OULUN YLIOPISTO
UNIVERSITY of OULU

FYSIIKAN LAITOS

## Fysiikan seminaarit -haku

Haku [2000-2013, laitos] tuotti seuraavat osumat:

- 22.02.2007 Kari Rummukainen (Oulun yliopisto)
Mikroaaltotaustaustasäteily kaiku maailmankaikkeuden syntyhetkistä *...lisää*
- 02.11.2007 Dos. Esa Turunen (Sodankylä Geophysical Observatory)
Northern lights: From myths to climatic effects *...lisää*
- 05.12.2007 Prof. Helena Aksela (Oulun yliopisto, Fysikaalisten tieteiden laitos)
Interaction between light and matter: Research with light 100 years after Einstein (Valon ja aineen vuorovaikutus: Tutkimusta valolla 100 vuotta Einsteinin jälkeen)
- 17.01.2008 Prof. Jukka Jokisaari
Magneettikuvaus ja muita radiosäteilyn sovelluksia / Magnetic resonance imaging and other applications of radio waves *...lisää*
- 21.02.2008 Prof. Juri Poutanen
Black holes - the power engines of universe *...lisää*
- 10.04.2008 C. Rodger (Otagon yliopisto, Uusi-Seelanti)
Explosions from the Sun: How do energetic particles affect the Earth´s polar atmosphere? *...lisää*
- 16.05.2008 Dr. Larry Esposito (LASP, Coloradon yliopisto, Boulder, USA)
Saturn´s rings *...lisää*
- 24.09.2008 Erkki Thuneberg (Oulun yliopisto)
Suprajohtavat piirit kvanttitietokoneen toteuttajana (Superconducting circuits realizing the quantum computer) *...lisää*
- 16.10.2008 Matti Weckström (Oulun yliopisto)
Näkemisen fysiikka (Physics of seeing)
- 06.11.2008 Dr. Peter Thejll (Danish Meteorological Institute)
How to tell the climate by looking at the Moon? *...lisää*
- 04.12.2008 Wladyslaw Trzaska (Jyväskylän yliopisto)
Big Science? Experimental high energy physics yesterday and tomorrow
- 26.03.2009 Annika Seppälä (British Antarctic Survey, Cambridge, U.K.)
Auroras and ozone loss: New results on the effects of solar particle bursts in the Earth´s atmosphere
- 16.04.2009 Thomas Ulich (Sodankylä Geophysical Observatory)
Is the sky falling on our head? Upper atmosphere greenhouse effect
- 03.06.2010 Steven Girvin (Department of Physics, Yale University)
Quantum Measurements, Noise, and Amplification: From Gedanken Experiments to the Real World

Abstract:

In the early days of quantum mechanics many gedanken experiments were proposed to explore the strange features of 'wave function collapse' in the measurement process. Today practical versions of these experiments are being performed. One example is the measurement of the position of a moveable mirror using optical interferometry. The more photons that are used, the more precisely the position can be determined. However, the greater the precision, the greater is the measurement 'back action' which disturbs the position due to the random momentum impulses delivered to the mirror by the photons. Hence the optimal measurement is a compromise between these two effects.

A second practical example, which has become possible because of remarkable progress in creating superconducting qubits, is that it is now possible to build microwave amplifiers whose performance comes very close to the limits set by the Heisenberg uncertainty principle. Such amplifiers are 40x better than the best HEMT amplifiers and hold the current world record for two mode squeezing of about 20dB. This talk will be a very simple and informal introduction to the physics of quantum measurements, noise, back action and amplification.

More about the speaker: *home page*, *Yale page*
Contact person: *Erkki Thuneberg*

- 25.01.2011 Dr. Thorsten Lisker (University of Heidelberg)
Do present-day galaxy clusters look as predicted by cosmological models?

Abstract: I report on an ongoing project that intends to bring together the galaxy content of observed and modeled galaxy clusters at redshift zero. Our observational reference are the Virgo, Fornax, Coma, and Perseus clusters. The model galaxies are provided by a recent semi-analytic model (Guo et al. 2011) based on hierarchical LCDM structure formation in the Millennium-II simulation. We are particularly interested in the question whether the properties of the observed diverse dwarf galaxy population are reproduced in the model. Should this not be the case, would it mean that many

dwarfs are formed by environmental mechanisms not included in the model? Or would it merely indicate that some of the complex physics of galaxy formation are not yet fully understood?

- 17.02.2011 MSc. Timo Virtanen (University of Oulu)
Quasiparticle dynamics in Fermi liquids

Abstract: Fermi liquid theory is a fundamental theory of interacting many body systems, a standard against which other theories can be compared. We have discovered a new feature originating from the theory, which we label ´Landau force´. The force is due to Fermi liquid interactions, and can be seen as elasticity of the interacting Fermion system in the collisionless ballistic limit. The elasticity of interacting Fermion system is observed in vibrating wire resonator experiments in 3He-4He mixtures at low temperatures as an increase in the resonant frequency of the wire. In this seminar I will describe how we have adapted Landau´s Fermi liquid theory to a form suitable for numerical calculations, and how the theory is applied to simulate vibrating wire resonator experiments. I will discuss the effects of interactions, confinement, boundary conditions, driving frequency, and many other parameters that have been studied in extensive numerical calculations.

- 03.03.2011 MSc. Arto Piironen (University of Oulu)
Ultra-small and customizable multichannel electrodes for extracellular recordings

Abstract: Recordings of electrical neural activity deep in nervous systems of intact animals are required to obtain information of the signals and information they conduct and process. Increasing demand exists for smaller multichannel electrodes to enable simultaneous recordings of several neurons in a non-invasive manner. In this talk a novel method is reported for manufacturing ultra-small carbon fiber electrodes with up to 7 closely spaced recording sites. The electrodes were designed to minimize damage to neuronal circuitry and to be fully customizable in 3D so that their dimensions can be optimally matched to those of the targeted neuron population.

- 17.03.2011 Christopher Pethick (NORDITA and the Niels Bohr International Academy, Copenhagen)
From nanokelvin to terakelvin: Spin fluctuations in cold gases and supernovae

Abstract: Despite the vast difference in the energy scales, the physics of ultracold atomic gases has much in common with that of dense matter in supernovae and neutron stars. After a general introduction, I shall discuss spin fluctuations in ultracold gases, where they are an important diagnostic tool for studying strong correlations, and in supernovae, where they are responsible for scattering of neutrinos. Similarities between ultracold Fermi gases with resonant interactions and nuclear matter at densities much below those in atomic nuclei will be explored.

- 14.04.2011 Matti Silveri
Modifying and controlling the energy levels of a superconducting Josephson element

Abstract: Recently, an increasing emphasis has been put on the study of systems formed by a superconducting Josephson element coupled to an LC-oscillator. The former comprises a discrete quantum few-level atom, whereas the latter supports electromagnetic oscillations at the microwave range. This kind of setup makes possible to study phenomena of quantum optics and atomic physics in parameter regime that have previously been inaccessible experimentally. After an short introduction to the physics of superconducting circuits, I will give two examples of research in such systems. First it is shown how the energy levels of a two-level atom change in a radiation field with high intensity. The second example shows how the very good controllability of the energy levels of the Josephson elements could be exploited in studying the motional averaging/narrowing phenomena in a single atom.

- 28.04.2011 Matti Hanni
Nuclear spin relaxation due to chemical shift anisotropy in gaseous xenon

Abstract: The nuclear spin relaxation times due to chemical shift anisotropy (CSA) of monoatomic gaseous xenon are computed from first principles using molecular dynamics simulations combined with pairwise additive approximation for the nuclear shielding tensor. The results are in excellent agreement with the experimental findings. The underlying physics is checked both for the Xe-Xe interaction potential and for the nuclear shielding tensor in the context of CSA relaxation. In the low-density xenon gas, different molecular interactions responsible for the relaxation are identified.

- 11.05.2011 Prof. Andrew S. French (Sigrid Juselius research fellow (Oulu); Department of Physiology and Biophysics, Dalhousie University in Halifax, Canada)
Excitatory and inhibitory opponent coding by Drosophila olfactory receptors

Abstract: The sense of smell relies on discrimination of many different odors, but mechanisms of discrimination are poorly understood. We measured frequency response functions of olfactory neurons in fruit flies to classify their dynamics, and found that both excitatory and inhibitory dynamic responses are transmitted to the brain. These results have implications for both odor transduction and odor discrimination.

- 12.05.2011 Timo Pitkänen (Magnetotail bursty bulk flows and their signatures in the ionosphere)

Abstract: The Earth´s magnetosphere is formed by the interaction between the solar wind and the terrestrial geomagnetic field. In the dayside, the geomagnetic field lines are compressed and in the night the field is stretched to a long elongated tail. The solar wind-magnetosphere interaction drives a global magnetospheric circulation pattern of plasma and magnetic flux tubes, in which plasma is convecting antisunward over the poles from the dayside to the magnetotail in the nightside, then from the tail Earthwards and eventually via dawn or dusk back to the dayside. The Earthward plasma and magnetic flux transport in the magnetotail is dominated by strong, transient and localized fast flows (bursty bulk flows, BBFs) in the ambient plasma convection. Currently, BBFs are best explained by underpopulated magnetic flux tubes i.e. depleted plasma bubbles. In this presentation, we first give a short introduction to the plasma convection, BBFs and the bubble model and then discuss the BBF ionospheric signatures. As an example, the results of a recent study of quiet-time near-Earth BBFs and their signatures on the ionosphere are shown. The results include new interesting magnetospheric observations related to so-called tailward return flows associated with BBFs and first simultaneous

high-resolution observations of the return flows in the magnetosphere and in the ionosphere.

- 08.12.2011 Timo Enqvist (Centre for Underground Physics in Pyhäsalmi)
CUPP at Pyhäsalmi - Present and future

Abstract: The Pyhäsalmi mine in Pyhäjärvi, Finland is a prominent candidate site for a large-scale research infrastructure for particle and astroparticle physics (LAGUNA). Two detector options, a liquid scintillation detector of 50 kton (LENA) at the depth of 1400 m and a liquid argon detector of 100 kton (GLACIER) at the depth of 900 m, are currently being discussed to be constructed in Pyhäjärvi. Decisions will probably be made in 2014. These detectors would allow to study a large variety of physics: Proton decay life time up to approximately 10^35 years is possible to reach. Observation of a supernova neutrino burst would probably reveal the explosion mechanism and that of diffuse (or relic) supernova neutrinos the birth rate of stars. Solar metallicity and the details of the CNO-cycle can be determined by measuring solar neutrinos with high statistics. Measurement of geoneutrinos would result in new information on the U/Th ratio and from the composition of the Earth crust. Pyhäjärvi situates also at the ideal distance from CERN, 2300 km. This is almost so called bi-magic distance which makes determination of some neutrino properties easier using neutrino beams, allowing the study of neutrino mass hierarchy and matter-antimatter asymmetry problem, for example. Currently there is one running experiment in the mine: cosmic-ray experiment EMMA.

- 19.01.2012 Alexander Fetter (Stanford university, USA)
TRAPPED ROTATING BOSE-EINSTEIN CONDENSATES

Abstract: After reviewing the basic physics of Bose-Einstein condensation, I discuss the Gross-Pitaevskii equation that provides a good description of a trapped dilute condensate. Here the interest is the rotational properties of the condensate, especially the role of quantized vortex lines. For slow rotations only a few vortices appear, but as the angular velocity increases, the vortices form a triangular lattice that is analogous to the Abrikosov vortex lattices in type-II superconductor. Eventually the system enters the lowest Landau level regime where the mean interaction energy per particle is small compared to the gap separating the lowest and next Landau level. For very fast rotations, theorists predict a quantum phase transition to a non-superfluid correlated state analogous to those seen in the quantum Hall regime for two-dimensional electrons in a strong magnetic field.

FYSIIKAN LAITOS

## Fysiikan seminaarit -haku

Haku [2000-2013, teoreettinen fysiikka] tuotti seuraavat osumat:

- 18.01.2006 Erkki Thuneberg
Theory of Josephson phenomena in superfluid 3He
- 25.01.2006 Jaakko Manninen
Heavy ions in colliders
- 01.02.2006 Timo Hyart
The feasibility of superlattice THz laser based on Bloch oscillations
- 08.02.2006 Timo Hyart
The feasibility of superlattice THz laser based on Bloch oscillations II
- 15.02.2006 Alexey Shorokhov
High-frequency absorption and gain in superlattices: Semiquasistatic approach
- 22.02.2006 Lauri Kurki
Magnetic Susceptibility of Helium 3 Superfluid at Bulk-Aerogel Interface
- 01.03.2006 Risto Sarjonen
Phase and angle variables in quantum mechanics
- 08.03.2006 Alexey Shorokhov
Berry phase
- 08.03.2006 Timo Virtanen
Force on a Slow Object in a Fermi Liquid in the Ballistic Limit (15 minute rehearsal talk for physics days)
- 22.03.2006 Jukka Isohätälä
Pendulum limits of semiconductor superlattice balance equations revisited -- some new results
- 29.03.2006 Kuan Li
Spin-orbit interaction in quantum dot
- 05.04.2006 Karri Kuula
- 12.04.2006 Ossi Tapio
Classical Rotational Intertia of Solid Helium-4
- 26.04.2006 Vesa Apaja
Diffusion Monte Carlo calculations of continuous and discrete systems
- 15.06.2006 Feo Kusmartsev
Escape of the string in Josephson annular junctions
- 02.09.2006 A. A. Ignatov (Institute for Physics of Microstructures Russian Academy, Nizhniy Novgorod)
Esaki-Tsu superlattice as an active device for the terahertz-frequency electronics
- 25.09.2006 Gintaras Valusis (Semiconductor physics institute, Vilnius, Lithuanian academy)
Terahertz radiation and semiconductor nanostructures
- 02.10.2006 A. A. Ignatov (Institute for Physics of Microstructures, Russian Academy, Nizhniy Novgorod)
Esaki-Tsu superlattice as an active device for the terahertz-frequency electronics
- 09.10.2006 Kari Rummukainen (University of Oulu)
QCD plasma instability in heavy-ion collisions
- 27.10.2006 Jaakko Manninen
Freeze out in relativistic nuclear collisions ...*lisää*
- 13.11.2006 Kari Laasonen (University of Oulu, Department of Chemistry)
Quantum mechanical modelling of water and aquaous systems
- 20.11.2006
KEVÄÄN 2007 TEOREETTISEN FYSIIKAN LUK-TUTKIELMAN / SEMINAARIN VALMISTELEVA KOKOUS

Abstract: Keväällä järjestetään teoreettisen fysiikan opintokokonaisuuteen kuuluva LuK/FK seminaari sekä siihen kuuluva aine. Tässä valmistelevassa kokouksessa keskustellaan käytännön järjestelyistä sekä sovitaan esitysten aiheista. Esitelmän aihe voi olla omavalintainen.

- 29.11.2006 Aleksi Kurkela (University of Helsinki)
Plaquette expectation value and hot QCD

Abstract: I discuss about weak-coupling expansion of hot QCD pressure. I outline the calculation of the first non-perturbative coefficient in the expansion and discuss it in the context of arbitrary number of colors. The calculation requires a numerical computation of the plaquette expectation value in an effective three dimensional pure gauge theory. I demonstrate that, in the limit of large N,

the functional form of the renormalized plaquette expectation value is 15.9(2)-44(2)/N^2.

- 15.01.2007 Juha Leppäkangas
Charge tunneling in a voltage-biased single-Cooper-pair transistor

- 29.01.2007 Jaime Zaratiegui
Multielectronic double quantum dots

- 31.01.2007 Prof Panu Helistö (VTT electronics)
THz imaging

- 05.02.2007 Jani Tuorila
Multiphoton Resonances in Superconducting 2-Level Systems

- 12.02.2007 Janne Kuokkanen
Small-x physics

- 16.02.2007 Anders Tranberg (DAMTP, University of Cambridge)
Oscillons and Quasi-breathers

- 19.02.2007 Viktor Sverdlov (Institute for Microelectronics, TU Wien, in collaboration with E. Ungersboeck, H. Kosina, S. Selberherr)
Electron mobility modeling in thin silicon body MOSFETs under general stress conditions

- 26.02.2007 Timo Hyart
Parametric effects in semiconductor superlattices

- 05.03.2007 Matti Raasakka
Gravitational waves (opponoija Ahti Leppänen)

- 12.03.2007 Jarno Rantaharju
Bose Einstein Condensation in Dilute Gases (opponoija Otto Simola)

- 26.03.2007 Matti Silveri
Ginzburg-Landau theory in superfluid He-3 and the B-B domain walls (opponoija Kimmo Tunkkari)

- 02.04.2007 Kimmo Tunkkari
Time-depended two-level system; Rabi oscillation and Bloch equations (opponoija Jarno Rantaharju)

- 16.04.2007 Otto Simola
Impulse Approximation for High Momentum Transfer in Neutron Scattering (opponoija Matti Silveri)

- 23.04.2007 Ahti Leppänen
Monte Carlo integration and Ising model (opponoija Matti Raasakka)

- 07.05.2007 Michela D´Onofrio
Gravitational lensing by cosmic strings

- 15.05.2007 Kirill Alekseev
Parametric amplification in superlattices. Introduction

- 28.01.2008 Heribert Weigert (Theoretical physics, University of Oulu)
The Color Glass Condensate, QCD at modern collider facilities

- 18.02.2008 Jukka Isohätälä
Plasma instability in semiconductor superlattices: quasiperiodic oscillations, Devil´s staircase and chaos

- 25.02.2008 Pekka Pietiläinen
Spin-orbit coupling in quantum dots

- 03.03.2008 Jani Tuorila
Cooling of a Resonator with Microwave Induced Charge-Phase Qubit Transitions (Rehersal for American Physical Society March meeting, New Orleans)

- 10.03.2008 Kari Oikarinen
Bloch Oscillating Transistor (opponent Anne-Mari Mykkänen)

- 17.03.2008 Lasse Ylitolonen
Hall effect in graphene (opponent Niko Säkkinen)

Abstract: Hall effect in graphene

- 31.03.2008 Anne-Mari Mykkänen
Klein paradox in graphene (opponent Katja Poikselkä)

Abstract: Klein paradox in graphene

- 07.04.2008 Niko Säkkinen
Band structure of graphene (opponent Kari Oikarinen)

- 14.04.2008 Katja Poikselkä
Akustiset piikit kosmisessa taustasäteilyssä (opponent Lasse Ylitolonen)

- 14.05.2008 Simon Hand (University of Swansea)
Two Color matters: a lattice study of extreme baryon densities

- 04.09.2008 Jari Kinaret (Chalmersin yliopisto, Göteborg, Ruotsi)
From Basic to Applied Research: Case of Carbon-Based NEMS

- 05.09.2008 Zaratiegui García, Jaime
Interacting electrons in two and three dimensional nanostructures

- 19.12.2008 Dr. Dmitry Gulevich (Loughborough University, U.K.)
Superconducting electronics with Josephson vortices

- 19.01.2009 Matti Silveri
Motional averaging in harmonic oscillator

- 26.01.2009 Risto Sarjonen
Lieb-Liniger model

- 02.02.2009 Mikko Saarela
Excitation Modes in Strongly Interacting Bose-Einstein Condensates

- 09.02.2009 Anne-Mari Mykkänen
On the thermodynamics of lattice gauge theories

- 23.02.2009 Jari Korkala
Kaluza-Klein theory (opponent Kalle Moilanen)

Abstract: Introduction to the topic can be found in: *Kaluza-Klein Gravity J.M Overduin, P.S Wesson (7.5.1998)* See introcution 2.1-2.5 and Kaluza-Klein basic things in 3.1-3.4 and 4.1-4.2.

- 02.03.2009 Jukka Väyrynen
Two-photon probe of the Jaynes-Cummings model (opponent Loïc Maurin)

Abstract: based on article by *Deppe et al*

- 09.03.2009 Joonas Karjalainen
Defining Muon Stopping Power Using Geant4 Simulation Toolkit (opponent Alberto Peña)

- 09.03.2009 Jani Tuorila and Matti Silveri
"Vibronic spectroscopy of an artificial molecule" and "Motional averaging in a harmonic oscillator"

Abstract: Two 12 minute rehearsal talks for Physics Days

- 16.03.2009 Mikko Savikko
Complete quantum control of a single quantum dot spin using ultrafast optical pulses (opponent Jari Korkala)

Abstract: based on article by *Press et al*

- 23.03.2009 Kalle Moilanen
Generation of Fock States in a superconducting quantum circuit (opponent Jukka Väyrynen)

Abstract: based on article by *Hofheinz et al*

- 24.03.2009 Frantz von Feilitzsch (TU Munchen)
Astroparticle physics in underground laboratories

Abstract: This talk reviews the present status and future prospects of the astroparticle physics in underground laboratories, including neutrino astrophysics, proton decay, and dark matter. I will also discuss the role of LAGUNA, the European planning organisation for future facilities in this field, including the LENA experiment. Pyhäsalmi mine is one of the candidate locations for this experiment.

- 30.03.2009 Loïc Maurin
The big-bang nucleosynthesis model (opponent Joonas Karjalainen)

- 06.04.2009 Alberto Peña
Coherent quantum state storage and transfer between two phase qubits via a resonant cavity (opponent Mikko Savikko)

Abstract: based on article by *Sillanpää et al*

- 22.04.2009 Timo Hyart
On the feasibility of Bloch gain in superlattices

Abstract: 20 minutes rehearsal talk for International Seminar and Workshop on Bloch oscillations and Landau-Zener tunneling, Germany

- 24.04.2009 Juha Leppäkangas
Josephson transistors interacting with dissipative environment (thesis defence, opponent prof. Gerd Schön from Karlsruhe, Germany)

- 24.04.2009 Gerd Schön (Institut für Theoretische Festkörperphysik, Universität Karlsruhe)
Lasing and cooling in circuit QED

- 10.11.2009 Prof. Andreas Wacker (University of Lund)

- 12.11.2009 prof. Edmund Bertschinger (Massachusetts Institute of Technology, USA)
Testing Gravity on Cosmological Scales

Abstract: For a given expansion history, models of modified gravity generically differ from general relativity in two ways: the growth of structure and the propagation of light (affecting both gravitational lensing and the integrated Sachs-Wolfe effect). In addition it is possible that non-minimal couplings to matter might cause departures from geodesic motion for cold dark matter. Given our lack of understanding of cosmic acceleration, all of these possibilities should be explored using galaxy clustering, peculiar velocities, weak gravitational lensing and the ISW effect. Cosmological tests based solely on the expansion history and growth of structure are inadequate to test modified gravity as an alternative to dark energy.

- 13.11.2009 Petri Mutka
Strong Gravitational Lensing and Structure Formation (thesis defece, opponent prof. Edmund Bertschinger from MIT, USA) *...lisää*

- 10.12.2009 Prof. Andreas Wacker (University of Lund)
Quantum Kinetics of Transport and Gain in Quantum Cascade Lasers

Abstract: Quantum Cascade Lasers (QCL) have become an important source for infrared

spectroscopy within the last decade. In addition, new structures operating in the THz-region have been developed, suggesting a variety of new applications including medical and security applications. These semiconductor heterostructure devices are based on optical transitions between electronic subband states, where the population inversion is caused by specifically designed tunneling processes at the operation bias.

The nature of transport in QCLs is an old issue of debate. In the original concept by Kazarinov and Suris [1] the transport mechanism was based on coherent tunneling between neighboring wells. In contrast, it is frequently argued that coherent effects are of minor importance if a basis of energy eigenstates is used. Correspondingly, standard simulations are based on rate equation models for the occupations of such states. This implies that scattering processes cause the spatial propagation of carriers through the device. Such a conception conflicts with the standard description of transport in bulk structures, where complex Bloch functions carry the current, while scattering redistributes the carriers in momentum space but does not change their spatial positions.

Based on quantum transport calculations it is shown that a description similar to the standard bulk case holds in quantum cascade lasers as well: The current is entirely carried by quantum-mechanical wavepackets, and the scattering acts locally to redistribute the momentum and energy of the carriers [2]. In particular, the current is determined by the off-diagonal elements of the density matrix in energy eigenstate basis which highlights its coherent nature [4]. This becomes of particular relevance at level crossings, where the rate equation model fails [4,5]. In this case a quantitative description requires to take into account that scattering redistributes the carriers locally, while spatial transport occurs via coherent evolution.

The gain profile of a quantum cascade laser is strongly influenced by the lifetime of the carriers in the upper and lower laser state. The quantitative description of gain within the concept of nonequilibrium Green functions allows for a detailed understanding of various features observed experimentally, such as the degradation of lasing operation with temperature [6] and dispersive gain without inversion [7].

[1] R.F. Kazarinov and R.A. Suris, Sov. Phys. Semicond. 5, 707 (1971)
[2] S.-C. Lee, F. Banit, M. Woerner, and A. Wacker, Phys. Rev. B 73, 245320 (2006)
[3] R.C. Iotti and E. Ciancio and F. Rossi, Phys. Rev. B 72, 125347 (2005)
[4] H. Callebaut and Q. Hu, J. Appl. Phys. 98, 104505 (2005)
[5] C. Weber, A. Wacker, and A. Knorr, Phys. Rev. B 79, 165322 (2009)
[6] R. Nelander and A. Wacker, Appl. Phys. Lett. 92, 081102 (2008)
[7] A. Wacker, R. Nelander, and C. Weber, Proc. SPIE, 7230, 72301A (2009)

- 11.12.2009 Timo Hyart
Tunable superlattice amplifiers based on dynamics of miniband electrons in electric and magnetic fields (thesis defence, opponent prof. Andreas Wacker from University of Lund, Sweden) *.../isää*

- 22.02.2010 Anders Tranberg (Helsinki Institute of Physics, University of Helsinki)
Counting topological defects with the 2-point field correlator

Abstract: Topological defects can (for instance) occur in field theories, where a symmetry is broken dynamically on time scales short compared to the size of the system. To predict the number of defects requires detailed knowledge of the non-perturbative and out-of-equilibrium field dynamics, which is usually out of reach analytically. We examine how these defects manifest themselves in the field two-point correlation function, and devise a method to extract the defect density numerically.

- 09.03.2010 Matti Silveri
Extreme driving of a Josephson qubit in circuit cavity quantum electrodynamics (12 min rehersal talk for Finnish Physical Society meeting)

- 15.03.2010 Erkki Thuneberg
Vortex Structures in Superfluids: Examples in 3He

Abstract: Vortices appear in superconducting metals under magnetic field and in superfluids under rotation. The best known superfluids are the helium-isotope liquids 4He and 3He and dilute atomic gases. While the standard vortex structures appearing in most superconductors and in 4He are well known, there is growing interest to study unconventional vortex structures appearing in some superconducting compounds and in dilute atomic gases. For this purpose we review what has been learned about vortex structures in superfluid 3He, which still is by far the best understood and most sophisticated system of unconventional vorticity. The topics discussed include introduction to non-scalar order parameters, introduction to vortex structures; topological and symmetry classification of single as well periodic vortex structures; different structures of vortex cores; vortex textures filling the whole space; vortex sheet; spin-current vortices.

- 19.03.2010 Giovanni Chirilli (CPHT Polytechnique and LPT d'Orsay)

The Structure of matter at high-energy

Abstract: Hadronic matter is made of asymptotically free particles which are quasi on-shell excitations, and because of their confining properties it is not possible to measure them directly. Deep Inelastic Scattering (DIS) experiments are therefore performed to study the structure functions of hadronic matter which to lowest order in Quantum Chromodynamics (QCD) are related to the number density of partons inside hadrons. At high-energy coherent interactions and non linear effects govern the dynamics of DIS processes and so non-linear evolution equations like the Balitsky-Kovchegov (BK)equation and the Jalilian-Marian, Iancu, McLerran, Weigert, Leonidov, Kovner (JIMWLK) equation play a central role.

- 29.03.2010 Matti Silveri
Population oscillations in a strongly driven two-state system

- 27.05.2010 Timo Hyart (Max Planck Institute for Solid State Research, Stuttgart, Germany)
Interlayer phase coherence in quantum Hall bilayer systems

- 03.06.2010 Steven Girvin (Department of Physics, Yale University)
Quantum Measurements, Noise, and Amplification: From Gedanken Experiments to the Real World

Abstract: In the early days of quantum mechanics many gedanken experiments were proposed to explore the strange features of 'wave function collapse' in the measurement process. Today practical versions of these experiments are being performed. One example is the measurement of the position of a moveable mirror using optical interferometry. The more photons that are used, the more precisely the position can be determined. However, the greater the precision, the greater is the measurement 'back action' which disturbs the position due to the random momentum impulses delivered to the mirror by the photons. Hence the optimal measurement is a compromise between these two effects.

A second practical example, which has become possible because of remarkable progress in creating superconducting qubits, is that it is now possible to build microwave amplifiers whose performance comes very close to the limits set by the Heisenberg uncertainty principle. Such amplifiers are 40x better than the best HEMT amplifiers and hold the current world record for two mode squeezing of about 20dB. This talk will be a very simple and informal introduction to the physics of quantum measurements, noise, back action and amplification.

More about the speaker: *home page*, *Yale page*

- 04.06.2010 Jani Tuorila
Spectroscopy of artificial atoms and molecules (thesis defence, opponent prof. Steven Girvin from Yale University, USA) *.../isää*

- 16.06.2010 Jani Tuorila
Spectroscopy of artificial atoms and molecules

Abstract: A 30 min rehearsal talk for the meeting of National Graduate Schools NGSMP and NGS-NANO in Jyväskylä 17.-18.6.

- 09.03.2011 Matti Silveri
Stark effect and genealized Bloch-Siegert shift in a strongly driven two-level system (a 10 minute rehearsal talk for American Physical Society March meeting.)

- 18.03.2011 Timo Virtanen
Numerical calculations of quasiparticle dynamics in Fermi liquids (thesis defense, opponent prof. Christopher Pethick from Nordita, Copenhagen)

- 23.03.2011 Jani Tuorila and Timo Virtanen
Mapping the energy landscape of a driven quantum system and Numerical calculations of quasiparticle dynamics in Fermi liquids (two 12 minute rehearsal talks for Finnish Physical Society meeting)

- 27.04.2011 Dr. Janne Viljas (Low temperature laboratory, Aalto University)
Self heating and nonlinear current-voltage characteristics in bilayer graphene

Abstract: Recent low-temperature experiments have shown that the current-voltage (I-V) characteristics of diffusive two-lead samples of bilayer graphene (BLG) at low bias are superlinear. This is in contrast to monolayer graphene (MLG), where the I-V characteristics are typically linear, apart from very low-mobility samples close to the Dirac point, where superlinearity has previously been attributed to Zener-Klein tunneling. We have simulated the I-V characteristics of graphene based on semiclassical theory, assuming carrier scattering to be due to charged impurities. It is concluded that the superlinearity seen in the BLG experiments can be explained by Joule heating and the associated increase of the conductivity by creation of electron-hole pairs. The effect is stronger in BLG than in MLG because of the larger electronic density of states close to the Dirac point in the former.

- 09.12.2011 Tuomas Lappi (University of Jyväskylä)
Classical color fields and heavy ion collisions

Abstract: Quark-gluon plasma in the laboratory is produced in ultrarelativistic heavy ion collisions, performed at the RHIC collider at BNL and the LHC at CERN. A variety of theoretical tools are needed to understand the spacetime evolution of the matter produced in these experiments. The physics of the initial stage of a high energy heavy ion collision is dominated by the nonlinear gluonic interactions of QCD. These lead to the concept of parton saturation. An effective theory framework to understand the physics of saturation is provided by the Color Glass Condensate (CGC), where the calculation is organized in terms of a classical color field and its quantum fluctuations. This talk discusses some applications of this idea to understanding the initial stage of a heavy ion collision,

such as computations of particle production and multiparticle correlations.

- 10.12.2011 Janne Kuokkanen
Non-Linear Small-x Evolution Equations and Their Applications to Describe High-Energy Scattering Processes (thesis defense, opponent prof. Tuomas Lappi, University of Jyväskylä) *...lisää*

- 20.01.2012 Janne Karimäki
Structure and Dynamics of Vortices in Superfluid 3He (thesis defense, opponent prof. Alexander Fetter, Stanford University, USA)

- 09.02.2012 Alexander Balanov (University of Loughborough, UK)
Effects of temperature on charge transport in semiconductor superlattice in an electric and a tilted magnetic field

Abstract: We show that resonant electron transport in semiconductor superlattices with an applied electric and tilted magnetic field can, surprisingly, become more pronounced as the lattice and conduction electron temperature increases from 4.2 K to room temperature and beyond. It has previously been demonstrated that at certain critical field parameters, the semiclassical trajectories of electrons in the lowest miniband of the superlattice change abruptly from fully localized to completely unbounded. The unbounded electron orbits propagate through intricate web patterns, known as stochastic webs, in phase space, which act as conduction channels for the electrons and produce a series of resonant peaks in the electron drift velocity versus electric-field curves. Here, we show that increasing the lattice temperature strengthens these resonant peaks due to a subtle interplay between the thermal population of the conduction channels and transport along them. This enhances both the electron drift velocity and the influence of the stochastic webs on the current-voltage characteristics, which we calculate by making self-consistent solutions of the coupled electron transport and Poisson equations throughout the superlattice. These solutions reveal that increasing the temperature also transforms the collective electron dynamics by changing both the threshold voltage required for the onset of self-sustained current oscillations, produced by propagating charge domains, and the oscillation frequency.

- 10.02.2012 Jukka Isohätälä
Strongly nonlinear transport in semiconductor superlattices (thesis defense, opponent dr. Alexander Balanov, University of Loughborough, UK) *...lisää*

- 13.03.2013 Matti Silveri (Teoreettinen Fysiikka, Oulu)
Random frequency modulation of a superconducting qubit (a 10 minute rehearsal talk for American Physical Society March meeting)

Abstract: Superconducting circuits with Josephson junctions are a promising platform not only for developing quantum technologies, but, importantly, also for the study of effects that typically occur in complex condensed-matter systems. Here, we employ a transmon qubit to conduct an analog simulation of motional averaging, a phenomenon initially observed in nuclear magnetic resonance spectroscopy. To realize this effect, the flux bias of the transmon is modulated by a controllable pseudo-random telegraph noise, which results in stochastic jumping of the energy separation (frequency) between two discrete values. This can also be seen as a simulated fast-fluctuation environment under direct experimental control. Additionally, we discuss the population dynamics using an analytical master equation, and apply the motional averaging analysis on phenomena where the fluctuation of the energy is due to quasiparticles or to photon shot noise.

- 16.05.2013 Jens Koch (Northwestern university, USA)
Prospects and challenges of superconducting circuits with many degrees of freedom

Abstract: Quantum coherence in superconducting circuits has seen remarkable improvements over the last ten years. Yet, in spite of the increase in coherence times of nearly 5 orders of magnitude, a different property has remained largely stagnant: following the "simpler is better" mantra, circuits across all borders between phase, flux, and charge qubits, consistently employ less than a handful of circuit elements. Recent experiments with the fluxonium circuit composed of over 40 elements could be the kick-off for a paradigm change and make the world of superconducting circuits a lot bigger. I will give a quick introduction to the basic physics of the fluxonium circuit and will present our most recent work on developing theory for quantum circuits with many degrees of freedom.