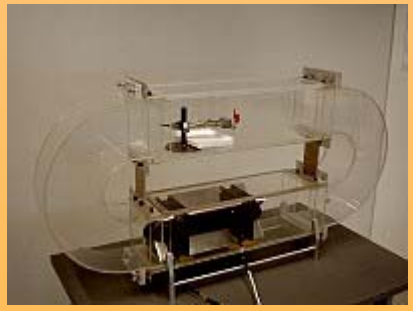
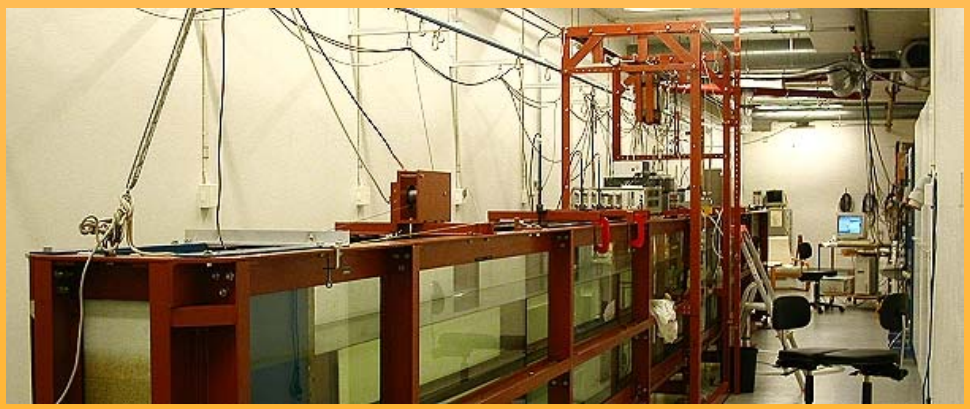
2002

ANNUAL REPORT





Department of Physics
Norwegian University of
Science and Technology
Trondheim, Norway

NTNU

DEPARTMENTAL BOARD

Head of the Department:	Professor Anders Johnsson
Deputy Head of the Department:	Professor Alex Hansen
Elected members:	
Representing the permanent scientific staff:	Professor Catharina Davies Professor Ola Hunderi Professor Berit Kjeldstad Professor Asle Sudbø
Representing the temporary scientific staff:	Dr. student Trude Støren
Representing the technical/administrative staff:	Engineer Anniken Paulsen
Representing the department's students	Student Lars Erik Walle
Appointed external member:	
From Electromagnetic Geoservice	Managing Director Terje Eidesmo

COVER PAGE
The research activity is dependant on high-quality products. The cover page shows examples of research equipment produced by the Mechanical workshop at the Department of Physics.
Upper left: Apparatus for pressure calibration produced in stainless steel
Upper right: Step motor control of computer controlled detection of interference pattern
Middle left: Vacuum connection in stainless steel
Middle right: Sealed wind tunnel in plexiglass
Lower: Equipment for simulating of wave energy, 12m long and containing 3000l water

DEPARTMENT OF PHYSICS, NTNU

http://www.phys.ntnu.no

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Edited by:

Brian Wall, Anders Johnsson, Emil J. Samuelsen, Margit C. Hagen

The Annual report is also available on the net at address:

http://www.phys.ntnu.no/instdef/rapporter/index-e.htm

THE DEPARTMENT OF PHYSICS

Synopsis of events in 2002

The Department of Physics at NTNU has three interrelated main tasks. The Department should provide top quality education to undergraduate and graduate students, should conduct research in physics at a high international level and, finally, should make available popularised information on topics related to physics to a public and non-technical sector.

The overall goal is to ensure that society is provided with a work force of highest standard, well suited for a broad spectrum of tasks in which knowledge of physics is a necessity and an advantage.

A major event in 2002 was the organisation of a new Faculty, the Faculty of Science and Technology, to which the Department has belonged since January 1st, 2002. The change in the faculty structure was part of a new restructuring of the University, the second one in a few years. The change was relatively smooth, and allows Department of Physics to collaborate with other natural science departments in the same faculty.

In year 2000, a major event for the Department was the move to the new natural science building. This meant that physics activities at the University for the first time were joined in one and the same building. The joint physics activities now had new and modern workspace and all of our laboratories became operational in the new Science Building during 2002. The Department is now in the position of adjusting some of its areas to optimize its teaching and research environments. Expanding activities require new space.

The year 2002 was, however, also characterized by serious financial signals: The Department was faced with a reduction in manpower, despite having rationalised both numbers of teachers, technical-administrative personnel and teaching courses. It is to be hoped that a further budget decrease at the department can be avoided.

The strategy plan of the Department is revised on an annual basis. It dates back to 1997 when the Department appointed an external evaluation committee with national and international members from the physics community as well as from industry. The committee work resulted in the evaluation report "*Physics at NTNU – in a decade of change*" which became available at the end of 1998. The Department, taking into consideration also other evaluations, uses its recommendations as guidelines. The strategy plan for the department gives the following approximate distribution of scientific staff: 30% theoretical physics, 20% experimental biophysics and 50% experimental and applied physics.

In 2002 the Department announced a full time position in Optics, and preparatory work for two new positions (in Condensed Matter Physics and Energy and Environmental Physics) ended successfully by announcements in early 2003.

The "Quality Reform" (a reform initiated by the Ministry of Research and Education) is now to be implemented and will provide an opportunity to improve the teaching quality. The reform will require a substantial amount of dedicated work by the teachers, for example at the introductory courses in Physics, attended by over 1000 students from other faculties. Hopefully, the resources of the Department will be sufficient to allow a successful implementation of the many ambitious goals of the reform. In 2002 the Department started planning the reform at the departmental level.

In this short synopsis it should also be emphasized that the research at the Department has resulted in substantial progress on many frontiers during the year. This is demonstrated by, e.g., a satisfactory publication rate with several publications in high rated journals, publications of international textbooks, presentation of valuable reports, conference contributions etc. Two research groups at the Department were - in cooperation with other groups - awarded so-called Strategic University Programs from the Norwegian Research Council ("Complex materials" and "Light Metals Technology"). New heavy advanced microscope equipments (FEG-TEM and variable temperature ultra high vacuum STM) for condensed matter physics were installed. External financing of research projects showed a positive increase.

We hope the reader will find it interesting to read about parts of the work at the Department, exemplified in the present short annual report.

Synopsis of the educational year

The Department of Physics educates physicists for industry, business, research, schools and administration. There is an increasing demand for physicists not only from the Norwegian market but also from the foreign market.

In addition, the Department staff teaches physics for students from the technological faculties at NTNU. The basic knowledge of physics disciplines, like mechanics, electromagnetism, wave theory, optics etc. is indispensable for all engineering students.

In general, lecturing and problem-solving education as well as laboratory exercises and report writing form the core of the education. Information technology and laboratory exercises could be said to place an especially high demand on resources.

The teaching at the Department - as well as in other parts of the University - is now under reorganization and the system in use until 2002 will be changed. A short overview of the current teaching at the Department follows.

Education of physicists

In 1997 the siv.ing. (graduate engineer) study in physics was expanded to last for 5 years instead of 4.5 years. The new curriculum also comprised courses each corresponding to 2.5 vt or credit points. A full semester of study comprised 10 vt.

Two compulsory common courses were introduced (totally 5 vt) in the first year of study. For the students of physics and mathematics the curriculum in physics was reduced while that in mathematics was maintained. With this reduced curriculum, general topics in physics are given on a basic level. After two years of study the students can choose whether they will continue with physics - technical physics or biophysics and medical technology - or with industrial mathematics. Those who choose physics have to take a series of compulsory physics courses during the 5th, 6th and 7th semesters. These courses have a broad basis, and they form a common foundation for continuing studies in one of the various directions that physics can offer. Two of the courses in these semesters are free choices by the student. Biophysics offers courses that are specific for this branch of study ("Biophysics and Medical Technology").

Semesters 8 and 9 consist of a combination of project work and regular courses. In the latter it is possible to specialize, on the basis of a suggested combination of topics and to a certain extent on topics of the students own choice. During semester 10 the students finish their siv. ing. degree by writing their diploma thesis.

In the natural science studies (cand.mag, cand.scient.), the studies follow a pattern characteristic for other Norwegian universities. The first exam (corresponding to a Bachelor) usually takes 3 years, with mathematics and physics as the main subjects in most cases. After this period a specialization leads the student to a cand.scient. exam in physics. The specialization can be in the direction of theoretical physics or experimental physics, with different parts of physics as the main subject.

One change in the teaching system that met the students in 2002 was that the examination results were judged according to a new system. The marks will, from 2002, be given in letters, from A to F, a European system replacing the old system with number characters. The new system is part of the reorganization of the teaching system that will be implemented in 2003 and that will be mentioned in a later annual report. Much effort and work are continuously used for these changes in the education system.

A survey of curricula is presented on page 34, and a survey of theses completed in 2002 is shown on page 36.

Doctoral study

Students who have obtained their siv.ing. degree or cand.scient. degree can start to qualify for a dr.ing. degree or dr.scient.degree. The effective study time to obtain the doctoral degree is stipulated to 3 years for which financial support is given. This is often extended by periods of 6 or 12 months, depending on external or internal NTNU funding.

A series of courses are given at the post-graduate level, often given each second year. Sometimes they will be given as self studies guided by the supervisor.

The Department of Physics is recognized for the high quality of its post-graduate study. Each year our doctoral students contribute a number of publications to reputed international journals. Our doctoral candidates represent an essential part of the working force of the scientific activity at the Department.

The total number of doctoral students amounted to about 50 in 2002, most of them being funded from external sources. Only a few graduated in 2002 but a substantial increase is foreseen for 2003. The scarcity of doctoral students is mainly related to the fact that, at present, it is possible to get better paid employment, and, to a certain extent, to the overall reduced number of students being interested in natural science.

Education of engineering students

As mentioned, the Department of Physics carries out an extensive education of students from various technology departments at NTNU. This education

consists mainly of introductory physics courses. As a part of several of these courses the students have to do compulsory laboratory excercises. In 2002 around 1100 students attended these courses, see page 34.

The Department of Physics intends to adjust the contents of these courses in accordance with the requirements of the faculties in question. The reorganization of the siv.ing. study from 4.5 to 5 years has resulted in a considerable increase in the need for lecturers for these courses. The Department is aware of the pedagogic and resources challenges these courses present and will continuously evaluate its work at this level.

Laboratory education

Physics is a natural science and basically an experimental science. Experimental studies of physical phenomena are of crucial importance for all physics students including those that later specialize in theory. Education in the laboratory contributes both to the understanding of physical phenomena and concepts connected to the laws of nature.

Laboratory work is also an important supplement to the lectures and provides an arena for understanding the necessity of precision measurements, data collecting, data treatment, measurement uncertainties etc. For students who want to specialize in technological or experimental directions, it is of special importance to become familiar with experimental equipment. The laboratory education includes also keeping laboratory records, writing reports and important applications of information technology.

Laboratory teaching in physics has become very demanding on resources. About 9 - 10 man years from the scientific staff were required for this education in 2002. The major part of the compulsory work load, which forms part of the doctoral students' commitment to the Department, is designated to supervising this education. Furthermore, a large part of the technical staff of the Department is used to build and maintain the experimental equipment.

International Master of Science Programme

The International Master of Science programme in Physics at NTNU is designed to train the students in chosen fields of physics and in scientific work and research. The programme is taught in English and stretches over two years, corresponding to 40 credit points including a thesis of 12 credit points.

The first year includes course work corresponding to 20 credit points at graduate level. During the second year the students choose their area of specialization and take courses and self study which are tailored to the area of specialization and to the theme of their thesis. The thesis is expected to contain some independent research, but can also be of purely expository nature. To be admitted to the programme it is required that the students have completed a Bachelor's degree of at least three years university study including at least one and a half years in physics.

The first students to this programme were admitted in 1999 and the first students thus graduated in the year 2001. So far the Department has restricted the uptake to about 6 students per year.

STAFF

Head of Department:
Professor Steinar Raaen (until 30.06.2002)
Professor Anders Johnsson (from 01.07.2002)

Deputy Head of Department:
Professor Alex Hansen

Permanent staff

Scientific staff:

Professors)
Johannes Bremer, Anne Borg, Catharina Davies, Arnljot Elgsæter, Kristian Fossheim, Alex Hansen, Eivind Hiis Hauge (University Rector 2002), Randi Holmestad, Per C. Hemmer, Ola Hunderi, Ragnvald K. O. Høier, Johan S. Høye, Anders Johnsson, Berit Kjeldstad, Hans Kolbenstvedt, Tore Lindmo, Ole J. Løkberg, Thor Bernt Melø, Frode Mo, Kjell Mork, Jan Myrheim, Kalbe Razi Naqvi, Kåre Olaussen, Hans M. Pedersen, Steinar Raaen, Emil J. Samuelsen, Bo-Sture Skagerstam, Helge R. Skullerud, Kim Sneppen (leave autumn 2002), Bjørn Torger Stokke, Asle Sudbø, Arne Valberg, Erlend Østgaard (retired 28.02.02).

Associate professors
Arne Brataas, Jon Otto Fossum, Per Morten Kind, Jørgen Løvseth, Tore H. Løvaas, Arne Mikkelsen, Souriraja Ramadurai (until 31.08.02), Kåre Stegavik (retired 31.07.02), Knut Arne Strand, Thorarinn Stefansson, Bård Tøtdal, Sigmund Waldenstrøm, Ingjald Øverbø.

Adjunct professors
Lasse Amundsen, Kjell A. Ingebrigtsen, Einar Rofstad, Arne Skretting, Tor Wøhni.

Technical and administrative staff:

Manager
Brian Wall

Technical staff
Irene Aspli, Lars Berntzen, Arnolf Bjølstad, Rolf Dahl, Knut R.Gjervan, Oddbjørn Grandum, Ole K.Holthe, Tor Jakobsen, Dagfinn Johnsen, Erling Kristiansen, Per Magne Lillebekken, Jan S. Mastad, Arne Moholdt, Anniken Paulsen, Jon Ramlo, Kåre O. Rokhaug, Inge Sandaunet, Bertil O. Staven, Tor A. Vassdal, Arild Vatn, Geir Wiker, Lise Wohlen.

Administrative staff
Margit C.Hagen, Inger Kosberg, Inger J. Lian, Eli Monsøy, Tove G. Stavø

Temporary staff:

Post doc.
Ali Ata, Geraldo da Silva, Paul Gunnar Dommernes, Jon Kåre Hansen, Morten Kildemo, Yves Meheust, Trond Morten Thorseth, Yingda Yu,

Senior staff
Johannes Falnes, Knut Lønvik, Reidar Nydal, Haakon Olsen, R.Svein Sigmond, Ivar Svare.

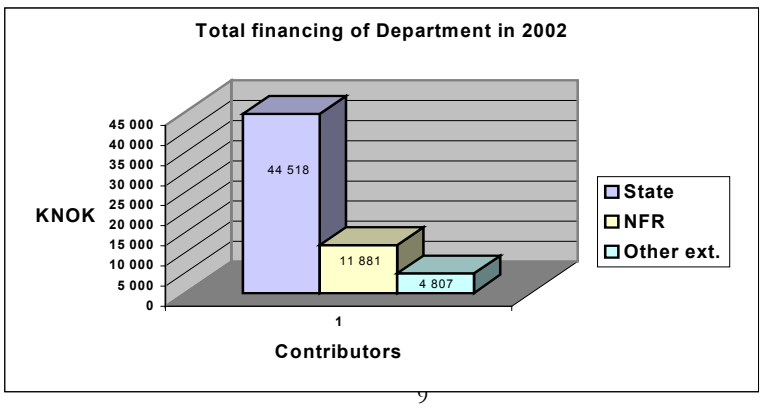
Doctor students (52)

Doctor of Engineering (36)
Carmen Andrei, Audun Bakk, Torkel Bjarte-Larsson, Øyvind Borck, Dag Werner Breiby, Signe Danielsen, Live Eikenes, Davi de Miranda Fonseca, Jesper Friis, Anders Frøseth, Fredrik Hansteen, Håkon Kortner Hasting, Hans Kristian Helgesen, Joakim Hove, Mari Juel, Henning Knudsen, Steinar Kragset, Gjertrud Maurstad, Sjur Mo, Lars Henrik Morset, Stine Nalum Næss, Kanak Parnar, Øystein Risa, Terje Røsten, Stein Olav Skrøvseth, Jo Smiseth, Eivind Smørgrav, Trude Elna Støren, Ingeborg-Helene Svenum, Oddbjørn Sæther, Torbjørn Sund, Ulrik Thisted, Heidi Kristine Toft (leave 2002), Khanh Minh Vu (leave 2002), Per Erik Vullum, Hans Magne Ådland.

Doctor of Science (16)
Tom Kristian Bardal, Bjørn Bergsjordet, Berit Bungum, Aktor Chikukwa, Nils Erland L.Haugen, Egil Holvik, Qu Hong, Terje Meisler, Devi Dhavraj Meena, Samsun Mohamad, Ståle Ramstad, Ellen Roll, Inger Rudvin, Marit Sletmoen, Aksel Straume, Roland Wittje

TOTAL FINANCING IN 2002

Description of project financed or name of contributor	Recipient	Amount KNOK
Financial contribution from the State		**44 518**
Contributions from the Norwegian Reasearch Council NFR		
Surface Physics	Bremer, Johannes	397
Structural, electronic and optical properties of atomic overlayers on surfaces	Borg, Anne	211
Dynamics and transport properties of nanoparticles	Elgsæter, Arnljot	397
Wave energy research	Falnes, Johannes	304
Elastic properties and melting of flux line lattice in high-Tc superconductor	Fossheim, Kristian	397
Experimental investigations	Fossum, Jon Otto	171
Post doc. appointment for Yves Méheust	Fossum, Jon Otto	234
Partial financing of dr. student Audun Bakk	Hansen, Alex	34
Multifunctional Nanoscale Biomaterials	Hansen, Alex	14
Cooperation and exchange with France	Hansen, Alex	100
Post doc. appointment for Jon-Kåre Hansen	Hansen, Jon-Kåre	524
Qantitative convergent beam electron diffraction	Holmestad, Randi	444
Hydrogen storage in metal hybrids	Holmestad, Randi	266
Micro- and nanostructure, materials development	Holmestad, Randi	2 860
Light Metal Surface Science	Hunderi, Ola	919
Heat treatment fundamentals	Høier, Ragnvald	2 500
Electromagnetic fields and biological effects	Johnsson, Anders	150
Coordinated Ozone and UV Project	Kjeldstad, Berit	155
Femtochemistry and Femtobiology	Naqvi, Razi	60
Travel support SNBL/ESRF	Mo, Frode	250
Diode materials from polymeric organic semiconductors	Samuelsen, Emil J.	172
Radiation-dominated accretion discs around black holes	Skagerstam, Bo-Sture	45
Marine biopolymers	Stokke, Bjørn	303
Mesoscale structures	Stokke, Bjørn	412
Centre for Biopolymer Engineering at NTNU	Stokke, Bjørn	562
	Sum	**11 881**
Contributions from other financial sources		
NorFa	Brataas, Arne	42
NEDO	Brataas, Arne	196
The Norwegian Cancer Society	Davies, Catharina	50
Statoil	Hansen, Alex	450
Hydro	Høier, Ragnvald	1 200
Elkem	Høier, Ragnvald	200
Raufoss	Høier, Ragnvald	200
Photocure ASA, Oslo	Johnsson, Anderrs	174
Nortib	Johnsson, Anders	50
Post- og teletilsynet	Johnsson, Anders	50
Læringssenteret	Kind, Per Morten	142
EU	Kjeldstad, B./Fossheim, K.	431
Statens strålevern	Kjeldstad, Berit	10
Medisinsk teknologi	Lindmo, Tore	80
NUFU	Løvseth, Jørgen	578
Teknologirådet	Oftedal, Gunnhild	54
Thonning Owesens legat	Valberg, Arne	900
	Sum	**4 807**
Total external financing in 2002		**16 688**



RESEARCH

DIVISION OF APPLIED PHYSICS AND DIDACTIC PHYSICS

Staff
Ass. Professor Per Morten Kind
Professor Berit Kjeldstad
Professor Ole J. Løkberg
Ass. Professor Jørgen Løvseth
Ass. Professor Tore Løvaas
Professor Hans M. Pedersen
Professor Helge R. Skullerud
Ass. Professor Thorarinn Stefansson
Ass. Professor Kaare Stegavik (retired 2002)
Ass. Professor Knut Arne Strand

Professor emeritus Johannes Falnes
Professor emeritus II Reidar Nydal
Professor emeritus R. Svein Sigmond

Overview

The research is mainly carried out within fields of electron and ion physics, energy and environmental physics, optics in addition to physics didactic. These contain several sub-fields with a large variety of topics. A brief overview is given. For the year 2002 we have chosen to give a more extended description of two research topics: Detecting hydrocarbon reservoirs in deepwater areas by Hans M. Pedersen, and Exploring technology in Norwegian education by Per Morten Kind.

Survey of research activities

The research is focused on several different topics as electrical breakdown in fluids and gases (*Løvaas, Sigmond)*; transport of ionized gases (*Skullerud)*. Research on video holography, and fibre optics interferometry are being performed (*Løkberg)*. Classical coherence theory with applications to the statistical foundation of radiometry is studied, as well as linear system theory models for signal processing and speckle statistics in optical coherence tomography (*Pedersen)*. Thermal fluctuations in mixtures of alkanes and in natural gas in gas phase and in condensed phase, as well as on the interface, are studied by laser light scattering. Measurements are performed at reservoir conditons (*Strand*). Renewable energy sources as wind, solar radiation (*Løvseth)* and ocean waves are studied (*Falnes*). Ultraviolet climatology is studied with emphasis on processes affecting transmission of ultraviolet radiation to the surface, for instance importance of aerosols and clouds (*Kjeldstad*). Finally there is research related to educational physics with particular emphasis on the interaction between practical work and the students' perception on the nature of science (*Kind)*. Development of a learning model adjusted for the situation how to learn through laboratory work. Educational materials are developed for testing the model (*Stefansson*).

Examples of Research carried out in 2002

1. Electromagnetic seabed logging (SBL)

By Hans M. Pedersen

SBL is an application of marine, controlled source electromagnetic sounding that can improve the accuracy in detecting and characterizing hydrocarbon reservoirs in deepwater areas. The basis of SBL is the use of a mobile horizontal electric dipole radiation source and an array of seafloor electric field receivers. The dipole source transmits a low frequency electromagnetic signal (0.05 to 10 Hz) into the overlying water column and downwards into the underlying sediments. Electromagnetic energy is rapidly attenuated in the conductive sea water and seafloor sediments, but in a high-resistive layer, e.g., in a hydrocarbon filled reservoir, electromagnetic energy is attenuated less and propagation is more efficient along the layer. Energy constantly leaks from the layer back to the seafloor, and when the source receiver offset is comparable to or greater than the depth of burial the energy from the layer will dominate over the directly transmitted energy. The detection of this guided energy is the basis of SBL.
The method was developed at the Statoil R&D Center in Trondheim and is now commercialized and further developed by the company EMGS AS (ElectroMagnetic GeoServices), Trondheim, (www.emgs.no). The NTNU activity in the SBL development started with theoretical models and field measurements in a down-scaled experiment at

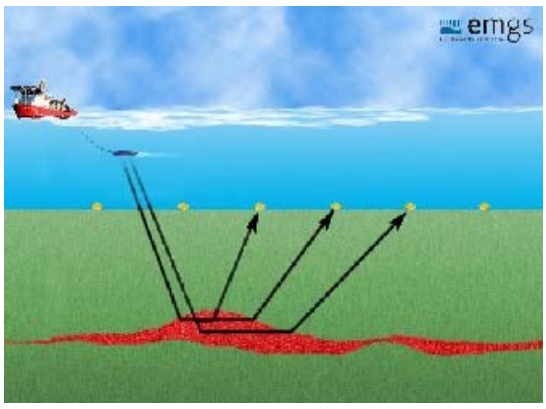


Figure: Illustration of SBL survey-layout: energy from a towed electric dipole source is guided through deeply buried high-restive layers and detected by an array of seafloor antennas.

the Statoil R&D Center in the spring of 1999 together with MyLab AS. There eight king size water beds filled with fresh water were used to simulate a high resistive layer submerged under low resistive sea water. The experimental results were fully confirmed by numerical field computations.

2. Exploring technology as a subject in Norwegian compulsory education

By Per Morten Kind

The importance of technology as a component of education for all is increasingly recognised. A range of curriculum initiatives therefore has been taken in order to establish and develop technology as a subject of teaching. In Norway, one important project of this kind is "Technology in school" (TiS) started by NITO. The project aims at introducing technology as an area of teaching in compulsory education. The rationale and implementation of the project is inspired by ideas embedded in the school subject *Design and Technology*, which was established as a compulsory subject in England and Wales in the late 1980s.

Transferring educational ideas across national and cultural borders, however, is a complicated affair. New ideas and intentions interact with the existing educational culture and may develop into something different from its origin. A crucial factor here is teacher interpretation and realisation of the subject. Based on this background a comprehensive study has been conducted by the physics education group to find out on how teachers involved in the TiS-project perceive and realise technology as a subject of teaching. Teachers have been interviewed and their classroom practices have been observed.

Results from the study underline the importance of teachers' role in developing a new subject. Rather than adopting the full rationale of the project policy it appears that the teachers utilise specific aspects of ideas and resources provided through the project in pursuing their *own* agenda for teaching. For instance teachers see technology teaching as a way of making school more practical, a way of revitalising science teaching, and as an attempt to alter characteristic aspects of conventional teaching. This may be regarded as a problem for developing technology as a school subject, because teachers tend not to emphasise aims set by the external curriculum developers. Contrary, teachers' contributions also have shown how technology education can contribute to general education in ways that not have been attended to in the national and international discourse of technology education. They thus represent an important source for increasing our understanding of the potential of technology teaching in schools. This should affect the further development of technology as an educational subject in Norway. The study, however, also points at the importance of considering other ideas for technology teaching than the ones represented by *Design and Technology*.

The research has been a part of a doctoral study.

DIVISION OF BIOPHYSICS AND MEDICAL TECHNOLOGY

Staff
Professor Catharina de Lange Davies
Professor Arnljot Elgsæter
Professor Anders Johnsson
Professor Tore Lindmo
Professor Thor Bernt Melø
Professor Arne Mikkelsen
Professor Kalbe Razi Naqvi
Professor Bjørn Torger Stokke
Professor Arne Valberg
Adjunct professor Einar Rofstad
Adjunct professor Arne Skretting
Adjunct professor Tor Wøhni
Guest
Gunnhild Oftedal

Overview

The research is divided into three main activities within biophysics and medical technology: *Biopolymers:* physical properties and organisation of biological molecules. *Medical technology*: using molecular and functional imaging to study properties and distributions of molecules in cells and tissue. *Biosystems*: including biophysics of plants, electromagnetic field exposure, space related research, photo-synthesis, and visual biophysics. A brief overview is given below and two projects are presented in more details.

Survey of research activities

Transport of macromolecules in tumour tissue

By C. de Lange Davies
The low and heterogeneous uptake of therapeutic macromolecules is a major obstacle to successful cancer therapy. We have shown using multicolour confocal laser scanning microscopy that enzymatic degradation of extracellular matrix by hyaluronidase and collagenase and inactivation of tumour cells by ionising radiation, increase the uptake and improve the distribution of therapeutic macromolecules. This is partly due to an increased transcapillary pressure gradient.

Functional Optical Coherence Tomography (OCT)

By T. Lindmo
OCT is extended from structural to functional imaging. By combining the OCT signal with a mathematical model of the one-dimensional diffusion process, we are able to determine the diffusion of the dye Aluminum Phthalocyanine Tetrasulfonate Chloride placed on the top of an agar gel. The motivation for our work is to be able to measure in vivo concentration profiles during uptake of photosensitizers in photodynamic therapy. For further details see the extended report under Division of Applied and Didactic physics.

Self-sustained biological oscillations

By A. Johnsson
Circadian rhythms and oscillatory growth movements are in focus, and for the time being analysis and modelling of biological clocks and rapid leaf movements are carried out. The latter movements reflect oscillatory water transport into and out from plant tissue - possible to record as overt leaf movements with a period of some minutes.

Influence of magnetic end electric fields on tissue and cells.

By A. Johnsson
Studies of the magnetic fields around mobile phone units, the temperature changes induced by the mobile phones etc.

Photoinduced reactions in bacteria

By A. Johnsson and T. B. Melø
Currently one investigates, e.g., the reactions started by esters of d-aminolevulinic acid that are transformed into porphyrins in the cells. Light irradiation will subsequently lead to selective destruction of the porphyrin "loaded" cells and the photo induced reactions leading to inactivation are studied by fluorescence spectroscopy, ESR, NMR etc.

Photosynthesis research

By K. R. Naqvi and T. B. Melø
Carotenoid-bacteriochlorophyll interactions in chlorosomes (which serve as antennae in green photosynthetic bacteria), and in the reaction centre protein (RC) of the purple bacterium *Rhodobacter sphaeroides* have been investigated (by comparing natural chlorosomes with those perturbed by hexanol, and RC from wild type bacterium with a carotenoid-deficient mutant).
Though vitamin E has been known for over 80 years, relatively little is known about its photo(phys/chem)ical behaviour. A new project, started with a view to filling this gap and exploring the photoprotective role of vitamin E, has shed much light on the long-lived transient photoproducts of vitamin E, and on their interaction with carotenoids.

Age-related macular degeneration

By A. Valberg
Binocular inhibition of contrast sensitivity was discovered in subjects with AMD, an eye disease that occurs frequently after 65 years of age. Contrast sensitivity was found to correlate better with reading speed than did visual acuity. This project will be continued as a three year EU-project, and we have started to analyse the topography of the retina by measuring multifocal electroretinograms (mfERG).

Visual Evoked Potentials (VEPs) to Chromatic and Achromatic Stimulation

By A. Valberg

Differentiation of cortical Visual Evoked Potentials (VEP) for onset of achromatic and chromatic contrast gratings was tested for robustness, and was reproduced in most, but not all subjects. For a systematic change in luminance balance for red-green bars, the amplitude and phase of steady-state reversal VEPs show a previously unreported asymmetry with respect to isoluminance that is sensitive to both spatial and temporal frequency. The results have been interpreted in terms of the responses of opponent and non-opponent cells to colour and luminance modulations.

Long-range Interaction in Human Vision .

By A.Valberg

In collaboration with the University of Freiburg, we have continued to explore and to measure the effect of a luminance modulated annulus onto a foveal afterimage. We have been concentrating on isolating the lateral effect from stray light artefacts.

Examples of reasearch carried out in 2002

1. Biological poly-electrolyte complexes

By B. T. Stokke

Electrostatic interactions are important driving forces for numerous biological processes, e.g. organization of DNA to packed chromosomes or interactions between enzymes and charged ligands. Linear, negatively charged biopolymers, such as DNA, can undergo a transition from extended to a compact state driven by intersegment attraction mediated by oppositely charged ions. The formation of the polyanion-polycation (polyelectrolyte) complexes is mainly driven by an electrostatic mechanism, where the exchange reaction of counter-ions with different valence is important. The valence of the counter-ion is a crucial factor for the efficiency of the complexation due to the entropy gain in release of electrostatic constrained counterions. Charge neutralisation and local overcompensation or bridging mediated by a multivalent counter-ion induces attraction between topologically separated segments of the polyelectrolytes, concomitant compaction and eventual stability of the compacted structure.

In 2002 we have obtained results on the complexation behaviour of DNA using various chitosans, as well as on model systems to identify the importance of polymer chain stiffness on the ability to form complexes with well-defined morphologies. The polyelectrolyte complexes were studied by atomic force microscopy. Quantitative image processing was applied to group the various morphologies into ensembles. The studies of the compaction of DNA by chitosan were motivated by the potential use of chitosan as gene delivery vehicle. Chitosan, being derived from a natural structural polysaccharide, offers the advantage of being less toxic to humans compared to synthetic competing gene delivery polycations. The results show that various chitosans are efficient in complexing DNA into the characteristic toroidal form in coexistence with linear and globular complexes. The toroidal and linear complexes have dimensions that appear to be independent on the size of the DNA, equal to about 1/10 of the DNA studied most extensively.

By opposing the formation of sharp bends, theoretical studies predict the chain stiffness to be one important factor influencing the occurrence and abundance of the toroidal morphology of compacted semiflexible polymers. We have provided experimental evidence showing the influence of chain stiffness on the abundance of various morphologies on the compacted structures. One of the systems studied in addition to the DNA-chitosan, consists of a polyanion with persistence length, L_p, about twice of DNA, complexed with the same polycations. In addition to forming toroidal structures with similar ratio between the radius and L_p, the system can be captured in kinetically trapped states allowing characterization of intermediates states on the folding pathway to the stable state. Thus, we have provided an experimental basis showing that the prominent toroidal shape of compacted DNA results from the chain stiffness of DNA, and that the toroidal state become the stable state when the chain stiffness exceed a lower limit.

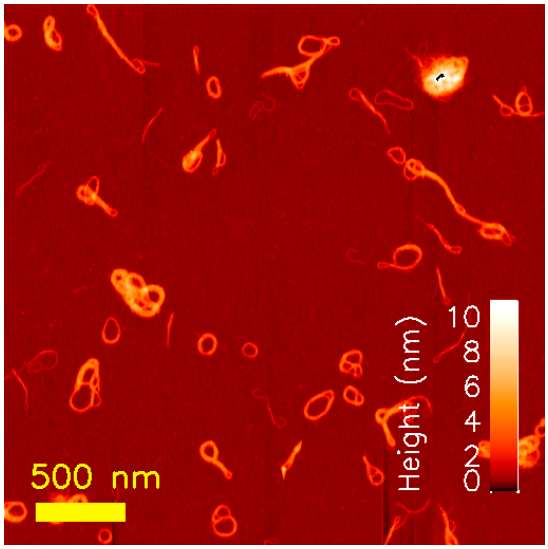


Figure: Atomic force microscopy topograph of polyelectrolyte complexes prepared using a semiflexible polyanion. The topograph shows different morphologies, where the toroids appear to be among the stable states, and others possibly represent intermediates captured on the folding pathway toward a stable state.

2. Biopolymer dynamics

By A. Elgsæter and A. Mikkelsen

The primary aim of our research in biological physics during the last few years has been to elucidate biological macromolecule systems where physics plays a crucial role in understanding biopolymer structure and function. Our work 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, and III) Experimental studies of macromolecule dynamics using methods such as electrically induced transient birefringence and dynamic light scattering. Two doctoral students have been working with problems related to these problems, and one of them finished in 2002 his doctoral thesis on Brownian dynamics of macromolecules consisting of two or three non-spherical end-to-end-linked rigid segments.

A major part of our work consists of further development and improvement of the instrumentation and experimental methods for studies of biological macromolecules and other nanoscale phenomena within biological physics. We have also applied the theories and methods developed within biological physics to studies of selected nanoparticle systems of non-biological origin.

As of the second half of 2002 all scientific activities in biopolymer dynamics constitute an integral part of "Complex" which is a national research collaboration focusing on the physics of complex systems. This collaboration includes theoretical as well as experimental work, and studies of biological as well as non-biological systems.

DIVISION OF CONDENSED MATTER PHYSICS

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Professor Randi Holmestad
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Professor Ragnvald Høier
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Ass. Professor Bård Tøtdal
Professor emeritus Ivar Svare
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Dr. Ali Ata (Post doc.)
Dr. Geraldo da Silva (Post doc.)
Dr. Yinda Yu (Post doc. 20%)
Dr. Jian Wang (Post doc.)

Overview

The research activities include a variety of topics in experimental *Condensed Matter Physics.* The members of the division work with many different experimental techniques for studying physical properties of materials and material structures. A brief survey of the research is given. For the year 2002 two research projects are described in more details.

Survey of research activities

Superconductivity in low-T_c and high T_c superconductors

By K. Fossheim

The roles of the BCS coherence factors *vs.* Meissner screening were studied in 6N grade single crystalline superconducting aluminium by transversely polarized ultrasound in the 100-300 MHz range with sub-millikelvin temperature resolution below T_c =1.17 K. The coherence factors were found to dominate the electron-phonon interaction within a 2 millikelvin range below T_c, followed by Meissner screening. The theory developed in the group fully agrees, and explains the data.

Measurements of the elastic properties of the flux line lattice in superconducting $La_{1.85}Sr_{0.15}CuO_4$ were made with unprecedented resolution and in fields of 0 - 5 T, using an in-house developed acoustic resonance method. Measurements revealed critical behaviour near T_c, and a distinct contribution to elastic constants over the entire superconducting range.

Systematic processing efforts were made to generate flux-pinning centers in superconducting $Bi_2Sr_2Ca_1Cu_2O_8$ by creation of nanoscale MgO precipitates. Careful TEM studies confirmed that such precipitates were formed in the superconducting matrix, and magnetization measurements showed that improved pinning was achieved.

Crystallography methods and instrumentation

By F. Mo

A major activity has been development and testing of a gas-flow thermostat sample cell with control of relative humidity and equipment for the application of an electric DC field on the crystal. The cell is designed for diffraction experiments with crystals that are unstable and denature easily upon changes in temperature and/or relative humidity under X-radiation. Crystals of the ferroelectric compound, Rochelle salt, have been used in this work. All experiments were carried out on the Swiss-Norwegian Beamlines at ESRF.

Transition electron microscopy

By R. Holmestad, R. Høier, B. Tøtdal

During 2002 the research activities have included micro/nanostructure studies of functional perovskite materials, ferroelastic materials, thin films, alloy nanoparticles in catalysts and materials for hydrogen storage/metal hydrides; bonding in materials/structure factor refinements, studied by convergent beam electron diffraction (CBED); alloy development and nucleation of precipitates in aluminium alloys; structure determination of metastable, hardening phases; atomistic modelling and *ab initio* methods in materials science; surface studies of light metals; nanoscale oxide layers, corrosion behaviour.

The group received their new 200keV field emission gun transmission electron microscope (FEG-TEM) this year.

Optical and magnetooptical properties of substituted iron garnet films

By J. Bremer and O. Hunderi

A series of approximately 4 mm thick Bi:ferrimagnetic garnets (FG) films grown by LPE on (100) oriented Gallium Gadolinium Garnet (GGG) substrates have been studied. The films have in-plane magnetization and were grown for magnetic-field imaging purposes. From variable angle spectroscopic ellipsometry (VASE) and magnetooptical Kerr effect (MOKE) measurements on magnetically saturated films, we have determined the diagonal and off-diagonal permittivity tensor elements of the garnet films in the range 1.5-5eV. The spectral behaviour of the off-diagonal tensor elements have been interpreted in terms of electric dipole transitions and related to the composition of the samples.

Scanning probe microscopy studies of surfaces

By A. Borg

During this year a research effort has been initiated on using the tip in a scanning tunneling microscope

(STM) to etch nanoscale structures in perovskite materials.
As part of the research project "Light metal surface science", adhesion forces at polymer/aluminium oxide interfaces have been determined through force measurements by an atomic force microscope.
A new variable temperture ultra high vacuum STM was installed in 2002.

Electronic properties and chemical reactivity of surface alloys

By S. Raaen

Several surface alloys have in recent years been investigated by photoelectron spectroscopy, low energy electron diffraction, and thermal desorption spectroscopy. Of special interest has been alloys based on thin overlayers of rare earth metals on catalytic active transition metals. It has been shown that the electronic structure as well as chemical reactivity may be dramatically altered. Rare earths are ideally suited for formation of surface alloys in view of their relatively low surface free energies. A recent result is that self assembled nano structured surface alloys form in the La-Rh(100) system (M. Kildemo *et al.*). Some progress has recently been made in analyzing temperature programmed desorption data by use of Monte Carlo simulations.

Synthetic clays; Experimental nvestigations of soft materials and complex systems

By J. O. Fossum

The research group has during several years focused on basic understanding of problems within soft materials and complex systems, in particular physical phenomena in soft matter using synthetic nano silicates (synthetic clays) as the physical complex model system. Important experimental methods that are being used in these studies include rheology and light scattering methods, synchrotron x-ray scattering methods (at ESRF and other sources) and neutron scattering methods (mostly in collaboration with IFE, Kjeller). A significant part of the activity also involves upgrading of instrumentation and experimental methods for soft condensed materials studies and other phenomena on the nano-scale. Recent publications (2002) include "Synchrotron x-ray scattering studies of water intercalation in a layered synthetic silicate" and "Viscosity and transient electric birefringence study of clay colloidal aggregation" (J. O. Fossum et al.).

Polymer and molecular organic semiconductors

By E. J. Samuelsen

The research has focussed on self-assembling of organic semiconducting polymers when deposited as thin films. For studies of nano-meter layers use was made of grazing incidence diffraction and reflectometry of synchrotron radiation at the ESRF. The drying of polymer solutions was studied *in situ*, and a *formation of a solid skin* on top of the solution could be followed. The skin influences strongly the anisotropy of the deposited solid films. Electrolytically deposited PEDOT films on ITO substrates were shown to be smectic-like in character.

Examples of research carried out in 2002

1. Self-organization in nanoscopic poly(alkylthiophene) films on water

By D.W. Breiby, E.J. Samuelsen, O. Konovalov[1], B. Struth[1]
[1] ESRF, B.P.220, F-38043 Grenoble, France

Introduction

Conjugated polymers are promising for electro-optical applications like light emitting diodes, solar cells and lasers. The present work is a contribution to improve the control the material anisotropy.
Regioregular poly(hexylthiophene) (R-PHT) with > 98% head-to-tail (h-t) couplings, and poly(octylthiophene) (POT) with ~80% h-t couplings were used. Closely analogous results were obtained also for poly(dodecylthiophene) and other poly(thiophene) derivatives.
A few drops of low concentration (~ 1 mg / ml) of solutions in chloroform were spread on a clean water surface in a shallow teflon trough. The films were studied at the X-ray beam line ID10B at the ESRF. A one-dimensional position sensitive detector covering a vertical angle γ of approximately 8º was used for collecting the scattered intensity. For the *grazing incidence diffraction* (GID) studies, an incidence angle α_i of 0.15º was used. For *in situ* doping of the floating films, $NOPF_6$ dissolved in acetonitrile was injected into the water subphase.

Results

***Diffraction*:** The films showed a large degree of anisotropy, as observed by GID: The *100*-reflection is strongest for the scattering vector perpendicular to the film plane, whereas the *010* reflection could only be observed for scattering vector parallel to the film plane. From the width of the *100* diffraction peak, the average dimension of the ordered regions could be estimated to about 10 nm, in fact coinciding with the reflectivity data. Structural changes associated with the insulating-conducting phase transition in conjugated polymers have been reported previously for PATs, notably an expansion of the *a*-axis. Such a change of the peak position following *in situ* doping of the floating films was indeed observed. The doping could also be observed visually, as the film changed its colour from being weakly reddish to a hardly visible pale blue. Dedoping takes place; after 2 hours the film is regaining its original colour accompanied by a contraction of the *a*-parameter.
***Reflectometry*:** X-ray reflectivity obtained from a POT film floating on the water surface is shown in Fig. 1. The fitted curve is obtained by applying standard matrix formalism from optical theory of stratified media, applied to a density profile of the inset of the figure. The refractive indices of water and polymer were determined from tabulated values. The air-

polymer interface was assumed graded, with a Gaussian smearing of a width 5.3Å. This particular film is seen to have a thickness of about 10 nm, corresponding to five repetitions units of the *a*-axis.
The feature at scattering vector $Q \sim 0.3 Å^{-1}$ is a result of this internal structure of the film, a Bragg-like signal interfering with the reflections from the interfaces. An exponentially damped harmonic variation of the electron density gave the best fit, a model sometimes used for smectic liquid crystals. The period of the modulation, 20.8 Å, is compatible with the *a* - parameter of solid POT of 20.4 Å. The model implies a well-developed layering near the air-polymer interface, decaying into the film, being least pronounced at the polymer-water interface, in qualitative agreement with the aliphatic side chains being hydrophobic.

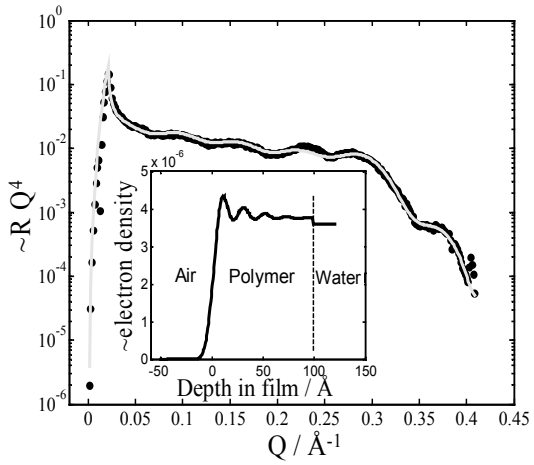

Fig. 1. Reflectometry data (dots) as obtained from a thin POT film floating on water versus scattering vector $Q=4\pi\sin\theta/\lambda$. The solid line is the fit. For increased readability, the curves are multiplied by Q^4.The inset shows the variation of the scattering density from air, through the film, into water. The damped periodic variation (unit cells) inside the polymer is shown.

2. Atomistic modelling of the Al-Mg-Si precipitation sequence

By A. Frøseth and R.. Holmestad

In Al-Mg-Si alloys, small amounts of Mg and Si are added to the aluminium solution. When this solid solution is brought through a heat treatment process, small particles called precipitates will start to form. Now, these precipitates are of fundamental importance for increasing the strength of the aluminium, which by itself is a rather soft material.

The precipitation sequence shows how the precipitates transform from one phase to another as
the material is heat treated.

SSSS -> Mg/Si Clusters -> GPZ -> β'' -> (β' + U2 + U1 + B') -> β

where SSSS is short for Super Saturated Solid Solution, and GPZ is short for Gunier Preston Zones. Just recently our group solved the crystallographic and electronic structure of the U1 and U2 phases using a combination of experimental and quantum mechanical modelling techniques. One of the most basic questions we would like to ask, is how the precipitate phases are constructed. The main building blocks are atoms - now how do they fit together? A well established theoretical tool for studying the electronic properties of a system of atoms is Density Functional Theory (DFT). We have used this technique both in the process of finding the crystallographic structure and in studying the electronic bonding properties of the precipitate phases. In the phases containing all three alloying elements - Al, Mg and Si - we have found that the structure is dominated by a strong bonding network between the Al and Si atoms which is made possible by the donation of electrons from the Mg atoms. The figures below show the bonding networks (indicated by the rods connecting Si and Al atoms) for the U1 and U2 precipitate phases.

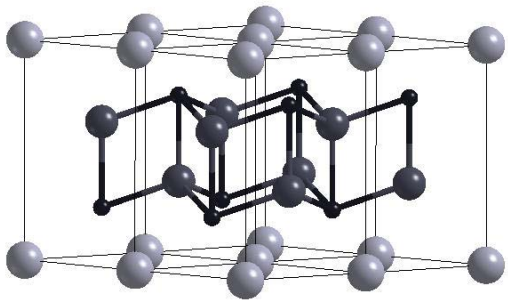

Fig. 1: *U1 phase bonding network. Large grey spheres indicat Mg atoms, while the darker grey spheres indicate Al atoms and the small black spheres indicate Si atoms.*

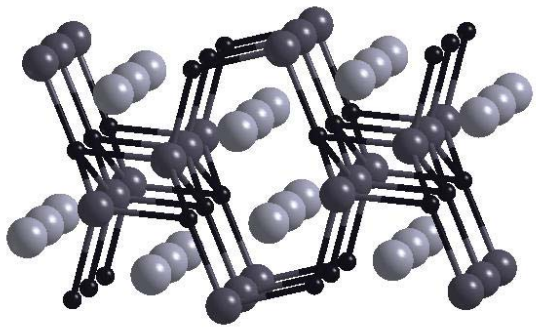

Fig. 2: *U2 phase bonding network*

We found that the $MgAl_2Si_2$, U1 phase can be categorized as belonging to a structure class called Zintl compounds, where each Mg atom donates 2 electrons to each unit of Al_2Si_2, thereby obtaining a filled valence shell. The MgAlSi U2 phase belongs to the TiNiSi class. Also for this structure type the electropositive Mg atoms donate charge to a Al-Si bonding network, although the charge transfer is not sufficient to produce a closed shell sub-structure as for the U1 phase.

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Professor Asle Sudbø
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Ass. Professor Ingjald Øverbø
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Guests
Dr. T. Øvergård (Scientist)
Dr. D. Østvang (Scientist)
Dr. P.Dommersnes (Post doc.)

Overview

The research is mainly carried out within the broad fields of *Condensed Matter Physics Theory*, *Statistical Physics*, and *Quantum Physics*. These contain several subfields with a large variety of topics. A brief overview is given. For the year 2002 we have chosen to give a more extended description of two research topics: *Spintronics and magneto-electronics* by Arne Brataas, and *Gauge theories for strongly correlated systems* by Asle Sudbø. As may be seen from the list of publications, the latter group had three Phys. Rev. Letters publications during the year.

Survey of research activities

Investigations of phase transitions in colloid mixtures is continued (*P. C. Hemmer*).

The SCOZA (self-consistent Ornstein-Zernike approximation), which has turned out to yield very accurate equations of state for fluids and lattice gases, is used to investigate polymers on a lattice (*J.S. Høye*). In the theory of ionic fluids the Debye-Hückel theory has been generalized to molecules with extended charges. Results have been evaluated for evenly charged aligned needles (*J. S. Høye*).
The one-dimensional Ising model is used to explain and describe the folding and unfolding of proteins of arbitrary length, and their measured heat capacities (*J. S. Høye, A. Bakk*). Methods for efficient treatment of the singular Couloumb potential in Quantum Monte-Carlo simulations are studied (*J. Myrheim*).
Investigation of methods for analyzing the time evolution of entanglement and other properties of a wide class of quantum states in models governed by quadratic Hamiltonians, including linear field theories (*K.Olaussen, S. O. Skrøvseth*). The distribution of areas *A(n)* encircled *n* times by a random walker is a problem of interest for the study of electrons in an environment of random magnetic impurities (and perhaps anyons). Ways to analyze this through combination of analytic and Monte-Carlo methods are being developed (*K. Olaussen, A. Westermoen*).

It is shown that the spin-one Upsilon (b - $\overline{b}$) meson is polarized when produced, thereby producing B and $\overline{B}$ polarized mesons. The polarization is relatively small, but not zero as assumed today (*H.A.Olsen*). A project on QED bremsstrahlung and pair production is ready for publication; here new features of QED have been seen (*H.A.Olsen*).

The problem of preparing pure quantum states in resonant cavities has been investigated (*P. Rekdal, B.-S. Skagerstam*)

Within biological physics a model for evolution of protein networks is formulated, leading to an article in Science (*K.Sneppen)*

Network models in general and econophysics are also studied (*K.Sneppen)*

Anomalous diffusion processes, protein folding, mechanical properties of rough surfaces, brittle fracture, mechanical properties of granular media, multiphase flow in prous media are studeied (*A. Hansen)*

Delbrück scattering is investigated (*K.Mork, I.Øverbø)*

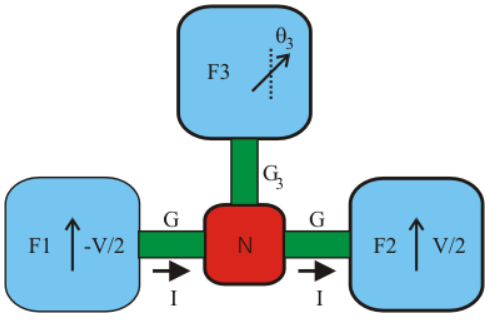
Examples of research carried out in 2002

1. Spintronics and magneto-electronics

By A. Brataas

Quite recently, it has been realized that the spin of the electron provides new functionality in electronics applications. The Giant Magneto Resistance (GMR) in magnetic metallic multi-layers discovered only ten years ago is now the leading technology in magneto-resistive read heads for hard disks in high-end desktop computers.
Ferromagnets in contact with a normal metal, a semiconductor or a superconductor produce a spin-polarized current into the normal metal, semiconductor or superconductor. On the other hand transport in mesoscopic and nano-scale devices test basic concepts of quantum mechanics, such as charge and conductance quantization. We focus our attention on mesoscopic and nanoscale hybrid circuits and devices of ferromagnets, normal metals, semiconductors and

superconductors. Our aim is to develop improved theoretical methods for describing transport and other phenomena in these systems, and to use these methods to improve our understanding of experiments.
When a current passes through a ferromagnet, the resistance experienced by an electron depends on the direction of its spin. This leads to the giant magneto-resistance effect and related phenomena. However, there is also the inverse effect which can be envisaged as roughly due to Newton's third law: Action equals reaction. The spin- current induces a torque, a "spin-torque", on the spins of the conduction electrons, which subsequently transmit this torque to the magnetization. This mechanism has attracted quite some interest recently, both because it is fundamentally interesting and because it has potential for use in magnetic random access memories, where the magnetization direction can be controlled by a current.
We have demonstrated that there is also the reverse mechanism: Precessing ferromagnets inject a spin-current into adjacent conductors. When the normal metal is a good sink this "pumping" of spins slows down the precession corresponding to an enhanced Gilbert damping in the Landau-Lifshitz equation describing the magnetization dynamics. This is important because it means that the magnetic response time of nanoscale magnets can be tuned by the surrounding media. In the opposite regime, when the spin-flip relaxation time in the normal metal is long, "spin-pumping" opens the way to create a pure spin source ("spin battery"). Consequently it is possible to create electronic circuits where only spins flow, but where there are no movement of the electronic charges. To this end we have formulated a theory of spin dependent transport of an electronic circuit involving ferromagnetic elements with non-collinear magnetizations. The magneto-electronic circuit theory is based on the conservation of spin and charge current and considerably simplifies the calculation of the transport properties of complicated ferromagnet-normal metal systems leading to a set of generalized Kirchoffs laws. Both novel DC and AC transport phenomena are found.



The figure shows a magneto-electronic circuit with ferromagnetic and normal metal elements. Spin and charge currents depend on the relative direction of the magnetization.

2. Gauge theories for strongly correlated systems

By A. Sudbø

The main research theme in the group is currently, and has been for the last 2-3 years, the investigation of effective gauge theories of strongly correlated systems, and whether so-called confinement-deconfinement transitions, either in the form of second- or first order phase transitions, or even considerably more subtle topological phase-transitions, can present a viable route for destroying Landau Fermi-liquid theory in more than one spatial dimensions. This problem represents a major challenge in contemporary condensed matter physics. Our investigations into this problem builds on the experience we have gained over the last 6-7 years in large-scale Monte Carlo simulations of lattice gauge theories capable of describing topological phase transition in the context of the metal-superconductor transition or the metal-insulator transition.
We have investigated the possibility of having a confinement deconfinement transition in the 2+1 dimensional compact Abelian Higgs model when the matter field is in the fundamental representation. We have found a topological phase transition driven by the proliferation of ”magnetic” monopoles, which is in the universality class of the Kosterliz-Thouless phase transition well-known from two-dimensional physics, but here it occurs in 2+1 dimensions. The work has been published in *Phys. Rev. Letters* (Kleinert et al).
We have also studied the possibility of spontaneously broken time-reversal symmetry in a strongly correlated fermion model system, published in another *Phys. Rev. Letters* (Marston *et al*). In a third work published in *Phys. Rev. Letters* (Sudbø *et al*) we studied the possibility of charge fractionalization within the insulating phase of a strongly correlated system by considering the confinement-deconfinement transition in the 2+1-dimensional compact Abelian Higgs model for matter fields in higher represen-tations than the fundamental. Here we intro-duced a new method of extracting two critical exponents from the computation and finite-size scaling of one quantity, namely the third moment of the action. We demonstrated that this quantity yields superior quality scaling compared to the second moment of the action (essentially the specific heat of the system) for practically accessible system sizes. The remarkable property we find for this case is that the critical exponents are non-universal, and therefore that the phase-transition line represents a fixed-line rather than a fixed point. More detailed expositions of the above works are available on *hep-th/0209132* and *cond-mat/0301297*.
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Studies of novel surface alloys using soft X-ray synchrotron radiation.
2. Brukermøte, Norsk synkrotronforskning, Sola, 2002-06-06 - 2002-06-07

Ramadurai, Souriraja; Indulekha, K.; Vijayagovindan, G.V.
Collapse of an inhomogeneous galaxy with random motions.
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Samuelsen, Emil J.
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Foredrag på NTNU seminar "Forum for nano-technology" Selbu Turisthotell 2002-10-29/30

Samuelsen, Emil J.
"Halvleiande polymerar – IKT-materiale for framtida?"
Invitert foredrag på "55. Studiemøte i elektronikk", Sandefjord, 2002-06-13

Sigmond, Reidar Svein; Chutov, Yu.; Fikke, S. M.; Kosharsky, K.; Kravchenko, K.; Kudu, Kalju; Lisitchenko, T; Sigmond, Turid; Veksklyarsky, R.
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Sigmond, Reidar Svein; Sigmond, Turid
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I: Proc. 3rd Electrostatics Conference (SFE2002). CD (Compact Disc). 1-7. Societé Francaise d'Electrostatique, 3rd Electrostatics Conference (SFE2002), Toulouse, France, 2002-07-03 - 2002-07-04

Sletmoen, Marit; Skjåk-Bræk, Gudmund; Stokke, Bjørn T.
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I: Book of abstracts Plant Polysaccharide Workshop, Palm Cove, Queensland, Australia, July 4 -6, 2002..
II: Poster Plant Polysaccharide Workshop, Palm Cove, Queensland, Australia, July 4 -6, 2002., Palm Cove, Queensland, Australia, 2002-07-04 - 2002-07-06

Sletmoen, Marit; Skjåk-Bræk, Gudmund; Stokke, Bjørn T.
Single-molecular pair AlgE4 epimerase-mannuronan interactions and polymer elasticity determined by AFM.
I: Book of abstracts XXIst International Carbohydrate Symposium, Cairns, Australia, July 7 - 12, 2002. XXIst International Carbohydrate Symposium, Cairns, Australia, July 7 - 12, 2002, Cairns, Australia, 2002-07-07 - 2002-07-12

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Stokke, Bjørn T.
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I: Book of abstract, Europolymer Conference 2002 (EUPOC 2002). Polymeric gels: Interesting synthetic and natural soft materials. Gragnano (Brescia), Italy, June 2 - 7, 2002..
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Sudbø, Asle
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Sudbø, Asle
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Sudbø, Asle
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Thisted, Ulrik; Zhilyaev, I.N.; Fossheim, Kristian
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I: Abstract booklet. ESF Vortex program workshop: Vortices in Josephson systems and nanoscale structures., Maratea, Italy, 2002-09-20 - 2002-09-25

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Valberg, Arne
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Valberg, Arne; Fosse, Per
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I: VISION 2002. Abstract Book.. 84. The 7th International Conference on Low Vision, Gøteborg, 2002-07-21/25

Wallis, Max; Ramadurai, Souriraja
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I: Proceedings from COSPAR 2002. 34th COSPAR SCIENTIFIC ASSEMBLY, Houston, Texas, 2002-10-10 - 2002-10-19

Wittje, Roland
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Wittje, Roland
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I: XVIII International Scientific Instrument Symposium. Moscow-St. Petersburg, Russia, 20-25 September 1999. Proceedings. s. 131-145. Moscow: Scientific publishing center *Engineer*, 2002. ISBN 5-8208-0031-1.

Wittje, Roland
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Other talks

Brataas, Arne
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Brataas, Arne
Spintronics
Norwegian Academy of Technological Sciences, Trondheim, February 2002,

Brataas, Arne
Nanotechnology, theoretical perspectives
Norwegian Trade Council Nanotechnology Study Tour, Boston, USA, December 2002

Brataas, Arne
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Brataas, Arne
Spintronics
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Brataas, Arne
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Delft University of Technology, Delft, The Netherlands, October 2002

Brataas, Arne
Enhanced Gilbert damping in thin ferromagnetic films
Basel University, Basel, Switzerland, May 2002

Brataas, Arne
Spin pumping and magnetization dynamics
Cornell University, Ithaca, USA, May 2002

Falnes, Johannes
Norway: Glimpses of past and present.
Nils Olsa/Borsheim Family Reunion 2002, Snow Mountain Ranch, Winter Park, Colorado, USA 80482, 2002-07-21/25

Kjeldstad, Berit
Vår ultrafiolette hverdag
Foredrag Suhmhuset, Trondheim 2002-01-16

Olaussen, Kåre
"Some Amusing Properties of the Virial Expansion of Ideal Quantum Gases",
Teoriseminar 3.9, Institutt for fysikk, NTNU

Olaussen, Kåre
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Olaussen, Kåre
"*Vacuum Entanglement and Geometric Entropy in 1+1 Dimensions",*
Bidrag på Antidot meeting 16.12, Fysisk Institutt, UiO.

Samuelsen, Emil J.
Ultra-Thin Conjugated Polymer Films Floating on Water, Studied by Synchrotron Radiation.
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Stefansson, Thorarinn
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Stokke, Bjørn T.
Nanoteknologi.
Faglig-pedagogisk dag, NTNU, Realfagbygget, NTNU, 2002-11-22

Stokke, Bjørn T.
Polysaccharide structures and interactions: Investigations using atomic force microscopy.
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Sudbø, Asle
Høy-temperatur superledere og kosmologi.
Høyskolen i Stavanger,
Institutt for tekniske fag, Stavanger, 2002-04-11

Valberg, Arne
Nevrobiofysikk.
Faglig-pedagogisk dag, NTNU, Trondheim, 2002-11-22

Wittje, Roland
Elektroakustikkens tidsalder: Akustikk, Akademisk Radioklubb og vitenskapelig instrumentering ved NTH i mellomkrigstiden.
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Wittje, Roland
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REPORTS AND COMPENDIA

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Topics on extraction of ocean-wave energy: Various leftover notes
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Fossheim., Kristian Report
Electropulse-Boring: A discussion of possible mechanisms.
Department of Petroleum Technology and Applied Geophysics, 2002. 30 pages

Fossheim, Kristian Compendium
Superconductivity: Physics and applications.
NTNU. 2002

Iversen, Tor-Henning; Svare, Håkon; Johnsson, Anders. Report
Root observation study report - Summary report
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Oftedahl, Gunnhild; Johnsson, Anders Report
Mobiltelephones and health damage.
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Stefansson, Thorarinn Study pamphlet
Educational experiments as a tool in the formation of ideas.
NTNU. 2002. 72 pages

COOPERATING INSTITUTIONS

Europe

Borg, A.:
* Schuit Institute of Catalysts, Eindhoven University of Science and Technology, The Netherlands, (G. J. Kramer)

Brataas, A.:
* TU Delft, Nederland (G. E. W. Bauer), Theoretical Physics
* Basel, Sveits (W. Belzig), Theoretical Physics

* Budapest,Ungarn (G. Zarand), Theoretical Physics
* Universitetet i Lund, Sverige (K..-A. Chao), Condensed Matter Physics

Davies, C.:
* Dept of Internal Medicine with Oncology, Austria (G Baumgartner), Biophysics

Fossheim, K.:
* Institute of Microelectronics Technology, Moscow, Russia (Zhilyaev), Condensed Matter Physics
* Institute of Solid State Physics, Sofia, Bulgaria (Christova), Condensed Matter Physics

Fossum, J.O.:
SNBL/ESRF France

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, The Netherlands (H. Zandbergen, J. Janssen) Electron microscopy
* Paul-Scherrer Institute, Villingen-PSI, Switzerland (P.Derlet), Atomistic modelling
* Århus University, Denmark (F.K. Larsen) Electron microscopy

Hunderi, O.:
* Techn Univ., Berlin (W. Richter), Surface Optics
* University of Nijmegem, (T.Rasing), Magnetooptics
* University of Liverpool, (P. Weightman), Surface Optics.

Johnsson, A:
* Arbetmiljöinstitutet, Umeå (K. Hansson Mild), Biophysics

Kjeldstad. B;
* EU-prosjekt Educe and Inspectro., Environmental Physics
* University of Hanover, Meteorological Institute (Gunther Seckmeyer), Environmental Physics
* University of Thessaloniki, Department of Physics (Alkis Bais), Environmental Physics
* Universiyt of Innsbruck, Institute of medical Physics, (Mario Blumthaler), Environmental Physics

Løvaas, T.H.;
KTH Stockholm, Alfvenlab. (S.Rosander), Electron Physics.

Løvseth, J;
* Risø Nationale Laboratorium, Danmark (Larsen), Wind Energy
* Danmarks Tekniske Universitet, Danmark (Hansen), Wind Energy

Mo, F.:
* SNBL, ESRF, Grenoble (J.A. Beukes), Condensed Matter Physics
* Institut Pasteur, Paris (P.M. Alzari), Condensed Matter Physics
* EMBL Grenoble Outstation, Grenoble (B. Rasmussen), Condensed Matter Physics

Naqvi, K.R.:
* Institute of Natural Resources and Agrobiology, Spain (J. B. Arellano), Biophysics
* Universidade de Coimbra, Portugal (L. G. Arnaut), Biophysics
* King's College, London (R. E. Dale), Biophysics
* Hungarian Academy of Sciences (G. Garab, T. Javorfi), Biophysics
* Universidade Nova de Lisboa, Portugal (ITQB), Biophysics
* Moscow State University, Russia (Mark N. Merzlyak), Biophysics
* Institute of Physical Chemistry, Spain (CSIC) (J. Gonzalez-Rodriguez), Biophysics

Olaussen. K.:
* Polish Academy of Sciences (Dr. A. Maciolek), Theoretical Physics

Samuelsen, E. J.:
* Linkøping University (O. Inganäs), Condensed Matter Physics
* Materials-Chem. Department, Mortsel, Belgium (L. B. Groenendaal), Condensed Matter Physics
* Univ. of Mining and Metallurgy, Krakow, Poland (W. Luzny), Condensed Matter Physics
* Experimental Division, ESRF, Grenoble, France (O. Konovalov and B. Struth), Condensed Matter Physics
* Kazan State Technological University, Kazan, Russia (Vladimir A. Petrov), Condensed Matter Physics

Sigmond, R.S.;

* École Superieure d'Électricité (SUPELEC), Laboratoire de Physique des Gaz et des Plasmas, (A. And M. Goldman), Applied Plasma Physics

Skullerud, H.R.;
* Universität Innsbruck, Inst. für Theoretische Physik (S.Kuhn), Plasma Physics
Stefansson, T;
* Univ. i Island, Haskli Islands, Reykjavik, Island (R. Olafsson), Didactics in Physics

Stokke, B. T.:
* Bristol Univ., UK (T. Atkins), Biophysics
* 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

Sudbø, A.:
* Freie Universitaet Berlin, Tyskland (F. S. Nogueira, H. Kleinert, K.H. Benneman), Condensed Matter Theory
* Katholieke Universiteit Leuven (V. Moschalkov), Condensed Matter Theory
* Loughboro University, UK (F. Kusmartsev), Condensed Matter Theory
* Leiden University, Holland (J.Zaanen)

Valberg, A..:
* University of Freiburg, Germany (L. Spillmann and T. Otte), Vision Biophysics
* University of Tübingen, Germany (J Kremer), Vision Biophysics

Africa

Løvseth, J;
* University of Durban Westville, Sør-Afrika (Heetkamp, Reinhardt, McPherson), Renewable Energy
* Eduardo Mondlane University, Mosambik (Cuamba), Solar Energy

America

Borg, A.:
* Materials Science Division, Lawrence berkeley National Laboratory, Berkley, USA (M.Salmeron)

Brataas, A.:
* Harvard, USA (Y. Tserkvonyak), Theoretical Physic
* University of Brasilia, Brazil, (C. Egues), Condensed Matter Theory.

Davies, C.:
* Harvard Medical School Boston, USA (R. K. Jain), Biophysics

Fossheim, K.:
* National High Magnetic Field Laboratory, Tallahassee, Florida, USA (Schneider-Muntau) Condensed Matter Physics
Fossum, J.O.:
* Brookhaven National Lab, USA (), Complex Materials
* University of Brasilia, Brazil, (), Complex Materials

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

Holmestad, R.:
* Arizona State University, Tempe, Arizona, USA (J.Spence, B.Jiang) Electron microscopy
* McMaster University, Hamilton, Ontario, Canada (G. Botton) Electron microscopy

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

Lindmo, T;
* Beckman Laser Institue, University of California, Irvine (J. S. Nelson, Z. Chen), Biophysics

Olaussen, K.:
* University of Berkeley (R. Chiao), Theoretical Physics

Stokke, B.T.:
* California, Irvine, California, USA (D. A. Brant) Biophysics
* Univ. of California, Santa Barbara, California, USA (H. Hansma), Biophysics

Sudbø, A.:
* John Hopkins University, USA (Z. Tesanovic), Condensed Matter Theory
* Bell Laboratories, USA (C. M. Varma), Condensed Matter Theory
* Brown University, USA (J. B. Marston), Condensed Matter Theory
* University of California LA, USA (J. O. Fjærestad), Condensed Matter Theory
* Los Alamos National Laboratory, USA (Z. Nussinov)
* Cornell University, USA (E.Babaev)

Tøtdal, B.:
* Lehigh University, USA (C.E.Lyman), Analytical electron microscopy

Asia

Brataas, A.:
* Nagoya, Japan (J. Inoue), Theoretical Physics
Fossheim, K;

* Department of Physics, University of Hiroshima, Japan (T. Suzuki , J. Hori), Condensed Matter Physics

Johnsson, A.:
* J. Nehru Centre for Advanced Scientific Research , Bangalore, India (V. Sharma), Biophysics

Mo, F.:
* Nanyang Techn. University, Singapore (J. Lescar), Condensed Matter Physics

Naqvi, K.R.:
* International Islamic University Malaysia, Kuala Lumpur (T. Hj. Hassan), Biophysics

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

Australia

Skullerud, H.R.;
* Australian National University, Canberra, Atomic d Molecular Physics Lab., Electron and Ion Physics

National cooperation

* Photocure ASA, Oslo
* Division of Biophysics and Medical Technology, Radium Hospital, Oslo (Ø.Bruland, A.Skretting)
* SINTEF (R.H. Mathiesen)
* 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 Institutte for Air Research, University of Oslo, (A.Kylling, G.Braathen)
* Tambartun National Resource Center for the Visually Handicapped, Melhus, Norway (P.Fosse)
* Institute for Energy Technology, Kjeller, Norway, (B.Hauback, K.D.Knudsen, A.Skjeltorp, P.G.Helgesen)
* SINTEF (C.Marioara, S.Andresen and J.Walmsley)
* Norwegian Radiation Protection Authority, (B.Johnsen, T.Christensen).

Local cooperation

* 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)
* Departemnt of process Technology, NTNU (P.V. Hemmingsen og J. Løvland)
* Department of Inorganic Chemistry, NTNU
* Institute of Reservoir Technology and Applied Geophysics, NTNU
* Inst. for bioteknologi, NTNU (B.E. Christensen, K.M. Vårum, G.S.B. Bræk, S. Valla, O. Smidsrød, K.I. Draget)
* Inst. for kreftforskning, NTNU: (T. Espevik, A. Sundan)
* Materialteknologi, NTNU, (K.Marthinsen, M.-A. Einarsrud og T.Grande)
* Fysikalsk elektronikk, NTNU (T.Tybell, J.K. Grepstad) SINTEF Energiforskning
* Kjemisk prosessteknologi NTNU (Z.Yu, De Chen, A. Holmen)

EDUCATION
SUBJECTS AND STUDENT ATTENDANCE

Some subjects were self-study courses in 2002

Siv.ing. study, 1st and 2nd year.	***Student attendance*:**	**1699**
Physics for Civil and Environmental Engineering		210
Physics for Geology and Petroleum Students		141
Physics for Electronics Students		176
Physics for Chemistry and Metallurgy Students		157
Physics for Informatic Students		82
Physics for Machine Technology Students		257
Physics for Marine Students		83
Laboratory for Physics Students - Mechanical Physics		131
Laboratory for Physics Students - Electromagnetism		117
Laboratory for Physics Students - Wave Physics		112
Laboratory for Physics Students - Thermal Physics		117
Physics for Energy and Environmental Students		116

Siv.ing. study, 3rd year.	**668**
Physics 2 for Electronics Students	106
Electronics	74
Instrumentation	63
Statistical Physics	56
Electromagnetic Theory	55
Atomic and Molecular Physics	87
Optics	71
Quantum Mechanics	56
Electron and Ion Physics	9
Cell Biology 1	49
Atmospheric Physics	8
Material Physics and Characterization	34

Siv.ing. study, 4th year.	**319**
Solid State Physics	49
Energy and Environmental Physics	7
Non-linear Dynamics	27
Optics, Advanced Course	11
Applied Quantum Mechanics	17
Solid State Physics, Advanced Course	17
Theory of Classical Fields	16
Molecular Biophysics	21
Biophysics (special)	17
Classical Transport Theory	4
Signal Processing	12
Subatomic Physics	6
Medical Physics	17
Nuclear and Radiation Physics	68
Experts in Team, Interdisciplinary Project	30

Siv.ing. study, 5th year.	**48**
Biophysical Micromethods	2
Biophysics, Specialization	8
Physics, Specialization	34
Functional Materials	4

Dr.ing. study.	**26**
Quantum Optics	1
Characterization of Solid Surfaces - Surface Physics	6
Phase Transitions and Critical Phenomena	1
Mathematical Approximation Methods in Physics	4
Crystallography - Scattering and Diffraction	1
Functional Integral Methods in Condensed Matter Physics	5
Advanced Statistical Physics	4
Dosimetry of Ionizing Radiation	1
Polymer Physics I	3

Cand.mag. study.	**278**
User Course in Physics	28
General Physics I	72
General Physics II	30
Mechanics	45
Electricity and Magnetism	23
Quantum Physics and Statistical Physics	27
System Dynamics	3
Energy and Environmental Physics	11
Biophysics I	2
Introduction to Quantum Mechanics	16
Astrophysics	21

Cand.scient. study.	**71**
Didactic in Physics	12
Measuring Sensors and Transducers	8
Signal Analysis	8
Optics	8
Physics of the Atmosphere	5
Cosmology and Extraterrestrial Biology	5
Subatomær Physics	5
Cosmology and Astro-particle Physics	10
Particle Physics	5
Relativistic Quantum Mechanics	5

Dr.scient. study.	**18**
Compact Stars	9
Quantum Field Theory	4
Quantum Optics	5

Other subjects.	
Space Technology	19

THESES - GRADUATE STUDIES

Engineering (siv. ing.)

Aksnes, Kyrre; *Design of short fiber Bragg gratings by optimization.*
Supervisor: Professor Ole Johan Løkberg.

Arnesen, Tonje Anette*; Computation of rocket trajectories*.
Supervisor: Professor Anders Johnsson.

Bakken, Hans; *Thermal analysis of a syntetic layered silicate.*
Supervisor: Associate professor Jon Otto Fossum.

Bergaplass, Vegard; *Small angle neutron scattering investigations of hydration dynamics in a nano layered silicate.*
Supervisor: Associate professor Jon Otto Fossum.

Bergene, Håvard Huru; *Elastic string between two rough surfaces.*
Supervisor: Professor Alex Hansen.

Bilberg, Ingvild Henningsen; *The effect of radiation with varying doserate on human cell lines in vitro*.
Supervisor: Professor Catharina Davies.

Bohman, Axel Fredrik; *Lightning properties of insulated overhead power lines*.
Supervisor: Professor R.Svein Sigmond.

Brenne, Jan Kristoffer*; Design of non-uniform grating-assisted co-directional couplers*.
Supervisor: Professor Ola Hunderi.

Brurberg, Kjetil Gundro; *Oxygen tension in human melanoma xenografts.*
Supervisor: Adjunct professor Einar K. Rofstad.

Eriksen, Jon Egil*; Construction of a magnetooptical Kerr spectrometer based on photoelastic modulation.*
Supervisor: Professor Johannes Bremer.

Fjelland, Marte; *Optimization of ultrasound SonoDoppler in laparoscopic surgery.*
Supervisor: Professor Catharina Davies.

Haldorsen, Tone; *2D Ultrasound imaging of blood vessels using contrast agents.*
Supervisor: Professor Catharina Davies.

Hasting, Håkon Kortner; *TEM-examination of thermocompression bonded wafers for MEMS.*
Supervisor: Professor Ragnvald Høier.

Haugen, Sigrun; *"Post-β" Phases as a Function of Alloy Composition in AlMgSi Alloys.*
Supervisor. Professor Randi Holmestad.

Holth, Linda; *Gel-based verification of dose-distribution in intensity-modulated radiation therapy.*
Supervisor: Professor Bjørn Torger Stokke.

Homme, Tønnes*; Design of semi-autonomous vehicle.*
Supervisor: Professor Tore Høe Løvaas.

Håland, Erling; *Regulating the water content in a plant growth chamber for experiments performed at the International Space Station.*
Supervisor: Professor Anders Johnsson.

Ingebrigtsen, Stian; *Charge injection in transformer oil.*
Supervisor: Professor Reidar Svein Sigmond.

Johannessen, Jorun Cecilie; *Spectral solar ultraviolet radiance measurements. Instrument testing and calibration.*
Supervisor: Professor Berit Kjeldstad.

Juel, Mari; *STM studies of Al_2O_3 -film formation on $Ni_3Al(111)$. Nucleation of Au clusters on $Al_2O_3/Ni_3Al(111)$.*
Supervisor: Professor Anne Borg.

Kragseth, Steinar; *Matter coupled Z_2 gauge theory in two dimensions.*
Supervisor: Professor Asle Sudbø.

Letnes, Frida; *Optimization of ultrasound SonoDoppler in laparoscopic surgery.*
Supervisor: Professor Catharina Davies.

Maribu, Karl Magnus*; Sustainable Nordic power supply. Analysis based on system dynamic modelling.*
Supervisor: Associate professor Jørgen Løvseth.

Marken, Endre; *AMF-investigation of bio nano-composites of chitosan and scleroglucan.*
Supervisor: Professor Bjørn Torger Stokke.

Mortensen, Pål Henriksen*; Numerical simulation of turbulent cavity flow.*
Supervisor: Professor Alex Hansen.

Nguyen, Le Anh Vu*; Photoinactivation of P. acnes: Importance of temperature during uptake of ALA or methyl-ALA.*
Supervisor: Professor Anders Johnsson.

Nygård, Geir Ivar Eliassen; *Cortical responses elicited by luminance and chrominance modulated gratings - possible contributions from the magnocellular and parvocellular pathways.*
Supervisor: Professor Arne Valberg.

Ramberg, Kristin; *Experimental investigations of light induced inactivation of Propionibacterium acnes. Measurements of light absorption, electron paramagnetic resonance and singlet oxygen emission.*
Supervisor: Professor Thor Bernt Melø.

Sagaas, Ellen Katrine*; A study of periodic gratings with electronically tunable surface modulation.*
Supervisor: Professor Ola Hunderi.

Sangar, Robin Kumar*; Observations of phase separation and electrorheology in a layered silicate system.*
Supervisor: Associate professor Jon Otto Fossum.

Simonsen, Annette; *Diffusion measurements by spectroscopic optial coherence tomography (OCT).*
Supervisor: Professor Tore Lindmo.

Smalø, Hans Sverre; *Wave equations for systems of spin-1/2 fermions with position dependent mass matrix.*
Supervisor: Professor Kåre Olaussen.

Stava, Mons*; One-dimensional correction in length of an artillery shell at long range fire using a dragbreak.*
Supervisor: Professor Johan Skule Høye.

Stokkeland, Ivar; *Vibration measurements on a Microscopic Scale using Time averaged ESPI.*
Supervisor: Professor Ole Johan Løkberg.

Stormo, Frank Thomas; *Lightning properties of insulated overhead power lines.*
Supervisor: Professor Reidar Svein Sigmond.

Svenum, Ingeborg-Helene; *STM studies of $Al_2 O_3$ /NiAl(110). Growth of Au overlayers on $Al_2 O_3$ /NiAl(110) and NiAl(110).*
Supervisor: Professor Anne Borg.

Talleraas, Olaug; *Film-based verification of dose distribution in intensity-modulated radiation therapy (IMRT).*
Supervisor: Professor Tore Lindmo.

Westermoen, Andreas; *Simulation of the winding distribution of a random walker.*
Supervisor: Professor Kåre Olaussen.

Ørnes, Hans; *Nested wavelet analysis.*
Supervisor: Professor Alex Hansen.

Ånensen, Dag Arne; *Microstructure studies of brazing of some Al alloys.*
Supervisor: Associate professor Bård Tøtdal.

Cand. Scient.:

Erikson, Arne; *Søkelys på fortolkninger, formuleringer og fundamenter.*
Supervisor: Professor Kjell Mork

Karlsen, Morten; *Characterisation of the deformation microstructure in friction stir welded 2024T351 and 7075T6 aluminium alloys using the SEM-EBSD technique.*
Supervisor: Associate professor Kaare Stegavik

Koziel, Michal; *Windlog-20: Development, testing and data quality control of a 20 HZ wind measurement system.*
Supervisor: Associate Professor Jørgen Løvseth

Raklev, Are; *Coupling constants in the minimal supersymmetric standard model.*
Supervisor: Professor Kjell Mork

Selnes, Øyvind; *Diskrete symmetrier i partikkelfysikk.*
Supervisor: Professor Kåre Olaussen

Straume, Aksel; *An investegation of skin temperature changes caused by use of mobile phones, and measurements of ELF magnetic field from a mobile phone.*
Supervisor: Professor Anders Johnsson

Weydahl, Helge; *Potential temperature and water conceentration profiles in a Fuel cell and its eqvivalent electrolysis cell.*
Supervisor: Førsteamanuensis Jørgen Løvseth og Professor Signe Kjelstrup

Master of Science:

Aggrey-fynn, Victor Christian Kweku: *Solar radiation measurements and intercomparison, using a moderate bandwidth multi channel instrument for ultraviolet radiation and a pyranometer.*
Supervisor: Professor Berit Kjeldstad

Bhattarai, Binod Kumar; *Direct solar ultraviolet radiation measurement*
Supervisor: Professor Berit Kjeldstad

Dellie, Seife; *Visualization, measuring of surface area and volume of three dimensional (3D) ultrasound images for use in telemedicine application.*
Supervisor: Professor Anders Johnsson

Fantahun A. Alemayehu; *Designing a graphical user interface for visualization of three-dimensional ultrasound image and telemedicine application.*
Supervisor: Professor Anders Johnsson

Gebreselassie, Bereket Medhane; *Developing and documenting use of Analog-Digital measurement and control microcontrollers with high-level language based software in low cost and high performance equipment.*
Supervisor: Associate Professor Tore Løvås

Ibrahim, Rafat Mohamed; *Spectroscopy of molecules with low-lying electronic states*
Supervisor: Professor Kalbe Razi Naqvi.

Mensah, Ebenezer Ekow; *Interferometric measurement of the temporal coherence of lasers.*
Supervisor: Professor Hans Magne Pedersen

Ofori, Emmanuel Kwesi; *Modelling of ultraviolet radiative transfer in the atmosphere and sensitivity studies using the libradtran.*
Supervisor: Professor Berit Kjeldstad

THESES - DOCTORAL STUDIES

Bakk,Audun*;*
Statistical thermodynamics of proteins
Supervisor: Professor Alex Hansen

Hove, Joakim;
Critical properties of the Abelian Higgs model
Supervisor: Professor Asle Sudbø

Knudsen, Henning Arendt;
A numerical study of steady-state two-phase flow in porous media
Supervisor: Professor Alex Hansen

Mo, Sjur;
Phase structure and critical properties of an abelian gauge theory
Supervisor: Professor Asle Sudbø

Qu, Hong;
Neuron/Glia interaction studied by MR spectroscopy
Supervisor: Professor Anders Johnsson

ACTIVITIES TO PROMOTE "PHYSICS"

PRESENTATIONS THROUGH THE MEDIA

Brataas, Arne
Verdens minste datachip. *Dagbladet* 2002-10-24.

Fossheim, Kristian
Baron Audun Hugleiksson: Eit 700-års minne. *NRK P2-Akademiet*, NRK-P2,
2002-03-21 - 2002-03-23

Fossheim, Kristian
Materialkunnskap i vidaregåande skole. *Fra Fysikkens Verden* 64. årgang(3): 2002.

Fossheim, Kristian
Superlab i *Fysikknett.no*. Internett, server ved UiO: Norsk Fysisk Selskap.
I samarbeid med Norges Forskningsråd, 2002.

Fossheim, Kristian
Verdt å vite. *Superconductor physics* NRK-P2 interview by A. Christensen 2002-04-14

Olaussen, Kåre;
Schrødingers katt, 2002-10-17 *NRK-TV*

Samuelsen, Emil J.;
"Verdt å vite" i *NRK2*, samtale med Arnfinn Christensen om "Polymer elekronisk minne og OPTICOM"
28. mars 2002 kl.12.30.

Samuelsen, Emil J.; Finn Halvorsen, referent:
"IKT-materiale for framtida?" Referat fra foredrag av Emil J Samuelsen, holdt i Sandefjord 2002-06-13
Teknisk Ukeblad 149 6 (2002-06-20)

PARTICIPATION IN EVALUATION COMMITTEES AND OTHER ACTIVITIES

Evaluation committee work.

Borg, A.:
* 1. opponent Ph.D., University of Tartu, Estonia (R. Lohmus)

Brataas, A.:
* External evaluator dr. Habil degree, Basel University, Switzerland, (C. Egues)
* 1. opponent dr. degree, Technical University, Delft (D. Huertas-Hernando)
* 2. opponent dr. Scient, Universioty of Oslo (J. Bergli)

Davies, C.:
* Evaluation committees: promotion HIST, Department of Biotechnology, NTNU

Fossheim, K.:
* Evaluation committe for promotion to 1. amanuensis, Høgskolen i Vestfold
* Member, dr scient thesis committe, University of Oslo (P.E.Goa)

Fossum, J.O.
* Sensor in physics courses /examinations at the University of Oslo

Hemmer, P.C.:
Chairman National Committee for promations to full professor.

Johnsson, A.:
Evaluation committee
* 2. opponent, dr.philos. University of Oslo, (P. Juzenaz),
* 1. opponent dr.scient, University of Oslo (K. S. Skauli),
* Sensor at two Master examinations in physics, Norwegian University of Agriculture, NLH

Kjeldstad, B.:
* 1. opponent: dr.scient, University of Bergen (Ø. Frette).

Mo, F.:
* Sensor in physics at Høgskolen in Gjøvik (ENG) (Fysikk (JøG103)

Mork, K.:
* Evaluation committee for position as 1. amanuensis, (HIST)

Olaussen, K.:
* Evaluation committee for promotion amanuensis, University of Oslo (physics)
* Opponent, dr.ing, NTNU (R. Meland, Mekanikk
* Sensor at many oral examinations and Master examinations at University of Oslo and Bergen

Samuelsen, E.J.:
Expert evaluation" of EU project HPRN-CT-2000_00135 " Large Area Molecular Electronics Initiative in Training and Education" LAMINATE; Hearing and reporting Univ. Mons 28-29/5; 20/6. Participating labs: Eindhoven, Cambridge, Durham, Mons-Hainaut, Marburg, Linkøping, Bologna.

Arrangements:

Borg, A.:
* Organizing Committee member, Nanoforum, Selbustrand

Bremer, J.:
* Convenor of "Fredagskollokviet i fysikk" spring and autumn 2002

Hansen, A.:
* Convenor of seminar series in theoretical physics spring 2002 (see program, page 45)

Johnsson, A.:
* Meeting for biophysicists at "Kongsvold Fjellstue". Norwegian Physical Society.
March 13 – 15, 2002.
* Arranged course in "Space technology", spring 2002, together with the Space Science Committee, NTNU, (with i.a. one week experimental activities at the Andøya rocket station).

Kjeldstad, B.:
*Co-convener of the ultraviolet radiation session at European Geophysical Society Conference in Nice, France. April 2002.

Olaussen, K.:
* Convenor seminar series in theoretical physics autumn 2002 (see program, page 45)
*Convenor of "fredagskollokviet i fysikk" spring and autumn 2002

Samuelsen, E.J.:
* Convenor of "Fredagskollokviet i fysikk" spring and autumn 2002

Skagerstam, B.-S.:
* Convenor of seminar series in theoretical physics spring 2002. (see programme)

Stefansson, T.:
* "Eksperimentet som et redskap i begrepsdannelsen". One-day course for teachers from secondary schools. March 8, 2002. Cooperation with "Skolelaboratoriet for matematikk, naturfag og teknologi".

Stokke, B.T.:
* One-day seminar during NTNU arrangement "Japan 2002".

PARTICIPATION ON NATIONAL, INTERNATIONAL, UNIVERSITY AND DEPARTMENTAL COMMITTEES

International commissions:

Borg, A.:
* Member of the ESF Nanotribology network, University of Basel, Switzerland
* Committee on Condensed Matter Physics, Swedish Research Council

Fossheim, K.:
* Member, Steering Committee Vortex Matter Programme under ESF
* Member, International Advisory Committe, M2S HTSC, the World conference in superconductivity to be held in Rio de Janeiro.
* Member, International Advisory Committee, International Superconductivity Seminar, Japan.
* Member, International Advisory Committee for the 24th Risø International Symposium on Materials Science Superconductivity and Magnetism: Materials Properties and Developments

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).

Hunderi, O.:
* Topical Editor, Journal of the Optical Society of America
* Editorial Board, New Jornal of Physics
* Member of the organizing committee, EPIOPTICS 6, Erice, Sicilia. Italy.
* Member of the organizing committee, 3rd. International Conference on Ellipsometry, Wien, Austria.
* Member of the organizing committee, OSI-2003, Leon, Mexico.

Johnsson, A.:
* Consultant, Italian Space Research Council
* Member of Research Committee, Swedish Space Science Research Board.

Kjeldstad, B.:
* Member, Advisory board for establishment of EU reference UV laboratory at Joint Research Centre in Ispra, Italy. (2001 – 2004)

Mo, F.:
* Associate editor - Crystallography Review (Taylor & Francis)

Mork, K.:
* Editor, Physica Scripta

Naqvi, K.R.
* Member, International Union of Pure and Applied Chemistry Task Group for updating and expanding "Glossary of Terms used in Photochemistry"

Samuelsen, E. J.:
* Norwegian representative in Council for ”European Synchrotron Radiation Facility” ESRF, Grenoble.
* Chairman, ”Nordsync”, Nordic Consortium for Synchrotron Radiation (Denmark, Finland, Norway, Sweden).

Valberg, A.:
* Norwegian representative in Division I (Vision and Colour), Commission Internationale d’lEclairage (CIE)
* Member of CIE international technical committee TC1-37, Physiological based system of colorimetry
* Member of the board (Deputy Secretary) of International Society for Low-Vision Research and Rehabilitation

National commissions:

Borg, A.:
* Vice President, Norwegian Physical Society

Brataas, A.:
* Member in council of the planned network of excellence in EU 6th programme "Fundamentals of nanoelectronics"

Hansen, A.:
* Member of Working Group on Nano Technology, Norwegian Research Council.

Hemmer, P.C.:
* Member, board of Vista
* Member (representing NTNU), board of Nansenfond.

Hunderi, O.:
* Chairman of the Norwegian Electrooptics Meeting, Flåm

Johnsson, A.:
* Member "Forskningsutvalget", Department of Physics, University of Olso

Kjeldstad, B.:
* Member, board of KLIMAPRO, Programme for climate research in Norway, The Norwegian Research Council
* Educational committee for geophysical courses at University of Svalbard

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

Olaussen, K.:
* Member of "Fordelingsutvalget for tungregning" The Norwegian Research Council.

Stokke, B.:
* Member of UHR, Nasjonalt råd for teknologisk utdanning
*Member, representing NTNU in the board of FUNMAT.

* Chairman, board of council in NORLIGHT
* Member, Advisory board, Polymer Networks Conference, Grenoble, sept. 2002

Sudbø, A.:
*Chairman, Norsk fysikkråd
* Member, NORDITA Committee on Condensed Matter Physics/Biophysics.

Valberg, A.:
* Member of the committee for Science and Development at Tambartun National Center for the Visually Handicapped

University and Departmental commissions:

Borg, A.:
* Committee member, Engineering studies at NTNU
* Chairman of Division of Condensed matter Physics, Department of Physics, NTNU

Hansen, A.:
* Vice Department Head, Department of Physics, NTNU

Hunderi, O.:
* Member of the Board, Department of Physics, NTNU
* Chairman, Study Programme for Physics and Mathematics.

Høye, J. S. . :
* Chairman of educational committee at Department of Physics

Johnsson, A.:
*Head, Department of Physics, NTNU
* Chairman, board of Museum of Natural History and Archaeology, (Vitenskapsmuseet), NTNU
* Member, Board of Torstein Erbos Gavefond (representing NTNU)

Kjeldstad, B.:
* Member, Board of Department of Physics,
* Substitute member, Board of the Faculty of Natural Science and Technology

Olaussen, K.:
* Chairman of Division of theoretical Physics, Department of Physics (since August 2002)

Skagerstam, B.-S.;
*Chairman of Division of theoretical Physics, Department of Physics (until August 2002)

Skullerud, H.R.:
Member, Board of the Faculty of Natural Science and Technology

Stefansson, T.:
* Member, board of steering committee, School Laboratory for Mathematics, Natural Sciences and technology, NTNU

Stokke, B.:
* Vice Dean at Faculty of Science and Technology
* Chairman of faculty education committee
* Chairman, committee for "Nanotechnology", NTNU
* Member, board of committee for Medical Technology at NTNU
* Substitute member, Board - Programme for Education of Teachers, NTNU
* Member, committee for new degree structure (UNG), NTNU
* Project Director, Thematic Area Materials at NTNU

GUEST LECTURES AT THE DEPARTMENT

Friday afternoon lectures on subjects of general interest. ("Fredagskollokviet i fysikk")

Programme - Spring term

25.01 Professor Asle Sudbø, Institutt for fysikk, NTNU:
"Nobelprisen i fysikk for år 2001: Bose-Einstein-kondensat"

01.02 Direktør Gudmunn Slettemoen, Conoptica, Klæbu:
"Optikk som levevei"

08.02 Professor Anders Johnsson, Institutt for fysikk, NTNU:
"Cellevolum-oscillasjoner og bladbevegelser"

15.02 Professor Christian Thaulow, Institutt for materialer og bearbeiding, NTNU:
"Eksperter-i-team, NTNU-opplegg for læring av samarbeid"

22.02 Stipendiat Roland Wittje, Institutt for fysikk, NTNU:
"Demonstrasjoner i NTHs fysikkundervisning - en lokalhistorisk tilnærming"

01.03 Forskningssjef Gordon Christensen, Institutt for energiteknikk, Kjeller:
"Utslipp av radioaktive stoffer til marint miljø "

08.03 Førsteamanuensis Per Morten Kind, Institutt for fysikk, NTNU:
"Fysikk i skolen: En statusrapport og analyse av utfordringer for undervisningen ved universitetene."

15.03 Prorektor, førsteamanuensis Julie Feilberg, Institutt for anvendt språkvitenskap, NTNU:
"Språk og kommunikasjon"

05.04 Forskningssjef Øyvind Gregersen, Papirindustriens Forskningsinstitutt, NTNU:
"Papir: Fysiske egenskaper og struktur"

12.04 Stipendiat Knut Røed Ødegaard, Astrofysisk institutt, UiO:
"Kosmiske katastrofer"

19.04 Forsker Pål-Eric Øren, Statoil:
"Three-Phase Flow in Porous Media: A Journey through the Pore Space"

26.04 Professor Ragnar Fjelland, Senter for vitenskapsteori, UiB:
"Vitenskapskrigen og de to kulturer"

03.05 Professor Reidar Nydal, Institutt for fysikk, NTNU, Trondheim:
"Radioaktive tidsserier (C-14) som bidrag til forståelsen av klimautviklingen"

Programme - Autumn term

20.09 Professor Asle Sudbø, Institutt for fysikk, NTNU:
Splintrede elektroner og "magnetiske monopoler" i faste stoff

27.09 Forskningssjef Stian Løvold, Forsvarets forskningsinstitutt:
Nanoteknologi - ute i verden og hjemme i Norge?

04.10 Professor Razi Naqvi, Institutt for fysikk, NTNU:
Absorption and utilisation of light by photosynthetic systems (molecular, supramolecular, cellular, and even larger): a short talk with a long title and unashamedly local perspective

11.10 Førsteamanuensis Arne Brataas, Institutt for fysikk, NTNU:
Spinntronikk

18.10 Professor Alex Hansen, Institutt for fysikk, NTNU:
Why do fractures look like they do?

25.10 Professor Yura Lyubarskii, Institutt for matematiske fag, NTNU:
Wavelets, mathematics, and physics

01.11 Forsker John Walmsley, SINTEF:
A new Transmission Electron Microscope at the NTNU Physics Department - Direct examination of materials at the nanometre-scale

08.11 Professor Martin Ystenes, Institutt for kjemi, NTNU:
Kvalitetsreformen: Hvordan kan vi få studentene til å arbeide mer, uten å bryte med "NTH-kulturen"? Erfaringer med alternative undervisnings- og evalueringsformer

15.11 Dr.scient. Øystein Elgarøy, NORDITA :
Neutrinos and large-scale structure in the Universe

22.11 Professor Peter Coveney, University College London:
Self-organization and complexity: a new age for theory, computation and experiment

29.11 Professor Edvard Moser, Psykologisk institutt, NTNU:
Hukommelse i distribuerte nettverk av nerveceller

6.12 Forsker Ahn Kiet Nguyen, SINTEF:
Kvantedatamaskiner

13.12 Dr.ing. Dag Anders Moldestad, Institutt for konstruksjonsteknikk, NTNU:
Friksjon: Fra "superglid" på ski til utvikling av bildekksokken AutoSock

Thursday lectures in Theoretical Physics

07.02 Kim Sneppen, Institutt for fysikk, NTNU
New Stuff on Statistical Patterns in Biological Evolution

14.02 Johan S. Høye, Institutt for fysikk, NTNU
Van der Waals-Casimir Force Between Point Particles

21.02 Joakim Hove, Institutt for fysikk, NTNU
The order of the superconductor to normal transition in the Ginzburg-Landau model

28.02 Henning Arendt Knudsen, Institutt for fysikk, NTNU
Two-Phase Flow in Three and Four-Dimensional Porous Doughnuts: A New Surprising Flow Equation

07.03 Jan Myrheim, Institutt for fysikk, NTNU
From PC to QC: A quantum leap in computation?

13.03 Asle Sudbø, Institutt for fysikk, NTNU
Spontaneous time-reversal symmetry breaking in a strongly correlated electron system

20.03 Stein Olav Skrøvseth, Institutt for fysikk, NTNU
Entanglement in a System of Harmonic Oscillators

03.04 Jens Oluf Andersen, ITF, Utrecht
Lav-dimensjonale bosegasser

10.04 Bo-Sture Skagerstam, Institutt for fysikk, NTNU
Quantum Field Theory and Experiments on Interference of Light - Are There Photon "Wave-Functions" and If so Do They Interfere?

17.04 Ingve Simonsen, NORDITA
A Random Walk Through Surface Scattering Phenomena

08.05 Jan Myrheim, Institutt for fysikk, NTNU
Compact stars - a do-it-yourself guide

22.05 Iver Brevik, Mekanikk, NTNU
Strålingskrefter på mikropartikler i det evanescente feltet

03.09 Kåre Olaussen, Institutt for fysikk, NTNU
Some Amusing Properties of the Virial Expansion of Ideal Quantum Gases

10.09 Audun Bakk, NORDITA
Motor Proteins

17.09 Fernando Oliveira, Universidade de Brasilia
Breakdown of the Fluctuation-Dissipation theorem for systems with memory

24.09 Bo-Sture Skagerstam, Institutt for fysikk, NTNU
Quantum Electrodynamics in Unusual Environments

01.10 Andreas Westermoen, Institutt for fysikk, NTNU
How and why to calculate the winding distribution of random walkers

22.10 Dag Østvang, Institutt for fysikk, NTNU
Pioneer Surprise!

29.10 Souriraja Ramadurai, Tata Institute for Fundamental Research
Evidences for time variation of the fine structure constant

05.11 Harald Hanche-Olsen, Institutt for matematiske fag, NTNU
Buckinghams Pi-teorem

12.11 Asle Sudbø, Institutt for fysikk, NTNU
The 2+1 dimensional Abelian Higgs-model

19.11 Jo Smiseth, Institutt for fysikk, NTNU
Criticality in the 2+1 dimensional compact Abelian Higgs-model

26.11 Nils Erland Leinebø Haugen, Institutt for fysikk, NTNU
Dynamos in turbulent magnetized media