YITP Annual Report

Yukawa Institute For Theoretical Physics
Kyoto University

2005

Foreword

We here present the annual report of the Yukawa Institute for Theoretical Physics (YITP) for a general survey of our activities in the academic year 2005.

In the year 2004, all national universities in Japan became independent administrative corporations, and even the cooperative research institutes at the inter-university level formally turned to be defined only in the individual universities to which they belong. So our YITP also turned into just an institute inside Kyoto University Corporation. Despite such a change of the formal status, our YITP declares to continue to be an inter-university cooperative research institute open to all the physicists.

This is because of our successful history of the system. YITP was founded in 1953, in commemoration of Prof. Yukawa's winning of the first Nobel Prize in Japan, as the first inter-university cooperative research institute, that is, a new type of national research center with its facilities open for use for research collaborations by the entire community of theoretical physicists in Japan. Moreover, YITP has adopted a new system for its operation: although it formally belongs to Kyoto University, its basic policy has been discussed and decided by the representatives of physicists elected from all over the country together with Institute's own academic staffs. One of the unique roles played by the institute is to provide a forum for physicists on various problems at the forefront of research in theoretical physics. Many physicists participate in the organization of topical workshops and international conferences at YITP and stayed at the Institute for some periods to work in collaboration with others. With this spirit and system, YITP has been successfully playing important roles in creating various novel and interdisciplinary fields in fundamental physics. Thus the spirit of the inter-university cooperative research has really taken root in YITP and now constitutes its identity.

We are now trying to make the present research cooperation based at YITP mainly nationwide lifted to that of more international level. For instance, we have changed Yukawa International Seminar to hold every year from every two years. The YKIS 2005 "The Next Chapter of Einstein's Legacy" was held for a week and its Post YKIS "Gravity and Cosmology" was held as a staying-type workshop for four weeks.

We are now applying for the fund for holding a few multi-month programs every year on timely and interdisciplinary themes in theoretical physics, selected from proposals from throughout the world. The application has not yet been approved, unfortunately, but we hope to realize this plan by the continual support from world-wide community.[1]

In the year 2003, we innovated our WWW homepage and started the publication of annual reports in English, in order to get people in the world more acquainted with the members and activities of our Institute. Thus, this is the third English annual report of our Institute. This report contains information concerning Institute members including graduate students, visitors, research contents, publications, workshops, schools and conferences of the academic year 2005. We have also included some brief highlight reports by individual members on their recent research achievements. Thus, the contents of the annual report are limited to the research activities in this Institute and the supporting activities of domestic as well as international collaborative researches, in general in 2005. Materials that are not specific to each year, such as the history, organization, services and facilities of our Institute, can be found in the WWW homepage, http://www.yukawa.kyoto-u.ac.jp/, which includes the html version of this report as well. We hope this report will help physicists in the world know our Institute much better and make it easier to access our research services.

Director
Taichiro Kugo

[1] Recently this application of ours for the governmental fund of fiscal year 2007 was approved: the title of the project is "International Collaboration Programs for Developing Theoretical Research in Quark-Hadron Science".

Contents

Chapter 1

People

1.1 Regular Staff and Guest Professors (2005 April – 2006 March)

Regular Staff

Taichiro Kugo
Professor (E)

Masao Ninomiya
Professor (E)

Ken-ichi Shizuya
Professor (E)

Hideo Kodama
Professor (A)

Teiji Kunihiro
Professor (N)

Shin Mineshige
Professor (A)

Hirokazu Tsunetsugu
Professor (C)

Misao Sasaki
Professor (A)

Takao Ohta
Professor (C) [– 2006.3.31]

Ryu Sasaki
Associate Professor (E)

Masatoshi Murase
Associate Professor (C)

Hiroshi Kunitomo
Associate Professor (E)

Mihoko Nojiri
Associate Professor (E) [– 2005.12.31]

Naoki Sasakura
Associate Professor (E)

Tetsuya Onogi
Associate Professor (E)

Keisuke Totsuka
Associate Professor (C)

Shigehiro Nagataki
Associate Professor (A)

Yoshiko Kanada-En'yo
Associate Professor (N) [2005.4.1 –]

Takao Morinati
Research Associate (A)

Shigeki Sugimoto
Research Associate (E) [– 2006.3.31]

Daisuke Jido
Research Associate (N) [2005.4.1 –]

Rika Endo
Research Associate (Project Manager) [2004.4.1 –]

In this list, the symbols A, C, E and N in the parenthesis are the following abbreviations of research fields:

A: Astrophysics and Cosmology
C: Condensed Matter and Statistical Physics
E: Elementary Particle Theory
N: Nuclear Physics Theory

Visiting Professors

Prof. Edward Francis Corrigan
(Univ. York)
2005.4.1 — 2005.6.30
Integrable field theory with boundary and defects

Prof. Andrei Linde
(Stanford Univ.)
2005.6.24 — 2005.9.23
Physics and spacetime structure of the early universe

Prof. Holger Bech Nielsen
(NBI, Univ. Copenhagen)
2005.8.1 — 2005.10.31
New formulation of string field theories and study of pre-big bang era after birth of the Universe

Prof. Ferdinand Alexander Bais
(Amsterdam University)
2005.9.20 — 2005.12.19
Topological interactions: on quantum symmetries and their breaking

1.2 Research Fellows and Graduate Students (2005 April – 2006 March)

Research Fellows

JSPS Research Fellows (domestic)

Kazuki Hasebe
JSPS fellow (E) [2003.4.1 – 2006.3.31]

Takashi Umeda
JSPS fellow (N) [2003.4.1 – 2005.5.31]

Hiroshige Kajiura
JSPS fellow (E) [2003.4.1 – 2006.3.31]

Toru Takahashi
JSPS fellow (N) [2004.4.1 –]

Shinsuke Kawai
JSPS fellow (E) [2004.4.1 –]

Makoto Uemura
JSPS fellow (A) [2004.4.1 – 2005.5.31]

Takahiro Sakaue
JSPS fellow (C) [2005.4.1 – 2006.6.30]

Hiroto Shoji
JSPS fellow (C) [2005.4.1 – 2006.6.30]

Akira Furukawa
JSPS fellow (C) [2005.4.1 – 2006.3.31]

Hidehiko Shimada
JSPS fellow (E) [2005.4.1 – 2005.9.30]

Masakiyo Kitazawa
JSPS fellow (N) [2005.4.1 – 2006.3.31]

JSPS Research Fellows (from abroad)

Sebastian Gurrieri
JSPS fellow (E) [2003.7.2 – 2005.7.1]

Oriol Pujolas
JSPS fellow (A) [2003.10.15 – 2005.10.14]

Antonino Flachi
JSPS fellow (A) [2004.8.3 – 2006.8.2 ∼]

Cristina Zambon
JSPS fellow (E) [2004.10.4 – 2006.10.3]

Alan Cornell
JSPS fellow (A) [2004.11.22 – 2006.9.30]

Cristiano Germani
JSPS fellow, Short term (A) [2005.3.30 – 2005.5.29]

Cecilia Albertsson
JSPS fellow (E) [2005.10.1 –]

Friedel Epple
JSPS fellow, Short term (A) [2006.3.1 – 2006.5.31]

JSPS Invitation Fellows (from abroad)

Marco Rossi
JSPS Inv. fellow, Long term (E) [2005.1.5 – 2005.11.4]

Oleg Andreev
JSPS Inv. fellow, Short term (E) [2005.4.25 – 2005.6.3]

Francesco Calogero
JSPS Inv. fellow, Short term (E) [2006.3.9 – 2006.4.21]

Other Research Fellows

Eliani Ardi
(A) [2003.4.1 – 2006.3.31]

Noriyuki Nakai
(C) [2003.10.1 – 2006.3.31]

Toru Goto
(E) [2003.10.1 –]

Hiroaki Abuki
(N) [2004.4.1 –]

Kunihito Uzawa
(A) [2004.4.1 –]

Shoji Zeze
(E) [2005.4.1 – 2005.9.30]

Kouhei Hasegawa
(E) [2005.4.1 – 2005.9.30]

Tatsuya Yamasaki
(A) [2005.4.1 –]

Yoshinobu Habara
(E) [2005.4.1 – 2006.3.31]

Yasunari Kurita
(A) [2005.10.1 – 2006.3.31]

Mitsuhiro Arikawa
(C) [2005.4.1 –]

Masaaki Kimura
(N) [2005.4.1 – 2006.3.31]

Eri Asakawa
(E) [2005.4.1 – 2006.3.31]

Akira Mizuta
(A) [2005.4.1 –]

Naotoshi Okamura
(C) [2005.5.1 –]

Michele Trenti
(A) [2005.5.1 – 2005.8.31]

Kazuaki Ohnishi
(N) [2005.7.1 – 2006.3.31]

Naoko Ikezi
(N) [2006.1.1 – 2006.3.31]

Graduate Students

Vierdayanti Kiki
(A) [2005.4.1 –]

Ryoji Kawabata
(A) [2005.4.1 –]

Sugure Tanzawa
(A) [2005.4.1 –]

Kohta Murase
(A) [2005.4.1 –]

Takahiro Okuma
(C) [2005.4.1 – 2006.3.31]

Hiroaki Ueta
(C) [2005.4.1 –]

Takayoshi Miki
(C) [2005.4.1 –]

Mitsuhisa Ohta
(E) [2005.4.1 –]

Yoshiharu Tanaka
(A) [2004.4.1 –]

Ken Nagata
(A) [2004.4.1 –]

Kazuya Mitsutani
(N) [2004.4.1 –]

Michihisa Takeuchi
(E) [2004.4.1 –]

Yuya Sasai
(E) [2004.4.1 –]

Youhei Ota
(E) [2003.4.1 –]

Takashi Uneyama
(C) [2005.4.1 – 2006.3.31]

Masafumi Kaga
(C) [2005.4.1 – 2006.3.31]

Norita Kawanaka
(A) [2003.4.1 –]

Tatsuya Tokunaga
(E) [2003.4.1 –]

Hidekazu Tokuda
(C) [2004.4.1 – 2006.3.31]

Tomohisa Takimi
(E) [2002.4.1 –]

Wataru Hikida
(A) [2001.4.1 – 2006.3.31]

Hidenori Fukaya
(E) [2001.4.1 – 2006.3.31]

Kazuyoshi Takahashi
(E) [2001.4.1 – 2006.3.31]

Kohtaro Yamada (C) [2004.4.1 – 2006.3.31]
(from Hiroshima Univ.)

Masayuki Ataka (C) [2004.4.1 – 2006.3.31]
(from Hiroshima Univ.)

Masato Minamitsuji (A) [2003.4.1 –]
(from Osaka Univ.)

Noriyuki Kogo (A) [2004.4.1 – 2006.3.31]
(from Osaka Univ.)

Ph.D Awarded

Kazuyoshi Takahashi
D-brane Physics from QED (E)
(advisor : Masao Ninomiya)

Wataru Hikida
Gravitational Radiation and Reaction in an Extreme Mass Ratio Binary System (A)
(advisor : Misao Sasaki)

Hidenori Fukaya
Lattice QCD with fixed topology (E)
(advisor : Tetsuya Onogi)

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Chapter 2

Research Activities

2.1 Research Summary

Astrophysics and Cosmology Group

The final goal of this group is to acquire a comprehensive understanding of the whole evolution of our universe from its birth to the present as well as its rich structures and diverse activities at present, on the basis of fundamental laws of nature and observations. Due to this basic nature, researches in this group are always cross-disciplinary and cover a quite wide range of subjects from mathematical studies of spacetimes to phenomenological modeling of astronomical objects. Further, major topics are strongly influenced by new developments in investigations of fundamental laws as well as in observations.

Now, we give the summary of major research activities and achievements by this group in 2005.

Black Hole and Neutron Star Astrophysics

Near- and Super-critical accretion flows and Outflows: On the basis of the two-dimensional radiation-hydrodynamic (2D RHD) simulations of super-critical black-hole accretion flow which we made in 2005, we newly calculated emergent spectra. We find that beaming effects become important for small inclination angles, leading to an increased photon number, enhanced average photon energy and non- negligible deviations from blackbody spectra. This gives an explanation for the observed high temperatures of ultra-luminous X-ray sources that can not be explained in the framework of intermediate mass black holes (*Heinzeller, Ohsuga, Mineshige*).

Iron Fluorescent Line Emission from Black Hole Accretion Disk with Corona: On the basis of the idea of magnetic reconnection-heated corona which we proposed in 2002, we calculated the iron fluorescent line profiles produced by hard X-ray photons emerging from the corona. The line profiles give excellent fits to the recent observational data of a typical Seyfert galaxy obtained by XMM-Newton satellite (*Kawanaka, Iwasawa, Mineshige*).

Formation of intermediate Mass Black Hole (IMBH) in the Dense Star Clusters: We examined the effects of mass segregation on the formation of IMBHs via runaway stellar merger within star clusters. It is known that the runaway merger leads to formation of a very massive star with mass exceeding 800 solar mass which finally collapse into a IMBH within 3 Myr. We found that a dense star cluster with a high central density potential indeed shows that in the inner core the massive stars undergo a runaway stellar merger even in a cluster, for which BH formation is impossible without mass segregation effects (*Eliani, Baumgardt, Mineshige*).

Alfven Wave-Driven Proto-Neutron Star Winds and R-Process Nucleosynthesis: We proposed magnetic proto-neutron star (PNS) winds driven by Alfven waves as an appropriate site for r-process nucleosynthesis. We found that a PNS with surface field strength $> 5 \cdot 10^{14}$G gives suitable wind properties for the r-process, when the wave amplitude is 10% of the Alfven speed at the surface (*Suzuki, Nagataki*).

Effects of Magnetic Fields on Proto-Neutron Star Winds: We investigated the effects of magnetic fields on proto-neutron star winds by performing numerical simulations. Our results show that even with a magnetar-class field strength, 10^{15}G, the features of the wind dynamics differ only little from those of non-magnetic winds and that the conditions for an effective r-process are not realized (*Ito, Yamada, Sumiyoshi, Nagataki*).

Supernovae and Gamma-Ray Bursts

Neutrino-cooled Accretion Disk as the Central Engine of Gamma-ray Bursts: It is often hypothesized that the enormous energy liberated from gamma-ray bursts is generated by gas accretion onto a stellar-mass black hole with extreme rate, about one solar mass per second. We calculate the structure of such high accretion-rate disk, taking into account the degeneracy of fermions, the opacity of neutrinos, and the equation of state of nuclear matter (*Kawanaka, Mineshige*).

Collimated Jet and Expanding Outflow from Collapsar: The propagation of outflows from the inside of the collapsar by two-dimensional (2D) relativistic hydrodynamic simulations is studied. A variety of outflows from collimated jet to expanding outflow is observed by changing both kinetic and thermal energy of the injected outflow, whereas total power of the injected outflow is fixed. The observed difference can explain the difference of Gamma-ray bursts, X-ray Flashes, and aspherical supernovae (*Mizuta, Nagataki, Yamasaki, Mineshige*).

Very High Energy Neutrinos Originating from Kaons in Gamma-Ray Bursts: We simulated neutrino production in a gamma-ray burst (GRB) with the most detailed method to date. We showed that the highest energy neutrinos from GRBs mainly come from kaons. Although there is little chance to detect such neutrinos, attempts of detection are very important to prove physical conditions in GRBs (*Asano, Nagataki*).

High energy neutrino emission and neutrino background from gamma-ray bursts: We studied high energy neutrino emission from gamma-ray bursts (GRBs). We calculated neutrino flux from one burst and a diffuse neutrino background are evaluated quantitatively. Detection of high energy neutrinos from GRBs will be one of the strong evidences that protons are accelerated to very high energy in GRBs (*Murase, Nagataki*).

Gravitational Waves

Gravitational radiation reaction: One of the most promising sources of gravitational waves is a compact star orbiting a super-massive black hole, which is accurately modeled as a point particle of small mass moving in a Kerr black hole. In this year, we developed a scheme to compute the radiation backreaction (self-force) acting on a point particle and discussed the dynamics of this system. Especially, we evaluated the change rates for constants of motion of a particle orbiting Kerr black hole under the adiabatic approximation, and the self-force in an eccentric orbit on a Schwarzschild spacetime without using the adiabatic approximation. Moreover, we evolved the orbit taking into account the self-force in Schwarzschild spacetime (*Sago, Tanaka, Hikida, Ganz, Nakano*).

Observational Cosmology

Constraining Cosmological Parameters by the Cosmic Inversion Method: We investigated the question of how tightly we can constrain the cosmological parameters by using the "cosmic inversion" method. In this method, we directly reconstruct the primordial curvature power spectrum from the temperature and polarization spectra of the cosmic microwave background (CMB). As a result of simulations taking the PLANCK observational errors into account, we found that typical uncertainty on the cosmological parameters is about 10% when one of the parameters is set to be free (*Kogo, Sasaki, Yokoyama*).

Higher-Dimensional Gravity and Cosmology

Graviton cross-section of a higher-dimensional black hole: We studied the graviton absorption probability (greybody factor) and cross-section of a higher-dimensional Schwarzschild black hole (BH). We were motivated by the suggestion that a great many BHs may be produced at the LHC and bearing this fact in mind, for simplicity, we investigated the intermediate energy regime for a static Schwarzschild BH. To find easily tractable solutions we worked in the limit $\ell \gg 1$, where ℓ is the angular momentum quantum number of the graviton. We were able to show that the WKB method can be applied to this case, and our results were also able to reproduce the classical cross-section in the high-energy limit (*Cornell, Nalyor, Sasaki*).

Quantum fluctuations in a braneworld with finite thickness: In the usual, infinitely thin braneworld, a quantized bulk field suffers divergence in approaching the brane, which cannot be avoided by usual UV renormalization, and it prevents us from evaluating quantum fluctuations exactly on the brane. As a natural regularization, we propose a method in which a finite thickness is taken into account. We showed that the self-consistency on the brane can be recovered even for relatively small brane thickness (*Minamitsuji, Naylor, Sasaki*).

Interaction of higher-dimensional black holes and branes: The study of the interaction of black holes and branes has many applications in the context of early universe cosmology and particle physics. Specifically it is found that once a black hole sitting on brane is perturbed, for example by emission of particles or fluctuations of the brane, an instability sets in and by a mechanism of reconnection the black hole is expected to slide off the brane into the bulk. This was verified numerically in different models by treating the brane as a Nambu-Goto surface or a domain wall. Then we took an analytical approach to understand not only the previous results but also the evolution of the system in a regime where the numerical calculations cannot be applied. As a result, we have seen that there are important differences between models depending on the number of co-dimensions, which in principle may be used to distinguish them experimentally/observationally (*Flachi, Pujolas, Sasaki, Tanaka*).

Four-dimensional effective theories from higher-dimensional supergravity: When we study the dynamics of our universe on the basis of a higher-dimensional unified theory, a four-dimensional effective theory for the higher-dimensional theory is widely used in a crucial way. Recent proposal to construct a cosmological model with fixed moduli and positive cosmological constant(KKLT construction) is not an exception. In this construction, flux in the interal space plays a crucial role in moduli stabilisation and produces warp in the geometry. However, the four-dimensional effective theory utilised in this construction is based on the general arguments in the no-warp case. Hence, its validity is not clear. Therefore, we constructed four-dimensional effective theories for flux compactification of the ten-dimensional IIB supergravity and the five-dimensional Heterotic M theory, taking into account the warped structure of the geometry. We found that these effective theories correctly describe SUSY breaking instabilities in the higher-dimensional theories found in our previous work, but at the same time, allow a much wider class of solutions than the original higher-dimensional theories. This result indicates that the effective four-dimensional theories should be used with caution, if one regards the higher-dimensional theories more fundamental (*Kodama, Uzawa*).

Dynamical light-like solutions to M-theory: In supergravity theories, any supersymmetric solution must be stationary unless it has a null Killing vector associated with a Killing spinor. Such a stationary solution cannot describe an accelerating universe due to the well-know No-Go theorem. In contrast, a solution with a null Killing vector can be dynamical and supersymmetric at the same time and may provide a cosmologically interesting model. On the basis of this fact, we explored general solutions that depend only on the two null-coordinates in M theory. We found a rather large class of such solutions with 9 arbitrary functions of a single null coordinate, which turned out to be pp-waves and have 16 Killing spinors.

We also pointed out that some of them provide models describing compactification-decompactification transition after toroidal compactification. (*Ishino, Kodama, Ohta*).

Condensed Matter and Statistical Physics Group

Condensed Matter Physics

The subjects of condensed matter physics are the states of matter that emerge at low-temperatures as a consequence of non-trivial many-body effects. Interplay among low-energy degrees of freedom such as charge, spin and (electron) orbital, when combined with a few simple fundamental principles (e.g. Fermi statistics, electromagnetic interactions among electrons), yields a variety of phenomena ranging from magnetism to superconductivity. The area of current research in our group covers frustrated magnets, low-dimensional quantum spin systems, vortices in type-II superconductors and high-temperature superconductivity.

Spin Disorder on a Triangular Lattice: The concept of spin liquid was proposed more than thirty years ago by P.W. Anderson. Since then a large number of materials have been examined as candidates, but no clear indication was reported until recently. Tsunetsugu and Nakatsuji have collaborated with the Group of Quantum Materials at the Department of Physics, Kyoto University, and investigated a new Ni-based compound with triangular lattice structure, NiGa2S4. This is an antiferromagnetic insulator with characteristic energy scale of 80K. Surprisingly, this material does not show a magnetic long range order down to 0.35K. Such a behavior is usually observed in spin gap systems, but this material does not have a spin gap. This is clearly demonstrated by a power-law temperature dependence of the specific heat $C(T) \sim T^2$, and a finite value of the magnetic susceptibility at low temperatures. These properties indicate that $NiGa_2S_4$ is the first example of bulky materials that undoubtedly show the spin liquid behavior (*Tsunetsugu and Nakatsuji*).

Spin Nematic Phase in $S = 1$ Triangular Antiferromagnets: Spin nematic order is investigated for a spin-1 system on a triangular lattice with the phenomenological bilinear-biquadratic Hamiltonian. Tsunetsugu particularly studied an antiferro nematic order phase and found that it has a stable three-sublattice structure on a triangular lattice. He also investigated magnetic properties at zero and low temperatures by bosonization of spin operators. Two types of bosonic elementary excitations are found and dynamic and static spin correlations were calculated. One is a gapless excitation with linear energy dispersion around $k \sim 0$, and this leads to a finite spin susceptibility at $T = 0$ and would have a specific heat $C(T) \sim T^2$ at low temperatures. These behaviors can explain many of the characteristic features of a recently discovered spin liquid state in the triangular magnet, $NiGa_2S_4$ (*Tsunetsugu and Arikawa*).

Mott transition in Kagomé lattice Hubbard model: Tsunetsugu investigated the effects of geometrical frustration on Mott transition. He particularly studied the Kagomé lattice Hubbard model by a cluster extension of dynamical mean field theory. The results of the double occupancy, the density of states, the static and dynamical spin correlation functions demonstrate that the system undergoes a first-order Mott transition at (Coulomb repulsion)/(band width)$\sim$1.4. In the metallic phase close to the Mott transition, a strong renormalization of three distinct bands was found which gave rise to the formation of heavy quasiparticles with strong frustration. It is elucidated that the quasiparticle states exhibit anomalous behavior in the temperature-dependent spin correlation functions. One very interesting result is that quasi-one-dimensional spin correlations appear in the insulating phase close to the transition point, and this is a manifestation of strong frustration effects (*Ohashi, Kawakami, Tsunetsugu*).

A unifying approach to frustrated spin systems: Competition among several different orders sometimes leads to novel types of physics and rich phase diagrams. It is one of the most intriguing problems in condensed-matter physics to understand the nature of quantum phase transitions between the competing orders and then to map out the (global) phase diagram. While several approaches have been proposed in systems of itinerant electrons to better understand the problems of competing orders, similar approaches are rare in the field of localized magnetism.

In recent years, several unconventional phases have been found and discussed in low-dimensional quantum spin systems. In particular, large-scale numerical simulations found that new kinds of order might be stabilized by including multi-spin interactions, which are in principle allowed by the Fermi statistics and Coulomb interactions among electrons. Motivated by this fact, two-dimensional spin systems have been considered with ring-exchange interactions which are sources of magnetic frustration and are believed to stabilize novel quantum phases. On the basis of previous analysis for (quasi) 1-diemensional system (spin 'ladder'), an effective Hamiltonian has been written down relevant to the competition among several quantum orders. It describes a system of interacting spin-1 bosons. The point is that different ordering patterns of this boson system can describe various competing phases (Neel antiferromagnet, p-type nematic etc.) This approach has much in common with the well-known $SO(5)$ theory of high-temperature superconductivity. The parameters contained in the model have been determined by a non-perturbative method called 'Contractor Renormalization Method (CORE).' By applying a simple variational analysis to the effective Hamiltonian obtained in this way, Totsuka has succeeded in describing the competition between Neel antiferromagnetism and a more exotic p-type nematic order in the square-lattice Heisenberg antiferromagnet with ring-exchange interaction (*Totsuka*).

Self-dual sine-Gordon model and its applications: The sine-Gordon model in $(1+1)$-dimensions is one of the integrable models and is known as a playground of the various non-perturbative concepts such as quantum solitons/boundstates and the Bose-Fermi duality. Totsuka generalized the multicomponent version of the sine-Gordon model by adding another cosine term so that the model may be invariant under the sine-Gordon duality. This multicomponent self-dual sine-Gordon model has various applications ranging from sliding Luttinger liquids to a problem of competing orders in frustrated magnets. Totsuka has shown that the model is equivalent to the level-2 $SO(N)$ ($N-1$ is equal to the number of compenents) Wess-Zumino-Witten model perturbed by a marginal current-current interaction which is closely related to an integrable fermionic model introduced by Andrei and Destri years ago. Its implications to several physical systems are discussed (*Totsuka*).

Hole induced chiral spin texture scenario for high-temperature superconductivity: High-temperature superconductors exhibit a quite rich phase diagram: In the absence of carriers, the ground state is the antiferromagnetic long-range ordered phase. Upon hole doping, the magnetic long-range order is rapidly suppressed. Then, a spin glass like phase emerges. Further doping leads to the d-wave superconducting phase. In the superconducting regime, there is the pseudogap phase above the transition temperature. Since this rich phase diagram is controlled by doping hole concentration, one of the most fundamental questions is the description of the holes. For such a description, antiferromagnetic correlations should play an important role because it is ubiquitous in the above phases.

From the analysis of the non-linear sigma model (NLSM), Morinari has proposed a half-skyrmion picture for the description of doped holes. In the NLSM, the skyrmion solution, which is characterized by chirality, is known to be an exact solution of the classical field equation. However, skyrmions are not stable in the pure NLSM. Some interaction effects are necessary to stabilize them. Morinari has argued that a singlet state, which is called Zhang-Rice singlet, should stabilize a skyrmion-like spin texture: In high-temperature superconductors, there is strong antiferromagnetic Kondo coupling between holes and the localized spin moments. If it is assumed that a hole forms a singlet state with a localized spin moment, then the wave function consists of the localized spin-up state and spin-down state. One of those states creates the skyrmion. Meanwhile, the other spin state does not create a spin texture at all. The superposition of those spin configurations leads to a skyrmion-like spin texture. In the presence of the antiferromagnetic long-range order, it is seen that the total topological charge density is quantized to one-half of that of a skyrmion from the Schwinger boson mean field theory. The excitation spectrum of the half-skyrmion, which is obtained by making use of the fact that the NLSM is Lorentz invariant, is in good agreement with angle resolved photoemission spectroscopy in the undoped compounds. Spin textures characterized by chirality induce a mangetic field like effect on carriers through the Berry phase. In the system of carriers with skyrmion-like spin textures, a chiral pairing state appears. Since there are two chiralities for half-skyrmions, there are two chiral pairing state with opposite chiralities. It turns out that the most stable pairing state in the bulk has d-wave symmetry. Therefore, the chiral spin texture scenario suggests a mechanism of d-wave superconductivity. It has been shown that this superconducting state is stable against the moderate Coulomb repulsion between the holes and the repulsive interaction between the chiral spin textures (*Morinari*).

Non-equilibrium Physics

Open systems far from thermodynamic equilibrium, such as living systems, provide a wide variety of self-organizing cooperative processes leading to the spontaneous formation of spatial and temporal order. The aim is to explain and predict their dynamics, and extract skeletons of mechanisms.

Interconnected Turing patterns in three dimensions: Shoji and Ohta study the self-organizing spatial structures generated by a Fitz-Hugh Nagumo type equation. They have shown that this kind of equations generate lamellar, hexagonal, sphere and gyroid structures by changing the control parameter (*Shoji and Ohta*).

Phase transition in Soft matter physics: The interests are focusing on nano-mesoscopic structures and their dynamics. Block copolymers show a variety of ordered mesophases. Ohta is investigating the morphologies transitions between ordered phases numerically and theoretically (*Ohta*).

Metastable and unstable structures in microphase separated diblock copolymers: Yamada and Ohta investigate possible intermediate structures in the process of microphase separation in diblock copolymers. By employing the two-mode expansion valid in the weak segregation regime, they have found that Fddd structure and Diamond structure of interconnected domains can be metastable whereas hexagonally perforated lamellar structure and FCC structure exist as a saddle point of the free energy landscape hence and these are unstable (*Yamada and Ohta*).

Different pathways in mechanical unfolding/folding cycle of a single semiflexible polymer: Yoshinaga and Ohta study dynamics of traveling waves under spatio-temporal forcing in non-equilibrium systems. Based on the model system where phase separation and chemical reactions take place simultaneously, they apply a spatially periodic external force which propagates with a constant velocity. Entrainment and modulation of traveling waves are investigated numerically in one dimension. A theoretical analysis to understand the obtained dynamics is developed (*Yoshinaga and Ohta*).

Elastic theory of microphase separated interconnected structures: Interconnected periodic structures such as gyroid appear in microphase separation in block copolymer melts. Yamada and Ohta derive the elastic free energy of gyroid and diamond structures in a weak segregation regime by the method formulated by Kawasaki and Ohta.

It is found that there is a simple relation among the elastic constants in the weak segregation limit (*Yamada and Ohta*).

Biological effects of electromagnetic fields: It is well known that there are some amplification mechanisms along the signal transduction pathways within living cells. Besides such mechanisms, many studies have shown that plastic changes in the function of specific parts of the central nervous system can be induced by novel stimulation or over-stimulation. Expression of neural plasticity may alter the excitability of neurons or shift the relationship between excitation and inhibition and thus cause hypo excitability or cause hyper excitability. Such plastic changes in the function of the central nervous system may occur at different rates. Usually, these plastic changes have been considered to be the signs of learning. However, the present hypothesis predicts that similar mechanisms would also cause symptoms like environmental illness. Murase proposed a hypothesis that electromagnetic fields cause hormonal effects (*Murase*).

Nuclear Theory Group

The main focus of our research group is the basic investigation of nuclear physics covering all the physical phenomena governed by the strong interactions, such as the structure and the dynamics of nuclei and hadrons, and properties of hadron-quark many-body system in finite temperatures and densities.

Here we briefly review our research activity in the academic year of 2005.

Nuclear Structure Physics

The goal of nuclear structure physics is to construct the unified microscopic comprehension of properties of nuclear many-body systems. One of the recent important achievements in nuclear structure physics is that nuclei far from the stability line have now been accessible experimentally. Various exotic phenomena have been discovered in unstable nuclei as well as stable nuclei. Our aim is to theoretically solve these problems and to provide theoretical predictions in systematic investigations of stable and unstable nuclei while focusing on the cluster aspect.

Recently, a new picture of a gas state of α clusters has been proposed by Tohsaki *et al.* Kanada-En'yo and Kimura studied the excited states of ^{11}C and ^{11}B with the method of antisymmetrized molecular dynamics(AMD), and found another candidate of a dilute state of weakly interacting clusters with 2α+^{3}He structure.

There were remarkable activities also in the research of unstable nuclei. The shape difference between proton and neutron density in neutron-rich nuclei is one of the hot subjects in unstable nuclear physics. Kanada-En'yo and Kimura formulated the time-dependent AMD for the dipole response, and predicted a new collective mode in neutron-rich nuclei due to the coherent motion of the valence neutrons. In a heavier mass number region than *p*-shell nuclei, they studied the deformations and cluster states in neutron-rich Ne and Mg isotopes, and showed that the cluster aspect is still important also in *sd*-shell nuclei. These results indicate that the coexistence of two natures, the cluster and the mean-field aspects provides a variety of structure in various nuclei (*Kanada-En'yo, Kimura*).

Hadron structure and dynamics

Lattice QCD studies of hadron properties: Numerical simulation based on Lattice QCD is a powerful approach to connect directly QCD to hadron physics, and also enable us to evaluate physical quantities, which are not easily achieved by experiments. Takahashi, Onogi, Kunihiro and their collaborators have investigated the properties for pentaquark and tetraquark. Takahashi and his collaborators have studied the nuclear force in Lattice QCD, which have been made possible recently by new ideas of calculation methods and developments of computer technology. While nuclear force potential is experimentally well-known by the phase shifts of nucleon-nucleon scattering and the deuteron properties, the origin of the short range repulsive core is not understood yet theoretically very much. To investigate nucleon interaction in such short ranges, it is necessary to incorporate non-perturbative regime of the quark degree of freedom into the calculation, since two nucleons touch each other in these ranges and the internal structure of the nucleon is important. In order to investigate the nuclear force potential in Lattice, they put two nucleons on the lattice and make one of the quarks in each nucleon heavy to fix the *positions* of the nucleons. Controlling the distance of the two nucleons, they calculate the energy shift of the system on lattice and obtain the potential as a function of the distance (*Kunihiro, Takahashi*).

Pentaquarks in the QCD sum rules: One of the recent important topics in hadron physics is the structure and properties of exotic hadrons. The first discovery of the baryonic resonance with $S = 1$, $\Theta^+(1540)$, and also the finding of the possible mesonic exotic states, $X(3872)$ and $D_s(2317)$, triggered tremendous amount of theoretical works on exotic hadrons. To investigate the structures of the exotic hadrons, theoretical computations in direct approaches of QCD with less assumptions and better accuracy are getting more important. The experimental confirmation for the existence of Θ^+ is not to be done yet, while theoretical study on existence of the Θ^+ is also a very important issue. Investigation of such an exotic hadron can be the first step to explore the quark matter.

Jido and his collaborators have proposed a new approach in the QCD sum rules applied for exotic hadrons. This approach enables us to extract the exotic hadron properties from the sum rules reliably with good stability in a remarkably wide Borel window, reducing the continuum contamination which generally appears in QCD sum-rules analyses of exotic hadrons. The idea of our new technique is a favorable setup of the correlation functions with the aid of chirality of the interpolating fields on the analogy of the Weinberg sum rules for the vector and axial-vector currents. This approach can be applied also to exotic hadrons in lattice QCD calculations. Taking the $\Theta^+(I = 0, J = 1/2)$ as an example to test our approach, we have calculated its mass as 1.68 ± 0.22 GeV with uncertainties of the condensate values independently in the chiral-even and odd parts. The sum rules indeed give rather flat Borel curves almost independent of the continuum thresholds both for the mass and pole residue (*Jido*).

η meson in nucleus and in-medium properties of $N^*(1535)$: The study of the in-medium properties of hadrons is one of the most interesting subjects in contemporary nuclear physics. The detailed investigation of hadrons inside nuclei clarifies quantitative information on basic hadron-nucleus interaction and further suggests partial restoration of chiral symmetry. Jido and his collabora-

tors have investigated the η meson in a nucleus, showing the formation spectra of the η-nucleus system which can be directly compared to observed spectra in experiments. One of the unique features of the η meson is that the η-nucleon system strongly couples to $N^*(1535)$, which is one of the possible candidates of the chiral partner of the nucleon. Thus the η-nucleus system is one of the probes to investigate the in-medium properties of N^*. It is also shown that the level crossing of the η meson and the N^*-h modes may take place owing to the in-medium reduction of the mass difference between N and N^*, and that the signal of the level crossing can be seen in experiments (*Jido*).

Partial restoration of chiral symmetry in nuclear medium: Exploring possible evidence of partial restoration of chiral symmetry in a nuclear medium is an intriguing subject in hadron physics. Systematic studies of deeply bound pionic states in Sn isotopes and pion-nucleus elastic scatterings in low energies suggest that the isovector pion-nucleus scattering length is repulsively larger than that of the pion-nucleon system. This leads to reduction of the temporal component of the pion decay constant in nuclear medium with the assumption that the pion-nucleus scattering length is given by the Weinberg-Tomozawa interaction with the in-medium pion decay constant. The question is how to conclude the reduction of the chiral condensate from the above observations. Jido, Kunihiro and their collaborator have shown, in a model independent way on the basis of the current algebra and the PCAC relation, that the in-medium chiral condensate and pion decay constant are related through the wavefunction renormalization of in-medium pion. Their investigation of the pion nucleon scattering amplitude leads us that the wavefunction renormalization is also reduced in nuclear medium at low densities. Thus They conclude the reduction of the chiral condensate in a nuclear medium together with the reduction of the pion decay constant suggested by the deeply bound pionic atom. It is also shown that the the pion-nucleus scattering length is given by the Weinberg-Tomozawa interaction at low densities (*Jido, Kunihiro*).

QCD phase structure

Color superconductivity and possible Bose-Einstein condensation in dense quark matter: Owing to the asymptotic freedom of QCD, it is most probable that the ground state of dense and cold (deconfined) quark matter is in a color-superconducting state. A lot of works have been done on the color superconductivity at extremely high densities using one-gluon-exchange model which should be valid owing to the asymptotic freedom in such extreme situation. At relatively low densities which may be realized in the compact stars and the intermediate stage in the heavy-ion collisions, the quark matter is a strongly coupled system. The strong coupling implies that there exist large fluctuations of the diquark-pair field, which implies that the color superconductivity at low densities may share some basic properties with the high-T_c superconductivity rather than the usual superconductivity in metals. Furthermore if the attractive force between the quarks is sufficiently strong, the diquark-Cooper pairs can change its nature to that of stable bosons at lower density, and then the ground state of the quark matter may become the Bose-Einstein condensation (BEC) of the diquarks. In this year, there have been active studies on the color superconductivity focusing on its strong coupling nature in our group.

To investigate the quark matter at intermediate densities, low energy effective models like the Nambu-Jona-Lasinio (NJL) model are widely used. In these models, the diquark coupling constant G_D is usually varied as a parameter. The properties of the quark matter can drastically change with a variation of the diquark coupling G_D. Kitazawa, Kunihiro and their collaborators study the quasi-particle picture of the quarks above the critical temperature of the color superconductivity with various diquark coupling G_D. It was found that a non-Fermi liquid behavior of the quarks is well developed when G_D is increased: There appears a gap-like structure in the spectral function at strong coupling. It was also discussed that the non-Fermi liquid behavior can be understood in terms of the so-called resonant scattering between the incident quark and a particle near the Fermi surface (*Kitazawa, Kunihiro*).

What would happen when the attraction between the quarks is further increased? Abuki and his collaborator show that there exist successive two crossover transitions as the diquark coupling G_D is increased; One from the usual BCS state to the BEC, then the one from the BEC to the relativistic Bose-Einstein condensation of nearly massless bound pairs, where antiparticles and particles equally contribute to the thermodynamic quantities (*Abuki*).

Diquarks can be realized in the quark matter at relatively low density. Nakano and his collaborators employ the quasi-chemical equilibrium theory between quark and diquark pairs in a relativistic framework to investigate the detailed properties of the diquarks in BEC. It is found that constituent-quark and diquark-composite masses play an essential role in determination of BEC. The critical temperature for a fixed baryon number density is calculated to be about $T_c \sim 100$ MeV which is comparable with those of color superconductivity obtained from the mean-field approximations (*Nakano*).

Phase structure of the neutral quark matter: For the quark matter realized in the compact stars, the electric- and color-neutrality and also the beta-equilibrium conditions must be satisfied. In addition, the effect of the strange quark mass m_s is not negligible since the quark chemical potential is of the same order as m_s in compact stars. All these properties bring about a mismatch in the density among the quarks with different flavors and colors, and in turn give rise to a surprisingly rich phase structure of dense quark matter inside the compact stars. It is especially notable that, under these constraints there appear the so-called gapless (Sarma-type) color superconducting states as a ground state in the mean-field approximation, owing to the density mismatch induced by the neutrality constraints. Moreover, the effect of the dynamical chiral symmetry breaking, which gives the constituent quark masses, should be taken into account at the densities in the compact stars. Abuki and Kunihiro perform a calculation of the phase diagram incorporating all above effects at finite temperature. It is found that various phases including the gapless phases appear in the phase diagram, and that the up-quark pairing (dSC) phase is favored over the down-quark pairing (dSC) phase in the realistic situation in the Ginzburg-Landau analysis, which is a resolution of a controversy (*Abuki, Kunihiro*).

Superconductivity with a mismatched density : As mentioned above, the densities of quarks in the compact stars are different by flavors and colors. Furthermore, they are relatively strongly-coupled system. The study on the color superconductivity under such conditions in turn give us the following simple but non-trivial question: What is the ground state of the fermionic system with mismatched densities, and how does the property change as the variation of the coupling constant especially at strongly coupling region? The answer for this question not only gives the deep understanding on the phase diagram of QCD, but also can be observed in experimental studies of trapped cold gases of fermionic atoms.

Kitazawa and his collaborators investigate the superconductivity with a mismatched density in the relativistic framework. It is found that there exist gapless phases which are characterized by either one or two gapless nodes, and the gapless phase having one gapless node can be realized as a true ground state at strong coupling. It is also found that the gapless phase at strong coupling is free of magnetic instabilities (*Kitazawa*).

Quasi-particle picture of quark at finite temperature : The properties of the quark-gluon plasma (QGP) near the critical temperature T_c of the QCD phase transition acquires much interest. The RHIC (Relativistic Heavy-Ion Collider) experiments and the Lattice QCD simulations at finite temperature are finding many non-trivial nature of the QGP near T_c: Now we know that the QGP near T_c is not the weakly interacting one, but the system composed of the strongly interacting quarks and gluons.

Kitazawa, Kunihiro and their collaborator explored the quasi-particle picture of the quark in the QGP near T_c. As the electrons drastically change their quasi-particle picture in some strongly correlated materials, one naturally expects that the quark can change its nature in the 'strongly interacting' QGP. To investigate the quasi-particle picture near T_c, they incorporated the effect of the soft-mode of the chiral phase transition into the quark self-energy and calculated the quark spectral function. In this calculation, it is found that there appears a peculiar feature in the quark spectrum: As T is lowered toward T_c from above, the quasi-particle splits and there appears a three-peak structure in the spectral function near T_c. It is shown that the similar multi-peak structure can be seen in the Yukawa model composed of the massive boson and massless and massive fermion. Kitazawa, Kunihiro, Mitsutani and their collaborator discussed that these novel spectra originate from the mixing between a quark (anti-quark) and an anti-quark hole (quark hole) caused by a 'resonant scattering' of the quasi-fermions with the bosonic excitation (*Kitazawa, Kunihiro, Mitsutani*).

Relativistic hydrodynamical equation: It was shown that the dynamical evolution of the hot and/or dense QCD matter produced in the RHIC experiments can be well described by the relativistic hydrodynamical simulations. A surprise was that the adopted hydrodynamical equation may not contain dissipative effects, suggesting that the created matter is a perfect fluid without viscosity. One should, however, notice that the dissipative effects were treated as a perturbation to the solutions of the perfect fluid equation. So there remains as an important task to study the dissipative hydrodynamical equations explicitly and fully for making a more precise description or even to confirm the suggested perfect fluidity itself. There are some attempts to derive the phenomenological equations from the microscopic equation, i.e., the relativistic Boltzmann equation, with use of the Chapman-Enskog method and the Grad's 14-moment method, and hence give a microscopic foundation to them. The problem is to reduce an effective infrared theory from the microscopic dynamics as mechanical as possible. In our point of view, the previous works more or less suffer from some obscure and ad hoc assumptions and approximations. Kunihiro, Ohnishi and their collaborator have started to derive relativistic hydrodynamical equation from Boltzmann equation using the renormalization group (RG) method, which is known to be so mechanical that one can identify the physical meaning in every procedure of the reduction. Indeed, the RG method was already applied to the non-relativistic case successfully. The essential point in the relativistic kinematics is choice of "time" coordinate. To specify the "time"coordinate, they introduce a vector, which is eventually related to (not necessarily the same as) the hydrodynamical flow-velocity. They find that the renormalization group method works well again in the relativistic kinematics, deriving a general form of the relativistic hydrodynamical equation which can be reduced to the known theories like the Landau's and Stuart's as special cases (*Kunihiro, Ohnishi*).

Particle Physics Group

The area of research carried out by the group members is wide and diverse. Particle physics is a branch of physics studying the origin of matter and spacetime as well as the interaction between them. Ultimately its goal is to find a single principle that governs the whole of nature; such a unifying theory is often dubbed Theory of Everything. *String theory* is a leading candidate of such a grandiose theory and is studied by many of the group members.

At low energy scales physical interactions observed in experiments are described accurately by the Standard Model of $SU(3)\times SU(2)\times U(1)$. This however is not a complete theory as it contains too many tuneable parameters, suffers from a hierarchy problem, and does not provide any good candidates for dark matter. *Phenomenology* of physics beyond the Standard Model is actively investigated by the group members, who work in close contact with experimental groups.

Lattice gauge theory is a powerful method for analyzing nonperturbative aspects of QCD. Understanding such aspects is essential for constructing phenomenological models beyond the Standard Model, and is also important for studying potentially new physical phenomena that may arise in finite temperature and/or finite density QCD.

Historically the development of particle physics came hand in hand with that of *Field theory*. The latter is not only a common language of particle physics but also a central tool in modern theoretical physics, including cosmology, condensed matter, and statistical physics. Driven by new concepts such as gauge-gravity correspondence, field theory has made remarkable progress in recent years. Supersymmetric quantum field theory, non-commutative field theory, and classical and quantum integrable systems are, among others, actively studied by the group members.

String theory

Twistor string theory, proposed by Witten, gives a new correspondence between perturbative N=4 super Yang-Mills (SYM) theory and topological string theory on a supertwistor space. Inspired by this theory, Cachazo-Svrcek-Witten (CSW) gave a new method to compute perturbative YM amplitudes. This has been extended by Kunitomo to $N=1$ and $N=4$ SYM theory and he calculated several tree and one-loop level gluon amplitudes. This method was extended to include (anti) quarks, and $N=1$ SQCD was reformulated so that the supersymmetry is manifest. Also all the one-loop maximally helicity violating (MHV) amplitudes with zero, one and two quark-antiquark pair(s) and arbitrary number of gluon external lines, were given (*Kunitomo*).

Bosonic, RNS and heterotic string theories on flat supermanifolds were constructed, and conformal anomaly cancellation and modular invariance were checked for these models. Bosonic string theories on supermanifolds have bosonic and fermionic coordinate dimensions $(D_B, D_F) = (26,0), (28,2), (30,4), \ldots$. In type II string theories one loop vacuum amplitudes were shown to vanish, suggesting the existence of supersymmetry on the supermanifold. Some examples in heterotic string theories were constructed explicitly. Moreover, D-branes on supermanifolds were constructed and their tensions were computed. It was shown that the fermionic contribution to the tensions of the D-branes is the inverse of the bosonic one. Some configurations of two D-branes satisfying BPS-like no-force conditions were also found (*Tokunaga*).

An example of 'twist-odd' solutions in open string field theory was investigated using the method of exact solutions. The solution was shown to be equivalent to the twist-even one through a transformation of the string field (*Zeze*).

Various aspects of algebraic structures arising from compactification of moduli spaces in string theory and their application to geometry were investigated by Kajiura and collaborators. In particular, (i) noncommuative deformation of D-brane categories (systems of D-branes and open strings between them) in the topological B-model on complex tori was studied; (ii) the D-brane category of B-twisted Landau-Ginzburg model having a superpotential with ADE singularities was investigated, and all such D-branes were classified; (iii) the open string spectrum between them was computed, and the structure of the D-brane category was completely determined; (iv) further physical interpretations of open-closed homotopy algebras previously defined in math.qa/0410291 were given (*Kajiura*).

Poisson-Lie T-duality, a generalisation of T-duality that requires no isometry of the target space, was applied in its canonical form to the superconformal boundary conditions of the open string worldsheet action. The transformation law of the gluing matrix defining a D-brane was explicitly derived, and shown to automatically preserve conformal invariance on the worldsheet boundary (*Albertsson*).

The interactions between the pion, vector mesons, and external gauge fields were investigated in the holographic dual of massless QCD, previously proposed in hep-th/0412141, on the basis of probe D8-branes embedded in a D4-brane background in type IIA string theory. By both analytic and numerical computations the coupling constants were obtained and were compared with experimental data. It was found that the vector meson dominance in the pion form factor as well as in the Wess-Zumino-Witten term holds in an intriguing manner. Moreover, the ω to $\pi\gamma$ and ω to 3π decay amplitudes were studied. It was shown that the interactions relevant to these decay amplitudes have the same structure as that proposed by Fujiwara et al. Various relations among the masses and the coupling constants of an infinite tower of mesons were derived. These relations play a crucial role in the analysis. Most of the results were shown to be consistent with experiments (*Sugimoto*).

Field theory

Tensor models were studied as dynamical models for fuzzy spaces. It was shown that a fuzzy two-sphere solution is, as a simple example, explicitly derived from a tensor model (*Sasakura*).

Field theory on non-associative commutative spaces was investigated, and various issues concerning its unitarity and locality were elucidated (*Sasakura, Sasai*).

The interplay between supersymmetry and topological excitations in gauge theory was investigated, with potential applications in brane-world scenarios and non-perturbative analysis of supersymmetric theories. It is known that in certain supersymmetric theories topological charges acquire a new type of quantum anomalies which govern the spectra of BPS-saturated excitations. The superfield formulation of such central-charge anomalies for solitons and domain walls, as well as vortices, was worked out. It was found, by the superspace approach, that the problem of topological-charge anomalies is essentially the same as that of superconformal anomalies. (*Shizuya*)

A supersymmetric generalisation of noncommutative geometry was investigated. Supersymmetric quantum Hall liquid on a fuzzy supersphere and on a noncommutative superplane was constructed. The construction of such supersymmetric quantum Hall systems is based on the supersymmetric generalisation of the 1st Hopf map, and it has been shown that interesting physical pictures (such as supermonopoles) and mathematical structures (such as the supersymmetric W_∞ algebra) arise. (*Hasebe*).

Integrable systems

Various classical and quantum integrable systems have been investigated by Sasaki and collaborators. In particular, (i) the A-type Gaudin model with integrable boundaries specified by non-diagonal K-matrices was studied. The commuting families of Gaudin operators were diagonalized by the algebraic Bethe ansatz method. The eigenvalues and the corresponding Bethe ansatz equations were obtained. (ii) certain multi-particle classical Calogero-Sutherland-Moser (CSM) systems were described by classical orthogonal polynomials (Hermite, Laguerre, Jacobi). Such a relation has been generalised to the Ruijsenaars-Schneider-van Diejen (RSvD) systems, which are integrable deformations of the CSM system. (iii) explicit solutions of the classical Calogero and Sutherland systems were obtained by diagonalization of certain matrices of simple time evolution, which works for generic models based on root systems (*Sasaki*).

Jump-defects in integrable systems have been investigated by Zambon and collaborators. In particular, (i) the sine-Gordon model with jump-defects has been investigated in the quantum context and, by solving a Yang-Baxter-like equation, the defects have been shown to store topological charges that are related to the stability of the defects. (ii) it has been shown that jump-defects can be classically incorporated into the non-linear Schrödinger model without spoiling integrability, and also a similar analysis has been done for the Korteveg-de Vries (KdV) and modified KdV models (*Zambon*).

An exactly marginal boundary deformation in $c = 1$ orbifold conformal field theory has been investigated. The boundary deformation has been formulated in the world sheet language at infinite as well as finite (rational-multiple of self-dual) orbifold compactification radii. This has been applied to the rolling tachyon picture of D-brane decay, and a new kind of S-brane solution (fractional S-brane) on a spacetime orbifold has been constructed (*Kawai*).

Phenomenology

The Standard Model (SM) describes the low energy particle phenomena correctly. Until today, no new phenomenon beyond the SM has been found. However, the SM is not considered as the theory of everything, because of its many parameters, of the hierarchy problem, and of no room for the candidates of the Dark Matter (DM). Since supersymmetric SM can solve the hierarchy problems and it has a good candidate for the DM, it offers one of the new frameworks for describing new physics beyond the SM.

There is no flavor changing neutral current (FCNC) and the lepton flavor violation (LFV) in the SM, if neutrinos are massless. However, super symmetric SM has the new sources of the FCNC and LFV process, in general. If super symmetry (SUSY) is realized, SUSY effects can be seen via the FCNC and/or LFV processes. Goto and his collaborator have studied the FCNC and LFV processes under the minimal super gravity SU(5) grand unified theory with right-handed neutrinos (*Goto*).

It is not easy to determine the mass type of gluino, which is the super partner of gluon, by the Large Hadron Collider (LHC), because of the complexity of the event. Nojiri and Takeuchi have studied the physics potential to distinguish the mass type of gluino by measuring squark pair production cross section by LHC (*Nojiri and Takeuchi*).

When the R-Parity is conserved, SUSY has a good candidate for the Dark Matter (DM), which is called the Lightest Super Particle (LSP). Nojiri and her collaborator suggest that the DM scattering with the high intensity electron beam inside the accelerator can be observed under certain conditions of the theory and machine parameters (*Nojiri*).

Nojiri and her collaborator study the potential of LHC for prediction the relic density of LSP from precise measurement of the SUSY spectrum and decay modes. They obtain that $\Delta(\Omega_\chi)/\Omega = 0.2$ for a reference point (*Nojiri*).

Higgs particle, which is not found yet, is the key particle of the SM, because vacuum expectation value of this particle gives mass to all fermions, Z^0, and $W^\pm$ bosons. Higgs particle is also a source of the electroweak symmetry breaking. Thus, the physics of Higgs particles is one of the important issues of the phenomenology. The MSSM is one of the two Higgs doublet models (THDM). In MSSM, quadratic coupling constant of the Higgs particle is related to its gauge coupling constant. However, there is no relation between quadratic coupling constant and gauge coupling constant under the general THDM. Asakawa and her collaborator study how to distinguish between the MSSM and the other THDM by using $pp(gg,bb) \to W^{\pm}H^{\mp}$ at LHC. They conclude that the THDM prediction for the hadronic cross section can be completely different from the MSSM prediction, because Higgs mass and the size of the MSSM cross section would not be sufficient to detect this process at LHC (*Asakawa*).

Linear Collider (LC), for the $e^{\pm}$ and $\gamma\gamma$ collision, is one of the great tools for searching new phenomena around a few TeV region. If the charged Higgs boson is so heavy, $e^{\pm}$ collider cannot make them for pair creation. However, $W^{\pm}H^{\mp}$ can be produced via the A^0, which is the pseudo-scalar Higgs, at the $\gamma\gamma$ collider. Asakawa and her collaborator calculate the cross section of $\gamma\gamma \to W^{\pm}H^{\mp}$ for the MSSM and the THDM. They show that the cross section of this process is roughly 0.1fb for the MSSM and $0.1 \sim 100$fb for the THDM, because mass of $H^{\pm}$ and A^0 is from the gauge coupling constant in the MSSM, but these are free parameters in the THDM (*Asakawa*).

In the THDM, including the MSSM, there is no $W^{\pm}H^{\mp}Z^0$ vertex at the tree level. This vertex appears at the tree level in models with Higgs triplets. Asakawa and her collaborator estimate the magnitude of the vertex for the model with additional real/complex triplets, the Littlest Higgs model, the general THDM, and the MSSM. They show that the magnitudes are hierarchically different among models, so that measuring the vertex in the $pp \to W^{\pm}Z^0X \to H^{\pm}X$ process can be useful to select new physics models (*Asakawa*).

Recent progress of neutrino experiments shows that some neutrinos have mass with two large mixing angles in the MNS (Maki-Nakagawa-Sakata) matrix, which denotes the lepton flavor mixing. Neutrino experiments will determine the magnitude of the mass-squared differences, the sign of the smaller one, the functional value of two of the three mixing angles, exact value of one of them, and the upper bound of the third mixing angle. The sign of the larger mass-squared difference (mass hierarchy pattern), the magnitude of third mixing angle, and the leptonic CP phase, which have not been measured, make the degeneracies. Okamura and his collaborator show the physics potential of detecting the neutrino beam from J-PARC (Japan Proton Accelerator Research Complex) by 100kt water Čerenkov detector in Korea about $L = 1000$km during the T2K (Tokai-to-Kamioka) experiment period, which runs for 5 years, 5×10^{21} POT (protons on target). Their analysis shows that the combination of the 3° off-axis beam (OAB) at SK and the 0.5° OAB in the east coast of Korea at $L = 1000$km solves the mass hierarchy degeneracy and constrain the leptonic CP phase uniquely without anti-neutrino phase (*Okamura*).

Lattice QCD

Lattice gauge theory is well-defined and it allows to calculate the dynamics non-perturbatively. Due to the discovery of the Ginsparg-Wilson fermion which satisfies the exact chiral symmetry on the lattice, it is now possible to study non-perturbatively dynamics of QCD in a realistic situation where chiral dynamics plays an important role. However, the formulation suffers both theoretical and technical problems when the topology changes during the simulation such as the breakdown of locality or huge increase of the numerical cost for simulation. In order to avoid such problems, Fukaya, Onogi and their collaborator introduce the “admissibility” condition, which means that the gauge field is smoothly configured, in the lattice calculation. Under this condition, the topological charge is always conserved automatically. They calculate the quark potential and renormalized coupling constant with the Lüscher action, which automatically satisfies the admissibility condition. Their results are consistent with those obtained with the Wilson action (*Fukaya, Onogi*).

The chiral perturbation theory provides a systematic method to calculate the low energy QCD dynamics. The lattice QCD calculation derive the many parameters which are related to the QCD dynamics without perturbations. However, QCD calculation on the lattice is very demanding, because of the large size lattice needed and the necessity to take the continuum and zero-mass limits, which are the sources of the systematic error. Fukaya and his collaborator adopt the new tactics. At first, they calculate the vector, axial-vector, scalar, and pseudo-scalar correlator under the small size lattice simulation, which energy region is named ε-regime. They attach their simulation results to the quenched-chiral perturbation theory in the same regime and fit the low-energy parameters by using the data from mesons correlators. Their method is applicable for the lower mass scale than the others' (*Fukaya*).

Because SUSY algebra needs an infinitesimal translation but lattice gauge theory has a finite cut-off, it is too difficult to integrate the SUSY with the lattice theory. In 2003, Cohen-Kaplan-Katz-Unsal formulated the the lattice gauge theory with nilpotent SUSY. The continuum limit of this theory is a 2 dimensional $N = (2,2)$ Super Yang-Mills theory. However, they do not take care of the quantum corrections and introduce the soft SUSY breaking mass term only for the scalar field. Onogi and Takimi examine that this formalism indeed recovers full SUSY in the continuum limit without fine-tuning and keep a stability of the space-time structure, when the quantum correction terms and the new soft breaking mass term for the fermion field are added. Their results tell that there is no fine-tuning problems on taking the infinite volume limit and the space-time structure is stable because of the fermion-boson cancellation of the quantum corrections (*Onogi,Takimi*).

2.2 Research Highlights

Worldsheet boundary conditions in Poisson-Lie T-duality

Cecilia Albertsson (YITP) and Ronald A. Reid-Edwards (Imperial College London and Queen Mary, University of London)

The importance of T-duality in string theory cannot be overstated. It establishes an equivalence between a priori different theories, providing, e.g., weak-coupling descriptions of strongly coupled physics, thus allowing access to nonperturbative information. Ultimately it leads to insights about the underlying theory unifying the different existing string theories.

T-duality may be realised as a transformation acting on the two-dimensional nonlinear sigma model. This model describes the worldsheet theory of a string propagating on some target manifold $\mathscr{M}$ equipped with a riemannian metric $g_{\mu\nu}$ and an antisymmetric B-field $B_{\mu\nu}$. For open strings the worldsheet has boundaries, by definition confined to D-branes. Originally the condition for this realisation to be possible was that $\mathscr{M}$ have some isometry group G (i.e., a group action G on $\mathscr{M}$ under which the target space metric is invariant) which leaves the sigma model invariant. The dual model is then obtained by gauging the isometry (promoting the global symmetry to a local one) to obtain a first-order parent action and integrating out gauge fields. The requirement that the background be isometric is a rather severe restriction, making it difficult to prove T-duality for models where no isometry exists. Moreover, for non-Abelian isometry groups, this procedure is not symmetric in the sense that repeated application does not necessarily recover the original theory.

Klimčík and Ševera [1] proposed a generalisation of T-duality to what is called Poisson-Lie T-duality. Traditional Abelian and non-Abelian T-duality arise as special cases in this framework. It allows duality on target spaces without isometries; instead the background satisfies the *Poisson-Lie condition*. This is a restriction on the Lie derivative $\mathscr{L}_{v^a}E_{\mu\nu}$ of the background tensor $E_{\mu\nu} \equiv g_{\mu\nu} + B_{\mu\nu}$ with respect to G-invariant vector fields v^a on $\mathscr{M}$, replacing the isometry condition $\mathscr{L}_{v^a}E_{\mu\nu} = 0$. The Poisson-Lie condition is necessary for the existence of well-defined worldsheets in the two target spaces, when the latter are both Poisson-Lie group manifolds (i.e., Lie groups with Poisson structures compatible with the group action) whose Lie algebras constitute a *Drinfel'd double*.

A Drinfel'd double is a Lie algebra $\mathscr{D}$ which decomposes into the direct sum, as vector spaces, of two maximally isotropic Lie subalgebras $\mathscr{G}$ and $\widetilde{\mathscr{G}}$, each corresponding to a Poisson-Lie group (G and $\widetilde{G}$), such that the subalgebras are duals of each other in the usual sense, i.e., $\widetilde{\mathscr{G}} = \mathscr{G}^*$. In this context the Poisson-Lie condition translates into a flat-curvature condition on the Noether current generating the left-action of G on itself in the sigma model. This is the condition for the worldsheet in G to be horizontally liftable into the group D that corresponds to the Lie algebra $\mathscr{D}$, and hence to project down to a well-defined dual worldsheet in $\widetilde{G}$. In this manner one obtains the dual theory without using isometries. The lift defines a dressing action of G on $\widetilde{G}$ and the D-branes on the dual target coincide with the orbits of the dressing action, which in turn coincide with symplectic leaves.

When performing traditional T-duality in the presence of an isometry, one finds equations of motion for the fields in the parent action, which constitute a map from the fields in the original model to those of the dual one. These are the canonical transformations, which if known can be applied directly to the fields in the model, without going to the trouble of gauging etc. In particular, they can be used to find the duals of the worldsheet boundary conditions (derived in [2]) for the open string. Such transformations exist also for Poisson-Lie T-duality [3], and, after showing that these can be written as a direct generalisation of the traditional Abelian T-duality map, we applied them in [4] to the boundary conditions in order to find the Poisson-Lie T-dual conditions.

In particular, we derived the duality map for the gluing matrix R which defines the relation between left- and right-moving fields on the worldsheet boundary. This matrix locally defines the properties of the D-brane; its eigenvalues determine the dimensionality of the brane, and its form the embedding of the brane in the target space. We showed that the form of the boundary conditions is invariant under the Poisson-Lie T-duality canonical transformations, and in particular that the model dual to a conformally invariant model is itself automatically conformally invariant. We worked out several examples explicitly, including traditional Abelian T-duality and non-Abelian T-duality, but also the non-Abelian double $\mathscr{D} = gl(2,\mathbf{R})$. In the latter case, we found that D0-branes are dual to D0-branes (with different embeddings in the two dual target spaces), and that, depending on the background fields on the two targets, D(-1)-branes and D1-branes are either dual to each other, or to branes of the same dimension. This toy model demonstrates the symmetric (or invertible) nature of Poisson-Lie T-duality.

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Spin dynamics on S=1/2 spin chains in a magnetic field

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What is elementary excitation picture in dynamics? In one-dimensional system, the conformal field theory has succeeded in the description of the low-energy physics of the Tomonaga-Luttinger liquid. Beyond the conformal field theory limit, exactly solvable models provide us chances to obtain analytical knowledge on thermodynamics and dynamics. Here we consider the dynamical spin structure factor $S(q,\omega)$ for the S=1/2 spin chain model,

$$\mathscr{H} = \sum_{i<j}^{N} J_{ij}\vec{S}_i\cdot\vec{S}_j - h\sum_{j=1}^{N} S_j^z. \qquad (1)$$

In particular we consider the two types of interaction: (i) nearest neighbor interaction $J_{ij} = J\delta_{j,i+1}$ (Heisenberg model) (ii) $1/r^2$ interaction $J_{ij} = J(\frac{\pi}{N})^2/\sin^2\frac{\pi}{N}(i-j)$ (Haldane-Shastry model). In the $h=0$ case, analytic expression of the dynamical spin structure factor $S(q,\omega)$ is known for the Heisenberg model [1]. For the Haldane-Shastry model, only the two-spinon excitations contribute to $S(q,\omega)$ [2]. For the Heisenberg model, the two-spinon excitations are main contributions, which dominates about 72.89 percent in the total spectral weight[1].

How the magnetic field h affects the spin dynamics? In the $h\neq 0$ case, Kitanine and his collaborators [3] developed the method to calculate the $S(q,\omega)$. The dynamical structure factor $S(q,\omega)$ is probed directly by neutron scattering, and more indirectly by NMR etc, which is defined by

$$S^{\bar{\alpha}\alpha}(q,\omega) = \sum_{\nu}|\langle\nu|S_q^{\alpha}|0\rangle|^2\delta(\omega - E_\nu + E_0), \qquad (2)$$

where $S_q^\alpha = 1/\sqrt{N}\sum_j e^{iqj}S_j^\alpha$, and $|\nu\rangle$ denotes an eigenstate of the Hamiltonian with energy E_ν. We evaluate $S^{+-}(q,\omega)$ up to two-spinon and two-antispinon $(2s2\bar{s})$ excitation contribution in Heisenberg model with extension of the work [4]. The corresponding contribution for the Haldane-Shastry model are so called Yangian highest weight states, whose spectral weight has the same analytic form as the advanced Green function for the spinless Sutherland model with coupling parameter $\beta = 2$[5] (see Fig. 2.1). In particular, the one antispinon (magnon) contribution for the momentum $0<q<\pi m$ (m being magnetization) remains as a δ-function peak in the thermodynamic limit, for the Haldane-Shastry model. From numerical study we confirmed that this property holds also in Heisenberg model.

When we include the Ising anisotropy Δ so that $\vec{S}_i\cdot\vec{S}_j \to S_i^xS_j^x + S_i^yS_j^y + \Delta S_i^zS_j^z$, for the Haldane-Shastry model, one antispinon $(1\bar{s})$ excitations plus two antispinon and β spinons $(\beta s2\bar{s})$ excitations ($\Delta = \beta(\beta-1)/2$, $\beta = 4,6,\cdots$) are main contributions to $S^{+-}(q,\omega)$ in the small energy. Remark that in contrast to isotropic case, the support of the spectrum,i.e., the region of nonzero spectral weight in the (k,ω)-plane, is not compact anymore for $\Delta\neq 1$.

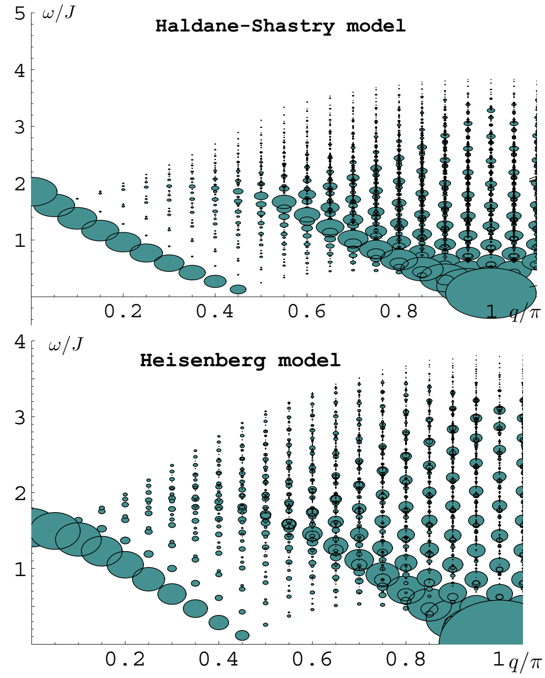

Figure 2.1: $S^{+-}(q,\omega)$ up to $2s2\bar{s}$ excitations contribution with $N=40$, $N_\uparrow = 30$ and $N_\downarrow = 10$ for the Haldane-Shastry model and the Heisenberg model. Each of the intensity is proportional to the area of the circle.

From numerical study we found that also in the Heisenberg model such one-antispinon excitations can appear. In fact the two spin chain models can be regarded as the two extreme cases of the one integrable model[6].

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The initial sensitivity of synchronization of integrate-and-fire oscillators with global pulse coupling

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The integrate-and-fire (IF) model is one of the simplest models for nonlinear oscillators. Mirollo and Strogatz[1] have studied synchronization of pulse-coupled IF oscillators generalizing Peskin's model[2] and they have proved that an assembly of finite number of oscillators is synchronized for almost all initial conditions within a finite time.

Let $\mathscr{O} = \{O_1, \ldots, O_N\}$ be a set of N oscillators, where each oscillator O_i is characterized by a phase ϕ_i and a state variable x_i, given by $x_i = f(\phi_i)$, where $f\colon [0,1] \to [1,0]$ is smooth, monotonic increasing, and concave down, i.e., $f' > 0$ and $f'' < 0$, and satisfies $f(0) = 0$ and $f(1) = 1$. We assume that the functions f are identical. When x_i exceeds a threshold at $x_i = 1$, the ith oscillator fires, and its state variable is instantaneously reset to zero, after which another cycle begins.

The interaction between oscillators is introduced as follows. When the ith oscillator fires, a small amount ε is added to the state variable x_j of all other oscillators $j\,(\neq i)$. In this sense there is a global coupling among the oscillators. If $x_j + \varepsilon > 1$, this oscillator fires so that these two have the same state variable 0. That is,

$$x_i(t) = 1 \to x_j(t^+) = \min(1, x_j(t) + \varepsilon) \quad \forall j \neq i. \qquad (1)$$

In our previous study[3], we studied an infinite assembly of integrate and fire oscillators with global coupling. Numerical simulations revealed that the time required for the mutual synchrony of all the oscillators exhibits singular behavior as a function of the interaction strength, as shown in Fig. 2.2. We also elucidated the origin of this anomalous synchronization by a theoretical analysis.

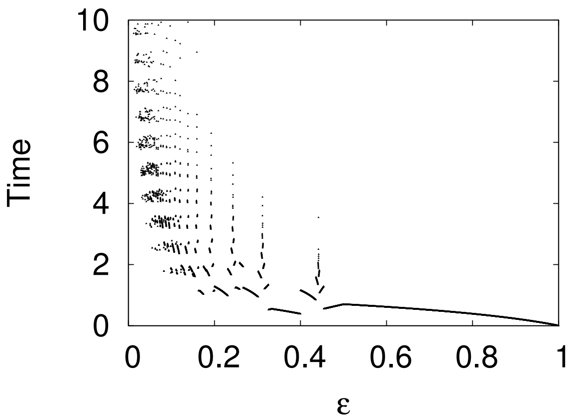

Figure 2.2: The time before synchronization of infinitely many IF oscillators for one coupling strength $0 < \varepsilon < 1$.

We are now interested in the variation of such an anomalous synchronization. We investigate the assembly of IF oscillators that consists of the two types of oscillators with different coupling strength value; the oscillators $\{O_1, \ldots, O_M\}$ has coupling strength ε_1, and the other oscillators $\{O_{M+1}, \ldots, O_N\}$ has coupling strength $\varepsilon_2\,(\neq \varepsilon_1)$. So, the interaction rule (1) is changed as below

$$x_i(t) = 1 \to x_j(t^+) = \min(1, x_j(t) + \varepsilon^i), \quad \forall j \neq i. \qquad (2)$$

$$\varepsilon^i = \begin{cases} \varepsilon_1 & (i \leq M), \\ \varepsilon_2 & (i > M). \end{cases}$$

Fig. 2.3 is the result of numerical simulations. The initial phases of the oscillators are uniformly distributed between 0 and 1. Fig. 2.3 shows that the time before synchronization is no more exhibits the singular behavior, that means the time before synchronization has the initial sensitivity to the distribution of initial phases of oscillators.

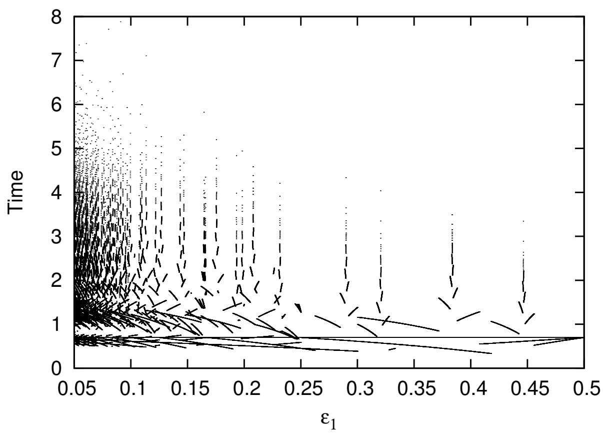

Figure 2.3: The time before synchronization of infinitely many IF oscillators for two coupling strengths, $0 < \varepsilon_1 < 0.5$ and $\varepsilon_2 = 0.5$.

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Four-dimensional effective theory for warped compactification

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Recently, a new class of dynamical solutions describing a size-modulus instability in the ten-dimensional type IIB supergravity model have been discovered by Gibbons et al. [1] and the authors [2]. These solutions can be always obtained by replacing the constant modulus h_0 in the warp factor $h = h_0 + h_1(y)$ for supersymmetric solutions by a linear function $h_0(x)$ of the four-dimensional coordinates x^μ. Such extensions exist for many of the well-known solutions compactified with flux on a conifold, a resolved conifold, a deformed conifold and compact Calabi-Yau manifolds [2].

In most of the literature, the dynamics of the internal space, namely the moduli, in a higher-dimensional theory is investigated by utilising a four-dimensional effective theory. In particular, effective four-dimensional theories are used in essential ways in recent important work on the moduli stabilisation problem and the cosmological constant/inflation problem in the IIB sugra framework [3]. Hence, it is desirable to find the relation between the above dynamical solutions in the higher-dimensional theories and solutions in the effective four-dimensional theory.

In the conventional approach where the non-trivial warp factor does not exist or is neglected, an effective four-dimensional theory is derived from the original theory assuming the "product-type" ansatz for field variables [4]. Under this ansatz, the four-dimensional effective action is obtained by integrating out the known dependence on the coordinates of internal space y^p in the higher-dimensional action.

The dynamical solutions in the warped compactification mentioned at the beginning, however, do not satisfy this ansatz. Hence, in order to incorporate such solutions to the effective theory, we have to modify the ansatz. Taking account of the structure of the supersymmetric solution, the most natural modification of the ansatz is to introduce the non-trivial warp factor h into the metric as $ds^2 = h^\alpha ds^2(\mathrm{X}_4) + h^\beta ds^2(\mathrm{Y})$ and assume that h depends on the four-dimensional coordinates x^μ only through the modulus parameter of the supersymmetric solution as in the case of the internal moduli degrees of freedom. This leads to the form $h = h_0(x) + h_1(y)$ for the IIB models, which is consistent with the structure of the dynamical solutions in the ten-dimensional theory.

In the paper [5], we have derived four-dimensional effective theories for the spacetime metric and the size modulus of the internal space for warped compactification with flux in the ten-dimensional type IIB supergravity and in the Hořava-Witten model of the eleven-dimensional M-theory. The basic idea was to consider field configurations in higher dimensions that are obtained by replacing the constant size modulus in supersymmetric solutions for warped compactifications, by a field on the four-dimensional spacetime. The effective action for this moduli field and the four-dimensional metric has been determined by evaluating the higher-dimensional action for such configurations. In all cases, the dynamical solutions in the ten- and eleven-dimensional theories found by Gibbons et al. [1], Kodama and Uzawa [2] and Chen et al.[6] were reproduced in the four-dimensional effective theories.

In addition to this, we have found that these four-dimensional effective theories have some unexpected features. First, the effective actions of both theories are exactly identical to the four-dimensional effective action for direct-product type compactifications with no flux in ten-dimensional supergravities. In particular, the corresponding effective theory has a kind of modular invariance with respect to the size modulus field in the Einstein frame. This implies that if there is a solution in which the internal space expands with the cosmic expansion, there is always a conjugate solution in which the internal space shrinks with the cosmic expansion.

Second, the four-dimensional effective theory for warped compactification allows solutions that cannot be obtained from solutions in the original higher-dimensional theories. The modular invariance in the four-dimensional theory mentioned above is not respected in the original higher-dimensional theory either. This situation should be contrasted with the no-warp case in which the four-dimensional effective theory and the original higher-dimensional theory are equivalent under the product-type ansatz for the metric structure. This result implies that we have to be careful when we use a four-dimensional effective theory to analyse the moduli stabilisation problem and the cosmological problems in the framework of warped compactification of supergravity or M-theory.

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Tensor model and dynamical generation of commutative nonassociative fuzzy spaces

Naoki Sasakura (YITP)

A fuzzy space is a kind of algebraic generalization of ordinary spaces. It is generally possible to characterize a space in terms of the algebra of functions on it. The algebra of functions on a usual space is commutative associative. One may consider a noncommutative space by considering a noncommutative algebra. This kind of space is called noncommutative geometry.

Another interesting direction of deformation is to consider a nonassociative algebra. While a field theory on a noncommutative space has some pathological behaviors, a field theory on a commutative nonassociative space respects the principles in physics more faithfully [1]. Moreover it is generally easier to construct nonassociative fuzzy spaces of physical interest than to construct noncommutative ones, since noncommutativity requires a symplectic structure and the class of such spaces is restricted too much. Therefore it seems that a commutative nonassociative fuzzy space is a more interesting object in physics than a noncommutative space.

A fuzzy space contains a kind of "fuzziness" in its formulation, and this feature may be related to the uncertainties of the space-time observables [2]. Therefore a fuzzy space is an interesting candidate for a new notion of quantum spacetime, and it is plausible that our spacetime can be described by a fuzzy space.

The main interest in my recent research is how to treat a commutative nonassociative space as a dynamical object. This direction is interesting, if the dynamics of fuzzy space can be regarded as a quantum version of the dynamics of spacetime, i.e. quantum gravity. An algebra of functions f_a can be characterized by a rank-three tensor $C_{ab}{}^c$ as $f_a \star f_b = C_{ab}{}^c f_c$. Therefore, a dynamical fuzzy space may be described by a theory with $C_{ab}{}^c$ as a dynamical variable [3]. Interestingly, this theory contains the fuzzy analogue of the general coordinate transformation in general relativity as the general linear transformation.

This kind of theory is called tensor model, and was originally considered to describe simplicial quantum gravity in more than two-dimensions [4]. However, the original interpretation assumes the correspondence between the dual diagrams of simplicial complexes and the Feynman diagrams of tensor model, and no physical results have been deduced from tensor model, since it is quite hard to know its quantum properties. On the contrary, in the present interpretation, the correspondence is between classical solutions and fuzzy spaces, and physical results can be deduced more easily.

In my most recent paper [5], it is numerically shown that some elementary commutative nonassociative fuzzy spaces can actually be obtained as classical solutions of the tensor model. As an example, in Fig.2.4, the tensor $C_{ab}{}^c$ of a classical solution and that of S^3 are compared. A

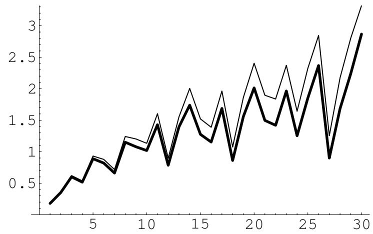

Figure 2.4: Bold line: the solution. Thin line: S^3.

good agreement is obtained. It has been also checked that, as the number of the degrees of freedom becomes larger, the agreement becomes better. Therefore the ordinary S^3 will be obtained in the infinite limit.

It is worth to stress that dimensions and cosmological constants are dynamically generated quantities in tensor model. Moreover, the fuzzy analogue of the general coordinate transformation is broken at classical solutions. There was an old idea to regard gravity as Nambu-Goldstone fields of the spontaneously broken local translational symmetry [6]. The above features may lead to the construction of quantum gravity in terms of tensor model.

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Integrable defects in the sine-Gordon model

Cristina Zambon (YITP)

A special type of local defect compatible with integrability, is permitted in the sine-Gordon model and it can be described in both the classical and the quantum version of the model. This type of defect, called a 'jump-defect', has a Lagrangian description via a one-parameter defect potential and its integrability is ensured by the existence of suitably modified Lax pairs [1]. Besides preserving integrability, it was found that the condition defining the defect allows not only the energy but also a generalized momentum to be conserved, including a contribution from the defect itself. Though energy conservation is not surprising, since time translation is unbroken, the existence of a conserved -though modified momentum- is unexpected since translation invariance is certainly lost. In fact, the defect potential appearing in the Lagrangian density may be regarded as being determined by demanding that it be possible to find a conserved generalized momentum functional. The jump-defect is purely transmitting and the field is, in general, not continuous at the defect location. Another characteristic feature is the fact that the defect conditions constitute a Bčklund transformation 'frozen' at the defect. It is worth pointing out that a jump-defect is not a δ-type impurity which, if introduced in a classical integrable nonlinear field theory, generally destroyed integrability.

Classically, a soliton going through a jump-defect is delayed, but for special values of its rapidity it can be turned into an anti-soliton, and viceversa, or being 'eaten' by the defect. As a consequence, the jump-defect can store topological charge. Classically, a defect cannot produce a soliton, since there is no information concerning the location (or time-origin) of the outgoing soliton. Instead, in the quantum context the jump-defect can emit a soliton since quantum mechanics can supply the probability of decay within a specific time of an excited defect, and therefore a soliton can emerge from the defect. Assuming a positive defect parameter, there are two types of defects. One type, carrying even charge, is stable, but the other type, carrying odd charge, is unstable and may be considered as a resonant bound state of a soliton and a stable defect.

The scattering of solitons with defect is considered in details in [2]. Here, a set of algebraic compatibility requirements satisfied by the bulk *S*-matrix and the missing transmission matrix of the sine-Gordon model and suitable to described purely transmission defects [3], were analyzed by first principles. Sufficient evidence was gathered to support the idea that the pure transmitting matrix proposed really described the quantum version of the sine-Gordon model with an even jump-defect (assuming a positive defect parameter). The presence of the unstable soliton-defect bound state is indicated by the existence of a complex pole in the transmission matrix found. The imaginary part of the pole location governs the width of the bound state, namely its decay, corresponding to emission. The bound state energy jump, in the classical limit, is real and corresponds to the classical energy of an emitted soliton with rapidity related to the defect parameter.

The scattering of breathers with defects is also considered in details and the transmission factors of the lightest breather is found to be independent of the bulk coupling constant. This is a property susceptible to a perturbative check, but not shared with any of the other breathers. Moreover, the expression of the transmission factor for the lightest breather is identical with the transmission factor in the classical linearized version of the jump-defect problem. This fact is a further piece of evidence to support the idea that the transmission matrix found describes the quantum version of the sine-Gordon jump defect, since the lightest breather corresponds to the quantum particle described by the fundamental bulk scalar field appearing in the Lagrangian density. In the same article is argued that jump-defects can move at constant speed and therefore interact amongst themselves.

There are other integrable models which can naturally incorporate jump-defect conditions of frozen-Bäcklund type. One such example is the nonlinear Schrödinger (NLS) model. A careful classical investigation of this model with a jump-defect is carried out in [4], together with a less detailed analysis for other non relativistic physical systems, such as the Korteveg de Vries model. Concerning the NLS model, it was found that this time a soliton solution cannot be 'eaten' by the defect, instead, alike the sine-Gordon model, bound states associated with the presence of the jump-defect were identified. This fact makes the NLS model particularly interesting for a quantum investigation.

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2.3 Publications

2.3.1 YITP preprints (January∼December 2005)

05-1 K. Terasaki and Bruce H J McKellar, *Charmed scalar resonances – Conventional and four-quark mesons* (January); Prog. Theor. Phys. **114** (2005) 205-211. hep-ph/0501188.

05-2 Bernard de Wit and Henning Samtleben, *Gauged maximal supergravities and hierarchies of non-abelian vector-tensor systems* (January); Fortsch. Phys. **53** (2005) 442-449. hep-th/0501243.

05-3 Masato Minamitsuji, Misao Sasaki and David Langlois, *Kaluza-Klein gravitons are negative energy dust in brane cosmology* (January); Phys. Rev. **D71** (2005) 084019. gr-qc/0501086.

05-4 Ken-ichi Nakao and Yoshiyuki Morisawa, *Gravitational Radiation from Cylindrical Naked Singularity* (January); Phys. Rev. **D71** (2005) 124007. gr-qc/0502017.

05-5 Naoki Sasakura, *Effective local geometric quantities in fuzzy spaces from heat kernel expansions* (February); JHEP **0503** (2005) 015. hep-th/0502129.

05-6 Yoshiyuki Morisawa and Daisuke Ida, *A boundary value problem for the five-dimensional stationary rotating black holes* (January); Phys. Rev. **D69** (2004) 124005. gr-qc/0401100.

05-7 E. Nakano and T. Tatsumi, *Chiral symmetry and density wave in quark matter* (January); Phys. Rev. **D71** (2005) 114006. hep-ph/0411350.

05-8 K. Shizuya, *Central charge and renormalization in supersymmetric theories with vortices* (February); Phys. Rev. **D71** (2005) 065006. hep-th/0502090.

05-9 Yukitoshi Motome, Hirokazu Tsunetsugu, Toshiya Hikihara, Nic Shannon and Karlo Penc, *Interplay among Spin, Orbital and Lattice Degrees of Freedom in t_{2g} Electron Systems with Edge-Sharing Network of Octahedra* (February); Prog. Theor. Phys. Suppl. **159** (2005) 314. cond-mat/0506598.

05-10 Takao Morinari, *Half-skyrmion picture of single hole doped high-T_c cuprate* (February); J. of Magnetism and Magnetic Materials **302** (2006) 382-386. cond-mat/0502437.

05-11 Kazuki Hasebe, *Quantum Hall Liquid on a Noncommutative Superplane* (March); Phys. Rev. **D72** (2005) 105017. hep-th/0503162.

05-12 Bernard de Wit, *Introduction to black hole entropy and supersymmetry* (March); hep-th/0503211.

05-13 Junji Hisano, Minoru Nagai, Mihoko M. Nojiri and Masato Senami, *Investigation of Possible Dark Matter Direct Detection in Electron Accelerators* (April); Phys. Rev. **D73** (2006) 031701. hep-ph/0504068.

05-14 Shin'ichi Nojiri, Sergei D. Odintsov and Misao Sasaki, *Gauss-Bonnet dark energy* (April); Phys. Rev. **D71** (2005) 123509. hep-th/0504052.

05-15 Yoshinobu Habara, Hikaru Kawai and Masao Ninomiya, *Cyclic Universe à la string theory* (April); Proc. of International Workshop "Frontier of Quantum Physics" 17–19 Feb. 2005. hep-th/0504103.

05-16 Yoshinobu Habara, Holger B. Nielsen and Masao Ninomiya, *Hole Theory of Boson Sea* (April); hep-th/0504173.

05-17 Noriyuki Kogo, Misao Sasaki and Jun'ichi Yokoyama, *Constraining Cosmological Parameters by the Cosmic Inversion Method* (April); Prog. Theor. Phys. **114** (2005) 555-572. astro-ph/0504471.

05-18 S. Rai Choudhury, A. S. Cornell, Naveen Gaur and G. C. Joshi, *Signatures of new Physics in dileptonic B-decays* (April); Int. J. Mod. Phys. **A21** (2006) 2617-2634. hep-ph/0504193.

05-19 Hidenori Fukaya, Shoji Hashimoto, Kenji Ogawa, *Low-lying mode contribution to the quenched meson correlators in the epsilon-regime* (April); Prog. Theor. Phys. **114** (2005) 451-476. hep-lat/0504018.

05-20 Hideo Kodama and Kunihito Uzawa, *Moduli Instability in Warped Compactifications of the Type IIB Supergravity* (April); JHEP **0507** (2005) 061. hep-th/0504193.

05-21 A. S. Cornell, Naveen Gaur and Sushil K. Singh, *FB asymmetries in the $B \to K^* \ell^+ \ell^-$ decay: A model independent approach* (May); hep-ph/0505136.

05-22 Yoshinobu Habara, Holger B. Nielsen and Masao Ninomiya, *Supersymmetric Relativistic Quantum Mechanics* (June); Int. J. Mod. Phys. **A21** (2006) 1333-1340. hep-th/0505237.

05-23 Yoshinobu Habara, Holger B. Nielsen and Masao Ninomiya, *Dirac Sea for Bosons also and SUSY for Single Particles* (June); Proc. of the International Workshop, "Frontier of Quantum Physics" 17–19 Feb. 2005, Kyoto, Japan. hep-th/0505238.

05-24 Tetsuya Onogi and Tomohisa Takimi, *Perturbative Study of the Supersymmetric Lattice Theory from Matrix Model* (September); Phys. Rev. **D72** (2005) 074504. hep-lat/0506014.

05-25 Masafumi Koike, Naotoshi Okamura, Masako Saito and Tatsu Takeuchi, *Leptonic CP Violation Search and the Ambiguity of δm^2_{31}* (October); Phys. Rev. **D73** (2006) 053010. hep-ph/0510082.

05-26 Hyun-Chul Lee, Misao Sasaki, Ewan D. Stewart, Takahiro Tanaka and Shuichiro Yokoyama, *A New delta N Formalism for Multi-Component Inflation* (September); JCAP **0510** (2005) 004. astro-ph/0506262.

05-27 Kunihito Uzawa and Kentaroh Yoshida, *Discrete Light-Cone Quantization in PP-Wave Background* (June); Phys. Lett. **B619** (2005) 333-339. hep-th/0506061.

05-28 Antonino Flachi and Takahiro Tanaka, *Escape of black holes from the brane* (June); Phys. Rev. Lett. **95** (2005) 161302. hep-th/0506145.

05-29 P. Bowcock, E. Corrigan and C. Zambon, *Some aspects of jump-defects in the quantum sine-Gordon model* (August); JHEP **0508** (2005) 023. hep-th/0506169.

05-30 H. Abuki, M. Kitazawa and T. Kunihiro, *How do chiral condensates affect color superconducting quark matter under charge neutrality constraints?* (April); Phys. Lett. **B615** (2005) 102-110. hep-ph/0412382.

05-31 Eri Asakawa and Shinya Kanemura, *The $H^{\pm}W^{\mp}Z^0$ vertex and single charged Higgs boson production via WZ fusion at the Large Hadron Collider* (July); Phys. Lett. **B626** (2005) 111-119. hep-ph/0506310.

05-32 M. E. Zhitomirsky and H. Tsunetsugu, *High field properties of geometrically frustrated magnets* (July); Prog. Theor. Phys. Suppl. **160** 361. (2005) cond-mat/0506327.

05-33 T. M. Aliev, S. Rai Choudhury, A. S. Cornell and Naveen Gaur, *CP violation in the $B \to K\ell^+\ell^-$ decay* (June); hep-ph/0506188.

05-34 Naoki Sasakura, *An invariant approach to dynamical fuzzy spaces with a three-index variable* (June); Mod. Phys. Lett. **A21** (2006) 1017-1028. hep-th/0506192.

05-35 Beatriz de Carlos, Sebastien Gurrieri, Andre Lukas and Andrei Micu, *Moduli Stabilisation in Heterotic String Compactifications* (February); JHEP **0603** (2006) 005. hep-th/0507173.

05-36 Tadakatsu Sakai and Shigeki Sugimoto, *More on a holographic dual of QCD* (July); Prog. Theor. Phys. **114** (2006) 1083-1118. hep-th/0507073.

05-37 Wen-Li Yang, Yao-Zhong Zhang and Ryu Sasaki, *A_{n-1} Gaudin model with open boundaries* (September); Nucl. Phys. **B729** (2005) 594-610. hep-th/0507148.

05-38 Holger B. Nielsen and Masao Ninomiya, *Intrinsic Periodicity of Time and Non-maximal Entropy of Universe* (January); Int. J. Mod. Phys. **A21** (2006) 5151-5162. hep-th/0601021.

05-39 Oriol Pujolas and Misao Sasaki, *Vacuum destabilization from Kaluza-Klein modes in an inflating brane* (August); JCAP **0509** (2005) 002. hep-th/0507239.

05-40 Masato Minamitsuji, Wade Naylor and Misao Sasaki, *Quantum fluctuations on a thick de Sitter brane* (January); Nucl. Phys. **B737** (2006) 121. hep-th/0508093.

05-41 Andrei Linde, Viatcheslav Mukhanov and Misao Sasaki, *Post-inflationary behavior of adiabatic perturbations and tensor-to-scalar ratio* (September); JCAP **0510** (2005) 002. astro-ph/0509015.

05-42 Syoji Zeze, *Twist Symmetry and Classical Solutions in Open String Field Theory* (August); JHEP **0510** (2005) 078. hep-th/0508196.

05-43 Holger B. Nielsen and Masao Ninomiya, *Unification of Cosmology and Second Law of Thermodynamics: Solving Cosmological Constant Problem, and Inflation* (September); hep-th/0509205.

05-44 Naotoshi Okamura, *Resolve the Neutrino Parameter Degeneracies with the T2K Off-axis Beam and the Large Detector in Korea* (September); Proc. of "PASCOS2005" **805** (2006) 310-313. hep-ph/0509164.

05-45 Naotoshi Okamura, *Solving the Neutrino Parameter Degeneracies by Measuring the T2K Off-axis Beam in Korea* (September); Nucl. Phys. Proc. Suppl. **115** (2006) 170-171.

05-46 Holger B. Nielsen and Masao Ninomiya, *Law Behind Second Law of Thermodynamics –Unification with Cosmology–* (September); JHEP **0603** (2006) 057. hep-th/0602020.

05-47 Tatsuya Tokunaga, *String Theories on Flat Supermanifolds* (September); hep-th/0509198.

05-48 Renata Kallosh, *Flux vacua as supersymmetric attractors* (September); hep-th/0509112.

05-49 Jose J. Blanco-Pillado, Renata Kallosh and Andrei Linde, *Supersymmetry and Stability of Flux Vacua* (September); JHEP **0605** (2006) 053. hep-th/0511042.

05-50 Satoru Nakatsuji, Yusuke Nambu, Hiroshi Tonomura, Osamu Sakai, Seth Jonas, Collin Broholm, Hirokazu Tsunetsugu, Yiming Qiu, and Yoshiteru Maeno, *Spin Disorder on a Triangular Lattice* (September); Science 9 September **Vol. 309. no. 5741** (2005) 1697 - 1700.

05-51 T. M. Rice and Hirokazu Tsunetsugu, *A Simple Model for the Checkerboard Pattern of Modulated Hole Densities in Underdoped Cuprates* (September); Eur. Phys. J. **B 49** (2006) 1-4. cond-mat/0509382.

05-52 Minako Honda, Yee Kao, Naotoshi Okamura and Tatsu Takeuchi, *A Simple Parameterization of Matter Effects on Neutrino Oscillations* (September); hep-ph/0602115.

05-53 Hidenori Fukaya, Shoji Hashimoto and Kenji Ogawa, *Meson correlators in a finite volume near the chiral limit* (October); PoS LAT2005 (2005) 133. hep-lat/0510049.

05-54 H. Fukaya, T. Onogi, S. Hashimoto, T. Hirohashi and K. Ogawa, *Parameter dependence of the topology change and the scaling properties of the topology conserving gauge action* (September); PoS LAT2005 (2005) 317. hep-lat/0509184.

05-55 H. Fukaya, S. Hashimoto, T. Hirohashi, K. Ogawa and T. Onogi, *Topology conserving gauge action and the overlap-Dirac operator* (October); Phys. Rev. **D73** (2006) 014503. hep-lat/0510116.

05-56 H. Fukaya, S. Hashimoto, T. Hirohashi, H. Matsufuru, K. Ogawa and T. Onogi, *Overlap fermion with the topology conserving gauge action* (October); PoS LAT2005 (2005) 123. hep-lat/0510095.

05-57 Takayuki Ishino, Hideo Kodama and Nobuyoshi

Ohta, *Time-dependent Solutions with Null Killing Spinor in M-theory and Superstrings* (September); Phys. Lett. **B631** (2005) 68-73. hep-th/0509173.

05-58 Misao Sasaki, *Conservation of nonlinear curvature perturbations on super-Hubble scales* (September); to appear in the proceedings of PASCOS05, ed. by Kiwoon Choi, Jihn E. Kim and Dongchul Son, pub. by AIP. astro-ph/0509793.

05-59 A. S. Cornell, Wade Naylor and Misao Sasaki *Graviton emission from a higher-dimensional black hole* (October); JHEP **0602** (2006) 012. hep-th/0510009.

05-60 R. Sasaki and K. Takasaki, *Explicit solutions of the classical Calogero & Sutherland systems for any root system* (October); J. Math. Phys. **47** (2006) 012701. hep-th/0510035.

05-61 Masato Minamitsuji, Wade Naylor and Misao Sasaki, *Can thick braneworlds be self-consistent?* (October); Phys. Lett. **B633** (2006) 607. hep-th/0510117.

05-62 Hiroshige Kajiura and Jim Stasheff, *Open-closed homotopy algebra in mathematical physics* (October); J. Math. Phys. **47** (2006) 023506. hep-th/0510118.

05-63 Hiroshige Kajiura, *Categories of holomorphic line bundles on higher dimensional noncommutative complex tori* (October); hep-th/0510119.

05-64 Hiroshige Kajiura, *Star product formula of theta functions* (October); Lett. Math. Phys. **75** (2006) 279-292. math.QA/0510307.

05-65 Hiroshige Kajiura, Kyoji Saito and Atsushi Takahashi, *Matrix Factorizations and Representations of Quivers II: type ADE case* (November); math.AG/0511155.

05-66 Holger B. Nielsen and Masao Ninomiya, *Compactified Time and likely Entropy – World Inside Time Machine: Closed Time-like Curve* – (October); To be published in the Proceedings to the 8th Workshop 'What Comes Beyond the Standard Models', Bled, July 19– 29., 2005, Slovenia. Bled workshops in physics, Vol.6, No.2, DMFA-Zaloznistvo, Ljubljana. hep-th/0601048.

05-67 Holger B. Nielsen and Masao Ninomiya, *Trouble with Irreversible Processes in Non-boundary Postulate* (October); hep-th/0602186.

05-68 unused no.

05-69 unused no.

05-70 Naoki Sasakura, *An invariant approach to dynamical fuzzy spaces with a three-index variable – Euclidean models* (November); Submitted to the Proc. of the 4th International Symposium "Quantum Theory and Symmetries" (QTS-4), 15-21 August 2005, Varna, Bulgaria. hep-th/0511154.

05-71 Antonino Flachi, Oriol Pujolas, Misao Sasaki and Takahiro Tanaka, *Black holes escaping from domain walls* (November); Phys. Rev. **D73** (2006) 125017. hep-th/0601174.

05-72 Christophe Galfard, Cristiano Germani and Akihiro Ishibashi, *Asymptotically AdS brane black holes* (December); Phys. Rev. **D73** (2006) 064014. hep-th/0512001.

05-73 Hideo Kodama and Kunihito Uzawa, *Comments on the four-dimensional effective theory for warped compactification* (December); JHEP **0603** (2006) 053. hep-th/0512104.

05-74 Shinsuke Kawai, *Fractional space-like branes* (December); Bulg. J. Phys. **33** no. s1 (2006) 261-268. hep-th/0512324.

05-75 K. Terasaki, *On charm scalar resonances* (December); Invited talk at the workshop on Resonances in QCD, July 11–15, 2005, ECT*, Trento, Italy. hep-ph/0512285.

05-76 M. M. Nojiri, G. Polesello and D. R. Tovey, *Constraining Dark Matter in the MSSM at the LHC* (December); JHEP **0603** (2006) 063. hep-ph/0512204.

05-77 E. Corrigan and C. Zambon, *Jump-defects in the nonlinear Schrodinger model and other non-relativistic field theories* (December); Nonlinearity **19** (2006) 1447-1469. nlin.SI/0512038.

05-78 Hirotaka Ito, Shoichi Yamada, Kohsuke Sumiyoshi and Shigehiro Nagataki, *Effects of Magnetic Fields on Proto-Neutron Star Winds* (March); Prog. Theor. Phys. **114** (2006) 995-1020. astro-ph/0508512.

05-79 Kohta Murase and Shigehiro Nagataki, *High Energy Neutrino Emission and Neutrino Background from Gamma-Ray Bursts in the Internal Shock Model* (March); Phys. Rev. **D73** (2006) 063002. astro-ph/0512275.

05-80 D.C. Heggie, M. Trenti and P. Hut, *HStar Clusters with Primordial Binaries: I. Dynamical Evolution of Isolated Models* (February); Mon. Not. Roy. Astron. Soc. **368** (2006) 677-689. astro-ph/0602408.

2.3.2 Publications and Talks by Regular Staff (April 2004 — March 2005)

Daisuke Jido

Journal Papers

1. H. Nagahiro, D. Jido and S. Hirenzaki
Formation of mesic nuclei by (γ, p) reactions.
Nucl. Phys. **A761** (2005) 92-119, [nucl-th/0504081].
2. D. Jido, W. Weise
Strange magnetic moment of the nucleon and SU(3) breaking: group theoretical approach.
Phys. Rev. **C 72** (2005) 045203, 6 pages, [nucl-th/0504012].

Books and Proceedings

1. D. Jido, J.A. Oller, E. Oset, A. Ramos, U.-G. Meissner
Structure of Lambda (1405) and chiral dynamics
Proceedings for 10th International conference on the Structure of Baryons (Baryons 2004), Palaiseau (France), Oct 25-29, 2004.
Nucl. Phys. **A755** (2005) 669-672, [nucl-th/0501044].
2. H. Nagahiro, D. Jido, S. Hirenzaki
In-medium properties of $N^*(1535)$ in chiral models and η-nucleus interaction
Proceedings for 10th International conference on the Structure of Baryons (Baryons 2004), Palaiseau (France), Oct 25-29, 2004.
Nucl. Phys. **A755** (2005) 491-494.
3. E. Oset, S. Sarkar, M.J.V. Vacas, A. Ramos, D. Jido, J.A. Oller and U.G. Meissner
Dynamically generated resonances in the chiral unitary approach to meson baryon interaction
Proceedings for 10th International symposium on Meson-nucleon physics and the structure of the nucleon (MENU 2004), Beijing (China), Aug 29 - Sep 4, 2004.
Int. J. Mod. Phys. **A20** (2005) 1619-1626, [nucl-th/0406047].

Invited Talks at International Conferences

1. Chiral symmetry for hadrons at finite density
YITP Workshop on Hadrons at finite density, February 20-22, 2006, Yukawa Institute for Theoretical Physics, Kyoto University, Kyoto, Japan.

Invited Seminars (in Japan)

1. Structure of $\Lambda(1405)$ and chiral dynamics (In Japanese)
June 14th, Nuclear physics group, Osaka University, Japan.

Yoshiko Kanada-En'yo

Journal Papers

1. M. Takashina, Y. Kanada-En'yo and Y. Sakuragi
^{16}C inelastic scattering studied with the microscopic coupled-channels method
Phys. Rev. **C71** (2005) 054602 (7 pages).
2. Y. Kanada-En'yo and M. Kimura
Dipole resonances in light neutron-rich nuclei studied with time-dependent calculations of antisymmetrized molecular dynamics
Phys. Rev. **C72** (2005) 064301 (13 pages).
3. Y. Kanada-En'yo and M. Kimura
Superdeformation and clustering in ^{40}Ca studied with antisymmetrized molecular dynamics
Phys. Rev. **C72** (2005) 064322 (17 pages).
4. Y. Kanada-En'yo, M. Kimura and H. Horiuchi
Cluster structure in stable and unstable nuclei
Eur. Phys. J. A **25** (2005) 305-310.

Invited Talks at international Conferences

1. Cluster aspect in C isotopes
Second Joint Meeting of the Nuclear Physics Divisions of the APS and JPS, September 18-22, 2005, Hawaii, U.S.A.

Hideo Kodama

Journal Papers

1. Hideo Kodama and Kunihito Uzawa
   Moduli Instability in Warped Compactifications of the Type IIB Supergravity
   JHEP **0507** (2005) 061:1-18, [hep-th/0504193].
2. Takayuki Ishino, Hideo Kodama and Nobuyoshi Ohta
   Time-dependent Solutions with Null Killing Spinor in M-theory and Superstrings
   Phys. Lett. **B 631** (2005) 68-73, [hep-th/0509173].
3. Hideo Kodama and Kunihito Uzawa
   Comments on the four-dimensional effective theory for warped compactification
   JEHP **0603** (2006) 053:1-19, [hep-th/0512104].

Books and Proceedings

1. Hideo Kodama and Kunihito Uzawa
   Moduli Instability in Warped Compactification
   Proc. of the 17th JGRG meeting (Tokyo Inst. Technology, 28 Nov. – 3 Dec. 2005), eds. T. Shiromizu, H. Yoshino, A. Hosoya, T. Nakamura and M. Sasaki, p.217-220, [hep-th/0601100].

Invited Talks at International Conferences

1. Black holes and singularities in higher dimensions
   TIFR black hole and singularities workshop, March 3-8, 2006, Mumbai, India.

Invited Seminars (in Japan)

1. Higher-dimensional unified theory and cosmology (in Japanese)
   Invited talk at the Symposium in celebration of Prof. Satoshi Matsuda's retirement, May 15, 2005, Yukawa Institute, Kyoto University.
2. Einstein's dream (in Japanese)
   Invited Lecture at the Summer School for Young Researchers in Astronomy and Astrophysics, August 3, 2005, Hotel Evergreen Fuji, Japan.
3. Is the four-dimensional effective theory effective? (In Japanese)
   Invited Talk at the KEK string workshop, March 13–16, 2006, High Energy Institute, Tsukuba, Japan.

Taichi Kugo

Invited Seminars (in Japan)

1. Developments in Field Theory in the World and in Japa (in Japamese),
   YITP workshop "Genealogy of Modern Physics – From Einstein to Yukawa and Tomonaga",
   Nov.7 - 8, 2005, YITP, Kyoto.

Teiji Kunihiro

Journal Papers

1. Masakiyo Kitazawa, Teiji Kunihiro and Yukio Nemoto
   Non-Fermi liquid behavior induced by resonant diquark-pair scattering in heated quark matter
   Phys. Lett. **B631** (2005) 157-163, [hep-ph/0505070].
2. Hiroaki and Teiji Kunihiro
   Nucl. Phys. **A768** (2006) 118-159, [hep-ph/0509172].
3. Masakiyo Kitazawa, Teiji Kunihiro and Yukio Nemoto
   Quark spectrum above but near critical temperature of chiral transition
   Phys. Lett. **B633** (2005) 269-274, [hep-ph/0510167].
4. Kyosuke Tsumura and Teiji Kunihiro
   Application of the renormalization-group method to the reduction of transport equations.
   J. Phys. **A39** (2006) 8089-8104, [hep-th/0512108].

Books and Proceedings

1. Toru T. Takahashi, Takashi Umeda, Tetsuya Onogi and Teiji Kunihiro
   Talk given at 23rd International Symposium on Lattice Field Field: Lattice 2005, Trinity College, Dublin, Ireland, 25-30 Jul 2005.
   PoS LAT2005 (2006) 071.
2. T. Kunihiro, S. Muroya, A. Nakamura, C. Nonaka, M. Sekiguchi and H. Wada
   I=1/2 scalar and axial vector mesons.
   Prepared for 23rd International Symposium on Lattice Field Field: Lattice 2005, Trinity College, Dublin, Ireland, 25–30 July 2005.
   PoS LAT2005 (2006) 034.

3. T. Kunihiro, S. Muroya, A. Nakamura, C. Nonaka, M. Sekiguchi and H. Wada
   Evidence for sigma meson in lattice QCD.
   Conference on Physics at LHC, Vienna, Austria, 13–17 July 2004.
   Czech. J. Phys. **55** (2005) B825-B830.

Invited Talks at international Conferences

1. Status of the chiral symmetry restoration and sigma-meson physics
   Round table discussion Searching for the mixed phase of strongly interactingmatter at the JINR Nuclotron, JINR, Dubna,
   July 7–9, 2005 (BLTP Conference hall).
2. Application of the Renormalization-group Method for the Reduction of Transport Equations
   Renormalization Group 2005 Henlsinki, Finland, Sep. 1–4, 2005.

Invited Seminars (Overseas)

1. Some Topics on Chiral Transition and Color superconductivity
   Heavy-Ion Meeting, APCTP, Pohang, Korea,
   4-5 November, 2005.

Invited Seminars (in Japan)

1. QCD Phase Transitions and Quark Quasi-particle Picture YITP Workshop' New Developments in Nuclear Self-consistent Mean-field Theories,
   May 30.
2. Effective Nuclear Forces including Tensor Force and Spin-Isospin Modes — Pion condensation revisited —
   YITP Workshop 'Tensor Forces and Nuclear Manybody Correlations,
   Sep. 1–6, 2006, YITP.
3. QCD Phase Transitions and Physics of Hadron-Quark Manybody Systems
   The 28th Soryushiron Group Shikoku Seminar, Dec. 26–27, 2005, Kochi Wemen University, Kochi.
4. Hadron-Quark Many-body Physics Based on Chiral Effective Theory
   Sepcial lectures for the graduate school at University of Tokyo, Dec. 5–7, 2005.

Shin Mineshige

Journal Papers

1. Ohsuga, K., Kato, Y., and Mineshige, S.
   Spectral Properties of Three-Dimensional Magnetohydrodynamical Accretion Flows
   ApJ, **627** (2005) 782–789.
2. Ohsuga, K., Mori, M., Nakamoto, T., and Mineshige, S.
   Super-Critical Accretion Flows around Black Holes: Two-Dimensional, Radiation-Pressure-Dominated Disks with Photon-Trapping
   ApJ, **628** (2005) 368–381.
3. Kawanaka, N., Mineshige, S., and Iwasawa, K.
   Iron Fluorescent Line Emission from Black Hole Accretion Disks with Magnetic Reconnection-heated Corona
   ApJ, **635** (2005) 167–172.

Books and Proceedings

1. Mineshige, S., and Ida, S. (ed)
   Origins: From Early Universe to Extrasolar Planets
   Prog. Theor. Phys. Supple. **158** (2005) 183pp.
2. Mineshige, S., and Watarai, K.
   Microquasar: Disk Models
   in proc. of Fifth Microquasar Workshop, ChJAA, **5** (2005) 49–56.
3. Ardi, E., Spurzem, R., and Mineshige, S.
   Dynamical Evolution of Rotating Single-Mass Stellar Cluster
   in proc. 6th East Asian Meeting of Astronomy, JKAS, **38** (2005) 207–210.
4. Mineshige, S., Kato, Y., Ohsuga, K., and Kawanaka, K.
   "Magnetized accretion flows, jets, and coronae"
   in proc. AIPC, **801** (2005) 147–152.

Invited Talks at international Conferences

1. Magneto-rotational Instability
   Astrophysical sources of high energy particles and radiation
   June 20–24, 2005 at Torun (Poland).
2. Near- and super-critical accretion flow
   High energies in the highlands
   June 27–July 1, 2005, at Fort Davis (Scotland).
3. Near- and super-critical accretion flow
   German-Japan seminar on Co-Evolution of Black Holes and Galaxies

July 19–22, 2005, at Regensburg (Germany).
4. Magnetohydrodynamical and Radiation-Hydrodynamical Accretion
APCTP Winter School on Black-Hole Astrophysics 2006
January 17–20, 2006, Pohang (Korea).
5. Compact Objects: Overview
East-Asia Young Astronomer Meeting (EAYAM) 2006
February 14–17, 2006, Nobeyama (Japan).

Invited Seminars (in Japan)

1. Magnetohydrodynamic Accretion Flow and Radiation Hydrodynamic Accretion Flow (in Japanese)
May 10, 2005, at Faculty of Science, Niigata University.
2. Introduction to Black Hole Astronomy (in Japanese)
March 8, 2006, at Hokkaido University.

Takao Morinari

Journal Papers

1. Takao Morinari
Half-skyrmion picture of single hole doped CuO_2 plane
Phys. Rev. **B 72** (2005) 104502 (10 pages).
2. Takao Morinari
Mechanism of $d_{x^2-y^2}$-wave superconductivity based on doped hole induced spin texture in high T_c cuprates
Phys. Rev. **B 73** (2006) 64504 (6 pages).

Masatoshi Murase

Books and Proceedings

1. M. Murase (ed.)
Biological effects of electromagnetic fields (in Japanese)
Bussei Kenkyu **86** no.5, 621-730.

Invited Seminars (in Japan)

1. What is Life? (in Japanese)
Waseda University December 8.
2. The dynamics of living systems (in Japanese)
Hokkaido University March 10.
3. Towards new frontiers in life science (in Japanese)
Kobe University March 20.

Shigehiro Nagataki

Journal Papers

1. T. K. Suzuki and S. Nagataki
Alfven Wave-Driven Proto-Neutron Star Winds and R- Process Nucleosynthesis
Astrophysical Journal **628** (2005) 914-922, [astro-ph/0412362].
2. H. Ito, S. Yamada, K. Sumiyoshi, S. Nagataki
Effects of Magnetic Fields on Proto-Neutron Star Winds
Prog. Theor. Phys. **114** (2005) 995-1020, [astro-ph/0508512].
3. K. Asano and S. Nagataki
Very High Energy Neutrinos Originating from Kaons in Gamma-Ray Bursts
Astrophysical Journal Letters **640** (2006) L9-L12, [astro-ph/0603107].
4. K. Murase and S. Nagataki
High energy neutrino emission and neutrino background from gamma-ray bursts in the internal shock model
Physical Review **D73** (2006) 063002, [astro-ph/0512275].

Books and Proceedings

1. S. Nagataki
High-Energy Neutrinos Produced by Interactions of Relativistic Protons in Shocked Pulsar Winds
Proceedings of Origin of Matter and Evolution of Galaxies; edited by M. Terasawa, S. Kubano, T. Kishida, T. Kajino, T. Motobayashi and K. Nomoto (World Scientific Publishing, Singapore, 2005) p.133.
2. A.Kawachi, T.Naito, S.Nagataki
High Energy Emissions from the PSR1259-63/SS2883 Binary System
Proceedings of High Energy Gamma-Ray Astronomy: 2nd International Symposium edited by Felix A. Aharonian, Heinz J. Volk, and Diete Horns. AIP Conference Proceedings, Volume 745 (New York: American Institute of Physics, 2005) p.353.
3. Rohta Takahashi, Shigehiro Nagataki
Neutrino Shadow and Explosion Mecha-

nism of GRB
18th Symposium of Theoretical Astrophysics Group, ed. Shigehiro Nagataki (Yukawa Institute for Theoretical Physics, 2005) p.155 (in Japanese).

4. Tsunehiko Kato, Shigehiro Nagataki
Dynamics of Collisionless Shock
18th Symposium of Theoretical Astrophysics Group, ed. Shigehiro Nagataki (Yukawa Institute for Theoretical Physics, 2005) p.222 (in Japanese).
5. Kohta Murase, Shigehiro Nagataki
High Energy Neutrinos from Gamma-Ray Bursts
18th Symposium of Theoretical Astrophysics Group, ed. Shigehiro Nagataki (Yukawa Institute for Theoretical Physics, 2005) p.269 (in Japanese).

Invited Talks at international Conferences

1. Explosion Mechanism of Core-collapse Supernovae and Collapsars
6th International Conference on High Energy Density Laboratory Astrophysics
March 11-14, 2006, Rice University, Houston, Texas.

Masao Ninomiya

Journal Papers

1. Yoshinobu Habara, Holger B. Nielsen, Masao Ninomiya
Supersymmetric Relativistic Quantum Mechanics.
Int. J. of Mod. Physics **A21** (2006) 1333-1340, [hep-th/0505237].
2. Holger B. Nielsen, Masao Ninomiya
Unification of Cosmology and Second Law of Thermodyanamics - Proposal for Cosmological Constant Problem and Inflation -
Prog. Theo. Phys. **116** (2006) 851-871, [YITP-05-43,hep-th/0509205].
3. Holger B. Nielsen, Masao Ninomiya
Intrinsic Periodicity of Time and Non-maximal Entropy of Universe
IJMPA **21** (2006) 5151-5162, [YITP-05-38, hep-th/0601021].
4. Holger B. Nielsen, Masao Ninomiya
Law Behind Second Law of Thermodynamics -Unification with Cosmology -
JHEP **0603** (2006) 057-072, [YITP-05-46, hep-th/0602020].

Books and Proceedings

1. H.B. Nielsen and M. Ninomiya
Compactified Time and Likely Entropy—World Inside of Time Machine:Closed Time -like Curve—
Proceedings to the 8th Workshop 'What Comes Beyond the Standard Models', Bled, July 19. - 29., 2005, Slovenia
Bled workshops in physics, **6** No. 2, DMFA-Zaloznistvo, [YITP-05-66, hep-ph/0512061].
2. H.B. Nielsen and M. Ninomiya
Future Dependent Initial Conditions from Imaginary Part of Lagrangian
Proceedings to the 8th Workshop 'What Comes Beyond the Standard Models', Bled, July 19. - 29., 2005, Slovenia
Bled workshops in physics, **7** 87–124, DMFA-Zaloznistvo, [YITP-06-06, hep-ph/0612032].

Mihoko M. Nojiri

Journal Papers

1. J. Hisano, M. Nagai, M. M. Nojiri and M. Senami
Investigation of possible dark matter direct detection in electron accelerators.
Phys. Rev. **D 73** (2006) 031701, 5 pages.
2. M. M. Nojiri, G. Polesello and D. R. Tovey
Constraining dark matter in the MSSM at the LHC.
JHEP **0603** (2006) 063, 22page,
YITP 05-76.
3. J. A. Aguilar-Saavedra *et al.*, Supersymmetry parameter analysis: SPA convention and project.
Eur. Phys. J. C **46** (2006) 43-60.
4. G. Weiglein *et al.* [LHC/LC Study Group]
Physics interplay of the LHC and the ILC.
Phys. Rept. **426** (2006) 47-358.

Invited Talks at international Conferences

1. Flavour studies and SUSY at the LHC
Workshop "Flavor in the era of LHC"
Nov. 7 -10 (2005) , CERN, Swiss.

2. New ideas on SUSY Dark Matter Study @ colliders
   The Sixth Particle Physics Phenomenology workshop (PPP6)
   Jun. 5- 8 (2005), Lo-Tung, I-Lan, Taiwan.
3. Physics at the LHC
   The 4th KAIST-KIAS workshop on particle physics and cosmology
   Oct. 10-14 (2005), Seoul, Korea.

Invited Seminars (in Japan)

1. How can we see the dark matter? The 18th Rironcon symposium, Frontier of High Energy Astrophysics",
   Dec. 25-27 (2005), YITP, Kyoto University.
2. Toward Unified Theory
   JSPS Science Seminar,
   Aug. 26-27 (2005), Tokyo, Japan.
3. Physics at LC –from recent developments
   Invited talk in the experimental particles physics session in JSPS meeting,
   Sep. 12-15 (2005), Osaka City University.

Takao Ohta

Journal Papers

1. K. Yamada , M. Nonomura, A. Saeki, and T. Ohta
   Metastable and unstable structures in microphase separated diblock copolymers
   J. Phys. Condensed Matter **17** (2005) 4877-4887.
2. N. Yoshinaga, K. Yoshikawa and T. Ohta
   Different pathways in mechanical unfolding/folding cycle of a single semiflexible polymer
   European Physical Journal **E17** (2005) 485-491.
3. H. Shoji, K. Yamada and T. Ohta
   Interconnected Turing patterns in three dimensions
   Phys. Rev. **E72** (2005) 065202(R).
4. K. Yamada and T. Ohta
   Elastic theory of microphase separated interconnected structures
   Europhysics Letters **73** (2006) 614.

Invited Talks at international Conferences

1. Synchronization of traveling waves in phase-separating reactive mixtures
   in Dynamics Days 2005
   July 25-28, 2005, Berlin.
2. Pattern dynamics
   in Forefront of Nonlinear Science and its Application to materials Science
   September 28-30, 2005 Kyoto.
3. Kinetics of mesoscopic structures in block copolymers
   in Pasifichem 2005, December 15-20, Honolulu.

Tetsuya Onogi

Journal Papers

1. H. Fukaya, S. Hashimoto, T. Hirohashi, K. Ogawa and T. Onogi
   Topology conserving gauge action and the overlap-Dirac operator
   Phys. Rev. **D73** (2006) 014503 [HEP-LAT 0510116].
2. Tetsuya Onogi and Tomohisa Takimi
   Perturbative study of the supersymmetric lattice theory from matrix model
   Phys. Rev. **D72** (2005) 074504 [HEP-LAT 0506014].

Books and Proceedings

1. Shunsuke Negishi, Hideo Matsufuru, Tetsuya Onogi and Takashi Umeda
   Study of 1/m corrections in HQET
   PoS LAT2005 (2005) 208 [HEP-LAT 0510048].

Invited Talks at international Conferences

1. Lattice calculations for B physics
   in Workshop on Flavour Dynamics
   Chamonix, France Oct 8-15, 2005.

Invited Seminars (Overseas)

1. A review of matrix theory construction of SUSY gauge theory on the lattice
   at CERN Theory Group, on Aug 3, 2005.

Invited Seminars (in Japan)

1. Study of pentaquark with lattice QCD (in Japanese)
   Univ. of Tokyo, Komaba June 1, 2005.
2. Lattice Study for Pentaquark States (in Japanese)
   Kobe Univ. July 6, 2005.

Misao Sasaki

Journal Papers

1. D. H. Lyth, K. A. Malik, M. Sasaki and I. Zaballa
Forming sub-horizon black holes at the end of inflation
JCAP **0601** (2006) 011,
[arXiv:astro-ph/0510647].
2. M. Minamitsuji, W. Naylor and M. Sasaki
Can thick braneworlds be self-consistent?
Phys. Lett. B **633** (2006) 607,
[arXiv:hep-th/0510117].
3. A. S. Cornell, W. Naylor and M. Sasaki
Graviton emission from a higher-dimensional black hole
JHEP **0602** (2006) 012,
[arXiv:hep-th/0510009].
4. A. Linde, V. Mukhanov and M. Sasaki
Post-inflationary behavior of adiabatic perturbations and tensor-to-scalar ratio
JCAP **0510** (2005) 002,
[arXiv:astro-ph/0509015].
5. M. Minamitsuji, W. Naylor and M. Sasaki
Quantum fluctuations on a thick de Sitter brane
Nucl. Phys. **B 737** (2006) 121,
[arXiv:hep-th/0508093].
6. O. Pujolas and M. Sasaki
Vacuum destabilization from Kaluza-Klein modes in an inflating brane
JCAP **0509** (2005) 002,
[arXiv:hep-th/0507239].
7. H. C. Lee, M. Sasaki, E. D. Stewart, T. Tanaka and S. Yokoyama
A new delta N formalism for multi-component inflation
JCAP **0510** (2005) 004,
[arXiv:astro-ph/0506262].
8. N. Kogo, M. Sasaki and J. Yokoyama
Constraining cosmological parameters by the cosmic inversion method
Prog. Theor. Phys. **114** (2005) 555,
[arXiv:astro-ph/0504471].
9. S. Nojiri, S. D. Odintsov and M. Sasaki
Gauss-Bonnet dark energy
Phys. Rev. **D 71** (2005) 123509,
[arXiv:hep-th/0504052].
10. M. Minamitsuji, M. Sasaki and D. Langlois
Kaluza-Klein gravitons are negative energy dust in brane cosmology
Phys. Rev. **D 71** (2005) 084019,
[arXiv:gr-qc/0501086].

Books and Proceedings

1. Misao Sasaki
Conservation of Nonlinear Curvature Perturbations on Super-Hubble Scales
the Proceedings of PASCOS 2005, Eds. K.W. Choi, J.E. Kim, D.c. Son (AIP, New York, 2005).

Invited Talks at international Conferences

1. Conservation of Nonlinear Curvature Perturbations on Super-Hubble Scales
Particles, Strings and Cosmology (PASCOS 2005)
30 May - 4 June, 2005, Gyeongju, Korea.
2. ΔN formalism for superhorizon perturbations and its nonlinear extension
Cosmological Landscape: Strings, Gravity, and Inflation
20-24 September, 2005, KIAS, Korea.
3. ΔN formalism
Workshop on Dark Energy
10-15 October, 2005, LMU Arnold Sommerfeld Center for Theoretical Physics, Germany.

Invited Seminars (Overseas)

1. ΔN formalism for supercurvature perturbations
27 Octorber, 2005
IAP, Paris, France.

Invited Seminars (in Japan)

1. Warped extra dimensions and the cosmological term (in Japanese)
Annual Meeting of the Physical Society of Japan
12 – 15 September, 2005, Osaka City University.

Ryu Sasaki

Journal Papers

1. Satoru Odake and Ryu Sasaki
Equilibrium Positions, Shape Invariance and Askey-Wilson Polynomials
J. Math. Phys. **46** (2005) 063513, (10 pages) [arXiv:hep-th/0410109].

2. W.-L. Yang, Ryu Sasaki and Y.-Z. Zhang
A_{n-1}Gaudin model with open boundaries
Nucl. Phys. **B729** (2005) 594–610, [arXiv:hep-th/0507148].
3. Satoru Odake and Ryu Sasaki
Calogero-Sutherland-Moser Systems, Ruijsenaars-Schneider-van Diejen Systems and Orthogonal Polynomials
Prog. Theor. Phys. **114** (2005) 1245–1260, [arXiv:hep-th/0512155].
4. Ryu Sasaki and Kanehisa Takasaki
Explicit solutions of the classical Calogero and Sutherland systems for any root system.
J. Math. Phys. **47** (2006) 012701, (13 pages) [arXiv:hep-th/0510035].

Books and Proceedings

1. Satoru Odake and Ryu Sasaki
Equilibrium Positions and eigenfunctions of shape invariant ('discrete') quantum mechanics.
in "Elliptic Integrable Systems", Rokko Lectures in Mathematics **18** (2005) 85–110, [arXiv:hep-th/0505070] ISBN 4907719183.
2. Ryu Sasaki
Yang-Mills Equations (in Japanese).
Suuri Kagaku, **504** (2005) 55-61.

Invited Talks at international Conferences

1. Symmetry & Integrability in classical and quantum many-particle dynamics.
mini-Workshop "The Meeting on New Topics in Particle Physics", Hanoi, Vietnam, 26 April 2005.
2. Explicit integration of Calogero and Sutherland systems.
APCTP, Focus Program Finite-size technology in low dimensional quantum field theory (II)
June-July 2005, APCTP Pohang, Korea.
3. Explicit Integration of Calogero & Sutherland Systems for any root system.
mini-Workshop: Multiparticle Integrable Systems, YITP Kyoto, 19 July 2005.
4. Classical and quantum integrability in multi-particle dynamics.
EUCLID Workshop "Integrable Models and Applications: from Strings to Condensed Matter"
12-18 September 2005, Santiago de Compostela, Spain.
5. Classical and Quantum Integrability in Multi-particle Dynamics.
Third FENOMEC: "Selected Topics in Mathematical Physics (II)"
10–12 November, Cocoyoc, Mexico.

Invited Seminars (Overseas)

1. Explicit Integration of Calogero and Sutherland Systems.
National Tsinghua University-National Jiaotang University Joint Seminar
25 October 2005, Hsinchu, Taiwan.
2. Classical and Quantum Integrability in Multi-particle Dynamics.
Tamkang University Seminar
28 October 2005, Tamkang, Taiwan.
3. Integrable Systems; Classical and Quantum.
9 November 2005, CIC, Cuernavaca, Mexico.
4. Explicit Integration of Calogero & Sutherland systems.
25 November 2005, Dept. Math. Univ. Queensland, Brisbane, Australia.

Invited Seminars (in Japan)

1. Classical and Quantum Integrability in Multi-particle Dynamics (in Japanese).
10 May 2005, Dept. Mathematical Science, Univ. Tokyo.
2. Classical and quantum integrability in multi-particle dynamics (in Japanese).
RIMS Workshop: From Soliton Theory to Integrable Mathematical Science, " de nouvelles perspectives "
22-24 August 2005, RIMS, Kyoto.

Naoki Sasakura

Journal Papers

1. Naoki Sasakura
An invariant approach to dynamical fuzzy spaces with a three-index variable
Mod.Phys.Lett. **A21** (2006) 1017-1028, [YITP-05-34, hep-th/0506192].

Invited Talks at international Conferences

1. An Invariant approach to dynamical fuzzy spaces with a three-index variable: Euclidean models
4th International Symposium on Quantum

Theory and Symmetries (QTS-4) and 6th International Workshop on Lie Theory and Its Applications in Physics (LT-6), Varna, Bulgaria, 15-21 Aug 2005.

Ken-ichi Shizuya

Books and Proceedings

1. K. Shizuya
   Scale anomaly, asymptotic freedom and supersymmetry (in Japanese)
   Suuri Kagaku **505** 55 - 62 (Science-sha, 2005).

Invited Talks at international Conferences

1. Supersymmetry and topological excitations
   International workshop on ”Characteristics of Supersymmetric Field Theories”,
   Nov. 18 -19, 2005, Seoul National University, Seoul, Korea.

Shigeki Sugimoto

Journal Papers

1. T. Sakai and S. Sugimoto,
   More on a holographic dual of QCD,
   Prog. Theor. Phys. **114** (2006) 1083-1118,
   [hep-th/0507073, YITP-05-36]

Invited Talks at international Conferences

1. Analysis of QCD via Supergravity
   Spring Mini-Workshop on Field Theories
   5/12-13/2005, Seoul.
2. Analysis of QCD via Supergravity
   Strings 2005
   7/11-16/2005, Toronto.
3. On the structure of interactions in holographic QCD
   Japan-Korea Mini-Workshop “QCD and hidden local symmetry in matter under extreme conditions”
   11/14–15/2005, Nagoya.
4. QCD and supergravity
   The 15th Workshop on General Relativity and Gravitation (JGRG15)
   11/28–12/2/2005, Tokyo.

Invited Seminars (in Japan)

1. Superstring theory and QCD (in Japanese)
   Seminar at Osaka city university,
   4/19/2005, Osaka.
2. Superstring theory and QCD (in Japanese)
   Seminar at Tohoku university,
   5/27/2005, Sendai.
3. QCD and String Theory
   Seminar at Tsukuba university
   6/10/2005, Tsukuba.
4. D-branes and tachyon in superstring theory (in Japanese)
   Invited lecture series at Wakate Summer School
   8/7-8/2005, Tokyo.
5. QED and superstring theory (in Japanese)
   Invited talk at Wakate Summer School
   8/7/2005, Tokyo
6. Superstring theory and QCD (in Japanese)
   Invited talk at JPS annual meeting
   9/12-15/2005, Osaka.
7. Superstring theory and QCD (in Japanese)
   Seminar at Kyoto university (Nuclear thoery group)
   10/11/2005, Kyoto.
8. D-branes and tachyon in superstring theory
   Invited lecture series at Chuo university
   10/18-19/2005, Tokyo.
9. Interplay of string theory and quantum field theory (in Japanese)
   Colloquium at Nagoya university
   10/20/2005, Nagoya.
10. QCD and string theory (in Japanese)
    Seminar at Hokkaido university
    11/4/2005, Sapporo.
11. Superstring theory and QCD (in Japanese)
    Seminar at Nihon university
    11/9/2005, Tokyo.
12. Superstring theory and QCD (in Japanese)
    Invited talk at YITP workshop ”From micro to macro, form macro to micro”
    11/16-18/2005, Kyoto.
13. Superstring theory and QCD (in Japanese)
    Invited lecture series at Nara women’s university
    12/8-10/2005, Nara.
14. Superstring theory and QCD (in Japanese)
    Invited lecture series at Kyoto university (Nuclear thoery group)
    12/15-16/2005, 1/24/2006, Kyoto.
15. Superstring theory and QCD (in Japanese)
    seminar at Shimane university

1/20/2006, Shimane.

16. Experimental Tests of Gauge/Gravity Duality (in Japanese)
    Invited talk at Nagoya workshop ”duality in string theory and gauge theory” 2/14-15/2006, Nagoya.

Keisuke Totsuka

Journal Papers

1. H.Kageyama, J.Yasuda, T.Kitano, K.Totsuka, Y.Narumi, M.Hagiwara, K.Kindo, Y.Baba, N.Oba, Y.Ajiro and K.Yoshimura
   Anomalous Magnetization of Two-Dimensional $S = 1/2$ Frustrated Square-Lattice Antiferromagnet (CuCl)LaNb$_2$O$_7$
   J. Phys. Soc. Jpn. **74** (2005) 3155-3158.

Invited Seminars (Overseas)

1. Low-dimensional spin systems with general multispin interactions: competing orders and hidden symmetries
   Hannover Graduate College Lectures, June 9 2006–June 17 2006, Hannover Germany.

Hirokazu Tsunetsugu

Journal Papers

1. Yukitoshi Motome and Hirokazu Tsunetsugu
   Orbital ordering and one-dimensional magnetic correlation in vanadium spinel oxides AV2O4 (A=Zn, Mg, or Cd)
   Physica **B 359-361** (2005) 1222–1224.
2. Yukitoshi Motome and Hirokazu Tsunetsugu,
   Spin Frustration and Orbital Order in Vanadium Spinels
   J. Phys. Soc. Jpn. Suppl. **74** (2005) 208–211.
3. Satoru Nakatsuji, Yusuke Nambu, Hiroshi Tonomura, Osamu Sakai, Seth Jonas, Collin Broholm, Hirokazu Tsunetsugu, Yiming Qiu, and Yoshiteru Maeno
   Spin Disorder on a Triangular Lattice
   Science **309** (2005) 1697–1700.
4. T. M. Rice and Hirokazu Tsunetsugu
   A Simple Model for the Checkerboard Pattern of Modulated Hole Densities in Underdoped Cuprates
   Euro. J. Phys. **B49** (2006) 1–4.

Books and Proceedings

1. Y. Motome, H. Tsunetsugu, T. Hikihara, N. Shannon, and K. Penc
   Interplay among spin, orbital and lattice degrees of freedom in t(2g) electron systems with edge-sharing network of octahedra
   Prog. Theor. Phys. Suppl. **159** (2005) 314-318.
2. M. E. Zhitomirsky and Hirokazu Tsunetsugu
   High field properties of geometrically frustrated magnets
   Prog. Theor. Phys. Suppl. **160** (2005) 361–382.
3. Yukitoshi Motome and Hirokazu Tsunetsugu
   “Theory of successive transitions in vanadium spinels and order of orbitals and spins”,
   Prog. Theor. Phys. Suppl. **160** (2005) 203–232.

Invited Talks at international Conferences

1. A Theory of “Spin Liquid Phase” in Triangular Antiferromagnets
   Miniworkshop on Strongly Correlated Electron Systems, Nov.4-5, 2005, at The Univ. of Hong Kong.

Invited Seminars (in Japan)

1. Quantum Ordered States in Furstarted Systems (in Japanese)
   Japanese Physical Society Meeting, Special Symposium on ”Novel States of Matter Induces by Frustration”,
   at Matsuyama Univ., Mar. 29, 2006.

2.3.3 Publications and Talks by Research Fellows and Graduate Students (April 2005– March 2006)

Cecilia Albertsson

Invited Seminars (Overseas)

1. Worldsheet boundary conditions in Poisson-Lie T-duality
June 14, 2006, Physics Department, Milano University, Italy, by invitation from Professor Dietmar Klemm.

Invited Seminars (in Japan)

1. Worldsheet boundary conditions and Poisson-Lie T-duality
March 16, 2006,
High Energy Physics Theory Group, Department of Physics, Faculty of Science, University of Tokyo, by invitation from Dr Yuji Sugawara.

Mitsuhiro Arikawa

Invited Seminars (Overseas)

1. Elementary excitation pictures in one dimensional spin chain
Hannover University (Nov.11th).

Invited Seminars (in Japan)

1. Dynamics and elementary excitation pictures in 1D spin systems (in Japanese)
Tokyo University ISSP (Oct.14th).

A. S. Cornell

Journal Papers

1. A. S. Cornell, W. Naylor and M. Sasaki
Graviton emission from a higher-dimensional black hole
JHEP **0602**, (2006) 012, [arXiv:hep-th/0510009].
2. S. R. Choudhury, A. S. Cornell, N. Gaur and G. C. Joshi
Signatures of new physics in dileptonic B-decays
Int. J. Mod. Phys. A **21** (2006) 2617, [arXiv:hep-ph/0504193].

Antonino Flachi

Journal Papers

1. Antonino Flachi, Oriol Pujolas, Misao Sasaki, Takahiro Tanaka
Critical escape velocity of black holes from branes.
Phys. Rev. **D 74** (2006) 045013.
2. Antonino Flachi, Oriol Pujolas, Misao Sasaki, Takahiro Tanaka
Black holes escaping from domain walls.
Phys. Rev. **D 73** (2006) 125017.
3. Antonino Flachi, Takahiro Tanaka
Escape of black holes from the brane.
Phys. Rev. Lett. **95** (2005) 161302.

Books and Proceedings

1. Antonino Flachi
Black holes on and off the wall
Published in the proceedings of the 15th Japanese General Relativity and Gravity conference.

Invited Talks at international Conferences

1. Black Holes escape from the brane
YKIS 2005 Kyoto, July 2005.
2. Black Holes on and off the wall
15th JGRG Tokyo, November 2005.

Invited Seminars (Overseas)

1. Interaction between black holes and branes and its relevance in cosmology and high energy physics.
INFN - Dipartimento di Fisica Universita' della Calabria
Septermber 2005.

Invited Seminars (in Japan)

1. On the interaction between black holes and branes
Tokyo Institute of Technology, December 2005
Tokyo University of Science, December 2005
Yukawa Institute for theoretical Physics, December 2005.

Hidenori Fukaya

Journal Papers

1. Hidenori Fukaya, Shoji Hashimoto and Kenji Ogawa
   Low-lying mode contribution to the quenched meson correlators in the epsilon-regime
   Prog. Theor. Phys. **114** (2005) 451-476,
   [hep-lat/0504018, YITP-05-19].
2. Hidenori Fukaya, Shoji Hashimoto, Takuya Hirohashi, Kenji Ogawa and Tetsuya Onogi
   Topology conserving gauge action and the overlap-Dirac operator
   Phys. Rev. **D 73** (2006) 014503,13pages,
   [hep-lat/0510116, YITP-05-55].

Books and Proceedings

1. Hidenori Fukaya, Tetsuya Onogi, Shoji Hashimoto, Takuya Hirohashi and Kenji Ogawa
   Parameter dependence of the topology change and the scaling properties of the topology conserving gauge action
   PoS **LAT2005** (2006) 317,
   [hep-lat/0509184, YITP-05-54].
2. Hidenori Fukaya, Shoji Hashimoto and Kenji Ogawa
   Meson correlators in a finite volume near the chiral limit
   PoS **LAT2005** (2006) 133,
   [hep-lat/0510049, YITP-05-53].
3. Hidenori Fukaya, Shoji Hashimoto, Takuya Hirohashi, Hideo Matsufuru, Kenji Ogawa and Tetsuya Onogi
   Overlap fermion with the topology conserving gauge action
   PoS **LAT2005** (2006) 123,
   [hep-lat/0510095, YITP-05-56].

Invited Seminars (in Japan)

1. Topology conserving actions and the overlap Dirac operator
   09 Dec 2005 at Hiroshima Univ.

Kazuki Hasebe

Journal Papers

1. Kazuki Hasebe
   Fuzzy Supersphere and Supermonopole; hep-th/0409230.
   Nucl. Phys. **B 709** (2005) 94-114.
2. Kazuki Hasebe
   Supersymmetric Quantum Hall Effect on a Fuzzy Supersphere
   Phys. Rev. Lett. **94** (2005) 206802 (4 pages); [hep-th/0411137].
3. Kazuki Hasebe
   Quantum Hall Liquid on a Noncommutative Superplane
   Phys. Rev. **D 72** (2005) 105017 (9 pages) [hep-th/0503162].

Books and Proceedings

1. Kazuki Hasebe
   Supersymmetric Quantum Hall Effect
   Soryushiron-kenkyu, **112** D18 (2006) (based on the presentation YITP Workshop, String Theory and Quantum Field Theory, 10 Aug.2005).

Invited Seminars (Overseas)

1. Supersymmetric Quantum Hall Effect
   19 April (2005) Stanford University.

Hiroshige Kajiura

Journal Papers

1. Hiroshige Kajiura
   Star product formula of theta functions.
   Lett. in Math. Phys., **75**, 279 –292 (2006),
   [arXiv:math.QA/0510307, YITP-05-64].
2. Hiroshige Kajiura, Jim Stasheff
   Open-closed homotopy algebras in mathematical physics.
   J. Math. Phys., **47** 023506 (2006),
   [arXiv:hep-th/0510118, YITP-05-62].
3. Hiroshige Kajiura, Jim Stasheff
   Homotopy algebra inspired by open-closed string field theories.
   Commun. Math. Phys. **263**, 553–581 (2006), [arXiv:math.QA/0410291, YITP-04-62].
4. Hiroshige Kajiura
   Noncommutative homotopy algebras associated with open strings.
   Reviews in Math. Phys. **19** (2007) 1–99,
   [arXiv:math.QA/0306332].

Invited Talks at international Conferences

1. Homotopy algebra of open-closed strings.
   COE conference: Groups, Homotopy and Configuration Spaces; in honor of Fred Cohen,
   July 8, 2005,
   Graduate School of Mathematical Sciences, The University of Tokyo.

Invited Seminars (in Japan)

1. Landau-Ginzberg B-branes and matrix factorizations for ADE singularities.
   Conference: Progress of Field theory · String theory
   February 7, 2006,
   Osaka-city University, Media center (in Japanese).
2. Open-closed homotopy algebras and related configuration spaces.
   Homotopy theory Okayama workshop 2005,
   November 17 & 18, 2005,
   Okayama University, Department of Science (in Japanese).

Shinsuke Kawai

Journal Papers

1. S. Kawai, E. Keski-Vakkuri, R. G. Leigh and S. Nowling
   Fractional S-branes on a spacetime orbifold,
   Phys. Rev. **D 73** (2006) 106004, [YITP-06-07, arXiv:hep-th/0602083].
2. S. Kawai, E. Keski-Vakkuri, R. G. Leigh and S. Nowling,
   The rolling tachyon boundary conformal field theory on an orbifold,
   Phys. Rev. **D 73** (2006) 106003, [YITP-06-08, arXiv:hep-th/0602081].
3. S. Kawai, E. Keski-Vakkuri, R. G. Leigh and S. Nowling
   Brane decay and an initial spacelike singularity
   Phys. Rev. Lett. **96** (2006) 031301, [arXiv:hep-th/0507163].
4. S. Hemming, S. Kawai and E. Keski-Vakkuri
   Coulomb-gas formulation of SU(2) branes and chiral blocks
   J. Phys. **A 38** (2005) 5809, [arXiv:hep-th/0403145].

Books and Proceedings

1. Shinsuke Kawai
   Free field formulation of boundary conformal field theory
   Soryushiron-Kenkyu **113** (2006) A30. Proceedings of the Workshop on Fundamental Problems and Applications of Quantum Field Theory (YITP, Kyoto, 2005).
2. Shinsuke Kawai
   Fractional spacelike branes on a timelike orbifold
   Proceedings of the Fifteenth Workshop on General Relativity and Gravitation in Japan (Tokyo Institute of Technology, Tokyo, 2005) 233-236.

Kohta Murase

Journal Papers

1. Kohta Murase and Shigehiro Nagataki
   High energy neutrino emission and neutrino background from gamma-ray bursts in the internal shock model
   Phys. Rev. **D 73** (2006) 063002.

Naotoshi Okamura

Journal Papers

1. Masafumi Koike, Naotoshi Okamura, Masako Saito and Tatsu Takeuchi
   Leptonic CP violation search and the ambiguity of δm^2_{31}
   Phys. Rev. **D73** (2006) 053010, [YITP-05-25, hep-ph/0510082].

Books and Proceedings

1. Naotoshi Okamura
   Resolve the neutrino parameter degeneracies with the T2K off-axis beam and the large detector in Korea
   AIP Conf. Proc. **805** (2006) 310-313. Also in *Gyeongju 2005, Particles, strings and cosmology* 310–313.
2. Naotoshi Okamura
   Solving the neutrino parameter degeneracies by measuring the T2K off-axis beam in Korea
   International Workshop on Neutrino Factories and Superbeams (NuFact 05), Frascati,

Italy, 21-26 Jun 2005
Nucl. Phys. Proc. Suppl. **155** (2006) 170–171.

Invited Talks at international Conferences

1. Solving the neutrino parameter degeneracies by measuring the T2K off-axis beam in Korea
   7th International Workshop on Neutrino Factories and Superbeams (NuFact 05)
   INFL, Frascati, Italy June, 2005.
2. Measuring CP violating phase from long baseline neutrino experiments
   3rd International Conference on Flavor Physics
   National Central University, Chungli, Taiwan October, 2005.
3. Resolving the neutrino parameter degeneracies
   An International Workshop on a Far Detector in Korea for the J-PARC Neutrino Beam
   KIAS, Seoul, Korea, Nov., 2005.

Invited Seminars (Overseas)

1. Neutrino oscillation and lepton universality
   Taiwan National Tsing Hua Univ., Oct. 2005.

Oriol Pujolàs

Journal Papers

1. Oriol Pujolas, Misao Sasaki
   Vacuum destabilization from Kaluza-Klein modes in an inflating brane.
   JCAP 0509:002, 2005, 20 pages,
   [YITP-05-39, ArXiv:hep-th/0507239].
2. Black holes escaping from domain walls.
   Antonino Flachi, Oriol Pujolas, Misao Sasaki, Takahiro Tanaka.
   Phys. Rev. D73 125017, 2006, 5 pages, [YITP-05-71, ArXiv:hep-th/0601174].

Invited Talks at international Conferences

1. Vacuum destabilization induced by Kaluza-Klein modes in an inflating brane
   Post-YKIS 2005 Workshop "Extra-dimensions"
   July 14, 2005. Yukawa Institute for Theoretical Physics.

Invited Seminars (Overseas)

1. Do Mini Black Holes escape the Brane?
   February 17, 2006. Universitat de Barcelona.
2. Do Mini Black Holes escape the Brane?
   February 22, 2006. Universitat Autonoma de Barcelona.

Takahiro Sakaue

Journal Papers

1. Takahiro Sakaue, Elie Raphaël, Pierre-Gilles de Gennes and Françoise Brochard-Wyart
   Flow-injection of branched polymers inside nanopores
   Europhys. Lett. **72** (2005) 83-88, [arXiv:cond-mat/0504586].
2. Takahiro Sakaue and Elie Raphaël
   Polymer chains in confined spaces and flow-injection problems: some remarks
   Macromolecules **39** (2006) 2621-2628, [arXiv:cond-mat/0506803].
3. Takahiro Sakaue
   DNA electrophoresis in designed channels.
   Eur. Phys. J. **E 19** (2006) 477-4187, [arXiv:cond-mat/0509403].

Invited Seminars (in Japan)

1. On Confined Polymers (in Japanese)
   22 April Dept. Phys. Kyoto University.
2. Statics and Dynamics of Confined Polymers (in Japanese)
   7 Dec. Dept. Phys. Kyoto University.

Tomohisa Takimi

Journal Papers

1. Tetsuya Onogi, Tomohisa Takimi
   Perturbative study of the supersymmetric lattice theory from a matrix model
   Phys. Rev. **D72** (2005) 074504 (19pages).

Books and Proceedings

1. Tetsuya Onogi, Tomohisa Takimi
   Perturbative study of the supersymmetric lattice model from a matrix model
   Proceedings of the "XXIII International Symposium on Lattice Field Theory" (School of Mathematics, Trinity College, Dublin,Ireland, 2005) PoS LAT2005:271 (2006) [hep-lat/0510037].

Chiyri Urabe

Journal Papers

1. Chiyori Urabe
   Dynamics of Fluctuation of the Top Location of a Sandpile.
   J. Phys. Soc. Jpn. **74** (2005) 2475-2479, [nlin.AO/0506005].

Books and Proceedings

1. Chiyori Urabe
   Dynamics of fluctuation of the top location in formation process of a sandpile II (in Japanese)
   Mathematical Aspects of Complex Fluids and Their Applications, (RIMS, 2006) **1472** of RIMS Kokyuroku 71-80.

Invited Seminars (in Japan)

1. Dynamics of fluctuation of the top location in formation process of a sandpile (in Japanese)
   Working Group on Particle Dynamics Simulation (The Society of Powder Technology, Japan), 12th Dec. 2005, Doshisya Univ.

Kunihito Uzawa

Journal Papers

1. Hideo Kodama & Kunihito Uzawa
   Moduli instability in warped compactifications of the type IIB supergravity
   Journal of High Energy Physics **07** (2005) 061, [YITP-05-20, arXiv: hep-th/0504193].
2. Hideo Kodama & Kunihito Uzawa,
   Comments on the four-dimensional effective theory for warped compactification
   Journal of High Energy Physics **03** (2006) 053, [YITP-05-73, arXiv: hep-th/0512104].

Books and Proceedings

1. Hideo Kodama & Kunihito Uzawa,
   Moduli Instability in Warped Compactification
   Proceedings of the 15th Workshop on General Relativity and Gravitation, (Tokyo Institute of Technology, Tokyo) (2005) 217-220, [YITP-06-02, arXiv: hep-th/0601100].

Tatsuya Yamasaki

Books and Proceedings

1. Tatsuya Yamasaki & Shoichi Yamada
   Inflating Horizons of Particle Astrophysics and Cosmology
   Proceedings of the Yamada Conference LIX, (Tokyo, 2005) 269-270.
2. Tatsuya Yamasaki & Shoichi Yamada
   Effects of Rotation on the Revival of a Stalled Shock in Supernova Explosions
   Journal of Physics: Conference Series, **31** (2006) 149-150.

Cristina Zambon

Journal Papers

1. P. Bowcock, E. Corrigan and C. Zambon
   Some aspects of jump-defects in the quantum sine-Gordon model.
   JHEP **0508** (2005) 023, [YITP-05-29, hep-th/0506169].
2. E. Corrigan and C. Zambon
   Jump-defects in the nonlinear Schrödinger model and other non-relativistic field theories,
   Nonlinearity **19** (2006) 1447-1469, [YITP-05-77, nlin.SI/0512038].

Invited Talks at international Conferences

1. Jump-defects in integrable models,
   19 Dec. 2005
   YITP Workshop-05-21: Fundamental problems and applications of quantum field theories.

Invited Seminars (Overseas)

1. Jump-defects in the sine-Gordon model and other integrable systems,
   26 Jan. 2006 Roma TRE University.

Invited Seminars (in Japan)

1. Jump-defects in the sine-Gordon model and other integrable systems,
   22 Feb. 2006 Tokyo Institute of Technology.
2. Jump-defects in the sine-Gordon model and other integrable systems,
   24 Feb. 2006 High Energy Accelerator Research Organization (KEK), Tsukuba.

2.4 Seminars, Colloquia and Lectures

▷ 2004.4.1 — 2005.3.31

4.6 Arne Hoell (Argonne National Laboratory): *Regarding Nucleon Electromagnetic Form Factors*

4.7 Nic Shannon (University of Tokyo): *A metamagnetic spin liquid in a three dimensional frustrated antiferromagnet*

4.7 Cristiano Germani (DAMTP, University of Cambridge): *On the black hole formation on the brane*

4.19 Andrei Frolov(Stanford University): *Semi-classical geometry of charged black holes*

4.20 Masaaki Kimura (YITP): *Clustering, superdeformation and motion of valence neutrons*

4.22 Zsolt Dombrádi (ATOMKI, Hungary): *In beam-gamma ray spectroscopy close to the neutron dripline*

4.22 Mitsuhiro Arikawa (YITP): *Dynamics and elementary excitation pictures in 1D spin systems*

4.22 Richard J. Hill (SLAC): *Factorization of form factors and beyond in soft-collinear effective field theory*

4.26 Daishin Ueyama (Hiroshima University): *Numerical study of self-organization of spiral waves in discrete reaction-diffusion systems*

4.27 Chen-Ning Yang (Tsinghua Univ./SUNY Yang Inst. Theor. Phys.; 1957 Nobel Laureate in Physics): *My Life as a Physicist*

4.28 Kentaro Nagata (Osaka University): *Particle acceleration in relativestic shock waves of electron-positron plasmas*

5.9, 16 & 20 Oleg Andreev (Landau Institute for Theoretical Physics): *Lecture Series: Notes on High-Energy Behavior of String Amplitudes*

5.12 V. Yu. Denisov (JAERI, JAPAN/Institute for Nuclear Research, Kiev, Ukraine): *Production and properties of Superheavy Elements*

5.13 Eri Asakawa (YITP): *Exploring the Higgs sector at LHC and LC*

5.18 Nguyen Van Giai (IPN, France): *Neutron star crust: superfluid properties and collective excitations*

5.19 Mark Alford (Washington University): *Color superconductivity and the strange quark*

5.20 Kouhei Hasegawa (YITP): *The condition to protect the primordial baryon asymmetry in the $SU(2)_L$triplet Higgs model –Analysis by Boltzmann equation–*

5.23 Daisuke Jido (YITP): *YITP Colloquium: Structure of Excited Baryons: under the aspect of chiral symmetry*

5.26 Michele Trenti (YITP): *Dynamical models for partially relaxed stellar systems*

5.27 Tonnis ter Veldhuis (Macalester College): *AdS brane dynamics*

6.3 Alexei B. Zamolodchikov (Montpellier University): *Gravitational Sin-Gordon Model Revisited*

6.6 Edward Corrigan (University of York/ YITP): *YITP Colloquium: Some aspects of Solitons*

6.7 Burt A. Ovrut (Pennsylvania University): *A Heterotic Standard Model*

6.9 Kohji Ogawa (Osaka City University): *Gravitatinal radiation from a rigidly and uniformly rotating cosmic string*

6.9 Katsuaki Asano (NAOJ): *Bursting Phenomena and Ultra High Energy Cosmic Rays*

6.13 D. P. Roy (Tata Institute of Fundamental Research): *Solar Neutrino Oscillation*

6.17 Sebastien Gurrieri (YITP): Stabilization of moduli in half-flat compactifications

6.24 Kazumitsu Sakai (Tokyo Institute of Technology): *Exact Analysis of ESR Shift in the Spin-1/2 Heisenberg Antiferromagnet chain*

6.27 Kenichi Kasamatsu (Ishikawa National College of Technology): *Spin textures in multicomponent Bose-Einstein condensates*

7.1 Yuri Aisaka (University of Tokyo, Komaba): *Origin of Pure Spinor Superstring*

7.15 V. V. Sreedhar (Indian Institute of Technology): *Duality and Symmetries in Fluid Dynamics*

7.19 Giuseppe Nardulli (University of Bari, Italy): *Color Superconductivity at intermediate densities*

7.20 Francesco Calogero (University of Rome ”La Sapienza”): *YITP Colloquium: The transition from regular to irregular motion explained as travel on Riemann surfaces: a new paradigm?*

7.22 Kenji Harada (Department of Applied Analysis and Complex Dynamical Systems, Kyoto University): *Numerical study of quadrupolar order in bilinear biquadratic model*

7.27 Kazuhiro Kuboki (Kobe University): *Anomalous surface state near the interface between unconventional superconductors and ferromagnets*

8.1 Karen Hallberg (Instituto Balseiro and Centro Atomico Bariloche): *Spin order in the one-dimensional Kondo and Hund lattices*

8.1 Marco Stratmann (University of Regensburg): *From RHIC to eRHIC – Spin Physics in the Next Decade*

8.1 Vladimir Belinski (National Institute for Nuclear Physics, Italy): *On the equilibrium state for two charged masses in General Relativity*

8.8 Bertrand G. Giraud (CE Saclay): *Coordinates, modes and maps for the density functional; a new family of orthogonal, constrained polynomials*

8.9 Hans-Peter Dürr (Former director of Max-Planck Institute für Physik at Munich): *Radically Quantum: Liberartion and Purification from Classical Prejudice*

8.9 Shufang Su (University of Arizona): *super-WIMP Dark Matter*

8.12 Adi Nusser (Technion, Haifa, Israel): *structure formation with a long-range scalar dark matter interaction*

8.25 Tatsuya Yamasaki (YITP): *Effects of Rotation on the Revival of a Stalled Shock in Supernova Explosions*

8.31 Eisei Takushi (University of the Ryukyus): *An Existence of Gel-Glasslike Transition in Complex Bio-System*

9.2 Kazuo Hosomichi (University of Toronto): *Non-perturbative orientifold transitions at the conifold*

9.6 Harald A. Posch (University of Vienna): *Lyapunov Modes and Phase-Space Fractals for Particle Systems*

9.9 Terry Mart (Universitas Indonesia): *Recent developments in photoproduction of strangeness on nucleons*

9.12 Shigeo Ohkubo (Kochi Women’s University): *Nuclear rainbow*

9.16 S. Peng Oh (Dept of Physics, UC Santa Barbara): *Spectral Signatures of Early Galaxy Formation*

9.22 Masaki Shigemori (California Institute of Technology): *Massless black holes and black rings as effective geometries of the D1-D5 system*

9.26 Yoshifumi Hyakutake (KITP, Univ. of California): *R^4 Corrections to 11D Supergravity via Supersymmetry*

9.28 Nigel Orr (LPC-Caen): *Exploring the Nucleus at and Beyond the Limits of Stability*

9.29 Holger Frits Bech Nielsen (Niels Bohr Institute/YITP): *YITP Colloquium: Law behind the second law of thermodynamics – Cosmological constant*

10.4 Yasutaka Takanishi (ICTP): *Informal Seminar “Majorana CP-Violating Phases, RG Running of Neutrino Mixing Parameters and Charged Lepton Flavour Violating Decays [arXiv:hep-ph/0508243]”*

10.7 Holger Frits Bech Nielsen (Niels Bohr Institute/YITP): *Explosive dark matter from degenerate vacua (MPP): Hierarchy problem and Higgs already found at LEP?*

10.13 Sander (F.A.) Bais (University of Amsterdam/YITP): *YITP Colloquium: Topological interactions*

10.14 Toru Sakai (JAERI): *Field-induced order in quasi-1D frustrated antiferromagnet*

10.18 Helen Quinn (SLAC): *B Physics and the Future*

10.18 Alexei A. Abrikosov (Argonne National Laboratory): *YITP Colloquium: Superconductivity: History and Modern State*

10.20 Shin’ichiro Ando (University of Tokyo): *Spectral Signatures of Early Galaxy Formation*

10.20 Marco Rossi (YITP): *Scattering factors in a one-dimensional spin chain*

10.21 Naveen Gaur (University of Delhi): *Low energy processes in Little Higgs model*

11.2 Yoshihiro Aritomo (Dubna, JINR): *Study* *of the fusion-fission dynamics of the superheavy elements*

11.14 Michio Hashimoto (The University of Western Ontario): *Gluonic phase and a neutral LOFF state in two-flavor dense QCD*

11.15 Evgeni Kolomeitsev (University of Minnesota): *Hadron Genesis*

11.15 Dominikus Heinzeller (University Heidelberg): *On the Eddington limit in accretion discs*

11.15 Evgeni Kolomeitsev (University of Minnesota): *Deeply Bound Pionic Atoms*

11.18 Sander (F.A.) Bais (University of Amsterdam/YITP): *Quantum symmetries and their breaking in planar physics*

11.21 Evgeni Kolomeitsev (University of Minnesota): *Chiral SU(3) Coupled Channel Model and Hadronic Resonances*

11.22 Frank E. Paige (Brookhaven National Laboratory): *LHC Physics Goals*

11.22 Evgeni Kolomeitsev (University of Minnesota): *Realistic Kaon-Nucleon interaction and Kaon Condensation in Neutron Stars*

11.25 Mark Strikman (Penn State Univ./KEK): *Discovery of high energy transparency and quest for color opacity*

11.28 Jean-Paul Blaizot (ECT, Trento): *YITP Colloquium: Thermodynamics of the Quark-Gluon Plasma*

12.2 Roderich Moessner (CNRS and Ecole Normale Superieure Paris): *Frustration, emergence and exotic order*

12.5 Tsutomu Momoi (RIKEN): *Nematic order in square lattice frustrated ferromagnets*

12.8 Sudhakar Panda (HRI, Allahabad, India/KEK): *de Sitter solution in N=4 gauged supergravity in D=4*

12.13 Avinash Khare (Institute of Physics, Bhubaneswar): *Linear Superposition For Nonlinear Equations and New Identities For Jacobi Elliptic Functions*

12.16 Daniel Baye (ULB): *Radiative-capture reactions near zero energy*

12.21 Karlo Penc (RISSP, Budapest): *Liquids and solids in spin-orbital and SU(4) Heisenberg models*

12.22 Antonino Flachi (YITP): *Escape of black holes from the brane*

12.26 Shoichi Kawamoto (University of Oxford): *Circular Loop Operators in Conformal Field Theory*

12.26 Satoshi Yamaguchi (IHES): *Supergravity solutions corresponding to Wilson line operators*

1.6 Naotoshi Okamura (YITP): *Prospect of T2K experiment with large detector in Korea*

1.11 Yoshiko Kanada-En'yo (YITP): *YITP Colloquium: Clustering in light nuclei*

1.13 Norihiro Iizuka (Tata Institute): *A Stringy-Small Black Ring*

1.20 Kenji Ogawa (The Graduate University for Advanced Studies): *Truncated fermion determinant for lattice QCD near the chiral limit in a finite volume*

1.26 Futoshi Yagi (University of Tokyo): *Pouliot Type Duality via a-Maximization*

2.3 Frieder Lenz (Erlangen-Nuremburg University): *Dynamics of Wilson-loops in Yang-Mills theories*

2.3 Akira Yotsuyanagi (Tohoku University): *Graviltino Problem and Constraint on the Reheating Temperature*

2.10 Henryk Arodz (Jagiellonian University): *On field theoretic models with V-shaped potentials*

2.15 S. V. Ketov (Tokyo Metropolitan University): *Non-ANTI-commutativity vs. Non-commutativity*

2.21 Naoyuki Watanabe (University of Tokyo): *Numerical Simulations of Magnetic Reconnection by Rlativistic MHD code with Resistivity*

2.23 Kiyotomo Ichiki (NAO): *Cosmological Magnetic Fields: Fossil of Density Fluctuations in the Early Universe*

3.2 Jonathan Shock (Institute of Theoretical Physics, Beijing): *Flavour physics and the AdS/CFT correspondence*

3.16 H.-J. Schulze (INFN): *Neutron Star Structure with Hyperons and Quarks*

3.23 R. A. Broglia (University of Milano): *The halo of the exotic nucleus 11Li: a single Cooper pair*

3.24 Jeff Tostevin (University of Surrey): *One- and two-nucleon knockout reactions at intermediate energies: correlations and the shell-model strengths*

2.5 Visitors (2005)

YITP Visitor Program

Yukio Nemoto
(Nagoya University, PD (COE))
2005.4.20–2005.4.22
Nuclear Physics

Atom-type Visitors

Shigeo Ohkubo
(Kochi Women's University)
2005.8.22 – 2005.9.21
Nuclear Theory

Satoshi Nagaoka
(KEK)
2005.8.29 – 2005.9.5
Astrophysics

Kazunori Takenaga
(Osaka University)
2005.12.2 – 2005.12.17;
2006.2.14 – 2006.2.28
Elementary Particle Physics

Short Visitors

Arne Hoell
(Argonne National Laboratory)
2005.4.5–2005.4.7

Andrei Frolov
(Stanford University)
2005.4.18–2005.5.2

Zsolt Dombradi
(ATOMKI, Hungary)
2005.4.21–2005.4.21

Richard J. Hill
(SLAC)
2005.4.21–2005.4.23

C.-N. Yang
(Tsinghua Univ./ SUNY YITP)
2005.4.27–2005.4.27

V. Yu. Denisov
(Institute for Nuclear Research, Kiev/JAERI)
2005.5.12–2005.5.13

Mark Alford
(Washington University)
2005.5.18–2005.5.21

Tonnis A. ter Veldhuis
(Mecalester College)
2005.5.26–2005.5.29

Alexei B. Zamolodchikov
(Montpellier University)
2005.5.31–2005.6.4

Burt A. Ovrut
(Pennsylvania University)
2005.6.6–2005.6.8

D. P. Roy
(Tata Institute of Fundamental Research)
2005.6.12–2005.6.14

Martin Blanck
(Columbia University)
2005.7.6–2005.7.14

Yao-Zhong Zhang
(University of Queensland)
2005.7.6–2005.7.13

Wen-Li Yang
(University of Queensland)
2005.7.6–2005.7.20

Patrick Dorey
(University of Durham)
2005.7.7–2005.7.14

Francesco Calogero
(University of Rome)
2005.7.15–2005.7.20

V. V. Sreedhar
(Indian Institute of Technology)
2005.7.15–2005.7.17

Giuseppe Nardulli
(University of Bari)
2005.7.16–2005.7.22

Vladimir Belinski
(National Institute for Nuclear Physics)
2005.7.25–2005.8.4

Karen Hallberg
(Instituto Balseiro and Centro Atomico Bar-

iloche)
2005.7.31–2005.8.3

Bertrand G. Giraud
(CE Saclay)
2005.8.5–2005.8.12

Shufang Su
(University of Arizona)
2005.8.7–2005.8.11

Hans-Peter Dürr
(Former director of Max-Planck Institute)
2005.8.9–2005.8.9

Adi Nusser
(Technion)
2005.8.10–2005.8.16

Harald A. Posch
(University of Vienna)
2005.9.5–2005.9.8

Terry Mart
(Universitas Indonesia)
2005.9.9–2005.9.9

S. Peng Oh
(UC Santa Barbara)
2005.9.16–2005.9.16

Joao de Providencia
(Coimbra University)
2005.9.21–2005.9.25

Masaki Shigemori
(Caltech)
2005.9.22–2005.9.23

Yoshifumi Hyakutake
(University of California)
2005.9.23–2005.10.26

Nigel Orr
(LPC-Caen)
2005.9.28–2005.9.28

Yasutaka Takanishi
(ICTP)
2005.10.1–2005.10.10

Yuri B. Suris
(TUM)
2005.10.6–2005.10.9

Helen Quinn
(SLAC)
2005.10.13–2005.10.19

Alexei A. Abrikosov
(Argonne National Laboratory)
2005.10.18–2005.10.18

Yoshihiro Aritomo
(JINR, Dubna)
2005.11.2–2005.11.2

Evgueni Kolomeitsev
(University of Minnesota)
2005.11.12–2005.11.26

Michio Hashimoto
(The University of Western Ontario)
2005.11.13–2005.11.14

Frank E. Paige
(BNL)
2005.11.20–2005.11.23

Mark Strikman
(Penn State University)
2005.11.23–2005.11.26

Yury Makeenko
(ITEP, Moscow)
2005.11.23–2005.12.6

J.-P. Blaizot
(ECT, Trento)
2005.11.27–2005.11.30

Roderich Moessner
(CNRS and Ecole Normale Superieure Paris)
2005.11.27–2005.12.7

Kensuke Yoshida
(Universita di Roma La Sapienza)
2005.12.4–2005.12.9

Sudhakar Panda
(HRI, Allahabad/KEK)
2005.12.7–2005.12.10

Daniel Baye
(ULB)
2005.12.11–2005.12.20

Karlo Penc
(RISSP)
2005.12.13–2005.12.22

Satoshi Yamaguchi
(IHES)
2005.12.18–2005.12.27

Norihiro Iizuka
(Tata Institute)
2006.1.10–2006.1.17

Frieder Lenz
(Erlangen-Nuremberg University)
2006.2.2–2006.2.5

Henryk Arodz
(Jagiellonian University)
2006.2.6–2006.2.20

Vladimir Zykov
(Technische Universitaet Berlin)
2006.2.12–2006.2.28

Vyaceslav Muchanov
(Ludwig-Maximilians-Universität München)
2006.2.25–2006.3.5

Jonathan Shock
(Institute of Theoretical Physics, Beijing)
2006.3.1–2006.3.5

H.-J. Schulze
(INFN)
2006.3.14–2006.3.19

Jeff Tostevin
(University of Surrey)
2006.3.23–2006.3.27

Chapter 3

Workshops and Conferences

3.1 International Workshops and Conferences

Since 1978, we have held a series of international physics workshops, called *Yukawa International Seminar (YKIS)* annually or bi-annually. We also support *the Nishinomiya Yukawa Memorial Project* sponsored by Nishinomiya city where the late Prof. Hideki Yukawa lived when he wrote his famous papers on the meson theory. As one of the major programs of this project, an international symposium open to public is held every year in Nishinomiya city, and its post/pre-workshop is held at YITP.

In addition to these regular annual conferences, we hold international workshops and conferences of various sizes and of durations from several days to more than one month every year.

Here, we give the list of main international workshops and conferences held in 2005.

Yukawa International Seminar (YKIS)

YKIS2005: The Next Chapter in Einstein's Legacy
27 Jun – 1 Jul. 2005, Chaired by M. Sasaki, 176 participants (46 from overseas)
Proceedings:*Prog. Theor. Phys. Suppl.* No.163 (2006).
For details, see http://ptp.ipap.jp/journal/PTPS-163.html

Nishinomiya Yukawa Symposium

Physics of Non-Equilibrium Systems: Self-Organized Structures and Dynamics Far from Equilibrium
3 – 4 Oct. 2005, Chaired by T. Ohta, 87 participants (15 from overseas)
Proceedings:*Prog. Theor. Phys. Suppl.* No.165 (2006).
For details, see http://ptp.ipap.jp/journal/PTPS-165.html

3.2 YITP Workshops, Mini-Workshops and Public Lectures

YITP workshops are one of our main activities. The aim of them is to open new research fields and stimulate nation-wide collaborations. Workshop plans can be proposed by any researcher and are selected by the Committee on Research Projects of our Institute. We also support small workshops and summer schools to educate young researchers.
In the past 5 years, we had more than 20 workshops and 1500 participants per year. The list of the workshops together with the number of participants for the last academic year is given below.
YITP organizes several Public Lectures every year for general audience and non-specialists including high-school students.

▷ 2005.4.1 — 2006.3.31

YITP-W-05-01
New developments in nuclear self-consistent mean-field theories, May 30, 2005 - Jun. 1, 2005. Organized by T. Nakatsukasa (Univ.of Tsukuba), *57 attendance* (Soryuushiron Kenkyuu 112-2)
http://wwwnucl.ph.tsukuba.ac.jp/MF05/

YITP-W-05-02
Progress in the Particle Physics 2005 - Beyond the hierarchy of the standard model, Jun. 20, 2005 - Jun. 24, 2005. Organzied by N. Okada (KEK), *82 attendance*
http://higgs.phys.kyushu-u.ac.jp/ppp05/

YITP-W-05-03
The bioligical effects of electromagnetic fields, Jul. 7, 2005 - Jul. 9, 2005. Organized by M. Murase (YITP), *97 attendance* (Bussei Kenkyuu 86-5)

YITP-W-05-04
Soft Matter as Structured Materials, Aug. 1, 2005 - Aug. 3, 2005. Organized by J. Fukuda (AIST), *118 attendance* (Bussei Kenkyuu 84-6)
http://staff.aist.go.jp/fukuda.jun-ichi/softmatter2005/

YITP-W-05-05
Summer School on Astronomy and Astrophysics 2005, Aug. 1, 2005 - Aug. 5, 2005. ,
http://th.nao.ac.jp/˜ss2005/

YITP-W-05-06
YONUPA Summer School 2005, Aug. 6, 2005 - Aug. 11, 2005. Organized by H. SAKATO, Y. NAKAMURA, N. MOROBASHI, K. MIZUYAMA, S. MATSUZAKI, H. MATSUURA, M. KIMURA, T. OHKI, K. TSUMURA, T. HATANAKA, R. SATO,

YITP-W-05-07
The 50th Summer Seminar for young researchers of condensed-matter phyisics, Aug. 7, 2005 - Aug. 11, 2005. ,

YITP-W-05-08
String Theory and Quantum Field Theory, Aug. 19, 2005 - Aug. 23, 2005. Organized by S. Sugimoto (YITP), *121 attendance* (Soryuushiron Kenkyuu 112-4)
http://www2.yukawa.kyoto-u.ac.jp/˜qft/

YITP-W-05-09
Thermal Quantum Field Theories and Their Applications, Aug. 24, 2005 - Aug. 26, 2005. Organized by H. Yabu, H. Matsumoto, S. Muroya, M. Asakawa, H. Nakagawa, Y. Tsue, H. Yokota, A. Niegawa, H. Sawayanagi, M. Tachibana, Y. Yamanaka, M. Sakagami, M. Okumura, T. Inagaki, *54 attendance* (Soryuushiron Kenkyuu 112-3)
http://www.riise.hiroshima-u.ac.jp/TQFT/

YITP-W-05-10
Tensor Correlation and many-bocy correlation in nuclei, Sep. 1, 2005 - Sep. 6, 2005. Organized by S. Sugimoto, Y. Funaki, T. Myo, M. Kimura, *42 attendance* (Soryuushiron Kenkyuu 113-6)
http://www2.yukawa.kyoto-u.ac.jp/ tensor05/

YITP-W-05-11
Formation and Evolution of Supermassive Binary Black Holes, Sep. 20, 2005 - Sep. 21, 2005. Organized by H. Hirabayashi, H. Sudou, K. Makishima, H.

Matsumoto, S. Mineshige, S. Iguchi, Y. Murata, Y. Taniguchi, *35 attendance* (Soryuushiron Kenkyuu 114-1)

YITP-W-05-12
Development of Non-Equilibrium Physics in Material and Biological Sciences, Oct. 5, 2005 - Oct. 7, 2005. Organized by T. Ohta (YITP), *151 attendance.*

YITP-W-05-13
Nanobeam 2005 (Approach to the physics of linear collider through formation of ultra-fine beam and possible its application), Oct. 17, 2005 - Oct. 21, 2005. Organized by Y. Iwashita, A. Noda, J. Urakawa, T. Tauchi, *104 attendance*
http://wwwal.kuicr.kyoto-u.ac.jp/nanobm/

YITP-W-05-14
The 6th Solar-B Science Meeting, Nov. 8, 2005 - Nov. 11, 2006. Organized by K. Shibata (Kyoto Univ.), *140 attendance*
http://www.kwasan.kyoto-u.ac.jp/solarb6/

YITP-W-05-15
Macrostructures from Microphsyics, Microphysics from Macrostructures - Theoretical Approaches to Order Formation and High Precision Computations -, Nov. 16, 2005 - Nov. 18, 2005. Organized by H. Tsunetsugu (YITP), T. Ohta, T. Kunihiro, M. Nojiri, S. Nagataki, Y. Kanada-En'yo, T. Onogi, *57 attendance*
http://www2.yukawa.kyoto-u.ac.jp/˜mscale/mscale-main.html

YITP-W-05-16
Trends of Fundamental Physics: From Einstein to Yukawa-Tomonaga, Nov. 7, 2005 - Nov. 8, 2005. Organized by T. Kunihiro, M. Sasaki, A. Sugamoto, H. Hayakawa, H. Ezawa, T. Ohta, K. Sato, Y. Kuramoto, H. Tanaka, T. Eguchi, T. Kugo, M. Bando, K. Aoki, Ken-Ichi, M. Toya, *79 attendance* (Soryuushiron Kenkyuu 112-6)
http://leo.aichi-u.ac.jp/˜bando/yukawa/yukawa.html

YITP-W-05-17
Econophysics II - Physical Approach to Social and Economical Phenomena –, Dec. 1, 2005 - Dec. 2, 2005. Organized by S. Wataru, Y. Fujiwara, H. Ietomi, H. Aoyama, *58 attendance* (Soryuushiron Kenkyuu 113-2, Bussei Kenkyuu 86-4)
http://bluegate.phys.h.kyoto-u.ac.jp/yitp05/

YITP-W-05-18
Unconventional Superconductivity in Strongly Correlated Electron Systems, Dec. 6, 2005 - Dec. 8, 2006. Organized by S. Fujimoto, *86 attendance* (Bussei Kenkyuu 86-2)
http://www.slab.phys.nagoya-u.ac.jp/sympo2005/index.html

YITP-W-05-19
Binding Mechanis and New Dynamics in Weakly Bound Systems, Dec. 12, 2005 - Dec. 14, 2005. Organized by Y. Utsuno, M. Yamagami, Y. Kanada-En'yo, E. Hiyama, K. Hagino, M. Kimura, S. Aoyama, *44 attendance* (Soryuushiron Kenkyuu 114-1)
http://www2.yukawa.kyoto-u.ac.jp/˜wbs05/

YITP-W-05-20
Statistical Physics of Single Molecular Systems: Towards Physical Understanding of Biomolecular Machines, Dec. 15, 2005 - Dec. 16, 2005. Organized by M. SASAI, S. TAKADA, N. GO, T. YANAGIDA, *86 attendance* (Bussei Kenkyuu 87-3)
http://theory.chem.sci.kobe-u.ac.jp/events/yitpseminar.php

YITP-W-05-21
Quantum Field Theories: Fundamental Problems and Applications, Dec. 19, 2005 - Dec. 23, 2005. Organized by Y. Kawamura, H. Yabu, A. Iwasaki, J. Goryo, K. Harada, K. Fujikawa, I. Tsutsui, S. Tanimura, H. Suzuki, K. Shizuya, N. Sakai A. Shimizu, R. Sasaki, T. Sakai, *160 attendance* (Soryuushiron Kenkyuu 113-1)
http://www.phys.aoyama.ac.jp/˜w3-matsu/jungoryo/qft6/index.html

YITP-W-05-22
Frontier in High Energy Astrophysics, Dec. 25, 2005 - Dec. 27, 2005. Organized by S. Nagataki (YITP), *197 attendance* (Soryuushiron Kenkyuu 113-6)
http://www2.yukawa.kyoto-u.ac.jp/˜05riron/rironkon-main.html

YITP-W-05-23

21st century COE symposium "Light and Physics", Feb. 13, 2006 - Feb. 14, 2006. Organized by Y. Takahashi, A. Onuki, K. Tanaka, K. Yoshikawa, Y. Maeno, M. Fukuma, K. Imai, F. Iwamuro, S. Sugimoto, S. Mineshige, M. Nojiri, *225 attendance* (Soryuushiron Kenkyuu 113-4).

YITP-W-05-24
Hadrons at finite density, Feb. 20, 2006 - Feb. 22, 2006. Organized by M. Harada, S. Hirenzaki, A. Hosaka, T. Hyodo, K. Itahashi, D. Jido, T. Kunihiro, N. Muramatsu, H. Shimizu, *68 atttendance* (Soryuushiron Kenkyuu 114-2)
http://www.phys.nara-wu.ac.jp/˜pnphys/nuclth/HFD06/

YITP-W-05-25
Actions and Symmetries in Lattice Gauge Theory, Feb. 13, 2006 - Feb. 24, 2006. Organized by Y. Kikukawa, H. So, S. Hashimoto, T. Onogi, *42 attendance* (Soryuushiron Kenkyuu 114-1)
http://www2.yukawa.kyoto-u.ac.jp/˜aslgt/index.html

Mini-Workshops

YITP-X-05-01
Multi-particle Integrable Systems, 19 July 2005, Organized by Ryu Sasaki (YITP).
http://www.yukawa.kyoto-u.ac.jp/contents/seminar/archive/2005/yitp-x-05-01/englishindex.html

YITP-X-05-02
Frontier Sciences Workshop–Dynamics: Frontiers in Geommetry, Analysis and Mathematical Physics, 7 October 2005, Organized by: T. Kugo, R. Sasaki, J. Scheurle.
http://www.yukawa.kyoto-u.ac.jp/contents/seminar/archive/2005/yitp-x-05-02/englishindex.html

YITP-X-05-03
Ziro Maki Memorial Symposium, 5 November 2005, Organized by: K. Aoki, Y. Igarashi, K. Ito, T. Inami, K. Inoue, T. Uematsu, R. Endo, M. Kato, T. Kugo, H. Kunitomo, M. Kenmoku, M. Kobayashi, M. Sakamoto, E. Takasugi, M. Toya, M. Nakahara, H. Hata, Z. Hioki, K. Higashijima, T. Maskawa, T. matsuyama, T. Muta, K. Yamawaki.
http://www2.yukawa.kyoto-u.ac.jp/˜endo/sympo/200511maki/index.html

YITP-X-05-04
Kansai Softmatter Union Workshop, 10 March 2006, Organized by: J. Yamamoto, T. Ohta, K. Yamada, H. Seto, T. Sakaue.
http://www2.yukawa.kyoto-u.ac.jp/˜softmat/

Public Lectures

From Car Navigation to Universe
–Present and Future of Einstein Theory–
2 July 2005, two lectures,
Title: The Origin and the Fate of the Universe,
Andrei Linde (SLAC, YITP)
Title: General Relativity and Gravitational wave,
Takashi Nakamura (Kyoto University).

17 October 2005,
Title: A Career in Physics,
Helen Quinn (SLAC).

3.3 Regional Schools supported by YITP

▷ 2005.4.1—2006.3.31

YITP-S-05-01
Hokuriku-Shinetsu Particle Physics Theory Group Meeting, Fukui-kenritsu Sabae Seinen no Ie,, 2005.5.20–22..
Invited speakers: K.Ito (Tokyo Institute of Technology), M. Yoshida (Univ. of Electro-Communications)
Participating univ.: Kanazawa Univ., Niigata Univ., Toyama Univ., Fukui Univ.

YITP-S-05-02
Niigata-Yamagata School, Yamagata-ken Iide Shonen Shizen no Ie, 2005.11.4–6..
Invited speakers: H. Suzuki (RIKEN)
Participating univ.: Niigata Univ., Yamagata Univ., Joetsu Univ. of Education, Univ. of Aizu.

YITP-S-05-03
Chubu Summer School 2005, Yamanakako Seminar House (Tokai Univ.), 2005.8.26–29..
Invited speakers: N. Ohta (Osaka Univ.)
Participating univ.: Tokai Univ., Shizuoka Univ., Shinshu Univ., Univ. of Shizuoka.

YITP-S-05-04
The 28th Shikoku-seminar, Kochi Women's Univ., 2005.12.26–27..
Invited speakers: T. Kunihiro (YITP, Kyoto Univ.)
Participating univ.: Ehime Univ., Tokushima Univ., Kochi Univ., Takamatsu National College of Technology.

YITP-S-05-05
The 19th Workshop in Hokkaido Nuclear Theory Group, Sapporo Gakuin Univ., 2006.2.10–12..
Invited speakers: K. Sagara (Kyushu Univ.), T. Nakatsukasa (Tsukuba Univ.)
Participating univ.: Hokkaido Univ., Hokusei Gakuen Univ., Wakkanai Hokusei Gakuen Univ., Sapporo Gakuin Univ.

YITP-S-05-06
Shinshu Winter School, , Ochanomizu Univ. Shiga Kogen Taiiku Undojo, 2006.3.16–19..
Invited speakers: Y. Fukui (Nagoya Univ.)
Participating univ.: Kanazawa Univ., Shinshu Univ., Kinjo College.