

Abstracts **talks**: Alphabetical by presenter.

Abstracts

Talks

Alphabetical

by presenter

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Spin echo in an arbitrary field: How to undo an unknown rotation

Abstract:

Spin echo in an arbitrary field: How to undo an unknown rotation

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In conventional spin echo experiments as used in NMR, control pulses are applied to a spin precessing in a magnetic field in such a way that the spin returns to the starting position at a specified time.

This will happen independently of the strength of the magnetic field (that is, the precession frequency). The usual pulse sequence, however, requires knowledge of the field direction. In experiments with single electrons trapped in quantum dots there is an interaction between the electron spin and the nuclear spins, the net effect of which is the precession of the electrons in a field that is unknown both in strength and direction. Motivated by this we investigate the possibility of finding a pulse sequence that will return the spin to the starting position with arbitrary magnetic field. A solution to this problem in the form of a series of longer and longer pulse sequences that approximate the solution was found, and the convergence properties of these sequences is discussed.



Abstracts **talks**: Alphabetical by presenter.

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Physics of non-centrosymmetric superconductors with significant spin-orbit splitting

Abstract:

Physics of non-centrosymmetric superconductors with significant spin-orbit splitting

Kjetil Børkje and Asle Sudbø

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Non-centrosymmetric superconductors have got a crystal lattice which lacks inversion symmetry. In some materials, like CePt₃Si and Cd₂Re₂O₇, this absence of inversion symmetry leads to significant spin-orbit splitting of otherwise degenerate bands. Taking this into account allows the superconducting order parameter in these systems to be of a new type, a linear combination of spin-singlet and spin-triplet states. I will give an introduction to these systems and their possibly exotic superconducting state. In the end, I will discuss our theoretical work on how to probe the superconducting state in such materials by means of Josephson junctions.

Abstracts **talks**: Alphabetical by presenter.

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Transport and topology in surfactant nanotube networks

Abstract:

Transport and topology in surfactant nanotube networks

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Networks of membrane nanotubes are involved in transport inside living cells. Recently it has also been revealed that cells can be connected by membrane nanotubes, these tubes apparently function as channels for inter-cellular transport and signaling. Membrane nanotubes can also be extracted from synthetic surfactant membranes. By direct micro-manipulation networks of nanotubes connecting vesicles has been constructed, and controlled nano-fluidic transport has been achieved. The aim of the talk is to discuss several theoretical questions raised by these experiments. We first discuss the hydrodynamics of formation of the network and the creation of flow inside the tubes by membrane tension gradients. We then show two applications of the nanotubes: the formation of liquid knots and single-file electrophoresis of DNA molecules. Finally we discuss the motion of Y-junctions in a tube network and the evolution of the network.

Abstracts **talks**: Alphabetical by presenter.

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Water diffusion in porous systems, gels and colloids: A nuclear magnetic resonance study.

Abstract:

Water diffusion in porous systems, gels and colloids: A nuclear magnetic resonance study.

Mario Engelsberg

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Nuclear magnetic resonance is a powerful tool for studying transport and diffusion of water or other fluids in a variety of systems. This can be done in at least two ways: Magnetic resonance imaging (MRI) can be used to measure the transport diffusivity through the space and time evolution of fluid concentration when a macroscopic concentration gradient is present. On the other hand pulsed field gradient (PFG) methods can be used to measure the self-diffusion coefficient of water molecules when no macroscopic concentration gradients exist. The usefulness of the information obtainable in each case is illustrated by two specific examples of considerable interest. a) Water transport diffusivity in zeolites: The transport process of water in porous samples of non-activated Y-type (Na) zeolite, was found, from MRI measurements, to exhibit subdiffusive behavior in all cases. The fractal time diffusion equation [1] appears to provide an adequate framework to interpret the data furnishing consistent values for the moisture-dependent effective transport diffusivity and revealing the interplay between mesopores and nanopores. b) Nematic order in the gel phase of a colloidal suspension of clay platelets: Water self-diffusion measurements in synthetic fluorhectorite platelets using the PFG method revealed a spatial anisotropy in the gel phase which was found to be consistent with the nematic order previously reported by Fossum et al [2]. The NMR data suggest that the anisotropy of the diamagnetic susceptibility is sufficient to orient the platelets with their normal perpendicular to a 2T magnetic field. The orientation takes place at different rates depending upon the concentration of an electrolyte (NaCl) which controls the competition between the attractive Van de Waals force and the electrostatic repulsion between platelets.

[1] Ralf Metzler, Eli Barkai, and Joseph Klafter, Phys. Rev. Lett. **82**, 3563 (1999).

[2] J. O. Fossum, E. Gudding, D. d. M. Fonseca, Y. Meheust, E. DiMasi, T. Gog, and C. Venkataraman, Energy **30**, 873 (2005).

Abstracts **talks**: Alphabetical by presenter.

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Ionization dynamics of atoms and molecules in superintense high-frequency attosecond pulses

Abstract:

Ionization dynamics of atoms and molecules in superintense high-frequency attosecond pulses

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The ionization dynamics of atoms and molecules in superintense, high-frequency, attosecond pulses is studied by fully three-dimensional ab initio wave packet calculations. A new form of the light-atom Hamiltonian is developed and used in a study of nondipole effects in these systems. The energy and angular distributions of the photoelectron are obtained. We identify a unique nondipole lobe in the angular distribution of the ejected electron and show that this lobe has a well-defined classical counterpart. Furthermore, in the nondipole regime, the ionization is likely to occur antiparallel with the laser propagation direction, which is opposite to what is predicted in intense low-frequency fields. Supported by classical calculations we develop a model that explains the emergence of the unique extra lobe in the angular distributions.

Abstracts **talks**: Alphabetical by presenter.

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Magnesium-based light transition metal alloys: physics and applications to solar collectors, hydrogen sensors and batteries

Abstract:

Magnesium-based light transition metal alloys: physics and applications to solar collectors, hydrogen sensors and batteries

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A renewed interest in Mg-TM (with TM standing for Sc, Ti, V, Cr) alloys was triggered by the recent observation that batteries made of these alloys have electrical storage capacities approx. 4 times higher than that of conventional Ni-metalhydride batteries¹. In a study based on hydrogenography we discovered that the same type of alloys exhibit also very interesting optical properties. Mg-Ti and Mg-V thin films have very attractive switchable optical properties that can be tuned by varying the composition and film thickness. The films absorb ~90% of the solar radiation in the hydrogenated state (bottom picture) and ~30% in the metallic state (top picture). Furthermore, in the absorbing state (bottom picture) Mg-Ti-H has a low emissivity: at 400 K only 10 % of black body radiation is emitted. The reflector-to-absorber transition is fast, reversible, robust and tuneable through

varying the Ti or V content. The combination of these properties offers completely new possibilities for applications as switchable smart coatings for solar collector² and hydrogen sensor.

From a physics point of view these films are rather puzzling. In bulk form it is known that Mg and Ti or V do not alloy. As films, however, they form metastable alloys that are, in fact, remarkably stable even after hundreds of hydrogen ab- and desorption cycles. Their optical and electrical properties can be understood if one assumes that hydrogen induces a reversible segregation in metallic and insulating nanoparticles. In addition a self-organized layering of the film during H absorption³ has to be taken into account to explain the strongly absorbing black state. However, the origin of the peculiar temperature dependence of their electrical resistivity ($(1-\alpha T)$ for Mg-V-H and $(1-\alpha \ln(T/T_0))$ for Mg-Ti-H) is still not identified.

[1] R. A. H. Niessen and P. H. L. Notten, *Electrochemical and Solid-State Letters*, 8 (2005) 534-538

[2] D. M. Borsa, A. Baldi, M. Pasturel, H. Schreuders, B. Dam, R. Griessen: Mg-Ti-H thin films for switchable solar collectors, *Appl. Phys. Lett.* (2006) in press

[3] W. Lohstroh, R. J. Westerwaal, B. Noheda, S. Enache, I. A. M. E. Giebels, B. Dam, and R. Griessen: *Phys. Rev. Lett.* 93 (2004) 197404

Abstracts **talks**: Alphabetical by presenter.

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The Mathematics of NanoCarbon

Abstract:

The Mathematics of NanoCarbon

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Much of current theoretical nanoscience is a pursuit for the electronic properties that characterize entire classes of the new and exotic molecular structures that are now being synthesized. Mathematics is therefore a large and indispensable part of the game. Together with a presentation of our own results, we review the essential mathematics of nanocarbon, from ancient theorems to recent graph theoretical techniques. The physical justification and accuracy of the underlying models will be discussed.

Abstracts **talks**: Alphabetical by presenter.

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Dendritic avalanches of magnetic flux in superconducting films

Abstract:

Dendritic avalanches of magnetic flux in superconducting films

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When magnetic flux penetrates a superconductor, the emerging flux pattern usually reflects the shape of the sample. The conventional flux penetration can however be interrupted by abrupt avalanches appearing due to thermo-magnetic instability. In the course of such an avalanche, the flux is rushing into the sample at velocities of 100 km/s along narrow and branching channels heated above the critical temperature. The resulting dendritic flux pattern is reminiscent of that produced by viscous fingering or dielectric breakdown. It never repeats itself when the experiment is repeated and has a number of other remarkable properties that will be described in the talk. The flux patterns were observed using magneto-optical imaging in various superconductors and we analyzed in detail their dependence on temperature, applied magnetic field and sample dimensions. The results are in excellent agreement with a proposed model of the thermo-magnetic instability based on a linear analysis of the Maxwell and thermal diffusion equations.

Abstracts **talks**: Alphabetical by presenter.

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XPS study of the electronic properties of the Ce/4H-SiC interface, and the formation of the SiO₂/Ce₂Si₂O₇/4H-SiC interface structure upon oxidation

Abstract:

XPS study of the electronic properties of the Ce/4H-SiC interface, and the formation of the SiO₂/Ce₂Si₂O₇/4H-SiC interface structure upon oxidation

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Abstract

The deposition and annealing in ultra high vacuum (UHV) of 5-6 monolayers (ML) of cerium on clean reconstructed Si-face 4H-SiC (0001) is studied by x-ray photoemission spectroscopy (XPS) ¹. Band bending as a function of annealing was studied by shifts of the bulk peak contribution in the C1s and Si2p spectra relative to the clean reconstructed surface. Additional data-points for Schottky barrier formation on 4H-SiC are thus obtained by the low work function rare-earth metals, and presented in the framework of the metal-induced-gap states and electronegativity model. A Ce/CeSi_{2-x}/4H-SiC interface alloy forms by annealing to 850-1050 °C. Kinetic information from the oxidation of the Ce/CeSi_{2-x}/4H-SiC interface alloy is also reported. In particular, a SiO_{2-x}/Ce-Si mixed oxide/4H-SiC forms upon oxidation. The shift of the C1s SiC-bulk-peak towards higher binding energies upon oxidation, indicates that the mixed Ce-Si oxide interface layer appears to passivate the near Fermi-level 4H-SiC interface states at least as well as SiO₂, and are expected to modify the electrical interface characteristics.

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Abstracts **talks**: Alphabetical by presenter.

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Interference-like cancellations in superconductor-hopping insulator interface

Abstract:

Interference-like cancellations in superconductor-hopping insulator interface

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Transport of Cooper pairs over a superconductor - hopping insulator interface is studied in both linear and non-linear regimes at low temperatures. It is shown that for hydrogen-like impurities, extreme cancellations occur, which suppress transport. The effect of interface barrier details is studied, and situations where the cancellations may be lifted are analyzed.

Abstracts **talks**: Alphabetical by presenter.

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Attosecond pulse generation and application

Abstract:

Attosecond pulse generation and application

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Attosecond pulses are among the most celebrated offspring of strong field physics. The pulses are generated through a process known as high-order harmonic generation (HHG) when ultra short laser pulses are focused into a gas. The prevailing and widely accepted model for HHG is the so-called three-step model where an electron tunnels out, through the disturbed Coulomb potential; gains energy from the electric field; and recombines with the ion producing a short burst of light.

In this talk we present how attosecond pulses are generated and characterized, and how our understanding of the generation process enables us to tailor the attosecond pulses. Using dispersive optics we show that the attosecond pulse can be further compressed and pulses with a transform limited duration delivered on target. We also show how the generation of the attosecond pulses can be controlled by adding the second harmonic of the fundamental to the driving laser field. The generated attosecond pulses are in the extreme ultraviolet wavelength region and will therefore ionize atoms they interact with, producing a novel type of temporally localized electron wave packets. These electron wave packets can, for instance, be used to study and control electron dynamics in external laser fields.

Abstracts **talks**: Alphabetical by presenter.

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Growth activity during fingering in a porous Hele Shaw cell.

Abstract:

Growth activity during fingering in a porous Hele Shaw cell.

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Yves Meheust, NTNU Trondheim,

Jean Schmittbuhl, Univ. of Strasbourg, Renaud Toussaint, Univ. of Strasbourg

We present an experimental study of the invasion activity during unstable drainage in a 2D random porous medium, when the (wetting) displaced fluid has a high viscosity with respect to that of the (non-wetting) displacing fluid, and for a range of almost two decades in capillary numbers corresponding to the transition between capillary and viscous fingering. We show that the invasion process takes place in an active zone within a characteristic screening length λ from the tip of the most advanced finger. The invasion probability density is found to only depend on the distance z to the latter tip, and to be independent of the value for the capillary number Ca . The mass density along the flow direction is related analytically to the invasion probability density, and the scaling capillary number is consistent with a power law. Other quantities characteristic of the displacement process, such as the speed of the most advanced finger tip or the characteristic finger width, are also consistent with power laws with respect to the capillary number. The link between the growth probability and the pressure field have been studied and an expression for the pressure boundary condition on the cluster have been calculated. The measured pressure has been compared with the corresponding simulated pressure using this expression for the boundary condition on the cluster.

Abstracts **talks**: Alphabetical by presenter.

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Slow relaxation and anomalous diffusion

Abstract:

Slow relaxation and anomalous diffusion

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Anomalous diffusion has been a source of surprises [1, 2]. For example for ballistic superdiffusion, ergodicity and the fluctuation-dissipation theorem does not hold [3]. In this talk we show that the correlation function, responsible for the major physical properties is an even function, therefore it can not be an exponential, stretched exponential, or power laws. However, for a proper choice of parameters, those function can be reproduced within certain intervals, with good precision [4]. We show as well that for ballistic propagation a non-Gaussian behavior occurs. This has important consequences for pattern formation.

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- [1] F. A. Oliveira, R. Morgado, C. Dias, G. G. Batrouni and A. Hansen, *Phys. Rev. Lett.*, **86**, 5839 (2001).
- [2] R. Morgado, F. A. Oliveira, G. G. Batrouni and A. Hansen, *Phys. Rev. Lett.*, **89**, 100601 (2002).
- [3] I. V. L. Costa, R. Morgado, M. B. V. T. Lima, and F. A. Oliveira, *Europhysics Letts* **63**, 173 (2005); M. H. Vainstein, I. V. L.M. Costa and F. A. Oliveira, *Lecture Notes in Physics* **668**, 159 (2006).
- [4] M. H. Vainstein, I. V. L. Costa, R. Morgado, and F. A. Oliveira, *Europhysics Letts* **73**, 726 (2006).

Abstracts **talks**: Alphabetical by presenter.

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Surface nano-precipitates in the Ti enhanced NaAlH₄ system

Abstract:

Surface nano-precipitates in the Ti enhanced NaAlH₄ system

Mark Pitt, Institute for Energy Technology, IFE, Kjeller, Physics Department,
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After almost a decade of research into the behaviour of transition metal additives in the NaAlH₄ system, with in the order of 150 citable experimental (20 different experimental methods) and modelling publications, there remains no simple answers to the basic but fundamental questions, a) where is the active Ti, and b) what does it do? In planetary milled samples, some 2/3rd of the added Ti is accounted for as an Al_(1-x)Ti_x solid solution ($x < 10\%$ solubility), however, all attempts at co-milling NaAlH₄ with Al_(1-x)Ti_x type phases have resulted in poor kinetics. As it is abundantly clear both experimentally and from DFT modelling that bulk substitution is unfavourable, the powder microstructure and powder surface remain as potential locations of kinetically active Ti. We have adopted a simple but powerful geometrical technique, the measurement of crystalline mosaic (domain) size from the diffraction lineshape (high resolution X-ray synchrotron), to determine what, if any influence, Ti additives have on the microstructure. In combination with the measurement of external powder grain dimensions by TEM, we can determine if changes in diffraction lineshape due to Ti addition are the result of internal changes in the powder grain microstructure, or a surface related decrepitation of the external powder grain size. Our study follows the behaviour of Ti rich (up to 10mol%) powders under a range of temperature and pressure conditions, from wet synthesised and ball-milled powders, to hydrogen-cycled powders.



Abstracts **talks**: Alphabetical by presenter.

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Earth's Carbon Cycle as a Problem of Reactive Diffusion

Abstract:

Earth's Carbon Cycle as a Problem of Reactive Diffusion

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Much of Earth's carbon cycles between photosynthesis and respiration. The extent to which respiration balances photosynthesis determines not only environmental concentrations of carbon dioxide but also free oxygen and the geologic accumulation of hydrocarbons. Respiration occurs at all time scales, but at progressively slower rates. Observations indicate that marine respiration rates decay like $1/t$ as organic matter falls from the sea surface to the sea floor, and as it proceeds through degradation in sediment. The relevant time scales span up to 10 orders of magnitude.

These observations motivate a theory for detrital decay. We find that the $1/t$ scaling for rates can be explained by processes in which the consumption of organic matter decreases exponentially with distance from the consumer (i.e., bacteria). A simple model of decay driven by the reactive diffusion of extra-cellular hydrolytic enzymes in porous sediments illustrates these ideas. It also suggests that the $1/t$ decay in rates is accompanied by a slow logarithmic decay of the concentration of organic matter. Analyses of approximately twenty sediment cores from widely different environments suggest that this logarithmic decay is ubiquitous. The significance of these findings for problems ranging from global warming to the rise of free oxygen and its implications for early animal evolution is briefly discussed.



Abstracts **talks**: Alphabetical by presenter.

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Avalanche prediction in Self Organized Critical Systems

Abstract:

Avalanche prediction in Self Organized Critical Systems

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The earthquake models based on the ideas of Self Organized Criticality (SOC) have been heavily criticized due to the lack of predictability in the Bak, Tang and Wiesenfeld (BTW) model, paradigm of the SOC. Nevertheless we have found a quasiperiodic behavior in a more realistic scenario (when dissipation is introduced to the system) [Phys. Rev. Lett. 96, 098591 (2006)]. Current simulations and experiments are performing in order to analyze the possibility of structural changes in the system before a large avalanche happening.

Abstracts **talks**: Alphabetical by presenter.

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Improved ResearchTools: Major upgrading of the ESRF

Abstract to be presented during the annual meeting for NFS members Thursday 14/9 :

”Improved ResearchTools: Major upgrading of the ESRF”

Emil J Samuelsen, (ESRF council member), Institutt for Fysikk, NTNU, Trondheim

Since its opening in 1994 the ESRF has aimed at staying at the forefront of the development of synchrotron radiation for materials research. Although new 3rd generation synchrotrons are being constructed, the goals of ESRF have been achieved. The beam-lines are periodically reviewed, and a refurbishment programme is carried out, with annual investment of the order of 15 M€. However, in order to keep European materials research properly updated, a major upgrading is presently being launched, involving the following ingredients:

- The synchrotron ring current be increase by a factor of 1.5, later further increased to a factor 2.5.
- “*Canted undulators*” be installed in 1/3 of the beam lines, thus increasing the available number of beams and their quality.
- 10-12 beam channels be lengthened from 50 meters to 120 meters, thus making fine-focussing to 40 nanometer beam size for nano-technological applications.
- Further refinement of x-ray mirrors, compound lenses and detectors.
- Special beamlines for studies under ultra-high pressures, temperatures and fields.
- Establishing of Nano-Science Centre, starting from already ongoing upgrading in nano-diffraction and nano-tomography. The Centre be modelled after “Partnership for Structural Biology” (2002).
- Estimated budget 175 M€, over five years from 2008.

The planning was approved by the ESRF Council in June 2006, aiming at initiating the programme in a year. Financing by EU-projects and member contribution, for Norway amounting to 8 MNOK over five years. The upgrading will require to close the ESRF for users for three quarters of a year.

Abstracts **talks**: Alphabetical by presenter.

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Pattern formation: building mazes with grains

Abstract:

Pattern formation: building mazes with grains

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The natural world displays a rich catalog of patterns formed in systems driven away from their equilibrium state. Familiar examples from the physical sciences include dendritic growth of crystals, fracture patterns, viscous fingering and the self-organized assembly of wind-blown grains into sand ripples and desert dunes. Here we demonstrate a new pattern forming process. Complex maze-like structures take shape during slow withdrawal of fluid from an initially uniform grain/fluid dispersion confined between two parallel glass plates. As the fluid/air interface recedes, an instability develops whereby fingers of invading air sweep the grains into compact walls spanning the gap between the plates. Finally, when all the fluid has been drained, we are left with a branching structure of compacted grains in narrow walls separated by channels of air in a pattern that topologically can be classified as a simply-connected maze. Results will be presented from both experiments and simulations revealing that the pattern forming instability is a result of a finely balanced interaction between friction and capillary forces. We also demonstrate how the characteristic length scale in the pattern is determined by parameters such as volume fraction of grains and the separation between the plates.

Abstracts **talks**: Alphabetical by presenter.

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Local Waiting Time Fluctuations along a Randomly Pinned Crack Front

Abstract:

Local Waiting Time Fluctuations along a Randomly Pinned Crack Front

Stephane Santucci

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The propagation of an interfacial crack along a heterogeneous weak plane of a transparent Plexiglas block is followed using a high resolution fast camera. We show that the fracture front dynamics is governed by local and irregular avalanches with very large size and velocity fluctuations. We characterize the intermittent dynamics observed, i.e., the local pinnings and depinnings of the crack front by measuring the local waiting time fluctuations along the crack front during its propagation. The deduced local front line velocity distribution exhibits a power law behavior, $P(v) \propto v^{-\eta}$ with $\eta = 2.55 \pm 0.15$, for velocities v larger than the average front speed $\langle v \rangle$. The burst size distribution is also a power law, $P(S) \propto S^{-\gamma}$ with $\gamma = 1.7 \pm 0.1$. Above a characteristic length scale of disorder $L_d \sim 15 \mu\text{m}$, the avalanche clusters become anisotropic providing an estimate of the roughness exponent of the crack front line, $H = 0.66$.



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Topics in Cavity Quantum Electrodynamics

Abstract:

Topics in Cavity Quantum Electrodynamics.

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We give a brief discussion of some recent work on the complex behaviour of micromaser systems and the role of detection efficiencies. Single photon detection in micromasers in the hunt for axions will also be briefly touched upon.

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Using oscillating magnetic holes for viscosity measurements of ferrofluids

Abstract:

Using oscillating magnetic holes for viscosity measurements of ferrofluids

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Ferrofluid is a liquid composed of nanoscale ferromagnetic particles suspended in a carrier fluid, usually an organic solvent or water. A ferrofluid becomes strongly polarised in the presence of a magnetic field.

A non-magnetic sphere contained in a ferrofluid, gives rise to a so called magnetic-hole. When two magnetic holes in a ferrofluid are contained between two glass plates, we get a quasi 2-D system. By applying a circulating magnetic field, the spheres may be manipulated to oscillate at a constant rate. This is possible due to the fact that the two holes interact according to a dipole model. By combining the dipole forces and the hydrodynamic forces acting on the spheres, the oscillating movement may be used to determine the viscosity of the ferrofluid. As the spheres used are only 50 μm in diameter, this technique for measuring viscosity represents a new microrheological method which requires only small volume samples, and a simple experimental setup. The method is useful for ferrofluids of low viscosity (1-10 mPa s).

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Quantum dot intermediate band solar cell

Abstract:

Quantum dot intermediate band solar cell

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Shumin Wang and Mahdad Sadegi
Arvid Larsson and Per-Olof Holt
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Linköping University, Sweden

One strategy to enhance the solar cell efficiency is to introduce intermediate energy levels in the forbidden semiconductor bandgap by insertion of quantum dots. The energy levels of the dots need to be coupled to form the intermediate energy bands, and the intermediate bands that are formed are decoupled from the valence and conduction band of the solar cell host material. Thus the photogenerated current increases by multi-step absorption of infrared photons, that otherwise would not be absorbed in the host material, while the voltage is determined by the host material. Multiple quantum dot layers are needed to raise the absorbance of the infrared part of the incoming solar radiation significantly. Recently the first experiments of MBE growth of InAs quantum dots buried in GaAs and AlAs for solar cell applications were performed. Results from atomic force microscopy, photoluminescence and absorbance studies will be presented.



Abstracts **talks**: Alphabetical by presenter.

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Interaction Between a Magnetic Domain Wall and Superconducting Vortices

Abstract:

Interaction Between a Magnetic Domain Wall and Superconducting Vortices

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We use magneto-optical imaging with single-vortex resolution to study interaction between a zigzag magnetic domain wall and vortices in a NbSe₂ superconductor. Surprisingly, the domain wall is found to attract a large number of vortices, despite that the common model of a domain wall as a out-of-plane bar magnet should lead to the opposite: repulsion of vortices. This apparent contradiction can be solved by taking into account the in-plane magnetization of the magnetic film. The component of the in-plane magnetization transverse to the domain wall gives rise to net magnetic charges at the wall and corresponding stray fields. The calculated magnitude of the interaction-force is in the experimental situation found to be of order 10pN.

For the model, we calculate the equilibrium vortex distribution in the superconductor and compare with the experiment.

Abstracts **talks**: Alphabetical by presenter.

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Simulation and Experiment of a Rayleigh-Taylor Instability in Granular Flow

Abstract:

Simulation and Experiment of a Rayleigh-Taylor Instability in Granular Flow

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A new gravitational instability, observed when a column of dense granular material is positioned above a gap of air in a gravitational field, is reported both numerically and experimentally. As the grains sediment a characteristic pattern of fingers emerges along the interface and a transient coarsening of the structure is caused by a coalescence of neighbouring fingers. The coarsening is slowed down and impeded by the production of new fingers as the separation of the existing fingers reach a critical distance. Both a qualitative and quantitative comparison of the experiment and simulation are presented. The data are further analysed by calculating the mean of the solid fraction power spectrum. This is a decreasing function of time which indicates a relocation of the dominating wave numbers as the observed structures enlarge. The growth rates of the solid fraction wave numbers are also analysed, and transient exponential growth rates are identified early in the evolution of the instability. The exponential growth makes a connection to the hydrodynamical Rayleigh-Taylor instability. The effect of changing the grain diameter or the granular dissipation are also investigated. If the grain diameter is doubled the size of the observed structures increase accordingly. Dissipation is controlled by a restitution coefficient which has an effect on the generation of fingers.

Abstracts **talks**: Alphabetical by presenter.

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Exciton transfer efficiency between asymmetric coupled GaAs V-groove quantum wires

Abstract:

Exciton transfer efficiency between asymmetric coupled GaAs V-groove quantum wires

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Exciton transfer between two GaAs V-groove quantum wires or two planar quantum wells separated by AlGaAs barriers ranging from 5.5 nm to 20 nm thickness are studied photoluminescence excitation spectroscopy. It is found that the transfer is strongly reduced between the widely spaced quantum wires compared with quantum wells. This observation is supported by numerical calculations, which yield strong dimensionality dependence of the photon-exchange transfer, resulting in negligible contribution to the transfer rate between the wires although it is the dominating transfer mechanism between widely spaced wells.

We have also studied coupled GaAs V-groove quantum wires embedded in a p-n junction, in which the electrons and holes are injected into different wires. Our experimental results indicate efficient electron and hole tunneling, despite a 7 nm thick AlGaAs tunnel barrier. Temperature dependent electroluminescence exhibits clear effects of tunneling up to room temperature but we cannot distinguish electron/hole tunneling from exciton tunneling.

Abstracts **talks**: Alphabetical by presenter.

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Complex superconductors: surface roughening and avalanches in the 'fluxscape'

Abstract:

**Complex superconductors:
 surface roughening and avalanches in the 'fluxscape'**

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Vortex matter is a special kind of granular matter with intriguing and complex behavior. It is composed of the vortices in type-II superconductors, which behave as granular particles with a repulsive interaction. Due to pinning, there is generally a strong gradient in vortex density. This sloping 'fluxscape' looks very similar to the surface of a sand heap and like a sand heap may also generate avalanches. The fluxscape can be easily observed (in particular in slab-shaped samples) using magneto-optic imaging, which yields a two-dimensional map of the magnetic field (and hence vortex density) on the surface of the sample.

In the present talk we discuss the statistical properties of the fluxscape itself and of the avalanches on its surface. We discuss the roughening properties of the fluxscape and determine its roughness exponent α and its growth exponent β . We analyze the avalanches in terms of self-organized criticality (SOC) and find a powerlaw probability density for the avalanche sizes. We also observe finite size scaling. Within SOC theory, 'exponent relations' should hold between α and β on one side and the exponents characterizing the avalanche behavior on the other side. These relations are verified experimentally.

In a system (NbH_x) where the amount of disorder can be continuously changed, we observe a transition from non-SOC to SOC behavior with increasing disorder. This transition is monitored in terms of the roughness and avalanche properties. Surprisingly, not all of these are affected by the transition.

Finally, we study the more dramatic thermo-magnetic avalanches, which are typically large and non-local in origin. Non-local avalanches are also invoked in the description of solar flares and are in both cases due to long range electrodynamic effects. A coupled thermo-magnetic model yields an excellent description of these avalanches, both in terms of stability analysis and in terms of morphology. Vortex matter is rather unique in being a reproducible granular system with fast dynamics and interaction of tunable range, thus opening many possibilities for future experiments in the field of complexity.

Abstracts **talks**: Alphabetical by presenter.

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High resolution thermal imaging of hotspots in superconducting films

Abstract:

High resolution thermal imaging of hotspots in superconducting films

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Thermal imaging of hotspots in bridge structures of YBaCuO thin films is presented with micrometer resolution. Hotspots formed by passing transport currents are observed using a method based on the temperature dependence in the photoluminescence of a polymer thin film deposited on the superconductor. It is shown that, e.g., passing a current of 10 mA in a 9 micrometer wide bridge the temperature distribution over the bridge and in its vicinity can be observed with a resolution better than 0.1 K. The local temperature rise has a maximum of 4.5 K. In a larger superconducting network several hotspots are observed in different branches of the network depending on the magnitude of the applied current. In an external magnetic field the hotspots are formed at lower transport current and at several seconds delay. It is also found that states with hotspots show hysteretic or bistable behavior, in agreement with earlier theoretical predictions. Also details of the experimental method will be reported.