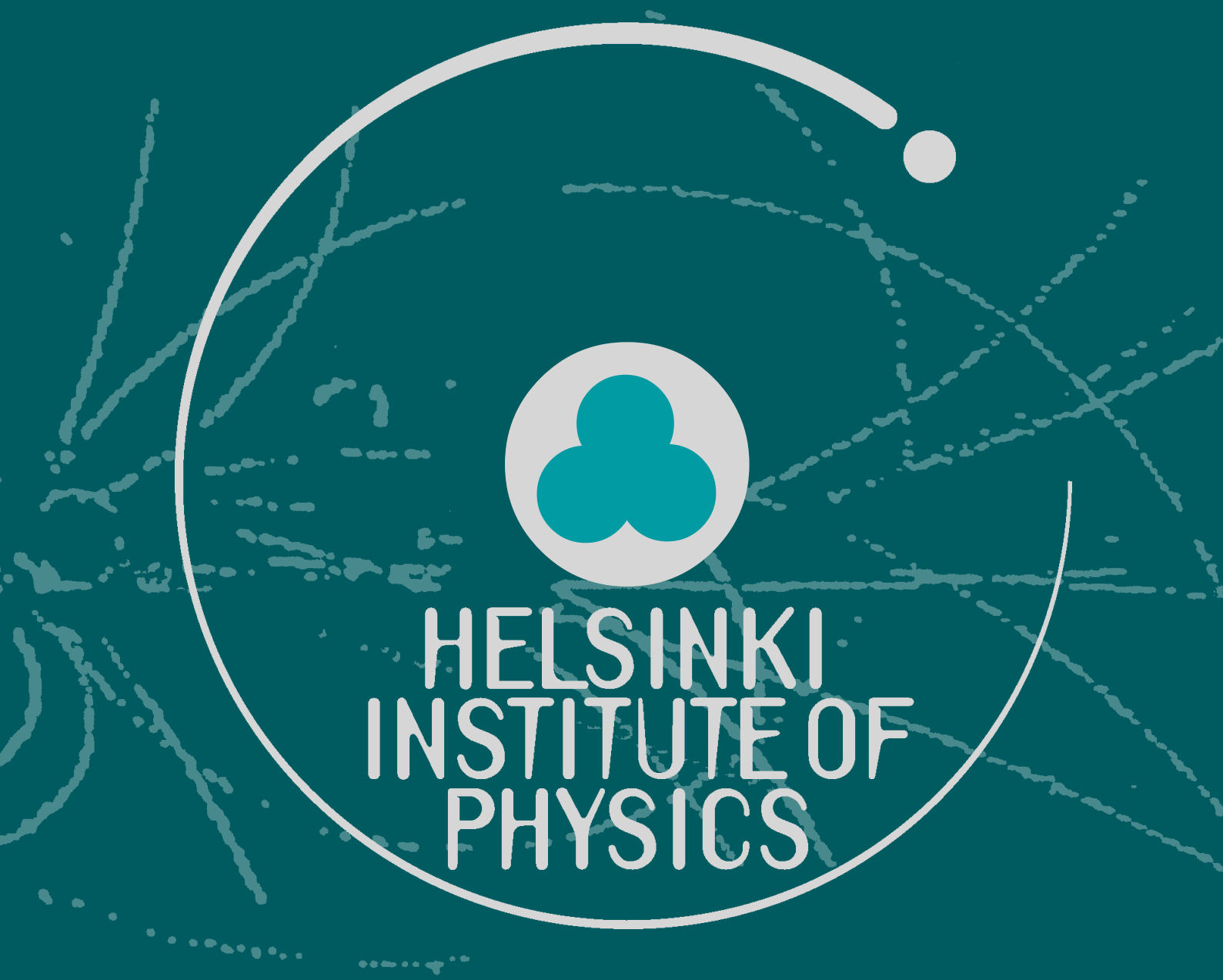
Annual Report 2000



HELSINKI INSTITUTE OF PHYSICS

Annual Report 2000

Rods being installed in the Big Wheel prototype. The Big Wheel is a full-scale, partial prototype of the outer part of the CMS tracker barrel.

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Introduction

Dan-Olof Riska

The Helsinki Institute of Physics is a joint research institute that is operated by the University of Helsinki, the Helsinki University of Technology and from the beginning of 2001 also by the University of Jyväskylä. The mandate of the Institute is to conduct research in basic and applied physics as well as technical research associated with accelerator laboratories and to provide graduate training in physics. The Institute is responsible for Finnish collaboration with CERN.

The Institute is governed by a board, which is advised by an internationally drawn scientific advisory board. During the year a new advisory board, chaired by Dr. Hans Falk Hoffman of CERN took over this duty.

During the year the research activity of the Institute was divided into the following main research programmes: (1) the "Theory Programme", (2) the "High Energy Physics Programme", (3) the "Large Hadron Collider (LHC) Programme" and (4) the "Technology Programme". These research programmes were supported by a base budget of 22 MFIM, obtained as an item in the Finnish state budget, as well as by external funds from different sources raised directly by the leaders responsible for specific tasks and research collaborations. The Institute is an assistant contractor of the European Data Grid project of the European Union.

The research projects of the Theory Programme were mathematical physics, statistical physics and materials science, laser physics and quantum optics, phenomenological particle physics and cosmology. The High Energy Physics Programme concentrated on the DELPHI detector collaboration and the final run of the LEP accelerator as well as on detector development. The LHC programme concentrated on the construction of the CMS tracker and software development for the CMS detector. An important component of the LHC programme is the nuclear matter project, the activities of which were divided between the ALICE detector development for the LHC and the ISOLDE facility for nuclear structure research.

During the year the development of software for distributed data management of the Technology Programme was brought to a conclusion with the commercialization of the software. The Programme was then oriented towards the development of the required software and knowledge base for the "European Datagrid" and Grid-style large scale computing over the Internet. The research programmes are described in detail later in this report.

Graduate training was carried out in collaboration with the Departments of Physics of the universities of Helsinki and Jyväskylä through a joint graduate school on nuclear and particle physics, with support from the Academy of Finland. Several of the graduate students in the theory programme participated in other graduate schools. In addition on site training at both graduate and undergraduate level was provided at CERN through participation in ongoing research activities. Many young researchers,

who belong to the staff as researchers also pursue their doctoral studies along with their research work. Part of this educational activity are the joint seminars and colloquia, which the Institute organizes in collaboration with the physics departments of the member universities.

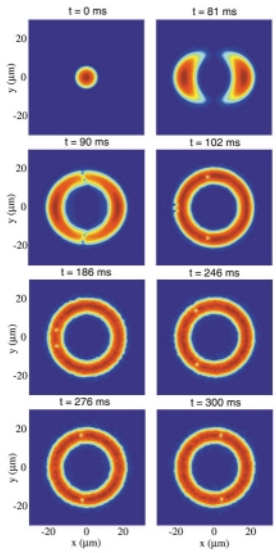
The year 2000 was the last full year, during which the Helsinki Institute of Physics was located in the old physics block at Siltavuorenpenger in the Kruununhaka district. In the beginning of the year 2001 the now separate units of the Institute will move to the new physics center in Kumpula about 3 km north of the city centre. The location in the new Physicum building, which has been designed and built to modern research standards will substantially improve working conditions and will also facilitate communication within the staff and with the larger physics community.

The former director of the Helsinki Institute of Physics, Professor Eero Byckling of the Helsinki University of Technology, retired at the end of June. Professor Byckling served as director from the start of the Institute, and planned the structure and functions of the Institute. The Institute is indebted to him for this pioneering effort. The Institute is also indebted to academician Ludwig Faddeev for his long association with the mathematical physics project which ended at the end of the year and to academy professor Antti Kupiainen, who also left at the end of the year, for his leadership of that project.

HELSINKI INSTITUTE OF PHYSICS

Highlights of Research Results

Theory Programme

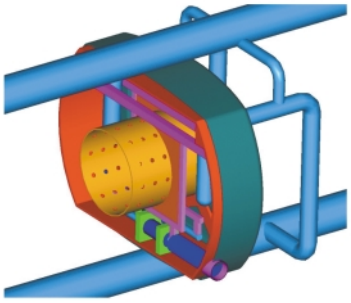


In statistical physics significant progress has been made in the quantum and classical dynamics of atoms on surfaces. A new collective diffusion mechanism was found by applying new methods to the diffusion of adatom clusters on metal surfaces. In quantum optics the controlled creation and evolution of vortex-antivortex pairs in atomic condensates was investigated. It was found that the pairs repulse each other, instead of attracting and annihilating. In particle theory a generalization of the anomaly-mediated supersymmetry breaking scenarios was found to lead to acceptable phenomenology because of additional D-term contributions. In cosmology it was shown that purely isocurvature Ω=1 models of cosmic microwave perturbations are ruled out by the Boomerang and Maxima-1 balloon experiments. In mathematical physics point particles in 2+1 dimensional AdS spacetimes were embedded as supersymmetric solutions to ten-dimensional supergravity as a step towards a string theoretic interpretation of black hole formation via colliding point particles.

High Energy Physics Programme

During the past year the High Energy Physics Programme comprised the following research activities: (1) electron-positron physics, (2) proton-proton forward physics, and (3) generic detector research for applications in high rate radiation environments.

The research activity is supported by the particle phenomenology groups of SEFO at the Department of Physics, University of Helsinki, and the Theory Programme of HIP. For detector research and development the domestic Detector Laboratory and the support by the Academy of Finland have been indispensable.

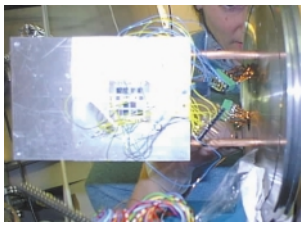


After reaching record luminosities, the data acquisition phase of the LEP experiments was completed at the beginning of November. The e^+e^- research activity now continues based on physics analysis of the large data sets collected and on physics feasibility studies and detector R&D for the next e^+e^- linear collider. However, the main aim of the programme will be to facilitate a significant physics contribution at the LHC. This will combine the group's physics interest with the experience it gained in designing and constructing parts of the DELPHI experiment.

The group has chosen the field of 'Forward Physics' as its speciality area. To prepare for decision making regarding the most suitable experimental environment at the LHC, a dedicated workshop was held in Helsinki during the first week of November last year.

LHC Programme

Several important milestones were reached by the HIP LHC programme in the design and prototyping of the CMS detector system during the year 2000. In the design of the Tracker Outer Barrel (TOB) support structure the Engineering Design Review (EDR) was successfully passed and a green light was given by CMS to start procurement. The EDR gives a detailed description of the layout of the mechanical structures



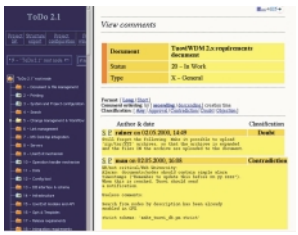
of TOB as well as their corresponding services. Another important milestone in the hardware development was the demonstration of the capabilities of the RPC trigger link boards and the connected data transmission chain to work with the 25 ns time structure. This was done in a test beam with LHC-like properties and time structure and with laboratory tests. An important step forward in the module and component testing was the establishment of a cooperation with the University of Jyväskylä Accelerator Laboratory to perform the irradiation tests of the prototype components.

In the preparation for physics analysis encouraging results were obtained in developing the algorithms to be used in the high level trigger to reject the jet background of the electron candidates, using some of the tracker information to match the electromagnetic calorimeter clusters. Another important result was the confirmation of earlier estimates for the b-tagging efficiency of the CMS tracker, done with detailed simulation studies using GEANT tools.

In ALICE, decisive progress was made in the experimental verification of the double track resolution of silicon drift detectors as well as in demonstrating the capability of Micro Channel Plate detectors to provide the required time resolution in triggering.

High-precision ISOLDE experiments on beta decay and the mass of ^{74}Rb are providing important new data for the more precise determination of the up-down quark mixing element V_{ud} in the CKM-matrix. Moreover, a first direct verification of the break-up of a magic nucleon number at N=20 was observed for a very neutron-rich ^{33}Na isotope. Also, for the first time, it was demonstrated that the storage of free ions in a Penning trap can provide new opportunities for extreme high-resolution nuclear spectroscopy.

Technology Programme



Significant effort was put into the development of the Tuovi-WDM (Web Document Management) system and its new release, which was put into production to the global user community in summer 2000. New add-ons were developed and implemented to improve the control of distributed project activities, especially tools to control and monitor the progress of work through various visualisation interfaces based on the log data generated while using the system. Other tools such as a comment collector and reporting tools were added, as well as mechanisms to manage complex compound documents with the system. After summer 2000, most of the original Tuovi development team moved over to a commercial company and later on they have closed an initial agreement to take care of the support and kernel development activities. This fortunate happening has enabled the programme to focus more on research and development. This rapid transition process resulted in the natural closing of the Project Tools project, and the overall focus of the programme moved on to the DataGrid activity. A new project was established with that name and highly skilled people were recruited at the beginning of autumn 2000. By the end of the year 2000 the DataGrid project, with its 8-person personnel has managed to produce the first prototypes using the distributed computing technologies that the LHC is expected to use when it is operational. Collaboration with the HIP's LHC-program has been intensified through the use of CMS simulation data and the Center for Scientific Computing has been integrated with the development work.

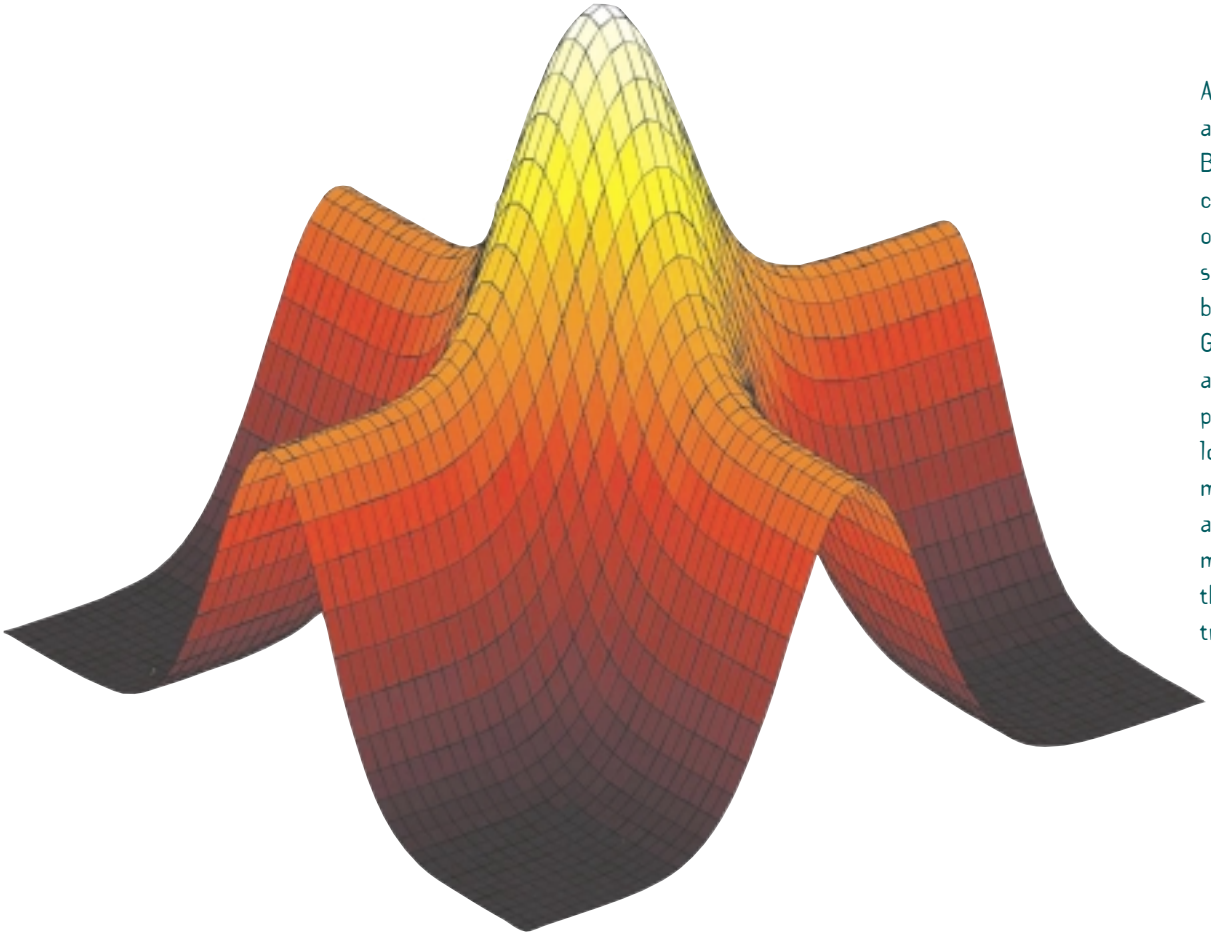
Theory Programme

Kari Enqvist

The Theory Programme provides a platform for the project leaders to carry out highly topical research in few selected subfields. Neither the subfields nor the number of projects are fixed. In the future, theory projects are expected to run for 3+3 years. In 2000 there were four projects: Laser Physics and Quantum Optics, Mathematical Physics and Field Theory, Particle Theory and Cosmology, and Statistical Physics and Materials Science. Most projects have been successful in attracting considerable external funding, and all have national and international collaboration.

Laser Physics and Quantum Optics

Experimental observation of Bose-Einstein condensation in dilute atomic gases has opened new possibilities for studying various phenomena in quantum mechanics, statistical physics and nonlinear physics. We have developed a method for deforming an optically trapped sample of condensed atoms into a toroid. If the toroid is formed by connecting two half-toroids, our simulations show that one should be able to create unstable solitons which decay into vortices. Unlike those observed so far in experiments, these vortices move and interact. The surprising result is that a vortex and an antivortex repulse each other, instead of attracting and annihilating each other. We have found that this peculiar situation is due to the special geometry of the toroid. It should be noted that the size of the vortex cores in atomic condensates is of the order of micrometers, making them three orders of magnitude larger than those produced in liq-



A sample trap for cold atoms and thus atomic Bose-Einstein condensates can be obtained by superimposing two laser beams which have Gaussian profiles. The atoms feel a force that pulls them to the localized field maximum. When an appropriate cooling mechanism is added, the atoms become trapped at that point.

uid helium. This work has been done in collaboration with researchers from the University of Hannover.

Quantum control of the internal degrees of freedom in molecules has become possible with femtosecond pulses; in 1999 Ahmed Zewail was awarded the Nobel Prize in chemistry for his pioneering work in this field. One possible application is highly efficient steering of chemical processes. We have studied how to manipulate the vibrational state populations with practically 100 % efficiency in molecules, using strong pulses in a counterintuitive order. Our approach relies heavily on establishing quantum coherence between a large number of vibrational states. Due to interference effects only a few of these states are truly populated during the process. If described with light-induced, time-dependent molecular electronic potentials, the complicated process can be understood in simple terms. This work has been done in collaboration with Dr. Barry M. Garraway from the University of Sussex, U.K.

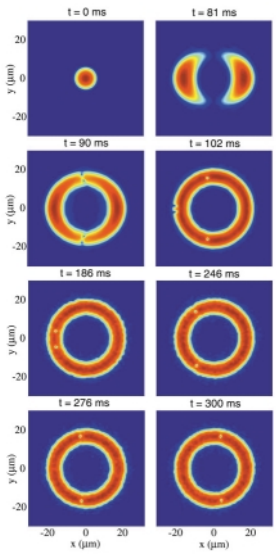
Laser cooling and trapping of atoms is the tool behind the atomic Bose-Einstein condensates, but its spin-offs include many other topics such as sensitive gravity measurements, atomic clocks, optical tweezers for biological and chemical applications and atom interferometers. One important aspect is the possibility of building periodical structures of light, i.e. optical lattices, for atoms. Lately it has been speculated that these systems could be used for building quantum computers. We have simulated atomic interactions in these lattices, and found that selective cooling (evaporation) takes place, because inelastic processes mainly remove the hotter atoms from the lattice. These Monte Carlo simulations are based on quantum jumps, and demand large computational facilities, which have been provided by CSC, Espoo, Finland. This work has been done in collaboration with Dr. Kirstine Berg-Sørensen, Nordita, Copenhagen.

A common theme in the above research is control and manipulation of the dynamics of quantum systems. Other research work in 2000 include studies of quantum cryptography and the role of entanglement in quantum communications (EU EQUIP project), alkaline earth atom collisions (EU CAUAC project) and STIRAP processes. Other activities include a jointly organized (with Prof. M. Kaivola, Helsinki University of Technology) one-week summer school on quantum optics and quantum information, in Espoo, with Prof. Ulf Leonhardt (Univ. of St. Andrews, Scotland) and Norbert Lütkenhaus (HIP) as lecturers.

Mathematical Physics and Field Theory

One of the main themes of the Mathematical Physics and Field Theory group is string theory. Esko Keski-Vakkuri, in collaboration with Vijay Balasubramanian (University of Pennsylvania), Jan de Boer (Amsterdam), and Simon F. Ross (Durham), has been searching for a string theoretic interpretation of black hole formation via colliding point particles. This is a long-term project, and as a first step, point particles in 2+1 dimensional AdS spacetimes were embedded as supersymmetric solutions to ten dimensional supergravity, via the Kaluza-Klein approach. They were also shown to be related to rotating black string solutions in 6d. Further, the point masses were given a dual holographic interpretation in the AdS/CFT framework. They were related to ensembles of chiral primaries in the N=4 SCFT.

Together with a graduate student, Samuli Hemming, Keski-Vakkuri investigated Hawking radiation from black holes in AdS space in a generic dimension. Hawking radiation was derived using three different approaches: Bogoliubov transformations in the eternal black hole and spherically symmetric collapse geometries, and particle tunneling across the horizon. The last method also gave the expected corrections to the emission probability.



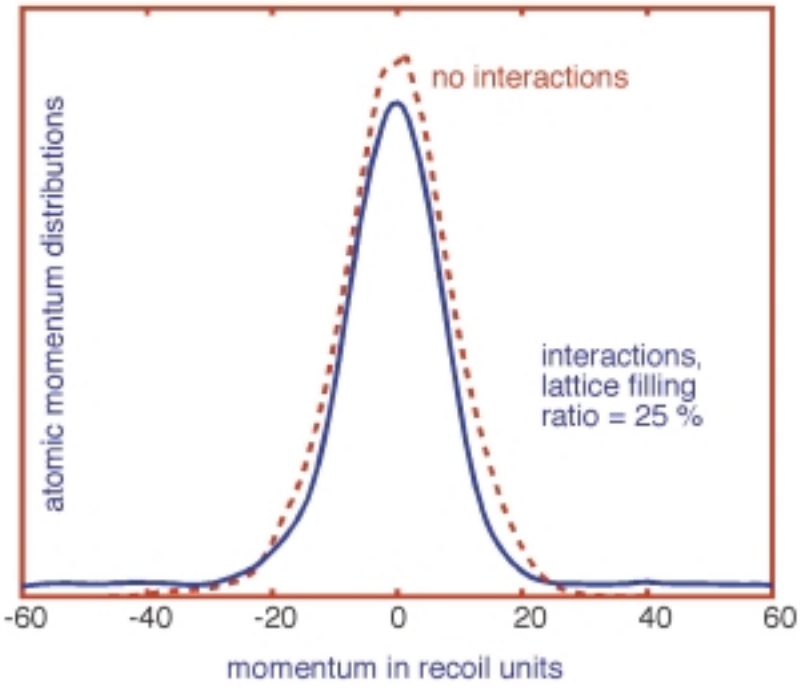
An optically trapped condensate can be split into two parts, which are merged into a ring structure (a toroid in three dimensions). Unstable solitons are formed at the junctures; they break into vortices which can move in the ring and interact. Due to the toroidial structure a vortex and antivortex repulse each other instead of the expected attraction and subsequent annihilation.

With another student, Ossi Pasanen, Keski-Vakkuri investigated time-dependent effects in the spherical collapse, in particular how to take them into account in the AdS/CFT duality.

The group has also welcomed a new postdoc Fawad Hassan. He has been investigating the structure of D-brane worldvolume actions, their coupling to gravity, and the associated effects.

Another main theme of research has been gauge theories and solitons. Ludwig Faddeev and Antti Niemi have been developing an effective field theory approach for electromagnetic interactions in an electrically neutral plasma, and have discovered solitonic equilibrium configurations in this context.

Monte Carlo simulations of a momentum distribution of atoms in a bright optical lattice for two interacting atoms. Compared to the noninteractive case, the momentum distribution narrows in the middle and develops strong wings, which is a sign of selective heating.



Particle Theory and Cosmology

In the phenomenology part of the project, the main focus has been in the consequences of the electroweak and supersymmetry breaking, while in cosmology the nucleosynthesis and cosmic microwave background have been studied. In the more theoretical studies e.g. noncommutativity and nonperturbative aspects of the field theory have been considered.

Phenomenology. Generally the models beyond the Standard Model have charged Higgses in the electroweak breaking sector. We have analyzed the possibilities to differentiate between models including charged Higgses in triplets and doublets.

Supersymmetry breaking is often parametrized by the so-called soft breaking terms. The phenomenology of the models depend strongly on the boundary conditions put on these soft breaking terms. We have studied supersymmetric grand unified theory with nonuniversal gaugino masses. We have investigated constraints from electroweak symmetry breaking, as well as some other theoretical and experimental constraints. We have also analyzed the $b \to s\gamma$ constraints in a special class of phenomenological supersymmetric models where the so called trilinear soft breaking terms, are not universal in flavour space. This class of models is particularly interesting for explaining large SUSY contributions to the direct CP violating parameter.

Using universal soft supersymmetric breaking terms, the neutralino-nucleon cross section has been compared with the limits from dark matter detectors. Our analysis is focused in the stability of the corresponding cross sections with respect to variations of the initial scale for the running of the soft terms. We have found extensive regions in the supersymmetric parameter space with cross sections in the range where current dark matter experiments are sensitive.

An interesting method for SUSY breaking is the anomaly-mediated breaking. We have

studied a generalization of anomaly-mediated supersymmetry breaking scenarios. While obtaining acceptable phenomenology, we require that the most attractive features of the breaking method are preserved. This turns out to be possible with additional so called D-term contributions.

Flavour violation and R-parity breaking in the supersymmetric models provide possibilities to constrain the parameter space of the models, since processes violating flavour are experimentally rare. We have analyzed the constraints from $\mu \rightarrow e\gamma$ and $\mu \rightarrow 3e$ (and analogous processes in the tau lepton sector) and μ – e conversion in nuclei, for a general class of lepto-quark models. The previous analyses in the literature have so far underestimated the constraints from $\mu \rightarrow 3e$ decay and μ – e conversion in nuclei. We have studied flavour violation also in the minimal SUSY grand unified theory. Sizable flavour violation is induced due to the renormalization effects. Given the present experimental constraints, the $\mu \rightarrow e\gamma$ and μ – e conversion branching ratios will be above the sensitivity of the planned experiments unless the SUSY scale is pushed above one TeV.

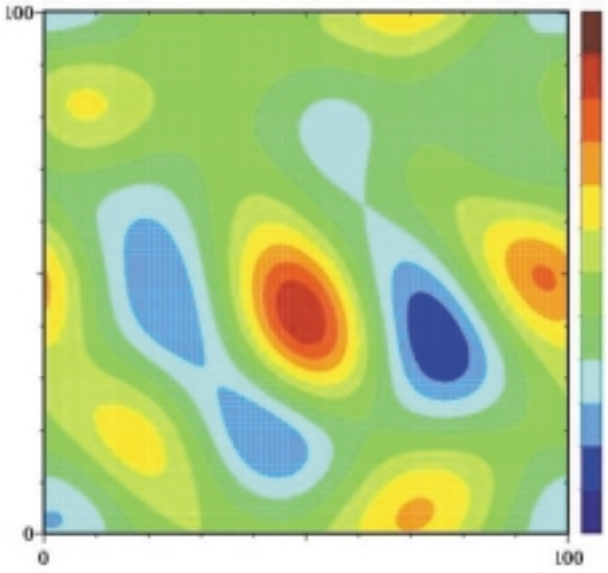
The baryon number violating R-parity breaking can be strictly bounded at future hadron colliders, such as the Fermilab Tevatron Run II or the CERN Large Hadron Collider (LHC). We have studied the production of $(t+\bar{t})\tilde{g}$ at the hadron colliders in an R-parity violating supersymmetric model. This process provides us with information not only about R_p violation, but may also help us to detect the supersymmetry itself. In addition to the minimal supersymmetric standard model we have also considered some models with a heavy gluino as the lightest supersymmetric particle.

Cosmology. We have continued our study on the effect of antimatter domains on big bang nucleosynthesis (BBN). We have improved on our earlier work by studying the relevant physics in more detail, especially the spectrum of photons produced in annihilations. Photodisintegration of nuclei by these photons is a major contributor to the effect antimatter has on BBN.

We have studied the effect of isocurvature density perturbations on cosmic microwave background anisotropy. We have compared the predictions of 1) pure isocurvature models and 2) mixed models with both an adiabatic and an isocurvature component to recent anisotropy data from the Boomerang and Maxima-1 balloon experiments. We conclude that 1) pure isocurvature models are ruled out by the present data, 2) a mixed model with a significant isocurvature component is still allowed. An isocurvature component could be the explanation for the second acoustic peak being so low in the data.

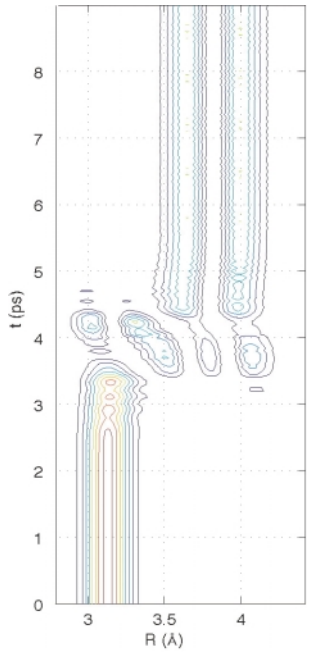
Selected theory topics. We have investigated the supersymmetric extensions and various generalizations of a renormalizable model for higher spin fields in four dimensional Euclidean space. These kinds of models are interesting for understanding the relation between unitarity and renormalizability of higher spin interactions.

Investigations have been carried out on both the principal aspects of noncommutative quantum field theories and the implications of such theories. In the first respect, we studied the issue of unitarity for noncommutative field theory on compact space-times, and found that such theories violate unitarity. We have also considered the problem of the violation of causality, but, although this feature allows for a possible violation of the spin-statistics theo-



Early stages of Q-ball formation in the early universe.

rem, such a violation does not rescue the situation. In view of the second aspect, which was aimed at the calculation of some phenomenological consequences of noncommutativity in space, we developed a formulation of NC quantum mechanics and studied the NC hydrogen atom, with an emphasis on the Lamb shift, and found that some corrections to this effect arise from noncommutativity even in the field theory tree level. In the same framework of NC quantum mechanics, the corrections to the Aharonov-Bohm effect were calculated and proven to be invariant under the noncommutative gauge transformations.



Using two short (in the picosecond range) laser pulses in counterintuitive order one can tailor the relative position of the atoms inside a sodium dimer molecule. The quantum mechanical position distributions are shown here as contour plots. The process induces strong quantum coherences between three electronic states, which result in selective change from one vibrational state to another.

The Schwinger proper-time method is an effective calculation method, explicitly gauge invariant and nonperturbative. We make use of this method to investigate the radiatively induced Lorentz and CPT-violating effects in quantum electrodynamics when an axial vector interaction term is introduced in the fermionic sector. The induced Lorentz and CPT-violating Chern-Simons term coincides with the one obtained using a covariant derivative expansion but differs from the result usually obtained in other regularization schemes. We also discuss a possible ambiguity in the approach.

The mechanism of colour confinement as a consequence of an unbroken non-abelian gauge symmetry and asymptotic freedom has been elucidated and compared with that of other models based on an analogy with the type II superconductor. It has been demonstrated that a sufficient condition for colour confinement is given by $Z_3^{-1}=0$ where Z_3 denotes the renormalization constant of the colour gauge field. It has been shown that this condition is actually satisfied in quantum chromodynamics and that some of the characteristic features of other models follow from it.

We have studied the localization of gravity in the presence of an extra time-like dimension. While the proposed model allows us to reconcile the solution to the hierarchy problem with a correct cosmological expansion of the visible universe, it generally suffers from the appearance of phenomenologically dangerous tachyonic KK modes of graviton. Some ways to overcome this problem have been also suggested. We have also studied necessary conditions for the Einstein gravity to be correctly reproduced on a 4-dimensional hypersurface embedded in the higher-dimensional bulk space-time within the scenario of warped compactification.

Statistical Physics and Materials Science

The activities of the Statistical Physics and Materials Science Project have focused on the theory of equilibrium and nonequilibrium behavior and dynamics in strongly interacting many-body systems, in particular as applied to complex systems, polymers, disordered materials, and surface physics. Significant results have been obtained in the following problems.

We have studied the reasons behind an unexpected intermediate power-law dependence of the velocity correlation and associated memory functions in the diffusive dynamics of strongly interacting particles. We have also undertaken to develop and test novel methods for finding transition paths and rates in many-particle systems. These methods have been applied to the diffusion of adatom clusters on metal surfaces where

we have found new collective diffusion mechanisms. Based on such mechanisms, we have carried out analytic calculations of diffusion rates using the Master equation formalism. We have also applied the extrapolation methods to study the stability of strained overlayers. Other diffusion problems studied concern 2D circles and hard rods on smooth surfaces, analysis on non-equilibrium effects in profile spreading, diffusive dynamics under steady-state sedimentation, critical dynamics on the W(001) surface, and path integral formalism of diffusion. We have completed the first application of the wave-function Monte Carlo method to dissipative quantum dynamics of hydrogen adatoms on metal surfaces.

What is known about elementary processes in surface diffusion has been used to predict the macroscopic morphological evolution of growing crystal surfaces. In particular, we have studied the reasons behind the onset of instability in step-flow growth in the case of copper surfaces vicinal to Cu(001). We have studied in detail adatom diffusion on Cu(111) surfaces.

We have continued our work on the properties of disordered fibre networks, and on the dynamics of fronts in such systems. We have introduced a continuum phase-field model to describe the dynamics and kinetic roughening of wetting fronts in porous media. This model gives novel predictions due to the non-locality of the problem which arises only through proper treatment of the underlying physics. The model has been applied to paper wetting, capillary rise, and diffusive droplet spreading.

In conjunction with the theoretical work on kinetic roughening, we have been closely involved in the experiments of the kinetic roughening of slow combustion fronts in a paper written by J. Timonen's group at the University of Jyväskylä. The most recent results elucidate the origin behind the unusual short-range behavior of combustion fronts.

In collaboration with Prof. J. Hietarinta (University of Turku) we have continued our numerical studies on the topological stable structures of the Faddeev-Skyrme model. We have found new ground state configurations with some values of the Hopf charge Q that improves the analytically predicted behavior for the total energy $E \propto |Q|^{3/4}$. Through video animations for all the systems studied we can investigate the elementary processes which lead to the modification of a specific system from one configuration to another.

We have continued first principles calculations for metallic alloys and alloy surfaces. Related with the above-mentioned study of the cluster diffusion on metal surfaces, we have studied the basic processes for adatom diffusion on Al(100). For this system, we have performed a careful comparison between different approximations to the density functional theory, showing that the widely used local density and generalized gradient approximations yield similar results, given that the lattice constant is the same in both cases. We have also applied ab initio methods to the oxidation of CO on the Pd(111) surface and S and O adsorption on pure and Ge doped Ag(111) surface.

Prof. Ulf Leonhardt (Univ. of St. Andrews, Scotland) and Norbert Lütkenhaus (HIP) lectured at the Summer school on quantum optics and quantum information, August 21–25, 2000, Helsinki University of Technology, Otaniemi, Espoo.

High Energy Physics Programme

Risto Orava

The year 2000 marked the end of the operation for the CERN LEP collider after reaching collision energies in excess of 207 GeV. The analysis of LEP data has probed physics in a parameter space which will remain unique for a number of years to come. Two main questions are at the heart of the physics analysis: Is there a light Higgs boson which manifests electro-weak symmetry breaking and the origin of mass? Do the supersymmetric partners of ordinary matter particles exist? In addition to Higgs searches, the Finnish group has been investigating subtle effects of Quantum Chromodynamics. In the field of heavy flavour physics, the group has completed and published the measurement of the $|V_{ub}|$ CKM mixing matrix element. This represents the most precise single measurement of $|V_{ub}|$ and provides a vital piece of input information for interpreting the CP violation data expected from the new bbar colliders in Japan and the U.S. The group has studied the precision and discovery potential of the Higgs sector with a 500 GeV e^+e^- collider (TESLA project) and it has completed a conceptual design of a vertex tracker based on a new type of Silicon pixel detectors. The high-energy physics programme is now concentrating on options for a second-generation experiment on forward physics and luminosity studies at LHC. A feasibility study for installing a very forward addition to a base-line design of an LHC experiment has been carried out. A novel small-angle detector system, called the μstation, has been invented and consists of a cooled semiconductor detector element, which is integrated with the beam vacuum chamber structure.

Electron - Positron Physics

The year 2000 marked the end of operation of the CERN LEP collider after reaching collision energies in excess of 207 GeV. The analysis of LEP data has probed physics in a parameter space which will remain unique for a number of years to come. Two main questions are at the heart of the physics analysis: Is there a light Higgs boson which manifests the electro-weak symmetry breaking and origin of mass? Do the supersymmetric partners of ordinary matter particles exist? The search for Higgs bosons has benefited from the experience gained in a decade of detailed physics investigation at LEP in reconstructing complex multipart on final states and in identifying the beauty quarks. Preliminary results of the SM Higgs boson searches show an excess of signal events as expected for a Higgs boson with a mass of 115 GeV. The observation is not firm enough to claim a discovery, but is in full accordance with the indirect experimental evidence obtained from the electro-weak radiative corrections and the predictions of supersymmetric grand unified theories.

With the LEP program ending and the low energy B-factories starting their operation, the focus of high energy e^+e^- physics studies are moving towards a high luminosity linear collider which will cover the energy range from the Z pole up to 500 GeV and beyond. The group has concentrated on defining the precision and discovery potential of the Higgs sector with such a collider. It has completed a conceptual design of a vertex tracker based on a new type of Silicon pixel detectors.

The anticipated detector response and expected large statistics should allow detailed studies of Higgs boson decay properties. Precise investigation of the Higgs sector, beyond the discovery potential of the Tevatron and LHC, are required for the unambiguous identification of

the mechanism responsible for the origin of mass. A detailed technical design report for the TESLA linear collider proposal has been prepared in the framework of a series of ECFA sponsored workshops.

The level of accuracy required by the physics programme of the next linear collider has been the basis for the group's efforts in developing a new type of Silicon pixel sensor. The work is based on past experience with the DELPHI microvertex detector and has been carried out in cooperation with the INFN group of Milano and the Institute for Nuclear Physics in Krakow.

In the field of heavy flavour physics, the group has completed and published the measurement of the $|V_{ub}|$ CKM mixing matrix element. This represents the most precise single measurement of $|V_{ub}|$ and provides a vital piece of input information for interpreting the CP violation data expected from the new bbar colliders in Japan and the U.S.

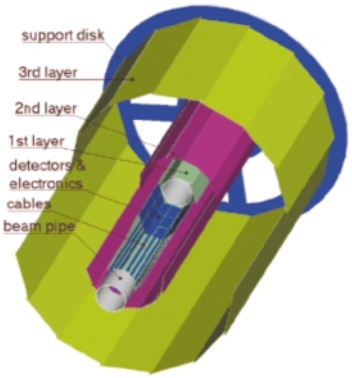
The group has actively studied the QCD coherence phenomena and developed a novel method for reconstructing colour dipoles and partons in the hard scattering final states. Two separate publications have been prepared, one for identifying gluon jets and another one confirming, for the first time, the dead cone effect in heavy quark final states.

The group has investigated high energy LEP 2 data by searching for pairs of charged Higgs bosons. These are predicted by several extensions of the Standard Model. The group has coordinated the DELPHI activity in these searches. The most recent results exclude mass values around the W-mass. The searches have been effective in using the Helsinki method for reconstructing event colour structures and jet flavour tagging. The experience gained at LEP has been used in carrying out feasibility studies of Higgs physics at future linear colliders. The group has shown - for the first time - that the full reconstruction of decays of very heavy charged Higgs bosons is possible. The decays of heavy charged Higgs's to lighter ones were also studied for the first time. These analyses can bring additional information about the details of the Higgs mechanism itself and they will be included in the Technical Design Report of the TESLA project.

Forward physics and luminosity studies at LHC

Exciting new cosmic ray results were recently recorded by LEP experiments. The bunches of high energy muons and jets seen in these experiments reflect the uncertainties in understanding physics processes responsible for particle production in the very forward region. In fact, very little is known of the dynamics of high energy particle interactions at small angles.

A forward extension of a general purpose proton-proton(antiproton) experiment would be sensitive to the production of Higgs, extra dimensions, glueballs, odderons, hybrids and



The design of a vertex tracker for a TESLA experiment.

From left
1. The Detector laboratory of the Department of Physics, University of Helsinki and the Helsinki Institute of Physics.

2. Set-up for the aging research.

3. Close-up of a part of a new data acquisition system for a GEM detector with two Helix-chips and bonding wires clearly shown.

new χ_c^0 and χ_b^0 decays. It can also do more orthodox QCD physics in unique ways, such as measuring the size of colour singlet gluon pairs at low x_{Bj}. In addition to the search for new physics it will enable systematic precision measurements of Double Pomeron Exchange.

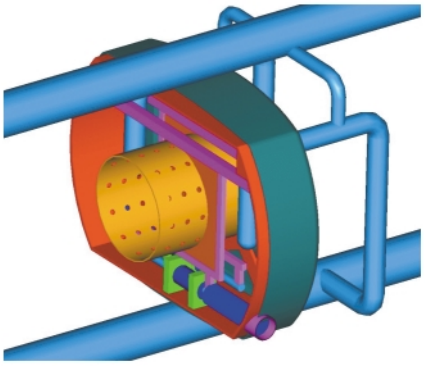
Starting in August 1999, the high-energy physics programme has investigated options for a second-generation experiment on forward physics and luminosity studies at LHC. A feasibility study for installing a very forward addition to a base-line design of an LHC experiment has been carried out. A novel small-angle detector system, called the *μstation*, has been invented, which consists of a cooled semiconductor detector element, integrated with the beam vacuum chamber structure.

A scheme, which optimizes the forward acceptance, can be achieved by using a number of *μstations* in conjunction with a base-line LHC experiment. The new detector system consists of several inelastic *μstations* inside the experimental cavern and a number of *μstations* in more distant locations in the machine tunnel to provide measurements of scattered protons. Sensors of two different technologies will be utilized in the forward detector: silicon and gaseous (GEM-based) pixel detectors. Since these new detectors have to meet the severe performance requirements of the LHC, a dedicated R&D project is being carried out.

A conceptual design of the *μstation* was validated by constructing and testing the first mechanical prototype versions during the year 2000. The results will lead to the development of an improved full prototype by fall 2001.

Detector laboratory

In the year 2000, the activities of the detector laboratory included the Academy of Finland funded detector development project which focused on generic detector technology R&D on silicon pixel detectors and gaseous micro-pattern detectors with applications in high energy physics and medicine. The laboratory provides the basic infrastructure for the detector R&D of the Vertex tracker for the TESLA linear collider project and for the Forward physics and luminosity studies of the LHC project and covers the following items:



The inner architecture of a μstation.

- Silicon pixel vertex detector,
- Detector R&D, prototype development for stations and outer telescope,
- Front-end electronics,
- Data acquisition and control system,
- Trigger system.

Generic Detector Research

During the last two years the characteristics of the *GEM detectors* have been investigated by the detector laboratory in cooperation with CERN. Several alternative methods for producing GEM channels in various polymer foils have been tested as well. The most promising results have been achieved by a combination of two different methods; laser ablation and plasma etching. Further investigations are still needed concerning the manufacturing process and materials used.

A new *data acquisition system* for GEM detector readout based on utilisation of the 128 channel preamplifier chip, Helix, and ROXI VME module has been constructed. DAQ is also based on MIDAS running on VME-Linux. Control signals for the GEM detector readout are generated by a SEQSI-sequencer (VME), triggered by an external trigger. This external trigger can be a scintillating hodoscope or auto-triggered by the GEM detector itself. Further development and performance tests of the whole signal chain from the GEM through the DAQ still need to be done.

During the on-going *aging research* on gase-

ous radiation detectors promising results have been obtained. A novel approach to the problem has offered a method to analyse directly from the gas mixture some potentially harmful compounds created in the electron avalanches. Some compounds found are known to be easily polymerized and can be considered as good candidates for causing the aging phenomenon. As a quantitative method it has proved to be able to measure the dependence of the concentration of these compounds on the operating parameters of detectors. The reaction mechanics and kinetics involved in the aging effect have also been studied with the software programs provided by the CSC (Center for Scientific Computing). The studies carried out confirmed the reaction products discovered by us earlier with our own special gas analysis system. They also clarified some chemical reaction chains occurring in the detector gas phase under high-rate radiation.

GEM development

- Study of *GEM detector characteristics*: position resolution, rate capability, large primary ionisations.
- Investigation of a new *GEM-foil manufacturing technique* with thicker foils including new foil materials, conductive platings and larger areas.
- Test of a *data acquisition system* with a two-dimensional, large area read-out, optimisation of the speed of signal read-out.

Aging studies

- Study of the effect of various *gas mixtures* on the products created in electron avalanches. Also the effect of different *additives and harmful compounds* already found to be produced in avalanches on the aging of the detector will be studied.
- Theoretical approach to *reaction kinetics* with simulation provided by CSC.
- Analysis of *solid aging products* with FTIR in collaboration with the VTT Analysis centre.

Silicon Pixel Detector Development

- *Silicon pixel detector test structures* based on a new design of capacitively coupled interleaved cells between two read-out pixels have been produced by the Helsinki Milan Krakow Warsaw R&D Collaboration.
- *The electrostatic characterisation* of the detectors was performed by the Detector laboratory at Helsinki and by other collaborating institutes; The results were in line with expectations.
- *GEANT and ANSYS models* of the Vertex Tracker geometry were prepared and used for the optimised detector geometry.
- *A first stage engineering design* based on the use of diamond coated carbon fibre support structures was completed.
- *Accelerator induced backgrounds:* electron-positron pairs, photon induced neutrons and two-photon interactions were simulated.
- *An optimised Vertex tracker design* was completed based on a detailed GEANT simulation of potential backgrounds.

The Vertex Tracker Design has been presented at the ECFA-DESY Working Group on detector concept and R&D and will be included in the TESLA Technical Design Report to be published in spring 2001.

LHC Programme

Jorma Tuominiemi

The HIP LHC programme is responsible for the Finnish participation in the design and construction of the large detector systems for the CMS and ALICE experiments at the CERN Large Hadron Collider as well as preparing their physics analysis. The main goals of these experiments are searches for the mechanism of the spontaneous breaking of the electroweak symmetry (Higgs bosons), for supersymmetry particles and for quark gluon plasma. With the participation in the CMS and ALICE experiments HIP will contribute to the next fundamentally important step in understanding the basic structure of matter and origin of the Universe. The experiments are now planned to begin in 2006. The LHC Programme is divided into three projects: 1) the CMS Software and Physics Project, the goal of which is to develop simulation and analysis software for the CMS experiment and to evaluate the physics discovery potential of the CMS detector design, 2) the CMS Tracker Project which will contribute to the design, construction and testing of the central tracking system as well as to its data acquisition, 3) the Nuclear Matter Project contributing to the design and construction of the ALICE Inner Tracker system as well as to heavy ion physics evaluation. The Nuclear Matter project also participates in the ISOLDE programme at CERN.

Software and Physics

The HIP software group continued to maintain and to be responsible for the CMS detector simulation package. Four major releases of CMSIM were issued during the year 2000. The Fortran based package continued to play an important role in CMS event simulation due to delays in the development of the corresponding C++ code by the collaboration. The HIP group participated in a massive event simulation effort totalling several Terabytes of output. The HIP contribution to this production in 2000 was about 200 GBytes. The production project is part of the CMS DataGrid activities with the goal to develop a world-wide distributed production and analysis computing network.

In event reconstruction the main activity was to define an algorithm to be used in the high level trigger phase of the data acquisition chain (Level-2) to reject the jet background of the electron candidates using some of the tracker information. In the trigger chain, this algorithm will be the first to use the tracker data. The first results matching the electromagnetic calorimeter clusters to the hits in the pixel layers for the jet rejection were obtained. The results were encouraging - a rejection factor of 12 with an electron efficiency of 95 % in the calorimeter barrel was obtained - and the work is continuing to extend the algorithm to full calorimeter and tracker coverage. Furthermore, we have started to study the identification of converted photons using the combined data from the calorimeter and the tracker.

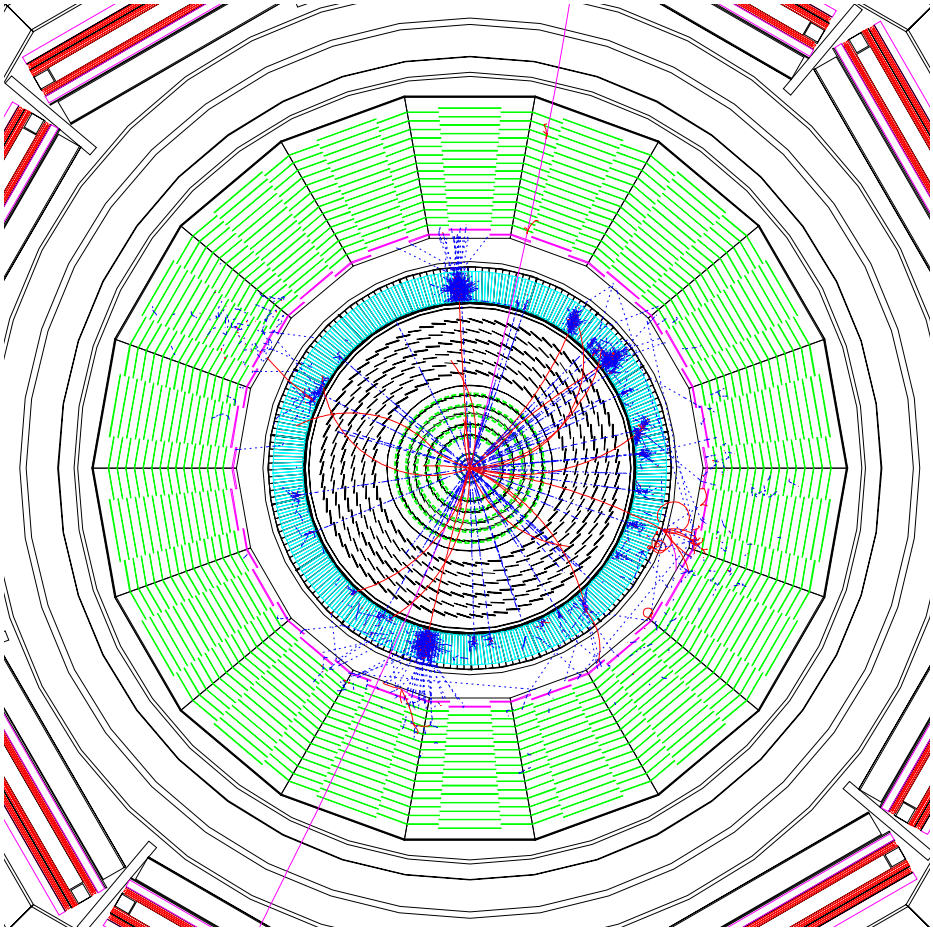
In the development of the GEANT4 toolkit major progress was made in the implementation of the HETC code and especially the hadronic evaporation processes to GEANT4. HIP is being accepted as a participating institution in the world-wide GEANT4 collaboration with the major responsibility for the development and maintenance of the nuclear evaporation and intra-nuclear cascade processes.

In physics simulation studies the main research subjects of the HIP physics team have been the following: study of the Level-1 (hard-

ware) and High Level tau trigger, missing transverse energy and Higgs mass reconstruction for $H \rightarrow \tau\tau$ events with the new OO software, development of b-tagging algorithms using the CMSIM package to detect the associated b-jets in the $H_{SUSY} \rightarrow \tau\tau$ events, evaluation of the discovery potential for heavy charged Higgs in the $gg \rightarrow tH^+$, $H^\pm \rightarrow \tau\nu$ channel, study of the Supersymmetry (SUSY) effects for the observability of the $H \rightarrow \tau\tau$ and $h \rightarrow \gamma\gamma$ events in the general Minimal Supersymmetric Standard Model (MSSM) and study of the Standard Model (SM) and MSSM Higgs discovery potential in the gg $(q\bar{q}) \rightarrow t\bar{t}H \rightarrow \tau\tau$ (WW^*) channels.

The neutral MSSM Higgs boson production and decay rates were studied in different SUSY scenarios. Our study shows that in the case of large stop mixing, if the stop quark is very light, the sensitivity of the CMS detector for detecting a light Higgs boson in a $\gamma\gamma$ final state is completely lost because of cancellations in the loops of the production mechanism. The heavy Higgs bosons decaying into τ leptons are only slightly affected via decreasing branching ratios, since most of them are produced in association with b-quarks with no loops in the production processes. The study of b-tagging efficiency and mistagging rates for the $b\bar{b}H_{SUSY} \rightarrow \tau\tau$ channel continued with detailed detector simulation. It was shown that the tagging efficiency is strongly dependent on the jet p_T and η, but it is possible on average to obtain a better than 30 % tagging efficiency for the signal jets with less than 1 % mistagging rate.

The trigger studies have shown that even relatively soft ($E_t \sim 60$ GeV) τ jets can be triggered with high efficiency, which is of vital importance for the SUSY Higgs detection in the $H \rightarrow \tau\tau \rightarrow 2jet$ channel. These studies were continued using a new sliding window algorithm at trigger Level-1, which allows us to improve the τ trigger efficiency for low mass Higgs (m_H = 200 GeV) at this level by a factor of 2. Using electromagnetic isolation at Level-2 a reduction factor of about 10 can be obtained with an efficiency of about 66 % for $H \rightarrow \tau\tau \rightarrow 2jet$ events with m_H = 200-500 GeV. Work has started on τ-jet identification at Level-3 using the Pixel Detector alone to find a hard isolated track with good matching with a calorimeter τ-jet found at Level-1 and -2. Resolution of the E_t^{miss} measurement was investigated in the QCD jet and in the $H \rightarrow \tau\tau \rightarrow 2jet$ events. Resolution of the reconstructed Higgs mass was found to depend strongly on the E_t^{miss} measurement which in turn was discovered to suffer from energy nonlinearity due to ECAL-

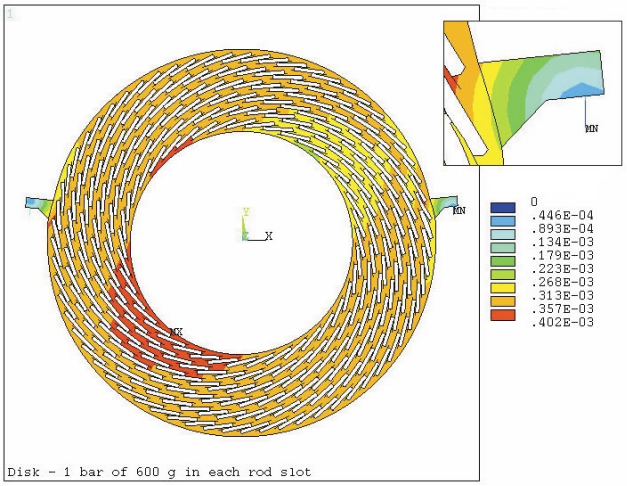


Simulation of the decay of a Higgs boson with 170 GeV mass into two Z-bosons, one of the Z's decaying into two electrons, the other into two muons. The picture shows what the event will look like in the CMS Tracker (innermost rings) and in the electromagnetic (blue ring) and hadronic (red rings) calorimeters.

HCAL intercalibration problems presently under study.

A large area of the SUSY parameter space ($m_{H^+} \gtrsim$ 180 GeV, $\tan\beta \gtrsim 10$) was found to be explorable through process $gg \to tH^+, H^+ \to \tau\nu$. A visible signal can be obtained in the transverse mass formed from E_t^{miss} and the τ-jet when the associated top is required to decay hadronically. A large enhancement of the signal over the main background coming from $t\bar{t}$ events can be obtained by exploiting the τ polarization effects selecting τ-jets with a single isolated charged hadron carrying more than 80 % of the visible τ energy. Our preliminary results for the $gg(q\bar{q}) \to t\bar{t}H \to \tau\tau\, WW^*$ channels indicate that the SM Higgs could be discovered in the difficult (but most probable) mass range 115 - 170 GeV and the lightest CP-even Higgs of MSSM almost everywhere in M_A, $\tan\beta$ parameter space.

Displacement (*in meters*) of the MSGC barrel disk under loading: the mechanical behaviour of the prototype was calculated using the Finite Element (FE) analysis code ANSYS. With relative simple modifications the FE model could be changed to correspond to the TOB layout.



CMS Tracker

The HIP Tracker project consists of three subprojects: 1) design and construction of the mechanical support of the Tracker Outer Barrel , 2) Tracker detector development and testing, 3) Trigger and data acquisition (TRIDAS) development for Resistive Plate Chamber detectors. The subprojects considerably overlap each other.

Mechanical structure. During the year 2000 the HIP Mechanics Group completed the static and dynamic stiffness measurements of the Big Wheel prototype. The Big Wheel is a full-scale, partial prototype of the outer part of the CMS tracker barrel (Tracker Outer Barrel, TOB) manufactured by Finnish industries in 1999. The motivation for the prototype was to verify experimentally the manufacturability and the functionality of the design. A combination of the application of touching measurement instruments and digital photogrammetry was used for the measurements. They confirmed that the structure could be assembled and aligned within the required tolerances. Furthermore, the results of the stiffness measurements were in a good agreement with the finite element analysis results, and the stiffness of the structure was found to be adequate for our purposes.

The decision of CMS at the end of 1999 to abandon the micro-strip gas chamber (MSGC) technique and to equip TOB with silicon strip detectors led to the need to change the design of the support structure. As the used design is flexible and modular it could be adapted for the new detector modules with minor modifications. The new TOB mechanics design has been assessed with computer models. The new TOB structure has been found to be better compared to the old MSGC desing. Sub-components of the TOB design have gone through different mechanical and assembly tests. The chosen glue material was found to withstand high radiation doses and temperature cycles

without losing its strength. The mechanical properties of the laminate material were verified with standard tension tests. Furthermore, high loaded connection elements of the TOB were re-examined. The design of the assembly and installation tools for the final support structure has started.

In November 2000, the readiness of the design of the CMS Tracker for the manufacture was evaluated in the Engineering Design Review (EDR) of the Tracker. Our TOB was the only sub-detector part that was approved by the EDR Committee to proceed with a tender of the mechanical structure. Tendering and manufacturing of components of TOB will start in 2001.

The Mechanics group has also started to work on the integration of the RPC Link Boards to the CMS structure. The plan includes the installation of the Link Boards as well as the supply of corresponding services, e.g. power supply, cooling pipes, data cables and optical fibres.

Detector activities. An R&D program to study the advantages of oxygen-rich silicon in radiation detectors has been pursued by the HIP Detector Group in collaboration with the University of Turku and the University of Oulu Microelectronics Instrumentation Laboratory. Oxygen-rich silicon has recently been found to be radiation harder than the standard float-zone silicon traditionally used in radiation detectors. CMS baseline type silicon detectors were processed at the University of Turku and irradiation of the test samples was done at the University of Jyväskylä Accelerator Laboratory. The properties of the radiated samples were measured at the Microelectronics Instrumentation Laboratory in Kemi. The project is continuing with new manufacturing concepts based on the preliminary results.

During 2000 the detector group started work on the design of a Long Term Test station for the CMS Silicon Strip Tracker (SST) modules to be built in the laboratory of the new Kumpula Physicum building. In order to assure the quality and the reliability of the SST modules before their final installation into the Tracker, the modules will be tested for system aspects at ten different laboratories of the CMS collaboration. These tests will also provide a thorough understanding of the functionality of the SST modules. Each test station will include a full CMS base-line APV read-out set-up and a climatic chamber for thermal cycling.

The detector group has operated, together with the HIP TRIDAS group and the HIP Software and Physics project, the Helsinki Silicon Beam Telescope (SiBT) at the H2 test beam. SiBT provides high precision reference information for CMS detector tests. It has been used for testing our own detectors and has provided a high quality reference beam for other detector groups in the CMS collaboration.

Trigger and Data Acquisition. The main activity of the HIP TRIDAS team in 2000 has been the design of the readout, data compression and data transfer system for the Resistive Plate Chamber (RPC's) trigger system of CMS. RPC's are fast muon detectors that are situated on the surface of the magnetic field return yoke in the outer part of the CMS detector to provide the first level muon trigger. This trigger is one of the most important aspects in the CMS detector design for the discovery of new physics.

The work has been done in collaboration with the CMS Warsaw group and the Bari group for the last two years, and recently the collaboration was joined by the Korean CMS groups. HIP is responsible for the RPC Trigger Optical Communication System and the Link Board. The LINX boards produced in Helsinki were tested at the H2 test beam in May 2000 with an LHC like time structure. The team built a data transmission chain from the Front End Boards of the RPC detector through fiber optic cables to the control room, where the data were received and analysed. The whole data transmission chain worked well. It was found that the data handling procedure in the FPGA circuit and in the synchronization process still needed more work. Algorithms for data packing, synchronization as well as the development of the Link Board were improved together with our colleagues in Warsaw. The results from the test beam experiments will be implemented in the Link Board design. In autumn 2000 unforeseen noise problems were detected in the RPC detectors.

The consequence of this is that the Link Boards need a higher data handling and data transfer capacity. A new design is being laid out to cope with a demanding performance of 2.5 Gbits/s.

The TRIDAS team continued the irradiation tests for the RPC Link Board components at the University of Jyväskylä Accelerator Laboratory. The performance of an important Link Board component, Virtex, was especially tested for Single Event Upsets (SEU). The fundamental layout of the Link Board is already done and the first prototype with the basic functionalities is being completed. Furthermore, the HIP TRIDAS team participated in the preparation of the CMS TRIDAS Technical Design Report (TDR), published in November.

Nuclear Matter

The Nuclear matter project is conducted in collaboration with the Department of Physics of the University of Jyväskylä. It contains research both in high energy heavy ion physics in the ALICE collaboration and low energy nuclear physics at the ISOLDE facility.

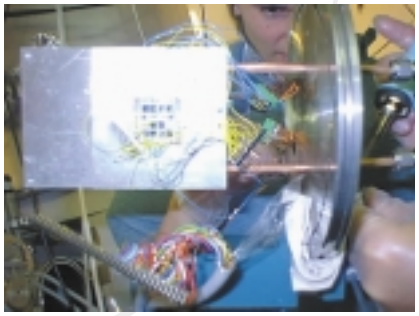
Participation in the ALICE experiment. Our contribution to the ALICE experiment is focused on the Inner Tracking System (ITS). Currently most of the manpower have been devoted to software development. For instance, our team is responsible for the development of the ITS framework and architecture. We have also substantially contributed to the experimental verification of the double track resolution of silicon drift detectors. Our software involvement has been steadily growing over the past year, recently a member of our group has been selected to the Offline Board. We have also been developing a vastly improved user interface for various event generators and for data visualization.

ALICE requires a high quality start signal (T0 detector). It is needed as a fast trigger, as a rough but rapid determination of the longitudinal vertex position, and for all Time-of-Flight (TOF) devices. T0 must be operational from the first day of data acquisition. There are three main concepts under consideration for the T0 detector: Cherenkov Counters, Resistive Plate Chambers and Micro Channel Plate (MCP) units. The MCP concept is the most challenging but it also promises the best performance. Since our group has a lot of experience in this field, we have been contributing to the T0 project by additional R&D work. The in-beam tests at CERN of T0-MCP sector prototypes, carried by our team jointly with the St. Petersburg and Bologna groups, have shown that MCP is indeed fully capable of providing sufficient efficiency and time resolution for operation with minimum ionizing particles.

Research at ISOLDE facility. Several nuclear physics experiments were conducted at ISOLDE during 2000. A detailed test was performed to compare the production rates of exotic nuclei in a spallation reaction with three different proton energies, namely 0.6, 1.0 and 1.4 GeV. The data obtained will be used to optimize the energy of the primary beam in future experiments. In addition, a set of high-precision measurements (IS384) for ^{74}Rb was performed including a half-life measurement, Penning-trap mass measurements of the parent and the daughter nuclei and decay spectroscopy for the non-analog decay branch. The obtained data extends the systematics of the superallowed beta decays towards higher Z, which is important for a better understanding of charge-dependent effects in superallowed Fermi decays. These, in turn, together with the muon-decay data, presently give the most precise value for the up-down quark mixing matrix element V_{ud} in the Cabibbo-Kobayashi-Maskawa (CKM) matrix. Penning-trap mass measurements using the ISOLTRAP mass spectrometer were also performed for ^{34}Ar (IS388), ^{76,77}Sr (IS377), $^{73\text{-}78}$Kr (IS384) and $^{179\text{-}181}$Hg (IS302). Moreover, for the first time, it was demonstrated that the decay spectroscopy of free ions stored in a Penning trap can provide new opportunities for extreme resolution spectroscopy.

In addition to the experimental effort, a program was launched with the University of Oslo to perform large-scale shell-model calculations to study the Coulomb effects in the β decay of ^{74}Rb. In addition, the nuclear shell-model was

used to investigate the lepton-flavour violating muon-electron conversion in light nuclei. New, stringent limits for the lepton-flavour violation parameters were extracted for ^{27}Al and ^{48}Ti. The same framework of the nuclear shell-model, with the most recent nucleon-nucleon interactions, was used to examine the renormalization of the weak current in the nuclear medium with an emphasis on the nucleonic degrees of freedom. The renormalization is extracted as a function of the reaction momentum exchange, and it was found to be nearly constant well beyond the beta decay energy range. However, in higher-energy processes, energy dependence is more prominent.



Radiation setup for oxygenated silicon diodes at the University of Jyväskylä Accelerator Laboratory.

Technology Programme

Ari-Pekka Hameri

Major restructuring has taken place in the Technology Programme during the year 2000. A new project has emerged and old ones have been finished or restructured drastically. After many twists the global DataGrid initiative aimed to tackle the vast data storage and computing challenge of LHC has formed the fundamental theme for the two projects of the programme. The Distributed Data Management project produced a completely new and revised version of the Tuovi document management system, with many add-ons to improve distributed project activities. As the support of this document management software was taken over by commercial organisations, the project has focused on implementing the existing metadata management know-how on various distributed computing platforms. Also the project has managed to initiate industrial collaboration with Finnish industry to transfer the know-how used in high energy physics into the supplier networks of small companies. The DataGrid project was set up in summer 2000 and it rapidly gained momentum by establishing working prototypes using the commonly accepted DataGrid technologies and by establishing close collaboration with other institutes within the CMS collaboration on the very issue of large-scale distributed computing. Along with this rapid development HIP has participated in two initiatives, namely the EU DataGrid proposal and a similar one on a Scandinavian scale, which both share the objectives set by the global Grid-community. Both projects are complementary and pave the ground towards well-concerted action to make forefront computational and software research of upmost importance to the high energy physics community and to the capabilities of the LHC.

Distributed Document Management

Collaboration with CERN's engineering data management system (EDMS) project has further intensified as the service has gained greater overall momentum within the high energy physics community. The LHC project has entered production status, and the requirements set by the authorities' demands for full life-cycle management for all information connected to the installed hardware. Following this growing need for more integrated information management the EDMS group has provided hosting for two large Tuovi installations within CERN, namely the EDMSWeb and EDMS standalone, the later being now known as TuoviDoc. Both installations have undergone changes that have provided the users with more security, a better user interface, improved report facilities and more performance. A project taking extensive advantage of the flexible metadata management concept has been installed. This concept enables the administrator to add data attributes to the documents and structures according to the diverse needs that emerge as the project evolves.

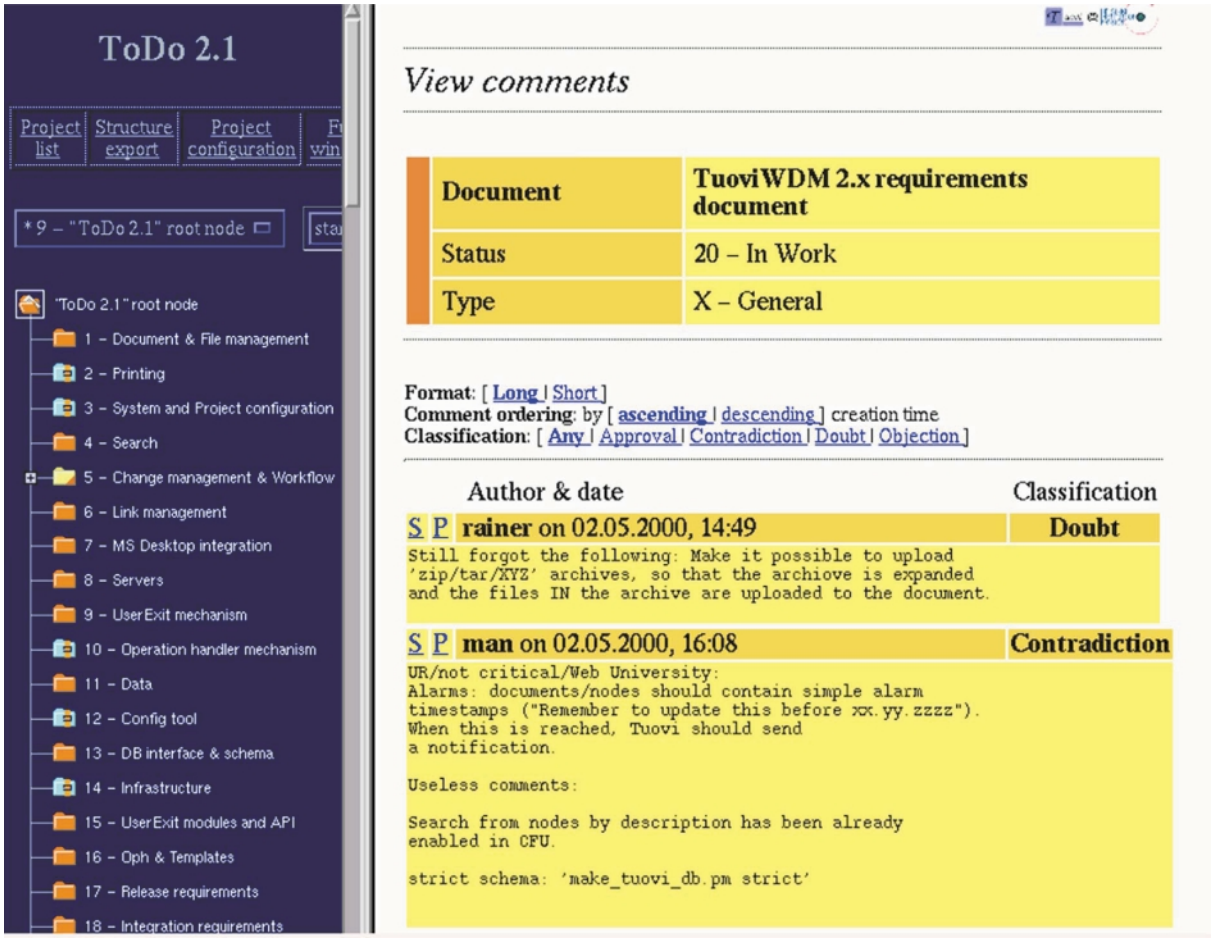
In co-operation with CERN's administrative division, a new and customised version of Tuovi 2.0 has been successfully introduced as the interface of the supplier contract follow-up database. The core of the software development has concentrated on integrating future user requirements into the system, which has resulted in the following major new features in the system:

- A comment editor that turns the system into a controlled discussion forum around documents and structures;
- An advanced notification system that informs the users on changes in docu-

ments and structures that are of interest to them;

- A desktop integration tool that enables Microsoft Windows -users to use Tuovi as a desktop folder;
- Improved searching facilities, archive input facilities, configuration facilities and a richer template language to better adjust to the diverse needs of the users.

During the year 2000 altogether nine researchers moved over to a commercial software company to further develop and commercialise the system. At the same time the overall EDMS effort entered the real production state leading finally to a decision for CERN to buy the support and maintenance work from this company. Therefore, besides the TuoviWDM development, the distributed document management team has started to gain expertise on distributed data management technologies related to CERN's DataGrid initiative (GLOBUS), a distributed directory system (LDAP) and XML-languages. Accessing TuoviWDM through a WAP phone and using GLOBUS as the storage interface of TuoviWDM have been demonstrated. Team members have been in active communication with potential future collaborators, which include industrial and academic collaborators from Finland. An active participation in conferences has also been an important part of the activities. At the same time the two



Comment editor to record the change history of documents or structures.

year Connecting Distributed Competencies (Nordisk Industrifond project #98082) project was successfully finished resulting in fruitful technology transfer of WWW-technologies developed at CERN to small and medium sized industrial companies in Scandinavia (more details at www.codisco.com).

DataGrid - TietoHila

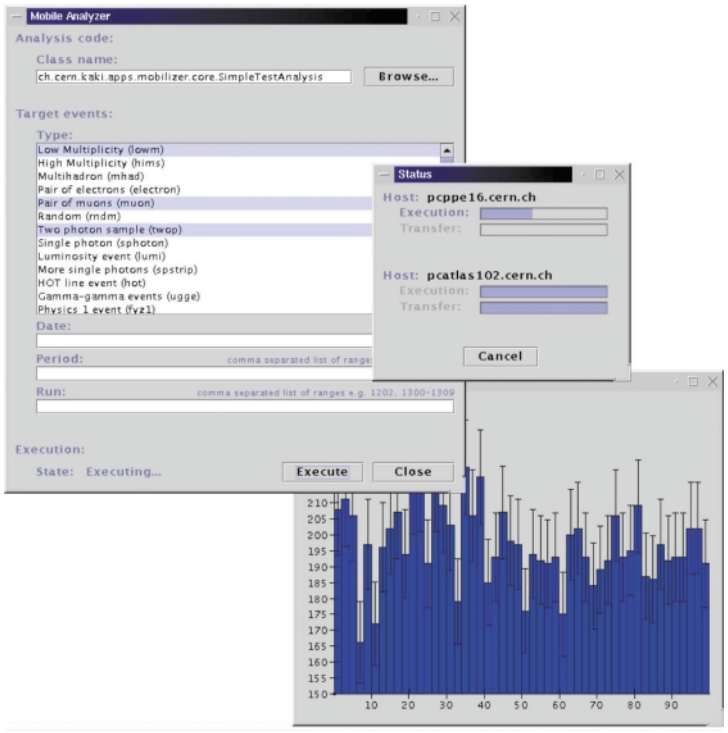
The global DataGrid project will develop, implement and exploit a large-scale data and CPU-oriented computational Grid. This will allow the analysis and management of distributed data and CPU intensive scientific computing models in an efficient manner. Once operational the LHC will produce terabytes of raw data, which is stored and analysed in a globally distributed manner. Within HIP a DataGrid project was initiated to prepare for the official start of the EU DataGrid project at the beginning of 2001. The goal of this preparation has been to establish an overall view of all the activities related to DataGrid. Two objectives were set for this work, to establish an outreach within the Grid community and to start concrete application development to build the expertise needed to contribute to the DataGrid challenge of the LHC.

Research activities were aimed at identifying suitable application areas within the Grid based on the existing know-how of the project team and other groups involved in DataGrid research. The goal of the application development has been to test different distributed computing platforms to study their suitability for rapid application development. Parallel to these activities the team has established contacts with other teams working in the DataGrid framework, especially within the CMS collaboration. These activities have generated the following results:

- Prototypes of distributed computing (Grid) applications:
  - VisualGFTP: a GLOBUS based graphical file transfer (FTP) application;
  - FileFetcher: a prototype exploring possibilities for Java agent platforms for Grid computing;
  - Mobile Analyzer: an illustration of high energy physics analysis done in a distributed heterogeneous environment;
  - Mobilizer: mobile code management system, where user defined physics analysis are executed in heterogeneous computing environments remotely largely without the user's interaction;
- A study of the potential uses of Grid technologies in the field of medicine;
- Establishing contacts with several partners in the EU DataGrid consortium and its corresponding project in Scandinavia, namely the Nordunet-2 project.

The prototype applications have been successfully demonstrated to different stakeholders at CERN and elsewhere. Collaboration with the Center for Scientific Computing in Finland has been established and other complementary initiatives with the distributed data management project of the programme have been mobilised. Preparations to test the already developed infrastructure with the simulated event data from the CMS has been completed and larger scale testing with the distributed processing structure started at the beginning of 2001.

The Mobile Analyzer is part of a DataGrid prototype to illustrate how high energy physics analysis could be executed in a distributed fashion. The user interface provides means for selecting the analysis code, target events and monitoring job execution statuses. The resulting histogram can be seen in the bottom right.



Administration

Mikko Sainio

One of the main tasks of HIP is to contribute to the graduate education of physics students. During the past year HIP has collaborated with three graduate schools sponsored by the Ministry of Education: The Graduate School in Particle and Nuclear Physics, The Graduate School of Modern Optics and Photonics and The National Graduate School in Material Physics. Several students are funded by the schools and HIP scientists are supervising them in HIP research groups. In addition to graduate research, a large number of undergraduates join the HIP research teams and finish their Masters thesis-work at HIP. Even though HIP is not a degree granting institution, we keep track of degrees, because, in fact, the number of degrees we are involved with contributes to our funding level. In addition, undergraduate students form an important recruitment channel for us. In particular, the CERN summer traineeships have turned out to be extremely efficient in this respect. During 1997-2000 12 doctoral degrees and 47 Masters' degrees have been earned at HIP groups.

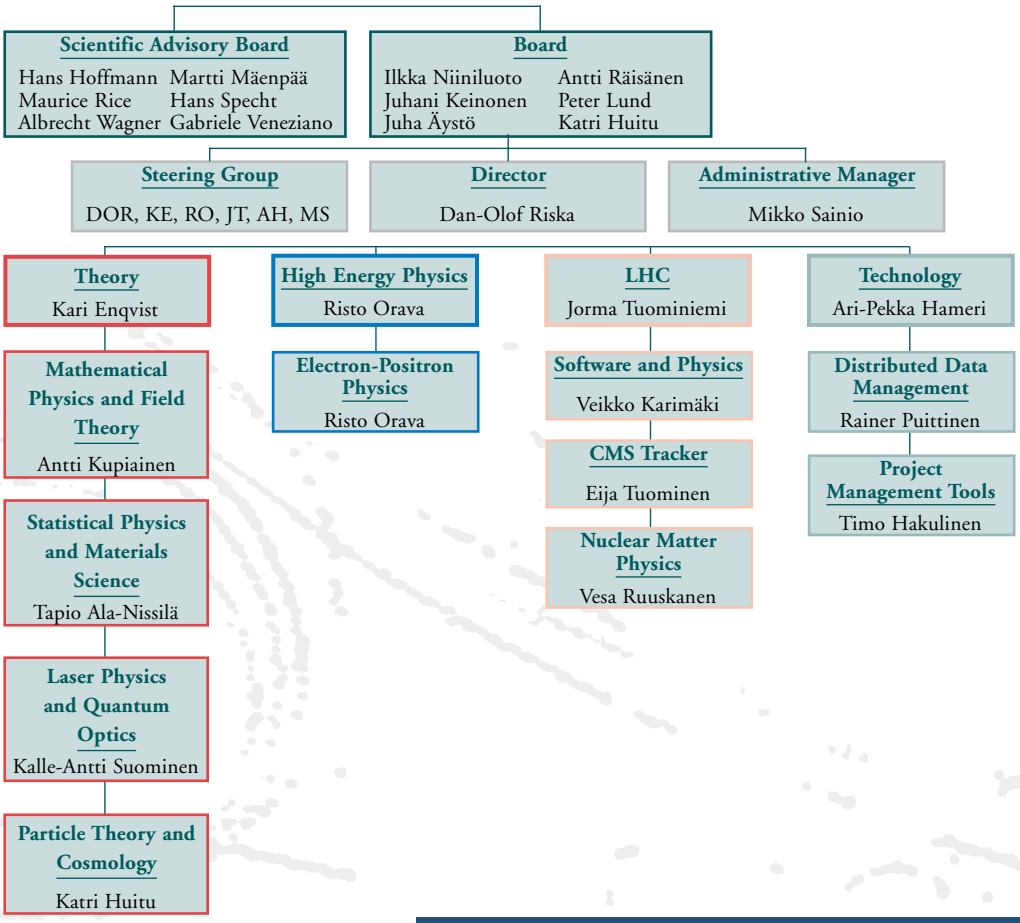
In 2000 the preparations for moving to the Kumpula campus, about 3 km from the present premises, have intensified. The actual construction work of the building had been finished by the end of 2000, but planning and setting up the laboratories and the rest of the research infrastructure has required the effort of several people in the Institute. Part of the move is a special fund of 0.68 MFIM available in 2000-2001 for laboratory equipment.

The Web University (WU) activity at CERN has continued. HIP participates in the Open Learning Environment -project led by the Tampere University of Technology and funded by the Finnish National Technology Agency (TEKES). Part of the project is the pilot WU where HIP collaborates with the CERN Education and Technology Transfer division. WU works as a virtual university, in which distance audiences participate in CERN seminars from their own countries. They communicate over the network using distribution techniques, such as multicast, interactive videoconferencing, webcast, video-on-demand, World Wide Web (Web), e-mail and mailing lists. The connections are made using national research networks, the European high speed Internet and the public Internet. Also, WU offers an opportunity for distance participation in CERN lectures given by distinguished experts. In autumn 2000 WU started to organize visits for high school students from Finland to CERN. The programme has been tested by three groups with more than 40 students. All students should study in their school the "modern physics course" before the CERN visit. WU has also produced and transmitted digital material where the CERN and Finnish scientists make the latest physics research results understandable at the high school level.

In matters of technological and commercial cooperation HIP works together with Cerntech, which is an independent programme providing services to Finnish companies with international Big Science projects such as CERN. Cerntech is mainly financed by TEKES.

Organization and Personnel

Organization



The Institute Board

Chairman	**Ilkka Niiniluoto**, Vice Rector (University of Helsinki)
Vice Chairman	**Antti Räisänen**, Professor (Helsinki University of Technology)
Members:	**Juhani Keinonen**, Professor (University of Helsinki)
	Peter Lund, Professor (Helsinki University of Technology)
	Juha Äystö, Professor (University of Jyväskylä, Appointed by the Ministry of Education)
	Katri Huitu, Docent (Chosen by personnel of HIP)

The Board: Keinonen, Räisänen, Huitu, Salomaa (substitute member), Niiniluoto, Äystö.

The Scientific Advisory Board

Chairman: **Hans Hoffmann**, Professor (CERN)

Members: **Martti Mäenpää**, Director General (Federation of Finnish Metal, Engineering and Electrotechnical Industries – MET)

Maurice Rice, Professor (ETHZ)

Hans Specht, Professor (U. Heidelberg)

Gabriele Veneziano, Professor (CERN)

Albrecht Wagner, Director General (DESY)

Personnel

Theory Programme

K. Enqvist, docent, programme director
A. Green, prof., adj. senior scientist
K. Rummukainen, prof., adj. scientist
T. Lähde, grad. student
M. Sloth, grad. student
J. Koponen, student

Laser Physics and Quantum Optics

K.-A. Suominen, prof., proj. leader
N. Lütkenhaus, senior scientist
M. Mackie, senior scientist
N. Vitanov, senior scientist
M. Havukainen, scientist
J. Calsamiglia, grad. student
O. Lindroos, grad. student
J.-P. Martikainen, grad. student
J. Piilo, grad. student
A. Collin, student
M. Jahma, student
T. Maila, student

Mathematical Physics and Field Theory

A. Kupiainen, prof., proj. leader
L. Faddeev, academician, senior scientist
J. Hietarinta, prof., adj. senior scientist
A. Niemi, prof., adj. senior scientist
C. Montonen, docent, senior scientist
E. Keski-Vakkuri, senior scientist
F. Hassan, scientist
R. Kashaev, scientist
A. Schenkel, scientist
S. Hemming, grad. student
O. Pasanen, grad. student

Particle Theory and Cosmology

K. Huitu, docent, proj. leader
M. Chaichian, prof., senior scientist
E. Gabrielli, senior scientist
H. Kurki-Suonio, docent, senior scientist
A. Kobakhidze, scientist
Z.-H. Yu, scientist
J. Laamanen, grad. student
J. Laitinen, grad. student
K. Puolamäki, grad. student
S. Räsänen, grad. student
E. Sihvola, grad. student
T. Rüppell, student

Statistical Physics and Materials Science

T. Ala-Nissilä, prof., proj. leader
M. Alatalo, senior scientist
M. Rost, senior scientist
H. Sabbagh, senior scientist
O. Trushin, senior scientist
P. Salo, scientist
J. Asikainen, grad. student
S. Badescu, grad. student
E. Falck, grad. student
M. Kuittu, grad. student
E. Kuusela, grad. student
J. M. Lahtinen, grad. student
S. Majaniemi, grad. student
M. Rusanen, grad. student
T. Fordell, student
J. Hirvonen, student
A.-P. Hynninen, student
A. Jaakkola, student
P. Nikunen, student
E. Simola, student
E. Terämä, student
A. Väihkönen, student

High Energy Physics Programme

R. Orava, prof., programme director
H. Saarikko, prof., adj. senior scientist
R. Brenner, senior scientist (at CERN)
S. Czellar, senior scientist (at CERN)
P. Eerola, adj. senior scientist
G. Forconi, senior scientist (at CERN)
J. Lamsa, senior scientist (at CERN)
S. Tapprogge, senior scientist (at CERN)
K. Österberg, adj. senior scientist (at CERN)
M. Battaglia, scientist (at CERN)
O. Bouianov, scientist (at CERN)
V. Nomokonov, scientist (at CERN)
V. Tikhonov, scientist (at CERN)
J. Ojala, researcher
A. Kiiskinen, grad. student (at CERN)
L. Salmi, grad. student (at CERN)
J. Heino, lab. engineer
K. Kurvinen, lab. engineer
R. Lauhakangas, lab. engineer
A. Numminen, lab. technician

LHC Programme

J. Tuominiemi, docent, programme director

Software and Physics

V. Karimäki, docent, proj. leader
R. Kinnunen, senior scientist (at CERN)
A. Nikitenko, senior scientist (at CERN)
N. Stepanov, senior scientist (at CERN)
K. Lassila-Perini, scientist (at CERN)
V. Lefebure, scientist (at CERN)
T. Lindén, scientist
C. Williams, scientist (at CERN)
A. Heikkinen, grad. student
T. Lampén, grad. student
S. Lehti, grad. student
J. V. Heinonen, student
J. Nysten, student (at CERN)
L. Wendland, student (at CERN)
T. Karevaara, summer student (at CERN)
T. Laitinen, summer student (at CERN)

CMS Tracker

E. Tuominen, proj. leader (at CERN)
A. Honkanen, senior scientist (at CERN)
E. Pietarinen, senior scientist
K. Banzuzi, scientist
H. Katajisto, scientist (at CERN)
K. Tammi, scientist (at CERN)
D. Ungaro, scientist
T. Vanhala, scientist (at CERN)
A. Heikkilä, student
P. Johansson, student (at CERN)
J. Li, student
P. Luukka, student (at CERN)
T. Mäenpää, student (at CERN)
M. Lahtinen, summer trainee (at CERN)
J. Modeen, summer trainee (at CERN)

Nuclear Matter

V. Ruuskanen, prof., proj. leader
J. Äystö, prof., adj. senior scientist
K. J. Eskola, adj. senior scientist
A. Jokinen, adj. senior scientist
W. Trzaska, adj. senior scientist
M. Oinonen, scientist (at CERN)
T. Siiskonen, scientist (at CERN)
M. Komogorov, grad. student
V. Lyapin, engineer

Technology Programme

A.-P. Hameri, docent, programme director (at CERN)

Distributed Data Management

R. Puittinen, proj. leader (at CERN)
M. Arenius, scientist (at CERN)
J. Hahkala, scientist (at CERN)
S. Itkonen, scientist (at CERN)
M. Niinimäki, scientist (at CERN)
P. Nitter, scientist (at CERN)
M. Puittinen, scientist (at CERN)
M. Silander, scientist (at CERN)
J. Suokuutti, scientist (at CERN)
M. Fallenius, summer trainee (at CERN)
H. Nyholm, summer trainee (at CERN)
T. Rinta-Filppula, summer trainee (at CERN)
J. Syrjälä, summer trainee (at CERN)

DataGrid

T. Hakulinen, proj. leader (at CERN)
M. Gindonis, scientist (at CERN)
M. Heikkurinen, scientist (at CERN)
M. Käki, scientist (at CERN)
A. Teräs, scientist (at CERN)
M. Tuisku, scientist (at CERN)
J. White, scientist (at CERN)
M. Happonen, student
P. Sohlman, summer trainee (at CERN)

Administration and Support

D.-O. Riska, prof., director (starting July 1)
E. Byckling, prof., director (until June 30)
M. Sainio, docent, adm. manager
T. Kalpio, financial manager
M. Flygar, secretary (at CERN)
T. Hardén, secretary (starting 1 July)
T. Jokinen, secretary
T. Karppinen, secretary (at CERN) (starting October 1)
K. Kraappa, secretary (until June 30)
C. Sivori, secretary (at CERN) (until September 30)
O. Vuola, tech. coordinator
T. Rautanen, researcher (CERN)
R. Rinta-Filppula, researcher (CERN)
N. Jiganova, senior system analyst
T. Vehviläinen, lab. engineer
P. Pennanen, trainee

Seminars

Seminars held in Helsinki

January 18th K. Enqvist (Academy of Finland/HIP)
Affleck-Dine baryogenesis revisited

January 25th A. Polosa (Dept. of Physics)
Wavelet analysis of blood pressure waves

February 1st J. Tuominiemi (HIP)
Towards the LHC experiments

February 3rd A.-P. Hameri (HIP)
Tuovi-software at CERN, the past and future

February 8th V. Capek (Charles University, Prague)
Active baths, selforganization and 2nd law of thermodynamics

February 15th J. Peltoniemi (University of Oulu)
Centre for underground physics in Pyhäsalmi

February 22nd A. Niemi (Uppsala/HIP)
Magnetic geometry and the confinement of electrically conducting plasmas

March 7th A. Nikitenko (HIP)
Measuring Higgs boson couplings at the LHC

March 28th K.-A. Suominen (HIP)
Time-dependent creation and control of quantum double wells

April 4th A. Kupiainen (Dept. of Mathematics/HIP)
Issues in 2nd turbulence

April 11th T. Ala-Nissilä (HIP/TKK)
Dynamics of non-equilibrium fronts

April 17th M. Laine (CERN)
Baryogenesis via the electroweak phase transition: the options remaining

April 18th R. Kinnunen (HIP)
Expectations for heavy SUSY Higgs observability in CMS

April 27th S. Eidelman (Novosibirsk)
Low energy e^+e^- annihilation into hadrons and its implications

May 2nd S. Barnett (Strathclyde University, UK)
Quantum retrodiction

May 9th S. M. Bilenky (Torino/Dubna)
Selected topics on neutrino mixing

May 16th K. Puolamäki (HIP)
Models with non-standard supersymmetry breaking

May 23rd D. Diakonov (NORDITA/St. Petersburg NPI)
Colour superconductivity and colour Meissner effect at high matter density

May 25th A. Kallio (University of Oulu)
Chemical equilibrium model for high T_c superconductors: explanation of charge and magnetic stripes

May 30th G. Barenboim (Mainz, Germany)
CP violation in the B system

June 5th J. Mickelsson (Stockholm)
Torsion, K-theory, and hamiltonian quantization

June 6th G. Amoros (Lund/Helsinki)
Kl4-decay and pi-pi scattering in CHPT

June 8th E. Gabrielli (Spain)
The flavour-changing neutral current and CP violating phenomena in the SUSY extensions of the Standard Model

June 12th C. E. Carlson (The College of William and Mary, USA)
Predictions for the decays of radially-excited baryons

June 13th O. W. Greenberg (University of Maryland)
Small violations of statistics; theory and high-precision bounds

June 15th H. Rubinstein (Stockholm/Uppsala)
Acoustic peaks at recombination: the early universe is talking to us!

June 19th D. Koltun (University of Rochester, USA)
Where are the nuclear pions? - inelastic scattering experiments and nuclear response functions

June 20th M. Noga (Comenius University, Bratislava, Slovakia)
Problems in the theory of electron plasma in metals

August 15th N. Lütkenhaus (HIP)
Quantum cryptography: theory, experiment, and real life

August 17th M. Hnatich (Inst. of Expt. Physics Slovak Academy of Sciences, Kosice, Slovakia)
Helical MHD turbulence: quantum field approach

August 22nd J. Louko (Nottingham University, UK)
Einstein-Kepler problem in 2+1 dimensions

August 29th D.-O. Riska (HIP)
Decays of heavy-light mesons

September 12th E. Thuneberg (Low Temperature Laboratory, HUT)
Pi state in 3He Josephson junctions

September 19th J. Soffer (Centre Physique Theorique, Marseille)
Polarized Λ ($\bar{\Lambda}$) fragmentation functions: present status and prospects

September 26th Y. Schröder (HIP)
The free energy of hot QCD

September 28th S. Sheikh-Jabbari (ICTP, Trieste)
Some new aspects of noncommutative QED

September 29th E. Rosenberg (SLAC/Iowa State University in Ames)
The elephant in the B factory: an asymmetric fable

October 2nd G. Kane (Michigan University, USA)
Supersymmetry - what? why? when?

October 3rd G. Kane (Michigan University, USA)
The supersymmetry soft-breaking Lagrangian - where experiment and string theory meet

October 5th S. Gerasyuta (St. Petersburg, Russia)
Bootstrap quark model and spectroscopy of low-lying hadrons

October 10th Conference Reports
J. Maalampi (TFO), **Int. Conf. High Energy Physics 2000 (Osaka, Japan)**
M. Roos (SEFO), **Neutrino 2000 (Sudbury, Canada) and Sym. on Cosmological data (Manchester, UK)**

October 17th A. Polosa (Dept. of Physics)
Hidden sigma resonance in heavy meson decays

October 24th T. S. Rahman (HUT/Kansas State University, USA)
Are we sacrificing physics in this craze for nanotechnology?

October 26th M. Robilotta (Sao Paulo, Brazil)
Chiral symmetry and nucleon-nucleon interactions

November 6th F. Myhrer (South Carolina, USA)
Effective theories, a novel approach in nuclear physics

November 7th V. A. Khoze (University of Durham, UK)
Selected topics on Higgs production processes: mythes and realities

November 14th N. Stepanov (HIP)
SUSY search at LHC

November 20th O. Ikkala (Materials Physics Laboratory,

Department of Engineering Physics and Mathematics, HUT)
The structures of hyperbranched polymers

November 21st E. Keski-Vakkuri (HIP)
Supersymmetric point masses in string theory

November 22nd G. Eigen (University of Bergen, Norway)
First results from BABAR

November 27th A. Skvortzov (Kazan State University, Russia)
Videocamera and computer in quantitative demonstration experiments

November 28th P. Schlein (UCLA, USA)
Status and future of the HERA-B experiment at DESY

November 30th D. Polyakov (KEK, Japan)
Holography and stochastic quantization are two different concepts relating field theories in D and D+1 dimensions

December 12th N. Vitanov (HIP)
Level crossing in coherent atomic excitation

December 15th M. Fleischhauer (University of Kaiserslautern, Germany)
Quantum networks and computing with photons and collective atomic excitations

December 19th L. Faddeev (HIP/Steklov Inst., St. Petersburg, Russia)
Electric-magnetic duality in the infrared parametrization of the Yang-Mills field

December 21st R. Unanyan (Armenian Academy of Sciences, Yerevan)
Creation of superposition states with the stimulated Raman adiabatic passage (STIRAP) method

Visitors

Theory Programme

Laser Physics and Quantum Optics

H. Inamori (UK) 11. - 18.3.
S. Barnett (UK) 30.4. - 14.5.
A. Ishkhanyan (Armenia) 18.9. - 16.10.
R. Unanyan (Armenia) 1. - 31.12.
M. Fleischhauer (Germany) 14. - 17.12.

Mathematical Physics and Field Theory

E. Aurell (Sweden) 3. - 7.4.
N. Antonov (Russia) 6. - 13.4.
J. Bricmont (USA) 17. - 20.4.
F. Bonetto (USA) 2. - 12.5.
N. Antonov (Russia) 1. - 12.11.
E. Aurell (Sweden) 7. - 12.11.

Particle Theory and Cosmology

V. Savrin (Russia) 2. - 15.1.
V. Capek (Czech) 3.1. - 14.2.
A. Demichev (Russia) 3.2. - 31.12.
S. Bilenky (Russia) 8.3. - 31.7.
M. Gogberashvili (Georgia) 15.4. - 15.5.
K. Nishijima (Japan) 24.4. - 25.5.
S. Bludman (Germany) 3.5. - 6.5.
A. Fathollahi (Iran) 22.5. - 22.6.
W.-F. Chen (Canada) 25.5. - 7.7.
G. Barenboim (Germany) 29.5. - 4.6.
R. Gonzalez Felipe (Portugal) 30.5. - 22.6.
P. Presnajder (Slovakia) 5.6. - 14.7.
E. Gabrielli (Spain) 6.6. - 11.6.
F. Pompilo (Italy) 10.6. - 17.6.
O. W. Greenberg (USA) 11.6. - 16.6.
H. Rubinstein (Sweden) 14.6. - 20.6.
R. Coquereaux (France) 1.7. - 20.7.
M. Ioffe (Russia) 30.7. - 21.8.
M. Sheikh-Jabbari (Iran) 19.9. - 29.9.
P. Presnajder (Slovakia) 9.10. - 8.12.
D. Polyakov (Japan) 22.11. - 4.12.

Hadron Physics Activity

M. Robilotta (Brazil) 17.9. - 27.10.
F. Myhrer (USA) 3. - 7.11.
E. Norvaisas (Lithuania) 3. - 9.11.

Statistical Physics and Materials Science

M. Haataja (Canada) 5. - 7.1.
S. Badescu (USA) 5. - 18.1.
I. Vattulainen (Denmark) 7.1.
M. Dubé (Canada) 7. - 23.3.
I. Vattulainen (Denmark) 8. - 16.3.
H. Sabbagh (UK) 15. - 19.3.
P. Pietiläinen (Finland) 16.3.
J. Kalluki (Germany) 20. - 24.3.
E. Granato (Brazil) 21. - 30.3.
S. C. Ying (USA) 23. - 30.3.
B. Persson (Germany) 25. - 30.3.
A. Neelov (Russia) 1.6. - 31.8.
S. C. Ying (USA) 2. - 7.6.
S. Badescu (USA) 10.6. - 15.7.
V. Bochkarev (Russia) 21. - 22.6.
M. Dubé (Canada) 16.7. - 8.8.
W. Sung (Republic of Korea) 2. - 6.8.
E. Carlon (Italy) 2. - 11.8.
T. S. Rahman (USA) 10.8.2000 - 4.1.2001
N. Tarasenko (Ukraine) 31.8. - 17.9.
I. Vattulainen (Denmark) 18. - 21.9.
C. Ghosh (USA) 21.9.2000 - 12.1.2001
S. C. Ying (USA) 25. - 29.9.
K. Kokko (Finland) 26.10.
A. Kara (USA) 5. - 20.12.

High Energy Physics Programme

E. Rosenberg (USA) 27.9. - 1.10.
G. Eigen (Norway) 7. - 9.11., 21. - 23.11.
V. A. Khoze (UK) 4.11. - 9.11.

LHC Programme

Software and Physics

G. Snow (USA) 3.11.

CMS Tracker

R. Kupchak (Poland) 10. - 15.1.
S. Ahn (Korea) 19.1. - 5.5.
I. Park (Korea) 26. - 28.10.

Conference participation, Talks and Visits by Personnel

Theory Programme

Laser Physics and Quantum Optics

Fundamentals of Quantum Optics V,
16-21 January, Kühtai, Austria (K.-A. Suominen, P. Törmä)

The Blackett Laboratory, Imperial College,
29 January - 14 April, London, U.K. (J. Calsamiglia)

University of Turku,
31 January, Turku, Finland (K.-A. Suominen)

Winter College on Optics and Photonics,
7-25 February, Trieste, Italy (J. Martikainen)

University of Turku,
11 February, Turku, Finland (K.-A. Suominen)

Department of Physics, University of Hannover,
21-29 February, Hannover, Germany (K.-A. Suominen)

The Annual Meeting of the Finnish Physical Society,
9-11 March, Espoo, Finland (M. Havukainen, J. Martikainen, J. Piilo and K.-A. Suominen)

Ørsted Laboratory, University of Copenhagen,
14-23 March, Copenhagen, Denmark (talk by K.-A. Suominen)

Ørsted Laboratory, University of Copenhagen,
18-22 March, Copenhagen, Denmark (J. Piilo)

University of Boston,
27 March - 3 April, Boston, MA, USA (talk by N. Lütkenhaus)

Institute for Theoretical Atomic and Molecular Physics (ITAMP),
28 March, Cambridge, MA, USA (talk by N. Lütkenhaus)

Department of Mathematics, University of Massachusetts,
29 March, MA, USA (talk by N. Lütkenhaus)

2000 Spring Eastern Sectional Meeting of the American Mathematical Society,
1-2 April, Boston, MA, USA (invited talk by N. Lütkenhaus)

Annual meeting of the German Physical Society,
5-7 April, Bonn, Germany (talk by N. Lütkenhaus)

University of Turku,
10-11 April, Turku, Finland (K.-A. Suominen)

Meeting of the COCOMO network,
12-16 April, Kaiserslautern, Germany (N. Vitanov)

Seventh Central-European Workshop On Quantum Optics,
28 April - 1 May, Balatonfured, Hungary (invited talk by K.-A. Suominen)

Universite Paul Sabatier,
2 May - 26 June, Toulouse, France (lectures by N. Vitanov)

Ørsted Laboratory, University of Copenhagen,
9-18 May, Copenhagen, Denmark (K.-A. Suominen)

Royal Holloway and New Bedford College,
22-28 May, London, U.K. (N. Lütkenhaus)

Trapped Particles and Fundamental Physics,
23 May - 2 June, Les Houches, France (J. Piilo)

Meeting on Quantum Cryptography,
26 May, London, U.K. (invited talk by N. Lütkenhaus)

Centre for Quantum Computing,
29 May - 1 June, Oxford, U.K. (N. Lütkenhaus)

International Conference on Atomic Physics, ICAP-2000,
5-9 June, Firenze, Italy (J. Martikainen and J. Piilo)

Lehrstuhl für Optik, University of Erlangen,
5-9 June, Erlangen, Germany (talk by N. Lütkenhaus)

Joensuu Summer School on Optics 2000,
19-22 June, Joensuu, Finland (A. Collin)

Meeting of the CAUAC network,
19 June, Copenhagen, Denmark (K.-A. Suominen)

Sektion Physik at the Ludwig-Maximilians Universität München,
23 June, Munich, Germany (talk by N. Lütkenhaus)

Quantum Communication, Measurement and Computing,
3-8 July, Capri, Italy (J. Piilo, invited talk by N. Lütkenhaus)

32nd EGAS Conference,
4-7 July, Vilnius, Lithuania (invited talk by K.-A. Suominen)

Workshop on Quantum Information,
2-21 July, Benasque, Spain (J. Calsamiglia, N. Lütkenhaus (starting 10 July))

University of Kaiserslautern,
19 July - 2 August, Kaiserslautern, Germany (N. Vitanov)

Euroconference on Atom Optics and Interferometry,
26-29 July, Cargèse, Corsica, France (K.-A. Suominen)

Summer school on quantum optics and quantum information,
21-25 August, Espoo, Finland (J. Calsamiglia, O. Lindroos, J. Piilo, lectures by N. Lütkenhaus, co-organized by K.-A. Suominen)

Ørsted Laboratory, University of Copenhagen,
28 August - 3 September, Copenhagen, Denmark (K.-A. Suominen)

Nordita meeting on low-dimensional physics in solids and trapped particles,
31 August - 2 September, Copenhagen, Denmark (invited talk by K.-A. Suominen)

ITAMP workshop on Collisions of Cold Alkaline-Earth Atoms,
7-9 September, Cambridge, MA, USA (co-organized by K.-A. Suominen)

1st QIPC workshop,
27-29 September, Potsdam, Germany (talk by J. Calsamiglia)

European Research Conference on Quantum Optics XI,
14-19 October, Mallorca, Spain (J. Calsamiglia)

University of Kaiserslautern,
23 October - 22 November, Kaiserslautern, Germany (N. Vitanov)

Erwin Schrödinger Institute,
9-16 November, Vienna, Austria (K.-A. Suominen)

Conference in commemoration of John S. Bell,
10-14 November, Vienna, Austria (K.-A. Suominen)

Final network meeting "Coherent Light-Atom interactions",
17-19 November, Ustaoset, Norway (K.-A. Suominen, talks by J. Calsamiglia and J.-P. Martikainen)

Ørsted Laboratory, University of Copenhagen,
29 November - 5 December, Copenhagen, Denmark (K.-A. Suominen)

Mathematical Physics and Field Theory

Spaatind 2000: The 16th Nordic Meeting in Particle Physics,
5-9 January, Spåtind, Norway (C. Montonen)

String Theory at the Millennium Conference,
12-15 January, Pasadena, CA, USA (E. Keski-Vakkuri)

Winter meetings, International Council for Scientific and Technical Information,
29-30 January, Paris, France (C. Montonen)

University of Turku,
14 February, Turku, Finland (talk by C. Montonen)

EU Network meeting,
15 February, Torino, Italy (invited talk by A. Kupiainen)

IHES,
1-31 March, Bures-sur-Yvette, France (invited talk by A. Kupiainen)

The Annual Meeting of the Finnish Physical Society,
9-11 March, Espoo, Finland (C. Montonen)

Harvard University,
20 March - 12 April, Cambridge, MA, USA (talk by E. Keski-Vakkuri)

Universite Paris 10,
22 March, Paris, France (invited talk by A. Kupiainen)

Council Meeting of the European Physical Society,
24-25 March, Dublin, Ireland (C. Montonen)

11th Nordic Meeting on Supersymmetric Field and String Theories,
4-6 May, Copenhagen, Denmark (S. Hemming, C. Montonen, O. Pasanen)

ESI Programme on Confinement; the Erwin Schrödinger Institute for Mathematical Physics,
7-20 May, Vienna, Austria (talk by C. Montonen)

Meeting in honor of J. Lebowitz,
20 May, Sienna, Italy (invited talk by A. Kupiainen)

Swedish Mathematical Society festivitie,
25 May, Uppsala, Sweden (invited talk by A. Kupiainen)

Summer school on wave propagation and diffusion in random media,
19-26 June, Warsaw, Poland (lectures by A. Kupiainen)

Banach center,
23-30 June, Warsaw, Poland (A. Kupiainen)

Analytical and Statistical Approaches to Fluid Models,
3-9 September, Oberwolfach, Germany (invited talk by A. Kupiainen)

University of Uppsala,
25 September, Uppsala, Sweden (talk by E. Keski-Vakkuri)

CCSD Steering Committee Meeting,
30-31 October, Lyon, France (talk by C. Montonen)

IAS Princeton,
10 November - 10 December, Princeton, NJ, USA (A. Kupiainen)

12th Nordic Meeting on Supersymmetric Field and String Theories,
16-18 November, Gothenburg, Sweden (S. F. Hassan, S. Hemming, talk by E. Keski-Vakkuri, C. Montonen, O. Pasanen)

University of Amsterdam,
23-26 November, Amsterdam, The Netherlands (E. Keski-Vakkuri)

Princeton University,
26 November, Princeton, NJ, USA (invited talk by A. Kupiainen)

Rutgers University,
27 November, NJ, USA (invited talk by A. Kupiainen)

Courant Institute, NYU,
28 November, New York, USA (invited talk by A. Kupiainen)

University of Chicago,
6 December, Chicago, USA (invited talk by A. Kupiainen)

Illinois Inst. of Technology,
7 December, Chicago, USA (invited talk by A. Kupiainen)

Particle Theory and Cosmology

Spaatind 2000: The 16th Nordic Meeting in Particle Physics,
4-10 January, Spåtind, Norway (K. Huitu, talk by K. Puolamäki)

Bariloche Res. Centre,
21 January, San Carlos de Bariloche, Argentina (talk by M. Chaichian)

Academy of Sciences of Cuba,
21 February, Havana, Cuba (talk by M. Chaichian)

Planck Low Frequency Instrument Consortium Meeting,
24-26 February, Saariselkä, Finland (K. Enqvist, H. Kurki-Suonio, E. Sihvola)

The Annual Meeting of the Finnish Physical Society,
9-11 March, Espoo, Finland (M. Chaichian, K. Huitu, two talks by H. Kurki-Suonio, K. Puolamäki)

Nordic LHC Physics Workshop,
16-18 March, Lund, Sweden (talk by K. Huitu, K. Puolamäki, T. Rüppell, Z. H. Yu)

Neutrino Physics and Cosmology, First Nordic Project Meeting,
31 March - 1 April, Copenhagen, Denmark (K. Enqvist, talk by H. Kurki-Suonio)

University of Oulu,
5 April, Oulu, Finland (talk by M. Chaichian)

ESA-CERN workshop,
April, CERN, Switzerland (K. Enqvist)

Int. Conference "Spin-Statistics connection and Theoretical Implications",
31 May - 3 June, Anacapri, Capri Island, Italy (talk by M. Chaichian)

International Conference "Quantization, Gauge Theory and Strings", dedicated to the memory of Professor Efim Fradkin,
5-10 June, Moscow, Russia (talk by M. Chaichian)

The 10th Jyväskylä Summer School,
10-11 August, Jyväskylä, Finland (six lectures by H. Kurki-Suonio)

Second Nordic Workshop,
8-9 September, Copenhagen, Denmark (talk by Z. H. Yu)

Planck Low Frequency Instrument Consortium Meeting,
19-21 October, Jodrell Bank Observatory, Macclesfield, U.K. (K. Enqvist, H. Kurki-Suonio)

University of Cape Town,
13 December, Cape Town, South Africa (talk by M. Chaichian)

VI IFT-UAM Christmas Workshop on Particle Physics,
18-21 December, Madrid, Spain (talk by E. Gabrielli)

Hadron Physics Activity

Department of Radiation Sciences, University of Uppsala,
25 May - 1 June, Uppsala, Sweden (talk by M. Sainio)

Workshop on Chiral Dynamics 2000,
17-22 July, Newport News, USA (invited talks by D.-O. Riska and M. Sainio)

University of Maryland,
14 August, College Park, USA (talk by D.-O. Riska)

XVIIth European Conference on Few Body Physics,
11-16 September, Evora, Portugal (invited talk by D.-O. Riska)

GSI Workshop on its Future Facility,
18-20 October, Darmstadt, Germany (invited talk by D.-O. Riska)

Department of Physics, University of Helsinki,
27 October, Helsinki, Finland (talk by M. Sainio)

Third Caribbean Workshop on Quantum Mechanics, Particles and Fields,
15-22 December, La Habana, Cuba (invited talks by D.-O. Riska)

Statistical Physics and Materials Science

Mathematics Days,
10-11 January, Turku, Finland (M. Rost)

Institute of Computer Physics, University of Stuttgart,
7 February - 3 March, Stuttgart, Germany (E. Kuusela)

Department of Physics, University of Turku,
25 February, Turku, Finland (P. Salo)

The European Science Foundation,
1-2 March, Strasbourg, France (T. Ala-Nissilä)

The Annual Meeting of the Finnish Physical Society,
9-11 March, Espoo, Finland (M. Alatalo, T. Hjelt, P. Salo; J. Asikainen, M. Kuittu, E. Kuusela, J. M. Lahtinen, M. Rusanen; E. Falck, P. Nikunen; talks by T. Ala-Nissilä, M. Rost and O. Trushin)

Physics Department, Essen University,
15-17 March, Essen, Germany (M. Rost)

Max-Planck Institute for Colloids and Interfaces,
17-21 March, Golm, Germany (talk by M. Rost)

Applied Physics Department, Ulm University,
24 March, Ulm, Germany (talk by M. Rost)

Winter School on Microscopic and Macroscopic Aspects of Friction,
26-30 March, Oulanka Biological Station (University of Oulu), Finland (organized by T. Ala-Nissilä, M. Alatalo and P. Salo; T. Ala-Nissilä, M. Alatalo, S. Badescu, E. Falck, T. Hjelt, E. Kuusela, J. M. Lahtinen, S. Majaniemi, O. Trushin)

Physics Department, Stuttgart University,
28 March, Stuttgart, Germany (M. Rost)

Institute of Microelectronics of RAS,
3-21 April, Yaroslavl, Russia (O. Trushin)

Department of Physics, University of Jyväskylä,
14 April, Jyväskylä, Finland (talk by M. Rost)

MATRA workshop,
14-15 April, Jyväskylä, Finland (organized by T. Ala-Nissilä, talks by M. Kuittu, E. Kuusela and M. Rost)

Brookhaven National Laboratory,
17-24 April, Upton, NY, USA (M. Alatalo)

Department of Physics, Brown University,
9-15 May, Providence, RI, USA (J. M. Lahtinen)

Department of Physics, McGill University,
15-18 May, Montreal, Canada (J. M. Lahtinen)

Workshop on Nanoscale Modification of Surfaces and Thin Films,
15-18 May, Bonassola, Italy (talk by M. Rusanen)

Department of Physics, McGill University,
15-22 May, Montreal, Canada (talk by T. Ala-Nissilä)

Tampere University of Technology,
17 and 25 May, Tampere, Finland (P. Salo)

The Czech Academy of Sciences,
26 May - 1 June, Prague, the Czech Republic (T. Ala-Nissilä, talk by J. M. Lahtinen)

Workshop on 'Simulations of long time scale dynamics, molecular and continuum descriptions',
25-30 June, Reykjavik, Iceland (J. M. Lahtinen, P. Salo, talks by T. Ala-Nissilä and O. S. Trushin)

University of Cologne, Institute for Theoretical Physics,
3-10 July, Cologne, Germany (M. Rost)

Department of Physics, University of Turku,
6 July, Turku, Finland (P. Salo)

Nordita Master Class in physics,
23-28 July, Copenhagen, Denmark (A.-P. Hynninen)

The 10th Jyväskylä Summer School,
31 July - 11 August, Jyväskylä, Finland (J. M. Lahtinen)

Department of Physics, University of Jyväskylä,
14-18 August, Jyväskylä, Finland (T. Ala-Nissilä)

The 10th Jyväskylä Summer School,
14-18 August, Jyväskylä, Finland (E. Kuusela)

Psi-k 2000 Conference,
22-26 August, Schwäbisch Gmünd, Germany (talk by M. Alatalo)

2000 EPSRC/IOP TCM Summer School,
3-15 September, Windermere, U.K. (M.-P. Kuittu, E. Kuusela, S. Majaniemi)

Department of Physics, University of Turku,
5 September, Turku, Finland (P. Salo)

ECOSS-19 Conference,
5-8 September, Madrid, Spain (E. Falck, J. M. Lahtinen, M. Rusanen, O. Trushin)

NATO ARW: Collective surface diffusion coefficients under nonequilibrium conditions,
2-6 October, Prague, The Czech Republic (E. Falck, J. Hirvonen, A.-P. Hynninen, E. Kuusela, J. M. Lahtinen, P. Nikunen, T. Rahman, M. Rusanen, talks by T. Ala-Nissilä and O. Trushin)

University of Oulu,
9 October, Oulu, Finland (M. Alatalo)

Department of Physics, University of Turku,
20 October, Turku, Finland (P. Salo)

Tel Aviv University, Raymond and Beverly Sackler Faculty of Exact Sciences, School of Physics and Astronomy,
22-28 October, Tel Aviv, Israel (J. Asikainen)

High Energy Physics Programme

Spaatind 2000: The 16th Nordic Meeting in Particle Physics,
4-10 January, Spåtind, Norway (invited lectures by K. Österberg, talk by R. Orava)

ATLAS Workshop on Luminosity and Forward Detectors,
7-8 February, CERN, Switzerland (talks by R. Orava)

ATLAS Plenary meeting,
11 February, CERN, Switzerland (summary talk by R. Orava)

Cavendish Laboratory, Cambridge University,
1 March, Cambridge, U.K. (talk by M. Battaglia)

The Annual Meeting of the Finnish Physical Society,
9-11 March, Espoo, Finland (J. Heino and R. Lauhakangas, talks by M. Battaglia and L. Salmi)

Berkeley-2000 Workshop on Linear Colliders,
29-31 March, LBNL, Berkeley, CA, USA (invited talks by M. Battaglia)

Joint Theoretical-Experimental Seminar at Fermilab,
6 April, Batavia, IL, USA (talk by M. Battaglia)

8th Pisa Meeting on Advanced Detectors,
21-27 May, La Biodola, Isola d'Elba, Italy (K. Kurvinen)

University of Geneva,
7 June, Geneva, Switzerland (talk by M. Battaglia)

ATLAS Plenary meeting,
24 June, Dubna, Russia (talk by R. Orava)

4th Int. Conf. on Hyperons, Charm and Beauty Hadrons,
27-30 June, Valencia, Spain (invited talk by M. Battaglia)

QCD00 EuroConference,
6-13 July, Montpellier, France (invited talk by M. Battaglia)

ICHEP2000 Conference,
28 July, Osaka, Japan (talk by A. Kiiskinen)

Open Meeting of the Scientific Advisory Board of HIP,
4 September, Helsinki, Finland (presentation by R. Orava)

Vertex-2000 9th Int. Workshop on Vertex Detectors,
10-15 September, Lake Michigan, MI, USA (invited talk by M. Battaglia)

7th ECFA Workshop on Physics and Detectors for a Linear Electron-Positron Collider,
22-25 September, DESY, Hamburg, Germany (invited talk by M. Battaglia)

International Linear Collider Workshop - LCWS2000,
25 October, Fermilab, Batavia, IL, USA (talk by A. Kiiskinen)

First Workshop on Forward Physics and Luminosity Determination at LHC,
31 October - 4 November, Helsinki, Finland (invited talks by V. Khoze, V. Nomokonov, and S. Tapprogge)

LHC Programme

Software and Physics

Spaatind 2000: The 16th Nordic Meeting in Particle Physics,
4-10 January, Spåtind, Norway (A. Heikkinen)

Computing in High Energy Physics, CHEP2000,
7-11 February, Padova, Italy (A. Heikkinen)

Triumph Laboratory, Geant4 Collaboration,
1-13 March, Vancouver, Canada (A. Heikkinen)

The Annual Meeting of the Finnish Physical Society,
9-11 March, Espoo, Finland (V. Karimäki, talks by R. Kinnunen, T. Lampén, T. Lindén, J. Tuominiemi)

Nordic LHC Physics Workshop,
16-18 March, Lund, Sweden (invited talks by R. Kinnunen and S. Lehti)

CMS High Level Trigger Workshop,
21 July, CERN/Geneva, Switzerland (invited talk by K. Lassila-Perini)

GRID workshop,
4 September, Center for Scientific Computing, Helsinki

(talks by J. Tuominiemi, V. Karimäki)

The 2000 CERN School of Computing,
17-30 September, Marathon, Greece (S. Lehti)

LHC Days in Split,
4-7 October, Split, Croatia (invited talks by R. Kinnunen and J. Tuominiemi)

VII International Workshop on Advanced Computing and Analysis Techniques in Physics Research ACAT 2000 (formerly AIHENP),
16-20 October, FNAL, USA (talk by N. Stepanov)

Monte Carlo 2000,
23-26 October, Lisbon, Portugal (A. Heikkinen)

Forward Physics at LHC,
1-3 November, Helsinki, Finland (J. Tuominiemi)

Nordisk samarbeidsnemnd for naturvitenskap (NOS-N) Seminar,
16 November, Helsinki, Finland (invited talk by V. Karimäki)

Workshop on Physics with CMS at the LHC,
11-15 December, TIFR, Mumbai, India (talks by R. Kinnunen and S. Lehti)

Working visits to CERN,
Geneva, Switzerland (A. Heikkinen, V. Karimäki, T. Lampén, S. Lehti, T. Lindén)

Working visits to Bern, University of Bern,
Bern, Switzerland (talks by T. Lindén)

Participation in the meetings of the EPS HEPP Board and RECFA,
(J. Tuominiemi)

CMS Tracker

CMS FWD Tracker Meeting,
2 February, Karlsruhe, Germany (A. Honkanen)

The Annual Meeting of the Finnish Physical Society,
9-11 March, Espoo, Finland (K. Tammi)

CMS Hybrid Integration Meeting,
10-11 April, Pisa, Italy (A. Honkanen)

European Conference on Spacecraft Structures, Materials and Mechanical Testing ESA/ESTEC,
29 November - 1 December, Noordwijk, The Netherlands (talk by H. Katajisto)

Workshop on Physics with CMS at the LHC,
11-15 December, Mumbai, India (A. Heikkilä)

Working visits to CERN,
Geneva, Switzerland (A. Heikkilä, J. Li, E. Pietarinen, D. Ungaro)

Working visits to University of Jyväskylä, Department of Physics,
Jyväskylä, Finland (A. Heikkilä, A. Honkanen, K. Lassila-Perini, E. Pietarinen)

Working visits to University of Turku, Laboratory of Electronics and Information Technology,
Turku, Finland (A. Honkanen, K. Lassila-Perini, E. Tuominen)

Working visits to University of Oulu, Microelectronics Instrumentation Laboratory,
Kemi, Finland (A. Honkanen, K. Lassila-Perini, E. Tuominen)

Working visit to Warsaw Technical University,
Warsaw, Poland (K. Banzuzi, E. Pietarinen)

Working visit to Helsinki University of Technology, University of Helsinki, and Technical Research Center of Finland,
Helsinki, Finland (H. Katajisto, E. Tuominen, J. Tuominiemi)

Nuclear Matter

The 5th International Conference on Radioactive Nuclear beams,
3-8 April, Divonne, France (talks by A. Jokinen and M. Oinonen)

Institute of Physics, Nuclear Physics Conference 2000,
April, Birmingham, U.K. (invited talk by J. Äystö)

International Symposium on Exotic Nuclear Structures,
15-20 May, Debrecen, Hungary (invited talk by A. Jokinen)

VII Hispalensis International Summer School. Nuclear Physics 2000: Master's Lessons,
June, Oromana, Sevilla, Spain (invited talk by J. Äystö)

GSI Symposium of Physics with Exotic Nuclei,
July, Darmstadt, Germany (invited talk by J. Äystö)

CERN Summer Student Lecture,
July, Geneva, Switzerland (invited lecture by J. Äystö)

2nd Euroconference on Atomic Physics Accelerators: Mass Spectrometry,
18-23 September, Cargèse, Corsica, France (invited talk by A. Jokinen)

5th International Conference on Nuclear and Radiochemistry,
September, Pontresina, Switzerland (invited talk by J. Äystö)

2nd International Balkan School on Nuclear Physics,
September, Bodrum, Turkey (invited talk by J. Äystö)

International Symposium on Perspectives in Physics with Radioactive Isotope Beams 2000,
November, Hayama, Japan (invited talk by J. Äystö)

International Workshop on Exotic Aspects of Nuclear Decay by Light-Particle Emission,
November, ECT*, Trento, Italy (invited talk by J. Äystö)

Technology Programme

Computing in High Energy and Nuclear Physics, CHEP2000,
7-11 February, Padova, Italy (talk by A.-P. Hameri)

Connecting Distributed Competences Workshop,
18-19 March, Aalborg, Denmark (talk by A.-P. Hameri)

CIMdata,
11-13 April, Palm Springs, USA (M. Puittinen)

Globus Workshop,
21-22 June, Rutherford Appleton Laboratory, U.K. (M. Heikkurinen)

7th European Accelerator Conference, EPAC2000,

26-30 June, Vienna, Austria (talk by A.-P. Hameri)

Connecting Distributed Competences Workshop,
24-25 August, Rauma, Finland (talk by A.-P. Hameri)

Data Grid Workshop,
4-6 September, Marseille, France (M. Heikkurinen)

Connecting Distributed Competences Workshop,
4-5 December, Malmö, Sweden (talk by A.-P. Hameri)

Administration and Support

Nykyaika Exhibition,
16 February, Helsinki, Finland (distance talk by R. Rinta-Filppula)

"Interaktiivinen tekniikka koulutuksessa" Conference,
6-8 April, Hämeenlinna, Finland (invited talk by R. Rinta-Filppula)

ED-MEDIA 2000, World Conference on Educational Multimedia, Hypermedia / Telecommunications,
26 June -1 July, Montreal, Canada (R. Rinta-Filppula)

MTV3 Huomenta Suomi TV Program,
21 July, Helsinki, Finland (interview with R. Rinta-Filppula)

Opetusministeriön Matematiikan, fysiikan, kemian ja tietojenkäsittelyn opetuksen kehittäminen ja virtuaaliopetus "Virtuaali-MFKT" Seminar,
20 November, Espoo, Finland (invited distance talk by R. Rinta-Filppula)

Publications

Theory Programme

Laser Physics and Quantum Optics

G. Brassard, N. Lütkenhaus, T. Mor, and B. C. Sanders,
Limitations on practical quantum cryptography,
Phys. Rev. Lett. 85 (2000) 1330

D. Bruß and N. Lütkenhaus,
Quantum key distribution: from principles to practicalities,
Appl. Algebr. Eng. Comm. 10 (2000) 383

G. Drobny, M. Havukainen, and V. Buzek,
Stimulated emission via quantum interference: scattering of one-photon packets on an atom in a ground state,
J. Mod. Opt. 47 (2000) 851

M. Dusek, M. Jahma, and N. Lütkenhaus,
Unambiguous state discrimination in quantum cryptography with weak coherent states,
Phys. Rev. A 62 (2000) 022306

M. Havukainen,
Comparisons of spectra determined using detector atoms and spatial correlation functions,
J. Mod. Opt. 47 (2000) 1179

N. Lütkenhaus,
Security against individual attacks for realistic quantum key distribution,
Phys. Rev. A 61 (2000) 052304

O. H. Pakarinen and K.-A. Suominen,
Atomic dynamics in evaporative cooling of trapped alkali-metal atoms in strong magnetic fields,
Phys. Rev. A 62 (2000) 025402

T. Rickes, L. P. Yatsenko, S. Steuerwald, T. Halfmann, B. W. Shore, N. V. Vitanov, and K. Bergmann,
Efficient adiabatic population transfer by two-photon excitation assisted by a laser-induced Stark shift,
J. Chem. Phys. 113 (2000) 534

M. Rodriguez, K.-A. Suominen, and B. M. Garraway,
Tailoring of vibrational state populations with light-induced potentials in molecules,
Phys. Rev. A 62 (2000) 53413

R. G. Unanyan, N. V. Vitanov, B. W. Shore, and K. Bergmann,
Coherent properties of a tripod system coupled via a continuum,
Phys. Rev. A 61 (2000) 043408

N. V. Vitanov,
Measuring a coherent superposition of multiple states,
J. Phys. B 33 (2000) 2333

N. V. Vitanov, B. W. Shore, R. G. Unanyan, and K. Bergmann,
Measuring a coherent superposition,
Opt. Comm. 179 (2000) 73

Mathematical Physics and Field Theory

M. Chaichian, S. S. Masood, C. Montonen, A. Pérez Martinez, and H. Pérez Rojas,
Quantum magnetic collapse,
Phys. Rev. Lett. 84 (2000) 5261

U. H. Danielsson, E. Keski-Vakkuri, and M. Kruczenski,
Black hole formation in AdS and thermalization on the boundary,
J. High Energy Phys. 02 (2000) 039

A. Kupiainen,
Lessons for turbulence,
Geom. Funct. Analysis, GAFA2000 (2000) 316

A. Kupiainen with J. Bricmont, R. Lefevere,
Probabilistic estimates for the two dimensional stochastic Navier-Stokes equations,
J. Stat. Phys. 100 (2000) 743

Particle Theory and Cosmology

M. Carena, K. Huitu, and T. Kobayashi,
RG invariant sum rule in a generalization of anomaly mediated SUSY breaking models,
Nucl. Phys. B 592 (2000) 164

M. Chaichian, A. Demichev, and P. Presnajder,
Quantum field theory on noncommutative space-times

and the persistence of ultraviolet divergences,
Nucl. Phys. B 567 (2000) 360

M. Chaichian, A. Demichev, and P. Presnajder,
Quantum field theory on noncommutative plane with $E_q(2)$ symmetry,
J. Math. Phys. 41 (2000) 1647

M. Chaichian, K. Huitu, and Z.-H. Yu,
R parity violation in $(t+\bar{t})\ \tilde{g}$ production at LHC and Tevatron,
Phys. Lett. B 490 (2000) 87

M. Chaichian and A. B. Kobakhidze,
Large hierarchy from extra dimensions,
Phys. Lett. B 478 (2000) 299

M. Chaichian and A. B. Kobakhidze,
Mass hierarchy and localization of gravity in extra time,
Phys. Lett. B 488 (2000) 117

M. Chaichian and T. Kobayashi,
On different criteria for confinement,
Phys. Lett. B 481 (2000) 26

M. Chaichian, S. S. Masood, C. Montonen, A. Pérez Martinez, and H. Pérez Rojas,
Quantum magnetic collapse,
Phys. Rev. Lett. 84 (2000) 5261

K. Enqvist, A. Jokinen and J. McDonald,
Flat direction condensate instabilities in the MSSM,
Phys. Lett. B 483 (2000) 191

K. Enqvist and H. Kurki-Suonio,
Constraining isocurvature fluctuations with the Planck Surveyor,
Phys. Rev. D 61 (2000) 043002

K. Enqvist, H. Kurki-Suonio, J. Väliviita,
Limits on isocurvature fluctuations from Boomerang and Maxima,
Phys. Rev. D 62 (2000) 103003

K. Enqvist, J. McDonald,
The dynamics of Affleck-Dine condensate collapse,
Nucl. Phys. B 570 (2000) 407; Erratum Nucl. Phys. B 582 (2000) 763

K. Enqvist and J. McDonald,
Inflationary Affleck-Dine scalar dynamics and isocurvature perturbations,
Phys. Rev. D 62 (2000) 043502

E. Gabrielli,
Model independent constraints on leptoquarks from rare muon and tau lepton processes,
Phys. Rev. D 62 (2000) 055009

K. Huitu, Y. Kawamura, T. Kobayashi, and K. Puolamäki,
Phenomenological constraints on SUSY SU(5) GUTs with nonuniversal gaugino masses,
Phys. Rev. D 61 (2000) 035001

H. Kurki-Suonio and E. Sihvola,
Constraining antimatter domains in the early universe with big bang nucleosynthesis,
Phys. Rev. Lett. 84 (2000) 3756

H. Kurki-Suonio and E. Sihvola,
Antimatter regions in the early universe and big bang nucleosynthesis,
Phys. Rev. D 62 (2000) 103508

K. Puolamäki,
Higgs sector and R-parity breaking couplings in models with broken $U(1)_{B-L}$ gauge symmetry,
Phys. Rev. D 62 (2000) 055010

J. Yi, W.-G. Ma, L. Han, Z.-H. Yu, and H. Pietschmann,
Pair production of neutralinos via gluon-gluon collisions,
Phys. Rev. D 62 (2000) 035006

Z.-H. Yu, H. Pietschmann, W.-G. Ma, L. Han, and J. Yi,
$\gamma\gamma \to t\bar{c}+c\bar{t}$ in a supersymmetric theory with an explicit R parity violation,
Eur. Phys. J. C 16 (2000) 541

Hadron Physics Activity

L. Hannelius and D. O. Riska,
Strangeness form factors of the proton in the chiral quark model,
Phys. Rev. C 62 (2000) 045204

L. Hannelius, D. O. Riska and L. Glozman,
The strangeness magnetic moment of the proton in the chiral quark model,
Nucl. Phys. A 665 (2000) 353

T. A. Lähde, C. J. Nyfält and D. O. Riska,
Spectra and M1 decay widths of heavy-light mesons,
Nucl. Phys. A 674 (2000) 141

D. O. Riska,
Mesonic anapole form factors of the nucleons,
Nucl. Phys. A 678 (2000) 79

Statistical Physics and Materials Science

J. Asikainen and T. Ala-Nissila,
Percolation and spatial correlations in a two-dimensional continuum deposition model,
Phys. Rev. E 61 (2000) 5002

M. Dubé, M. Rost, and M. Alava,
Conserved dynamics and interface roughening in spontaneous imbibition: critical overview,
Eur. Phys. J. B 15 (2000) 691

M. Dubé, M. Rost, K. Elder, M. Alava, S. Majaniemi, and T. Ala-Nissila,
Conserved dynamics and interface roughening in spontaneous imbibition: a phase field model,
Eur. Phys. J. B 15 (2000) 701

V. J. Ghosh, M. Alatalo, P. Asoka-Kumar, K. G. Lynn, B. Nielsen, A. C. Kruseman, and P. Mijnarends,
Calculation of the Doppler broadening of the electron-positron annihilation radiation in defect-free bulk materials,
Phys. Rev. B 61 (2000) 10092

E. Granato, T. Ala-Nissila, and S. C. Ying,
Anomalous sliding friction and peak effect near the flux lattice melting transition,
Phys. Rev. B 62 (2000) 11834

J. Hietarinta and P. Salo,
Ground state in the Faddeev-Skyrme model,
Phys. Rev. D 62 (2000) 081701(R)

T. Hjelt and T. Ala-Nissila,
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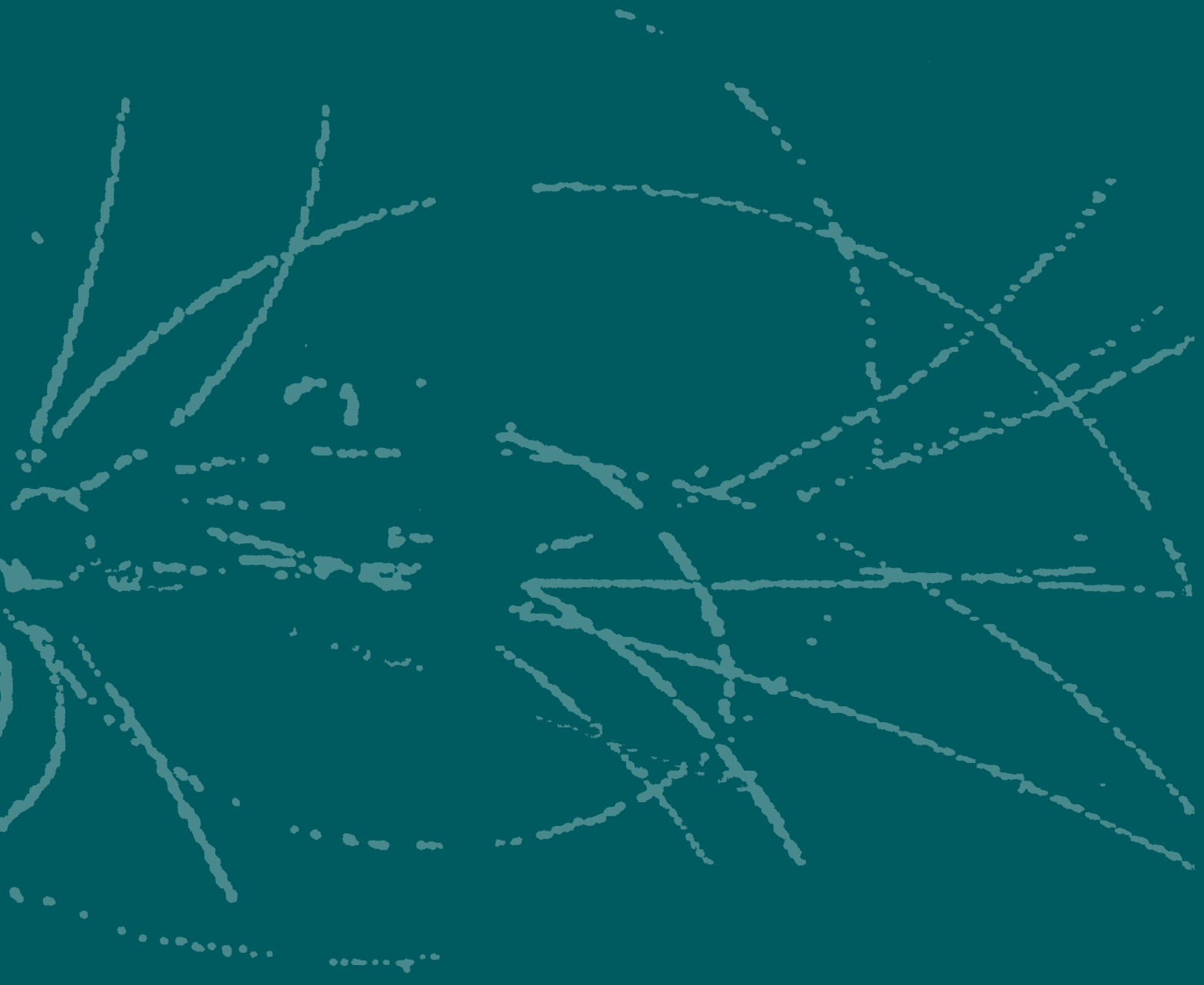

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