialia* 2006;55:939-942

Høye, Johan Skule; Brevik, Iver Håkon; Aarseth, Jan Bjarte; Milton, KA. What is the temperature dependence of the Casimir effect? *Journal of Physics A – Mathematical and General* 2006;39:6031-6038

Høye, Johan Skule; Reiner, Albert. Selfconsistent Ornstein-Zernike approximation for molecules with soft cores. *Journal of Chemical Physics* 2006;125

Jávorfi, T; Erostyák, J; Gal, J; Menczel, M; Naqvi, Kalbe Razi; Garab, G. Quantitative spectrophotometry using integrating cavities. *Journal of Photochemistry and Photobiology. B, Biology* 2006;82(2):127-131 Johansen, A; Simonsen, Ingve; Jensen, MH. Optimal investment horizons for stocks and markets. *Physica A: Statistical Mechanics and its Applications* 2006;370:64-67

Johnsson, Anders; Moan, Johan. Rytmer, depresjoner og lys. *Tidsskrift for Den norske lægeforening* 2006;126(8):1044-1047

Johnsson, Anders; Stette, Gunnar. Drøfting av et "Et Cavoritt-problem". *Fra fysikkens verden* 2006(2):55-58

Johnsson, Anders; Stette, Gunnar. Et Cavorittproblem. *Fra fysikkens verden* 2006(1):27-27

Johnsen, Bjørn; Kjeldstad, Berit Johanne; Aalerud, T.N.; Nilsen, Lill Tove Norvang; Schreder, JOn; Blumthaler, M; Bagheri, Asadollah; Bhattarai, Binod Kumar. International intercomparison of multiband filter radiometer in Oslo 2005. I: *Remote Sensing 2006*. Bellingham, USA: SPIE - International Society for Optical Engineering 2006. 12 s.

Juel, Mari; Samuelsen, BT; Kildemo, Morten; Raaen, Steinar. Valence variations of Sm on polycrystalline Ag. *Surface Science* 2006;600:1155-1159

Kachelriess, Michael; Semikoz, Dimitry. Clustering of ultra-high energy cosmic ray arrival directions on medium scales. *Astroparticle physics* 2006;26:10-15

Kachelriess, Michael; Semikoz, Dimitry. Reconciling the ultra-high energy cosmic ray spectrum with Fermi shock acceleration. *Physics Letters B* 2006;634(2-3): 143-147

Kachelriess, Michael; Serpico, Pasquale. The Compton-Getting effect in ultra-high energy cosmic rays of cosmological origin. *Physics Letters B* 2006;620:225

Kachelriess, Michael; Serpico, Pasquale; Teshima, Masahiro. The Galactic magnetic field as spectrograph for ultra-high energy cosmic rays. *Astroparticle physics* 2006;26:378-386

Kachelriess, Michael; Tomas, Ricard. High energy neutrino yields from astrophysical sources. *Physica scripta. T* 2006;127

Kachelriess, Michael; Tomas, Ricard. High energy neutrino yields from astrophysical sources I: Weakly magnetized sources. *Physical Review D*, *Particles and fields* 2006;74 Kildemo, Morten; Grossner, U; Juel, M; Samuelsen, B; Svensson, Bengt G.; Raaen, Steinar. Electronic properties of the Sm/4H-SiC surface alloy. *Journal of Applied Physics* 2006;99

Kildemo, Morten; Grossner, U; Juel, Mari; Samuelsen, Bjørn Tore; Svensson, BG; Raaen, Steinar. Experimental study of the formation and oxidation of the Sm/4H-SiC surface alloy. *Materials Science Forum* 2006;527-529:681-684

Kildemo, Morten; Grossner, U; Juel, Mari; Svensson, BG; Raaen, Steinar. Oxidation of 4H-SiC covered with a SmSix surface alloy. *Surface Science* 2006;600:1300-1307

Kildemo, Morten; Grossner, U; Raaen, Steinar. Electronic properties of the Ce/4H-SiC interface studied by x-ray photoemission spectroscopy. *Journal of Applied Physics* 2006;100

Kildemo, Morten; Raaen, Steinar. Catalytic oxidation of 4H-SiC by a Ce overlayer. *Physical Review B* 2006;73:205338

Kjeldstad, Berit Johanne. Underwater Radiation Measurements: Consequences of and increased UV-B radiation. I: *Environmental UV Radiation: Impact on Ecosystems and Human Health and Predictive Models*. Pisa, Italy: Springer Verlag 2006: 193-203

Knowles, Kevin; Van Helvoort, Antonius. Anodic bonding. *International Materials Reviews* 2006;51(5):273-311

Knudsen, Henning Arendt; Hansen, Alex. Two-Phase Flow in Porous Media: Dynamical Phase Transition. *European physical journal. B, Condensed matter phisics* 2006;49:109

Knudsen, Kenneth Dahl; Maloy, KJ; Fossum, Jon Otto; Meheust, Yves; Fonseca, Davi de Miranda; Parmar, Kanak Pal Singh. Intercalation-enhanced electric polarization and chain formation of nano-layered particles. *Europhysics letters* 2006;74:438-444

Kolstø, Stein Dankert; Bungum, Berit; Arnesen, Erik; Isnes, Andres; Kristensen, Terje; Mathiassen, Ketil; Mestad, Idar; Quale, Andreas; Tonning, Anne Sissel Vedvik; Ulvik, Marit. Science students' critical examination of scientific information related to socio-scientific issues. *Science Education* 2006;90(4):632-655

Kovalev, AA; Bauer, GEW; Brataas, Arne. Magnetomechanical torques in small magnetic cantilevers. *Japanese Journal of Applied Physics* 2006;45:3878-3888 Kovalev, AA; Bauer, GEW; Brataas, Arne. Perpendicular spin valves with ultrathin ferromagnetic layers: Magnetoelectronic circuit investigation of finite-size effects. *Physical Review B* 2006;73(054407)

Kragset, Steinar; Babaev, Egor; Sudbø, Asle. Thermal Fluctuations of Vortex Matter in Trapped Bose-Einstein Condensates. *Physical Review Letters* 2006;97

Kragset, Steinar; Smørgrav, Eivind; Hove, Joakim; Nogueira, Flavio; Sudbø, Asle. First-Order Phase Transition in Easy-Plane Quantum Antiferromagnets. *Physical Review Letters* 2006;97(247201)

Lein, Hilde Lea; Andersen, Øystein Skottun; Vullum, Per Erik; Lara-Curzio, E; Holmestad, Randi; Einarsrud, Mari-Ann; Grande, Tor. Mechanical properties of mixed conducting La0.5Sr0.5Fe1-xCoxO3-delta (0 <= x <= 1) materials. *Journal of Solid State Electrochemistry* 2006;10(8):635-642

Leinaas, JM; Myrheim, Jan; Ovrum, E. Geometrical aspects of entanglement. *Physical Review A* 2006;74

Linder, Jacob. Parametric resonance for antineutrino conversions using LSND best-fit results with a 3+1 flavor scheme. *Physical Review D*, *Particles and fields* 2006;74(053001)

Løseth, Lars Ole; Pedersen, Hans Magne; Ursin, Bjørn; Amundsen, Lasse; Ellingsrud, Svein. Low-frequency electromagnetic fields in applied geophysics: Waves or diffusion? *Geophysics* 2006;71(4):W29-W40

Makin, O Sumner; Sikorski, Pawel ; Serpell, Louise C. Diffraction to study protein and peptide assemblies. *Current opinion in chemical biology* 2006;10:417-422

Marioara, CD; Nordmark, Heidi; Andersen, Sigmund; Holmestad, Randi. Post-beta " phases and their influence on microstructure and hardness in 6xxx Al-Mg-Si alloys. *Journal of Materials Science* 2006;41:471-478

Meheust, Yves; Fossum, Jon Otto; Måløy, Knut Jørgen; Fonseca, Davi de Miranda. Using synchrotron X-ray scattering to study the diffusion of water in a weakly-hydrated clay sample. *Clay Science* 2006;12 Suppl 2:66-71

Minaev, Boris; Jansson, Emil; Lindgren,

Mikael. Application of density functional theory for studies of excited states and phosphorescence of platinum(II) acetylides. *Journal of Chemical Physics* 2006;125

Morten, Jan Petter; Brataas, Arne; Belzig, Wolfgang. Circuit theory of crossed Andreev

reflection. Physical Review B 2006;74:214510

Naqvi, Kalbe Razi; Melø, Thor Bernt.

Reduction of tetranitromethane by electronically excited aromatics in acetonitrile: Spectra and molar absorption coefficients of radical cations of anthracene, phenanthrene and pyrene. *Chemical Physics Letters* 2006;428(1-3):83-87

Nguyen, Anh Kiet; Shchelushkin, Roman; Brataas, Arne. Intrinsic domain-wall resistance in ferromagnetic semiconductors. *Physical Review Letters* 2006;97(136603)

Nguyen, Anh Kiet; Shchelushkin, Roman; Brataas, Arne. Intrinsic Resistance of Magnetic Topological Defects. *Bulletin of the American Physical Society* 2006

Nilsson, Peter; Hammarstrøm, Per; Ahlgren, Fredrik; Herland, Anna; Lindgren, Mikael; Westermark, Gunilla; Inganæs, Olle; Schnell, Edrun Andrea. Conjugated polyelectrolytes – conformation sensitive optical probes for staining and characterization of amyloid deposits, *ChemBioChem (Print)* 2006;7:1096-1104

Olsen, Haakon. Relativistic positronium production: Positronium particle physics. *Radiation Physics and Chemistry 75* (2006) 712-722

Otte, T; Valberg, Arne; Spillmann, L. Surroundinduced foveal afterimage pulsation: Evidence for a long-range neural effect. *Vision Research* 2006;46:1187-1193

Perello, J.; Montero, M.; Palatella, L.; Simonsen, Ingve; Masoliver, J. Entropy of the Nordic electricity market: anomalous scaling, spikes, and mean-reversion. *Journal of Statistical Mechanics: Theory and Experiment* 2006

Pradhan, Srutarshi; Hansen, Alex; Hemmer, Per Christian. Crossover behavior in failure avalanches. *Physical Review E* 2006;74

Ramstad, Ståle; Anh-Vu, NL; Johnsson,

Anders Carl G. The temperature dependence of porphyrin production in Propionibacterium acnes after incubation with 5- aminolevulinic acid (ALA) and its methyl ester (m-ALA) *Photochemical and Photobiological Sciences* 2006;5:66-72

Ramstad, Thomas; Hansen, Alex. Cluster evolution in steady-state two-phase flow in porous media. *Physical Review E* 2006;73

Rudvin, Inger. Visual evoked potentials for reversals of red-green gratings with different chromatic contrasts: asymmetries with respect to isoluminance. *Visual Neuroscience* 2006

Rudvin, Inger; Valberg, Arne. Flicker VEPs refelecting multiple rod and cone pathways. *Vision Research* 2006;46:699-717

Røyset, Arne; Støren, Trude Elna Marie; Lindmo, Tore. Speckle noise in polarization sensitive optical coherence tomography. *Proceedings of SPIE* 2006;6079

Røyset, Arne; Støren, Trude Elna Marie; Stabo-Eeg, Frantz; Lindmo, Tore. Quatitative measurements of flow velocity and direction using transversal Doppler optical coherence tomography. *Proceedings of SPIE* 2006;6079

Samsun, Mohamad Baharin Bin; Yousef, Y. A.; Melø, Thor Bernt; Partali, Vassilia; Jávorfi, T; Sliwka, Hans-Richard; Naqvi, Kalbe Razi. Singlet oxygen quenching by thione analogues of canthaxanthin, echinenone and rhodoxanthin. *Journal of Photochemistry and Photobiology. B, Biology* 2006;84(2):135-140

Sandberg, N; Holmestad, Randi. First-principles calculations of impurity diffusion activation energies in Al. *Physical Review B* 2006;73

Schmittbuhl, Jean; Chambon, Guillaume; Hansen, Alex; Bouchon, Michel. Are stress distribution alog faults the signature of asperity squeeze? *Geophysical Research Letters* 2006;33:L123307

Shchelushkin, Roman; Brataas, Arne. Spin Hall effects in diffusive normal metals. *Bulletin of the American Physical Society* 2006

Sikorski, Pawel ; Sørbotten, Audun; Horn, Svein Jarle; Eijsink, Vincent G.H.; Vårum, Kjell Morten. Serratia marcescens chitinases with

tunnel-shaped substrate-binding grooves show endo activity and different degrees of processivity during enzymatic hydrolysis of chitosan. *Biochemistry (Easton)* 2006;45(31):9566-9574

Skagerstam, Bo-Sture. On collective effects in cavity quantum electrodynamics. *Physica A: Statistical Mechanics and its Applications* 2006;A 362:314-326

Skagerstam, Bo-Sture; Hohenester, Ulrich; Eiguren, Aiser; Rekdal, Per Kristian. Spin Decoherence in Superconducting Atom Chips. *Physical Review Letters* 2006;97:070401-070401

Skagerstam, Bo-Sture; Hohenester, Ulrich; Eiguren, Asier; Rekdal, Per Kristian. Relpy to Comment on "Spin Decoherence in Superconducting Atom Chips". *arXiv* 2006

Skagerstam, Bo-Sture; Rekdal, Per Kristian. Collective two-atom effects and trapping states in the micromaser. *Physical Review A* 2006;A47:063805-1-063805-6

Skrøvseth, Stein Olav. Entanglement properties of quantum spin chains. *Physical Review A* 2006;74

Skrøvseth, Stein Olav. Thermalization through unitary evolution of pure states. *Europhysics letters* 2006;76(6):1179

Sletmoen, Marit; Geissler, Erik; Stokke, Bjørn Torger. Determination of molecular parameters of linear and circular scleroglucan coexisting in ternary mixtures using light scattering. *Biomacromolecules* 2006;7

Sletmoen, Marit; Stokke, Bjørn Torger; Geissler, Erik. Small angle x-ray scattering study of local structure and collapse transition of (1,3)beta-D-glucan-chitosan gels. *Journal of Chemical Physics* 2006;125

Solheim, Bjarte Gees Bokn; Kittang, Ann-Iren; Iversen, Tor-Henning; Johnsson, Anders. Preparatory experiments for long-term observation of Arabidopsis circumnutations in microgravity. *Acta Astronautica* 2006;59:46-53

Steindal, Arnfinn; Juzeniene, Asta; Johnsson, Anders; Moan, Johan. Photodegradation of 5methyltetrahydrofolate: Biophysical aspects. *Photochemistry and Photobiology* 2006;82:1651-1655 **Støren, Trude Elna Marie; Røyset, Arne; Svaasand, Lars O.; Lindmo, Tore**. Measurement of dye diffusion in scattering tissue phantoms using dual-wavelength low-coherence interferometry. *Journal of Biomedical Optics* 2006;11

Svenningsen, Gaute; Larsen, Magnus Hurlen; Walmsley, John C; Nordlien, Jan Halvor; Nisancioglu, Kemal. Effect of artificial aging on intergranular corrosion of extruded AlMgSi alloy with small Cu content. *Corrosion Science* 2006;48(6):1528-1543

Sæther, Oddbjørn; Midelfart, Anna; Risa, Øystein; Haraldseth, Olav; Krane, Jostein. Proton decoupled F-19 NMR spectroscopy of drugs used in eye treatment. *Spectroscopy Letters* 2006;39(2):135-14

Tanem, Bjørn Steinar; Kvien, Ingvild; Van Helvoort, Antonius Theodorus Johannes; Oksman, Kristiina. Morphology of cellulose and its nanocomposites. *A.C.S. symposium series* 2006;938:48-62

Thorkildsen, Gunnar; Larsen, Helge Bøvik; Beukes, Jon Are. Angle calculations for a threecircle goniostat. *Journal of applied crystallography* 2006;39:151-157

Toussaint, Renaud; Hansen, Alex. Mean-field theorey of localization in the fuse model. *Physical Review E* 2006;73

Traub, Barbel; Nguyen, Anh Kiet; Rieder, Matthias. Fast Free-surface Multiple Attenuation Work- Flow for 3D OBS Data. *Expanded abstracts with biographies* 2006;25:2664

Tserkovnyak, Y; Skadsem, Hans Joakim; Brataas, Arne; Bauer, GEW. Current-induced magnetization dynamics in disordered itinerant ferromagnets. *Physical Review B* 2006;74(144405)

Vamvounis, George; Nystrøm, Daniel; Antoni, Per; Lindgren, Mikael; Holdcroft, Steven; Hult, Anders. Self-Assembly of Conjugated Polymers to form Highly Ordered Isoporous Films via Blending. *Langmuir* 2006;22:3959-3961

Van Helvoort, Antonius; Tanem, Bjørn Steiner; Holmestad, Randi. Annular bright and dark field imaging of soft materials. *Institute of Physics Conference Series* 2006;26:42-45

Vermang, B; Juel, Mari; Raaen, Steinar. CO adsorption on Ce-Pt(111) studied with LEED, XPS and temperature programmed desorption. *Physical Review B* 2006;73:033407-1-033407-4

Vestberg, Robert; Westlund, Robert; Eriksson, Anders; Lopes, Cesar; Carlsson, Marcus; Eliasson, Bertil; Glimsdal, Eirik; Lindgren, Mikael; Malmstrøm, Eva. Dendron Decorated Platinum(II) Acetylides for Optical Power Limiting. *Macromolecules* 2006;39:2238-2246

Vullum, Per Erik; Mastin, Johann Roland M; Wright, J; Einarsrud, Mari-Ann; Holmestad, Randi; Grande, Tor. In situ synchrotron X-ray diffraction of ferroelastic La0.8Ca0.2CoO3 ceramics during uniaxial compression. *Acta Materialia* 2006;54:2615-2624

Wahlstrøm, Jan Erik; Brucas, Rimantas; Hanson, Maj. Scanning tunneling microscopy for laterally resolved measurements of magnetoresistance through a point contact. *Applied Physics Letters* 2006;88 Wallin, Anita; Bungum, Berit; Andersson, Björn. NorDiNa: En mångdimensjonell nordisk tidsskrift! *NorDiNa* 2006(3):1-2

Wallin, Anita; Bungum, Berit; Andersson, Björn. NorDiNa och kunskapsbildning. *NorDiNa* 2006(4):1-2

Wang, Xuhui; Bauer, GEW; Van Wees, Bart J.; Brataas, Arne; Tserkovnyak, Y. Voltage Generation by Ferromagnetic Resonance at a Nonmagnet to Ferromagnet Contact. *Physical Review Letters* 2006;97(216602)

Østvang, Dag. Classical electrodynamics in quasimetric space-time. *Gravitation & Cosmology* 2006;12(4 (48)):262-272

CONFERENCES, OTHER TALKS, REPORTS, BOOKS AND COMPENDIA

ConferencesAlme, Lars Ramstad; Fossum,

Jon Otto; Meheust, Yves. *WAXS studies of water transport in alayered synthetic silicate,* Norwegian Physical Society: Annual Meeting of The Division for Condensed Matter Physics with Atomic Physics, Wadahl (Norway), Sep. 13-15, 2006

Arstad, Bjørnar; Venvik, Hilde Johnsen; Aardal, Brynjar Fausk; Klette, Hallgeir;

Walmsley, John; Tucho, Wakshum Mekonnen; Bredesen, Rune; Holmen, Anders. Studies of selfsupported 1.6 um thich Pd/23 wt.% Ag membranes during and after hydrogen production by steam reforming of methanol in a catalytic membrane reactor. Nordic Hydrogen Seminar 2006; 06.02.2006 - 08.02.2006

Babaev, Egor; Ashcroft, Neil W.; Sudbø, Asle.

Observability of a projected new state of matter: a metallic superfluid hydrogen. March Meeting of the American Physical Society; 13.03.2006 - 17.03.2006

Bakke, Jan Øystein Haavig; Hansen, Alex; Kertész, János. Failures and avalanches in complex networks. Annual Meeting of The Condensed Matter Physics with Atomic Physic

Condensed Matter Physics with Atomic Physics Division of the Norwegian Physical Society; 13.09.2006 - 15.09.2006

Banino-Rokkones, Cyril; Amundsen, Jørn

Aslak; Smørgrav, Eivind. Parallelizing Lattice Gauge Theory Models on Commodity Clusters. IEEE International Conference on Cluster Computing (ISSN 1552-5244); 25.09.2006 -28.09.2006

Bhattarai, Binod Kumar; Kjeldstad, Berit Johanne; Bagheri, Asadollah; Thorseth, Trond Morten. Aerosol climatology in Kathmandu using Sun Photometry. Foredrag; 11.09.2006 -16.09.2006

Bjarte-Larsson, Torkel; Falnes, Johannes; Moan, Torgeir. *Comparison of results from timedomain simulations and model tests of a waterpumping wave-power unit*. The Sixteenth (2006) International Offshore and Polar Engineering Conference ; 28.05.2006 - 02.06.2006

Brataas, Arne. *Current Induced Macrospin vs. Spin-wave Excitations in Spin Valves*. MRS Spring meeting; 05.04.2006 - 10.04.2006 **Brataas, Arne**. *Magnetization Noise in Magnetoelectronic Circuits*. NYU Courant Institutt on spin-transfer torques in nano magnets; 02.06.2006 - 05.06.2006

Brataas, Arne. *Magnetoelectronic Circuits: Torque, Pumping, and Noise*. Nanoelectronics 2006; 08.01.2006 - 11.01.2006

Brataas, Arne. *Magnetoelectronic Circuits: Torque, Pumping, and Noise*. EU Dynamax oppstartsmøte; 15.09.2006 - 16.09.2006

Brataas, Arne. *Magnetoelectronic Circuits: Torque, Pumping, and Noise*. KITP workshop; 15.03.2006 - 01.04.2006

Borkje, Kjetil. *Physics of non-centrosymmetric superconductors with significant spin-orbit splitting*. Annual Meeting of the Division for Condensed Matter Physics with Atomic physics; 13.09.2006 - 15.09.2006

Børkje, Kjetil. *Tunneling between noncentrosymmetric superconductors*. Meeting in Nordforsk Nordic Network "Low-dimensional physics"; 15.08.2006 - 19.08.2006

Christensen, Bjørn Erik; Vold, Inger Mari Nygård; Kristiansen, Kåre Andre; Stokke, Bjørn Torger; Sletmoen, Marit. Analysis of Shape and Interactions of Polysaccharides and Polysaccharide Complexes Using Size-Exclusion Chromatography With Multiple Detectors. XXIIIrd International Carbohydrate Symposium; 23.07.2006 - 28.07.2006

da Silva, Geraldo J.; Mundim, Maria Suley P.; Fossum, Jon Otto; Meheust, Yves; Maløy, Knut Jørgen; Fonseca, Davi de Miranda. Difusão geometricamente restrita em nano-camadas de silicatos sintéticos, Reunião anual de usuários do LNLS – Campinas – SP. Brasil, 20-21 February 2006

da Silva, Geraldo J.; Fossum, Jon Otto; Ribeiro, Luciano; Mundim, Kleber C.; Mundim, Maria Suley P.; de Vasconcelos, Dionicarlos S. Relação sinergética simulação-experimento no estudo dos processos de intercalação em nano silicatos sintéticos, I SEEDMOL –DF – First Symposium on Electronic Structure and Molecular Dynamics of DF, Universidade de Brasilai, Brazil, 13-15 of February 2006

Davies, Catharina de Lange; Eikenes, Live; Erikson, Arne; Tufto, Ingunn; Lindgren,

Mikael. *Transport of macromolecules in tumour tissue*. Biofysikk-møtet 2006; 15.03.2006 -17.03.2006

Dischler, Eirik Øverland; Valberg, Arne.

Comparing chromatic detection ellipses of colourdeficient subjects with standard colour vision tests. ECVP 2006; 20.08.2006 - 25.08.2006

Erikson, Arne; Örtegren, Jonas; Davies, Catharina de Lange; Lindgren, Mikael. Secondorder nonlinear susceptilbilities in collagen I. Northern Optics 2006, Bergen; 14.06.2006 -16.06.2006

Falnes, Johannes. *A review of wave-energy extraction*. Challenges for Wave Energy Technology; 14.12.2006 - 15.12.2006

Fonseca, Davi de Miranda; Meheust, Yves; Fossum, Jon Otto; Knudsen, Kenneth Dahl; Måløy, Knut Jørgen; and Parmar, Kanak P.S. Phase behavior of platelet-shaped nanosilicate colloids in saline solutions — a SAXS study, Norwegian Physical Society: Annual Meeting of The Division for Condensed Matter Physics with Atomic Physics, Wadahl (Norway), Sept. 13-15, 2006

Fonseca, Davi de Miranda; Méheust, Yves; Fossum, Jon Otto; Knudsen, Kenneth Dahl. SAXS study of the positional order in a colloidal solution of fluorohectorite clay at different temperatures, The International Conference on Small Angle Scattering, Kyoto, (Japan), July 2006

Fonseca, Davi de Miranda; Méheust, Yves; Fossum, Jon Otto; Knudsen, Kenneth Dahl; Måløy, Knut Jørgen; Parmar, Kanak P.S. Phase separation and orientational ordering in aqueous suspensions of fluorohectorite clay, Groupe francais des argiles GFA - Clay Minerals Society CMS Clay Conference, Ile d'Oleron, (France) June 2006

Fonseca, Davi de Miranda.; Méheust, Yves; Fossum, Jon Otto; Knudsen, Kenneth Dahl; Måløy, Knut Jørgen; Parmar, Kanak P.S.

Nematic ordering of platelet-shaped nanosilicate colloids in saline solutions,, The International Conference on Small Angle Scattering, Kyoto, (Japan), July 2006

Foros, Jørn; Brataas, Arne; Heinrich, Bret; Woltersdorf, Georg. *Magnetization dynamics in nanoscale ferromagnets*. 3. nasjonale FUNMATmøte; 05.01.2006 - 06.01.2006 **Fossum, Jon Otto** *Complex Physical Phenomena in Nanolayered Silicates (Clays)*,* Workshop on Neutron and X-ray Scattering for the Structures and Dynamics of Nanoscale Materials, KAIST, Daejeon, Korea, December 7-8, 2006

Fossum, Jon Otto. Nanolayered Silicates (Clays) as Example of Soft and Complex Matter: From Nano to Macro using Synchrotrons and Microscopes, * Veeco Scandinavian SPM Conference and Users Meeting 2006, Chalmers University, Goteborg, Sweden, November 15 2006

Fossum, Jon Otto; Méheust, Yves; Parmar, Kanak P.S.; Knudsen, Kenneth Dahl; Måløy, Knut Jørgen; Fonseca, Davi de Miranda.

Spontaneous and guided self-assembly of clay nanoplatelet, Norwegian Physical Society: Annual Meeting of The Division for Condensed Matter Physics with Atomic Physics, Wadahl (Norway), Sept. 13-15, 2006

Fossum, Jon Otto; Méheust, Yves; Parmar, Kanak P.S.; Knudsen, Kenneth Dahl; Måløy, Knut Jørgen; Fonseca, Davi de Miranda. Spontaneous and guided self-assembly of clay nanoplatelets, Proceedings from YITP Workshop "Structures and Dynamics in Soft Matter– Beyond

"Structures and Dynamics in Soft Matter– Beyond Self-Organization and Hierarchical Structures –" Kyoto (Japan), July 2006

Fossum, Jon Otto. From Self-Organization of Nanoparticles to Advanced and Smart Materials,, Reserach Council of Norway, Nanomat Conference, Oslo (Norway), June 2006

Fossum, Jon Otto. Nanolayered Silicates (Clays) as Example of Soft and Complex Matter: From Nano to Macro using Synchrotrons and Microscopes, First User Meeting of NTNU nanolab, Jægtvolden (Norway) March 9-10, 2006

Fossum, Jon Otto. Interconnected Physical Phenomena in Clays: Scattering Experiments,, 3rd Nordic workshop *on* Scattering from soft matter, Uppsala, (Sweden), Feb. 2-3, 2006

Gjervan, Torbjørn; Prestvik, Rune; Tøtdal, Bård; Lyman, Charles; Holmen, Anders.

Influence of drying and reduction temperature on the degreee of Pt-Re alloy formation and metal particle size on reforming catalysts. Fifth Tokyo Conference on Advanced Catalytic Science and Technology; 23.07.2006 - 28.07.2006

Glimsdal, Eirik; Eriksson, Anders; Carlsson, Marcus; Eliasson, Bertil; Lindgren, Mikael. Multi-Photon Absorption and Luminescence of some novel Thiophenyl Pt(II)-ethynyl Derivatives.

Northern Optics 2006; 14.06.2006 - 16.06.2006

Glomm, Wilhelm; Volden, Sondre; Lindgren, Mikael; Sjöblom, Johan. *Photophysical*

properties of Ru(III) Tris(2,2'-bipyridine) and Ln(III) [Ln=Eu, Er, Nd] photonic sol-gel materials. Northern Optics 2006, Bergen; 14.06.2006 -16.06.2006

Gmira, Ahmed; Fossum, Jon Otto. *Water-Na-Fluohectorite interactions: An AFM study,* Norwegian Physical Society: Annual Meeting of The Division for Condensed Matter Physics with Atomic Physics, Wadahl (Norway), Sept. 13-15, 2006

Gmira, Ahmed; Fossum, Jon Otto; Bjørnsen, Hege S. Laponite nanoparticle droplet evaporation on a glass surface: "The coffee stain effect" studied by AFM., Norwegian Physical Society: Annual Meeting of The Division for Condensed Matter Physics with Atomic Physics, Wadahl (Norway), Sept. 13-15, 2006

Gmira, Ahmed; Fossum, Jon Otto. *Study of individual Na-fluotohectorite particles, size, morphology and atomic structure,* Groupe francais des argiles GFA - Clay Minerals Society CMS Clay Conference, Ile d'Oleron, (France) June 2006

Gmira, Ahmed; Fossum, Jon Otto. *Water Nafluotohectorite interactions; An AFM study*, Groupe francais des argiles GFA - Clay Minerals Society CMS Clay Conference, Ile d'Oleron, (France) June 2006

Gmira, Ahmed; Fossum, Jon Otto. *Water Nafluorohectorite interactions; A microscopical study*, Nanotechnology in Northern Europe, Helsinki (Finland) May 2006

Hammer, Nina; Kvande, Ingvar; Gunnarsson, Vidar; Tøtdal, Bård; Xu, Xin; Chen, De; Rønning, Magnus. Au/oxide catalysts on carbon nanofibres for water-gas shift reaction. EuropaCat VII; 28.08.2006 - 01.09.2006

Hasting, Håkon Stokka; Van Helvoort, Antonius; Marioara, Calin D; Andersen, Sigmund; Holmestad, Randi; Walmsley, John C. Z-contrast of precipitation phases in AlMgSiCu alloys. 16th Internation Microscopy Conference (IMC16); 03.09.2006 - 08.09.2006

Huber, Florian; Yu, Zhixin; Walmsley, John; Venvik, Hilde Johnsen; Chen, De; Holmen,

Anders. Nanocrystalline Cu-Ce-Zr mixed oxide catalysts for clean fuel applications: Carbon nanofibers as dispersant for the mixed oxide particles. International Symposium on Nanotechnology in Environmental Protection and Pollution; 18.06.2006 - 21.06.2006

Huertas-Hernando, Daniel; Alhassid, Yoram.

Detecting the GS Spin of a Quantum Dot in the Coulomb Blockade regime. Dynamics and Relaxation in Complex Quantum Systems: Graphene Week Conference; 25.09.2006 -29.09.2006

Huertas-Hernando, Daniel; Alhassid, Yoram. Spin and Interactions in chaotic Ouantum Dots.

International Conference NANOELECTRONICS 2006; 08.01.2006 - 11.01.2006

Huertas-Hernando, Daniel; Guinea, Fransisco; Brataas, Arne. Spin-orbit coupling in carbon based Nano materials. Condensed Matter Seminar ICMM-UAM; 08.06.2006 - 09.06.2006

Huertas-Hernando, Daniel; Guinea, Fransisco; Brataas, Arne. Spin-orbit coupling in curved graphene. Dynamics and Relaxation in Complex Quantum Systems: Graphene Week Conference; 25.09.2006 - 29.09.2006

Huertas-Hernando, Daniel; Nazarov, Yu. V.; Belzig, Wolfgang; Brataas, Arne; Morten, Jan Petter. *The circuit theory of mesoscopic transport for S*|*F heterostructures*. 374. WE-Heraeus-Seminar on "Spin Physics of Superconducting Heterostructures"; 09.12.2006 - 13.12.2006

Hunderi, Ola. On the optical properties of inhomogeneous materials and rough and textured surfaces. EPIOPTICS-9; 20.07.2006 - 26.07.2006

Hunderi, Ola. *Plasmonics*. Plasmonicsseminar; 08.11.2006 - 08.11.2006

Iversen, Tor-Henning; Kittang, Ann-Iren; Solheim, Bjarte G.B.; Johnsson, Anders; Svare, Håkon; Migliaccio, Fernando. *The Multigen experiment in the EMCS*. Seminar på Plantebiosenteret; 25.10.2006 - 26.10.2006

Jonsson, Per; Kullander, Fredrik; Vahlberg, Claes; Jelger, Pär; Tiihonen, Mikael; Wästerby, Pär; Tjärnhage, Torbjörn; Lindgren, Mikael. Spectral detection of ultraviolett laser induced fluorescence from individual bioaerosol particles. SPIE 6398: Optically based biological and chemical detection for defence iii; 10.09.2006 -13.09.2006

Kachelriess, Michael. Anisotropies of ultra-high energy cosmic rays. Invited talk at CRIS 2006, Ultra-High Energy Cosmic Rays: Status and Perspectives, Catania, Italy, 29.05.2006 – 02.06.2006 **Kachelriess, Michael.** *Dark matter in the universe.* Invited review at the 372th Int. Heraeus seminar, Massive Neutrinos'', Bad Honnef, Germany, 10.07.2006 – 12.07.2006

Kildemo, Morten. *Optical properties of SiC polytypes*. Northern Optics; 14.06.2006 - 16.06.2006

Kildemo, Morten. *XPS study of the electronic properties of the Ce/4H-SiC interface, and the formation of the SiO2/Ce2Si2O7/4H-SiC interface structure upon oxidation.* annual meeting of the division of condensed physics with atomic physics; 13.09.2006 - 15.09.2006

Kildemo, Morten; Grossner, U; Raaen, Steinar; Svensson, BG. XPS study of the electronic properties of the Ce/4H-SiC interface, and the formation of the SiO2/Ce2Si2O7/4H-SiC interface structure upon oxidation. ECSCRM 2006; 03.09.2006 - 07.09.2006

Klein, Dionne C.G. Activation of Toll-like receptors of the immune system studied by atomic force microscopy and confocal microscopy. Meeting of the Norwegian Biopolymer Laboratory NOBIPOL; 04.05.2006 - 05.05.2006

Klein, Dionne C.G. Molecular interactions that trigger the innate immune system probed at the nanometer scale. Doctor Technicae Honoris Causa Prof. J.E. Mooij NanoScience-Nanotechnology seminar 2006

Klein, Dionne C.G. Toll-like receptors studied by atomic force microscopy and fluorescence correlation spectroscopy. Annual autumn meeting Norwegian Biochemical Society; 18.09.2006 -19.09.2006

Klein, Dionne C.G. *Toll-like receptors studied by FCS and AFM*. Seminar day Toll Group 2006

Klein, Dionne C.G.; Latz, Eicke; Stokke, Bjørn Torger; Espevik, Terje. *Binding of different classes of CpG-DNA to Toll-like receptor 9 investigated with fluorescence correlation spectroscopy*. 9th Carl Zeiss sponsored workshop on FCS and related methods; 04.12.2006 -06.12.2006

Klein, Dionne C.G.; Stokke, Bjørn Torger; Espevik, Terje. Activation of Toll-like receptors studied by atomic force microscopy and confocal microscopy. Toll 2006, Recent Advances in Pattern Recognition; 04.03.2006 - 07.03.2006 Klein, Dionne C.G.; Stokke, Bjørn Torger; Espevik, Terje. Visualization of the first step in activation of Toll-like receptors by atomic force microscopy and confocal microscopy. Norwegian Biophysics Meeting; 15.03.2006 - 17.03.2006

Kragset, Steinar; Babaev, Egor; Sudbø, Asle. *Monte Carlo simulations of thermal vortex fluctuations*. Computational Physics Seminar at NTNU; 29.09.2006 - 29.09.2006

Kragset, Steinar; Babaev, Egor; Sudbø, Asle. *Vortex fluctuations in Bose-Einstein condensates.* 3:rd Nordforsk Nordic network meeting on Lowdimensional physics; 30.03.2006 - 01.04.2006

Kragset, Steinar; Sudbø, Asle; Babaev, Egor. *Crossover States of Vortex Matter in Trapped Bose Condensates*. Nordita Conference on Strongly Correlated Fermi Systems; 14.06.2006 - 16.06.2006

Lilledahl, Magnus Borstad; Haugen, Olav A; Schnell, Edrun Andrea; Erikson, Arne; Davies, Catharina de Lange; Svaasand, Lars O. *Multiphoton microscopy of vulnerable plaque*. Northern Optics 2006; 14.06.2006 - 16.06.2006

Linder, Jacob; Sudbø, Asle; Grønsleth, Martin. Interplay between superconductivity and ferromagnetism in tunneling. 2006 APS March Meeting; 13.03.2006 - 17.03.2006

Maurstad, Gjertrud; Danielsen, Signe; Stokke, Bjørn Torger. *Contrasting the role of chitosan valence and chitosan charge density in polyelectrolyte complexation*. 6th International Symposium on Polyelectrolytes; 04.09.2006 -08.09.2006

Maurstad, Gjertrud; Kitamura, Shinichi; Stokke, Bjørn Torger. *AFM and ITC studies of xanthan-chitosan complexation: influence of polyanion and polycation chain length.* 6th International Symposium on Polyelectrolytes; 04.09.2006 - 08.09.2006

Maurstad, Gjertrud; Kitamura, Shinichi; Stokke, Bjørn Torger. *Polyelectrolyte complexation between xanthan and chitosan*. Kyoto International Forum for Energy and the Enviroment,; 06.09.2006 - 08.09.2006

Meheust, Yves; Dagois-Bohy, Simon; Fossum, Jon Otto; Knudsen, Kenneth Dahl. Mesoscopic structure of dried-pressed clay samples from SAXS measurements, Norwegian Physical Society: Annual Meeting of The Division for Condensed Matter Physics with Atomic Physics, Wadahl (Norway), Sept. 13-15, 2006

Meheust, Yves; Dagois-Bohy, Simon; Fossum, Jon Otto; Knudsen, Kenneth Dahl. *Mesoscopic*

structure of dried-pressed clay samples from SAXS measurements,, The International Conference on Small Angle Scattering, Kyoto, (Japan), July 2006

Minaev, Boris; Glimsdal, Eirik; Lindgren,

Mikael. Theoretical and experimental investigation of excited states in Platinum(II) Acetylides. Northern Optics 2006, Bergen; 14.06.2006 -16.06.2006

Mo, Frode. *Diffraction studies of ferroic materials under an electric field*. Synchrotron Radiation in Studies of Nanoscaled Materials; 22.06.2006 - 23.06.2006

Morten, Jan Petter; Belzig, Wolfgang; Brataas, Arne. Circuit theory of crossed Andreev reflection. Spin physics of superconducting heterostructures; 09.12.2006 - 13.12.2006

Morten, Jan Petter; Belzig, Wolfgang; Brataas, Arne. Spin Transport in Diffusive Superconductors. Nanoelectronics 2006; 07.01.2006 - 11.01.2006

Morten, Jan Petter; Brataas, Arne. Nonlocal conductance in N|S devices: Crossed Andreev reflection. Annual meeting of the networks "Fundamentals of Condensed Matter" and "Quantum Transport in Nanoscale Systems"; 18.09.2006 - 19.09.2006

Myrheim, Jan. *Numerical approximation by separable states*. XXXVIII Symposium on Mathehatical Physics, "Quantum Geometry and Entanglement"; 04.06.2006 - 07.06.2006

Nordmark, Heidi; Ulyashin, Alexander; Walmsley, John C; Tøtdal, Bård; Holmestad, Randi. Evolution of hydrogen induced defects

during annealing of plasma treated Czochralski silicon. European Materials Research Society spring meeting 2006; 29.05.2006 - 02.06.2006

Ofteda, Gunnhild; Straume, Aksel; Johnsson, Anders; Stovner, Lars Jakob. *Mobile phone headache: a provocation study with subjects attributing symtoms specifically to the phones*. In abstract of the 8th Congress of European BioElectromagnetics Association, 2007 April 10-12, Bordeaux Parmar, Kanak S.P.; Meheust, Yves; Fossum, Jon Otto; Knudsen, Kenneth Dahl; Maløy,Knut Jørgen; and Fonseca, Davi de Miranda. *The porous space inside bundles of polarized phyllosilicate crystallites – A SAXS study*, Norwegian Physical Society: Annual Meeting of The Division for Condensed Matter Physics with Atomic Physics, Wadahl (Norway), Sept. 13-15, 2006

Parmar, Kanak S.P.; Meheust, Yves; Fossum, Jon Otto; Knudsen, Kenneth Dahl; Maløy, Knut Jørgen; Fonseca, Davi de Miranda. *A* small angle scattering study of the porous space inside bundles of polarized clay particles,, The International Conference on Small Angle Scattering, Kyoto, (Japan), July 2006

Paula, Fábio Luiz de Oliveira; Depeyrot, Jerome; da Silva, Geraldo J., Aquino, Renata; Tourinho, Fransisco A.; Fossum, Jon Otto; Knudsen, K.D. SANS and SAXS Investigations of Colloidal Dispersions of Clay Nanoplatelets and Magnetic Nanoparticles, Norwegian Physical Society: Annual Meeting of The Division for Condensed Matter Physics with Atomic Physics, Wadahl (Norway), Sept. 13-15, 2006

Paula, Fábio Luiz de Oliveira; Depeyrot, Jerome; da Silva, Geraldo J., Aquino, Renata; Tourinho, Fransisco A.; Fossum, Jon Otto; Knudsen, K.D. SANS and SAXS Investigations of Colloidal Dispersions of Clay Nanoplatelets and Magnetic Nanoparticles, The International Conference on Small Angle Scattering, Kyoto, (Japan), July 2006

Paula, Fábio Luiz de Oliveira; Depeyrot, Jerome; da Silva, Geraldo J., Aquino, Renata; Tourinho, Fransisco A.; Fossum, Jon Otto; Knudsen, K.D. Experimental investigations of dispersion of clays and magnetic nanoparticles,, Groupe francais des argiles GFA - Clay Minerals Society CMS Clay Conference, Ile d'Oleron, (France) June 2006

Paula, Fábio Luiz de Oliveira; Depeyrot, Jerome; da Silva, Geraldo J., Aquino, Renata; Tourinho, Fransisco A.; Fossum, Jon Otto; Knudsen, K.D. Colloidal stablity of dispersion of laponite platelets and magnetic nanoparticles,, XXIX Encontro Nacional de Física da Matéria Condensada, 2006, Sao Lourenco-MG, (Brazil) May 2006

Polívka, T; Pellnor, M; Melo, E; Pascher, T; Sundström, V; Osuka, A; Naqvi, Kalbe Razi.

Polarity-tuned energy transfer in carotenoidpyropheophorbide artificial antenna. 16th International Conference on Photochemical Conversion and Storage of Solar Energy (IPS-16); 02.07.2006 - 07.07.2006

Ramstad, Thomas; Hansen, Alex. Steady-state cluster formation in porous media. Gordon Research Conferences, Flow and Transport in Permeable Media; 30.07.2006 - 04.08.2006

Reitan, Nina Kristine; Juthajan, Aphirak; Davies, Catharina de Lange; Lindmo, Tore.

Fluorescence correlation spectroscopy as a tool for studying dynamic processes of biomolecules in cellular environments. Biofysikk-møtet 2006; 15.03.2006 - 17.03.2006

Reitan, Nina Kristine; Juthajan, Aphirak; Lindmo, Tore; Davies, Catharina de Lange.

Fluorescence correlation spectroscopy as a method for studying interstitial diffusion in cancer tissue. FCS workshop 2006; 04.12.2006 -06.12.2006

Ribeiro, L.; Mundim, Maria Suley P.; da Silva, Geraldo J.; Fossum, Jon Otto; Mundim, Kleber

C. Temperature investigations of intercalation and diffusion processes in synthetic nano-silicates by means of synchrotron X-ray absorption spectroscopy, International Confeence on Electronic Spectroscopy and Structure, Foz do Iguacu, Brazil, August 28 - September 1, 2006

Ribeiro, Luciano; Mundim, Kleber C.; Mundim, Maria Suley P.; de Vasconcelos, Dionicarlos S.; da Silva, Geraldo J.; Fossum, Jon Otto Random Intercalation studies of nanosilicates utilizing the self-consistent x-ray scattering model and GSA, XXIX Encontro Nacional de Física da Matéria Condensada, 2006, Sao Lourenco-MG, (Brazil) May 2006

Rørvik, Per Martin; Einarsrud, Mari-Ann; Grande, Tor; Lyngdal, Tone; Holmestad, Randi; Van Helvoort, Antonius; Sæterli,

Ragnhild. *Chemical preparation of ferroelectric nanorods*. Third national FUNMAT meeting; 05.01.2006 - 06.01.2006

Sandnes, Bjørn; Buchanan, Mark; Måløy, Knut Jørgen; Helgesen, Geir; Fossum, Jon Otto.

Optical trapping and microrheology in complex fluids, Norwegian Physical Society: Annual Meeting of The Division for Condensed Matter Physics with Atomic Physics, Wadahl (Norway), Sept. 13-15, 2006

Shchelushkin, Roman; Brataas, Arne. *Spin Hall effect in diffusive normal metals*. American Physical Society March Meeting; 11.03.2006 -15.03.2006

Sletmoen, Marit; Christensen, Bjørn Erik;

Stokke, Bjørn Torger. *Structure and behaviour of Scleroglucan and polyC-scleroglucan complexes.* the second KIFEE symposium; 06.09.2006 -08.09.2006

Sletmoen, Marit; Skjåk-Bræk, Gudmund;

Stokke, Bjørn Torger. *Dynamic force* spectroscopy used to reveal macromolecular motion at the nanoscale of enzymes working on polysaccharides. Gordon research conference on single molecule approaches to biology; 18.06.2006 - 23.06.2006

Sletmoen, Marit; Stokke, Bjørn Torger.

Strukturstudier av sirkulære 1,3-beta-D-glukaner og 1,3-beta-D-glukanpolynukleotid komplekser. Biofysikermøtet 2006; 15.03.2006 - 17.03.2006

Solheim, Bjarte Gees Bokn; Johnsson, Anders.

Multigen-1 - a long term growth and circumnutation experiment in weightlessness. Biofysikkmøtet på Kongsvold; 15.03.2006 -17.03.2006

Stabo-Eeg, Frantz; Kildemo, Morten; Lindgren, Mikael. *Scattering Mueller matrix measurements on aggregating protein samples*. Northern Optics 2006; 14.06.2006 - 16.06.2006

Stokke, Bjørn Torger. *Bionanotechnology - of relevance for hydrocolloids?*. 8th International Hydrocolloids Conference; 18.06.2006 -22.06.2006

Stokke, Bjørn Torger. Bionanoteknologi - noe nytt i nanoverdenen?. Biofysikermøtet 2006; 15.03.2006 - 17.03.2006

Stokke, Bjørn Torger. *Polysaccharide bionanotechnology*. Nanotechnology seminar; 09.02.2006 - 10.02.2006

Stovner, Lars Jacob; Straume, Aksel; Oftedal, Gunnhild; Johnsson, Anders Carl G. Mobile Phone Headache Is Not Related To Radiofrequency Fields: A Double Blind Provocation Study. EHF congress; 26.04.2006 -29.04.2006

Strandberg, Rune; Thomassen, Sedsel

Fretheim; Worren, Turid. *Quantum dot intermediate band solar cells*. Summerschool on Wide-bandgap Semiconductor Quantum Structures; 27.08.2006 - 01.09.2006 **Strandberg, Rune; Worren, Turid**. *PC1D*simulations of solar cells containing regions with enhanced infrared absorption. Annual Meeting of The Condensed Matter Physics with Atomic Physics Division of the Norwegian Physical Society; 13.09.2006 - 15.09.2006

Straume, Aksel; Stovner, Lars Jacob; Johnsson, Anders Carl G.; Oftedal, Gunnhild. *Do mobile phones cause headaches? A double blind provocation study*. Miljø, Gener og Helse, Forskerseminar; 17.10.2006 - 18.10.2006

Straume, Aksel; Stovner, Lars Jacob; Johnsson, Anders Carl G.; Oftedal, Gunnhild. *Pain and discomfort in the head attributed to mobile phones. A double blind provocation study of a highly selected group of users*. The Bioelectromagntics Society 28th Annual Meeting (2006); 11.06.2006 -15.06.2006

Sudbø, Asle; Babaev, Egor; Ashcroft, Neil W.; Smiseth, Jo; Smørgrav, Eivind. *A metalic* superfluid in a two-component superconductor. Intl. Workshop on Superconductivity and Bose Einstein Condens; 21.06.2006 - 24.06.2006

Sudbø, Asle; Smiseth, Jo; Smørgrav, Eivind; Babaev, Egor. *Observation of a metallic superfluid in a numerical experiment*. 2006 APS March Meeting ; 13.03.2006 - 17.03.2006

Sæther, Heidi Vogt; Holme, Hilde K.; Maurstad, Gjertrud; Smidsrød, Olav; Stokke, Bjørn Torger. *Polyelectrolyte complex formation of alginate and chitosan*. 8th International Hydrocolloids Conference; 18.06.2006 -22.06.2006

Thomassen, Sedsel Fretheim; Worren, Turid; Fimland, Bjørn-Ove; Strandberg, Rune; Myrvågnes, Geir. Quantum Dot Intermediate Band Solar Cells. 1st NTNU NanoLab User Meeting; 09.03.2006 - 10.03.2006

Tierney, Sven; Stokke, Bjørn Torger; Hjelme, Dag Roar; Sundan, Anders. *Polymer gel transducers as an interface for optical detection of biological macromolecules*. Biofysikermøtet 2006; 15.03.2006 - 17.03.2006

Tucho, Wakshum Mekonnen; Holmestad, Randi; Walmsley, John C.; Arstad, Bjørnar; Klette, Hallgeir; Venvik, Hilde Johnsen.

Microstructural Characterization of Free-Standing Pd/Ag Membranes for Hydrogen Separation. 9th International Conference on Inorganic Membranes; 25.06.2006 - 29.06.2006 **Tyholt, Frode; Mottern, Matthew; Ulyashin, A.; Van Helvoort, Antonius; Haavik, C; Fagerberg, Ragnar**. *Optical thin films*. Third national FUNMAT meeting; 05.01.2006 - 06.01.2006

Tyholt, Frode; Ulyashin, A.; Mottern, Matthew; Van Helvoort, Antonius; Bredesen, Rune; Ræder, H. Chemical solution deposition of oriented ITO films. Piezoceramics for end-users II; 06.03.2006 - 08.03.2006

Ulyashin, Alexander; Nordmark, Heidi; Walmsley, John C; Tøtdal, Bård; Holmestad, Randi. Influence of an intensive hydrogenation on structural and point defect formation in silicon. 21st European Photovoltaic Solar Energy Conference; 03.09.2006 - 08.09.2006

Vamvounis, George; Nyström, Daniel; Antoni, Per; Lindgren, Mikael; Hult, Anders. Formation and properties of isoporous films composed of polymer semiconductors. SPIE 6401: Optical Materials in Defence Systems Technology; 14.09.2006 - 14.09.2006

Vamvounis, George; Nystrøm, David; Antoni, Per; Lindgren, Mikael; Holdcroft, Steven; Hult, Anders. Preparation and properties of highly ordered isoporous conjugated polymer films. Northern Optics 2006, Bergen; 14.06.2006 -16.06.2006

Van Helvoort, Antonius. *Practical use of energy filtered electron microscopy*. Scandem 2006; 12.06.2006 - 15.06.2006

Van Helvoort, Antonius; Eberg, Espen; Holmestad, Randi; Soleim, Bjørn Gunnar; Dahl, Øystein; Tybell, Thomas. Ferroelectric thin film interfacial characterisation. 4th THIOX meeting; 19.03.2006 - 20.03.2006

Van Helvoort, Antonius; Holmestad, Randi; Soleim, Bjørn Gunnar; Eberg, Espen; Dahl, Øystein; Tybell, Thomas. Ferroelectric thin filmsubstrate interfacial characterisation. 16th Internation Microscopy Conference (IMC16); 03.09.2006 - 08.09.2006

Van Helvoort, Antonius; Holmestad, Randi; Walmsley, John C. Opportunities of using electrons for (sub) nanometer characterisation. 1st NTNU Nanolab User Meeting; 09.03.2006 -10.03.2006 Van Helvoort, Antonius; Soleim, Bjørn Gunnar; Dahl, Øystein; Holmestad, Randi;

Tybell, Thomas. *Ferroelectric thin films study using various transmission electron microscopy techniques*. Third national FUNMAT meeting; 05.01.2006 - 06.01.2006

Westlund, Robert; Malmstrøm, Eva; Hoffmann, Markus; Vestberg, Robert; Hawker, Craig; Glimsdal, Eirik; Lindgren, Mikael; Norman, Patrick; Eriksson, Anders; Lopes,

Cesar. *Multi-functionalized Platinum(II) Acetylides for optical power limiting*. SPIE 6401: Optical materials in defence systems technology III; 14.09.2006 - 14.09.2006

Wittje, Roland. "How should scientific instruments teach us about 20th century science?" A collection policy for 20th century scientific instrumentation. Workshop Acquiring, Collecting and Using the Technical and Scientific Heritage of the Second Half of the 20th Century 2006

Wittje, Roland. Nuclear physics instrumentation in Norway: 1933-1955. Annual Meeting of the History of Science Society; 02.11.2006 -05.11.2006

Wittje, Roland. Nuclear physics instrumentation in Norway: 1933-1955. 2nd International Conference of the European Society for the History of Science; 06.09.2006 - 09.09.2006

Wittje, Roland. *The rise of electroacoustics in Germany during the interwar years*. Workshop "Acoustics: Applied and Pure"; 05.05.2006 - 06.05.2006

Wittje, Roland. *The rise of electroacoustics in Germany during the interwar years*. 33rd Symposium of the International Committee for the History of Technology; 15.08.2006 - 20.08.2006

You, Chang Chuan; Rystad, N.V; Liu, Yun; Borg, Anne; Tybell, Thomas. Fabrication of ferroelectric nanostructures. 4th THIOX Topical Meeting; 19.03.2006 - 21.03.2006

You, Chang Chuan; Rystad, N.V; Liu, Yun; Borg, Anne; Tybell, Thomas. Synthesis of ferroelectric structures on nanoscale perovskite templates. 3rd national FUNMAT meeting; 05.01.2006 - 06.01.2006

Other talks

Andersen, Jens Oluf. *Hard-thermal-loop resummation and the thermodynamics of QCD*. Invitert foredrag, 10.04.2006 - 10.04.2006 **Brataas, Arne**. *Magnetoelectronic Circuits: Torque, Pumping, and Noise*. Foredrag for gruppe for kondenserte medier, Columbia U. USA; 19.12.2006 - 19.12.2006

Brataas, Arne. *Magnetoelectronic Circuits: Torque, Pumping, and Noise*. Foredrag ved Autonoma Universitet, Madrid; 19.10.2006 -19.10.2006

Brataas, Arne. *På jakt etter Schrødingers katt: Kvantefysikk for sykkelreperatører*. Åpen dag om naturfag i den videregående skole; 28.03.2006 -28.03.2006

Brataas, Arne. *Schrødinger's Cat in Nanoscopolis*. Onsdags-seminar; 05.09.2006 - 05.09.2006

Brataas, Arne. *Theory of Magnetization Dynamics*. Forelesning ved TU Delft; 15.01.2006 - 15.01.2006

Bungum, Berit. *Teknologi og Design i nye læreplaner: Hvilke ideer ligger bak?*. Kurs: Teknologi og Enteprenørskap; 13.09.2006 -15.09.2006

Bungum, Berit. "*Vi lager mekaniske leker.*" Workshop på Naturfagkonferansen, UiO, 26.-27. oktober 2006

Bungum, Berit. *Mekaniske leker: Prinsipper og ideer.* In-service course for teachers, Skolelaboratoriet, October 24th.

Bungum, Berit. *"Å skape en binders".* Contribution to conference for teachers on teaching in technology and design, November 11th

Bungum, Berit. *Teknologi og Design i nye læreplaner: Hvilke ideer ligger bak?*. Kurs: Teknologi og Enteprenørskap; 13.09.2006 -15.09.2006

Fossheim, Kristian. Seminar series: 24 lectures on superconductivity. Lecture series under EU structural program; 27.09.2006 - 29.09.2006

Fossheim, Kristian. *Funksjonelle materiale* NTNU-Trondheim, Lørdagsuniversitetet, 18.11.2006

Fossheim, Kristian. Nanoteknologi - Ein ny teknisk revolusjon? Forelesing, Høgskolen i Sogn & Fjordane, Førde, Norway 10.11.2006

Fossheim, Kristian. *Superleiing, fysikk og praktisk bruk*. Forelesing med demonstrasjonar, Firda vgs, Sandane, 03.04.2006

Fossheim, Kristian. *Superleiing*. Forelesing med demonstrasjonar, Firda vgs, Sandane, 04.04.2006

Fossheim, Kristian. *Superleiing, eit naturens mirakel* Forelesing med demonstrasjonar, Firda vgs, Sandane, 05.04.2006

Fossheim, Kristian. Superleiing-eit naturens mirakel Researchers' night, NTNU, 22.09.2006

Fossum, Jon Otto *Fysiske fenomener i leire* (*Physical Phenomena in Clays*), Jærmuseet: Vitenfabrikken (Science museum), Sandnes Norway, November 10 2006

Fossum, Jon Otto *Complex Physical Phenomena in Clays: Spontaneous and Guided Selfassembly of Clay Nanolayered Particles studied by Synchrotrons and Microscopes,* Massachusetts Institute of Technology (MIT), Department of Earth, Athmospheric and Planetary Sciences, Dan Rothman Group, November 30 2006

Fossum, Jon Otto Spontaneous and guided selfassembly of clay nanoplatelets, Universidade Federal de Pernambuco (UFPE), Department of Physics, Mario Engelsberg Group, Recife, Brazil, July 27 2006

Fossum, Jon Otto *Spontaneous and guided selfassembly of clay nanoplatelets*, Postech, Department of Physics, Pohang, South Korea, July 5 2006

Fossum, Jon Otto Spontaneous and guided selfassembly of clay nanoplatelets, KAIST, Korea Advanced Institute of Science and Technology, Sung-Min Choi and Mahn Won Kim groups, Daejeon, South Korea, July 4 2006

Fossum, Jon Otto *Clays as Example of Soft and Complex Matter : From Nano to Macro using Synchrotrons and Microscopes,* University of Utrecht, Netherlands, Department of Geochemistry, February 2006

Hunderi, Ola. Materialer, metamaterialer og lasere. Invitert foredrag 2006

Kachelriess, Michael. *Physics of high-energy cosmic rays*. Colloquium at University of Oslo, February 2006

Kachelriess, Michael. Anisotropies of high energy cosmic rays. Seminar at Max-Planck-Institut für Physik, Munich, Germany, July 2006 Kachelriess, Michael. (Superheavy) dark matter. Invited talk at "High-energy gamma rays from space", NordForsk Network Meeting in Astroparticle Physics, Bergen, Norway, November 2006

Kachelriess, Michael. *Multi-messenger astronomy*. Invited plenary talk at the 3rd Annual ILIAS/N6-ENTApP meeting, Paris, France, December 2006

Kachelriess, Michael. *High energy cosmic rays and neutrinos*. Seminar at Max-Planck-Institut für Kernphysik, Heidelberg, Germany, December 2006

Klein, Dionne C.G. *Activation of Toll-like receptors of the immune system studied by atomic force microscopy and confocal microscopy.* Biophysics seminar; 02.02.2006 - 02.02.2006

Klein, Dionne C.G. Activation of Toll-like receptors of the immune system studied by atomic force microscopy and confocal microscopy. Seminar at the Institute for Cancer Research and Molecular Medicine Faculty of Medicine, NTNU 2006

Méheust, Yves; Parmar, Kanak P.S.; Fossum, Jon Otto; Knudsen, Kenneth Dahl; Måløy, Knut Jørgen; Fonseca, Davi de Miranda. Polarization and aggregation of clay particles suspended in oil a study using x-ray scattering. Groupe francais des argiles GFA - Clay Minerals Society CMS Clay Conference, Ile d'Oleron, (France) June 2006

Parmar, Kanak P.S.; Méheust, Yves; Fossum, Jon Otto Electro-rheology of smectite clay suspensions submitted to a strong electric field, Groupe francais des argiles GFA - Clay Minerals Society CMS Clay Conference, Ile d'Oleron, (France) June 2006

Sudbø, Asle. Novel quantum fluid states in hydrogen. Opening of the 15th academic year of the Centre for Advanced Study; 05.09.2006 - 05.09.2006

Sudbø, Asle; Babaev, Egor; Ashcroft, Neil W.; Smiseth, Jo; Smørgrav, Eivind. Novel Quantum Fluids of Metallic Hydrogen. Opening of Academic year, Center for Advanced Study, Oslo; 05.09.2006 - 05.09.2006

Sudbø, Asle. *Deconfined quantum criticality in quantum antiferromagnets*. Institutt kollokvium; 26.09.2006 - 28.09.2006

Tybell, Thomas; Stokke, Bjørn Torger.

Nanotechnology at NTNU: an Overview. Nanotechnology seminar; 09.02.2006 - 10.02.2006

Valberg, Arne. *Farge: Fra netthinne til hjerne.* Foredragserie i Biofysikkgruppen; 04.12.2006 - 04.12.2006

Valberg, Arne. *Farge som fenomen og filosofi*. Vitforums seminarserie; 28.03.2006 - 28.03.2006

Wittje, Roland. *Hva kan gjenstandene lære oss om vitenskapen i det 20. århundre*. Brochmannseminar; 05.10.2006 - 06.10.2006

Wittje, Roland. *Kjernefysikk i Norge: 1933-1955*. Forum for universitetshistories forskerseminar 2006

Reports

Borck, Øyvind:

Adsorption of organic molecules at surfaces: A first-principles investigation. Trondheim, NTNU, 2006. ISBN 82-471-7914-8 (PhD thesis)

Eikenes, Live:

Transport of therapeutic macromolecules in tumour tissue: The impact of enzymatic degradation. Trondheim, NTNU, 2006. ISBN 82-471-8087-1 (PhD thesis)

Hasting, Håkon Stokka:

Clustering and precipitation in 6xxx al allys: TEM and APT studies. Trondheim, NTNU, 2006. ISBN 82-471-8139-8 (PhD thesis)

Helgesen, Hans Kristian:

Anisotropic depth migration of converted wave data, inversion of multicomponent data to estimate elastic parameters at the seafloor and onedimensional data-driven inversion. Trondheim, NTNU, 2006. ISBN 82-471-8198-3 (PhD thesis)

Kragset, Steinar:

Phase transitions in effective lattice models for strongly correlated system. Trondheim, NTNU, 2006. ISBN 82-471-8119-3 (PhD thesis)

Lysko, Meena D:

Measurement and Models of Solar Irradiance. Trondheim, NTNU, 2006. ISBN 82-471-7175-0 (PhD thesis)

Parmar, Kanak P.S:

Oil dispersions of nanolayered silicates in an external electric field: An experimental study. Trondheim, NTNU, 2006. ISBN 82-471-8215-7 (PhD thesis)

Sairanen, Risto; Persson, Per; Jensen, Per Hedemann, Lindmo, Tore.

NKS-145: Evaluation of NKS Research Activities during 2002-2005, Danmark: NKS (Nordisk kjernesikkerhetsforskning), 126 s, 2006

Samsun, Bahrin Bin Mohamad:

Intermolecular quenching and transfer of electronic excitation in systems containing pigments and molecular oxygen. Trondheim, NTNU, 2006. ISBN 82-471-7760-9 (PhD thesis)

Shchelushkin, Roman:

Spin-orbit coupling induced transport in normal Metals and ferromagnetic semiconductors. Trondheim, NTNU, 2006. ISBN 82-471-8181-9 (PhD thesis)

Skrøvseth, Stein Olav

Entanglement and Its Applications in Systems with Many Degrees of Freedom. Trondheim, NTNU, 2006. ISBN 82-471-8194-0 (PhD thesis)

Sletmoen, Marit:

Structure, dynamics and force-induced dissociation of biomacromolecular complexes involving polysaccharides. Trondheim, NTNU, 2006. ISBN 82-471-7363-8 (PhD thesis)

Books and book chapter

Bhattarai, Binod Kumar; Kjeldstad, Berit Johanne; Bagheri, Asadollah; Thorseth, Trond Morten. Aerosol climatology in Kathmandu using Sun Photometry. I: Remote Sensing 2006. Bellingham, USA: SPIE - International Society for Optical Engineering 2006. ISBN 9780819464637. 11 s.

Bungum, Berit. *Mekaniske leker: Prinsipper og ideer*. Trondheim: Skolelaboratoriet for matematikk, naturfag og teknologi 2006. ISBN 978-82-7923-048-9. 44 s. Sl-serien ; 10

Bungum, Berit; Isnes, Anders. *Naturfag tema: Energi i hverdagen*. Oslo: Cappelen 2006. ISBN 9788202254582. 48 s.

Glimsdal, Eirik; Carlsson, Marcus; Eliasson,

Bertil; Lindgren, Mikae. *Photo-physical properties and OPL of some novel thiophenyl Pt(II)-ethynyl derivatives*. I: Optical Materials in Defence Systems Technology III: SPIE -International Society for Optical Engineering 2006. ISBN 0-8194-6499-6

Grote, James G.; Kajsar, Francois; Lindgren, Mikael. *Optical Materials in Defence Systems Technology III*: SPIE - International Society for Optical Engineering 2006. ISBN 0-8194-6499-6. 144 s.

Hansen, Alex; Mathiesen, Joachim. Survey of Scaling Surfaces. I: *Modelling critical and catastrophic phenomena in geoscience: A statistical physics approach*. Berlin: Springer Verlag 2006. ISBN 978-3-540-35373-7

Holm, Dagny; Jensen, Inger Kristine; Johnsrud, Marit; Langholm, Guri; Spilde, Ingrid; Utklev, Anne-Elisabeth; Bungum, Berit. Gaia 3. Naturog samfunnsfag for barnetrinnet. Elevbok. Oslo: Gyldendal undervisning 2006. ISBN 978-82-05-34135-7. 179 s.

Holm, Dagny; Jensen, Inger Kristine; Johnsrud, Marit; Langholm, Guri; Spilde, Ingrid; Utklev, Anne-Elisabeth; Bungum, Berit. Gaia 3. Naturog samfunnsfag for barnetrinnet. Lærerveiledning. Oslo: Gyldendal Undervisning 2006. ISBN 978-82-05-34140-1. 272 s.

Hunderi, Ola; Ryum, Nils. Introduction to "On the theory of Normal and Abnormal Grain Growth". I: Thermodynamics and Phase Transformations. Les Ulis, France: EDP Sciences 2006. ISBN 2-86883-889-8. s. 231-233

Johnsen, Bjørn; Kjeldstad, Berit Johanne; Aalerud, T.N.; Nilsen, Lill Tove Norvang; Schreder, JOn; Blumthaler, M; Bagheri, Asadollah; Bhattarai, Binod Kumar.

International intercomparison of multiband filter radiometer in Oslo 2005. I: Remote Sensing 2006. Bellingham, USA: SPIE - International Society for Optical Engineering 2006. ISBN 9780819464637. 12 s. Jonsson, Per; Kullander, Fredrik; Vahlberg, Claes; Jelger, Pär; Tiihonen, Mikael; Wästerby, Pär; Tjärnhage, Torbjörn; Lindgren, Mikael. Spectral detection of ultraviolet laser induced fluorescence from individual bio-aerosol particles. I: Optically Based Biological and Chemical Detection for Defence III: SPIE - International Society for Optical Engineering 2006. ISBN 0-8194-6496-1. 12 s.

Kjeldstad, Berit Johanne. Underwater Radiation Measurements: Consequences of and increased UV-B radiation. I: Environmental UV Radiation: Impact on Ecosystems and Human Health and Predictive Models. Pisa, Italy: Springer Verlag 2006. ISBN 1-4020-3696-5. s. 193-203

Spilde, Ingrid; Bungum, Berit. Gaia 3. Natur- og samfunnsfag for barnetrinnet. Arbeidsbok. Oslo: Gyldendal Undervisning 2006. ISBN 978-82-05-34665-9. 47 s.

Spilde, Ingrid; Bungum, Berit. Gaia 5. Naturfag for barnetrinnet. Arbeidsbok. Oslo: Gyldendal Undervisning 2006. ISBN 978-82-05-34675-8. 47 s.

Spilde, Ingrid; Bungum, Berit. *Gaia 5. Naturfag for barnetrinnet. Lærerveiledning*. Oslo: Gyldendal Undervisning 2006. ISBN 82-05-33592-3. 182 s.

Wittje, Roland. *The founddation of N.T.H. in 1910 in international context.* I: Perspectives on Scandinavian Science in the Early Twentieth Century. Oslo: Novus Forlag 2006. ISBN 978-82-7099-442-7. s. 111-132

PHYSICS PRESENTATION THROUGH MEDIA

Fossheim, Kristian. *Er vi klare for Kina?* Adresseavisen, kronikk , 02.11.2006

Fossheim, Kristian. Er vi klare for Kina? Kronikk. Dagbladet, 21.11.2006

Fossheim, Kristian. *Er vi klare for Kina?* Kronikk. Firda, 22.12.2006

Fossheim, Kristian. *Erik Sandvold*. Minneord. Adresseavisen, 15.11.2006

Fossheim, Kristian. *Erik Sandvold*. Minneord. Varden, November 2006

Fossheim, Kristian. *Teknologane må på banen*. Adresseavisen (kronikk), 20.03.2006

Hustad, Johan Einar; Worren, Turid; Tande, Johan Olav; Ryghaug, Marianne; Sørensen, Åse Lekang; Andresen, Inger; Holt, Arve; Finden, Per. *Billigere strøm og bedre miljø*. Dagbladet 12.11.2006

Johnsson, Anders; Brekke, Asgeir. Åpen forskningspublisering? Universitetsavisa 18.04.2006

Kjeldstad, Berit Johanne. *Katta nøtter.* Schrødingers katt.

Kjeldstad, Berit Johanne. *Katta-nøtter*. *Levende lys oppgave*. NRK Schrødingers katt [TV] 03.03.2006

Kjeldstad, Berit Johanne. Katta nøtter Levende lys svar. NRK Schrødingers katt [TV] 16.03.2006

Kjeldstad, Berit Johanne. *Katta nøtter, Snøkrystaller oppgave*. NRK Schrødingers katt [TV] 23.03.2006 **Kjeldstad, Berit Johanne**. *Katta nøtter Snøkrystaller løsning*. NRK Schrødingers katt [TV] 30.03.2006

Kjeldstad, Berit Johanne. *Blås liv i naturfagrommet. Adresseavisen* 02.01.2006

Løvseth, Jørgen. *Solovn*, P2 - Verdt å vite [Radio] 23.05.2006

Løvseth, Jørgen. *Termiske solkraftverk*. P2 - Verdt å vite [Radio] 19.04.2006

Løvseth, Jørgen. *Vindkraft, ren og billig elkraft.* Aftenposten 12.01.2006

Salter, Stephen; Taylor, Jamie; Falnes, Johannes; Yemm, Richard; Bratland, Andreas. *Verdt å vite spesial: Bølgeenergi*. NRK- P2 [Radio] 13.02.2006

Skrøvseth, Stein Olav. *Doktoren svarer*. Morgenbladet 22.12.2006

Tande, Johan Olav; Andresen, Inger; Holt, Arve; Finden, Per; Hustad, Johan Einar; Ryghaug, Marianne; Svensson, Ann Mari; Sørensen, Åse Lekang; Worren, Turid. Billigere strøm og bedre miljø. Dagbladet 12.11.2006

Thomassen, Sedsel Fretheim. *Newton: Sola.* NRK [TV] 21.05.2006

Thomassen, Sedsel Fretheim; Alvestad, Per Olav. Newton - Hva er kraft? NRK1 [TV] 22.01.2006

Wittje, Roland; Nordal, Ola; Asphjell, Arne. Datahistorie i Realfagbiblioteket. Universitetsavia Trondheim 25.10.2006

COOPERATING INSTITUTIONS

EUROPE

Andersen, J.O.:

* Vrije Universiteit Amsterdam, The Netherlands (Daniel Boer)

* Department of Theoretical Physics, Nuclear

Physics Institute ASCR, Czech Republic, (Tomas Brauner)

* Frankfurt University, FIAS, Germany (Michael Strickland)

Borg, A.:

* Department of Physics and Engineering Physics, Chalmers University of Technology, Gothenburg, Sweden (docent E. Schrøder)

* Experimental Solid State Physics II, Nijmegen Science Research Institute for Molecules and Materials, Nijmegen, The Netherlands (professor Theo Rasing)

Brataas, A.:

* TU Delft, Kavli Institute of Nanoscience (Gerrit E. W. Bauer) (Nederland)* University of Konstance, Department of Physics

(Wolfgang Belzig) (Tyskland)

Bungum, B.:

* Göteborgs Universitet, Institutionen för pedagogik och didaktik, Sweden (Björn Andersson, Anita Wahlin)

Fossum, J.O.:

* SNBL/ESRF France

* ESRF/SNBL, Grenoble, France

* Universite Paris 7,Paris, France (Professor Paul Dommersnes)

* Ecole Normal Superieure, Paris, France and University of Amsterdam, Netherlands (Professor Daniel Bonn)

Hansen, A.

* Universite de Nice-Sophia Antiplois, France (Batrouni)

* Ecole Normale Superieure, Paris, France (Schmittbuhl)

* Technical University of Budapest, Hungary (Kertesz)

* Nordita/NBI, Copenhagen, Denmark (Sneppen, Jensaen) Complex Systems, Condensed Matter Theory

Holmestad, R.:

* TU Delft, Netherlands (H. Zandbergen, J. Janssen)

* Rouen University/CNRS, France (F Danoix, W Lefebvre)

Hunderi, O.:

* TU-Berlin (Prof. Wolfgang Richter) Surface Optics

* University of Nijmegen (Prof. Theo Rasing) Magnetooptics

* University of Liverpool (Prof. Peter Weightman) Surface Optics

Høye, J.S.:

* Instituto de Quimica Fisica Rocasolano, CSIC C/ Serrano 119, 28006 Madrid, Spain (Enrique Lomba)

Johnsson, A:

* Arbetmiljöinstitutet, Umeå (K. Hansson Mild, J. Wilén), Biophysics
* Institut für Biologi, Universität Tübringen (W. Engelmann, biophysics

Kachelriess, M.:

* AHEP Group, C.S.I.C/Universitat de Valencia, Spain (R. Tomas)
* APC (Laboratoire AstroParticule et Cosmologie), Paris, France (D. Semikoz)
* Institute for Nuclear Research, Moscow, Russia (V. Berezinsky, D. Semikoz)
* Laboratori Nazionali del Gran Sasso, I-67010, Assergi (AQ), Italy (R. Aloisio, V. Berezinsky)
* MPI für Physik (Werner-Heisenberg-Institut), Munich, Germany (P. Serpico)
* Stepanov Institute of Physics, Minsk, Belarus (A. Gazizov)

Lindgren, M.:

* Linkőpings Universitet, IFM (protein structure and dynamics)

* Kungliga Tekniska Høgskolan, Polymer Technology, Stockholm (dendritic nanomaterial, laser technology)

* Umeå Universitet, Organisk kemi, Umeå

(photoprocesses, organic molecules)

* Totalfőrsvarets forskningsinstitut, Linkøping (bio-sensing; laser protecting materials and devices)
* Université Claude Bernard (Lyon1), Laboratoire des Multimatériaux et Interfaces (sol-gel/hybrid materials)

Melø, T.B., Naqvi, K. R.:

* Biological Research Center, Hungarian Academy of Sciences, Szeged, Hungary (G. Garab, T. Jávorfi, E. Hideg)

* ITQB, Universidade Nova de Lisboa, Oeiras, Portugal (E. Melo)

* Instituto de Recursos Naturales y Agrobiología, CSIC, Salamanca, Spain (J.B. Arellano)

* Department of Physiology of Microorganisms, Moscow State University, Moscow, Russia (M.N. Merzlyak)

Mo, F.:

* SNBL, ESRF, Grenoble (V. Dmitriev, D. Cherbnyshov), Condensed Matter Physics

Sikorski, P.:

* Department of Biochemistry, School of Life Sciences, University of Sussex, UK. (Dr. L.C. Serpell). Biophysics.

Skagerstam, B.S.;

- * P.L. Knight, Imperial College, London
- * P.K. Rekdal, Imperial College, London
- * Gøran Wendin, CTH, Gøteborg, Sverige

Stokke, B. T.:

* La Sapienza University, Roma, Italia (M. Dentini), Biophysics

* Munchen Techn. Univ., Tyskland (A. Bausch, E. Sackmann), Biophysics

* Univ. Joseph Fourier, Grenoble, Frankrike (E. Geissler), Biophysics

* Univ. College Dublin, Dublin, Ireland (S. Jarvis), Biophysics

Sudbø, A.:

* Universita di Catania, Italia (prof. Giuseppe Angilella)
* Freie Universitaet Berlin (dr. Flavio S. Nogueira)

* Kunglega Tekniska Høgskolan (prof. Mats Wallin)

Valberg, A.:

* Tambartun Centre for the Visually Impaired, Melhus (Per Fosse)

* University of Oslo, Art Conservation Study (Tine Frøysaker).

Wahlstrøm, E.:

* Chalmers tekniska högskola (Maj Hanson, Lars Walldén) Teknisk fysik

Walmsley, J.:

* Cambridge University, Cambridge, UK (P. Midgley)

Worren, T.:

* Chalmers University of Technology (Mahdad Sadeghi and Shumin Wang) Department of Microtechnology and Nanoscience
* Linköping University (Per-Olof Holtz) Materials Science

AMERICA

Brataas, A.:

* UCLA, Department of Physics (Yaroslav Tserkovnyak) (USA)
* New York University, Department of Physics (Andy Kent) (USA)

Davies, C.:

* Harvard Medical School Boston, USA (R.K. Jain Y. Boucher)

Fossum, J.O.:

* Universidade Federal de Pernambuco, UFPE, Recife, Brazil (Professorr Mario Engelsberg)
* LNLS, Campinas, Brazil (Scientist Roosevelt Droppa)
* University of Brasilia, UnB, Brasilia, Brazil (Professor Geraldo Jose da Silva)

Hansen, A.:

- * Uni Ceara, Fortaleza, Brazil (Soares)
- * University of Brasilia, Brazil (Oliveira)
- * University of Arizona, USA (Franzikonis)
- Complex Systems, Condensed Matter Theory

Holmestad, R.

* University of Illinois, Urbana-Champaign, USA (JM. Zuo)

- * Arizona State University, USA (J. Spence)
- * McMaster University, Ontario, Canada (G. Botton)

Høye, J.S.:

* Stony Brook University, New York, USA. (G. Stell, F. Raineri, C.-L. Lee), Theoretical Physics
* Oklahoma University, Norman, Oklahoma, USA (K. A. Milton), Theoretical Physics

Lindmo, T.:

* Beckman Laser Institute, University of California, Irvine (B. Tromberg, J. S. Nelson, Z. Chen), Biomedical optics.

Skagerstam, B.S.:

- * University of Florida (J.R. Klauder) USA
- * Syracuse University, N.Y., USA

Stokke, B.T.:

* Univ. of California, Santa Barbara, California, USA (H. Hansma), Biophysics

Sudbø, A.:

* University of California, Riverside (prof. C.M. Varma)

- * Johns Hopkins University (prof. Z. B. Tesanovic)
- * University of Toronto (prof. John Wei)

Valberg, A.:

* State University of New York (SUNY) (Barry B.Lee)

ASIA

Fossum, J.O.:

*Gwangju Institute of Science and Technology, South Korea

* Pohang Accelerator Laboratory, South Korea

Hansen, A.:

* Institute of Mathematical Sciences, Chennai, India (Ray)

* Saha Institute of Nuclear Physics, Kolkata, India (Chakrabarti)

Holmestad, R.

* Toyoma University, Graduate school of Science and Engineering, Japan (K Matsuda)

Johnsson, A.:

* J. Nehru Centre for Advanced Scientific Research, Bangalore, India (V. Sharma, S. Visu), Biophysics

Naqvi, K.R.:

* The Aga Khan University, Karachi, Pakistan (C. W. Vellani)

* Yarmouk University, Irbd, Jordan (Y.A. Yousef)
* Department of Chemistry, Kyoto University, Japan (A. Osuka)

Sikorski, P.:

* Department of Biomaterials Sciences, Graduate School of Agricultural and Life Sciences, The University of Tokyo, Japan. (Dr. M. Wada). Biophysics.

Stokke, B.T.:

* Osaka Prefecture Univ., Osaka, Japan (S. Kitamura), Biophysics
* Kyoto Inst. of Technology, Kyoto, Japan (K. Kajiwara) Biophysics

AUSTRALIA

Davies, C.:

* Cancer Biology Laboratory, Peter Mac Callum Cancer Centre, Melbourne (Robin Anderson)

NATIONAL COOPORATION

* Naturfagsenteret (Nasjonalt senter for naturfag i opplæringen)

* NAROM (Nasjonalt senter for romrelatert opplæring)

* Department of Chemistry, Biotechnology and Food Science, Norwegian University of Life Sciences, Ås, Norway (Prof. V.G.H. Eijsink) * Institute for energy technology, Kjeller, Norway (senior scientists Arne Skjeltorp, Geir Helgesen, Kenneth D. Knudsen) * Photocure ASA, Oslo * Division of Biophysics and Medical Technology, Radium Hospital, Oslo (Ø. Bruland, A. Skretting) * Statoil Research Centre, Trondheim (F. Antonsen, H. Widerøe) * University of Oslo (J.M. Leinaas, A. Dahlback, E.G. Fjelløy, K.J. Måløy) * Optomed (R.Ellingsen, D.R. Hjelme, B. Falch) * FMC Biopolymers (E. Onsøyen) * Norwegian Radiation Protection Authority (Bjørn Johnsen, Terje Christensen) * Department of Biology, Dag Hessen, University of Oslo * Norwegian Institutte for Air Research, University of Oslo, (A. Kylling, G. Braathen) * Tambartun National Resource Center for the Visually Handicapped, Melhus (P. Fosse) * Institute for Energy Technology, Kjeller, (B.Hauback, K.D. Knudsen, A.Skjeltorp, P.G. Helgesen, H. Brinks)

* Centre for Viking and Medieval Studies, University of Oslo

LOCAL COOPERATION

* Skolelaboratoriet for matematikk, naturfag og teknologi, NTNU

* Program for Lærerutdanning, NTNU

* Department of Oncology, St.Olav's Hospital

(T. Strickert, J. Frengen)

* Department of Circulation and Medical Imaging

(O. Haraldseth, C. Brekken)

* Department of Electronics and Telecommunications, NTNU (T. Tybell)

* Department of Process Technology, NTNU (P.V. Hemmingsen)

* Høgskolen i Sør-Trøndelag, HIST (G. Oftedal,

S. Ramstad)

* SINTEF (C. Marioara, S. Andersen, J. Walmsley, R. Mathiesen)

* Institutt for konstruksjonsteknikk, NTNU.

(I. Brevik og J.B. Aarseth)

* Pedagogisk institutt, og Skolelaboratoriet for matematikk, naturfag og teknologi, NTNU

* Organic Chemistry, NTNU (P.H. Carlsen)

* Plantebiosenteret NTNU (T.-H. Iversen)

* Department of Inorganic Chemistry, NTNU

* Institute of Reservoir Technology and Applied Geophysics, NTNU

* Centre for Biology of Memory, Centre of

Excellence, NTNU (E. Moser)

* Institute of Neuroscience, St. Olav Hospital

Norsk Lysteknisk komité

* Trondheim Science Centre

* Inst. for Bioteknologi, NTNU (B.E. Christensen,

K.M. Vårum, G. Skjåk-Bræk, S. Valla,

O. Smidsrød, K.I. Draget)

* Inst. for kreftforskning, NTNU: (T. Espevik,

A. Sundan)

* Institutt for Petroleumsteknologi, NTNU

* Materialteknologi, NTNU, (K.Marthinsen, M.-

A. Einarsrud og T. Grande, O. Lohne)

* Institutt for elektronikk og telekommunikasjon,

NTNU (T. Tybell, J.K. Grepstad)

* SINTEF Energiforskning

* Institutt for Kjemisk prosessteknologi NTNU

(Z. Yu, Chen, A. Holmen)

EDUCATION

SUBJECTS AND STUDENT ATTENDANCE Some subjects were self-study courses in 2006

Subjects		Student
мат	1 st 1 and	Attendance
M.Sc. Tech	nnology 1" and 2" year.	
TFY4102	Physics for Product Design Engineering, Marine	342
	Technology, Earth Sciences and Petroleum Engineering (incl. lab)	
TFY4106	Physics for Civil and Transport Engineering, Industrial	213
	Economics and Technology Management, Product Design	
	and Manufacturing	
TFY4115	Physics for Electronics Engineering, Engineering	149
	Cybernetics (incl. lab)	
TFY4120	Physics for Chemical Engineering and Biotechnology,	101
	Materials Science and Engineering (incl. lab)	
TFY4125	Physics for Computer Science, Communication	218
	Technology	
TFY4135	Physics for Marine Technology (incl. lab)	65
TFY4145	Mechanical Physics (incl. lab)	105
TFY4155	Electromagnetism (incl. lab)	92
TFY4160	Wave Physics (incl. lab)	87
TFY4165	Thermal Physics (incl. lab)	100
TFY4180	Physics for Energy and Environment (incl. lab)	100
TFY4215	Chemical Physics and Quantum Mechanics	110

M.Sc. Technology 3rd year.

TFY4170	Physics 2 for Electronics Engineering	67
TFY4175	Material Physics and Characterization (incl. lab)	22
TFY4185	Measurement Techniques (incl. lab)	51
TFY4190	Instrumentation (incl. lab)	67
TFY4195	Optics (incl. lab)	78
TFY4205	Quantum Mechanics	70
TFY4230	Statistical Physics	54
TFY4240	Electromagnetic Theory	45
TFY4250	Atomic and Molecular Physics	41
TFY4260	Cell Biology and Cellular Biophysics (incl. lab)	28

M.Sc. Technology 4th year.

TFY4200	Optics, Advanced Course (incl. lab)	23
TFY4210	Applied Quantum Mechanics	34
TFY4220	Solid State Physics (incl. lab)	59
TFY4225	Nuclear and Radiation Physics (incl. lab)	61
TFY4235	Computational Physics	29
TFY4245	Solid State Physics, Advanced Course	26
TFY4255	Materials Physics (incl. lab)	15
TFY4265	Thermal Physics	18
TFY4270	Theory of Classical Fields	21
TFY4275	Classical Transport Theory	4
TFY4280	Signal Processing (incl. lab)	10
TFY4292	Quantum Optics	17
TFY4300	Energy and Environmental Physics	20
TFY4305	Non-linear Dynamics	21
TFY4310	Molecular Biophysics (incl. lab)	16
TFY4315	Biophysics (special)	14
TFY4320	Medical Physics (incl. lab)	14
TFY485x	Experts in Team, Interdisciplinary Project	50

M.Sc. Technology 5th year.

TFY4265	Biophysical Micromethods (incl. lab)	18
TFY4700	Biophysics, Specialization	11
TFY4705	Physics, Specialization	48

B.Sc.

FY0001	Service Course in Physics (incl. lab)	45
FY1001	General Physics I (incl. lab)	77
FY1002	General Physics II (incl. lab)	45
FY1003	Electricity and Magnetism I	71
FY1004	Introduction to Quantum Physics	80
FY1005	Thermal Physics (incl. lab)	25
FY1013	Electricity and Magnetism II (incl. lab)	44
FY2045	Quantum Physics (incl. lab)	15
FY2302	Biophysics I (incl. lab)	11
FY2450	Astrophysics I	65
FY3020	Space Technology I	39

M.Sc.

FY2290	Energy Resources	9
FY2900	Didactics in Physics (incl. lab)	2
FY3021	Space Technology II	12
FY3070	Light, Vision, Colour (incl. lab)	8
FY3114	Functional Materials	10
FY3201	Atmospheric Physics (incl. lab)	12
FY3402	Subatomic Physics	31
FY3403	Particle Physics	10
FY3450	Astrophysics II	7
FY3900	Master Thesis in Physics	6

PhD

FY8102	Electron Microscopy and Diffraction	6
FY8105	Superconductivity: Physics and Application	1
FY8200	Advanced Statistical Physics	2
FY8302	Quantum Theory of Solids	1
FY8304	Mathematical Approximation Methods in Physics	11
FY8305	Functional Integral Methods in Condensed Matter Physics	3
FY8306	Quantum Field Theory II	5
FY8307	Relativistic Quantum Mechanics	1
FY8401	Interactions of Ionizing Radiation with Matter	1
FY8402	Dosimetry of Ionizing Radiation	1
FY8406	Non-ionizing Radiation and its Biological Action	2

THESES - GRADUATE STUDIES

Master of Science in Applied Physics and Mathematics

Bentsen, Vegard Storjord;

Fracture Width and Roughness Exponent of Singly Connected Fracture in the Random Fuse Modelial MR relaxometry Supervisor: Alex Hansen

Berg, Thomas;

Numerical study of light scattering from rough surfaces. Supervisor: Ola Hunderi

Berstad, Leiv Jakob;

A photoemission and electron diffraction study of nanostructured rare earth/transition metal system while annealing and oxidizing Supervisor: Steinar Raaen

Birkeland, Asgeir;

Crystallographic Orientations of silicon precipitates in aluminium alloys. Supervisor: Randi Holmestad

Bjønnum, Anne-Berit;

The Effect of the Enzymes Collagenase and Hyaluronidase on Uptake and Distribution of Macromolecules in Spheroids and Tumor Xenografts Supervisor: Catharina Davies

Brennodden, Glen;

The influence of folic acid on the PDT effect on cells in vitro and on the photobleaching of porphyrins in solutions Supervisor: Anders Johnsson

Dischler, Eirik Øverland;

Quantitative tests of the spectral proximity model of defective colour vision Supervisor: Arne Valberg

Døli, Tone Elise;

T_1-relaxation in rat brain: MR sequence optimization and in-vivo mapping Supervisor: Tore Lindmo

Ekker, Ragnar;

Electromagnetic scattering from a spheroidal particle Supervisor: Ola Hunderi

Ellingsen, Simen Andreas;

Casimir Effect in Plane Parallel Geometry Supervisor: Johan S. Høye

Gabrielsen, Andreas;

Clinical and dosimetric evaluation of the dose planning algorithms collapsed cone and pencil beam for irradiation of lung tumors Supervisor: Tore Lindmo

Gisetstad, Ragnhild;

Irradiation of breast cancer cell lines: effects of different photon energies and dose rates Supervisor: Catharina Davies

Hagen, Sindre;

Direct irradiance measurements, calibrations, precision test of tracker, calculation of aerosol optical depth and size distribution, and wavelength shift with SHICRivm Supervisor: Berit Kjeldstad

Haugen, Håvard

Dynamical System Techniques Applied to Cosmological Problems Supervisor: Michael Kachelriess

Hedalen, Kristin;

Dynamic contrast-enhanced magnetic resonance imaging of human melanoma xenografts with necrotic regions Supervisor: Einar K. Rofstad

Heldahl, Mariann Gjervik;

MR proton T_2-mapping in rat brain - methods and measurements at 2,35 and 7 T Supervisor: Tore Lindmo

Huuse, Else Marie;

Vital microscopy studies of human melanoma xenografts Supervisor: Einar K. Rofstad

Høyvik, Lars Martin;

Application of different three-dimensional imaging systems for treatment of cardiac arrythmias Supervisor: Tore Lindmo

Jensen, Jørgen;

Measurement of UV erythemal irradiance and ozone total column using a ground based UV filter instrument. Comparison of results with satellite data. Supervisor: Berit Kjeldstad

Jensen, Lars Lægreid;

Calculations of aerosol size distribution, optical depths and scattering by use of direct and global irradiance measurements. Supervisor: Berit Kjeldstad

Juthajan, Aphirak;

Diffusion measurement in gels and multicellular spheroids using fluorescence correlation spectroscopy Supervisor: Catharina Davies

Kaupang, Halvard;

A Simulation Study on Aberration and Generation of Three-Dimensional Second-Harmonic Ultrasound Beams in Heterogeneous Soft Tissue and Parallelization of Simulation Code Supervisor: Tore Lindmo

Kvalvåg, Berit Winsnes;

Automatic polarisation control in networks Supervisor: Ola Hunderi

Lieng, Magnus Hov;

Automated Systems for the Testing and Training of Multi Wire Proportional Chambers Supervisor: Anne Borg

Lippard, Jon;

Entanglement properties of the Fractional Quantum-Hall System Supervisor: Kåre Olaussen

Laastad, Odd Fredrik;

Modeling direct and diffuse radiation Supervisor: Berit Kjeldstad

Mohammad, Abdul Basit;

The Universe as an Interface (a Brane) Supervisor: Kåre Olaussen

Monsen, Åsmund Fløystad;

TEM characterization of LaFe_O3 thin films Supervisor: Randi Holmestad

Nilsen, Line Brennhaug; *Applications of MR-images as a basis for radiation treatment planning* Supervisor: Arne Skretting

Rostad, Maja Elise;

In vitro studies of the effects of Taxotere on the radiosensitivity and growth rate of breast cancer cells Supervisor: Thor Bernt Melø

Saxegaard, Magne;

Scanning tunneling microscopy based point contact measurements of giant magnetoresistance in Py/Cu/Co spin valve rings Supervisor: Erik Wahlstrøm

Skoe, Inger Marie;

TEM/STEM studies of catalyst systems with Pt nanoparticles supported on carbon nanofibers Supervisor: Randi Holmestad

Steinsland, Siri;

Collagen-HA network as a model for a molecular trafficking study within the ECM Supervisor: Catharina Davies

Storlien, Leif Sigurd;

Silicon Wafer Passivation Supervisor: Turid Worren

Stubhaug, Elin;

Investigations of dislocation clusters in solar cell graded silicon with TEM Supervisor: John Walmsley

Sæterli, Ragnhild Kjæstad;

TEM characterization of lead titanate nanorods synthesized under hydrothermal conditions Supervisor: Randi Holmestad

Sæther, Heidi Vogt;

The stability of alginat-chitosan polyelectrolyte complexes Supervisor: Bjørn Torger Stokke

Tjørholm, Henning;

Quantum Erasure and Applications Supervisor: Bo-Sture Skagerstam

Tonheim, Celin Russøy;

Growth and characterization of Cd_xHg_l-x Te multiple quantum wells Supervisor: Turid Worren

Tørlen, Idar Kolstad

Measurement of high frequency dielectric response for oil/paper systems Supervisor: Tore Løvaas

Tørå, Glenn;

Role of disorder and thermal diffusion in the fuse model Supervisor: Alex Hansen

Vestvik, Ida Kathrine;

Hypoxia-induced gene expression in human melanoma cells grown in culture Supervisor: Einar Rofstad

Aasland, Elisabeth Urstad;

Clinical and dosimetric evaluation of the dose planning algorithms collapsed cone and pencil beam for irradiation of lung tumors Supervisor: Tore Lindmo

Cand. Scient. in Physics

Andersen, Hilde Nortvedt:

Strukturen av ekstracellulær matriks og dens betydning for diffusjon av makromolekyler i kreftvev. Supervisor: Catharina Davies

Gaustad, Peder Anders

Noen neglisjerte tema i fysikkundervisningen Supervisor: Hans Kolbenstvedt

Steen, Ola:

Tidsstrukturen av vind på Skipheia målestasjon. Spektralanalyse, kvalitetsikring og parametrisering av eksperimentelle data. Supervisor: Jørgen Løvseth

Aarø, Per Lønning:

Bridging the Quantum Leap An ontological approach to quantum mechanics with emphasis upon historical development and underlying philosophy? Supervisor: Hans Kolbenstvedt

Master of Science in Physics

Coelho, Liz Helena Froes:

Freeze fracture and electron microscopy of water lipid systems Supervisor: Arnljot Elgsæter

Egeland, Tormod Andre Mjelde:

Photoinduced cell death in Jurkat cells: A flow cytometric study using endogenous and exogenous protoporphyrin IX photosensistizer Supervisor: Thor B. Melø

Godwin, Amo-Kwao:

A new parameter for Direct Solar Radiation Model Supervisor: Turid Worren

Nigussa, Kenate Nemera:

Photoemission, Low energy electron diffraction and temperature programmed desorption studies of nanostructured surfaces. Supervisor: Steinar Raaen

Regmi, Nilmani:

Characterization of Aerosols in Kathmandu and Trondheim Supervisor: Berit Kjeldstad

Twinamasiko, Benon Fred:

Measurement of Solar Radiation Supervisor: Berit Kjeldstad

THESES - DOCTORAL STUDIES

Borck, Øyvind:

Adsorption of organic molecules at surfaces: A first-principles investigation Supervisor: Anne Borg

Eikenes, Live:

Transport of therapeutic macromolecules in tumour tissue: The impact of enzymatic degradation Supervisor: Tore Lindmo

Hasting, Håkon Stokka:

Clustering and precipitation in 6xxx al allys: TEM and APT studies Supervisor: Randi Holmestad

Helgesen, Hans Kristian:

Anisotropic depth migration of converted wave data, inversion of multicomponent data to estimate elastic parameters at the seafloor and onedimensional data-driven inversion Supervisor: Alex Hansen

Kragset, Steinar:

Phase transitions in effective lattice models for strongly correlated system. Supervisor: Asle Sudbø

Lysko, Meena D:

Measurement and Models of Solar Irradiance Supervisor: Jørgen Løvseth

Parmar, Kanak P.S:

Oil dispersions of nanolayered silicates in an external electric field: An experimental study. Supervisor: Jon Otto Fossum

Samsun, Bahrin Bin Mohamad:

Intermolecular quenching and transfer of electronic excitation in systems containing pigments and molecular oxygen Supervisor: Kalbe Razi Naqvi

Shchelushkin, Roman:

Spin-orbit coupling induced transport in normal Metals and ferromagnetic semiconductors Supervisor: Arne Brataas

Skrøvseth, Stein Olav

Entanglement and Its Applications in Systems with Many Degrees of Freedom Supervisor: Kåre Olaussen

Sletmoen, Marit:

Structure, dynamics and force-induced dissociation of biomacromolecular complexes involving polysaccharides. Supervisor: Bjørn Torger Stokke

PARTICIPATION IN COMMITTEES

Evaluation committees:

Andersen, J.O.:

* Evaluation committee at PhD dissertation of Håvard Alnes, Universitetet i Oslo, 23/11-2006.

Borg, A .:

* Opponent for PhD defense Karin Habermehl-Cwirzen, Laboratory of Physics, Helsinki University of Technology, March 2006.
* Faculty opponent, for the PhD defense of Jan Hinnerk Richter, Uppsala University, November 2006.

* Member of evaluation committee (betygsnemnd), for the PhD defense of Lassana Ouattara, Lund University, December 2006.

* Evaluation committee for professor competence of 1 candidates in Physics, Karlstad University.

* Evaluation committee for professor competence of 1 candidates in Physics, Örebro University.

* Evaluation committee for appointing university lecturer in physics at Karlstad University, September 2006.

Bungum, B.:

* External examiner of PhD thesis (Litšabako Ntoi) from University of the Western Cape, South Africa.

Kjeldstad, B.J.:

* 1st opponent, Antti Arola, University of Kuopio, Finland, Department of applied physics.

Worren, T.:

* Administrator for Phd defense of Meena Davraj.

International committees

Borg, A.:

* Member of "Beredningsgrupp för kondenserade materiens fysik", The Swedish Research Council, Sweden.

* Member of the "Beredningsgrupp 2" under the Committee of Research infrastructure (KFI), The Swedish Research Council, Sweden.

* Member of the IUPAP (International Union of Pure and Applied Physics) Working Group on Women in Physics.

* Member of the steering committee of the ESF Scientific Program "Nanotribology (NATRIBO)".

Bungum, B.:

* Editor of scientific journal NorDiNa (Nordic Studies in Science Education).

* Member of the board for the 9th Nordic Research Symposium on Science Education.

Hansen, A.:

* Secretary to the Board of European Physical Society's Computational Physics group.
* Member of the prize committee for European Physical Society's Berni Alder Prize in Computational Physics.

* Member of the International Union of Pure and Applied Physics (IUPAP), Commission of Statistical Physics (C3).

Holmestad, R.:

* Member of the board of the Scandinavian Electron microscopy society, SCANDEM.

Hunderi, O.:

* Editorial board for scientific journals. Editorial Board, New Journal of Physics 2002-

* Member of the publication Council, The optical Society of America 2007-

* Member of the organising committee for ICSE4, Stockholm, June 2007.

* Member of the organising committee forOSI-VII, Jackson Hole, Wyoming, July 2007.

Kjeldstad, B.J.:

* Member of World Meteorological Organisation, Scientific advisory Group for Ultraviolet Radiation measurements (WMO UVSAG).

Lindmo, T.:

* Member of commission evaluating NKS (Nordic Nuclear Safety) research activities during 2002-2005.

Mo, F.:

* Associate editor - Crystallography Review

(Taylor & Francis).

* Member of the Proposal Review Committee at SLS (Swiss Light Source), Villigen, Switzerland.

Samuelsen, E. J.:

* Norwegian representative in the Council of the European Synchrotron Radiation Facility ESRF, Grenoble.

* Chairman of Nordsync, the Nordic Consortium for Synchrotron Radiation (Denmark, Finland, Norway, Sweden.

* Nordic member in "ESRF Working Group on *Balance of Use and Payment*".

Stokke, B.T.:

- * Editorial Advisory Board Biopolymers (Wiley).
- * Member of administrative group of NORDTEK.
- * Member of Administrative Council of SEFI.
- * Board of Directors, CESAER.
- * Scientific advisory committee, 8th International Hydrocolloids Conference, 18-22 june 2006, Trondheim, Norway.

Valberg, A.:

* Norwegian Representative in Commission Internationale de l'Eclairage (CIE), Division I, Vision and Colour.
* Member of Tecnical Committee TC1-37 of the CIE.

National committees

Borg, A.:

* President, Norwegian Physical Society.
* Member of "Ressursfordelingskomiteen for tungregning", Norwegian Research Council.
* Member of the board of NTVA.

Bungum, B.:

* Member of the board for NAROM (Rådet for Nasjonalt senter for romrelatert opplæring).
* Member of expert group for developing a national curriculum for the subject 'Teknologi og Forskningslære', Utdanningsdirektoratet.
* Member of the board for "Nasjonalt nettverk for naturfagutdanning" (National network for science education).

Fossum, J. O.:

* Leader of Condensed Matter with Atomic Physics Division of Norwegian Physical Society.

Holmestad, R.:

* Member of the board of UNINETT Sigma, dealing with high performance computing in Norway.

Johnsson, A.:

* Member of "Norsk Fysikkråd".

Kjeldstad, B.J.:

* Member, Board of University of Svalbard (until June, subsitute member from Jun.).

* Education committee for geophysical courses at University of Svalbard.

* Substitute member, Board of Sør Trøndelag University College, Faculty of Technology.

Mo, F.:

* Member of the Committee for Synchrotron Research, Norsk Synkrotronforskning AS.

Stokke, B.T.:

* Chairman of the board, NANOMAT Research Program, The Norwegian Research Council * Leader National council for technological education, The Norwegian Association of Higher Education Institutions.

Worren, T.:

* Member of the board "Solenergiforeninga".

University and Departmental committees

Andersen, J.O.:

* Member of "Studieprogramrådet for Realfag".

Borg, A.:

* Member of FUS ("Forvaltningsutvalget for

sivilingeniørutdanningen") at NTNU.

* Vice dean on education, Faculty of Natural

Sciences and Technology.

* Member of FUL ("Forvaltningsutvalget for Lærerutdanningen") at NTNU.

* Member of Educational Committee of NTNU

* Member, "Studieprogramråd for Lærerutdanningen i Realfag".

Brataas, A.:

* Member of the board of "Realfagsbiblioteket".

Bungum, B.:

* Member of the steering committee for TIGRIS -

Teknologi i grunnopplæringa i skolen.

* Member, "Studieprogramråd for Lærerutdanningen i Realfag".

* Chairman, Division of Applied Physics and Didactic Physics (1.des.-31-des).

Davies, C.:

* Elected member of Departmental Council.

* Member, "Studieprogramråd for MSc Condensed Matter Physics and Biophysics".

Fossheim, K.:

* Chairman, "Formidlingsutvalget ved Institutt for fysikk".

Hansen, A.:

* Member, "Studieprogramråd for fysikk og matematikk".

* Elected member of Departmental Council.

Holmestad, R.:

- * Chair/co-chair of the TEM Gemini Centre .
- * Elected member of Departmental Council.
- * Chairman, "Studieprogramråd for MSc

Condensed Matter Physics and Biophysics".

Hunderi, O.:

* Chairman, Division of Condensed Matter Physics.
* Chairman, "Studieprogramråd for fysikk og matematikk".

Johnsson, A.:

* Member, board of the Faculty of Natural Science and Technology.

* Member of "Studieprogramrådet for Fysikk".

Kjeldstad, B.:

* Head of the Department of Physics.

* Chairman, "Rekrutteringsutvalget ved Institutt for fysikk".

Lindgren, M.:

* Chairman, Division of Applied Physics and Didactic Physics (1.jan – 31.aug).

* Elected member of Departmental Council.

Lindmo, T.:

* Chairman, Division of Biophysics and Medical Technology.

* Member, "Studieprogramråd for fysikk og matematikk".

* Chairman, "Studieprogramråd for MSc Medical Technology".

Mikkelsen, A.:

* Chairman, Division of Complex Materials.

Olaussen, K.:

* Deputy Head of the Department of Physics.

Samuelsen, E.J.:

* Organiser of the Annual Nordsync Meeting, NTNU.

* Organiser of the "Functional materials and Polish-Norwegian Co-operation", Topical meeting, NTNU.

Sikorski, P.:

* Member (acting chairman from Dec 2006) of detail planning committee for the bionanotechnology clean room, NTNU Nanolab.

* Member, Ledergruppen NTNU Nanolab.

* Organizer, 1st NTNU NanoLab User Meeting. March 9-10. Jægtvolden Fjordhotell.

Stokke, B.T.:

* Chairman of the board, NTNU Nanolab, NTNU. * Dean of Engineering Studies, NTNU; Leader of FUS.

Støvneng, J.A.:

* Chairman, "Undervisningsutvalget ved institutt for fysikk".

* Member, "Studieprogramråd for Lærerutdanningen i Realfag".

Sudbø, A.:

* Chairman, Division of Theoretical Physics.

Valberg, A.:

* Member of the board of the interdisciplinary Program for Master Studies in Neuroscience at NTNU.

Wahlstrøm, E.:

* Chairman, detail planning committee for the physical clean room, NTNU Nanolab.

* Member, "Studieprogramråd for nanoteknologi".

Worren, T.:

* Member leader group "Senter for fornybar energi"
* Member, board of the "Geminisenter PV solcellematerialer".
* Member, "Studieprogramråd for MSc Condensed Matter Physics and Biophysics".
* Chairman, Division of Applied Physics and Didactic Physics (1.sep-1.des).

Øverbø, I.:

* Chairman, "Studieprogramrådet for Realfag".

Arrangement committees:

Bungum, B.:

* Organizer of conference "Forskning i realfagsdidaktikk", on current research in science and mathematics education, NTNU, October 10th.
* Co-organizer of conference for teachers:
"Teknologi og design – eksempler på undervisningsopplegg", arranged by TIGRIS November 11th.

Hansen, A.:

* Convenor of "Fredagskollokviet i fysikk".

Skagerstam, B.-S.:

* Convenor of "Fredagskollokviet i fysikk".

Fossum, J.O.:

* Organizer of "Annual meeting of the Condensed Matter Physics and Atomic Physics Division of the Norwegian Physical Society", Wadahl, Norway, September 13-15, 2006.

Lindgren, M.:

* Co-chairing the conference: Optical materials in defence systems technology II (ed110). Part of the SPIE Symposium "Defence and Security" Stockholm, Sept 11-15, 2006.

* Chairman of Technical and Scientific committee of conference: Northern Light 2006, Bergen June 2006.

Worren, T.:

* Organizer Internal Seminar SFFE (Centre for Renewable Energy), Stjørdal 13.-14.11. 2006.

FRIDAY AFTERNOON LECTURES

"Fredagskollokviet i fysikk"

Convenors: Mikael Lindgren (spring) - Alex Hansen and Bo-Sture Skagerstam (autumn)

Programme – spring term

<u>27.01.</u> - Professor Peter L. Biermann, Max Planck Institute for Radioastronomy, Bonn, and Dept. of Physics and Astronomy, Bonn University:

Origin and physics of the highest energy cosmic rays

<u>03.02.</u> - Visiting Professor Boris Minaev, NTNU:

Theory and applications to singlet oxygen biochemistry - Magnetic-dipole phosphorescence of molecular oxygen in zero pressure gase phase and its enhancement in solvents.

<u>10.02.</u> - Seniorforsker Odd Løvhaugen / Forskningssjef Erik Wold, Sintef IKT:

Mikrooptiske sensorer for spektroskopi

17.02. - Prof. Kåre Olaussen, NTNU:

Thoughts and Ramblings about Strings and Universes and Everything Outside

<u>24.02.</u> - **Prof. Otto Lohne, NTNU:** Silisium – solceller : FoU ved NTNU / SINTEF

<u>17.03.</u> - **Prof. Ole Johan Løkberg, NTNU:** Optikk i Naturen

<u>24.03.</u> - Lars Onsager Professor John R. Klauder:

Path Integration: An Historical Slice

<u>31.03.</u> - Professor Emeritus Torbjørn Helle, NTNU:

Papir: Da, nå, fremtid

<u>21.04.</u> - Dr. Ingve Simonsen, Researcher at CNRS (Paris):

Light playing Houdini: Squeezing light through sub-wavelength openings

28.04. - Dr. Hans Blom, KTH:

Fluorescence correlation spectroscopy - technique and applications

<u>05.05.</u> - Dr. Svein Winther, Research Manager Unifob Naturvitenskap, Bergen:

Om skillingsboller og Brann, oppdragsforskning og Universitetet i Bergen, men mest om "Optical Transfer Diagnosis".

12.05. - Dr. Kay Gastinger, Sintef-Optikk:

Low Coherence Speckle Interferometry (LCSI) when TV-Holography goes sub-surface

19.05. - Dr. Berit Bungum, NTNU:

Nye læreplaner i videregående skole - hva slags faglig bakgrunn vil våre nye studenter komme med?

Programme – autumn term

<u>01.09.</u> - (Chairmen Prof. A.Elgsæter, NTNU). Marit Stranden, Institutt for biologi, NTNU, og Professor Grude Førre, NTNU: Insect Olfactory Coding and the Challenge of Acquring Neural Signals.

08.09. - Professor Axel Brandenburg,

NORDITA, Copenhagen, Denmark: Astrobiology, Homochirality, and the Origin of Life.

<u>22.09.</u> - Professor John Hertz, NORDITA, Copenhagen, Denmark:

Mean Field Theory: From Magnets to Brains.

<u>29.09.</u> - **Professor Alex Hansen, NTNU:** Computational Physics Seminar at NTNU

<u>06.10.</u> - Professor Göran Wendin, MC2, Chalmers, Göteborg, Sweden:

Nanotechnology for Future Electronics: "More and Moore" and "Beyond Moore".

<u>13.10.</u> - Professor Alex Hansen, NTNU:

Two-Phase Flow in Porous Media: Some Answered and Some Open Questions - and Some Answers that Open Questions.

20.10. - Professor Kazimierz Jelen, Prorector of **Research at AGH-UST, Kraków, Polen:** Physics Research in Poland.

27.10. - Professor Michael Schreckenberg, Department of Physics, Physics of Transport and Traffic, University of Duisburg-Essen, Duisburg, Germany:

The Physics of Traffic Jams.

<u>03.11.</u> - Professor Thomas Heimburg, Niels

Bohr Institute, Copenhagen, Denmark: Thermodynamics of Pulse Propagation in Nerves and the Role of General Anesthetics.

<u>**10.11.</u>** - **Professor Øystein Elgarøy, UiO:** Dark Energy and the Accelerating Universe</u>

<u>17.11.</u> - Professor Ralf Metzler, Canada Research Chair for Biological Physics, Physics Department, University of Ottawa, Canada: Anomalous Transport and Efficiency of Search Processes: On Drunken Sailors and Straying Proteins.

24.11. - Professor Tom Johansen, UiO:

Mobile Magnetic Walls as Nano-Manipulators.

<u>01.12.</u> - Professor Bo-Sture Skagerstam, NTNU:

On the 2006 Nobel Prize in Physics to John C. Mather and George F. Smoot "for their discovery of the blackbody form and the isotropy of the cosmic microwave background radiation"

Annual Report for Department of Physics 2006

NTNU – Innovation and Creativity

Innovation and Creativity

The Norwegian University of Science and Technology (NTNU) in Trondheim represents academic eminence in technology and the natural sciences as well as in other academic disciplines ranging from the social sciences, the arts, medicine, architecture to fine arts. Cross-disciplinary cooperation results in ideas no one else has thought of, and creative solutions that change our daily lives.

Address, contact information

Department of Physics, NTNU N-7491 Trondheim, Norway

E-mail: postmottak@phys.ntnu.no

www.ntnu.no/fysikk