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INSTITUTE FOR NUCLEAR THEORY

ANNUAL REPORT #3
For the Period 1 March 1992 - 28 February 1993

Wick Haxton
George Bertsch
Ernest M. Henley

University of Washington
Seattle, Washington

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University of Washington

Institute for Nuclear Theory

158 Henderson Hall, HN-12

Annual Report #3: March 1, 1992, to February 28, 1993

DOE Grant #DE-FG06-90ER40561

The Institute for Nuclear Theory was created as a national center by the Department of Energy. It began operations March 1, 1990. This annual report summarizes the INT's activities during its third year of operations. The INT is administered by a Director, who reports within the University to the Dean of Arts and Sciences on daily INT matters, and to the Provost on matters concerning the Department of Energy, interuniversity relations, and long-term planning. The Director is advised by a National Advisory Committee (NAC) comprised of leading physicists who broadly represent the nuclear physics community.

Scientific Personnel

Wick Haxton continued as Director of the INT during the third year, and Ernest Henley, remained Associate Director while maintaining his full-time appointment in the Department of Physics. Professor Henley acted as Director for the period December 1, 1992-February 28, 1993, while Professor Haxton was on sabbatical at the University of Melbourne.

In September, 1992, George Bertsch joined the INT as its first Senior Fellow/Professor of Physics. This appointment was recommended by selection committees from the INT's National Advisory Committee and from the Physics Department, following a national search. The committee cited Professor Bertsch's breadth and creativity, his enthusiasm for theory in support of experiment, and his expertise in heavy ion physics.

During the first part of year three, the research staff consisted of one 5-year Fellow, Tetsuo Hatsuda, and four postdoctoral research associates, Steven Pollock, David Harley, Antje Höring, and Ming Xing Luo. Dr. Hatsuda received his Ph.D. in Kyoto, and served as a postdoctoral research associate at KEK, Stony Brook, and CERN (where he was a CERN Fellow). Dr. Pollock received his Ph.D. from Stanford University and was a postdoctoral fellow at NIKHEF. Dr. Harley received his Ph.D. from the University of Arizona, where he worked under the direction of Johann Rafaelski and Berndt Müller. Dr. Höring received her degree from the University of Heidelberg, where she worked with Hans Weidenmüller, and Dr. Luo earned his Ph.D. at the University of Pennsylvania under the direction of Paul Langacker.

The research interests of these five cover a wide range of topics: QCD at high density and temperature, nuclear astrophysics, electroweak interactions, muon-catalyzed fusion, statistical properties of nuclei, and radiative corrections.

In September 1992, Dr. Hatsuda moved to a tenure-track assistant professor position in the Physics Department, Dr. Harley returned to his homeland, South Africa. and Dr. Pollock returned to assume a 5-year postition at NIKHEF. (Dr. Pollock will return to

the US next September as an Assistant Professor at the University of Colorado). They were replaced by two German Humbolt Fellows, Michael Herrmann and Thomas Meißner. Dr. Herrmann received his Ph.D. from TH Darmstadt, working under the direction of Professors W. Nörenberg and B. L. Friman, while Dr. Meißner received his Ph.D. from University of Bochum, working under Professor Klaus Göke. The INT also hosted two long-term visitors in 1992 who were not directly associated with the visitor programs, Dr. John Millener (Brookhaven National Laboratory) and Dr. Kazuhiro Yabana (Niigata University, Niigata, Japan). The salary support for these visits was provided by Brookhaven and by the Nishima Memorial Foundation, Tokyo, a scientific exchange program in Japan, respectively.

In early 1993, the INT conducted searches for two 5-year Fellows, and together with the Department's nuclear physics group, for two postdoctoral research associates. Five-year offers were made to Matthias Bukardt, MIT, and to Michael Frank, CEBAF. Both work at the QCD-nuclear physics interface, with their recent work including topics such as light-cone methods, lattice QCD, and heavy quark symmetry. The two new postdoctoral appointments are Yong-Zhong Qian, a student from U. C. San Diego who worked under George Fuller, and Ubirajara Van Kolck, a Texas student who worked with Steve Weinberg. Van Kolck has worked on effective chiral Lagangian theories of nuclear structure, while Qian has worked on the supernova mechanism, r-process nucleo-synthesis, and neutrino oscillations. Van Kolck will be assigned to the Nuclear Theory Group, while Qian will be in the INT. An INT offer to a third postdoctoral candidate, Gladys Lang at Caltech, is pending; one of our continuing postdocs, Antje Höring, has been offered a permanent position in the UW Applies Physics Laboratory, and thus may vacate her present position. These five candidates (Burkardt, Frank, Van Kolck, Qian, and Lang) were our first choices among approximately 150 applicants for the 5-year Fellow and postdoctoral positions.

In the Autumn of 1992, the INT began its search for its second Senior Fellow/Professor. On the advice of the NAC, the initial area of choice is the nuclear-particle physics QCD interface. The search is being conducted with the help of NAC and Physics Department selection subcommittees.

We have taken a number of steps to build a feeling of community among the young and senior scientific staff. Tuesdays at the INT members meet together for lunch and informal physics discussions. A more formal Thursday bag lunch discussions is also held, with the nuclear theory group participating. These gatherings generally do not include the program visitors, since their intent is to keep the focus on the graduate students and postdoctoral research associates.

Administrative Personnel

At the close of the third year the support staff included the administrative head, Madhavi RajGuru, two program coordinators, Julia Malloy and Fran White, and a program assistant, Pippin Sardo. Mrs. RajGuru is in charge of all financial and administrative functions, including the processing of foreign visitors; the program coordinators monitor space and finances for INT programs, and arrange housing and other matters for our

visitors; and Ms. Sardo assists the program coordinators and Mrs. RajGuru, and takes care of visitor needs while they are in residence at the INT.

Research Efforts of the Scientific Staff

The various members of the INT's scientific staff maintain highly visible research programs. Curriculum Vitae, a list of publications and invited talks for each is given in Appendices A to J, along with a narrative description of research activities.

Some portion of the scientific work performed by INT visitors is also published under the auspices of the INT. In Appendix K we list the papers submitted during the past year.

INT Program Operations

The INT conducts three programs of three to four months duration each year. Each program focuses on some area at the forefront of nuclear physics, including interdisciplinary topics on the boundaries of nuclear physics and other fields. The programs are usually organized by outside experts, with the financial and administrative help of the INT. Programs originate from proposals submitted by interested members of the physics community. The INT's National Advisory Committee reviews the proposals and advises the Director on their timeliness and suitability. The summer program may include a two-week school for the benefit of younger participants. Once or twice a year the INT may also host short workshops, which are often scheduled during the breaks between programs. Other workshops may be held as part of programs.

During the first two years of operations members of the nuclear theory group were very active and helpful in the organization of programs. Their service as "local co-organizers" took much of the administrative burden off the external organizers. This help was particularly important during the period when the administrative staff was being appointed. Although local members of the nuclear theory group participated actively in third-year programs, their role as local co-organizers was de-emphasized as the INT scientific staff shouldered most of the burden. (Haxton helped with the organization of the Spring and Fall, 1992, programs, while Henley is helping with the organization of the Spring, 1993, program.)

Second-year Program Scientific Summaries

Appendices L, M, and N include the final report, list of participants, and list of seminars for programs 7, 8, and 9.

Program 7 (INT-92-1)
Fundamental Interactions In Nuclei
February 1, 1992 - May 31, 1992
Organizers: Barry Holstein and Wick Haxton

The 1992 spring program focused on nuclear tests of symmetries and conservation laws. A number of low-energy precision experiments are providing new information on the

parameters of the standard model and constraining possible extensions of that model. The participants were concerned with the theory issues important to the interpretation of experiments, the relevance of measurements to weak interaction models, and opportunities for exploiting nuclear and atomic systems in future experiments. Participants included nuclear, particle, and atomic theorists, as well as a number of experimentalists who described both current and planned experiments.

There were extensive discussions of parity nonconservation studies in atoms and at electron accelerators, and their relationship to high energy tests of standard model parameters. Both classes of experiment depend crucially on the precision of theory, including the accuracy of atomic structure calculations, the effects of uncertainties in neutron distributions on the nuclear weak charge distribution, techniques for evaluating radiative corrections, and various hadronic physics corrections effecting weak couplings. Nuclear tests of parity violation in hadronic systems were considered in light of recent chiral Lagrangian results on new operators associated with strange quarks. Theoretical efforts to understand the strength of parity mixing in LAMPF neutron transmission experiments were discussed extensively.

There was great interest in tests of the neutrino mass, including solar neutrino oscillations, double beta decay, and tritium endpoint measurements, and in extensions of the standard model that could permit 17 keV neutrinos, large magnetic moments, etc. The origin of CP violation remains unclear; neutron and atomic electric dipole measurements were examined from the perspective of their relative sensitivities to possible sources of CP violation. There were discussions of T-violation in beta decay and muon capture, and of T-violating P-conserving nuclear forces. Several experimentalists described searches for rare decays of kaons and muons, prompting discussions of the theoretical importance of new limits. A group of six visitors who attended almost all of the program help set the intellectual tone: Barry Holstein, Peter Herczeg, Lincoln Wolfenstein, Iosif Khriplovich, Bruce McKellar, and Jim Pantaleone.

Program 8 (INT-92-2)
Strangeness in Hadrons and Nuclei
June 8-August 31, 1991
Organizers: Carl Dover, Ben Gibson, Jerry Miller

The program focused on various themes related to the strangeness degrees of freedom in hadronic systems, with emphasis on questions such as the stability of strange quark matter and its production in relativistic heavy ion collisions, strangeness as a signature of quark-gluon plasma formation, and the production mechanisms, structure and decays of hyper nuclei.

The first part of the program brought together researchers in astrophysics and relativistic heavy ion physics for a very spirited discussion of possible quasi-stable "strangelets". As a result of these debates, a collaboration was formed to investigate the limits of stability of hyperonic matter with mean field interactions, the relation to strange quark matter, and the weak decays of such multi-strange bound states.

The second part of the program concentrated on open problems in hypernuclear production mechanisms, structure, and decays. The discussions during and after the seminars led to collaborative efforts on the development of an improved reaction code for hyper nuclear production with meson beams, weak decay modes and magnetic moments of hyper nuclei, double strangeness exchange reactions induced by kaon beams on nuclear targets, and reactions involving cascade particles in deuterium, among others.

The theoretical discussions of strangeness were tempered by occasional experimental talks, which reviewed the constraints on the existence of strangelets, and the prospects for advances in hypernuclear research with intense hadron and electron beams.

The program benefited from the presence of a significant number of students who became actively involved in the discussions and, in several instances, in collaborations.

Program 9 (INT-92-3)
Microscopic Nuclear Structure Theory
September 8, 1992 - December 18, 1992
Organizers: Bruce Barrett, James Vary, and Wick Haxton

The goal of the program on Microscopic Nuclear Structure Theory was to focus attention on the long-standing problem of accurately computing two- particle matrix elements for performing nuclear structure calculations, starting from realistic formulations of the nucleon-nucleon (N-N) interaction. The tone of the entire program was set by the workshop held 14-18 September and attended by 28 out-of-town participants plus local physicists. This workshop was completely successful in identifying the important points of interest: successes and limitations of existing N-N interactions, the failure of these N-N interactions alone to bind nuclear systems sufficiently, the status of existing shell-model technology, the problems of trying to compute the basic perturbation series for the shell-model effective interaction (now generally referred to as the Q-box), the advantage of the "no-core" model-space approach to computing the Q-box, and the extreme usefulness of the Lee-Suzuki approach for summing the folded Q-box series to all orders, so as to produce an energy-independent effective interaction. The participants came away from the workshop with well-directed enthusiasm.

This high-level of enthusiasm was maintained throughout the program, because of its large core group of 12 physicists who were present for all or nearly all of the 15 weeks of the program. We were able to assemble such a large core group, because of our long lead time of two years in organizing the program. Over the course of the program 49 out-of-town participants took part, of whom 29 were from domestic institutions and 20, from foreign institutions. Of this 49 there were 34 senior researchers (31 theorists, three experimentalists), five research associates and junior faculty and ten graduate students. The average number of participants per week was 21, with a peak of 28 during the workshop. Besides our seminar schedule (limited to not more than one per day), there was a series of tutorials by senior participants, including the organizers, to present in detail how one performs numerical calculations for determining effective interaction matrix elements.

The main thrust of the program was to seek and find solutions to the difficult remaining problems in computing the shell-model effective interaction, and the majority of the core group plus a number of the shorter-term participants concentrated on this. The principal successes were (1) the use of a "no-core" model space, in which all A nucleons are taken as active particles in a large basis space; (2) the simplification of the Q-box to being only the two-particle Brueckner reaction matrix G, because of the existence of no hole states in the no-core model space; (3) the convenience of the Lee-Suzuki approach for summing the folded Q-box series to all orders to obtain an energy-independent and basis-independent (i.e., independent of the unperturbed Hamiltonian) effective Hamiltonian, even in a one-dimensional model space; (4) the modification of the Lee-Suzuki approach to yield Hermitian effective-interaction matrix elements; and (5) the first development of the formulation for computing other effective operators, besides the interactions, in the same model space, using the Lee-Suzuki approach.

It was decided by the participants that we should have a "test problem", against which we could measure the progress of the field. This "test problem" is being formulated and will be sent to participants in the near future.

Administrative Details of Third-Year Programs

A reasonably stable mode has been established for operating the programs. After approval of a program, the organizers are asked to identify a few key participants who would provide intellectual leadership. These participants are encouraged to attend the entire program, and, if the budget permits, partial salary support may be offered to those who would have to request sabbatical leave. A longer invitation list is also compiled. The programs are advertised through Newsletters published by the INT (#4 and #5 are enclosed as Appendix O) and by the APS Division of Nuclear Physics. The INT also produces posters announcing upcoming programs (the latest #4 is enclosed as Appendix P), sending these to universities, laboratories, and institutes around the world. Finally, there is a great deal of word-of-mouth advertising carried out at professional meetings by the Director and Associate Director and by program organizers. The organizers review all responses to such advertising, and make their selections based on the qualifications of the applicants and scientific balance. Efforts are made to encourage the participation of women and minorities, younger researchers, and interested experimentalists.

The responses to all of the initial programs have been very strong. In some cases as many as 200 applications have been received for a single program. The INT has great difficulty accommodating more than 20 visitors at any one time. Because many visitors may attend for just a few weeks, typical total participation may be 45-50 scientists.

We have instituted closer controls on invitations, since one of our programs grew well past the optimal size. We strongly urge organizers to avoid paying travel support whenever possible; to limit salary support so that most of the budget can be used for nonsalaried visitors; to avoid salary support during the summer; and to adopt uniform policies for visitor support. All organizers are given a copy of the "Instructions for Organizers," an instruction manual that the INT administrative staff has compiled.

Organizers are also contacted as early as possible by the Director and by the program coordinators, so that we can reinforce the advice given in the manual. We suggest a limit of one seminar per day during programs, apart from special workshop weeks. Seminars are usually held at 10:30 in a seminar room within the Applied Physics Laboratory; on Fridays we often move the seminar to Physics in order to encourage interactions between the INT and the Department. Usually a number of the local theoreticians and experimentalists attend INT seminars.

We encourage organizers to set aside part of their budget for outside seminar speakers. This fund is particularly useful as a means of bringing experimentalists to the programs.

We encourage summer program organizers to provide a school for the benefit of younger researchers. The INT-91-2 school was held off-site at CEBAF, who cosponsored the school. A school will also be held during the program INT-93-2. Half of the support for this program is being provided by the Physics Department's Uehling Fund. Approximately 45 students have been accepted to the 1993 school.

A number of past programs have contained short workshops, periods of two days to a week where more intense discussions of certain physics topics took place. The program INT-92-3 held such a workshop, attended by approximately 30 visitors

A few of the statistics on third-year programs are given below:

Program #	Peak Attendance	Average Attendance	Total	Postdocs	Graduate Students	Women
7	19	13	42	4	6	2
8	23	17	29	3	16	2
9	26	20	49	2	8	1

We continue to encourage organizers to invite younger physicists and those from under represented groups.

One nice development is the growing number of visitors who desire to attend for an entire program. The program INT-92-3 set a new record, 12 . Such long-term visitors are certainly important, since they tend to set the tone for the program and provide a sense of continuity.

While no "stand-alone" workshops were held in 1992, several are being planned for 1993 and early 1994. Many of these involve collaborations with national laboratories and other institutions:

1. Meson Interferometry in Relativistic Heavy Ion Collisions - April 16-17, 1993 - Brookhaven National Laboratory

2. Perspectives in High Energy Strong Interaction Physics at High Energy Facilities" - August 4-11, 1993 - Fermilab

3. Relativity in Two-body and Few-body Systems - September 17-26, 1993 - CEBAF

4. Dark Matter Detection - February 13-19, 1994 - Lawrence Berkeley Laboratory (Nuclear Science Division) and the Center for Particle Astrophysics

Future Programs

Brief descriptions are given below of the programs that will be held during the INT's third year.

Program 10 (INT-93-1)
Nuclear Physics in Atoms and Molecules
February 15 - May 28, 1993

This program will examine problems in atomic and molecular physics that have relevance to nuclear theory. Historically, the first examples were the small nuclear effects on atomic spectroscopy resulting from the finite size and shape of nuclei and from nuclear moments (hyperfine structure). Internal conversion and inner-shell electron and muon capture were also early examples of dynamic nuclear processes that involve the atomic environment.

One focus of the program will be precision weak interaction measurements in atomic nuclei, including the atomic and nuclear physics issues in atomic parity violation and in measurements of nuclear anapole and electric dipole moments. The atomic physics of molecular tritium is now crucial in endpoint beta decay measurements of the electron neutrino mass: experiments are persistently yielding negative values for the square of the electron neutrino mass.

There will be discussions of electron screening of nuclear reactions as seen in atoms, molecules, and plasmas, including the many applications to astrophysics; the use of "atomic clocks" to measure nuclear lifetimes; the theory of muonic and hadronic atoms; muon-catalyzed fusion; and atomic and QED effects in nuclear collisions. The intent of the program is to gather people together who have different scientific backgrounds, but who share a common interest in interdisciplinary problems of nuclear and atomic/ molecular physics. Both established physicists and young researchers and students are encouraged to apply.

Organizers: Eugen Merzbacher, James Friar, and Berndt Müller

Program 11 (INT-93-2)
Phenomenology and Lattice QCD
June 21 - September 3, 1993

This program will focus on lattice QCD and its connections with phenomenology. Three broad areas of discussion will be:

1) Finite temperature (and density) QCD. Questions include the order and nature of the phase transition, the detailed properties of the high temperature phase, fundamental excitations, and correlation functions.

2) Hadron structure and matrix elements, including hadronic wave functions, weak decay form factors, B-parameters, structure functions, etc. As many approximate methods have been used to address these problems (e.g., bag models, sum rules, and chiral perturbation theory), the comparison with lattice results should be of great interest. We will discuss how to formulate appropriate lattice QCD tests of such methods, and how to combine them with lattice techniques to make improved predictions.

3) Heavy quarks. There has been an explosion of interest in the properties of heavy quark hadrons since the discovery of the Isgur-Wise symmetry. It remains to be seen how useful this symmetry is for the decays of B and D mesons. A crucial testing ground is the lattice, where one has the freedom to vary the heavy quark mass continuously.

The program will begin with a two-week summer school intended for students and young researchers, June 21-July 2.

Organizers: Stephen Sharpe, Gregory Kilcup, and John Negele

Program 12 (INT-93-3)
Large Amplitude Collective Motion
October 4 - December 17, 1993

Nuclei are essentially the only quantum systems where large amplitude collective motion has been observed in experiment and described by theory; however the ideas developed in nuclear physics are now being applied to other areas, including cluster physics and chemical reactions. The program will focus on the unsolved issues of defining collective variables and constructing the collective Hamiltonian, including nonadiabatic effects and other poorly understood corrections. The role of noncollective degrees of freedom, dissipation and friction, the onset of chaotic motion, and the interaction between collective and noncollective degrees of freedom will be discussed.

The program will bring together experts who approach LACM from very different perspectives. The methods include adiabatic time-dependent Hartree-Fock theory, generator coordinate methods, the cranking model, coherent states, collective liquid drop descriptions with and without shell corrections, adiabatic dissipative dynamics, stochastic approaches, effective gauge fields and fractional quantum numbers, boson expansion methods, path integral techniques, etc. The range of physical phenomena is equally impressive: collective motion, rotation and large amplitude vibrations, fission, superdeformation, heavy ion collisions, and the temperature dependence of nuclear properties. The program will be concerned with both the formal issues that arise in LACM and practical issues, such as developing tractable numerical techniques.

Organizers: Aurel Bulgac and George Bertsch

Program for 1994

The following programs were approved for 1994 by the NAC at their August 22, 1992, meeting :

INT-94-1 - Solar Neutrinos and Neutrino Astrophysics - February 22 to May 31, 1994
Organizers: Baha Balantekin and Eugene Beier

INT-94-2 - Applications of Chaos in Many-Body Quantum Physics
Organizers: Steven Tomsovic, Eric Heller, and Hans Weidenmüller

INT-94-3 - Hot and Dense Nuclear Matter - September 12 to December 10, 1994
Organizers: Jørgen Randrup, George Bertsch, and Ulrich Mosel

Office Space and Equipment

The INT is temporarily housed in 15 fairly new offices in the Applied Physics Annex on the first floor of Henderson Hall. One office is used for coffee, mail, xeroxing, and impromptu discussions, and three others are occupied by the administrative staff. The remainder are available to the visitors and the INT scientific staff. Each office has two or three desks.

Space remains a limiting factor for our operations, so the staff carefully monitors programs with the goal of avoiding large peaks in attendance. Another shortcoming of our current accommodations is the absence of a nearby technical library: the Physics Library is located about three blocks away. We have compensated for this, in part, by bringing collections of Physical Review Letters, Physical Review C and D, Physics Letters B, Annals of Physics (NY), and Reviews of Modern Physics to the INT. (One of the larger rooms serves as both a visitor office and the INT "library.")

Work on the new Physics building is well advanced and remains close to schedule. We hope to move to our new quarters in the fourth floor of the Physics tower in summer, 1994.

During the second year of operations the INT acquired a UNIX-based computing system consisting of three DECstation 5000's and associated X-terminals and a few Visual terminals. The workstation monitors are available to visitors, as are two Macintosh SE/30s. Approximately 5Gb of disk storage is available. The Nuclear Theory group continues to make available one VaxStation for visitors who prefer VMS. Typical uses of the computing system range from Email and TEX, to large-scale number crunching and graphics. The University continues to make time available on its IBM 3090/Vector Facility, but only one visitor has made use of this resource. Similarly, visitors have access to the Livermore Crays through the MFE Computer Center grant to the Nuclear Theory group. (A small part of the annual request is specifically for the INT.)

Murdock Trust Support

A starting grant of $276,000 was provided by the Murdock Charitable Trust to help the INT to a fast start during its first 2 1/2 years. These funds allowed us to accommodate many more long-term program visitors than otherwise would have been possible. In recognition of this support, in each program 4-6 outstanding physicists visiting INT are named "Murdock Fellows". A list of those named Murdock Fellows for Programs 1 thorugh 10 is given in Appendix Q. This start-up grant is now exhausted.

Relations to the University and to the Community

The Director and Associate Director, with considerable help from the chairman of the NAC (Steve Koonin) and the Director of the Division of Nuclear Physics of the DOE (Dave Hendrie), renegotiated the reporting scheme for the INT shortly after the new Director was chosen. Previously the INT was considered part of the Physics Department, and thus reported through the Department Chair to the Dean of Arts and Sciences. The INT is now established as a "super Department" in the eyes of University administration. The Director reports on day-to-day matters to Dean of Arts and Sciences, but on matters concerning the Department of Energy, interuniversity or inter laboratory relations, or new initiatives, he reports to the Provost. Included in the new agreement is a provision returning a department's share of indirect costs directly to the INT. The INT will continue to make joint 5-year Fellow/Assistant Professor appointments with the Department of Physics, and Physics must ratify INT tenure decisions (since it is the seat of tenure). The new reporting scheme allows the INT greater independence in personnel and financial matters.

The primary vehicle for interactions with the physics community continues to be the INT Affiliates. The list of interested colleagues now numbers well over 1,000. Newsletters are sent twice yearly to each Affiliate, informing him/her about new programs and old, and other INT matters of interest.

The INT continues to have a special relationship with US National Laboratories and with TRIUMF. After the INT was formed, these laboratories were contacted and asked to become "supporters," in the sense that they would send their staff members to participate in INT programs at no salary cost to the INT. All laboratories responded positively. This has been an enormous financial and intellectual help to the INT, allowing us to significantly enlarge our programs.

The NAC remains the INT's strongest tie to the community. It meets once each year to advise the Director on administrative matters, on program and workshop selection, and on external organizers for the programs. The meetings are scheduled in August. Once an initial rotation is established, NAC members will serve three-year terms. New members are selected by the NAC, with the concurrence of the Director of the Division of Nuclear Physics of the DOE. The membership lists for 1992 and 1993 are enclosed as Appendix R and S. John Negele, MIT, succeeded Steve Koonin, Caltech, as chair of the NAC at

the August 22, 1992, meeting. The NAC strives to remain broadly representative of the nuclear physics community. The NAC is currently involved in the search of the second Senior Fellow/Professor.

Enclosures: Appendices A to S

WCH:mkr

University of Washington
Institute for Nuclear Theory
158 Henderson Hall, HN-12
Seattle, WA 98195

List of Appendices to Annual Report #3

A. Wick Haxton CV, Publications, & Invited Talks

B. Ernest Henley CV, Publications, & Invited Talks

C. George Bertsch CV, Publications, & Invited Talks

D. Tetsuo Hatsuda CV, Publications, & Invited Talks

E. David Harley CV, Publications, & Invited Talks

F. Antje Hoering CV, Publications, & Invited Talks

G Mingxing Luo CV, Publications, & Invited Talks

H. Steven Pollock CV, Publications, & Invited Talks

I. Michael Herrmann CV, Publications, & Invited Talks

J. Thomas Meißner CV, Publications, & Invited Talks

K. List of INT Publications

L. Program 7: Scientific Summary, Participants, & Seminars

M. Program 8: Scientific Summary, Participants, & Seminars

N. Program 9: Scientific Summary, Participants, & Seminars

O. INT Poster #4

P. Newsletter #4 & #5 (removed)

Q. Murdock Fellows

R. NAC Members (1992)

S. NAC Members (1993)

VITA

Haxton, Wick C.

[redacted]

Citizenship: U. S.

[redacted]

Telephone: (206) 545-2397
Home Address: 4910 N.E. 180th St., Seattle, WA 98155
Telephone (206) 367-4547
Marital Status: Married Laura K. Haxton
Children: Daniel James and Thomas Kirk

Education:

University of California, Santa Cruz, 1967-71
National Merit Scholar, 1967-71
B.S. in Physics with highest honors, 1971
B.S. in Mathematics with highest honors, 1971
College honors, 1971

Stanford University, 1971-75
Thesis: Semileptonic Weak Interactions in Complex Nuclei
Thesis Advisor: T.W. Donnelly

Professional Employment:

Postdoctoral Research Associate, Institut für Kernphysik
der Universität Mainz, October 1975-January 1977
Postdoctoral Staff Member, Los Alamos Scientific Laboratory,
February 1977-June 1979
J.R. Oppenheimer Fellow, Los Alamos Scientific Laboratory
July 1979-June 1983 (on leave 8/80-8/81)
Assistant Professor of Physics, Purdue University, August 1980-
December 1982 (on leave 8/81-12/82)
Staff Member, Theory Division, Los Alamos National Laboratory
Los Alamos, New Mexico, July 1983-September 1985
Associate Professor of Physics, University of Washington, 1984-87
Professor of Physics, University of Washington, 1987-
Associate Director, National Institute for Nuclear Theory (INT), 3/90-9/91
Director, INT, 9/91-

Research Interests:

Weak interactions with nuclei and tests of conservation laws
(parity violation, lepton number conservation and double
beta decay, muon number conservation, time reversal invariance, etc.)
Electromagnetic interactions with nuclei
Neutrino physics
Nuclear astrophysics, solar neutrinos
Many-body techniques in nuclear, atomic, and condensed matter physics

Professional Activities:

Member:
APS (Fellow), AAAS (Fellow)
Vice-chairman/Chairman-elect DNP, 1991-92
Councillor-at-large, APS, 1991-95
Division of Nuclear Physics Committees:
- Executive Committee, 1989-present
- Bonner Prize Committee, 1987-88
- Nuclear Science Resources Committee, 1987-present
- Physics News 1988 and 1991 (chair) Committees
- Program Committee, 1982-84
- Nominations Committee, 1989

Member-at-large, Section Committee (Physics) AAAS, 1990-94
NSAC Theory Subcommittee, 1987-88
NSF Theoretical Physics Review Committee, 1987
Panel Member, Theory/Lab Astrophysics, Astronomy and Astrophysics Survey, 1990-
Theoretical Division External Advisory committee, Los Alamos, 1987-present
Physics Advisory committee, Los Alamos Meson Physics Facility, 1984-87; Chairman, Neutrino Subcommittee, 1986; Chairman, Electroweak Committee, 1987
Board of Directors, LAMPF, 1988-1990
Advisory Committee, TUNL, 1987-present
Advisory Committee, IUCF and Indiana University Nuclear Theory Group, 1988-present
NSERC Advisory Committee, Sudbury Neutrino Observatory
Organizing Committee, National Summer School in Nuclear Physics, 1987-present
MSU Superconducting Cyclotron Laboratory Physics Advisory Committee, 1992-present
Editorial Board, Modern Physics Letters A, 1986-1991
Journal of Modern Physics A, 1987-1991
US Managing Editor, Reports on Nuclear Physics (Int. Journal Modern Physics E)
NSERC Grant Selection Committee, 1989-1991
Advisory Committe, *Physics Today*, 1991-
Advisory Board, Institute for Theoretical Physics (Santa Barbara), 1993-
NSF Physics Division Young Investigator Panel (Chair), 1993

Chairman: Organizing Committee of the Workshop on Science Underground, September 27-October 1, 1982, Los Alamos National Laboratory Study Center

Co-Director: University of Washington Summer Institutes on *Nuclear Astrophysics*, July 15-August 9, 1985; on *Symmetries and Weak Interactions*, July 10-August 4, 1989; *Summer School in Nuclear Theory*, University of California, Santa Cruz, Aug. 5-17, 1990; Institute for Nuclear Theory programs on *Nuclear Astrophysics* (Summer, 1990), *Electron Scattering and Few-Body Systems* (Winter/Spring, 1991), and *Symmetries in Nuclei* (Spring, 1992).

Research Visits

Visiting Scientist, Inst. Theoretical Physics, Santa Barbara, Summer, 1982
Visiting Scientist, Dept. of Physics, Princeton University, Fall Semester, 1983
Visiting Scientist, Dept. of Physics, University of Melbourne, 12/1/92-2/28/93

1. "Semileptonic Weak and Electromagnetic Interactions in the Goldhaber-Teller Model," Nucl. Phys. A251, 353 (1975) (with T.W. Donnelly and J. Dubach).

2. "Absorption and Defocusing of Electromagnetic Radiation by a Schwarzschild Black Hole," Ann. Phys. 95, 1 (1975) (with Remo Ruffini).

3. "Solar Neutrino-Induced Reactions," Phys. Lett. 66B, 123 (1977) (with T.W. Donnelly).

4. "Neutrino Reactions in the Mass-37 System," Nucl. Phys. A287, 506 (1977) (with T.W. Donnelly).

5. "Threshold Electroproduction of Charged Pions from Light Nuclei," Phys. Rev. Lett. 38, 742 (1977) (with F. Borkowski *et al.*).

6. "Threshold Pion Photoproduction in ^{12}C and the 15.11 MeV M1 Form Factor," Phys. Lett. 76B, 165 (1978).

7. "Threshold Pion Electroproduction and the Nuclear Response Surface," Nucl. Phys. A306, 429 (1978).

8. "Nuclear Structure and (e,e'): The Significance of High Momentum Transfer Data and Meson Exchange Currents," Phys. Rev. Lett. 41, 1453 (1978) (with J.F. Dubach).

9. "Multipole Operators in Semi-Leptonic Weak and Electromagnetic Interactions with Nuclei: Harmonic Oscillator Single-Particle Matrix Elements," Atomic Data and Nuclear Data Tables 23, 103 (1979) (with T.W. Donnelly).

10. "Electron Scattering, Isospin Mixing, and the Structure of the 12.71 and 15.11 MeV Levels in ^{12}C," Phys. Rev. Lett. 43, 1922 (1979) (with J. Flanz *et al.*).

11. "Pion Photoproduction and the Optical Potential," Phys. Lett. 92B, 37 (1980).

12. "The Heavy Quark-Antiquark Potential in the MIT Bag Model," Phys. Rev. D 22, 1198 (1980) (with Leon Heller).

13. "Solar Neutrino Production of Long-lived Isotopes and Secular Variations in the Sun," Science 210, 897 (1980) (with G. Cowan).

14. "Low Energy Angular Distributions for the ^{12}C$(e,\pi^+)e'$ Reaction," Phys. Rev. C 23, 1293 (1981) (with R.M. Sealock, H.S. Caplan and G.J. Lolos).

15. "Multipole Operators in Semileptonic Weak and Electromagnetic Interactions with Nuclei: II. General Single-Particle Matrix Elements," Atomic Data and Nuclear Data Tables 25, 1 (1980) (with T.W. Donnelly).

16. "Parity Nonconservation in ^{18}F, ^{19}F, and ^{21}Ne," Phys. Rev. Lett. 45, 1677 (1980) (with B.F. Gibson and E.M. Henley).

17. "Parity Nonconservation in ^{18}F and Meson Exchange Current Contributions to the Axial Charge Operator," Phys. Rev. Lett. 46, 698 (1981).

18. "The Solar Neutrino Capture Cross Section for ^{81}Br," Nucl. Phys. A367, 517 (1981).

19. "Double Beta Decay and the Majorana Mass of the Electron Neutrino," Phys. Rev. Lett. 47, 153 (1981) (with G.J. Stephenson Jr. and D. Strottman).

20. "The Solar Neutrino Production of ^{97}Tc and ^{98}Tc," Science 216, 51 (1982) (with G.A. Cowan).

21. "Lepton Number Conservation and the Double Beta Decay of ^{128}Te and ^{130}Te," Phys. Rev. D 25, 2360 (1982) (with G.J. Stephenson Jr. and D. Strottman).

22. "Double Beta Decay and Lepton Number Conservation," Physics News in 1981 (with G.J. Stephenson Jr. and D. Strottman).

23. "Solar Variability, Glacial Epochs, and the Solar Neutrino Flux," Los Alamos Science 3, No. 2, 46 (1982) (with G.A. Cowan).

24. "Gamow-Teller Strength Functions and Neutrino Problems," in *Spin Excitations in Nuclei*, ed. F. Petrovich *et al.*, pg. 605-626 (1982).

25. "A Proposed Geological Solar Neutrino Flux Measurement," in the Proc. of the 1982 Summer Workshop on Proton Decay Experiments, Argonne National Laboratory, June, 1982 (with G.A. Cowan).

26. "A Proposed Geological Solar Neutrino Measurement," in *Science Underground*, ed. M.M. Nieto *et al.*, pg. 105-108 (1982) (with G.A. Cowan).

27. "Higgs Exchange Mechanisms in Double Beta Decay," Phys. Rev. D 26, 1805 (1982) (with S.P. Rosen and G.J. Stephenson, Jr.).

28. "Double Beta Decay," Comments in Nuclear and Particle Physics 11, 41 (1983).

29. "Double Beta Decay," in the McGraw-Hill 1984 Yearbook of Science and Technology.

30. "The Beta Decays of ^{18}Ne and ^{19}Ne and their Relation to Parity Mixing in ^{18}F and ^{19}F," Phys. Rev. C 27, 2833 (1983) (with E.G. Adelberger, M.M. Hindi, C.D. Hoyle, and R.D. Von Lintig).

31. "Enhanced T-Nonconserving Nuclear Moments," Phys. Rev. Lett. 51, 1937 (1983) (with E.M. Henley).

32. "A Radiochemical Test of Double Beta Decay," Phys. Rev. C 28, 467 (1983) (with G.A. Cowan and M. Goldhaber).

33. "Neutrino Masses, Right-handed Currents, and Double Beta Decay," in *Progress at LAMPF 1983* (with G.J. Stephenson, Jr.).

34. "A Comment on Nilsson-Pairing Model for Double Beta Decay ," Phys. Rev. C 28, 458 (1983) (with G.J. Stephenson, Jr.).

35. "Neutron and Proton Transition Matrix Elements for ^{90}Zr from a Microscopic Analysis of 0.8 GeV Proton Inelastic Scattering," Phys. Rev. C 28, 294 (1983) (with M.M. Gazzaly et al.).

36. "Double Beta Decay: Theory," in *Resonance Ionization Spectroscopy 1984*, ed. G.S. Hurst and M.G. Payne, pg. 269-278.

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41. "Solar Neutrinos: Prospects for Detection and Implications," in *Neutrino '84*, ed. K. Kleinknecht and E.A. Paschos, pg. 214-228 (1984).

42. "New Developments in the Theory of Double Beta Decay," in *Neutrino '84*, ed. K. Kleinknecht and E.A. Paschos, pg. 130-144.

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45. "Current Conservation and the Transverse Electric Multipole Field," Phys. Rev. C 31, 2027 (1985) (with J.L. Friar).

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49. "Atomic Effects and Heavy Neutrino Emission in Beta Decay," Phys. Rev. Lett. 55, 807 (1985).

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56. "Nuclear Physics Issues in Double Beta Decay," in *Nuclear Beta Decays and Neutrinos*, ed. T. Kotani, H. Ejiri, and E. Takasugi, pg. 225-236 (1987).

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61. "Nuclear Structure Aspects of T Invariance Tests," in *Tests of Time Reversal Invariance in Neutron Physics*, ed. N.R. Roberson, C.R. Gould, and J.D. Bowman (World Scientific, 1987), p. 108.

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70. "Neutrino-Induced r-process Nucleosynthesis," Phys. Rev. Lett. 61, 2038 (1988) (with R. Epstein and S. Colgate).

71. "Contribution of the Axial Charge Operator in 2ν Double Beta Decay," in *Intersections between Particle and Nuclear Physics*, ed. G.M. Bunce (AIP Conf. Proc. 176, 1988), p. 924 (with A.G. Williams).

72. "Neutral Currents, Supernovae Neutrinos, and Nucleosynthesis," in *Contemporary Topics in Nuclear Structure Physics*, ed. R. F. Casten *et al.*, pp. 41-54 (1988).

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83. "Neutrino Disintegration of Deuterium," in *Weak and Electromagnetic Interactions in Nuclei*, ed. P. Depommier (Editions Frontières, 1990), p. 715 (with S. Ying and E.M. Henley).

84. "Parity Nonconservation and Nuclear Polarizabilities," in *Parity Violation in Electron Scattering*, ed. E.J. Beise and R.D. McKeown (World Scientific, Singapore, 1990), p. 182.

85. "A Proposed Neutrino Monitor of Long-Term Solar Burning," Phys. Rev. Lett. 65, 809 (1990).

86. "Weak Interaction Rates in ^{16}O," Phys. Rev. Lett. 65, 1325 (1990) (with C. Johnson).

87. "The Neutrino Process in Supernovae," in *Physics News in 1990* (AIP, New York, 1990), p. 55.

88. "Supernova Neutrinos, Giant Resonances, and Nucleosynthesis," Nucl. Phys. A522, 325 (1991).

89. "Neutrino Induced Light Element Synthesis," to be published in *Nuclei in the Cosmos*, ed. H. Oberhummer (MPI Munich, 1990) (with D. Hartmann, G. Mathews, T.A. Weaver, and S.E. Woosley).

90. "Neutrino-Induced Nucleosynthesis in Core-Collapse Supernovae," Nucl. Phys. A527, 663c (1991) (with D.H. Hartmann, R.D. Hoffman, and S.E. Woosley).

91. "Neutrino-Nucleus Interactions in Core-Collapse Supernovae," Ap. J. 376, 678 (1991) (with S.W. Bruenn).

92. "Solar Weak Currents, Neutrino Oscillations, and Time Variations," Phys. Rev. D 43, 2484 (1991) (with W.-M. Zhang).

93. "Red Giant Evolution, Metallicity, and New Bounds on Hadronic Axions," Phys. Rev. Lett. 66, 2557 (1991) (with K.Y. Lee).

94. "Solar and Supernova Neutrino Interactions," in *Trends in Astroparticle Physics*" ed. D. Cline and R. Peccei (World Scientific, Singapore, 1992), p. 483.

95. "Long-term Neutrino Flux Integrations," in *Trends in Astroparticle Physics*, ed. D. Cline and R. Peccei (World Scientific, Singapore, 1992), p. 369.

96. "The Neutrino Process and Neutrino R-Process," Proc. Workshop on *Unstable Nuclei in Astrophysics*, Tokyo, June 1991.

97. "Double Beta Decay Mass Constraints on 17 keV Neutrinos," Phys. Rev. Lett. 67, 2431 (1991).

98. "A 17 keV Neutrino?", in *Physics News 1991* (AIP, New York, 1991).

99. "Charged and Neutral Current Solar Neutrino Cross Sections for Heavy-Water Cerenkov Detectors," Phys. Rev. C 45, 1982 (1992) (with S. Ying and E.M. Henley).

100. "Solar Neutrinos: Theoretical Status," in *Current Topics in Astrofundamental Physics*, eds. N. Sanchez and A. Zichichi (World Scientific, 1992), p. 537.

101. "Solar Neutrinos: Theory vs. Experiment," in *TAUP '91*, eds. A. Morales, J. Morales and J.A. Villar (North-Holland, 1992), p. 88.

102. "Stellar Neutrinos," Proceedings *Benjamin Franklin Symposium in Celebration of the Discovery of the Neutrino*, Philadelphia, PA, April 29-May 1, 1992.

103. "Shape Coexistence, Polarizabilities, and Large-Basis Shell-Model Techniques," Proceedings Intl. Conf. on *Nuclear Structure at High Angular Momentum*, Ottawa, May 1992.

104. "Double Beta Decay: Comparison of Theory to Experiment," Proceedings XV Intl. Conf. on *Neutrino Physics and Astrophysics (NEUTRINO '92)*, Granada, Andalucía, Spain, June 1992.

105. "Nuclear Astrophysics," Proc. Intl. Nucl. Phys. Conf., Wiesbaden, July, 1992.

106. "Effective Summation over Intermediate States in Double-Beta Decay," Phys. Rev. C 46, R2153 (1992) (with J. Engel and P. Vogel).

107. "The Fractional Quantum Hall Effect and the Rotation Group," to be published in Proc. *Symmetries in Science VI*, Austria, August 1992 (with J. Ginocchio).

108. "Time-Reversal-Noninvariant, Parity-Conserving Nuclear Interactions," submitted to Nucl. Phys. A (with A. Höring).

109. "Accelerator Calibration of Solar Neutrino Detectors," submitted to Phys. Lett. B (with E.G. Adelberger, L. DeBraeckeleer, and K.A. Snover).

110. "Calibration of the Iodine Solar Neutrino Detector with an Electron Neutrino Beam," Proc. 22nd Int. Conf. Cosmic Ray Physics, 1993 (with B.T. Cleveland et al.).

Unpublished Reports

1. "Theory of Pion Electroproduction," LA-UR-77-1687.

2. "Massive Neutrinos, Oscillations, and Possible Applications of 100 Atom Techniques in Nuclear Chemistry," LA-UR-80-1907.

3. "Science Underground," LA-UR-82-3601.

4. "Proposal to the Department of Energy for a Gallium Solar Neutrino Experiment," LA-UR-85-3820.

5. "Gravity, Spin, and Atomic Physics," LA-UR-85-1575 (with E. Fischbach and M. Haugan), honorable mention in the 1985 Gravity Research Foundation competition.

Books

1. "Science Underground," AIP Conference Proceedings No. 96, 1983 (ed. by M.M. Nieto, W.C. Haxton, C.M. Hoffman, E.W. Kolb, V.D. Sandberg, and J.W. Toevs).

Talks presented: 1987 to present

93. "New Developments in the Solar Neutrino Problem," invited talk, San Francisco APS meeting, January, 1987
94. "Oscillations of Solar Neutrinos," Univ. of California, Santa Cruz, January, 1987
95. "Nuclear Tests of Time Reversal Invariance," invited talk, Workshop on *Time Reversal Tests with Neutrons*, North Carolina, April, 1987
96. "Nuclear Tests of Time Reversal Invariance," Physics Division, NSF, March, 1987
97. "Analytic Treatments of Matter-Enhanced Solar Neutrino Oscillations," invited talk, Workshop on *Solar and Supernovae Neutrinos*, Santa Barbara, May, 1987
98. "Parity Nonconservation," Yale University, May, 1987
99. "Nuclear Tests of Parity Nonconservation," invited talk, Workshop on Parity Nonconservation, Vancouver, BC, May, 1987
100. "The Nuclear Response of Water Cerenkov Detectors to Supernova and Solar Neutrinos," invited talk, Rochester workshop on Nonaccelerator Physics, June, 1987
101. "Nuclear Tests of Symmetries," Georgetown National Summer School Lectures, June, 1987
102. "Fundamental Physics with Nuclei," invited talk, Symposium in Honor of D.A. Bromley, Yale University, August, 1987
103. "Theoretical Issues in Neutrino Physics," invited talk, American Chemical Society Meeting, New Orleans, August, 1987
104. Lecture series, TUNL/Duke University, October, 1987:
"Matter Enhanced Oscillations and the Solar Neutrino Puzzle"
"The Galactic Neutrino Flux and SN1987A"
"Double Beta Decay"
"Parity Nonconservation in the NN System"
"Nuclear Tests of Time Reversal Violation"
105. "The Detection of Solar and Galactic Neutrinos," Princeton University, November, 1987
106. "Symmetry Tests in Nuclei," Caltech, February, 1988
107. "Neutrino Reheating in Stellar Collapse," Ohio State, March, 1988
108. "Supernova Neutrinos," University of Wisconsin, March, 1988
109. "Double Beta Decay," University of Wisconsin, March, 1988
110. "The Origin of Fluorine and Other Supernova Stories," Lawrence Berkeley, April, 1988
111. "Theoretical Issues in Double Beta Decay," invited talk, Baltimore APS meeting, April, 1988
112. "Electric Dipole and Anapole Moments of Nuclei and Atoms," Institute for Theoretical Physics, Santa Barbara, May, 1988

113. "Neutrino Opacity in Stellar Collapse," invited talk, International Conference on *Contemporary Topics in Nuclear Structure Physics*, Cocoyoc, Mexico, June, 1988

114. "Summary Talk: Spin and Symmetries," invited talk, International Conference on *High Energy Spin Physics*, Minneapolis, September, 1988

115. "The Origin of ^{19}F and other Supernova Stories," Princeton University, November, 1988

116. "Neutrino Physics in Collapsing Stars," University of Virginia, December, 1988

117. "The Origin of ^{19}F and other Supernova Stories," Michigan State University, January, 1989

118. "The Origin of ^{19}F and other Supernova Stores," TRIUMF, February, 1989

119. "Neutrino Reheating and Nucleosynthesis in Supernovae," invited talk, UCLA Workshop on the Next Supernova, February, 1989

120. "Nuclear Physics of Supernovae," colloquium, Oregon State University, February, 1989

121. "Nuclear Physics of Supernovae," colloquium, University of Oregon, February, 1989

122. "Particle Properties, New Particles, and Anomalous Phenomena," provocateur's talk, Town Meeting on Electroweak Interactions and Astrophysics, Santa Fe, April, 1989

123. "Double Beta Decay," Lawrence Berkeley Laboratory, May, 1989

124. "Neutrino-induced Nucleosynthesis in Supernovae," Department of Physics, University of California, Berkeley, May, 1989

125. "The Nuclear Physics of Stars," invited talk, K1200 Inauguration, Michigan State University, May, 1989

126. "Neutrino Astrophysics and the Shell Model," invited talk, Argonne Symposium on the 40th Anniversary of the Shell Model, May, 1989

127. "Parity Violation in the NN Interaction," invited talk, TRIUMF Symposium on Spin and Symmetries, June, 1989

128. "Nuclear Astrophysics and Electroweak Physics in the 1990's," invited talk, Asilomar APS meeting, October, 1989

129. "Lanczos Algorithm Hamiltonian and Green's Function Techniques," invited talk, Livermore Shell Model Symposium, October, 1989

130. "Neutrino Process Synthesis of Light Elements," colloquium, University of Chicago, November, 1989

131. "Long-Term Neutrino Monitors of Solar Behavior," Fermi Lab, November, 1989

132. "The Solar Neutrino Problem and Double Beta Decay: Theory Summary," invited talk, Berkeley Symposium on Dark Matter/Low-Activity Counting, December, 1989

133. "Neutrino Nucleosynthesis in Core-Collapse Supernovae," colloquium, Stanford University, January, 1990

134. "Parity Nonconservation and Nuclear Polarizabilities," invited talk, Workshop on Parity Violation in Electron Scattering, Caltech, February, 1990

135. "The Neutrino Process," colloquium, University of South Carolina, March, 1990

136. "The Neutrino Process," invited talk, Hollifield Theory Users Group, Oak Ridge National Lab., March, 1990

137. "Nuclear Physics in the 1990's," invited talk, Pacific Northwest Association of College Physics Professors, University of Oregon, April, 1990

138. "CP, P, and T Tests in Atoms and Nuclei," invited talk, Washington APS meeting, April, 1990

139. "Supernova Neutrinos, Giant Resonances, and Nucleosynthesis," invited talk, Symposium in Honor of Akito Arima, Santa Fe, May, 1990

140. "Neutrino-induced Nucleosynthesis in Core-Collapse Supernovae," invited talk, PANIC '90, Boston, June, 1990

141. "Neutrino Tests of Solar Variability," colloquium, University of Texas, September, 1990

142. "The Solar Neutrino Problem: Theoretical Status," invited talk, Southeastern APS Sectional meeting/SSC meeting, Atlanta, October, 1990

143. "Weak Current Effects in the MSW Mechanism," invited talk, UCLA Workshop on the Next Supernova, November, 1990

144. "Long-time Integrations of the Solar Neutrino Flux," invited talk, UCLA Conference on Particle Astrophysics, November, 1990

145. "Neutrino-Nucleus Interactions: Theory Overview," invited talk, LAMPF Neutrino Physics Workshop, January, 1991

146. "Oscillations of Solar Neutrinos," Texas A&M, April, 1991

147. "Supernova Neutrino Physics," colloquium, Florida State University, April, 1991

148. "Oscillations of Solar Neutrinos," colloquium, MIT, April, 1991

149. "Weak Interactions and Astrophysics," 10 lectures, Tokyo Metropolitan University, June, 1991

150. "The Neutrino Process and Neutrino r-process," invited talk, Workshop on Unstable Nuclei in Astrophysics, Tokyo, Japan, June, 1991

151. "Neutrinos: Theory," invited talk, American Chemical Society Meeting, New York, August, 1991

152. "Solar and Supernova Neutrinos," invited talk, School on Astrofundamental Physics, Erice (Sicily), August, 1991

153. "Theory Overview: Solar Neutrinos," invited talk, Workshop on Theoretical Aspects of Underground Physics, Toledo, Spain, September, 1991

154. "Oscillations of Solar Neutrinos," Colloquium, University of California, San Diego, October, 1991

155. "Red Giant Evolution, Metallicity, and New Constraints on Axions," APS meeting, Michigan State University, October, 1991
156. "Constraints on T-Violating, P-Conserving NN Forces," APS meeting, Michigan State University, October, 1991
157. "Solar Neutrinos," invited talk, AAPT meeting, Michigan State University, October, 1991
158. "Neutrino Physics in Supernovae," University Lecture, University of Wisconsin, November, 1991
159. "Oscillations of Solar Neutrinos," colloquium, University of British Columbia, December, 1991
160. "Neutrino Physics of Core-Collapse Supernovae," colloquium. Physics Division, Argonne National Laboratory, February, 1992
161. "The Neutrino from Hell and Related Stories," colloquium, University of California, Santa Cruz, February, 1992
162. "Neutrino Oscillations and the Solar Neutrino Problem," colloquium, Iowa State University, April, 1992
163. "The Neutrino from Hell and Related Stories," Iowa State University, April, 1992
164. "Double Beta Decay," colloquium, Washington University, April, 1992
165. "Stellar Neutrinos," invited talk, Benjamin Franklin Symposium, Philadelphia, April, 1992
166. "Shape Coexistence, Polarizabilities, and Large-Basis Shell-Model Techniques," invited talk, Int. Conf. on Nuclear Structure at High Angular Momentum, Ottawa, May, 1992
167. "Double Beta Decay: Comparison of Theory to Experiment," invited talk, Neutrino '92, Granada, Spain, June, 1992
168. "Neutrino Astrophysics," invited talk, Int. Nuclear Physics Conference, Wiesbaden, July, 1992.
169. "Neutrino Astrophysics," lecture series, TRIUMF Summer School, July, 1992.
170. "Kaon Regeneration by Density Gradients," University of Melbourne, January, 1993.
171. "Nuclear Astrophysics," lecture series, Victor Harbor Summer School, Australia, February, 1993.
172. "The Oscillations of Solar Neutrinos," colloquium, University of Oregon, April, 1993.
173. "A Strategy for Calibrating the ^{127}I Solar Neutrino Detector," invited talk, Workshop on (p,n) Calibrations and Solar Neutrino Detectors, University of Pennsylvania, April, 1993.
174. "The Solar Neutrino Puzzle and Neutrino Oscillations," Natural Science Association colloquium, University of Pennsylvania, April, 1993.
175. "Solar Neutrino Oscillations," invited talk, International Symposium on Nuclear Structure Physics Today, Taiwan, May, 1993.

176. "Density Fluctuations and Neutrino Oscillations," Caltech, May, 1993.

177. "The Neutrino Process," invited talk, Symposium on Weak Interactions, Nuclear Astrophysics, and Cosmology, in Honor of Sam Austin, Michigan State University, June, 1993.

CURRICULUM VITA

Name:	Ernest M. Henley
Address:	4408 55th Avenue N.E. Seattle, Washington 98105
[redacted]	[redacted]
Wife:	Elaine M. Henley, M.D.
Children:	M. Bradford ([redacted]), Karen M. ([redacted])
Education:	College of the City of New York, 1941-1944, B.E.E., 6/44
	University of California, Berkeley, 1948-51, Ph.D. (Physics), 6/52
Positions:	
Professional:	Electrical Engineer, Airborne Instruments Laboratory, Mineola, NY, 8/46-8/48
	Electrical Engineer, Microwave Laboratory, University of California, Berkeley, CA 9/48-6/50
	Research Associate, Stanford University, Stanford, CA, 9/51-6/52
	Physicist, Brookhaven National Laboratory, Upton, NY, 6/52-9/52, 6/54-9/54, 6/57-9/57
	Lecturer, Columbia University, New York, NY, 9/52-6/54
	Assistant Professor, 9/54-9/57 Associate Professor, 9/57-9/61 Professor, 9/61- Department of Physics, University of Washington, Seattle, WA
Administrative:	Acting Chairman, Dept. of Physics, University of Washington Seattle, WA, 9/64-9/65
	Chairman, University Faculty Senate, University of Washington, 9/71-9/72
	Chairman, Dept. of Physics, University of Washington, 5/73-12/76
	Acting Associate Dean, College of Arts and Sciences, University of Washington, 3/78-6/78
	Dean, College of Arts and Sciences, University of Washington, 9/79-8/87
	Director, Institute for Nuclear Theory, University of Washington 4/90-9/91
	Associate Director, Institute for Nuclear Theory, University of Washington, 9/91-

Professional Service (cont'd.)

Coordinator (editor) for *Comments on Nuclear and Particle Physics* (Gordon and Breach, N.Y.) 1980-84

Member, Editorial Committee, *Annual Reviews of Nuclear and Particle Science*, 1979-83

Vice-Chairman of Nominating Committee, American Physical Society, 1982, Chairman, 1983

Divisional Councilor (Nuclear Physics) to the American Physical Society, 1982-86

Publications Committee, American Physical Society, 1983-85

Executive Committee, American Physical Society, 1984

Chairman, Committee on Committees, American Physical Society, 1984; member, 1985

Member, Board of Directors, The Washington Technology Center, 1983-87

Member, National Advisory Board to SURA 1985-1986

Member-at-large, Steering Committee, American Association for the Advancement of Science, Physics, 1984-88
Chairman, Physics Section, 1989, past-chair, 1990

Member, Board of Directors, Pacific Science Center, 1984-87

Chairman, Nuclear Science Advisory Committee (to Department of Energy and National Science Foundation) 1986-89

Member, International Advisory Committee for "International Symposium on Medium Energy Physics", Beijing, 1987

Member, Advisory Committee, Dean of Liberal Arts and Sciences, Stanford, 1987-

Member, Advisory Committee and co-editor, International School on Medium Energy Physics, Taipei, Taiwan, 1988

Member, Scientific and Educational Advisory Committee to President, University of California, 1988-1992

Member, International Advisory Committee for Yamada Conference, Osaka, Japan, 1989

Member, International Advisory Committee for *International Conference on Few Body Problems*, Vancouver, BC, 1989

Member, Board of Trustees, Associated Universities, Inc., 1989-

AIP Governing Board, 1990-; Executive Committee, 1993

Professional Service (cont'd.)

President-elect, American Physical Society, 1991
President, 1992
Member, SLAC Policy Committee, 1990-; Chairman 1993
Member, RHIC Policy Committee, 1990-
Chairman, CEBAF Policy Committee, 1992
Member, International Advisory Committee for 2nd European Workshop on *Hadronic Physics with Electrons Beyond 10 GeV*, 1990
Member, International Advisory Committee for International Symposium on *Hypernuclear and Strange Particle Physics*, 1991
Member, Organizing Committee for 4th Conference on *Intersections Between Particle and Nuclear Physics*, 1990-91
Member, International Advisory Committee for *International Nuclear Physics Conference*, 1991-

Honors:

Undergraduate Scholarship, College of the City of New York, 1942
Frank B. Jewett Fellow, 1952-53
National Science Foundation Senior Fellow, 1958-59
John Simon Guggenheim Fellow, 1967-68
NATO Senior Postdoctoral Fellow, 1976-77
National Science Foundation Exchange Scientist to India, 1975 (December)
National Academy of Sciences Exchange Scientist to the USSR, June 1977
Elected to membership National Academy of Sciences, 1979
Distinguished Scholar to People's Republic of China, 1983
Elected to Fellowship, AAAS, 1983
Honorary Member, Golden Key National Honorary Society, 1984
Senior Alexander von Humboldt Award, 1984
American Physical Society Tom W. Bonner Prize, 1989
City College of New York Townsend Harris Medal, 1989
Distinguished Lecturer, Republic of China, 1991

Professional Societies:

Tau Beta Pi (honorary Electrical Engineering Society)
Fellow, American Physical Society
American Association for the Advancement of Science
Sigma Xi

Hobbies:

Sports (swimming, tennis, climbing, hiking, skiing, bicycling), photography, music

Ernest Mark Henley

PUBLICATIONS

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2. π-Meson Production by Protons on Nuclei, Phys. Rev. 85, 204 (1952).

3. Nonlinear Pseudoscalar Meson Theory, Phys. Rev. 87, 42 (1952).

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5. Recoil Effects in Meson-Nucleon Scattering, Phys. Rev. 90, 719 (1953) (with M.A. Ruderman).

6. Mu-Mesonic Atom and the Electromagnetic Radius of the Nucleus, Phys. Rev. 92, 801 (1953) (with L.N. Cooper).

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2. *Subatomic Physics* (Prentice-Hall, Inc., Englewood Cliffs, N.J., 1974) 553 pp., translated into German, Chinese, Japanese and Russian (with H. Frauenfelder).
3. *Nuclear and Particle Physics* (W.A. Benjamin, Inc., Reading, Mass., 1975), 573 pp. (with H. Frauenfelder).
4. *Subatomic Physics*, 2nd Ed., Prentice-Hall, Englewood Cliffs, NJ, 1991 (with H. Frauenfelder).
5. Solutions Manual to *Subatomic Physics*, Prentice-Hall, Englewood Cliffs, NJ, 1991.

CURRICULUM VITAE

Name: George F. Bertsch

[redacted]

EDUCATION

1962 - 1965 Graduate Student in Physics Department, Princeton University and N.S.F. Predoctoral Fellow. Ph.D., 1965

1959 - 1962 Undergraduate at Swarthmore College. Physics major B.A. with Highest Honors, June 1962

ACADEMIC POSITIONS

1992 - Professor of Physics, University of W shington and Senior Fellow, Institute for Nuclear Theory

1985 - 1992 Hannah Professor of Physics, Michigan State University

1984 - 1985 Professor of Physics, University of Tennessee, and Distinguished Scientist, Oak Ridge National Laboratory

1973 - 1984 Professor of Physics, Michigan State University

1971 - 1973 Associate Professor in Physics, Michigan State University

1969 - 1970 Assistant Professor in Physics, M.I.T.

1968 - 1971 Assistant Professor in Physics, Princeton University (on leave 1969-1970)

1966 - 1968 Instructor in Physics, Princeton University

DISTINCTIONS

1969 - 1971 A.P. Sloan Foundation Fellow

1978 Fellow of the American Physical Society

1986 Humboldt Foundation Senior Scientist Award

EXTERNAL SERVICE

1989 - Associate Editor, Reviews of Modern Physics

1989 - Editor, Physics Letters B

1986 - 1990	Coordinator, NSF Nuclear Physics Summer School
1984 - 1988	Editorial Board, Annual Review of Nuclear Science
1983 - 1984	Chairman of Division of Nuclear Physics, American Physical Society
1978 - 1981	Advisory Board, NSF Institute for Theoretical Physics at Santa Barbara, CA
1981	Program Coordinator, ITP, Santa Barbara
1979 - 1981	Executive Board, Division of Nuclear Physics, APS
1979 - 1981	Editorial Board, Physical Review C
1978	DOE/NSF Nuclear Long-Range Planning Panel

PUBLICATIONS OF GEORGE F. BERTSCH

A. Refereed Journal Articles

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66. Heavy Ion Dynamics at Intermediate Energy, Chapter in Progress in Particles & Nuclear Physics, vol. 4, 483-501 (Pergamon Press, 1980).

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POPULAR LEVEL PUBLICATIONS

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161. "Atoms", article in Macropedia of Encyclopedia Britannica, Vol. 1 (1989) pp. 329-352.

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EXPERIMENTAL PAPERS FOR WHICH THEORY HELP WAS PROVIDED

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5. Excitation of the Giant-Resonance Continuum with Intermediate-Energy Protons, J.M. Moss, T.A. Carey, J.B. McClelland, N.J. DiGiacomo, S.J. Seestrom-Morris, G.F. Bertsch, O. Scholten, G.S. Adams, M. Gazzaly, N. Hintz, and S. Nanda, Phys. Rev. Lett. 48 (1982) 789.

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7. Final State Interaction between noncompound light particles for 16O- induced reactions on 197Au, C. Chitwood, J. Aichelin, D.H. Boal, G. Bertsch, et al., Phys. Rev. Lett. 54 (1985) 302.

Invited Talks and Seminars

1. March 9, 1992 Seminar at Texas A & M University, "Single-Particle and collective motion in buckyballs".

2. March 11, 1992 Colloquium at Indiana University, "Single-particle and collective motion in buckyballs."

3. May 19, 1992 Colloquium at Michigan State University, "Pairing on the neutron drip line."

4. July 6-9, 1992 Lectures at Varenna, Italy, "Theory of drip-line nuclei."

5. Oct. 15, 1992 Plenary talk at Santa Fe meeting of DNP/APS, "Single-Particle and Collective Motion in Buckyballs".

6. Nov. 5, 1992 Seminar at NIKHEF, Amsterdam, "Single-Particle and Collective Motion in Buckyballs."

7. Jan. 29, 1993 Seminar at Caltech, Pasadena, "Magnetism in Clusters"

8. Feb. 8, 1993 Winter School at Les Houches, France. i) "Boltzmann Equation for Bosons" ii) Conference Summary

9. Feb. 19, 1993 Cosmic Ray Seminar, Univ. Washington, "Heavy ion collisions at CERN"

Summary of Research

My research has been on the following topics.

1. Hot Hadronic Matter. A long term project is to study the dynamics of the hadronic final state produced in high-energy nuclear collisions. My current research here is in collaboration with Michael Herrmann, a postdoctoral Lynen Fellow. We have been working on two aspects of this general problem, both connected with the pion distributions. It may be the case that pions are produced out of chemical equilibrium, and if there is a large excess of pions, interesting effects might arise from their Bose statistics. Our first project was to study rates for processes that change the number of pions, to get some estimates for how much deviation from chemical equilibrium could be expected. It is difficult to make believable estimates of the important cross sections, but we can get some useful guidance from simple bounds. The other project is a model study of the pi-pi correlations. The motivation is the common practice to analyse these correlations with the statistical assumptions of Hanbury-Brown--Twiss interferometry. We take a simple model in which the quantum amplitudes can be calculated, and apply the HBT analysis in parallel. The HBT correlation function can be calculated in two ways, and we find one to be clearly preferable, if the limitation is due to the assumption of statistical independence of the sources. In general, we find that the statistical assumptions are more difficult to realize that may be generally appreciated.

2. Large amplitude collective motion. One of my long-term interests is the dynamics of large-amplitude shape change, taking as a starting point the static Hartree-Fock picture of nuclear structure and a statistical treatment of the distribution of Hartree-Fock states and their interactions. Recently we have applied this to the theory of fission. One arrives at a diffusion equation (the Smolukowsky equation), and the diffusion constant is calculated from the phenomenology of the residual interaction in the shell model. This past year I have been making a systematic survey of the newer fission data, mainly prescission neutron and gamma yields, but including also evaporation residue yields. This is in collaboration with Michael Thoennessen of Mich. State. University. In general, the fission according to the diffusion equation is greatly retarded, in comparision to the statistical theory. However, the empirical diffusion coefficient is significantly larger than the theory predicts.

3. Structure of Li-11. This nucleus is interesting because its very weak binding (about 300 KeV with respect to 2 neutron removal) gives it unusual properties. In particular, it is very easy to fragment this nucleus in an external Coulomb field. With Henning Esbensen we pursued a three-body model of this nucleus, in which all correlations could be studied quantitatively. The correlations predicted by the model are confirmed by experiment, with only one exception. We interpret this to mean that standard nuclear theory works very well for properties dependent on the neutron-neutron interaction at low density. This may be of interest to those studying neutron matter in other contexts.

4. Cluster physics. I have been applying techniques of nuclear theory to atomic cluster physics. This work has been in collaboration with Kazu Yabana, who was an Institute visitor during the past year. In the current period, we concentrated on the excitations in C-60 clusters. The physical questions we examine are the nature of weak nondipolar transitions seen in inelastic electron scattering and the coupling of the vibrations to the electronic motion. We have found that a spherical representation is very useful to describe the single-particle wave functions. The inelastic scattering calculations is calculated using the the Distorted Wave Born Approximation and the collective model for vibrational transitions. Our results seem to show that quadrupole transitions are present in low electronic spectrum. Concerning the electron-vibration coupling, we have used techniques of large scale matrix diagonalization by the Lanczos algorithm. However, we have not yet achieved a satisfactory description of all aspects of the coupling with a common Hamiltonian.

Tetsuo Hatsuda

Curriculum Vitae
June 1993

[redacted]

MARITAL STATUS : Married

EDUCATIONAL BACKGROUND :

B.S., Physics, Kyoto University (Japan), March 1982

Ph.D., Physics, Kyoto University (Japan), March 1986

RESEARCH EXPERIENCE :

1986 (April) - 1987 (March): Postdoctoral Research Fellow at National Laboratory for High Energy Physics (KEK, Japan).

1987 (April) - 1988 (March): JSPS Fellow at KEK.

1988 (April) - 1990 (March): Postdoctoral Research Fellow at State University of New York at Stony Brook.

1990 (April) - 1990 (Sept.): Research Associate Fellow at CERN.

1990 (Oct.)-1992 (Sept.): Research Assistant Professor at Institute for Nuclear Theory, University of Washington.

1992 (Oct.)- present: Assistant Professor at Physics Department, University of Washington.

Tetsuo Hatsuda

SUMMARY of RESEARCH (March 1, 1992 - Feb. 28, 1993)

My main interests are on the non-perturbative aspects of QCD and its implication to the phenomena in the nucleon structure, the nuclear structure, relativistic heavy ion collisions and the theories beyond the standard model.

1. QCD and Hadron Structure

(a) OZI Violation in hadrons

T. Kunihiro (Ryukoku Univ.) and I have been working on the Nambu-Jona-Lasinio description of hadrons and the OZI violation in QCD on the basis of the instanton-induced interaction. Part of this work was recently published (ref.[34]). We are currently preparing a review article "Chiral Phenomenology in the Nambu-Jona-Lasinio model" which will be published in Physics Reports.

(b) $\rho - \omega$ mixing in the space like region

Th. Meissner, E. M. Henley, G. Krein and I studied the off-shell $\rho - \omega$ mixing on the basis of the QCD sum rule. We found that there is a sizable momentum dependence of the mixing angle, thus the conventional isospin-breaking nuclear force due to the $\rho - \omega$ mixing is reduced drastically. The result is reported in ref.[38].

(c) Twist 4 matrix elements of the nucleon

The recent CERN and SLAC data on the deep inelastic structure functions indicate the existence of the twist 4 contribution (the quark-gluon correlation inside the nucleon). We have analysed the available data and extracted the magnitude of the twist 4 matrix elements of the nucleon. The result is reported in ref.[37].

(d) pion-nucleon form factor in the QCD sum rules

Th. Meissner, E. M. Henley and I are working on a model independent prediction of the pion-nucleon form factor in the space-like region on the basis of the QCD sum rules. This will serve as a basic constraint on the phenomenological form factors used in the nuclear forces.

(e) H-particle in the QCD sum rules

M. Oka (Tokyo Institute of Technology) and I are studing the H-particle which is one of the most controversial hadrons in QCD. Our Borel stability analyses of the QCD sum rules show that H could be a true bound state

below 2Λ threshold. We are currently looking at the sensitivity of the result by the change of the current quark masses and quark condensates.

(e) Pion wave function in the QCD sum rules

Su. H. Lee, G. Miller and I are working on the Bethe-Salpeter amplitude of the pion using the QCD sum rules. The amplitude gives a measure of the transverse size of the pion and provides us with a complementary information to the light-cone wave function. Comparison of our result with the lattice QCD data is also under progress.

2. Hadron properties in hot/dense medium

(a) QCD sum rules for vector meson in nuclear medium

Su H. Lee, Y. Koike (Michigan State univ.) and I are studing the propoeties of the vector mesons in nuclear medium by taking into account all the twist 4 terms in the operator product expansion to see whether our previous results (ref.[33]) are modified or not.

(b) QCD Sum rules at finite temperature (T)

Su H. Lee, Y. Koike and I developed a consistent method of the QCD sum rule at finite temperature. At low T, the current algebra + systematic operator product expansion with twist 2, 4 and 6 operators give enough information on the hadron mass shift. The result is published in ref.[36].

We are also preparing a review article on the QCD sum rules in medium.

(c) Hadronic screening mass at high T and QCD_3

M. Ishii and I are working on QCD hadronic correlations at high T by combining the idea of the dimensional reduction at high T and the spectral sum rules in QCD_3.

Tetsuo Hatsuda

PUBLICATION LIST

1. Baryon Spectra in a Relativistic Quark Model with Pion Field;
   Prog.Teor.Phys. 70 (1983), pp.1685-1688.
2. A Self-Consistent Mean-Field Approach to the Dynamical Symmetry
   Breaking: The Effective Potential of the Nambu and Jona-Lasinio Model;
   Prog.Theor.Phys. 71 (1984), pp.1352-1365. (with T. Kunihiro)
3. Possible Critical Phenomena Associated with Chiral Symmetry Breaking;
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4. Nonlinear Fields based on the Coherent State Path Integrals:
   Topological Index and Semiclassical Quantization.
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5. Collective Dynamics for the Bag: Semiclassical Approach to the Breathing Motion;
   Z.Phys. C27 (1985), pp.455-460. (with H. Kuratsuji)
6. Fluctuation Effects in Hot Quark Matter; Precursors of Chiral Transition
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7. Soft Modes Associated with Chiral Symmetry Breaking: The use of
   a QCD-Motivated Effective Interaction;
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8. Effects of Finite Density on Chiral Domain Wall in Neutron and Quark Matter;
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9. Dynamical Motion of a Kink-Bag system in (1+1)-Dimensions: Inertia
   of the Vacuum Confined in a Bag;
   Phys.Lett. 167B (1986), pp.351-355.
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    Nucl.Phys. A458 (1986), pp.583-604.
11. Character Changes of Pion and Sigma-meson at Finite Temperature;
    Phys.Lett. 185B (1987), pp.304-309. (with T. Kunihiro)
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    Prog.Theor.Phys.Suppl. 91 (1987), pp.284-298. (with T. Kunihiro)

13. Strange Stars and Neutrino Burst from Supernova 1987A;
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14. Effect of Explicit SU(3) Breaking on the Quark Condensate;
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15. Radiative Neutrino Decay and the Unusual X-ray Flux from SN1987A;
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18. Effects of Flavour Mixing induced by Axial Anomaly on the Quark Condensates and Meson Spectra;
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19. Strangeness Mixing in Nucleon and Scalar Mesons;
Phys.Lett. 213B (1988) 361-364.

20. Mean Field Theory and Boson Expansion at Finite Temperature on the basis of the Thermo Field Dynamics;
Nucl. Phys. A492 (1988), pp.187-204.

21. Parity Doubling of the Nucleon and First Order Chiral Transition in Dense Matter;
Phys. Lett. 224B (1989), pp.11-15. (with M. Prakash)

22. Spin of the Proton and the Axial Anomaly;
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23. Anomalous Gluon Content of the Proton;
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24. OZI Breaking in Nucleon, Delta and Hyperons;
Phys. Lett. 240B (1990) 209. (with T. Kunihiro)

25. The Applications of the QCD Sum Rule at Finite Temperature;
Phys. Rev. D42 (1990) 1744. (with R. J. Furnstahl and S. H. Lee)

26. The QCD Sum Rule at Low Temperature;
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27. Convergence Radius of the Chiral Perturbation Theory in the Large N_c limit;
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Interplay of the $SU_f(3)$ Breaking and the $U_A(1)$ Anomaly;
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29. Proton-Neutron Mass Difference in the Medium and
the Okamoto-Nolen-Schiffer Anomaly;
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30. QCD Sum Rules and the Okamoto-Nolen-Schiffer Anomaly;
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31. Radiative Z^0 Decay and the Color-Sextet Quarks;
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32. Strong CP Violation and the Neutron Electric Dipole Moment Revisited;
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33. QCD Sum Rules for Vector Mesons in the Nuclear Medium;
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34. Strange Quark, Heavy Quarks and Gluon Contents of Light Hadrons;
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35. Pattern of Chiral Restoration at Low Temperature from QCD Sum Rules;
Phys. Rev. D47 (1993) 1225. (with Y. Koike and Su H. Lee)

36. Finite-temperature QCD sum rules reexamined;
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37. Twist 4 matrix elements of the nucleon from recent DIS data at CERN and SLAC;
submitted to Phys. Lett. B. (with S. Choi, Y. Koike and Su H. Lee)

38. The off-shell ρ-ω mixing in the QCD sum rules;
submitted to Phys. Rev. C. (with Th. Meissner, E.M. Henley and G. Krein)

CONFERENCE REPORTS AND INVITED TALKS

39. Pion and Sigma-meson at Finite Temperature;
Invited talk given at *1st International Seminar on Mesons and Quarks in Nuclei* (Kyoto, April 15-18, 1987, Japan).
Prog.Theor.Phys.Suppl. 91 (1987), pp.284-298.

40. Hadrons in Hot and Dense Medium;
Talk at *QCD'90* (Montpellier, France, 8-13 July, 1990)
report INT-4-90 (1990).
Nuclear Physics B (Proc. Suppl.) 23B (1991) pp.368-371.

41. Anomalous Gluon Content of the Proton;
Talk at *QCD'90* (Montpellier, France, 8-13 July, 1990)
report INT-5-90 (1990).
Nuclear Physics B (Proc. Suppl.) 23B (1991) pp.108-111.

42. Chiral Symmetry, Axial Anomaly and the Structure of Hadrons;
Invited lectures given at *International Workshop on Nuclear Physics*;
(Mt. Sorak, Korea, Feb. 26 - March 1, 1991).
INT report 40561-18-INT91-00-06.

43. Structure and Dynamical nature of Hot and Dense QCD Matter;
Invited talk at *International Symposium on High Energy Nuclear Collisions and Quark Gluon Plasma* (Kyoto, Japan, June 6-8, 1991),
INT report 40561-08-INT91-00-05.

44. Soft Modes associated with Chiral Restoration in Hot QCD;
Talk at the workshop on QCD at finite temperature and density;
(Brookhaven National Lab., August 6-16, 1991).
INT report 40561-19-INT91-00-07.

45. Convergence Radius of the Chiral Perturbation in QCD;
Talk at the international conference *Particles and Fields '91*
(Vancouver, Canada, August 19-22, 1991).

46. QCD Sum Rules in the Nuclear Medium;
Invited talk at *Fall Meeting of American Physical Society*
(Lansing, October 23-27, 1991).

47. Theoretical Overview - Hot and Dense QCD in Equilibrium —;
Invited talk at the international conference *Quark Matter '91*

(Tennessee, November 11-15, 1991).

48. Anomalous Quarks and Gluon Contents of Light Hadrons;
Invited talk at the international conference *Strangeness and Hyper Nuclei*
(Shimoda, Japan, December 10-18, 1991).

Résumé of DAVID HARLEY

Work Address

Department of Physics
University of Arizona
Tucson, Arizona 85721
USA

Tel: (602) 621-2497
621-4680
Fax: (602) 621-4657
e-mail: HARLEY@ARIZRVAX (bitnet)
harley@muon.physics.arizona.edu (internet)

Home Address

819 N. 1st Avenue #203
Tucson, Arizona 85719
USA

Tel: (602) 791-0774

PERSONAL

[redacted]

EDUCATION

B.Sc. (Hons) University of Cape Town, 1984-1987, majoring in Theoretical Physics, Mathematics and Applied Mathematics

Ph.D. University of Arizona, 1988-present; to be completed spring 1991. Thesis title: "Nuclear and Molecular Processes in Muon Catalyzed Fusion"

EMPLOYMENT

1987: Teaching assistant, University of Cape Town

1988: Teaching assistant, University of Arizona

1989,90: Research assistant, University of Arizona

RESEARCH INTERESTS[1]

- Muon Catalyzed Fusion
- Electroweak Interactions
- Self Organization in Neural Networks
- Non-perturbative Quantum Field Theory
- Nuclear Reactions at Low Energy

OTHER QUALIFICATIONS

- Administration of UNIX-based workstations and local area networks
- Programming in Fortran, C and Pascal

REFERENCES

Thesis supervisor:

Prof. J. Rafelski, Dept. of Physics, University of Arizona, Tucson, Arizona 85721, USA

Co-authors and collaborators:

- Prof. I. Bialnicki-Birula, Institute for Theoretical Physics, Lotnikow 32/46, 02-668 Warsaw, Poland
- Prof. B. Müller, Deptartment of Physics, Duke University, Durham, North Carolina 27706, USA
- Prof. G. Soff, GSI, Postfach 11 05 52, D-61 Darmstadt, Germany

[1] In order of preference

PUBLICATIONS

Publications in refereed journals:

1. D. Harley, B. Müller and J. Rafelski: "Muon catalyzed fusion with $Z > 1$", *J. Phys. G* **16**, 281-294 (1990)
2. D. Harley, B. Müller and J. Rafelski: "Time independent description of the $t(d,\mu)\alpha$ fusion reaction in the presence of a muon", *Z. Phys. A* **336**, 303-312 (1990)
3. D. Harley, G. Soff and J. Rafelski: "Localized Higgs-Fermion states", *J. Phys. G* **16**, L207-L212 (1990)
4. J. Rafelski, M. Sawicki, D. Harley and M. Gajda: "How cold fusion can be catalyzed", *Fus. Tech.* **18**, 136-142 (1990)
5. H. Rafelski, D. Harley, G. Shin and J. Rafelski: "Cold fusion: Muon catalyzed fusion", Accepted by *J. Phys. B* (1990)

Conference proceedings and preprints:[2]

1. D. Harley, B. Müller and J. Rafelski: "MuCF with $Z > 1$" *Muon Catalyzed Fusion* (AIP conference proceedings 181, 1989) S.E. Jones *et al*, editors
2. J. Rafelski, M. Gajda and D. Harley: "Limits on cold fusion in condensed matter: a parametric study", University of Arizona preprint AZPH-TH/89-19-2 (1989)
3. D. Harley, M. Gajda and J. Rafelski: "Review of the current theoretical status of cold fusion", *Emerging Nuclear Energy Systems* (World Scientific 1989) pp 308-313
4. D. Harley, M. Gajda and J. Rafelski: "Review of the current status of cold fusion", *Proc. NATO Summer Institute on the Nuclear Equation of State* (Plenum Press 1990) W. Greiner, editor
5. D. Harley, J. Rafelski and B. Müller: "$(t\mu) + d$ in-flight fusion", *Proceedings of an International Symposium on Muon Catalyzed Fusion μCF-89* (RAL publication RAL-90-022) J.D. Davies, editor
6. D. Harley and J. Rafelski: "Nonresonant fusion reactions in the $t\mu + d$ system", Submitted to the proceedings of the 1990 Vienna conference on Muon Catalyzed Fusion September 1990

[2]Preprints that have subsequently been published in a conference proceeding or journal have been omited.

Summary of Activities

David Harley **June 22, 1992**

During 1991/92 my research has been directed towards the following topics.

Muon Catalyzed Fusion: The low temperature behavior of *dt* fusion has been investigated in terms of a subthreshold continuum, leading to unusual temperature and density dependence [2]. This work has been motivated by experimental observations of similar anomalies. A second line of research is *dt* fusion in dense, degenerate plasmas, such as may be created in inertially confined fusion experiments [3]. The key observation is the large regeneration of the $\alpha\mu$, permitting more than 10,000 fusions per muon [4]. I have computed a large number of molecular and fusion rates relevant to the MuCF cycle in such an environment [5].

Neutrino Oscillations: The recent GALLEX data for solar neutrino luminosity has been interpreted in terms of a three-flavor neutrino mixing model [7], originally proposed by Mikheyev, Smirnov, Wolfenstein. One of our objectives has been to display the allowed four-dimensional mixing parameter space in a simple, comprehensible way. Towards this end we have developed a set of procedures to render three-dimensional contour plots as shaded surfaces embedded in three dimensions.

Lattice Dynamics: Two codes have been developed for performing the efficient computation of the two-dimensional Hubbard and Ising models, respectively. The Hubbard code was developed to investigate the possibility of performing an exact diagonalization of a truncated spin space; the results were unfortunately disappointing[1]. The Ising code was developed as part of an investigation to explore surface free energies, for which a very efficient code is required[2]. This investigation is still underway.

Statistical Mechanics: The lack of ergodicity in a classical system has been investigated numerically. In non-time reversal invariant systems this results in an interesting situation: in order to satisfy the second law of thermodynamics the system must not be ergodic. A report of these results is in preparation [6].

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[1] Collaborator: Wick Haxton, INT

[2] Collaborator: Suzhou Huang, Dept. Physics, U. Washington

APPENDIX F

VITA
Antje Höring

Current Address:
Institute for Nuclear Theory
University of Washington, HN-12
Seattle, WA 98195
Tel: (206) 685-3970
Fax: (206) 685-3730
E-Mail: hoering@ben.npl.washington.edu

Personal:

[redacted]
Citizenship: German

Present Position:

Postdoctoral Research Associate at the Institute for Nuclear Theory.

Education:

Dr. rer. nat.	Max Planck Institut für Kernphysik, Heidelberg	
October, 1991	Thesis Advisor:	Professor Hans A. Weidenmüller
	Thesis Title:	Dipol-Gammaemission in Präequilibrium-Kernreaktionen
M.S. degree	Oregon State University	
September, 1988	Thesis Advisor:	Professor Victor Madsen
	Thesis Title:	Application of the Schematic Model to Four-Quasiparticle States
Vordiplom	Universität Tübingen	
October, 1985	Major: Physics	

Experience:

12/91-present:	Postdoctoral Research Associate at the National Institute for Nuclear Theory.
11/91:	Postdoctoral Research Associate at the Max Planck Institut für Kernphysik.
1/89-10/91:	Research Assistant at the Max Planck Institut für Kernphysik.
10/88-12/88:	Teaching Assistant at the Universität Tübingen — taught recitations in quantum mechanics for first year graduate students.
1/87-8/88:	Research Assistant in the Physics department, Oregon State University — worked with Professor V. Madsen on BCS pairing theory, seniority model, two particle-two hole TDA.
9/86-12/86:	Teaching Assistant at the Oregon State University — taught undergraduate physics laboratory.

Conferences:

Summer School for Graduate and Beginning Postdoctoral Students in Nuclear Physics, Oregon State University, OR, July, 1988.

Spring meeting of the German Physical Society, Nuclear Physics Section, Bonn, Germany, March, 1989.

"Ettore Majorana" International Workshop of Nuclear Physics: "The Nature of Hadrons and Nuclei studied by Electron Scattering", Erice, Sicily, July, 1989.

Spring meeting of the German Physical Society, Nuclear Physics Section, Strasbourg, France, March, 1990.

Seventh International Symposium on Capture Gamma-Ray Spectroscopy and related topics, Asilomar, CA, October, 1990 (presented a poster).

Summer School for Graduate and Beginning Postdoctoral Students in Nuclear Physics Research, Oregon State University, OR, July, 1992.

APS Division of Nuclear Physics Fall Meeting, Santa Fe, NM, October 1992.

Publications:

A. Höring, H. A. Weidenmüller, F. S. Dietrich, M. Herman, and G. Reffo, "A Study of Reaction Mechanisms for Gamma Production in Fast-Nucleon Induced Reactions", AIP Conference Proceedings, Capture Gamma-Ray Spectroscopy and Related Topics-1990 (International Symposium, Asilomar, California).

A. Höring, and H. A. Weidenmüller, "Gamma Emission in Precompound Reactions. I. Statistical Model and Collective Gamma Decay" , Phys. Rev. C, **46**, 2476 (1992).

M. Herman, A. Höring, and G. Reffo, "Gamma Emission in Precompound Reactions, II. Numerical Application", Phys. Rev. C, **46**, 2493 (1992).

W. C. Haxton, A. Höring, "Time-reversal-noninvariant, Parity-conserving Nuclear Interactions", accepted by Nuc. Phys. A.

References:

Professor Hans A. Weidenmüller
Max-Planck Institut für Kernphysik
Postfach 10 39 80
D-6900 Heidelberg 1
Germany
Tel: 49-6221-516291

Professor Wick C. Haxton
Institute for Nuclear Theory
University of Washington, HN 12
Seattle, WA 98195
Tel: (206) 685-3971

Professor Victor Madsen
Physics Department
Oregon State University
Corvallis, OR 97331
Tel: (503) 737-1694

Summary
Antje Höring

I have primarily focused on the understanding of collective phenomena, such as nuclear giant resonances and collective surface vibrations, their description within the framework of microscopic quantum mechanical models, and their interplay with statistical nuclear reactions. Recently, I have become very interested in fundamental symmetries pertaining to nuclear physics. Of particular interest to me in each of my research projects has been the direct connection to experiments.

In my master's thesis supervised by V. A. Madsen, I studied the leading order anharmonic effect in vibrational motion. This effect is due to the coupling between collective states with one and two phonons, which corresponds to the coupling between collective states with two and four quasiparticles. I derived and solved the Tamm–Dancoff equation of motion for four BCS quasiparticles, calculated the coupling matrix element between the two- and four-quasiparticle states and investigated its effect on the energy level diagram and on the strength of the crossover transition $2_2^+ \rightarrow 0_1^+$ for several Palladium and Selenium isotopes. This model offers the possibility of an analytical treatment and at the same time reproduces experimental spectra surprisingly well.

As a Ph.D. student under the supervision of H. A. Weidenmüller, I studied gamma emission in precompound nuclear reactions. Models for pre-equilibrium nuclear reactions are statistical in nature, while gamma emission mainly originates from the decay of the electric dipole giant resonance (GDR), *i.e.* from a highly collective and non-statistical mode of nuclear excitation. The theoretical modeling of gamma emission in precompound reactions thus required a suitable combination of statistical and collective aspects of excited nuclear states. I also focused attention to include the GDR built on the ground state as well as on the excited states of the composite system consistently within one quantum mechanical model. Previous investigations treated the processes arising from the GDR on the ground state and on excited states in spite of their common physical origin by different and mostly phenomenological methods. In contrast to this, in my formulation the gamma emission in a precompound reaction is due to the combined action of all these giant resonance states, thus allowing for the first time for interference effects. In this way, I arrived at a formulation which encompasses the model of the direct–semidirect capture process, the exciton model, etc., as special cases. I believe that this contributes to a better conceptual understanding of both the reaction itself, and of various ways of modeling it. The aim of this investigation, however, goes beyond establishing a formal framework which contains several models as special cases. The analytically derived expressions for energy-averaged cross-sections for gamma emission were used for a direct numerical calculation. It turned out that this formulation allows

for a parameter-free calculation of gamma emission in precompound reactions that agrees well with experimental data.

As a postdoctoral research associate at the Institute for Nuclear Theory I have become very interested in fundamental symmetries. Currently, I am working on a project together with Wick Haxton on time reversal invariance. We are studying atomic electric dipole moments (edm) induced by a T-odd, P-even nuclear interaction combined with a Z_0 exchange between atomic electrons and the nucleus. The nuclear part of the interaction is described by the exchange of a ρ meson. Very precise measurements on the static atomic dipole moment were performed by N. Fortson's group here at the physics department of the University of Washington. Our calculations relate this experimentally observed bound to an upper limit on time reversal non invariant (TRNI), parity conserving (PC) nucleon nucleon interactions. We find a bound on the ratio of the nucleon-nucleon matrix elements of the TRNI, PC and strong interactions of about 10^{-5}. TRNI, PC nuclear interactions can also be tested directly in detailed balance experiments and in studying spectral fluctuations or strength distribution in the region of isolated compound nuclear (CN) resonances. Both investigations yield a bound of 2×10^{-3}. Since atomic edm limits are improving rapidly, our constraints will continue to become more stringent.

Besides the mechanism discussed above there is a variety of other mechanisms that can also generate atomic edms from TRNI, PC interactions. W. Haxton, M. Musolf and I are currently investigating these to compare their relative contribution to the atomic edm.

Curriculum Vitae

Mingxing Luo

Institute of Nuclear Theory
Henderson Hall, HN-12
University of Washington
Seattle, Washington 98195

(206)-685-3546

5035 NE 15th Ave, Apt 103
Seattle, Washington 98105

(206)-527-5275

PERSONAL

[redacted]

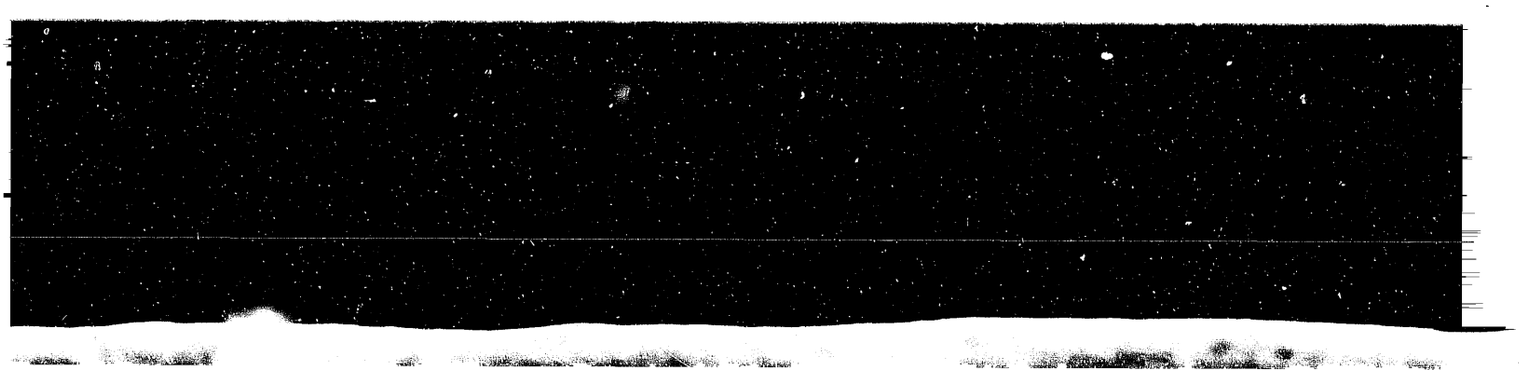
Marital Status: Married

EDUCATION

1983-1990	Department of Physics, University of Pennsylvania	
	December 1990	Ph.D. awarded
1979-1983	Department of Physics, Zhejiang University	
	July 1983	B.S. awarded

EMPLOYMENT

1991-present	Postdoctoral Research Fellow, Institute of Nuclear Theory, University of Washington
1990-1991	Postdoctoral Research Fellow, High-Energy Theory Group, Department of Physics, University of Pennsylvania (one-year fellowship)
1988-1990	Graduate Research Assistant, Department of Physics, University of Pennsylvania; P. Langacker, Ph.D. advisor
1984-1988	Graduate Study, Dean's Fellow, Department of Physics, University of Pennsylvania; P. Steinhardt, Ph.D. advisor
1983-1984	Graduate Study, Teaching Assistant, Department of Physics, University of Pennsylvania



Publications

Articles

1. *High precision electroweak experiments: a global search for new physics beyond the Standard Model*, with Paul Langacker, Alfred K. Mann, Rev. of Mod. Phys. Vol. 64, No. 1, 87-192 (1992).
2. *The status of weak neutral current phenomena and radiative corrections in the Standard Model*, with Paul Langacker (in preparation).
3. *High precision electroweak experiments and physics beyond the Standard Model*, UPR-0446T/90, PHD thesis, Paul Langacker, supervisor.
4. *Implications of precision electroweak experiments for* m_t, ρ_0, $\sin^2\theta_W$, *and grand unification*, with P. Langacker, Phys. Rev. D44, 817-822 (1991).
5. *Constraints on additional Z bosons*, with P. Langacker, Phys. Rev. D45, 278-292 (1992).
6. *Hadronic tau decays and perturbative quantum chromodynamics*, with W. Marciano, DOE/ER/40561-043-INT92-00-01, to appear in Phys. Rev. D.
7. *The future of high precision experiments*, to appear in *Precision Test of the Standard Electroweak Model*, ed. P. Langacker.
8. *Mass threshold problems in tau decays*, in preparation.

Mingxing Luo

Published papers since Oct. 1992

1. *Hadronic tau decays and perturbative quantum chromodynamics*, with W. Marciano, to appear in Phys. Rev. D.
2. *The future of high precision experiments*, in *Precision Test of the Standard Electroweak Model*, ed. P. Langacker.

Preprints since Oct. 1992

3. *Mass threshold problems in tau decays*, in preparation.

Mingxing Luo

My main interests are on the tau physics, high precision electroweak experiments, and non-standard Higgs physics.

1. Tau Physics

One of the most important fundamental constant, the strong coupling constant α_S or the QCD scale $\Lambda_{\overline{MS}}$, is poorly determined for the following reason: high energy experiments induce big experimental errors since they are insensitive to $\Lambda_{\overline{MS}}$ while low energy experiments induce big theoretical errors due to non-perturbative effects. Since the mass of tau m_τ is reasonably close to $\Lambda_{\overline{MS}}$, the hadronic tau decays can be used to determine precisely $\Lambda_{\overline{MS}}$ if the theoretical uncertainties are under control.

A year ago, W. Marciano and I examined the hadronic tau decays within the framework of perturbative Quantum Chromodynamics [1]. We find that the recent precise measurements of the tau lepton, its lifetime, mass and decay branching ratios, can be used to determine $\Lambda_{\overline{MS}}$ very precisely. Including both the theoretical and experimental uncertainties, we find that $\Lambda^{(4)}_{\overline{MS}}$ is about $280 \pm 40\ MeV$, which is presently the most precise determination of the QCD scale. We pointed out that the natural scale to study the hadronic tau decays is approximately $m_\tau/2$ rather than m_τ as usually assumed. At $m_\tau/2$, the perturbative expansion series is extremely well behaved and that in turn minimized the theoretical uncertainties on $\Lambda_{\overline{MS}}$. We have also pointed that combined the precise value of α and $\sin^2\theta_W$, our value of $\Lambda_{\overline{MS}}$ strongly favors the supersymmetric $SU(5)$ model with 2 Higgs doublets and a generic SUSY mass scale $M_{SUSY} \sim 1\ TeV$.

One of the subtle point in the study of hadronic tau decays is how to deal with the masses of the quarks. First, the charm-quark is light than the tau but the lightest charm-meson is heavier than the tau. The question is how to treat the charm in the tau-decay analysis. Our direct calculation showed that the contribution from charm is very small and can thus be ignored without inducing any significant

uncertainties. On the other hand the strange-quark mass is not insignificant compared with the tau mass. The non-zero mass affects the final state phase-space as well as the vacuum polarisation of the strange channel. A two-loop calculation and a summation of four strange quark final states show that the strange-quark can indeed be treated as massless [2].

2. High Precision Electroweak Experiments

A few years ago, P. Langacker, A. Mann, and I developed a framework for analysis of the high precision electroweak experiments [3]. Since then, significant experimental progresses have been made, especially at the e^+e^- collider LEP at CERN. The mass of the Z boson M_Z has been shifted from $91.177 \pm 0.031\ GeV$ to $91.187 \pm 0.007\ GeV$, the error is much better than anticipated. The errors on the various Z decay widths have also been improved to be better than anticipated. Furthermore, there are preliminary results of the various asymmetries at the Z pole in the e^+e^- collision. The error on forward-backward asymmetry of μ is again better than anticipated. On the other hand, the global analysis of existing W and Z particle properties and weak-neutral current data yields a new constraint on the mass of the top quark, $m_t = 150^{+17+15}_{-23-25}$. We updated the analysis by incorporating these new experimental results [4].

Three general conclusions emerged from the analysis. First, an analytic framework is necessary for the understanding of future high precision experiments and their interpretation within the SM. Second, the outcome of the global analysis will include accurate determinations of the radiative corrections within the SM, which will test the gauge nature of the theory at its foundation. The high precision experiments uniquely verify renormalizibility of the theory and the consistency of the calculations of the radiative corrections. Finally, the variety of observables open to precise experimental study and the precise nature of the electroweak theoretical predictions jointly constitute a powerful means of searching for new physics.

3. Non-standard Higgs Bosons

In the SM, $\rho_0 = M_W^2/M_Z^2 \cos^2\theta_W$ is unity. In theories beyond the SM, if (color-

singlet) scalars which carry non-standard $SU(2)$ charges (*i.e.*, $SU(2)$ triplets) develop vacuum expectation values, ρ_0 will be different from unity. The non-standard Higgs fields thus manifest themselves at tree level. Similar to the $\sin^2\theta_W$, there are ambiguities about how ρ is defined at the loop level. We have tried to clarify the situation and to see the various implications [5].

References

1. *Hadronic tau decays and perturbative quantum chromodynamics*, with W. Marciano, DOE/ER/40561-043-INT92-00-01, to appear in Phys. Rev. D.
2. *Mass threshold problems in tau decays*, in preparation.
3. *High precision electroweak experiments: a global search for new physics beyond the Standard Model*, with Paul Langacker, Alfred K. Mann, Rev. of Mod. Phys. Vol. 64, No. 1, 87-192 (1992).
4. *The future of high precision experimentsi*, to appear in *Precision Test of the Standard Electroweak Model*, ed. P. Langacker.
5. Work in progress.

Steven J. Pollock

Personal: *Current address:*
Institute for Nuclear Theory
Henderson Hall, HN-12
University of Washington
Seattle, WA 98115
phone: (206) 685-3606
fax: (206) 685-3730

Passport: U.S.A.

Education:
1982-87 Stanford University
PhD. - Sept 1987
M.S. - June 1984

1978-82 Massachusetts Institute of Technology
B.S. - June 1982

Positions:
1988-90 Postdoctoral Fellow, NIKHEF-K, Amsterdam

1990-92 Postdoctoral Fellow, INT, Seattle

Awards:

1990	NSF/NATO Postdoctoral Fellowship in Science
1990	NSERC Postdoctoral Fellowship - PDF 1 (Declined)
1986-87	Commonwealth of Virginia graduate fellowship
1982-85	National Science Foundation graduate fellowship
1982	(MIT) J.M. Orloff prize. (Outstanding graduating senior in physics)

Teaching:
Netherlands:
Lecture series on parity violation for graduate students in nuclear physics.

Stanford University:
Teaching assistant (T.A.) for premedical physics classes, engineering physics class, freshman physics majors

MIT:
T.A. for advanced Junior-level physics labs, computer science class, tutor for freshman physics classes.

Research Interests - S.J. Pollock

My work has focussed primarily on new means to investigate the structure of the nucleon. I have concentrated on elastic electroweak cross sections and asymmetries, atomic parity violation, and Compton scattering on nucleons. Of particular interest to me are heavy quark components of the nucleon wave function, anomalous axial currents, and off-shell effects.

In my thesis, and later at NIKHEF and Seattle, I have looked at general electroweak single nucleon processes [Refs 2-5,10,14,16]. The goal there was originally to find tests of the Standard Model by considering an overconstrained, complete set of single nucleon elastic experiments. Spurred by the possible explanation of recent polarized deep inelastic (DIS) results in terms of a large heavy-quark content of the proton, I have extended my thesis research by looking for the effects of s-quark currents on several elastic electroweak processes. Parity violation in polarized e^{-}-p and e^{-}-d scattering, and both ν-p and ν-d elastic neutral-current cross sections, turn out to be sensitive to vector and axial-vector heavy quark currents. The deuteron appears to be an excellent laboratory for studying heavy quark effects [Refs 5,10,12-16]. Being a purely isoscalar target, $\bar{s}s$ effects may show up more clearly. This provides real possibilities for lower energy, nuclear physic experiments to complement the high energy, DIS measurements as probes of the quark structure of nucleons.

Another related topic I have worked on recently involves atomic parity violation in heavy systems, such as ^{133}Cs or ^{208}Pb. This has long been considered a promising means to make high precision measurements of the weak mixing angle in a low energy regime. This could provide a test of the Standard Model at the level of one loop radiative corrections, which could then be used as a way to look for heavy quark, and/or new physics effects. Measuring ratios of parity non-conserving observables for different isotopes seems especially intriguing, since many atomic physics uncertainties cancel. However, nuclear physics effects, including both the large scale neutron distributions in these heavy nuclei, and the small scale internal quark structure of individual nucleons, then become important. I have been working on classifying and formalizing these effects, in order to

provide a separation of nuclear (and nucleon) strong interaction physics effects from weak Standard Model physics.

Another problem I have worked on involves off-shell effects on single nucleon form factors [Ref 9]. There is much interest in medium effects on the proton's internal structure, e.g. whether the nucleon "swells" in a nuclear environment. One must separate from this the effects which arise when a nucleon is simply off its mass shell (for instance, as in two step processes on a free proton.) An off-shell nucleon has not 2 but 12 elastic form factors. I have looked at both the general structure of the photon-nucleon coupling, including constraints made by symmetry principles and the Ward-Takahashi identities, and also at some detailed results in a simple microscopic model for the nucleon. My recent work has involved using Compton scattering on nucleons as a probe of these off-shell form factors, and to investigate the consequences of gauge invariance on observables.

As far as future work is concerned, I have begun working on a simple model of nucleon structure, in terms of a hybrid of hadronic and quark degrees of freedom, as a means to estimate the vector strange component of the nucleon. This quantity is directly measurable in the electroweak experiments discussed above. It is currently unmeasured, and of considerable theoretical interest. I am more generally interested in the connections between DIS and elastic weak form factor measurements. The axial vector matrix element at low q^2 is precisely the quantity which must be evolved and compared with the high q^2 matrix element measured in DIS experiments. There exists some information on the former quantity already, from moderate energy ν-p scattering. I am interested in better extracting vector and axial heavy quark matrix elements from this data. It will be important to calculate quantitative relations between form factors measured in asymmetry, neutrino, and atomic experiments, and the spin structure functions found in deep inelastic experiments. Parity violating asymmetries always involve a very subtle interference, and are sensitive to many small effects. It will be very interesting to continue working on intrinsic nucleon isospin breaking, and radiative corrections [e.g. as in Ref 7] which are also critical for interpreting asymmetry measurements.

Publications – S.J. Pollock

[1] "A Scanning 3-axis Squid Magnetometer for Measurement of Sub- Microgauss Magnetic Fields." J. Lockhart, B. Cabrera, E. Cornell, S. Pollock, Proceedings of the 17th International Conference on Low Temperature Physics (15-22 Aug, 1984) North-Holland

[2] "Elastic Electroweak Processes with Nucleons" S. Pollock, submitted paper to the APS Nuclear physics division. Abstract published in "Bulletin of the American Physical Society" 28-30 October 1985

[3] "$p(\vec{e},e)p$ in the Standard Model." S. Pollock, Proceedings of the Parity Violation Workshop (Dec 11-12, 1986) CEBAF

[4] "Electroweak Interactions with the Nucleon and Tests of the Standard Model." S. Pollock, Nuclear Physics **A461** (1987) 553

[5] "Electroweak Interactions in the Nuclear Domain." S. Pollock, Stanford University PhD thesis

[6] "Single Nucleon Coincidence Cross Sections in a Relativistic Mean Field Theory." S. Pollock, Acta Physica Polonica Vol **B19** (1988) 419

[7] "Signatures of an extra Z^0 gauge boson in elastic e^- - proton scattering." S. Pollock, Phys. Rev **D39** (1989) 163

[8] "The Spin Structure of the Nucleon and its Evolution " J. Kunz, P.J. Mulders, S. Pollock, Physics Letters **B222** (1989) 481

[9] "Electron Scattering from a Bound Nucleon." H.W.L. Naus, S. Pollock, J.H. Koch, U.Ölfke, Nuclear Physics **A509** (1990) 717

[10] "Parity Violating Electron Scattering, and the s-Quark Content of the Proton." S. Pollock, T.W. Donnelly, J. Dubach. In preparation

[11] "Polarization experiments at NIKHEF." K. Allart, Th. Bauer, C.W. de Jager, J.H. Koch, J. Konijn, L. Lapikás, P.J. Mulders, S. Pollock, G. van der Steenhoven, H. de Vries. Letter of Intent, NIKHEF 89-E12.

[12] "Strange Quarks in the Deuteron" S. Pollock. Phys. Rev **D42** (1990) 3010. (Err., Phys. Rev **D43** (1991) 2447.)

[13] "Parity violating e^- deuteron scattering as a probe of the strangeness content of the nucleon" S. Pollock, AIP Conference Proceedings No. 223, Particles and Fields Series 42, 1991 (Polarized Collider Workshop, Ed. Collins, Heppelman, and Robinett) p.335

[14] "Measuring Strangeness Matrix Elements of the Nucleon" E.M. Henley, G. Krein, S.J. Pollock, and A.G. Williams. Physics Letters **B269** (1991) 31. (Abstract submitted to the Gordon Conference "QCD in Nuclear Physics", Tilton, NH, July 22-26, 1991.)

[15] "Neutrino and Antineutrino-deuteron Elastic Scattering and the Axial Isoscalar Nucleon Current" T. Frederico, E.M. Henley, S.J. Pollock, and S. Ying. U.Wash. preprint DOE/ER/40427-28-N91. Submitted to Physical Review C.

[16] "Some Measurement for Determining Strangeness Matrix Elements in the Nucleon" E.M. Henley, T. Frederico, S.J. Pollock, S. Ying, G. Krein, and A.G. Williams. Few-Body Systems, Suppl. 6 (1992) 66 (Abstract in Conference Proceedings of the 13th European Conference on Few Body Problems in Physics, Sept 9-14, 1991. Elba, Italy.)

[17] "Atomic Parity Nonconservation: Electroweak Parameters and Nuclear Structure" S.J. Pollock, E.N. Fortson, L. Wilets. Abstract for invited talk submitted to APS Washington meeting, April 20-23, 1992. DOE/ER/40561-060-INT92-00-14, submitted to Phys. Rev. C

[18] "On Form Factors and Gauge Invariance in Pion Photoproduction" R. L. Workman, H.W.L. Naus, S.J. Pollock. VPI-CAPS-92-2, Phys. Rev. **C45** (1992) 2511

[19] "Strangeness Matrix Elements in the Nucleon" W. Koepf, E.M. Henley, S. Pollock. University of Washington Preprint 40427-15-N92. Submitted to Physics Letters.

[20] "Strangeness in Nucleons" E.M. Henley, T. Frederico, W. Koepf, G. Krein, S.J. Pollock, A.G. Williams, and S. Ying. Abstract submitted to LEAP '92 conference, Sept. 14-19, 1992. Courmayeur, Italy.

Invited talks – S.J. Pollock

Dec. 1986	CEBAF	"Elastic polarized electron-proton scattering "
Jan. 1987	CEBAF	"Coincidence cross sections in a relativistic mean field theory."
Mar. 1987	University of Tennessee	"Electroweak interactions on single nucleons. "
Apr. 1987	University of Maryland	"Electroweak interactions on single nucleons."
Sep. 1987	Stanford University	"Electroweak interactions in the nuclear domain"
Feb. 1988	NIKHEF	"Parity violation in $p(\vec{e}, e')p$"
Oct. 1988	University of Virginia	"Parity violation and tests of the Standard Model"
Oct. 1988	Los Alamos	"Parity violation and tests of the Standard Model"
Nov. 1988	KVI, Groningen	"Signatures of heavy Z bosons in elastic $e^- - p$ scattering"
Feb. 1989	Univ. of Utrecht	"Signatures of heavy Z bosons in elastic $e^- - p$ scattering "
Dec. 1989	Landelijk Seminarium	"Strange currents in the nucleon"
Feb. 1990	CERN	"Low q^2 probes of strangeness in the nucleon"
Mar. 1990	Saclay	"Low q^2 probes of strangeness in the nucleon"
Nov. 1990	Oregon State University	"The strangeness of the proton"
Nov. 1990	Penn State (Workshop)	"Strange quarks in the deuteron"
Feb. 1991	University of Washington	"Hadronic neutral currents, and the structure of nucleons."
Mar. 1991	TRIUMF	"Strange nuclear currents "
Dec. 1991	University of Washington	"Gauge Invariance in pion photoproduction"
Dec. 1991	University of Washington	"Particle and nuclear physics in atomic parity violation"
Jan. 1992	Cal Tech	"Effects of particle and nuclear physics in atomic PNC"
Feb. 1992	Argonne	"Effects of particle and nuclear physics in atomic PNC"
Mar. 1992	CEBAF	"Effects of particle and nuclear physics in atomic PNC"
Mar. 1992	Hampton, and ODU	"The Strangeness of the proton"
Apr. 1992	APS - Wash.	"Atomic PNC: electroweak parameters and nuclear structure"
May. 1992	Los Alamos	"Particle and nuclear physics in atomic PNC"

S. J. Pollock June, 1992

My research interests at the INT remain focussed on electroweak nucleon structure. One underlying motivation has been an interest in the strangeness content of proton and neutron. There is currently some controversy about axial s-quark nucleon matrix elements, and indeed very little is currently known about the analogous vector s-quark matrix elements. I have considered a variety of alternative experimental probes, and their sensitivity to this physics. A secondary motivation has been a more general interest in tests of the standard model, and the use of the nucleon (free, or in nuclei) as a filter to provide such tests in low or medium energy experiments.

My work here has proceeded in five main directions:

1. Neutrino-deuteron scattering

In a continuation of work begun earlier, collaborating here with Ernest Henley and Tobias Frederico, I investigated neutrino-deuteron elastic scattering as a probe of *nucleon* structure. This process is sensitive to interesting axial current matrix elements, as well as currently unknown weak vector matrix elements. Using a covariant body form factor approach, evaluating matrix elements with simple non-relativistic wavefunctions, allows estimates of intermediate energy processes, figures of merit, and sensitivities to the matrix elements of interest. This work was essentially completed in late 1991. Refs [1-4].

2. Gauge invariance in pion photoproduction

In collaboration with Ron Workman and Rik Naus, I have considered the effects of strong interaction vertex corrections on the gauge invariance properties of pion photoproduction amplitudes. It appears that minimal substitution techniques yield the same result as the simplest unmodified Born approach for a certain invariant amplitude. This is in disagreement with certain recipes that multiply Born amplitudes by an average form factor. This work was essentially completed in spring '92. Ref [5]

3.Modeling strangeness in the nucleon

In collaboration with Ernest Henley and Werner Koepf, I have constructed a series of simple hadronic-based nucleon models with which to estimate matrix elements of strange quark operators. Based on a meson-loop picture of nucleon structure, strangeness is built in through virtual kaon loops. The underlying models are a simple pointlike relativistic picture, a nonrelativistic quark model, and an extended cloudy bag model. Results for vector strangeness matrix elements are now completed. Ref [6]

4. Parity violation on single nucleons and nuclei

In collaboration with Bill Donnelly and Mike Musolf at MIT, I have continued investigating the use of parity violating $\vec{e}-p$ and $\vec{e}-d$ elastic scattering, again generally with an emphasis on finding sensitivities to s-quark content. This work has also considered the

need to understand and evaluate radiative as well as nuclear physics corrections, and was done partly with the goal of finding low energy tests of the standard model at the one loop level. We are currently working on a major review paper on this material. Ref [7]

5. Atomic parity nonconservation

In collaboration with L. Wilets and N. Fortson, I have been studying parity nonconservation in heavy atomic systems. The experimental motivation has been to make high precision measurements of $\sin^2\theta_W$, as a complement to direct high energy experiments, and thus to probe radiative corrections including top quark mass effects. My work has examined nuclear structure effects, especially considering the currently fairly poorly known neutron distributions, to see if the uncertainties will allow the desired high precision electroweak physics extractions. I have also investigated the effects of nucleonic internal weak structure in these processes. This work was submitted for publication in spring, '92. Ref [8]

Future Plans

My plans are currently focussed on the latter 3 above mentioned programs. In the case of strangeness models, an obvious extension of the work is to look at the scalar $\bar{s}s$ matrix elements, for which some data already exists. For parity violation, the case of inelastic $\vec{e}$-$p \rightarrow \Delta$ is an interesting extension of my present work. This requires some (possibly model dependent) knowledge of axial transition matrix elements, and could provide an independent low energy measure of $\sin^2\theta_W$ which is much less sensitive to s-quark effects, and thus complements elastic measurements when seeking medium energy tests of the standard model. I am also working on a reanalysis of Brookhaven elastic ν-p data, to measure bounds on vector s-quark matrix elements. Although it is claimed in the literature that these matrix elements are currently unknown, one can in fact extract (loose) bounds from the q^2 dependent data. With atomic parity violation, future work will possibly involve extending the calculations to other (lighter) nuclei, rather than just the lead isotopes considered so far, and a study of the $\mathcal{O}(\alpha)$ QED corrections due to vacuum polarization. I am also interested in extending the study to muonic atoms, whose small size should increase the sensitivity to nuclear and nucleon structure.

References

[1] "Measuring Strangeness Matrix Elements of the Nucleon" E.M. Henley, G. Krein, S.J. Pollock, and A.G. Williams. Physics Letters **B269** (1991) 31. (Abstract submitted to the Gordon Conference "QCD in Nuclear Physics", Tilton, NH, July 22-26, 1991.)

[2] "Neutrino and Antineutrino-deuteron Elastic Scattering and the Axial Isoscalar Nucleon Current" T. Frederico, E.M. Henley, S.J. Pollock, and S. Ying. U.Wash. preprint DOE/ER4042728N91. Submitted to Physical Review C.

[3] "Some Measurement for Determining Strangeness Matrix Elements in the Nucleon" E.M. Henley, T. Frederico, S.J. Pollock, S. Ying, G. Krein, and A.G. Williams. Few-Body Systems, Suppl. 6 (1992) 66 (Abstract in Conference Proceedings of the 13th European Conference on Few Body Problems in Physics, Sept 9-14, 1991. Elba, Italy.)

[4] "Strangeness in Nucleons" E.M. Henley, T. Frederico, W. Koepf, G. Krein, S.J. Pollock, A.G. Williams, and S. Ying. Abstract submitted to LEAP '92 conference, Sept. 14-19, 1992. Courmayeur, Italy.

[5] "On Form Factors and Gauge Invariance in Pion Photoproduction" R. L. Workman, H.W.L. Naus, S.J. Pollock. Phys. Rev. **C45** (1992) 2511

[6] "Strangeness Matrix Elements in the Nucleon" W. Koepf, E.M. Henley, S. Pollock. University of Washington Preprint 40427-15N92. Submitted to Physics Letters.

[7] "Probing the Hadronic Neutral Current with Electron and Neutrino Scattering. J.M. Musolf, T.W. Donnelly, J. Dubach, S. Pollock, S. Kowalski, E.J. Beise. In preparation.

[8] "Atomic Parity Nonconservation: Electroweak Parameters and Nuclear Structure" S.J. Pollock, E.N. Fortson, L. Wilets. Abstract for invited talk submitted to APS Washington meeting, April 20-23, 1992. DOE/ER40561060INT920014, submitted to Phys. Rev. C

Talks since spring '91:

Mar '91 TRIUMF "Strange currents in the nucleon"

Dec '91 U. Washington "Gauge Invariance in pion photoproduction"

Dec '91 U. Washington "Particle and nuclear physics in atomic parity violation"

Jan '92 Cal Tech "Effects of particle and nuclear physics in atomic PNC"

Feb '92 Argonne "Effects of particle and nuclear physics in atomic PNC"

Mar '92 CEBAF "Effects of particle and nuclear physics in atomic PNC"

Mar '92 Hampton, and ODU "The strangeness of the proton"

Apr '92 APS (Wa. D.C) "Atomic PNC: E-weak parameters and nuclear structure"

May '92 Los Alamos "Particle and nuclear physics in atomic PNC"

Bibliography – S. J. Pollock

- "A Scanning 3-axis Squid Magnetometer for Measurement of Sub- Microgauss Magnetic Fields." J. Lockhart, B. Cabrera, E. Cornell, S. Pollock, Proceedings of the 17th International Conference on Low Temperature Physics (15-22 Aug, 1984) North-Holland
- "Elastic Electroweak Processes with Nucleons" S. Pollock, submitted paper to the APS Nuclear physics division. Abstract published in "Bulletin of the American Physical Society" 28-30 October 1985
- "$p(\vec{e}, e)p$ in the Standard Model." S. Pollock, Proceedings of the Parity Violation Workshop (Dec 11-12, 1986) CEBAF
- "Electroweak Interactions with the Nucleon and Tests of the Standard Model." S. Pollock, Nuclear Physics **A461** (1987) 553
- "Electroweak Interactions in the Nuclear Domain." S. Pollock, Stanford University PhD thesis

- "Single Nucleon Coincidence Cross Sections in a Relativistic Mean Field Theory." S. Pollock, Acta Physica Polonica Vol **B19** (1988) 419
- "Signatures of an extra Z^0 gauge boson in elastic e^- - proton scattering." S. Pollock, Phys. Rev **D39** (1989) 163
- "The Spin Structure of the Nucleon and its Evolution " J. Kunz, P.J. Mulders, S. Pollock, Physics Letters **B222** (1989) 481
- "Electron Scattering from a Bound Nucleon." H.W.L. Naus, S. Pollock, J.H. Koch, U.Ölfke, Nuclear Physics A509(1990) 717
- "Polarization experiments at NIKHEF." K. Allart, Th. Bauer, C.W. de Jager, J.H. Koch, J. Konijn, L. Lapikás, P.J. Mulders, S. Pollock, G. van der Steenhoven, H. de Vries. Letter of Intent, NIKHEF 89-E12.
- "Strange Quarks in the Deuteron" S. Pollock. Phys. Rev **D42** (1990) 3010. (Erratum, Phys. Rev **D43** (1991) 2447.)
- "Parity violating e^- deuteron scattering as a probe of the strangeness content of the nucleon" S. Pollock, AIP Conference Proceedings No. 223, Particles and Fields Series 42, 1991 (Polarized Collider Workshop, Ed. Collins, Heppelman, and Robinett) p.335
- "Measuring Strangeness Matrix Elements of the Nucleon" E.M. Henley, G. Krein, S.J. Pollock, and A.G. Williams. Physics Letters **B269** (1991) 31. (Abstract submitted to the Gordon Conference "QCD in Nuclear Physics", Tilton, NH, July 22-26, 1991.)
- "Neutrino and Antineutrino-deuteron Elastic Scattering and the Axial Isoscalar Nucleon Current" T. Frederico, E.M. Henley, S.J. Pollock, and S. Ying. U.Wash. preprint DOE/ER/40427-28-N91. Submitted to Physical Review C.
- "Some Measurement for Determining Strangeness Matrix Elements in the Nucleon" E.M. Henley, T. Frederico, S.J. Pollock, S. Ying, G. Krein, and A.G. Williams. Few-Body Systems, Suppl. 6 (1992) 66 (Abstract in Conference Proceedings of the 13th European Conference on Few Body Problems in Physics, Sept 9-14, 1991. Elba, Italy.)
- "Atomic Parity Nonconservation: Electroweak Parameters and Nuclear Structure" S.J. Pollock, E.N. Fortson, L. Wilets. Abstract for invited talk submitted to APS Washington meeting, April 20-23, 1992. DOE/ER/40561-060-INT92-00-14, submitted to Phys. Rev. C
- "On Form Factors and Gauge Invariance in Pion Photoproduction" R. L. Workman, H.W.L. Naus, S.J. Pollock. Phys. Rev. **C45** (1992) 2511
- "Strangeness Matrix Elements in the Nucleon" W. Koepf, E.M. Henley, S. Pollock. University of Washington Preprint 40427-15-N92. Submitted to Physics Letters.
- "Strangeness in Nucleons" E.M. Henley, T. Frederico, W. Koepf, G. Krein, S.J. Pollock, A.G. Williams, and S. Ying. Abstract submitted to LEAP '92 conference, Sept. 14-19, 1992. Courmayeur, Italy.

CURRICULUM VITAE

Michael Herrmann

Personal

[redacted]

Citizenship: German

Current Address

National Institute for Nuclear Theory
University of Washington, HN-12
Seattle, WA 98195

Education

Dr. rer. nat.	Technische Hochschule Darmstadt	
April 1992	Thesis Advisor:	Prof. Wolfgang Nörenberg
	Thesis Title:	*Eigenschaften des ρ-Mesons in dichter Kernmaterie*
Diplom	Technische Hochschule Darmstadt	
May 1989	Thesis Advisor:	Prof. Wolfgang Nörenberg
	Thesis Title:	*Paarerzeugung in einem endlichen dynamischen System*
Vordiplom	Technische Universität Braunschweig	
October 1985	Major: Physics	

Experience

Sep. 92 - present	Research associate Institute for Nuclear Theory (INT) Seattle
Feb. 92 - Sep. 92	Research associate Gesellschaft für Schwerionenforschung (GSI) Darmstadt
May 89 - Jan. 92	Research assistant Gesellschaft für Schwerionenforschung (GSI) Darmstadt
Oct. 89 - Mar. 90	Teaching assistant for Theoretical Nuclear Physics Institut für Kernphysik TH Darmstadt
Oct. 87 - Mar. 88	Teaching assistant for Theoretical Nuclear Physics Institut für Kernphysik TH Darmstadt
Oct. 86 - Mar. 87	Teaching assistant for Theoretical Mechanics Institut für Theoretische Physik TU Braunschweig
Apr. 86 - Sep. 86	Teaching assistant for Scientific Computing Institut für Theoretische Physik TU Braunschweig
Oct. 85 - Mar. 86	Teaching assistant for Mathematics Institut für theoretische und praktische Informatik TU Braunschweig

Scholarship

Sept. 92 - present	*Feodor-Lynen-Fellow* of the German *Alexander von Humboldt* foundation

List of Publications

Publications

1) M. Herrmann
Paarerzeugung in einem endlichen dynamischen System
Diploma Thesis, TH Darmstadt, GSI Report 1989

2) M. Herrmann and J. Knoll
Space-time Effects in the Decay of Strings by Pair-Creation
Phys. Lett. **B 234** (1990) p. 437-443

3) M. Herrmann
Eigenschaften des ρ-Mesons in dichter Kernmaterie
PhD-Thesis, TH Darmstadt, GSI Report 92-10

4) M. Herrmann, B.L. Friman, and W. Nörenberg
Properties of the ρ-Meson in Dense Nuclear Matter
Z. Phys. **A 343** (1992) p. 119-120

5) M. Herrmann, B.L. Friman, and W. Nörenberg
Properties of ρ-Mesons in Nuclear Matter
GSI-preprint GSI-93-12 and Nucl. Phys. **A** (*in print*)

Talks at Workshops

1) M. Herrmann, B.L. Friman, and W. Nörenberg
Dilepton Production by $\pi^+\pi^-$ Annihilation in Hot and Dense Matter, in *Proc. of the 4th Journ'ees des Th'eoriciens*, Saturne, Saclay, 1990, p. 84-91

2) M. Herrmann, B.L. Friman, and W. Nörenberg
Dilepton Production by $\pi^+\pi^-$ Annihilation in Hot and Dense Matter, in *Proc. of the International Worshop on Gross Properties of Nuclei and Nuclear Excitations XIX*, Hirschegg, Austria, 1991, ed. H. Feldmeier, p. 134-141

3) M. Herrmann, B.L.Friman, and W. Nörenberg
Dilepton Production by π^+ π^- Annihilation in Hot and Dense Matter, in *Proc. International Workshop on Pions in Nuclei*, Penyscola, Spain, 1991, ed. E. Oset, M.J. Vicente Vacas, and C. Garcia Recio, p. 690-694

Contributions to Workshops

1) M. Herrmann, B.L. Friman, and W. Nörenberg
Properties of the ρ-Meson in Dense Nuclear Matter, in *Proc. of the International Worshop on Gross Properties of Nuclei and Nuclear Excitations XX*, Hirschegg, Austria, 1992, ed. H. Feldmeier, p. 178-182

2) M. Herrmann, B.L. Friman, and W. Nörenberg
ρ-mesons in dense nuclear matter, in *International Workshop on Dynamical Fluctuations and Correlations in Nuclear Collisions*, Aussois, France, March 16-20 1992,
Nucl. Phys. **A 545** (1992) p. 267c-270c

SUMMARY

Since my arrival in Seattle in the middle of September 1992, I have been studying several aspects of "many-particle dynamics in heavy ion collisions". I am performing these studies in collaboration with Prof. G.F. Bertsch.

- An important tool to investigate many particle effects is the measurement of correlation functions. Recently correlations of like-charged pions have received great interest.

  The quantum statistics of these particles gives the unique possibility to get information about the space and time extension of the collision zone. The existing analysis of experiments is mostly based on a (quasi-) classical treatment assuming noncoherent emissions. The goal of our study is to test whether these assumptions are justified for the description of heavy ion collisions.

- To identify signals of an quark gluon plasma which is sought to be produced in ultra-relativistic heavy ion collisions at CERN or RHIC one has to understand the behavior of a hot meson gas.

  The experimentally observed enhancement of pions with small tranverse momenta could be caused by a transition from quark gluon plasma to a gas of hadrons that is not in chemical equilibrium.

  However, there are presently no simulations available that include the dynamical processes that give rise to a change of the chemical composition of a hadron gas.

  Using different models for the interaction of hadrons we estimate the relevant time-scale for equilibration.

APPENDIX J

Curriculum Vitae

Thomas Meissner

[redacted] as first son of the post officer Walter Meissner and his wife Elfriede

confession: lutherian

1968-1981: visiting elementary school and high school (Hans-Sachs-Gymnasium) in Nuernberg

1981: Abitur at the Hans-Sachs-Gymnasium in Nuernberg

1981-1987: studying physics at the Universities of Erlangen and Bonn, Germany.

1986-1989: working at the Forschungszentrum Juelich, Germany in the theory group of Prof. Dr.Klaus Goeke

1987: Diploma Thesis at the University of Bonn on *Roper Resonance and GCM in the Linear Chiral Sigma Model.*

1989-1992: working as scientific university assistent at the University of Bochum, Germany with Prof.Dr.Klaus Goeke

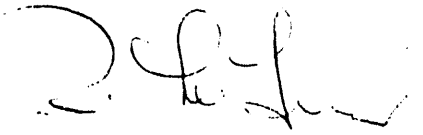
July 1991: PhD at the Univesity of Bochum on *The Nucleon as Soliton in an Effective Chiral Model with Polarized Diracsea*

Scientific research stays at the Forschungszentrum Rossendorf, Germany (November 1989) and the Chalk River Nuclear Laboratories, Canada (September 1991)

since September 1992: scholarship from the Alexander-von-Humboldt foundation for a postdoctoral fellowship at the Uni-

versity of Washington (Institute for Nuclear Theory), Seattle, on invitation by Prof.Dr.E.Henley

currently working with Prof.Dr.E.Henley on the *Application of QCD Sum Rules in Hadronic and Nuclear Physics*



Thomas Meissner

Talks and Conference Contributions

[1] Spring Meetings of the German Physical Society (DPG):
1988 Berlin
1989 Bonn
1990 Straßburg
1991 Darmstadt

[2] October 1989: Workshop on the Nambu-Jona-Lasinio Model at the Institute for Nuclear Physics at the Forschungszentrum Juelich

[3] November 1989: Seminar Talk at the Forschungszentrum Rossendorf (Dresden)

[4] February 1990: Short Contribution at the Les Houches Winter School on *Hadronic Physics with Multi-GeV Electrons* (France)

[5] September 1991: Seminar Talk at the Chalk River Nuclear Laboratories (Canada)

[6] September 1991: Seminar Talk at the Institute for Theoretical Physics of McMasters University, Hamilton (Canada)

[7] June 1992: Short Contribution to the Workshop *QCD 20 years later* in Aachen

[8] July 1992: Contribution to the Workshop *Quark Cluster Dynamics* in Bad Honnef (proceedings published as *Springer Lecture Notes in Physics* no.417, ed.by K.Goeke et.al.)

Publications

Journals:

[1] Th.Meißner, E.Ruiz Arriola, Grümmer, K. Goeke, H.Mavromatis
Phys. Lett. **B 214** (1988) 312
Sea quark effects in non-topological chiral soliton models and the Nambu-Jona-Lasinio approach

[2] Th.Meißner, F. Grümmer, K. Goeke, M.Harvey *Phys.Rev.* **D 39** (1989) 1903
Roper resonances and generator coordinate method in the chiral soliton model

[3] Th.Meißner, F. Grümmer, K. Goeke *Phys.Lett.* **B 227** (1989) 296
Solitons in the Nambu-Jona-Lasinio model

[4] Th.Meißner, F. Grümmer, K. Goeke *Ann.of Phys. 202,2* (1990) 297
Sea and Valence Quarks in the Nambu-Jona-Lasinio Model

[5] Th.Meißner, E.Ruiz Arriola, K. Goeke *Z.Phys.* **A 336**(1990) 91
Regularization scheme dependence of vacuum observables in the Nambu-Jona-Lasinio model

[6] A.Blotz, F.Döring, Th.Meißner, K. Goeke *Phys.Lett.* **B 251** (1990) 235
A consistent description of momentum-regularized solitonic solutions in the Nambu-Jona-Lasinio model

[7] Th.Meißner, K.Goeke *Nucl.Phys.* **A 524** (1991) 719
Solitonic solutions of the Nambu-Jona-Lasinio model: Selfconistency and mean-field quantities

[8] K.Goeke, A.Gorski, F.Grümmer, Th.Meißner, H.Reinhardt, R.Wünsch
Phys.Lett **B 256** (1991) 321
Quantization of the Nambu-Jona-Lasinio soliton and the nucleon-delta splitting

[9] Th.Meißner, K.Goeke *Z.Phys.* **A 339** (1991) 513
The axial form factor in the Nambu-Jona-Lasinio model

[10] F.Döring, A.Blotz, C.Schüren, Th.Meißner, E.Ruiz Arriola, K.Goeke
Nucl.Phys. **A 536** (1992) 548
The connection between soliton and vacuum regularization in the Nambu-Jona-Lasinio model

[11] P.V.Pobylitsa, E.Ruiz Arriola, Th.Meißner, F.Grümmer, K.Goeke, W.Broniowski
Journ.of Phys **G 18** (1992) 1455
Static and inertial mass of the nucleon in the Nambu-Jona-Lasinio model and the zero point energy

[12] P.Sieber, Th.Meißner, F.Grümmer, K.Goeke *Nucl.Phys.* **A 547** (1992) 459
The Collapse in the Solitonic Sector of the Linear Nambu-Jona-Lasinio-Model

[13] Th.Meißner, G.Ripka, R.Wünsch, P.Sieber, F.Grümmer, K.Goeke
Phys.Lett. **B 299** (1993) 183
Scale Invariance and the Stability of a Hedgehog Soliton

[14] T.Hatsuda, E.Henley, Th.Meißner, G.Krein
preprint DOE/ER/40561-103-INT93-00-36; DOE/ER/40427-09-N93
subm. to *Phys.Rev.* **C**
The Off-Shell ρ-ω Mixing in the QCS Sum Rules

Invited Articles:

[15] Th.Meißner, E.Ruiz Arriola, A.Blotz, K.Goeke
Ruhr University Bochum report No. RUB-TPII-42/93
to be published in *Rep.Prog.Phys.*
Baryons in Effective Chiral Quark Models with Polarized Dirac Sea

PhD-Thesis:

[16] Th.Meißner: *Das Nukleon als Soliton in einer effektiven chiralen Theorie mit polarisiertem Diracsee*
Forschungszentrum Jülich Gmbh: Jül-2501; July 1991; ISSN 0366-0885

INT Register of INT Preprints

INT Register # DOE/ER/40561-044 - INT92 - 00 - 02 **NT #**

Title Regeneration and Stopping of (alpha mu) in a Degenerate Plasma

Author(s) David Harley

Publication Reference Physical Review A 45, 12 (1992)8981-8983

INT Register # DOE/ER/40561-045 - INT91 - 05 - 15 **NT #** DOE/ER-40427-26-N91

Title Color Transparency Phenomenon and Nuclear Physics

Author(s) Gerald A. Miller; Leonid Frankfurt; Mark Strikman

Publication Reference Comments Nuclear Particle Physics, 21,1 (1992) 1-39

INT Register # DOE/ER/40561-050 - INT92 - 00 - 14 **NT #** DOE/ER/40427-09-N92

Title Atomic Parity Nonconservation: Electroweak Parameters and Nuclear Structure

Author(s) Steven J. Pollock, E.N. Fortson, Lawrence Wilets

Publication Reference pending:Physical Review C

INT Register # DOE/ER/40561-054 - INT92 - 06 - 03 **NT #**

Title Comment on QCD Effects in the Nuclear Medium, the Effective Nucleon Mass and the Nolen-Schiffer Anomaly

Author(s) Naftali Auerbach

Publication Reference Physics Letters B 282 (1992) 263-266

INT Register of INT Preprints

INT Register # DOE/ER/40561-055 - INT91 - 05 - 16 **NT #**

Title Model-Independent Connections Between Pion Photoproduction and Compton Scattering in the Δ (1232) Region

Author(s) M. Benmerrouche and Nimai Mukhopadhyay

Publication Reference pending: Physical Review D

INT Register # DOE/ER/40561-056 - INT92 - 07 - 01 **NT #**

Title Neutrino Oscillations at High Densities

Author(s) James Pantaleone

Publication Reference pending: Physics Letters B

INT Register # DOE/ER/40561-057 - INT92 - 00 - 18 **NT #** DOE/ER-40427-07-N92

Title First Forbidden Beta-Decays as a Probe of T-Odd Nuclear Forces

Author(s) Ernest M. Henley, Iosif Khriplovich

Publication Reference

INT Register # DOE/ER/40561-058 - INT92 - 00 - 19 **NT #** DOE/ER-40427-15-N92

Title Strangeness Matrix Elements in the Nucleon

Author(s) Werner Koepf, Ernest M. Henley, Steven Pollock

Publication Reference pending: Physics Letters B

INT Register of INT Preprints

INT Register # DOE/ER/40561-059 - INT92 - 07 - 02 **NT #**

Title Electron-neutrino Appearance for "Muon-neutrino - Tau-neutrino" Oscillations in Matter

Author(s) James Pantaleone

Publication Reference pending: Physics Letters B

INT Register # DOE/ER/40561-060 - INT92 - 07 - 03 **NT #**

Title General Results for the Decays D ---> $\pi\ell\,\nu$ and B ---> $\pi\ell\,\nu$

Author(s) Lincoln Wolfenstein

Publication Reference

INT Register # DOE/ER/40561-061 - INT92 - 07 - 04 **NT #**

Title Neutron Electric Dipole Moment Due to Higgs Exchange in Left-Right Symmetric Models

Author(s) D. Chang, Ziao-Gang He, W.-Y. Keung, Bruce H.J. McKellar, Daniel Wyler

Publication Reference

INT Register # DOE/ER/40561-062 - INT92 - 07 - 05 **NT #**

Title Relativistic Corrections to the Neutron Electric Dipole Moment in Valence Quark Models

Author(s) John P. Costella , Bruce H.J. McKellar

Publication Reference

INT Register of INT Preprints

INT Register # DOE/ER/40561-063 - INT92 - 07 - 06 **NT #**

Title Master Equations for Oscillating Doublet Neutrinos

Author(s) Bruce H.J. McKellar, M.N. Thomson

Publication Reference

INT Register # DOE/ER/40561-064 - INT92 - 07 - 07 **NT #**

Title Chiral Symmetry and Nucleon Structure

Author(s) Barry R. Holstein

Publication Reference

INT Register # DOE/ER/40561-065 - INT92 - 07 - 08 **NT #**

Title Components of a Chiral Coefficient

Author(s) John F. Donoghue, and Barry R. Holstein

Publication Reference

INT Register # DOE/ER/40561-066 - INT92 - 07 - 09 **NT #**

Title Electromagnetic Polarizability of the Nucleon

Author(s) Barry R. Holstein

Publication Reference

INT Register of INT Preprints

INT Register # DOE/ER/40561-067 - INT92 - 07 - 10 **NT #**

Title Low Energy Theorems in Pion Production

Author(s) Barry R. Holstein

Publication Reference

INT Register # DOE/ER/40561-069 - INT92 - 00 - 20 **NT #**

Title Gamma Emission in Precompound Reactions
I. Statistical Model and Collective Gamma Decay

Author(s) Antje Höring, and Hans Weidenmüller

Publication Reference

INT Register # DOE/ER/40561-070 - INT92 - 00 - 21 **NT #**

Title Gamma Emission in Precompound Reactions
II Numerical Application

Author(s) M. Herman, Antje Höring, and G. Reffo

Publication Reference

INT Register # DOE/ER/40561-071 - INT92 - 00 - 22 **NT #**

Title Form Factors and Gauge Invariance in Pion Photoproduction

Author(s) Ron. L. Workman, H.W.L. Naus, Steven J. Pollock

Publication Reference Physical Review C 45, 2511(1992)

INT Register of INT Preprints

INT Register # DOE/ER/40561-072 - INT92 - 00 - 23 **NT #** DOE/ER/40427-18-N92

Title Stellar Neutrinos

Author(s) Wick C. Haxton

Publication Reference

INT Register # DOE/ER/40561-073 - INT92 - 00 - 24 **NT #** DOE/ER/40427-21-N92

Title Double Beta Decay: Comparison of Theory to Experiment

Author(s) Wick C. Haxton

Publication Reference

INT Register # DOE/ER/40561-074 - INT92 - 00 - 25 **NT #** DOE/ER/40427-22-N92

Title Shape Coexistence, Lanczos Techniques, and Large-Basis Shell-Model Calculations

Author(s) Wick C. Haxton

Publication Reference

INT Register # DOE/ER/40561-075 - INT92 - 08 - 01 **NT #**

Title Semi-Empirical Mass Formula for Drops of Strange Matter and Constrains from Recent Experiments

Author(s) Mukesh S. Desai, Henry J. Crawford, Gordon L. Shaw

Publication Reference

INT Register of INT Preprints

INT Register # DOE/ER/40561-076 - INT92 - 00 - 26 **NT #**

Title The SU(3)-Nambu-Jona-Lasinio Soliton in the Collective Quantization Formulation

Author(s) Andree Blotz,D. Diakonov, Klaus Goeke, N.W. Park, V. Petrov, P.W. Pobylitsa

Publication Reference

INT Register # DOE/ER/40561-077 - INT92 - 07 - 11 **NT #**

Title Solar Neutrinos with Three Flavor Mixings

Author(s) David Harley, T.K. Kuo, James Pantaleone

Publication Reference

INT Register # DOE/ER/40561-078 - INT92 - 07 - 12 **NT #** DOE/ER/40427-26-N92

Title Effective Summation Over Intermediate States in Double-Beta Decay

Author(s) Jonathan Engel, Wick C. Haxton, Petr Vogel

Publication Reference Phys. Rev. C46, R2153, (1992)

INT Register # DOE/ER/40561-079 - INT92 - 00 - 27 **NT #** DOE/ER/40427-17-N92

Title QCD Sum Rules for Nucleon Current in a Nucleus

Author(s) Ernest M. Henley, J. Pasupathy

Publication Reference

INT Register of INT Preprints

INT Register # DOE/ER/40561-080 - INT92 - 00 - 28 **NT #** DOE/ER/40427-27-N92

Title Nuclear Astrophysics

Author(s) Wick Haxton

Publication Reference

INT Register # DOE/ER/40561-081 - INT92 - 09 - 01 **NT #**

Title Normalization for the RPA with Energy-Dependent Interactions

Author(s) Klaas Allaart, Paul J. Ellis, W.J.W. Geurts, Jifa Hao, Thomas T.S. Kuo, and G.A. Rijsdijk

Publication Reference Physical Review C 47, 2 (1993)

INT Register # DOE/ER/40561-082 - INT92 - 09 - 02 **NT #**

Title Self-Gravitating Symplectic Systems

Author(s) George Rosensteel

Publication Reference

INT Register # DOE/ER/40561-083 - INT92 - 09 - 03 **NT #**

Title Lax Representation of Riemann Ellipsoids

Author(s) George Rosensteel

Publication Reference

INT Register of INT Preprints

INT Register # DOE/ER/40561-084 - INT92 - 09 - 04 **NT #** DOE/ER-40427-31-N92

Title The Fractional Quantum Hall Effect and the Rotation Group

Author(s) Joseph N. Ginocchio and Wick C. Haxton

Publication Reference

INT Register # DOE/ER/40561-085 - INT92 - 09 - 05 **NT #**

Title Hermitian Effective Interactions Derived from the Paris and Bonn Potentials

Author(s) Thomas T.S. Kuo, Paul J. Ellis, Jifa Hao, Zibang Li, K. Suzuki, R. Okamoto, and H. Kumagai

Publication Reference

INT Register # DOE/ER/40561-086 - INT92 - 09 - 06 **NT #**

Title Group O(4) in the Nuclear IBA Model

Author(s) Pertti O. Lipas

Publication Reference

INT Register # DOE/ER/40561-087 - INT92 - 00 - 29 **NT #**

Title Scale Invariance and the Stability of a Hedgehog Soliton

Author(s) Thomas Meissner, G. Ripka, R. Wünsch, P. Sieber, F. Grümmer, and Klaus Goeke

Publication Reference Physics Letters B 299 (1993) 183-185

INT Register of INT Preprints

INT Register # DOE/ER/40561-088 - INT92 - 00 - 30 **NT #**

Title The 12C(n,p)12B Reaction at En=98 MeV

Author(s) Olsson,Condé, Ramström, Rönnqvist, Zorro, Blomgren, Håkansson, Tibell, Jonsson, Nilsson, Renberg, Brockstedt, Ekström, Oesterlund, Van der Werf,

Publication Reference

INT Register # DOE/ER/40561-089 - INT92 - 09 - 07 **NT #**

Title Origin of the Non-Hermiticity of Effective Interactions

Author(s) Kenji Suzuki, Ryoji Okamoto, Paul J. Ellis, Jifa Hao, Zibang Li, and Thomas T.S. Kuo

Publication Reference

INT Register # DOE/ER/40561-090 - INT92 - 09 - 08 **NT #**

Title Finite Temperature Many-Body Theory with the Lipkin Model

Author(s) S.Y. Tsay Tzeng, Paul J. Ellis, Thomas T.S. Kuo, Eivind Osnes

Publication Reference

INT Register # DOE/ER/40561-091 - INT92 - 09 - 09 **NT #**

Title Kelvin Circulation in a Cranked Anisotropic Oscillator + BCS Mean Field

Author(s) George Rosensteel, and A.L. Goodman

Publication Reference

INT Register of INT Preprints

INT Register # DOE/ER/40561-092 - INT92 - 09 - 10 **NT #**

Title Exact Solutions of Model Hamiltonian Problems with Effective Interactions

Author(s) Dao-Chen Zheng, James P. Vary, and Bruce R. Barrett

Publication Reference

INT Register # DOE/ER/40561-093 - INT92 - 09 - 11 **NT #**

Title Energy Difference of T=1 and T=0 J=0- States in 16O: Effects of the Tensor Interaction, Configuration Mixing, and Density-Dependent Dirac Spinors

Author(s) Dao-Chen Zheng, L. Zamick and H. Müther

Publication Reference

INT Register # DOE/ER/40561-094 - INT92 - 06 - 04 **NT #**

Title Absorption Contribution to the Pion Double-Charge-Exchange Reaction

Author(s) Eulogio Oset, Mikael Khankhasayev, Juan Nieves, H. Sarafian, Manuel J. Vicente-Vacas

Publication Reference Physical Review C 46, 6 (1992)

INT Register # DOE/ER/40561-095 - INT93 - 00 - 32 **NT #**

Title Future High Precision Experiments and New Physics Beyond Standard Model

Author(s) Mingxing Luo

Publication Reference

INT Register of INT Preprints

INT Register # DOE/ER/40561-096 - INT92 - 08 - 02 **NT #**

Title A Generalized Bethe-Weizsäcker Mass Formula for Strange Hadronic Matter

Author(s) Carl B. Dover, and Avraham Gal

Publication Reference

INT Register # DOE/ER/40561-097 - INT93 - 00 - 31 **NT #** DOE/ER/40427-02-N93

Title Time-Reversal-Noninvariant, Parity-Conserving Nuclear Interactions

Author(s) Wick C. Haxton and Antje Höring

Publication Reference

INT Register # DOE/ER/40561-098 - INT92 - 00 - 33 **NT #**

Title Finite Temperature QCD Sum Rules Reexamined -- ρ, ω and A1 Mesons

Author(s) Tetsuo Hatsuda, Yuji Koike, and Su Houng Lee

Publication Reference Nuclear Physics B394(1993) 221-264

Institute for Nuclear Theory

University of Washington
Seattle, WA 98195

Program 7 - Fundamental Interactions in Nuclei

1 February 1992 - 31 May 1992
Organizers: B.R. Holstein (UMass) and W. Haxton (UW)

Final Report

Scientific Program:

The four-month program Fundamental Symmetries in Nuclei concentrated on aspects of symmetry relevant to contemporary experimental nuclear physics. A wide range of topics was covered by the various participants, and no emphasis was associated with any particular time slot in the program. Nevertheless, there were a number of areas which received considerable attention:

i) *Neutrino Physics*: There are a number of critical issues here. One deals with the anomalous dearth of (high energy) neutrinos from the sun and its possible interpretation in terms of mixing scenarios or of the possible existence of a neutrino magnetic moment. Also receiving attention was the role of neutrinos in carrying away energy from supernova processes. Of great interest was the implication of a possible neutrino mass. In this respect, the careful beta spectral measurements indicating the possible presence of a seventeen KeV species as well as the negative results in the eV range generated a good deal of discussion. Finally, the use of double beta decay as a probe of the age of the universe and of the Majorana character of the neutrino was discussed.

ii) *CP/T Violation*: A second area generating a great deal of interest was that of CP and/or T violation in the nuclear medium. The goal here is to discover some sort of signal in any system other than that of K^0 - $\bar{K}^0$ decay. After a general overview of the field, various approaches were presented including studies of triple product correlations in nuclear beta decay and muon capture processes as well as in neutron-nuclear scattering and hyperon

Wyler). Solar Neutrino Constants (J. Pantaleone and D. Harley); Chiral Molecules (I. Khriplovich and M. Pospelov); Neutron Electric Dipole Moment Calculations (B. McKellar and J. Castella).

Administrative Summary:

It was decided from the inception of program planning to attempt to operate Program 7 in a mode somewhat different from previous ones: i.e., to attempt to recruit a small but distinguished group of researchers who would spend essentially the entire four months at the INT. This was successful in that six physicists (Holstein, Khriplovich, McKellar, Pantaleone, Herczeg and Wolfenstein) were able to spend three or more months in Seattle. The advantages in having such a stable core of long-term participants is apparent. However, there was also an associated disadvantage in that this option commits a large fraction of program funds (~ 65%) to a small group, reducing the money available for shorter term visitors. Nevertheless, I think this mode was a successful one. Indeed we were able to support thirty-five additional physicist for terms ranging from one to eight weeks. This group included twenty-two senior researchers, four graduate students and nine post-docs/junior faculty. On the average about a dozen visitors were present at any given time and overcrowding was not a problem. About $110K was available for the program of which $120K was spent! Even so, a significant number of applications had to be rejected.

The program format consisted of three to four seminars each week, which were held in the morning in the fifth floor meeting room or on Friday afternoon in the Physics Department for talks of a more general interest. The morning format was useful in that it encouraged a continued discussion of the seminar topic at the ensuing lunch. In addition to INT seminars many visitors also participated in a Thursday bag lunch with members of the nuclear theory group as well as in the Monday Gravity/Levity bag lunch. In fact, this program of possible activities together with the rich departmental seminar program made sometimes for a level of activity which was almost "too much". However, this was the exception rather than the norm and most participants were quite

pleased with the opportunity both for interaction and to get work done unencumbered by the usual ringing telephone and other interruptions.

The comments by participants were uniformly positive about their INT experience. Of course, there were the usual problems with the lack of a dedicated seminar space and with the distance of library facilities. However, this will surely be alleviated when the "new improved" INT opens in 1994. Also the lack of space (other than the mail room) for informal discussion was noted. This too should not be a problem after the move to the new building. A few random suggestions include: i) purchase a large chart of nuclei for the wall; ii) connect the library MAC to a printer; iii) pay people who make coffee more than once a day (!!). Since most participants stay at the University Motel, I pass along a final quote by one visitor: "The University Motel room was excellent but the manager and (particularly) his wife seemed to go out of their way to be difficult and unpleasant."

From an organizer's standpoint, the efficient and very cordial INT staff made the administration of this program very efficient and remarkably painless.

Institute for Nuclear Theory
University of Washington
Henderson Hall, HN-12, Seattle, WA 98195

Fundamental Symmetries in Nuclei
February 8, 1992 to May 31, 1992

Program 7 Participants

Balantekin, Baha *University of Wisconsin* ..... April 23 - May 7
May 11 - May 23

Bilenky, Samoil *Joint Institute for Nuclear Research-Moscow* ..... April 9 - April 29

Bowman, J. David *Los Alamos National Laboratory* ..... April 29 - May 1

Bryman, Douglas *TRIUMF* ..... May 21 - May 23

Chupp, Timothy *University of Michigan* ..... May 23 - May 30

Cline, David *University of California at Los Angeles* ..... May 18 - May 22

Costella, John *University of Melbourne* ..... April 5 - June 1

Desplanques, Bertrand *Institut des Sciences Nucléaires-Grenoble* ..... April 15 - April 26

Deutsch, Jules *University of Louvain* ..... April 8 - April 18

Engel, Jon *University of Delaware* ..... March 1 - March 24

Flambaum, Victor *University of New South Wales* ..... Feb. 2 - Feb. 22

He, Xiao-gang *University of Melbourne* ..... March 13 - April 4

Herczeg, Peter *Los Alamos National Laboratory* ..... Feb. 17 - June 1

Holstein, Barry *University of Massachusetts at Amherst* ..... Feb. 3 - May 31

James, Jessica *University of Oxford* ..... March 26 - April 29

Johnson, Walter *University of Notre Dame* ..... March 31 - May 3

Kabir, Prabahan *University of Virginia* ..... April 28 - May 10

Kayser, Boris *National Science Foundation* ..... March 22 - March 28

Kennedy, Dallas *Fermilab* ..... March 16 - March 30

Khriplovich, Iosif *Novosibirsk* ..... Jan. 1 - April 30

Kostyuk, Svyatoslav *Novosibirsk* ..... April 5 - May 31

McKellar, Bruce *University of Melbourne* ..... March 7 - June 29

Meissner, Ulf *University of Bern* ..... April 22 - May 9

Millener, John *Brookhaven National Lab* ..... April 7 - May 31

Morita, Masato *Josai University* ..... March 9 - March 26

Morita, Reiko *Josai University* ..... March 9 - March 26

Mukhopadhyay, Nimai *Rensselaer Polytechnic Institute* ..... May 3 - May 23

Musolf, Michael *Massachusetts Institute of Technology* ..... May 11 - May 31

Pantaleone, Jim *University of California at Riverside* ..... Jan. 28 - June 1

University of Washington
Institute for Nuclear Theory
Henderson Hall, HN-12
Seattle, WA 98195

Program VII Seminars

Fundamental Symmetries in Nuclei
February 8 to May 31, 1992

Week 1: No Seminars Scheduled

Week 2:

Wednesday, Feb. 19	**Dynamical Enhancement of Weak Interactions** Victor Flambaum, University of New South Wales
Friday, Feb. 21	**Measurements of the Nucleon Polarizability** Alan Nathan, University of Washington

Week 3:

Monday, Feb. 24	**Search for Direct CP Violation** Lincoln Wolfenstein, Carnegie Mellon University
Wednesday, Feb. 26	**Nuclear Tests of Chiral Symmetry** Barry Holstein, University of Massachusetts
Friday, Feb. 28	**Measurement of Recoil Form Factors and Symmetry Tests in A=8 Nuclei** Ludwig de Braeckeleer, University of Washington

Week 4:

Monday, March 2	**Spin Content of the Proton** Steven Bass, University of Washington
Wednesday, March 4	**37Ca Beta Decay: Is the Gamow-Teller Coupling Renormalized in Nuclei?** Eric Adelberger, University of Washington.
Friday, March 6	**Neutron Electric Dipole Moment Calculations** Iosif Khriplovich, University of Michigan

Week 5:

Monday, March 9

The Nuclear Structure Dependence of Radiative Corrections in Superallowed Fermi Decay
Ian Towner, Chalk River Labs

Wednesday, March 11

Nuclear Physics and Dark Matter
Jon Engel, University of Delaware.

Friday, March 13

Non-Mesonic Hypernuclear Weak Decay and Possible Violation of the Delta I=1/2 Rule
Reinhard Schumacher, University of Washington

Week 6:

Monday, March 16

Optical Model Description of Parity Nonconserving Neutron Scattering
Petr Vogel, Caltech

Wednesday, March 18

Particle Physic Implications of High Accuracy Analysis of Parity Nonconservation in Cesium
Jonathan Sapirstein, Notre Dame

Thursday, March 19

A Search for mu --> e + gamma and a New Determiination of the Michel Parameter rho
Robert Tribble, Texas A&M

Week 7:

Monday, March 23

What's (m) up?
Daniel Wyler, University of Zurich

Tuesday, March 24

Symmetry Tests in the Nucleon- Nucleon System
Willem van Oers, University of Manitoba

Wednesday, March 25

Recent Investigations on the Structure of the Weak Nucleon Current
Masato Morita, Josai University

Precision Tests of Electroweak Interactions
Dallas Kennedy, Fermilab

Thursday, March 26

Quantum Mechanics of Neutrinos at High Density
Jim Pantaleone, University of California at Riverside

Friday, March 27

Quark-Lepton Families Understood (?)
Denys Wilkinson, University of Washington

Friday, March 27	**Physics of a 17 KeV Neutrino** Boris Kayser, Nat'l Science Foundation
Week 8:	
Monday, March 30	**CP Violating eN Interactions** Xiao-gang He, University of Melbourne
Wednesday, April 1	**Variations on the Aharonov-Bohm Effect** Barry Holstein, University of Massachussetts
Friday, April 3	**Muonium to Antimuonium Conversstion and Exotic Muon Decay in Left-Right Symmetric Models** Peter Herczeg, LANL
Week 9:	
Monday, April 6	**CP Violation in Nonleptonic Lambda Decay** Gerald Miller, University of Washington
Wednesday, April 8	**Measurements of Strangenss Matrix Elements of the Nucleon** Ernest Henley, University of Washington
Friday, April 10	**CP Violating NN Interaction** Bruce McKellar, University of Melbourne
Week 10:	
Tuesday April 14	**Anapoles and Tetrapoles** Patrick Sandars, Oxford University **Long Baseline Neutrino Oscillation Experiments** James Pantaleone, UC Riverside
Thursday, April 16	**Search for T-Violation in Nuclear Muon-Capture: Why and How?** Jules Deutsch, University of Louvain
Friday, April 17	**Atomic Parity and Time Reversal Experiment at UW** E. Norval Fortson, University of Washington.

Week 11:

Tuesday, April 21	**Nuclear Parity Violation** Bertrand Desplanques, ISN, Grenoble
Thursday April 23	**Effects of Isotope Shifts on Atomic Parity Nonconservation** Jessica James, University of Oxford
Friday April 24	**Tests of Parity and Time Reversal with Cold Neutrons** Steve Lamoreaux, University of Washington

Week 12:

Monday, April 27	**Neutral Currents and Strangeness of the Nucleon** Samoil Bilenky, University of Valencia
Tuesday, April 28	**Atomic Structure Calculations for Parity Violation Studies in Atomic Cs** Walter Johnson, University of Notre Dame
Wednesday, April 29	**Quadrupole P-Odd Electron-Nucleus Interaction** Maksim Pospelov, Novosibirsk
Thursday, April 30	**The Compound Nucleus: Statistics and Tests of Fundamental Symmetries** Steve Tomsovic, University of Washington
Friday, May 1	**Parity Violation in the Compound Nucleus** J. David Bowman, LANL

Week 13:

Monday, May 4	**Chiral Corrections to Photon-Nucleon Processes** Ulf Meissner, University of Bern
Tuesday, May 5	**The Rules of Baseball** Jerry Miller, University of Washington
Wednesday, May 6	**Quaternions in Quantum Mechanics** Bruce McKeller, University of Melbourne
Thursday, May 7	**Electromagnetic Deflection of Spinning Particles** John Costella, University of Melbourne

Friday, May 8	**T-Tests with Polarized Neutrons** Pasha Kabir, Univeristy of Virginia

Week 14:

Monday, May 11	**Delta (1232) Excitations in Compton and Neutrino Scattering** Nimai Mukhhopadhyay, R.P.I.
Wednesday, May 13	**Magnetic Neutrino Interactions with Solar Matter** Baha Balantekin, University of Wisconsin
Thursday, May 14	**Double Beta Decay and an Exotic Connection to Solar Neutrinos** Wick Haxton, University of Washington
Friday, May 15	**The Solar Neutrino Puzzle: What's SNU?** John Bahcall, University of Washington

Week 15:

Monday, May 18	**Measuring Nuclear Form Factors Using Polarized Leptons** Paul Souder, Syracuse University
Wednesday, May 20	**Progress in Liquid Drift Chamber Detectors for Astroparticle Physics** David Cline, UCLA
Thursday, May 21	**Atomic Effects in Beta Decay** E. G. Drukarev
Friday, May 22	**Rare Meson Decay: Probing the Generation Structure** Douglas Bryman, TRIUMF

Week 16:

Tuesday, May 26	**Scattering of Polarized Particles on Chiral Molecules** Maxim Pospelov
Wednesday, May 27	**Time Reversal Experiments with Polarized Nuclei** Timothy Chupp, University of Michigan

Program 8 (INT-92-2)

STRANGENESS IN HADRONS AND NUCLEI

Organizers: Carl Dover, Ben Gibson and Jerry Miller

The strangeness degree of freedom in hadronic systems provided the overall physics focus of this program. The principal topics investigated were strange quark matter, strangeness as a signature of quark–gluon–plasma formation, and the structure, decays and production mechanisms of hypernuclei.

In the first part of the program, the main topic of discussion was "strangelets", a hypothetical form of stable strange quark matter. The focus was on mass predictions for such objects, regions of stability with respect to weak and strong decays, production in relativistic heavy ion collisions, either by coalescence of hyperons and nucleons, or by strangeness distillation from a quark–gluon–plasma, and astrophysical implications of stable strange quark matter, such as in neutron stars. Several efforts, both individual and collaborative, arose from the rather spirited discussions on strangelets. For instance, Jes Madsen completed a paper on the strangelet mass formula, in which the consequences of a curvature term (proportional to the radius R) were explored. This term, which is repulsive, was found to be significant for small baryon number A. Shaw and Desai, together with Crawford, an experimentalist who provided an injection of realism into the theoretical discussion, completed a paper on constraints on strange matter production from existing heavy ion data. A collaboration of Dover, Gal, Millener, Schaffner and Stöcker was formed to investigate the limits of stability of multi–strange hyperonic matter in a relativistic mean field approach. This effort yielded a striking result: using experimental data on Λ and Ξ hyperon binding to nuclei, it was found that hyperonic matter with strangeness $|S|/A \simeq 1$, and density $\rho \approx 2\rho_0$, could be stable in the bulk limit ($A \to 0$, charge $q \to 0$). Due to the Pauli blocking of strong $\Xi N \to \Lambda\Lambda$ decays when Λ orbits are occupied, multi–strange systems as light as ${}^{\Xi^0}_{\Lambda\Lambda}{}^{7}\mathrm{He}$ can be stable against strong decay. Such light systems could be formed with observable rates in Au+Au collisions at AGS energies, and serve as "doorway states" for the formation of even more stable strange quark objects of the same A, if the latter exist. This work, initiated at the NINT, is nearing completion.

The second major thrust of the program was hypernuclear physics. Here, numerous seminars focused on hypernuclear structure, production mechanisms, as well as strong, electromagnetic and weak decays. The active discussions which ensued led to a number of collaborations on specific topics. For example, Kaufmann and Chakravarti focussed on the construction of an improved reaction code for hypernuclear production with the (π^+, K^+) reaction, Gobbi, Gal and Dover worked on the analysis of recent (K^-, K^+) data on nuclear targets, Afnan and Gibson collaborated on studies of reactions induced from the $\Xi^- + d$ system, using a three–body formalism, as well as $\Lambda + d$ scattering in the vicinity of the threshold for Σ production, Dover and Volkovitsky worked on theoretical estimates of H dibaryon and pentaquark production with high energy hyperon beams, and Bennhold, Ramos and Saghai are investigating photoproduction processes involving strangeness (relevant to the CEBAF program). It is anticipated that most of these collaborations, begun during Program 8, will lead to research papers. There were also numerous other discussions on a variety of topics in strange particle nuclear physics. Essentially all attendees participated actively in the seminars and subsequent discussions. The program benefited from the presence of a number of students (Blotz, Desai, Gobbi, Olesen,

INSTITUTE FOR NUCLEAR THEORY

Strangeness in Hadrons and Nuclei
June 8, 1992 to August 31, 1992

PROGRAM 8 (INT-92-2) PARTICIPANTS

		Arrive	*Depart*
1.	Iraj Afnan *Flinders University*	July 13 July 19	July 15 August 29
2.	Roger C. Barrett *University of Surrey*	August 9	September 1
3.	Cornelius Bennhold *TRIUMF*	July 20	July 24
4.	Andree Blotz *Ruhr-Universität Bochum*	June 7	June 28
5.	Joseph Carlson *Los Alamos National Lab*	July 8	August 7
6.	Soumya Chakravarti *California State Polytechnic*	July 1	September 1
7.	Steve Cotanch *North Carolina State University*	July 17	August 3
8.	Henry Crawford *University of California*	June 22	June 28
9.	Mukesh Desai *University of California at Irvine*	June 1	July 26
10.	Carl Dover *Brookhaven National Laboratory*	June 8	July 31
11.	Avraham Gal *Hebrew University*	June 15 July 14	June 28 August 21
12.	Ben Gibson *Los Alamos National Laboratory*	July 13 August 17	August 7 August 29
13.	David Gill *TRIUMF*	July 19	July 24
14.	Carlo Gobbi *Università di Pavia*	June 6	August 28
15.	Carsten Greiner *Universität Erlangen/Nürnberg*	June 10	June 26
16.	Dean Halderson *Western Michigan University*	July 20	July 31
17.	Atsushi Hosaka *TRIUMF*	June 29	June 30
18.	Byron Jennings *TRIUMF*	July 13 August 3 August 12	July 15 August 8 August 14
19.	Chueng-Ryong Ji *North Carolina State University*	July 6	July 12
20.	William Kaufmann *Arizona State University*	June 22	August 15
21.	Boris Kerbikov *Institute for Theoretical and Experimental Physics*	June 12 August 16	August 9 August 18

		Arrive	Depart
22.	Gregory Kilcup *Ohio State Uinversity*	June 9	
23.	Peter Koch-Steinheimer *Universität Regensburg*	June 14	July 11
24.	Boris Kopeliovich *Joint Institute for Nuclear Research*	June 15	August 9
25.	Rubin Landau *Oregon State University*	July 20	July 31
26.	Clarence L. Lee *California Institute of Technology*	August 25	September 8
27.	Dinghui Lu *Oregon State University*	July 19	July 31
28.	Matthias Lutz *Universität Regensburg*	July 18	July 24
29.	Jes Madsen *University of Aarhus*	June 7	July 10
30.	Kim Maltman *York University*	August 8	August 22
31.	Raffaele Mattiello *Universität Frankfurt*	August 1	August 18
32.	Tim Mefford *Oregon State University*	July 19	July 31
33.	David John Millener *Brookhaven National Laboratory*	June 7 August 22	August 8 August 31
34.	Toshio Motoba *Osaka Electro-Communication University*	July 24	August 21
35.	Makoto Oka *Tokyo Institute of Technology*	August 2	August 16
36.	Michael Olesen *University of Aarhus*	June 7	July 12
37.	Angela Olinto *Fermi National Accelerator Lab*	June 13	June 29
38.	Madappa Prakash *State University of New York at Stony Brook*	June 22	June 28
39.	Johann Rafelski *University of Arizona*	June 10	June 17
40.	Angels Ramos *TRIUMF*	July 20	July 24
41.	Andreas Reuber *Institut für Kernphysik-Jülich*	August 7	September 1
42.	Bijan Saghai *Centre d'Etudes Saclay*	July 14	August 30
43.	Jürgen Schaffner *Universität Frankfurt*	June 10	July 17
44.	Gordon Shaw *University of California*	June 14	June 27
45.	Peter B. Siegel *California State Polytechnic University*	August 9	September 1
46.	Horst Stöcker *Universität Frankfurt*	June 6	June 19
47.	Peter Volkovitsky *Institute for Theoretical and Experimental Physics*	June 12	August 1
48.	Anthony G. Williams *Florida State University*	July 26	August 8

Institute for Nuclear Theory
University of Washington
Henderson Hall, HN-12, Seattle, WA 98195

Strangeness in Hadrons and Nuclei
June 8, 1992 to August 31, 1992

Program 8 Participants

Afnan, Iraj *Flinders University* ..... July 12- July 15
July 18- August 29

Barrett, Roger *University of Surrey* ..... August 9 - September 1

Bennhold, Cornelius *TRIUMF* ..... July 20 - July 24

Blotz, Andree *Ruhr-University Bochum* ..... June 7 - June 28

Carlson, Joseph *Los Alamos National Lab* ..... July 8 - August 7

Chakravarti, Soumya *California State Polytechnic University* ..... July 1 - Sept. 1

Cotanch, Steve *North Carolina State University* ..... July 17 - August 3

Crawford, Henry *Lawrence Berkeley* ..... June 22 - June 28

Desai, Mukesh *University of California-Irvine* ..... June 1 - July 26

Dover, Carl *Brookhaven National Lab* ..... June 8 - July 31

Gal, Avraham *The Hebrew University* ..... June 15 - June 28
July 14 - August 25

Gibson, Benjamin *Los Alamos National Lab* ..... July 13 - August 7
August 17 - August 29

Gill, David *TRIUMF* ..... July 19 - July 24

Gobbi, Carlo *University of Pavia* ..... June 6 - August 28

Greiner, Carsten *University of Erlangen* ..... June 10 - June 26

Halderson, Dean *Western Michigan University* ..... July 20 - July 31

Hosaka, Atsushi *TRIUMF* ..... June 29 - June 30

Jennings, Byron *TRIUMF* ..... July 13 - July 15
August 3 - August 8
August 12 - August 14

Ji, Chueng-Ryong *North Carolina State University* ..... July 6 - July 12

Kaufmann, William *Arizona State University* ..... June 22 - August 15

Kerbikov, Boris *ITEP Moscow* ..... June 12 - August 9
August 16 - August 18

Kilcup, Gregory *Ohio State University* ..... June 8 -June 17

Koch-Steinheimer, Peter *University of Regensburg* ..... June 14 - July 11

Kopeliovich, Boris *Joint Institute for Nuclear Research* ..... June 8 - August 9

Landau, Rubin *Oregon State University* ..... July 20 - July 31
Lee, Clarence *Caltech* ..... August 25 - September 8
Lu, Dinghui *Oregon State University* ..... July 19 - July 31
Lutz, Matthias *University of Regensburg* ..... July 18 - July 24
Madsen, Jes *University of Aarhus* ..... June 7 - July 10
Maltman, Kim *York University* ..... August 8 - August 22
Mattiello, Raffaele *University of Frankfurt* ..... August 1 - August 18
Mefford, Tim *Oregon State University* ..... July 19 - July 31
Millener, John *Brookhaven National Lab* ..... June 7 August 8
August 22 - August 31
Miller, Gerald *University of Washington* ..... June 7 - August 23
Motoba, Toshio *Osaka Electro-Communication University* ..... July 24- August 21
Oka, Makota *Tokyo Institute of Technology* ..... August 2 - August 16
Olesen, Michael *University of Aarhus* ..... June 7 - July 12
Olinto, Angela *University of Chicago* ..... June 13 - June 29
Prakash, Madappa *SUNY- Stony Brook* ..... June 22- June 28
Rafelski, Johann *University of Arizona* ..... June 10 - June 17
Ramos, Angels *TRIUMF* ..... July 20 - July 24
Reuber, Andreas *IKP, Julich* ..... August 7 - Sept. 1
Saghai, Bijan *C.E. Saclay* ..... July 14 - August 31
Schaffner, Juergen *University of Frankfurt* ..... June 10 - July 17
Shaw, Gordon *University of California* ..... June 14 - June 27
Siegel, Peter *Caltech* ..... August 9 - Sept. 1
Stoecker, Horst *University of Frankfurt* ..... June 6 - June 19
Volkovitsky, Peter *ITEP Moscow* ..... June 12 - August 1
Williams, Anthony *Florida State University* ..... July 26 - August 8

University of Washington
Institute for Nuclear Theory
Henderson Hall, HN-12
Seattle, WA 98195

Program 8 Seminars

Strangeness in Hadrons and Nuclei
June 8 - August 31, 1992

Week 1:

Thursday, June 11	**Strange Quark Matter** Carl Dover, Brookhaven National Lab
Friday, June 12	**Strange Baryons as Solitons in the Nambu-Jona-Lasinio Model** Andree Blotz, Ruhr University-Bochum

Week 2:

Monday, June 15	**Multi-strangeness Production in Relativistic Heavy Ion Collisions** Horst Stoecker, University of Frankfurt
Tuesday, June 16	**Hot Hadronic Matter and Strange Antibaryons** Johann Rafelski , University of Arizona
Wednesday, June 17	**Weak Decay Rates in Strange Quark Matter** Jes Madsen, University of Aarhus
Thursday, June 18	**Boiling of Quark Matter Droplets and Neutron Stars** Michael Olesen, University of Aarhus
Friday, June 19	**Production of S-Drops in Relativistic Heavy Ion Collisions** Mukesh Desai, University of California-Irvine

Week 3:

Monday, June 22	**Technological Implications of Stable Strange Quark Matter** Gordon Shaw, University of California-Irvine
Tuesday, June 23	**High Sensitivity Searches for Exotic Objects** Hank Crawford, Lawrence Berkeley Lab
	Survival of Strange Quark Droplets Carsten Greiner, University of Erlangen

Wednesday, June 24	**Strangeness in the Heavens** Angela Olinto University of Chicago
	Rapid Cooling of Neutron Stars by Hyperons and Strange Condensates Madappa Prakash, SUNY-Stony Brook
Thursday, June 25	**Strange Baryons in the Skyrme Model** Carlo Gobbi, INFN- Pavia

Week 4:

Tuesday, June 30	**Metastable Exotic Multistrange Objects** Juergen Schaffner, University of Frankfurt
Wednesday, July 1	**Strangeness as a Signature of the Quark-Gluon-Plasma** Peter Koch, University of Regensburg
Thursday, July 2	**Strange Baryon-Antibaryon Interactions at Low Energy** Boris Kerbikov, ITEP-Moscow

Week 5:

Monday, July 6	**Interaction of Charmonia with Nucleons and Nuclei at Low Energy** Peter Volkovitsky, ITEP-Moscow
Tuesday, July 7	**Hadro- and Electro-production of the Phi, OZI Rule Violation and Strangeness in the Proton** Boris Kopeliovich, JINR Moscow
Wednesday, July 8	**Mesons in the Light-Cone Quark Model** Chueng-Ryong Ji, North Carolina State University

Week 6:

Monday, July 13	**The Binary Reactions of Strange and Charmed Particle Production in Proton-Antiproton Collisions** Peter Volkovitsky, ITEP-Moscow
Tuesday, July 14	**Hyperons and the Spin-Orbit Force** Byron Jennings, TRIUMF
Friday, July 17	**Hyperon-Nucleon Interactions and Light Hypernuclei** Joseph Carlson, LANL

Week 7:

Monday, July 20	**Open Questions in Strange Particle Nuclear Physics** Carl Dover, Brookhaven National Lab
Tuesday, July 21	**Hypernuclear Structure Physics** John Millener, Brookhaven National Lab
Wednesday, July 22	**Prospectus for Hypernuclear Physics at KAON** David Gill, TRIUMF
	Kaons in Dense Matter Matthias Lutz, University of Regensburg
Thursday, July 23	**Hypernuclear Weak Decay** Angels Ramos, TRIUMF
Friday, July 24	**Kaon Electromagnetic Production on Nucleons and Nuclei** Cornelius Bennhold, TRIUMF

Week 8:

Monday, July 27	**The Lambda-Nucleon G-Matrix** Dean Halderson, Western Michigan University
Tuesday, July 28	**Bound States, Resonances and Poles in Kaon-Nuclear Systems** Rubin Landau, Oregon State University
Wednesday, July 29	**Kaon Radiative Capture, Electroproduction, and Form Factors** Steven Cotanch, North Carolina State University
Thursday, July 30	**Spin Observables in Kaon Photoproduction** Bijan Saghai, Saclay

Week 9:

Monday, August 3	**Production of Polarized Hypernuclei with Pions, Kaons and Photons** Toshio Motoba, Osaka Electro-Communications University
Tuesday, August 4	**Lambda-Deuteron Scattering** Iraj Afnan, Flinders University
Thursday, August 6	**Phi-production as a Probe of the Strangeness Content of the Nucleon** Anthony Williams, Florida State University
Friday, August 7	**Instanton Induced Interaction in Hadron Spectra** Makoto Oka, Tokyo Institute of Technology

Week 10:

Monday, August 10	**Creation of Extended Strange Many-Particle States in Relativistic H. I. Reactions** Raffaele Mattiello, University of Frankfurt
Tuesday, August 11	**High-Energy Pion-Nucleus Scattering** Soumya Chakravarti, California State Polytechnic University
Friday, August 14	**Kaon-Nucleus Interactions** Peter Siegel, California State Polytechnic University

Week 11:

Tuesday, August 18	**Hyperon-Nucleon Interactions in Free Space and in Nuclear Matter** Andreas Reuber, Institut fuer Kernphysik- Juelich
Wednesday, August 19	**Hypernuclear Properties Derived from Juelich and Nijmegen YN Interactions** Toshio Motoba, Osaka Electro-Communications University
Thursday, August 20	**Kaon Regeneration and the MSW Effect** Wick Haxton, University of Washington

Week 12:

Tuesday, August 25	**Relativistic Equations for Meson-Nucleus Reactions** Roger Barrett, University of Surrey
Thursday, August 27	**Informal Summary: '92 Photonuclear Gordon Conference** John Millener, Brookhaven National Lab

PROGRAM #9: MICROSCOPIC NUCLEAR STRUCTURE THEORY
8 SEPTEMBER - 18 DECEMBER 1992
B. R. BARRETT(U ARIZONA) AND J. P. VARY(IOWA STATE U)
FINAL REPORT

The goal of the program on Microscopic Nuclear Structure Theory was to focus attention on the long-standing problem of accurately computing the effective Hamiltonian for performing nuclear structure calculations, starting from realistic formulations of the nucleon-nucleon (N-N) interaction. The tone of the entire program was set by the workshop held 14-18 September and attended by 28 out-of-town participants plus local physicists. This workshop was completely successful in identifying the important points of interest to the problem, such as, the best N-N interactions to use, the fact that these N-N interactions alone tend to underbind nuclear systems, the status of existing shell-model technology, the problems of trying to compute the basic perturbation series for the shell-model effective interaction (now generally referred to as the Q-box), the advantages and limitations of the "no-core" model-space approach to computing the Q-box, and the extreme usefulness of the Lee-Suzuki and Kuo-Krenciglowa approaches for summing the folded Q-box series to all orders, so as to produce an energy-independent effective interaction. The participants came away from the workshop with well-directed enthusiasm, leading to early breakthroughs in outstanding problems.

Because of our large core group of 12 physicists who were present for all or nearly all of the 15 weeks of the program, this high-level of enthusiasm was maintained throughout the program. We were able to assemble such a large core group, because of our long lead time of nearly two years in organizing the program. Over the course of the program 49 out-ot-town participants took part, of whom 29 were from domestic institutions and 20, from foreign institutions. Of this 49 there were 34 senior researchers (31 theorists, three experimentalists), five research associates and junior faculty and ten graduate students. The average number of participants per week was 21, with a peak of 28 during the workshop. The seminar schedule was limited to not more than one per day (except during the workshop). The seminars were well-attended (generally over 20 attendees) with lively discussions and interactions. There was a series of tutorials by senior participants,

including the organizers, to present in detail how one performs numerical calculations for determining effective interaction matrix elements.

The main thrust of the program was to seek and find solutions to the difficult remaining problems in computing the shell-model effective interaction, and the majority of the core group plus a number of the shorter-term participants concentrated on this. Some of the principal successes were:

1. The initial development of improved effective interactions for model spaces in which there is a second truncation at a fixed level of many particle excitations;
2. The identification of more optimal methods to treat the spurious CM motion problem;
3. The use of a "no-core" model space, in which all A nucleons are taken as active particles in a large basis space;
4. In connection with #3, the verification that the Q-box is well approximated by the two-particle Brueckner reaction matrix G, and effective 3-body forces seem to be relatively weak;
5. The convenience of the Lee-Suzuki and Kuo-Krenciglowa approaches for summing the folded Q-box series to all orders to obtain an energy-independent effective Hamiltonian;
6. The modification of the Lee-Suzuki approach to yield Hermitian effective-interaction matrix elements; and
7. The first development of the formulation for computing other effective operators, besides the interactions, in the same model space.

A number of other problems were also discussed and investigated, such as,

(1) shell-model calculations in a correlated space for studying the microscopic origin of the Interacting Boson Model,

(2) higher-order Random-Phase-Approximation calculations,

(3) the use of symmetries for determining optimal truncations for shell-model calculations,

(4) the application of nuclear many-body techniques to atomic clusters, and

(5) the determination of potentials for doing hypernuclei calculations.

It was decided by the participants that we should have a "test problem," against which we could measure the progress of the field over the time span of a decade or more. The "test problem" agreed upon is to obtain the low-lying (up to 15 MeV excitation energy) spectroscopy of ^{16}O, including the binding energy of the ground state, using a realistic N-N potential supplemented by a three-nucleon interaction. The suggested interaction is the Reid soft core (preferably rewritten in the V14 form of Wiringa and coworkers). The test problem includes the evaluation of all experimental observables with these states, where data exist for comparison.

In this regard the organizers recommend that the INT sponsor a two-week workshop in about two years time (the best time would be the summer of 1995) to determine what progress has been made, both with regard to the test problem and to other outstanding problems in the field.

Overall, the participants were satisfied with and enthusiastic about the program, starting with the workshop. The program interactions greatly stimulated their interests, so that considerable progress was achieved. Some participants would have preferred even more interactions by more of the participants, but it is not obvious how this can or should be done. A major problem with the existing facilities is the lack of space for a discussion room with a blackboard. With three to five physicists per room, informal discussions were greatly inhibited, because such discussions would annoy the other occupants of the room who might be trying to work. Hopefully, this will be remedied by the new home of the INT in 1994, which will have much more space, especially its own discussion and seminar room(s) where researchers can meet. Overall group communication could perhaps be increased by having regular group functions, such as a group dinner once a week or every other week. The few group functions, which we had, were well-attended and highly successful.

We thank the INT staff for their help, especially regarding the day-to-day operation of the program. In retrospect it is clear that forms regarding participation dates and housing should have been mailed earlier to proposed participants, as is now being done for future programs.

INSTITUTE FOR NUCLEAR THEORY

Microscopic Nuclear Structure Theory
September 8, 1992 to December 18, 1992

PROGRAM 9 (INT-92-3) PARTICIPANTS

		Arrive	*Depart*
1.	Klaas Allaart *Free University*	September 7	September 19
2.	Chairul Bahri *Louisiana State University*	November 1	December 2
3.	Akif Baha Balantekin *University of Wisconsin*	September 3	October 14
4.	Bruce R. Barrett *University of Arizona*	September 5	December 19
5.	Jonathan R. Bennett *University of Wisconsin*	September 20	October 15
6.	Ignazio Bombaci *State University of New York at Stony Brook*	October 12	December 9
7.	Pieter Brussaard *R.J. van de Graafflaboratorium*	September 15	October 15
8.	Richard F. Casten *Brookhaven National Laboratory*	November 4	November 7
9.	Alan J. DeWeerd *University of Wisconsin-Madison*	September 20	October 9
10.	Abdoulaye Diallo *University of Arizona*	September 26	October 3
11.	Alex E. L. Dieperink *Rijksuniversiteit*	September 13 October 4	October 3 October 9
12.	Paul John Ellis *University of Minnesota*	September 8	December 14
13.	Hendrik Geyer *University of Stellenbosch*	November 24	December 10
14.	Joseph N. Ginocchio *Los Alamos National Laboratory*	September 7	October 2
15.	Jifa Hao *State University of New York at Stony Brook*	September 6	December 18
16.	Jochen H. Heisenberg *University of New Hampshire*	September 8 November 4 November 15	September 25 November 12 November 20
17.	Dieter Heiss *University of Witwatersrand*	September 18	October 29
18.	Hartmut Hofmann *Universität Erlangen-Nümberg*	September 13	September 30
19.	Lene Jaqua *University of Arizona*	September 13	September 26
20.	Calvin Johnson *California Institute of Technology*	September 3	October 1
21.	Michael Kirson *Weizmann Institute of Science*	September 7	September 19
22.	Thomas T.S. Kuo *State University of New York at Stony Brook*	September 7	December 16
23.	Serdar Kuyucak *Australian National University*	October 4	October 13

		Arrive	Depart
24.	Zibang Li *State University of New York at Stony Brook*	September 6	December 18
25.	Pertti Lipas *University of Jyväskylä*	October 5	November 28
26.	Eugene R. Marshalek *University of Notre Dame*	October 1 November 1	October 13 December 8
27.	Robert J. McCarthy *Kent State University*	September 8	December 18
28.	David John Millener *Brookhaven National Laboratory*	September 8	December 16
29.	Takahiro Mizusaki *University of Tokyo*	September 10 November 6	October 5 December 12
30.	Steven A. Moszkowski *University of California - Los Angeles*	November 18	November 21
31.	Hitoshi Nakada *University of Juntendo*	November 4	November 22
32.	Rashid Nazmitdinov *University of Notre Dame*	October 1	October 28
33.	Ryoji Okamoto *Kyushu Institute of Technology*	November 22	December 3
34.	Eivind Osnes *University of Oslo*	September 7	September 20
35.	Takaharu Otsuka *University of Tokyo*	September 15 November 10	September 23 December 19
36.	Stuart Pittel *University of Delaware*	October 11	November 1
37.	George Rosensteel *Tulane University*	September 8	December 18
38.	Alan James Sommerer *Iowa State University*	November 7 December 5	November 15 December 11
39.	John Spence *Iowa State University*	November 4 December 3	November 14 December 14
40.	Kenji Suzuki *Kyushu Institute of Technology*	November 22	December 3
41.	Igal Talmi *Weizmann Institute of Science*	September 1	December 16
42.	Dimitri Van Neck *Laboratory for Theoretical Physics*	October 5	October 25
43.	James P. Vary *Iowa State University*	August 16	December 16
44.	Petr Vogel *California Institute of Technology*	September 7	September 17
45.	Michel Waroquier *Laboratory for Nuclear Physics*	October 4	October 13
46.	Hans Weidenmueller *Max Planck Institut für Kernphysik*	August 23	September 12
47.	Robert Wiringa *Argonne National Laboratory*	November 8	December 4
48.	Victor Zamfir *Brookhaven National Laboratory*	September 13	September 20
49.	Dao-Chen Zheng *University of Arizona*	September 13	December 18

INSTITUTE FOR NUCLEAR THEORY

Microscopic Nuclear Structure Theory
September 8, 1992 to December 18, 1992

PROGRAM 9 (INT-92-3) SEMINARS

Klaas Allaart *Free University*
September 10 The Shell Structure of a Quantum Liquid Drop as Seen in Nuclear Spectral Functions and Response

Chairul Bahri *Louisiana State University*
November 9 Pseudo-spin Symmetry in Nuclear Physics

Akif Baha Balantekin *University of Wisconsin*
September 16 Use of Symmetry Techniques in Nuclear Structure Physics

Bruce R. Barrett *University of Arizona*
October 23 The Theory of the Reaction Matrix G and Its Calculation Using the BHM Approach
November 10 Superdeformed Bands in Nuclei and the Proton-Neutron Interacting Boson Model

Jonathan R. Bennett *University of Wisconsin*
September 22 NUC.PHYS.LAB SEM.:Descrip.of Nuc. Struct. Effects in Subbarrier Fission by the Interacting Boson Model

Ignazio Bombaci *State University of New York at Stony Brook*
November 18 Properties of Nuclear Matter in an Extended Brueckner Approach

Pieter Brussaard *R.J. van de Graafflaboratorium*
September 18 Other Forms of Effective Interactions
October 14 Two-body Currents and the Transverse Response of Nuclei at Large Momentum Transfer

Richard F. Casten *Brookhaven National Laboratory*
November 6 Valence Correlation Schemes and Nuclear Phenomenology: A Challenge to Microscopic Theories

Alan J. DeWeerd *University of Wisconsin-Madison*
October 2 Quark-antiquark Pair Production in Flux Tubes

Abdoulaye Foula Diallo *University of Arizona*
September 29 An Improved 1/N Boson Expansion and Its Application to g-factors in Nuclei

Alex E. L. Dieperink *Rijksuniversiteit*
September 28 Semi-inclusive Deep Inelastic Scattering on Nucleons and Nuclei

Paul John Ellis *University of Minnesota*
October 30 Implications of a Modified Glueball Potential for Nuclear Matter

Leonid Frankfurt *Tel Aviv University*
October 5 New Insight into Internucleon Forces

Hendrik Geyer *University of Stellenbosch*
December 8 Effective Operator Theory in Boson Mappings

Joseph N. Ginocchio *Los Alamos National Laboratory*
September 15 Towards a Microscopic Understanding of the Interacting Boson Model
September 23 Nuclear Structure Physics for Cross-Disciplinary Application "Fractional Quantum Hall Effect"

Wick Haxton *University of Washington*
September 17 Lanczos Techniques in Shell Model Calculations

Jochen H. Heisenberg *University of New Hampshire*
September 17 What the Experimentalists Want

Dieter Heiss *University of Witwatersrand*
October 1 Phase Transitions in Nuclei and Quantum Chaos

Michael Herrmann *University of Washington*
October 28 NUC. THEORY SEM.: Properties of the Rho-meson in Dense Nuclear Matter: A Hadronic Point of View

Hartmut Hofmann *Universität Erlangen-Nürnberg*
September 24 Cluster Symmetry in Light Nuclei

Charles Horowitz *University of Indiana*
October 6 Relativistic Nuclear Structure

Lene Jaqua *University of Arizona*
September 15 Status of Microscopic Effective Interaction Calculations

Calvin Johnson *California Institute of Technology*
September 11 Monte Carlo Path Integrals for the Nuclear Shell Model

Michael Kirson *Weizmann Institute of Science*
September 18 Program 9 Workshop Summary Talk

Thomas T.S. Kuo *State University of New York at Stony Brook*
September 14 Basic Theory of the Shell Model Interaction
September 30 Interdisciplinary Applications of Nuclear Structure Physics -"An Ising Model for Nuclear Matter"
November 5 Tutorials on Effective Interaction Calculations
December 10 Intruder States and the Difference Between Hermitian and Non-Hermitian Effective Interactions

Serdar Kuyucak *Australian National University*
October 8 1/N Expansion in the Interacting Boson Model; Gentler Approach to Some Structure & Reaction Problems

Pertti Lipas *University of Jyväskylä*
October 21 Interdisciplinary Applications of Nuclear Structure Physics "Shell-Model Calculations of Atomic Clusters"

Eugene R. Marshalek *University of Notre Dame*
November 20 Cranking Anharmonic Collective Vibrations

Robert J. McCarthy *Kent State University*
September 16 Better N-N Potentials
December 9 Self-Consistent Lee-Suzuki Calculations in a One-Dimensional Model Space with Applications to A<5 nucl.

Thomas Meissner *University of Washington*
November 4 NUCLEAR THEORY SEMINAR: Baryons as Solitons in the Nambu-Jona-Lasinio Model

David John Millener *Brookhaven National Laboratory*
September 17 Large Basis Shell Model Claculations

Gerald Miller *University of Washington*
December 1 Color Transparency-A Quantum Mechanical Invisibility

Takahiro Mizusaki *University of Tokyo*
December 7 A Microscopic Calculation of the IBM Hamiltonian for the Xe-Ba Isotopes

Steven A. Moszkowski *University of California - Los Angeles*
November 19 Nambu-Jona-Lasinio Model: A Bridge from QCD to Nuclear Structure?

Hitoshi Nakada *Juntendo*
November 16 Proton Halo in 8B??

Rashid Nazmitdinov *University of Notre Dame*
October 20 Collective Excitations of Rotating Nuclei

Ryoji Okamoto *Kyushu Institute of Technology*
November 23 Hermitian Effective Interaction Theory and Its Application to the Nuclear Many-Body Problem

Elvind Osnes *University of Oslo*
September 14 Status of Microscopic Effective Interaction Calculations

Takaharu Otsuka *University of Tokyo*
September 16 Shell Model of Unstable Nuclei

Stuart Pittel *University of Delaware*
October 19 The Nuclear Detection of Galactic Dark Matter

George Rosensteel *Tulane University*
September 21 Unified Dynamical Symmetry of Rotating Systems in Classical and Quantum Mechanics

John Spence *Iowa State University*
November 13 Variational Tamm-Dancoff Approach to QCD

Kenji Suzuki *Kyushu Institute of Technology*
November 23 Hermitian Effective Interaction Theory and Its Application to the Nuclear Many-Body Problem
November 30 Reformulation of the Coupled-Cluster Method in View of the Effective-Interaction Theory

Igal Talmi *Weizmann Institute of Science*
September 14 Empirically Determined Effective Interactions
November 2 PHYSICS COLLOQUIUM: The Shell Model and Binding Energies of Nuclei and Atoms

Dimitri Van Neck *Laboratory for Theoretical Physics*
October 13 Fragmentation of Single-particle Strength for Deep-lying Hole States

James P. Vary *Iowa State University*
October 7 NUCLEAR THEORY SEMINAR: Continuum Bound State Phenomena in QED
November 12 Tutorials on Effective Interaction Calculations: Treatment of Spurious Center-of-Mass Motion

Petr Vogel *California Institute of Technology*
September 15 Nuclear Physics, Double Beta Decay and Dark Matter

Michel Waroquier *Laboratory for Nuclear Physics*
October 12 Single-particle Fragmentation in Open-Shell Nuclei

Robert Wiringa *Argonne National Laboratory*
November 24 Microscopic Calculations of Nuclear Structure and Nuclear Correlations

Dao-Chen Zheng *University of Arizona*
September 18 Relativity of the Shell Model
December 3 Exact Solutions of Model Hamiltonian Problems with Effective Interactions

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INSTITUTE FOR NUCLEAR THEORY
UNIVERSITY OF WASHINGTON
HENDERSON HALL, HN-12 • SEATTLE, WA 98195
TELEPHONE (206) 685-3340
FAX (206) 685-3720

SCHEDULE OF INT PROGRAMS - 1993 AND 1994

INT-93-1/Spring 1993
NUCLEAR PHYSICS IN ATOMS AND MOLECULES - February 15, 1993 to May 28, 1993
Organizers: Eugen Merzbacher - email: ulysse@unc tel: 919-962-3021
Jim Friar - email: friar@lampf tel: 505-667-6184
Berndt Müller - email: muller@phy.duke.edu tel: 919-684-8195

INT-93-2/Summer 1993
PHENOMENOLOGY AND LATTICE QCD - June 21, 1993 to September 3, 1993
Organizers: Stephen Sharpe - email: sharpe@galileo.phys.washington.edu tel: 206-685-2395
Gregory Kilcup - email: kilcup@pacific.mps.ohio-state.edu tel: 614-292-3224
John Negele - email: negele@mitlns.mit.edu tel: 617-253-7077

INT-93-3/Autumn 1993
LARGE AMPLITUDE COLLECTIVE MOTION - October 4, 1993 to December 17, 1993
Organizers: Aurel Bulgac - email: bulgac@msunscl tel: 517-353-5964
George Bertsch - email: bertsch@phast.phys.washington.edu tel: 206-685-3972

INT-94-1/Spring 1994
SOLAR NEUTRINOS AND NEUTRINO ASTROPHYSICS - February 22, 1994 to May 31, 1994
Organizers: Baha Balantekin - email: baha@wisnud.physics.wisc.edu tel: 608-263-7931
Eugene Beier - email: geneb@upenn5.hep.upenn.edu tel: 215-898-5960

INT-94-2/Summer 1994
APPLICATIONS OF CHAOS IN MANY-BODY QUANTUM PHYSICS
- June 13, 1994 to September 2, 1994
Organizers: Steven Tomsovic - email: tomsovic@max.u.washington.edu tel: 206-543-3901
Eric Heller - email: heller@gibbs.chem.washington.edu tel: 206-543-1767
Hans Weidenmüller - email: haw@dhdmpi5.bitnet tel: 49-30-89001223 before 7/31/93
49-6221-516540 after 7/31/93

INT-94-3/Autumn 1994
HOT AND DENSE NUCLEAR MATTER - September 12, 1994 to December 10, 1994
Organizers: Jørgen Randrup - email: randrup@lbl.bitnet tel: 510-486-6157
George Bertsch - email: bertsch@phast.phys.washington.edu tel: 206-685-3972
Ulrich Mosel - email: mosel@piggy.physik.uni-giessen.de tel: 49-641-702-2800

If you are interested in participating in any of these INT programs, please contact the program's organizers directly. Researchers at the beginning of their careers and from under-represented groups are especially encouraged to apply. Summer programs will usually include a one to two week school and/or a short workshop aimed at advanced graduate students and beginning researchers.

CALL TO INSTITUTE AFFILIATES

All interested physicists (experimental and theoretical) are invited to become Affiliates of the Institute. We will keep Institute Affiliates informed of INT activities and plans by means of periodic newsletters; there is no charge. To become an Affiliate, please send your name, address, telephone number and email address to the Institute at the address listed above.

January 1993

Please Post

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INSTITUTE FOR NUCLEAR THEORY
UNIVERSITY OF WASHINGTON
HENDERSON HALL, HN-12 • SEATTLE, WA 98195
TELEPHONE (206) 685-3360
FAX (206) 685-3730

Named Murdock Fellows

Program 1 - None

Program 2

Hans A. Bethe, Newman Laboratory, Cornell University, Ithaca, NY
Gerald E. Brown, SUNY, Stony Brook, NY
Jim Wilson, Livermore National Laboratory, Livermore, CA
Wolfram Weise, University of Regensburg, Germany
Stanford Earl Woosley, UCSD, Santa Cruz, CA

Program 3

Miklos Gyulassy, Lawrence Berkeley Laboratory, Berkeley, CA
Berndt Müller, Duke University,Durham, NC
Robert D. Pisarski, Brookhaven National Laboratory, Upton, NY
Edward Shuryak, SUNY, Stony Brook, NY

Program 4

James Friar, Los Alamos National Laboratory, Los Alamos, NM
Walter Gloeckle, Univeristy of Bochum, Bochum, Germany
Peter Sauer, University of Hannover, Hannover, Germany
John Tjon, University of Utrecht, Utrecht, The Netherlands

Program 5

Robert Carlitz, University of Pittsburg, Pittsburg, PA
Carl Carlson, College of William & Mary, Williamsburg, VA
Frank Close, Rutherford Laboratory, Oxon, England
Richard Cutkosky, Carnegie-Mellon University, Pittsburg, PA
Nathan Isgur, CEBAF, Newport News, VA
Gabriel Karl, University of Guelph, Guelph, Ontario, Canada
Harry Lipkin, Weizmann Institute of Science, Rehovot, Israel
Ulf Meissner, Universität Bern, Bern, Switzerland

Program 6

David Ernst, Texas A & M Univniversity, College Station, TX
Gerald Garvey, Los Alamos National Lab, Los Alamos, NM
William Gibbs, Los Alamos National Lab, Los Alamos,NM
Mikkel Johnson, Los Alamos National Lab, Los Alamos, NM
Leonard Kisslinger, Carnegie Mellon University, Pittsburgh, PA
Brian Serot, University of Indiana, Bloomington, IN
Joseph Speth, Institut für Kernphysik, Jülich, Germany
Daniel Strottman, Los Alamos National Lab, Los Alamos, NM

Named Murdock Fellows (continued)

Program 7

Peter Herczeg, Los Alamos National Lab, Los Alamos, NM
Barry Holstein, University of Massachusetts, Amherst, MA
Iosif B. Khriplovich, Academy of Science, Novosibirsk, USSR
Bruce McKeller, University of Melbourne, Victoria, Australia
Lincoln Wolfenstein, Carnegie Mellon University, Pittsburgh, PA

Program 8

Carl B. Dover, Brookhaven National Laboratory, Upton, NY
Avraham Gal, Hebrew University, Jerusalem, Israel
Benjamin F. Gibson, Los Alamos National Lab, Los Alamos, NM
Jes Madsen, University of Aarhus, Aarhus, Denmark

Program 9

None

Program 10

Ludmila Bogdanoma,Institute of Theoretical & Experimental Physics, Moscow, Russia
James L. Friar, Los Alamos National Laboratory, Los Alamos, NM
Walter Johnson, University of Notre Dame, Notre Dame, IN
Iosif S. Khriplovich, Institute of Nuclear Physics, Novosibirsk, Russia
Eugen Merzbacher, University of North Carolina, Chapel Hill, NC
Peter Mohr, National Institute of Standards & Technology, Gaithersburg, MD
John D. Morgan III, University of Delaware, Newark, DE
Berndt Müller, Duke University, Durham, NC
P. G. H. Sandars, Clarendon Laboratory, Oxford, UK

University of Washington
Institute for Nuclear Theory
Henderson Hall, HN-12, Seattle, WA 98195

Members of 1992 National Advisory Committee

	E - mail	Home Phone	Office Phone	Fax
Professor Akito Arima Tokyo, Japan			03-3812-2111	03-3918-3163
Professor George Bertsch East Lansing, MI	bertsch@msunscl.bitnet		517-353-5963	517-353-5967
Professor Gerald E. Brown Stony Brook, NY	popenoe@sunysbnp.bitnet	516-941-9293	516-632-7989	
Dr. Gerald T. Garvey Los Alamos, NM	garvey@lampf.bitnet		505-667-2000	
Professor Steven Koonin Pasadena, CA	koonin@caltech	818-794-3520	818-356-4586	818-564-8708
Professor Arthur McDonald Kingston, Ontario	mcdonald@mips2.phy.Queensu.cat	613-389-1365	613-545-2702	613-545-6813
Professor Alfred H. Mueller New York, NY			212-854-3338 212-854-3339(secy) 212-854-3366(dept)	212-932-3169
Professor John Negele Cambridge, MA	negele@mitlns.bitnet	617-862-1812	617-253-7077	617-253-8674
Dr. Helmut Satz Geneva, Switzerland	satz@cernvm	41-22-767-2466	41-22-782-3914	
Dr. J. D. Walecka Newport News, VA	walecka@cebafvax		804-249-7583	804-249-7398

US Department of Energy Representatives

Dr. David Hendrie Washington, D.C.	hendrie@anlphy		301-353-3613	
Dr. Joseph McGrory Washington, D.C.	mcgrory@mailgw.er.doe.gov		301-903-3613	301-903-3833

6/25/92

University of Washington
Institute for Nuclear Theory
Henderson Hall, HN-12, Seattle, WA 98195

Members of 1993 National Advisory Committee

	E - mail	Home Phone	Office Phone	Fax
Professor Akito Arima Tokyo, Japan			81-3-3812-2111	81-3-3818-3163
Dr. Carl B. Dover Upton, NY	dover@bnldag	516-928-9154	516-282-3791	516-282-3000
Dr. James L. Friar Los Alamos, NM	friar@lampf.bitnet	505-672-1924	505-667-6184	505-665-4055
Dr. Gerald T. Garvey Los Alamos, NM	garvey@lampf.bitnet	505-983-3430	505-667-2000	505-665-4055
Dr. Robert McKeown Pasadena, CA			818-356-4316	818-796-5675
Professor Alfred H. Mueller New York, NY			212-854-3338 212-854-3339(secy) 212-854-3366(dept)	212-932-3169
Dr. Ben Mottelson Copenhagen, Denmark	mottelson@nordita.dk		45-3142-1616	45-3138-9157
Professor John Negele Cambridge, MA	negele@mitlns	617-862-1812	617-253-7077	617-253-8674
Dr. Helmut Satz Geneva, Switzerland	satz@cernvm		41-22-767-2466	41-22-782-3914

US Department of Energy Representatives

Dr. David Hendrie Washington, D.C.	hendrie@anlphy		301-903-3613	301-903-3833
Dr. Joseph McGrory Washington, D.C.	mcgrory@mailgw.er.doe.gov.		301-903-3613	301-903-3833

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