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說明：

本刊主要是中研院物理研究所從八十一年七月一日到八十二年六月三十日間之學術活動紀錄，本刊內容共包括六大部份，第一部份是本所五組之研究及發展和設備的介紹；第二部份是所內研究人員執行之計劃；第三部份是近兩年裡（92、93）研究人員之著作目錄（不含開會發表之論文）；第四部份是本所圖書館、技術組及電腦室之概況；第五部份則是學術諮詢委員會報告、本所所舉辦之學術演講、所內研究人員出席國際會議及來訪學人之一覽表；第六部份則是所內人員名冊。

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Review of Research Projects

NUCLEAR PHYSICS GROUP

Our group has presently five research fellows, two associate research fellows and two assistant research fellows, conducting research works covering both experimental and theoretical nuclear physics. Since about two years ago one of our group members has spent a great deal of his time for the development of the experimental high-energy physics program for the Institute.

Among our research staffs six are experimentalists and three theoreticians. The experimental nuclear physics programs are focused on the accelerator-based physics and are conducted at the tandem accelerator laboratory of our Institute. Our major facilities include a 3MV 9SDH-2 pelletron accelerator, manufactured by the National Electrostatic Corporation (NEC), USA., capable of producing light and heavy ion beams in the MeV range for a variety of research purposes. Since its installation in the middle of 1989, we have dedicated ourselves to establish the beamline system and have used the accelerator for research in low energy nuclear physics, atomic physics, and applied physics and technology. During the calendar year 1992 the accelerator has run 3400 hours without major problems. A fraction of the machine time was provided to the users from local universities such as the National Tsing Hua University.

The accelerator system is now equipped with six beamlines used for experiments, one with a specially designed scattering chamber for coincident measurement of scattered particles, and γ-rays or X-rays in the charged-particle induced nuclear reaction experiment and the ion-atom collision experiment. One beamline has a gas-target chamber for experiments of charged particles on gas-target nuclear reaction and of ion-atom single collision. We also have beamlines equipped with a NEC RC43 RBS end-station and a 17 inch chamber assembly for experiments of RBS, NRA and channeling, with an external beam milliprobe for PIXE experiment, and with a small scattering chamber for experiments aiming at radiation damage study. In 1992-93 the sixth beamline was setup with a scattering chamber and detection system designed for off-beam γ-spectroscopy and radiative capture experiment. This new beam transportation line which includes a quadruple-doublet lens, a double slit assembly and an ion pump has been installed in the position of 45° from the switching magnet for the capture reaction experiments. In order to reduce the electronic noises caused by the multi-loop to the ground, a new clean power system with a single-ground has also been installed especially for the electronic system.

A fast electronic system for data acquisition was builtup and completed in 1991. This fast logic system consists of a fast NIM modules, CAMAC modules and a micro VAX II computer as host. The data are recorded, event-by-event, in 8 mm tape. The software Q of LAMPF is used for data acquisition and replay. In addition to the micro Vax II computer which is used for the data acquisition, our computing facilities for experiments include two work stations, one being a VaxStation 3100/76 with 20 MB RAM, 2.3 GB disk and a 8 mm tape driver, and another a VaxStation 3100/34 with 16 MB RAM and 1.3 GB disk. These two work stations are mainly used for the data replay, and off-line analyses. For theoretical calculations, eight SUN4 and two IBM/RISC/6000 work stations are available in IPAS computer room of the Physics building. All the individual stations are connected in Ethenet with 6 PC/486 and the whole system works very well. Besides, the Computing Center of the Academic Sinica is equipped with a ETA10-Q108 supper computing system and a VAX 8530 computing system, both are available for us to use at the Institute via the connection of MICROM 6000.

The theoretical nuclear physics research activities are mainly involved in the areas of medium energy and finite-temperature physics. Some specific topics are: nuclear matter phase transitions, neutrino and double beta decays, dark matter and its scattering from nuclei, quark models and hypernuclei.

Research accomplishments in 1992-93 by the staff members of this group include a publication of about twenty research papers, as described below:

I. Experimental Nuclear Physics

Research works were performed on the 3MV tandem accelerator here, concentrating mainly on low energy nuclear reactions, light- and heavy-ion impact ionization, and particle induced X-ray emission (PIXE).

1. Nuclear reaction induced by ^{7}Li-particles at 4.9-11.9 MeV

We attempt to study the nuclear excitation of ^{7}Li projectile from ^{7}Li-ion bombardment on thick Cu target in the energy range 4.9-11.9 MeV.

Gamma-rays emitted from ^{7}Li-ion + Cu (thick target) system have been measured for E(^{7}Li)=4.9-11.9 MeV with 700 keV energy step. In addition to the gammas from Coulomb excitation of ^{63}Cu and ^{65}Cu nuclei, a broad and prominent γ-ray peak was observed at $E_\gamma \sim 480$ keV. The relation between the width of this gamma-ray and the projectile velocity was found to be well consistent with the Doppler broadening relation of the 478 keV γ-ray from ^{7}Li nucleus (478 keV $\rightarrow$ 0), indicating that this γ-ray originated from ^{7}Li excitation during the collision. The dependence of the normalized intensity of this γ ray on the projectile energy showed that the excitation was via Coulomb excitation mechanism.

2. Resonance state at $E_p = 1381.6$ keV from nuclear reaction ^{27}Al(p,γ)^{28}Si

The nuclear state of ^{28}Si at 12916.4 keV excitation has been populated through ^{27}Al(p,γ)^{28}Si reaction st E_p=1381.6 keV. Gamma-ray spectrum was measured by using a large volume ($\sim$ 237 c.c.) HpGe spectrometer. Gamma-ray yields of ^{27}Al(p,γ) at E_p=991.9 and 2045.1 keV resonances and their published branching ratios were used for detector efficiency calibration. The 12916.4 keV resonance investigated in this work was found to decay mainly to the energy levels at 1779 keV, 4618 keV, and 6276 keV, and the γ-ray branching ratios were deduced to be 76.0%, 13.8%, and 10.2%, respectively.

3. Off-beam γ-spectroscopy and radiative capture studies

The off-beam γ-Spectroscopy of radioactivity measurements have been performed. The radioactive samples were prepared by thermal neutron irradiation at the National Tsing-Hua University reactor. Gamma-ray singles, coincidence spectra and the $\gamma - \gamma$ directional correlation functions for the selected cascades were measured by the HPGe-NaI(Tl) Compton suppression spectrometer and the HpGe-HpGe coincidence spectrometer for the nuclear structure parameters. The measured results are compared with IBA and BSDI model calculations. Some heavy nuclei such as ^{110}Cd, ^{124}Te and ^{152}Gd have been studied and published in the last year.

Another going-on research program is the radiative capture studies. The (d, pγ), (α, pγ) or other (particle, particle γ) reactions induced by the low-energy ion beams of the 9SDH-2 Pelletron are proposed to measure the nuclear structure parameters and the short lifetime with Doppler Shift Attenuation Method (DSAM). The experimental results were compared with shell model calculations with OXBASH and FDU0 codes. Since, so far, the existence structure data of the odd-odd nuclei are still not enough, a series of studies for the fp-shell nuclei will be carried out in this laboratory. In these studies, we measure the outgoing particle, particle-γ and $\gamma-\gamma$ spectra, and extract the structure information for the specific nucleus. Last year, the ^{54}Cr(d, pγ)^{55}Cr reaction at E_d=4.5 MeV was performed. Lifetimes of fifteen low lying excited states of ^{55}Cr up to 2.68 MeV are obtained. The primary report has been submitted to the National Science Council, detailed analyses and a full paper are in preparation. The ^{50}Ti(d, p γ)^{51}Ti, and ^{48}Ca(α, pγ)^{51}Se reactions are scheduled to be carried out soon.

The low energy proton capture reactions, such as (p, γ), (p, α), (p, p') and (p, d) for light nuclei, are also planed to study the γ and particle emission branching ratio. This ratio is an important information for understanding the steller evolution. Also, the ^{74}Ge(p, γ) reactions at E_p=1.2-2.8 MeV has been measured since the previously available data of ^{75}As from (p, γ) reaction contain somewhat ambiguity. Study for the nuclear dynamics of the very light nuclei via the capture reactions, such as D(p, γ)^{3}He reaction for observing the meson exchange current effect *etc.* are proposed to be investigated.

As for the improvement of the hardware for the experiments, two special scattering chambers for this purposes have been designed and constructed, a negative charged bias ring has been installed in the beam entrance of the chamber in order to reduce the unwanted scattered positive ions. An integrated multi-detector system of multi-strip Si detector plus four high resolution HPGe detectors assembly are adopted for the out-going particles and gammas measurement.

We have developed successfully a Monte Carlo calculation code in C language last year. Simulations for the response functions of various HPGe detectors, and the detector efficiencies have been calculated and published. Also, a number of optimal geometric relationships of the main and shielding detectors for the HPGe-NaI(Tl) Compton suppression system in various shapes, such as T-shape and L-shape, have been simulated and published. A program for a new design of the Compton suppression spectrometer has been initiated. With BGO crystal, organic scintillator, or even the small BGO pieces plus liquid-scintillator combination considered as the shielding materials, the Monte Carlo calculations for both the response characteristics and the geometries are

in progress.

4. Light and heavy ion impact ionization

Inelastic collisions of charged projectiles with atoms produce inner-shell vacancies through the process of Coulomb ionization to the continuum of the target atoms or by electron capture into unoccupied projectile state. In recent years, there has been a great deal of interest in the ionization of inner-shell atoms by charged particles bombardment. To test the various theoretical predictions and to examine the dependence of ionization processes on energy and target, there is a continuing need for accurate measurements of cross section induced by many different ions. In an extensive work we made a detailed measurement of the K X-ray production cross sections induced by protons, deuterons, ^{3}He and ^{4}He-ions, ^{12}C and ^{16}O-ions at certain energy range, and compared the results with the predications of the ECPSSR theory, first Born approximation and molecular orbital theory. The targets investigated cover a wide range of elements with Z=22-47.

(a) ^{3}He ion induced K X-ray emission cross sections of Mn, Fe, Ni, Cu and Zn

The K X-ray production cross sections σ_x have been accurately measured for Mn, Fe, Ni, Cu and Zn induced by ^{3}He ions in the energy range 1.5 to 6.0 MeV. The measurements are compared with the predictions of both the first Born and ECPSSR ionization theories using single-hole fluorescence yields. The ECPSSR theory is shown to be in much closer agreement with the data. The values of the K_β/K_α intensity ratio are also obtained. Our results were found to be in good agreement with other published data.

(b) K-shell vacancy production cross sections for Se, Br, Rb, and Y induced by 1.5 to 9.0 Mev ^{3}He ions

The K X-ray production cross sections have been accurately measured for Se, Br, Rb, and Y (in the atomic number range Z=34-39) using 1.5-9.0 MeV ^{3}He ions as incident beams. We made a detailed comparison of the obtained data with the predictions of the first Born and ECPSSR ionization theories using single-hole fluorescence yield. The ECPSSR theory was found to be in better agreement with the measurements than the first Born theory. From the observed data we also extracted the K_β-to-K_α X-ray intensity ratios and observed their variation with the atomic number and incident energy.

(c) Cross sections for K-shell ionization of atom induced by 1.5-6.0 MeV ^{4}He ions

The K-shell X-ray production cross sections have been measured for elements of Ti, Mn, Co, Ni, Cu, Zn and Ga (Z=22-31) using ^{4}He-ion beams in the energy range 1.5-6.0 MeV. Results are compared with the predictions of the first-order Born approximation (FOBORN) and the energy-loss Coulomb-deflection perturbed-stationary-state relativistic theory (ECPSSR), and those of earlier measurements. The agreement with the ECPSSR theory is within 10%. In addition to the experimental cross sections, the K_β/K_α X-ray yield ratios have been extracted, and found to have good agreement with the calculated values of Scofield, and the "recommended" values of Khan and Karimi.

(d) Ionization of the cobalt K shell by low energy protons, deuterons, and Helium-3 ions

The characteristic X-ray spectra of cobalt (Z=27) have been obtained as a function of energy in the energy range from 0.7 to 2.0 MeV amu^{-1} for incident protons, deuterons and ^{3}He ions. K X-ray production cross sections σ_x were measured by a comparison with the simultaneously measured Rutherfold scattering cross sections. Uncertainties inherent in this method are minimized to $\sim$ 8%. For protons, the measurement was extended at energies up to 3.0 MeV. The results are compared with the predictions of the perturbed-stationary-state with energy-loss, Coulomb deflection, and relativistic corrections (ECPSSR) ionization theory and first Born approximation. From obtained σ_x measured with two types of projectile, the effects of the Coulomb deflection and the increased binding energy were investigated.

(e) Atomic K shell ionization of Mn, Fe, Ni, Cu and Zn by carbon ions

Yields of the K X-rays and elastic scattering particles induced by carbon ion impact on thin targets of Mn, Fe, Ni, Cu and Zn have been measured simultaneously at incident energies ranging from 3.0 to 9.0 MeV with steps of 0.6 MeV. Experimental K shell X-ray production cross sections were obtained and compared to the first-order Born and the ECPSSR theories, as well as to the results of previous measurements. The ECPSSR theory gives results much closer to the experimental data except at low energies, while the first-order Born approximation overestimates the data by more than a factor of 6 at all energies. In addition, we obtained the K_β/K_α intensity ratios as well.

5. Proton induced X-ray emission(PIXE)

The proton induced X-ray emission is an useful tool for a variety of application over a broad range of sample types and specimens. We have established the beamline system and experimental setup for elemental analysis using PIXE method with an external beam. An external beam milliprobe was designed specially for the PIXE measurement. The proton beam was led to air passing through slits and graphite collimator with a circular aperture inside the milliprobe. In 1992-93, we completed experiments for the elemental analysis of some ancient Chinese artifacts.

We applied the external-beam PIXE for the determination of the elemental composition of ancient Chinese bronze artifacts. Characteristic X-ray spectra from the samples bombarded with protons of 2-3 MeV have been measured with a Si(Li) detector. At each sample between 2 and 3 spots were irradiated per run. Results of measurements on three fragments of bronze drinking vessels and helmet of Chinese ancient Chou and Shang dynasties (17th-8th century BC) were obtained. Trace elements in composition have been determined in ppm.

6. International research collaboration

(a) With the Cyclotron and Radioisotope Center (CYRIC) at Tohoku University, Sendai, Japan

For years members of our group have performed experiments at CYRIC using their 35 MeV cyclotron to study the charge exchange (p,n) reactions and single-proton transfer (d,n) reaction. In 1992 nuclear charge exchange reactions continue to be of our interest, particularly the ΔJ=1 Gamow-Teller and isobaric-analog state transitions in sd-shell nuclei. By means of high resolution time-of-flight technique, (p,n) reactions on many sd-shell nuclei have been studied to investigate systematically the isovector potential parameters in the nucleon-nucleon channel. Also, we made a measurement of differential cross sections for the ^{9}Be(d,n)^{10}B reaction at E_d=25 MeV using the time-of-flight technique. Experimental angular distributions for the states below E_x=6.57 MeV were analyzed with the distorted-wave theory including the S-wave deuteron-breakup effects in the adiabatic approximation. The extracted spectroscopic factors were compared with previous data. Coupled-reaction-channel calculations were also performed, and significant improvements were seen for weakly excited states.

(b) With Fermi National Accelerator Laboratory (FNAL), USA, for high energy physics experiments

We joined the E789 project of Fermi Laboratory in 1989 initiated by Dr. J.C. Peng of Los Alamos National Laboratory for a long-term collaborative work on the experimental investigation of the rare two-body decay modes of B-mesons and D-mesons. Observation of such decays could provide the first definitive experimental evidence on the coupling between beauty-quark and up-quark as well as the possibility of observing CP-violation in B-meson decays. Such measurements will give vital information on the origin of CP-violation, so far only observed in the neutral kaon system. To accomplish this task E789 has developed a powerful particle-antiparticle spectrometer. It combines a very high-rate microvertex detector and a magnetic spectrometer with excellent invariant mass resolution. A state-of-the-art Ring Imaging Cerenkov detector provides particle identification over the full range of accepted momentum.

E789 received its first allotment of beam time during May-August, 1990. This was low-intensity test run at a low-mass spectrometer setting optimized for charm decays. With a total of 8 Silicon Microstrip Detector, the two-body decay modes of the D mesons have been observed successfully. Sufficient data were taken to see D→ $K\pi$ at the few-hundred-event level and to search for dileptonic D decays at the 10^{-5} level.

E789 began its second run in Aug. 1991 and ended the run in Jan. 1992. Two different settings of spectrometer, which separately optimized the acceptance for charm or beauty decays, were used in this run. The charm data will provide 10^3 to 10^4 reconstructed D→ $K\pi$ events. The A-dependence of J/ψ production will be studied. Limits on D → dilepton decays are expected at 10^{-5} at 90% confidence.

Beauty sensitivity is provided in the modes B → $J/\Psi + X$ and B → dihadron. Data were taken at 5×10^{10} proton per pulse on a 3 mm-thick gold target, corresponding to a 50-MHz interaction rate. Data analysis is in progress. B production cross section in 800 GeV pN collision will be obtained.

II. Theoretical Nuclear Physics

1. Nuclear Physics and Quark Models

(a) Nucleon's possible quark-diquark structure

Nucleon's possible quark-diquark structure has been proposed to study the data of lepton-nucleon deep inelastic scattering, as well as high energy $N\bar{N}$ and $N\bar{N}$ reactions and the associated baryon and meson Regge trajectories. These studies suggested that a proton could have a $u(ud)_0$ configuration in which the u and d quarks form a bound object with both spin and isospin equal to 0. This bound object was given the name of diquark. Other combinations of the constituent quarks such as $(uu)_1, (ud)_1$ and $(dd)_1$ with S=I=1 are less likely to exist as bound objects due to the one gluon exchange force being repulsive in the S=1 qq configurations. Similarly, a neutron could have a $d(du)_0$ configuration.

We have made a review related to such quark and diquark structure. Its considerable success in various applications seems to suggest that this structure may be consistently applied to explain nucleons' properties. Effort was made to take the nucleons' charge RMS radii as an example. We demonstrated a simple model and obtained very nice results. Some other possible applications will also be considered.

(b) Nucleon-antinucleon system and quark models

Because the particle identities of the nucleon-antinucleon ($N\bar{N}$) system often undergo dramatic changes after interactions, the $N\bar{N}$ system can be a nice test ground for quark dynamics. Though rich of physics information, this system is much more difficult and complicated to deal with than the $N\bar{N}$ system. To avoid unnecessary complications in the beginning, we draw attention on the elastic scattering $N\bar{N} \to N\bar{N}$ and the charge exchange reaction $p\bar{p} \to n\bar{n}$ with the possible extension to $N\bar{N} \to Y\bar{Y}$ or other related interactions. Through the investigations of different quark reaction diagrams, we have obtained some understanding of qq, $q\bar{q}$ interactions.

2. Dark Matter, nuclear interactions and structures and quark models

It has been believed that within our Universe, most of the matter is invisible, neither emitting nor absorbing electromagnetic radiations of any frequencies, and interacting with other particles very weakly. Experiments to detect its interactions with nuclei are among those designed to discover its existence. We plan to study its possible interaction with nucleons via quark models, and apply the resultant nucleon-dark matter interaction to predict dark matter-nuclei interactions.

3. Nuclear properties

(a) A semi-emperical determination of the properties of nuclear matter

The temperature dependence of the coefficients in the semi-empirical mass formula has been determined from a least squares fit to the canonical ensemble average of the observed excitation energy per particle for nuclei throughout the periodic table. The low temperature behavior in the leading coefficient, namely the bulk energy density, was found to be in disagreement with current parameterizations used in the equations of state for symmetric nuclear matter. Peaked structure in the specific heat occurs at a temperature of approximately 1 MeV in agreement with theoretical predictions of the critical temperature of a pairing phase transition in nuclear matter.

(b) Constrained mean field calculations

The shape transition in ^{24}Mg has been studied within the finite temperature Hartee-Fock approximation by introducing an extra volume constraint. We found that a 2.5% compression on the system causes the critical temperature of the deformed-to-spherical shape transition to shift downward by about 0.7 MeV. The density of states of the compressed system is also decreased drastically, and disagrees with the predictions of a simple Fermi gas model because finite size effects have been neglected. Such a sensitive response of the structures in the specific heat and the many body level density to the compression, we believe, can be used to determine the density of a compressed system and provide information about the nuclear equation of state.

The experimental nuclear spectra indicate that the rare-earth nuclei undergo a collective-to-noncollective transition even for a closed-shell spherical nucleus. For off-shell deformed nuclei this transition may be accompanied by a change in the nuclear shape in finite temperature mean field theories which is not seen in exact canonical calculations. Therefore, a theory using the quadrupole deformation parameter β and γ as the order parameter for these transitions may be misleading. Many body level density is believed to be the relevant order parameter for these transitions.

We also studies the finite size effects in the calculation of nuclear level densities within the framework of a Fermi gas model. A simple geometrical correction to the single particle density of states leads to an increase in the Fermi energy which drastically reduces the many body density of states. For light nuclei such as ^{24}Mg, the nuclear level density at T=3 MeV is reduced by roughly an order of magnitude when finite size

effects are taken into account and the reduction is more pronounced in heavier systems such as ^{208}Pb. Meanwhile, we found that the Bloch formula for the many body level density requires a high order correction when $T > 3$ MeV.

(c) A microscopic description of the lithium isotopes

A unified calculation of neutron rich isotopes in lithium has been performed in a hyperspherical basis in which the underlying symmetry of each isotope exhibits a simple structure. The variation in the binding energy as a function of mass number is qualitatively reproduced, and the error is comparable, on the average, with that of the results of the large scale shell model calculations. Furthermore the radial distribution of each isotope was found to decrease exponentially in the asymptotical region.

4. Heavy Quark Symmetry

Recent years have seen intense activities in the field of heavy quark physics, and remarkable progress has been made. In the limit of infinite heavy quark mass, the strong interactions of a heavy quark become much simplified at low momentum transfers. Namely, the heavy quark sector of the effective QCD Lagrangian becomes independent of the flavors and spins of the heavy quarks. For N_f heavy quark flavors, the new spin and flavor symmetries combine to form a $SU(2N_f)$ symmetry group (heavy quark symmetry) which is not manifest in the original Lagrangian. With the help of heavy quark symmetry, one can establish useful relationships among the static and transition properties of different heavy hadrons, which would be otherwise unrelated.

On the other hand, it is well known that the light quark sector of the QCD Lagrangian obeys an approximate $SU(3)_L \times SU(3)_R$ chiral symmetry, which is spontaneously broken, resulting in the existence of the eight "massless" pseudoscalar Goldstone bosons (π, K, and η). Consequently, to study the interactions of heavy hadrons with low energy Goldstone bosons requires a synthesis of the heavy quark symmetry and chiral symmetry.

In several recent works, we have developed a framework which is suitable for the description of heavy hadrons interacting with Goldstone bosons at low energies. Specifically we have written down chiral Lagrangians, with heavy quark symmetry incorporated, which describe the strong and weak interactions of low-energy pseudoscalar bosons with heavy hadrons. Such a framework has also been extended to include electromagnetic radiative processes. Furthermore, we have also studied the $1/M_Q$ and SU(3) symmetry breaking corrections to the chiral dynamics of heavy hadrons.

HYDRODYNAMICS AND ATMOSPHERIC PHYSICS GROUP

Review of Research Activities

The members in our group are actively involved in both academic and applied researches related to the physics of fluid. On the academic side, we have concentrated on the basic phenomenon of fluids. These phenomena include turbulence, flow instabilities and pattern formation in fluids, hydrodynamics of complex fluids, flow in porous medium. On the applied side, research projects are being conducted in environmental fluid mechanics, physics of the atmosphere, development of numerical scheme for computational fluid mechanics, and instrumentation in measurement of fluid. Followings are descriptions of selected ongoing research projects conducted by our group members.

1. In turbulent modeling, we have investigated the applicability of k-ϵ model to flows with stagnation points. Using both the control volume method and the finite element method, the sensitivity of various parameters in the model is tested. It was found that the prediction of separation points depends sensitively on the estimation of the second order quantities. It is the over estimation of production, dissipation, and diffusion of k and ϵ that suppress the separation. We are now trying to develop a non-isotropic model to improve the accuracy of the second order quantities. We plan to perform related experiments and numerical simulations in the future.

2. We are also working on a Reynolds stress model with a cross diffusion of k in the ϵ equation. Based on the more physical assumption that small turbulence eddies can be anisotropic, our model can improve the predictability without tunning the model constants. Applications of our model in four turbulent free shear flows compare favorably to the existing turbulent models. The applicability of this model to various complex shear flows will be conducted in the future.

3. Convective instabilities are investigated by variational method as well as numerical simulations. The system studied is a Newtonian fluid contained in a cell with walls of various thermal properties. It has been known that a particular flow pattern emerges at the onset of the convective instability. The purpose of this study is to establish a quantitative relation between the wavelength selection and the conductivity of the

wall. The numerical simulations show that the wavelength of the convection rolls varies monotonically with the wall conductivity. In the future we hope to see if this trend holds in more complex fluids such as binary liquid mixture.

4. Phase separated binary liquid mixture is one of the complex fluids investigated in our group. The interface between the two phases is observed using a laser scanning reflectometer developed by one of our group member. With this technique, convection driven deformation of the interface has been observed with high angular magnification. By keeping the binary mixture closed to its critical point at which both the density difference and the surface tension are vanishingly small, new phenomena at the interface have been observed.

5. Studies of the demixing of immiscible binary liquid mixture show that the demixing rate depends not only on the intrinsic properties of the mixture but also on the geometry of the container. It was found that container with walls making a finite angle with the direction of gravity can enhance the demixing rate due to the convective flow induced at the inclined walls. Using video imaging technique, the time variation of the volume V(t) of the fluid separated from the mixture was extracted from the recorded images during demixing. Scaling behavior was observed such that V(t) collapse onto a single universal curve for difference temperatures as well as different inclinations. We are now improving the imaging system so that the convective flow induced at the inclined wall can be studied quantitatively.

6. In a separate project, we are trying to develope particle imaging techniques for measuring the flow field in unsteady flows and slow-motion flows. An automatic analysis system is under development to extract the flow field from pictures containing light scattering seed particles within the flow. The accuracy and the performance of this technique will be investigated in various unsteady flows.

7. Two phase flow within porous medium has been studied for a long time due to its importance in industrial processes. Usually the porous medium are three dimensional (such as glass beads packing) and observation within the medium is difficult. By filling water in the gap between two parallel ground glasses, we can study the effects of the

randomly oriented glass surface on the dynamics of a driven air-water interface. A semi-automatic video imaging system has been developed to acquire and analyze the recorded images of the air-water interface when it moves within the glass plates. The experimental results are interpreted in the framework of self-organized criticality.

8. In the area of atmospheric studies, we tried to understand the reflected sunlight characteristics in the near infrared carbon dioxide channels in the High-Resolution Infrared Radiation Sounder aboard the NOAA meteorological satellites. The reflected sunlight is considered to be a noise in the satellite radiation data. Using a radiative transfer model developed by one of our members, we can determine the directional distribution of the reflected sunlight. In the future we are going improve this method for better performance.

9. Oil spill in the ocean is one of the most important problems in environmental engineering. We are trying to understand and predict the spread and diffusion of the emulsified oil-droplets under the sea water surface after an oil spill occurred. The alternating-direction-implicit scheme is applied to solve the time-dependent three dimensional convection-diffusion finite difference equation with the buoyant terminal velocity and turbulent diffusion coefficient modeled as function of oil-droplets and ambient oceanic environment characteristics. The applicability and the precision of this numerical model will be checked in experiments to be conducted in the future.

Research facilities

On the experimental side, we have an environmental wind tunnel laboratory, a water channel laboratory, an optical hydrodynamic laboratory. In the environmental wind tunnel laboratory, studies of turbulent flow are carried out in an open suction type wind tunnel with a $3 \times 2.2 \times 18.5m^3$ test section. Flow field information within the test section are collected by hot wire and hot film anemometer systems. In the water channel laboratory, we have an 8 m long water channel with $0.6 \times 0.6m^2$ cross section. With a wave generator, the interaction between the surface wave and the stratified flow in the channel is being studied. In the optical hydrodynamic laboratory, the physical scale of the apparatus is much smaller that those in the other two laboratories. Most of the experiments in this laboratory are related to the studies of basic phenomena in complex fluids. Instrumentations in this laboratory are mainly designed and built by our researchers. A partial list of these setups includes: programmable temperature controlled water and air baths, video image acquisition and processing systems, static and dynamic light scattering systems and liquid-liquid interface shape reflectometer.

For numerical works in computational fluid dynamics and simulations, most jobs are performed by the computers maintained in our institute. The machines used most frequently are the IBM RISC/6000 and the SUN SPARC workstations. Occasionally IBM/PC compatible computers of our group are employed to verified codes before sending the jobs to the larger computers.

Future Outlook

In the future our group would like to recruit new members to enhance the ongoing researches. At the same time, the members are encouraged to response to stimulus from other research communities to keep pace with new developments occuring in other parts of the world. On the other hand, we notice that the academic research environment in Taiwan has come to a stage in which team efforts can be more fruitful than individual works. Based on this idea, we are planning to initiate close collaborations among the members of our group as well as those outside. We hope that by gathering expertise from different fields (or even different disciplines) we can attack specific problems in different perspectives so that a complete understanding of the problems can be condensed. As a first step, we are going to establish a research team, which consists of members who will carry out closely related analytic, numerical and experimental studies of the fundamental and applied issues of turbulence.

Solid State and Biological Physics Group

The main research areas of our research activities are surface physics, superconductivity, Raman and infrared spectra physics, magnetism, thermodynamic and biophysics etc. During the last few years, a significant progress has been made. Current research projects focus on some of the fundamental problems of surface physics, solid state physics, as well as material sciences. The following summary is not intended to cover of all the work done in this group; instead it describes briefly only some of our recent researches in this area.

Solid State Physics:

1. Surface physics:

Our research efforts focus on basic physics of solid surfaces and thin films. The surface physics laboratory is currently equipped with general surface science analytical instruments having the following macroscopic techniques: ESCA, UPS, LEED, AES, HREELS etc., and microscopic techniques: STM, AFM, FIM and Atom-Probe FIM. The thin film laboratory has a Microwave plasma chemical vapor deposition system and a mini MBE system. In addition, we have an active theoretical program in surface physics. Recent works accomplished and research projects in progress are summarized below.

a. Dynamical behavior of metal surfaces:

This project is done in cooperation with students of Tien T. Tsong at the Pennsylvania State University. Using the FIM, we have determined the equilibrium shape of the Ir(001) layer. In addition, the detailed atomic processes of dissociation of Ir atoms to terraces of this surface layer at high temperature have been observed, and the active energies for these processes have been measured. This work has been accepted for publication in Phys Rev. B.

b. Diffusion behaviors of Ni on the Cu(111) surfaces:

The temperature dependent behavior of vapor-deposited Ni atoms on the Cu(111) surface has been studied by HREELS. The different diffusion behaviors of Ni atoms at different temperatures have been observed. We find that association of Ni atoms into 2-D islands can occur around 180K, and atomic exchanges between Ni adatoms and substrate Cu atoms can occur around 260K. A paper about this work has been accepted by Phys. Rev. B.

One or two overlayers of Rh were deposited on a clean Pt(001) surface to study diffusion of Rh atoms into the Pt matrix. The kinetics of Rh diffusion from the overlayer into the bulk were monitored by AES as a function of time and the annealing temperature. The activation energy for this diffusion has been measured. We are currently preparing this result for submission to surface science.

c. Basic principle of atomic manipulation:

Applying Tersoff and Boldings' interatomic potential for Si-Si atoms, we have theoretically calculated the critical field strength for field evaporation and the charge state of the evaporated ions under the configurations of the FIM and STM. These results were compared to experimental observations of the FIM and the STM. This work has been published in Physical Review Letter.

In experiments , we have been able to routinely deposit clusters of atoms from the tip to the sample surface or vice versa with the STM. The deposition occurs by the application of a voltage pulse and is generally believed to be produced by field evaporation process. A system of Au tip and Au sample has been used to study the process of field evaporation and the stability of deposited atoms in different environments, i.e. in air, HV and UHV. We are currently accumulating data and analyzing the results for publication.

d. Surface reaction mechanisms and applications to diamond thin film growth:

This project is under the direction of Yung Liou. In this project diamond thin films were grown by a microwave plasma chemical vapor deposition system. The gas-surface reaction and plasma chemistry were carried out with an optical emission spectroscope. From the optical emission spectra of the plasma above the subtract surface, we were able to investigate the reaction radicals by changing different gas feeding into the plasma. The surface analysis of the adsorption and reaction of hydrogen and oxygen with diamond was carried out with a high resolution electron energy loss spectrometer and an Auger electron spectrometer. Non-diamond and diamond bondings were distinguished in these two different spectra.

e. Surface lattice dynamics by high resolution electron energy loss spectroscopy:

Metal superlattices and oxides were grown by a molecular beam epitaxy system (MBE). The MBE system, equipped with three electron beam evaporators, thickness monitor and reflection high energy electron diffractometer (RHEED), is able to grow single crystal metal films with controlled thickness. Surface phonons of these thin films were investigated by high resolution electron energy loss spectroscopy (HREELS). Different thickness of thin metal films, multilayers and superlattices are grown. The effects of thickness and structure change in lattice dynamic phenomena are major interests. This project is under the direction of Yung Liou.

f. Surface structure by diffraction techniques:

This project is under the direction of C.M. Wei. In this project theoretical methods for the studies of the ordered and disordered surfaces including LEED, DLEED, ARXPS, ARAES, EDPD, HREELS, XANES and EAM have been developed. Research cooperative projects with experimental group in Taiwan, USA and German have also been established.

Another research direction is to develop electron-emission holography - a direct method without any dynamical calculations. Using an integral energy phase-summing method, a complete structural determination of 3D atomic images of the surface structure with a high resolution of $\sim 1\AA$ has been achieved, thus qualifying this technique as a direct structural tool.

2. Superconductivity:

A number of significant researches concerning high temperature superconductivity in various systems have been reported during recent years. We have obtained a lot of experience in the fabrication and the physical properties of various high Tc oxides. It is evidently that the high Tc superconductors have much better potential for the future applications. Therefore, it is worthwhile for us to study the details and to find the mechanism and to improve the quality of high Tc superconductors.

3. Raman and infrared spectra physics:

a. Enhanced Raman scattering studies:

In this study, we have found that the enhancement of sulfite ions adsorbed on an Ag island film could reach as high as $10^{10} - 10^{12}$ times, far more exceeding the well-known 10^6 value. The aim of this research, is to investigate the enhancement more accurately by use of the XPS measurement of sulfur content on the Ag thin film. In addition, in order to understand the underlying physics and therefore to determine appropriate model for the enhancement mechanism, we propose to measure the relation among the enhancement factor and the energy of incident photons as well as the thickness of thin Ag film.

b. Raman and Infrared Spectra of Crystalline $KHCO_3$:

Potassium hydrogen carbonate ($KHCO_3$) is a typical molecular crystal in which the molecular vibrations are divided into two groups. The high frequency modes correspond to internal molecular stretching while the low frequency group belongs to their lattice vibration modes. This information can give a help to the lattice dynamics calculation in molecular crystals. An X-ray diffraction measurement has shown that the crystal undergoes several phases from 10K to their melting point.

Applying the laser Raman and infrared spectroscopic techniques, we can obtain the complete temperature dependent Raman and infrared spectra of this crystal from 10K to 400K. A detailed study of the spectra of the mode frequency, line width, line shape and intensity versus temperatures, together with the group correlation table, give us accurate information of the crystal structures of different phases and also the identification of the vibration modes. These assignments propose a useful optical data in lattice dynamics calculations.

c. Excitation spectra study:

Recently, the Institute of Physics of Academia Sinica has added a high resolution Fourier Transform infrared spectrometer. We propose to measure the electronic excitation spectra of various donor and acceptor impurities in silicon and germanium. The measurements will be made mostly with the sample cooled to liquid helium temperature. Due to the very high resolution of the spectrometer, the positions of the peaks of the absorption lines could be determined precisely. Weak lines could also be resolved and observed. Besides, the shape and the width of the absorption lines from the high resolution measurements are also going to be used to study the possible reasons for the

line broadening phenomenon.

4. Magnetism:

a. Magnetic property of binary alloys:

Binary alloys, besides the single crystal and amorphous materials, belong to the polycrystalline structures. There are at least two kinds of structures which exist in the polycrystalline alloys. That is the grain and grain boundary. Usually, the chemical compositions are quite different between the grain and the grain boundary. The grain boundary segregation means that some elements are in favor of the grain boundary. Therefore, the physical properties of these polycrystalline alloys will depend on the situations of the grain and the grain boundary. Much works concerning the morphology and growth kinetics of the grain boundary precipitation and segregation have been studied through optical microscopy. Comparatively, little effort has been devoted to the relation between the physical properties and the grain boundary precipitation and segregation.

Under this research topic, we will prepare a systematic binary alloys or compounds by means of the arc meter. Their electrical resistivity, magnetization and thermal properties etc. will be studied.

b. Magnetic, optical and electric properties of magnetic alloy films:

The main goal in this is to study the magnetic, optical and the electric properties of magnetic alloy films. Especially, we shall pay attentions to those physical properties at various temperatures. As to the magnetic properties, the measured quantities include magnetization, magnetoresistance, and magnetostriction etc. As to the electric properties, electrical resistivity and heat capacity of these specimens will be measured. For optical properties, the measured quantities include absorption, transmittance and reflectance etc.

c. Noise and electrical conductivity in metal oxide-glass thick films:

Metal oxide-glass thick film resistors (TFR), such as Bi_2 Ru_2 O_7^- glass and RuO_2^- glass, are the cremate made by conductive metal-oxide particles and insulative glass particles. Thick film resistors have been widely used in hybrid circuits due to its easy, low cost fabrication and small size. The disadvantage of this material is its ac noise induced by dc voltage bias. After the failure in explanation by conductive path model and its statistical calculation, R.W. West. G.E. Pike and C.H. Segar in 1975 based on "metal-insulator-metal tunneling" model successfully constructed noise and electrical conductivity mechanism of TFR. The noise-frequency relation can be described by Hooge's law as follows

$$S_v = K \cdot V_{dc} \cdot \triangle f / f^{\alpha}$$

S_v : noise power spectrum. V_{dc} : DC voltage bias across TFR, f and $\triangle$ f: frequency and its band width, α : the exponent index, ranged approximately from 0.8 to 1.2.

So far we have completed the noise and resistivity measurements for temperature range from 77K to 300K. Our experimental results are in good agreement with those of G.E. Pike et al. using Island model. We plan to complete our noise study in rest temperature ranges, i.e., from 1.5K to 77K and 300K to 800K. In these temperature ranges, we will have the chance to study the electronic excited states in barrier and voltage-current relation. Based on the theory of quantum tunneling effect we believe that the barrier thickness and its magnitude (which are related to particle size and its properties) are involved in mechanism of noise and electrical conductivity.

d. Magnetostriction and Hall effect of Co-Pd alloys:

(1) We have successfully set up a system to measure the saturation magnetostriction of any ferromagnetic materials. The sensitivity of our device is in the range of micro-strain. The strain-gauge was made by the Measurement Group Company. Because our measurement must be carried out in a magnetic field, it is necessary to eliminate the magnetoresistance signal from the gauge. We have used a half-bridge circuit with an active gauge and a dummy gauge at each arm. The gauge factor can be calibrated either by a standard resistor or by simulating a known strain from a cantilever. Temperature variation range is from 4 to 300K.

(2) A thin film coater is built up. Testing procedures have just begun. This machine is specially designed for coating ferromagnetic films; while making the film, we are able to apply an external field to define the easy direction.

(3) A 6 Tesla superconducting magnet will be used to measure the Hall effect of ferromagnetic metals.

5. Thermodynamic physics:

a. Specific heat of rare-earth compounds:

Valence fluctuation compound $CePd_3$ is a typical example in which the valence of Ce is dependent on time, temperature and pressure. In Heavy Fermion compound $CeAl_3$., the effective mass of f electron of Ce is about 1000 times of the rest mass of free electron. This result is shown by the specific heat coefficient measurement. Superconductivity in Heavy Fermion compounds, which is seldom to occur in the appearance of magnetic moment, have been commonly observed in these rare-earth alloys and compounds in the past two decades. These interesting physical phenomena made the study on these materials more important.

We believe to perform heat capacity measurements and Hall effect measurements on these compounds will give us more clear picture in explanation the mechanism of coherence occurred in these rare-earth materials.

b. Coherence effects in Kondo lattice studied by specific heat:

The coherence of 4f magnetic moments among rare earth ions (for example Ce ions) in Kondo lattice system is an important and difficult problem. C.D. Bredl *et al.* had found anomaly in low temperature specific heat of $CeCu_2Si_2$ and $CeAl_3$ Kondo lattice systems. This anomaly which has never been observed in Kondo ion system is believed to be relevant to the coherence in Kondo lattice system. C.D. Breel *et al.* had proposed the existence of pseudogap near Fermi energy to explain the specific heat anomaly.

The Kondo temperature values of $CeCu_2Si_2$ and $CeAl_3$ are 3K and 5K respectively. Because of the small values, the measurements had to be performed in very low temperatures (about 1-2K). The Kondo temperatures of Ce_3 X (X=Al, In, Sn) are around 10-20K. If we perform same experiments for the system, we will have better chance to observe how the coherence is affected by magnetic field. No exact answer has been reported in this yet. We hope through the specific heat measurement of Ce_3 X in applied magnetic field the answer of mechanism of coherence can be found.

Biophysics:

Organs influence on the blood pressure wave propagation:

Rats will be used as the experimental animal to study the effect of organ on the blood pressure wave and flow.

Energy in the circulatory system is mainly in the form of pressure. Kinetic energy is only a few percent. The pressure wave is the main energy source to push the blood flow. This project will study the relation between blood pressure wave and blood flow especially the blood pressure wave and the blood flow into organs. The main organ is kidney.

We will study the change of its elasticity and resistance effect on the blood pressure wave as well as the blood flow.

Theoretical Physics Group

Review of Research Projects

1. Gauge field theory and vacuum structure of gauge theory
2. Quantum group, integrable system and two dimensional gravity
3. Effective field theory and electroweak radiative corrrections
4. Heavy quark and chiral symmetry
5. Nonleptonic weak decays of charmed baryons
6. Polarized sea-quark and gluon structure functions
7. QCD sum rules and perturbative QCD
8. Particle phenomenology
9. Astrophysics and cosmology
10. Statistical physics
11. Nonequilibrium phase transitions in sandpiles and interfaces
12. Nonlinear and strongly correlated systems
13. Many body theory

1. Guage Field Theory and Vacuum Structure of Gauge Theory

The mathematical aspects of the gauge theory is quite well understood now. From the physics point of view, gauge fields arise as a result of frustration. Frustration usually arises when "pairing" occurs in the underlying system. If some pairings fail to form due to dynamical or boundary conditions, the system will be frustrated. When frustration occurs, the ground state of the system is usually degenerate. Attempt to understand gauge theory from the point of view of frustration has just been started in the field of condense matter physics. We are very interested in trying to understand such phenomena as gauge symmetry broken, current anomaly etc. from such a point of view. We have also been studying the following specific problems during the past years: (1). Renormalization of the nonlocal guage invarinat operators. We tried to derive the complete renormalization matrix of twist two, twist three and twist four gauge invariant nonlocal operators such as strings. This amounts to calculating the string split and fusion amplitude under change of scale. The result can then be iterated to derive an equation generalizing the Alteraeli-Parisi equation and may shed some light on the x-dependence of the parton distribution function. (2). Studies of chiral gauge field theory. In particular, the chiral Schwinger model provides an example when one can have a consistent massive guage particles without the Higgs. Whether such a phenomenon can occur in non-abelian and higher dimensional models is yet to be seen. (3). How can we write down an effective low energy Lagrangian involving both mesons and baryons which summarizes the effect of chiral anomaly just as the WZW term summarizes the anomaly effect in the meson sector?

The vacuum polarization around a classical magnetic flux string (F) located at the origin has been studied. The feedback interaction of the induced currents in 2+1 dimensions appears as a Chern-Simons term with a dimensional coefficient $e^2/4\pi$ in the Lagrangian. This coefficient is equivalent to an effective photon mass. We have studied the dependence of the induced currents on the Chern-Simons mass. The characteristic length scale of the current distribution transits from the fermion Compton wavelength to the photon one as the Chern-Simons mass increases. The similar approach has been applied to the 3+1 dimensional case. It is observed that the vacuum polarization screens the applied flux completely. That is, a magnetic flux string in fact does not exist. It is also found that the vacuum currents in the vicinity of the magnetic flux are

sensitive not only to the fractional part of F, à la Aharonov and Bohm, but also to the sign of F. We have discussed why these facts are an inevitable corollary of helicity conservation, and go on to describe the relation of induced vacuum currents to the beta function for coupling of charge to flux. The form of this function suggests that Nielsen-Olesen magnetic flux spaghetti may characterize the vacuum of any gauge theory on scales where its coupling becomes strong. This non-perturbative vacuum structure provides the possibility of explaining electric charge quantization, and of damping the catastrophic growth of the coupling as found in a conventional perturbation theory.

2. Quantum Group, Integrable System and Two Dimensional Gravity

This is one of the hottest topics in theoretical physics in recent years. The whole concept of symmetry is generalized and its implication could be enormous. We had done some studies on the three dimensional integrable system in relation to the so called Chern-Simon field theory. The development in this area will be closely followed.

3. Effective Field Theory and Electroweak Radiative Corrections

The recent studies of electroweak radiative corrections are mainly on locating the effects due to heavy particles which do not decouple in the low energy processes. These effects may be utilized to confirm the existences of those undiscovered particles. For example, one may be able to set a range for the mass of the top quark by analyzing various low energy processes. On the other hand, it is rather non-trivial to find a suitable process for this purpose unless a systematic method is developed. The systematic approach is to integrate out the top quark degree of freedom from the standard electroweak theory to obtain an effective theory which is suitable for describing the low energy physics. We had reached some definite results. We constructed an effective Lagrangian describing all bonsonic physical processes which receive contributions from the virtual top quark through radiative corrections. We applied our results to one loop corrections of the ρ parameter and the process $H \to \gamma\gamma$. In recent months, we extended the investigations to include two external light fermions in the the effective Lagrangian. Typical processes of this kind are flavor changing neutral current decays often used for probing the basic structure of various proposed theories. Since we exclude the top quark as a possible external state, the effective theory so constructed would not generate gauge invariant Green's functions. The S matrix, however, is still gauge invariant. To obtain all possible gauge non-invariant structures, it is more convenient to work on the generating functional W for the connected Green's function rather than the effective action Γ. The gauge non-invariant structures can be quickly extracted by expanding W around the background fields which are chosen to be solutions of classical equations of motion in the limit $M_t \to \infty$. We have so far obtained an effective Lagrangian for low energy processes involving two external light fermions. Both gauge invariant and gauge non-invariant structures are included in the effective theory. This result was applied to some known processes such as $b \to s\gamma$, $Z \to b\bar{s}$, and $Z \to b\bar{b}$. It was found that predictions due to the effective theory agree with those from direct calculations. The method of effective field theory is however much simpler. Furthermore, the effective Lagrangian method clearly explains why the rare decay $Z \to b\bar{s}$ contains terms proportional to M_t^2 in its amplitudes whereas $b \to s\gamma$ does not. It is because that certain higher dimensional operators with $O(M_t^2)$ contributions would only contribute to the former process. To further demonstrate the usefulness of the effective Lagrangian, we also applied it to compute electroweak radiative corrections to the process $W^+W^- \to b\bar{b}$. The signature of such a process may be identifiable at the upcoming HERA machine.

4. Heavy Quark and Chiral Symmetry

We have studied implications of the heavy quark spin-flavor symmetries on the heavy-hadron chiral dynamics. Six topics are covered in this area. They include: strong decays of heavy hadrons, electromagnetic decays of heavy hadrons, heavy-flavor-conserving nonleptonic weak decays of heavy baryons, semileptonic decays $\bar{B} \to D(D^*)\pi\ell\bar{\nu}$, symmetry corrections-SU(3) breaking and $1/m_Q$ correction, weak radiative decays of heavy baryons.

For a hadron(meson or baryon) containing one heavy quark, its chiral dynamics is dictated by its light quark contents. However, this dynamics will be further constrained by the heavy quark symmetry arising from the heavy quark in the hadron. We have developed a formalism for the heavy-hadron chiral dynamics by constructing a chiral invariant Lagrangian which respects constraints given by the heavy quark symmetry. This formalism was also applied to study $B \to D\pi l\nu$ and $B \to D^*\pi l\nu$ In particular,

we studied the ratio

$$R_4(v \cdot v') = \frac{d\Gamma(B^0 \to D^{*+}\pi^0 l^- \bar{\nu_l})/d(v \cdot v')}{d\Gamma(B^0 \to D^{+}\pi^0 l^- \bar{\nu_l})/d(v \cdot v')}$$

which can test our formalism in a model independent way. The synthesis of heavy quark and chiral symmetries can also be adopted to formulate other interactions. We applied this synthesis to study the non-leptonic weak decays of heavy baryons and the radiative decays of heavy-hadrons. For non-leptonic weak decays, we focus on those with heavy-flavor conserved and $\Delta S = 1$. Typical examples are $\Xi_c \to \Lambda_c\pi$ and $\Omega_c \to \Xi'_c\pi$. The former process is found to have a branching ratio of the order 10^{-4} whereas the latter one is found to have a branching ratio of the order 10^{-5}. The radiative decays of heavy-hadrons are formulated by gauging the strong-interaction chiral Lagrangian of heavy hadrons and adding additional interaction terms arising from anomalous magnetic moments of heavy hadrons. Constraints from the heavy quark symmetry is also taken into account. Such a formalism was applied to compute decays $\Sigma_c^+ \to \Lambda_c^+\pi^0\gamma$ and $\Sigma_c^0 \to \Lambda_c^+\pi^-\gamma$ which can be stringent tests to our formalism.

We have studied symmetry breaking effects to our formalisms discussed above. Since both the chiral and heavy quark symmetries are not exact, we need to know how large the correction will be in a real physical situation. As is well known, $SU(3)$ flavor symmetry is broken by non-vanishing light quark masses. Similarly, the heavy quark symmetry is broken due to a finite heavy-quark mass. We have extracted important $SU(3)$-breaking effects from one-loop diagrams involving light mesons which now have non-vanishing masses. We have also identified corrections to the heavy-hadron chiral Lagrangian in the case of finite heavy-quark mases.

5. Nonleptonic Weak Decays of Charmed Baryons

With more and more data of charmed baryon decays becoming available at ARGUS, CLEO, CERN and Fermilab, it reaches the point that a systematical and serious theoretical study of the underlying mechanism for nonleptonic decays of charmed baryons is called for. It is known for meson nonleptonic decays that the factorizable contribution dominates over the nonfactorizable ones such as W-exchange and W-annihilation. For baryon decays, *a priori* the nonfactorizable contribution can be as important as the factorizable one since W-exchange, contrary to the meson case, is no longer subject to helicity and color suppression.

How do we handle the W-exchange contribution in the baryon decay? In principle the W-exchange amplitude can be expressed as a sum of all possible intermediate hadronic states. In practice, one assumes pole approximation, namely that only one-particle intermediate states are kept; that is, the W-exchange contribution is assumed to be approximately saturated by pole intermediate states. Among all possible pole contributions, including resonances and continnum states, one usually concentrates on the most important poles such as the low-lying $J^P = \frac{1}{2}^+, \frac{1}{2}^-$ states. In general, nonfactorizable s- and p-wave amplitudes are dominated by $\frac{1}{2}^-$ low-lying baryon resonances and $\frac{1}{2}^+$ ground-state baryon poles, respectively. Evidently, the estimate of the s-wave terms is a difficult and nontrivial task since it involves weak baryon matrix elements and strong coupling constants of $\frac{1}{2}^-$ baryon states, which we know very little. Nevertheless, there is one exceptional case: For hyperon nonleptonic decays, the evalution of s waves is no more difficult than the p-wave amplitudes. This comes from the fact that the emitted pion in this case is soft.

Traditionally, the two-body nonleptonic weak decays of charmed baryons is studied by utilizing the same technique of current algebra as in the case of hyperon decays. However, the use of the soft-meson theorem makes sense only if the emitted meson is of the pseudoscalar type and its momentum is soft enough. Obviously, the pseudoscalar-meson final state in charmed bayon decay is far from being "soft". Therefore, it is not appropriate to make the soft meson limit. Moreover, since the charmed bayon is much heavier than the hyperon, it will have decay modes involving a vector meson; this is certainly beyond the realm of current algebra. Because of these two reasons, it is no longer justified to apply current algebra to heavy-baryon weak decays, especially for s-wave amplitudes. Thus one has to go back to the original pole model, which is nevertheless reduced to current algebra in the soft pseudoscalar-meson limit, to deal with nonfactorizable contributions. The merit of the pole model is obvious: Its use is very general and is not limited to the soft meson limit and to the pseudoscalar-meson final state.

We have presented a calculation of the nonfactorizable s- and p-wave amplitudes of charmed baryon decays through the pole contributions from the low-lying $\frac{1}{2}^-$ resonances and ground-state $\frac{1}{2}^+$ baryons. We use the MIT bag model to tackle both $\frac{1}{2}^-$ and $\frac{1}{2}^+$ baryon poles. By comparing the pole-model and current-algebra results for the s waves of $B_c \to B + P$, we reach an important conclusion: the parity-violating amplitude of charmed baryon decays is no longer dominated by the commutator terms. That is to say, away from the soft meson limit the correction to the commutator terms is very important. This correction will affect the magnitude and sometimes even the sign of the asymmetry parameter α. Needless to say, the pole model also allows us to treat the weak decays $B_c \to B + V(1^-)$ on the same footing as $B_c \to B + P(0^-)$ decays.

Previously, we have applied the pole model to some selected decay modes, namely $\Lambda_c^+ \to p\bar{K}^0(\bar{K}^{*0})$, $\Lambda\pi^+(\rho^+)$, $\Sigma^0\pi^+(\rho^+)$, $\Sigma^+\pi^0(\rho^0)$. The main purpose of the present work is to complete the pole-model analysis for all two-body Cabibbo-allowed weak decays of the antitriplet charmed baryons Λ_c^+, Ξ_c^{+A}, Ξ_c^{0A} and the sextet charmed baryon Ω_c^0.

6. Polarized Sea-quark and Gluon Structure Functions

Hadron colliders with polarized proton beams are conceivably available in the future at RHIC and SSC. Depending on whether the proton beams are polarized longitudinally or transversely, parton spin densities of the proton can be probed via the studies of helicity or spin transverse asymmetries. With longitudinal polarization, the double helicity asymmetry defined by $\mathcal{A}_{LL} = \frac{d\sigma^{++} - d\sigma^{+-}}{d\sigma^{++} + d\sigma^{+-}}$ is the observable most commonly discussed in the literature, where $d\sigma^{++}$ ($d\sigma^{+-}$) denotes the inclusive cross section for the configuration where the incoming hadron's longitudinal polarizations are parallel (antiparallel). Double asymmetries at high energies have been investigated for many different processes, such as single-jet, two-jet, two-jet plus photon and three-jet production, double-photon production, direct photon production at large transverse momentum, and the Drell-Yan process. Most recent works were motivated by the European Muon Collaboration (EMC) measurement of the polarized proton structure function $g_1^p(x)$. The central issue of much theoretical controversy is whether or not gluons contribute to the first moment of $g_1^p(x)$. Two extreme possibilities for the explanation of the EMC experiment have been explored in the past: large (negative) sea polarization or large (positive) gluon polarization. Measurements of aforementioned processes will help determine the spin dependent parton distributions and shed light on the interpretation of the EMC results.

Contrary to previous work, we analyze the single helicity asymmetry $\mathcal{A}_L$ in high energy proton-proton collisions. Experimentally, it should be much easier to measure $\mathcal{A}_L$ than the double helicity asymmetry. However, theoretically a nonzero $\mathcal{A}_L$ can occur only if some of the parton-parton scatterings involve parity-violating weak interactions. Therefore, single helicity asymmetry probes parity violation in parton-parton subprocesses. Another party-violating (pv) effect of interest is the longitudinal polarization $\mathcal{P}_L$ of a high-energy baryon produced from unpolarized incident proton beams. Owing to the small size of weak effects, pv parameters $\mathcal{A}_L$ and $\mathcal{P}_L$ arise from the coherent interference between the strong-QCD and weak amplitudes. Such pv effects were first analyzed by Cheng and Fischbach (CF). Specifically, the asymmetry parameter $\mathcal{A}_L$ for the processes $p+p \to \pi^+ + X$ and $p+p \to \text{jet} + X$, and the longitudinal polarization of Λ's in $p+p \to \Lambda + X$ were studied. The content of the present work is in some sense the extension of the previous analysis of CF. First, pv effects in two-jet, two-jet plus photon are investigated in Secs.3 and 4, resepctively. Second, inspired by the EMC experiment and armed with the phenomenologically determined polarized valence-quark spin densities, we have extracted the polarized sea and gluon distributions from the EMC data for several different possibilities.

7. QCD Sum Rules and Perturbative QCD

The non-perturbative QCD sum rule method has been very successful in describing the two- and three-point processes. The former includes quark distribution functions of various hadrons. The latter is mainly hadron form factors at momentum transfer Q around 1 GeV. On the other hand, the modified factorization theorem with Sudakov effects included for soft gluon exchange has been shown to produce reliable results for hadron form factors, which are in agreement with experimental data for Q beyond $2 \sim 3$ GeV. We have extended the QCD sum rule method to a simple four-point process, pion Compton scattering. Power corrections from quark and gluon condensates are also derived, and a careful stability analysis is performed. We have also calculated the same process using modified perturbative QCD, and compare the results with those from QCD sum rules. The additional angular dependence of Compton scattering with

respect to form factors provides a nontrivial comparision between the two approaches. We have found that they show dramatically different angular dependence: QCD sum rule predictions have weaker angular dependence. The transition energy scale from non-perturbative QCD to perturbative QCD, on which both methods give comparable results, then varies with angles. This observation may open a door to experimental determination of which approach gives a better description to the process.

8. Particle Phenomenology

We shall continue to investigate interesting phenomena that may be observed in the current experiments. We have been involved heavily in building up the high energy experimental group at the Institute. The group is participating in E789(Charmless B-decays), CDF(top search etc.) and GEM(SSC physics). We are also considering joining L3 and other fixed target experiments at FNAL. It is important that theorists work closely with the experimentalists and we hope that such a close working relation can be established from the very beginning when the experimental group is just formed.

9. Astrophysics and Cosmology

The discovery of the cosmic microwave background radiation (CMBR) in 1964 provides the most strong evidence that the Universe began from a hot big bang. In subsequent studies, the CMBR has been found to possess a very high degree of uniformity. However, the Universe we observed have a variety of structures, such as galaxies and clusters of galaxy. It is generally believed that the density inhomogeneities in the Universe can account for the CMBR anisotropy, which is regarded as evidence for the seeds of galaxies formation.

The recent (1992) detection of large-angular-scale temperature quadrupole anisotropy in the CMBR by the DMR aboard the COBE satellite opens a window to our understanding of physics associated with the initial conditions of the early Universe. There are two sources of CMBR anisotropy, namely, the density perturbations (scalar mode) and the primordial gravitational waves (tensor mode). Using the existing COBE-DMR data, we propose to search for large-scale polarization of CMBR to separate the scalar from tensor mode contribution to CMBR anisotropy. Particular interest will be given to examine the polarization component of the Galactic synchrotron radiation. After subtracting the radiation, one can set a limit on the intrinsic polarization measurement of CMBR. This limit is particularly useful to place constraint on the recombination dynamics and the re-ionization history of the universe.

In the area of astrophysics, one of the areas of research involves a general analysis of the conversion of a neutron star into a strange star using relativistic combustion theory. We have shown that for all physically reasonable parameters the conversion takes place much faster than was previously thought. Moreover, the burning is most probably absolutely unstable with no well defined burn front. Future research plans in this area include repeating the analysis using a more realistic spherical geometry as well as extending the analysis to the electro-weak transition in cosmology.

Also in the area of astrophysics, we are currently studying the nature of Dark Matter in galactic halos using Einstein's equation. In particular, we analyzed the motion of massive test particles in a galactic halo which is filled with Dark Matter having an energy density with a $1/r^2$ behavior. We have shown that, contrary to intuition, the motion is non-newtonian. In fact, there is no physically relevent choices for the energy density which, for static, spherically symmetric geometries, will be able to explain the velocity curves for orbiting bodies in the galactic halo. This may have profound consequences in the solution of the dark matter problem. Further research includes extending these results to the axisymmetric case.

We are also working on a formulation of equilibrium statistical mechanics on stationary curved spacetimes. To this end, we have calculated the energy density for a gas of photons surrounding a spherical mass M at a non-zero temperature and have shown that at large r the energy density of the photons have a $1/r^2$ behavior, which is what one would expect for Dark Matter. Moreover, the proportionality constant is a fundamental constant which is independent of the mass and temperature of the spherical body. In fact, we have also shown that *any* gas of particles which is sufficiently weakly interacting will have a $1/r^2$ behavior at large r.

10. Statistical Physics

The main research results are:

(1). Review on numerical studies of phase transitions based on the connection between percolation and phase transitions was presented. Some historical developments on the connection between phase transitions and percolation transitions was also briefly reviewed in this work. The numerical methods under discussion include the percolation renormalization method, cluster Monte Carlo simulation method, and biased static Monte Carlo simulation method.

(2). We formulated a general concept of thermal transmissivity in discrete spin systems and applied such concept to some spin models. The idea in this work is useful for renormalization group studies of phase transition models.

(3). We applied the cluster Monte Carlo simulation method to the q-state Potts model on hypercubic lattices with dimensions 3-6. We calculate critical point as a function of q for q up to 2048. The implication of this work on percolation theory of supercooled water is discussed.

(4). We proposed a histogram Monte Carlo renormalization group method (HMCRGM) and applied this method to random percolation and q-state Potts model on two and three dimensional lattices. The method has following advanges: a. It may be applied to many phase transion models; 2. it may be implemented easily to calculate free energy, critical exponent, critical exponents, and order parameter for phase transition models ; 3. it does not has any critical slowing down; 4. it may give very accurate results. For example, the calculated free energy, internal energy, specific heat, and order parameter of the Ising model on the square lattice are almost the same as exact results.

(5). We present a simple method to obtain geometrical meaning of thermal and field scaling powers for correlated percolation models corresponding to phase transition models. The HMCRGM was also used to calculate the scaling function for the existence probability which is important for renormalization group studies of phase transitions. We found that for linear dimensions L near 16, the existence probability already has good scaling behavior.

(6). The fractal diagrams for a relativistic standard map are calculated.

11. Nonequilibrium Phase Transitions in Sandpiles and Interfaces

Phase transition of many-body systems in non-equilibrium states are, unlike its equilibrium counterparts, relatively unexplored. However, many natural phenomena of interest are intrinsically non-equilibrium. They often escape the conventional Gibbs formalism of equilibrium statistical mechanics. Specifically, we have considered 1D sandpile cellular automata. These models are paradigms of a novel concept termed self-organized criticality, which attempts to relate the ubiquity of power-law correlations in space (e.g. fractals) and in time (e.g. $1/f$ noise). Under open boundary conditions, sandpiles naturally evolve into scale-invariant critical states without fine tuning. Despite their apparent simplicity, such models defy most analytical attacks. We have elucidated the issue of universality for the simplified two-state models, and derived for the general multi-state cases scaling properties of local-state distributions. The results establish the hierarchical structure of the various local states.

In another example of non-equilibrium steady states, we found that the otherwise rough interfaces between two coexisting phases in Ising model at low temperature become smooth, when an external drive is applied. The mechanism of smoothening was explored with computer simulations. We found that it is distinct from the equilibrium kind in which typically the associated Goldstone mode acquires a mass. While the non-equilibrium propagator remains singular at small momemta, its divergence is sufficiently weak to give rise to finite interface width, i.e., a smooth interface.

12. Nonlinear and Strongly Correlated System

(1). We have investigated one dimensional sandpile models on a lattice with open and periodic boundary conditions and have been able to obtain exact solutions in the deterministic case. Most of the results published now are based on numerical studies. An exact solution of the random sandpile model will provide important insight into such models. (2). We are also intersted in Frenkel-Kantorova model and similar models to understand how solitons arsize and how they are related to transition to chaos etc. (3). Other models of strongly correlated system such as t-J model, Hubbard model etc. have also been investigated.

13. Many Body Theory

Research is being conducted in varies areas of Many Body theory ranging from the theory of superfluidity in two dimensions to the application of Many Body theory in astrophysics to the formation of equilibrium quantum statistic on curved spacetimes. In the area superfluidity in two dimensions we have been interested in studying the Kosterlitz-Thouless phase transition as it is used to explain superfluid phase transition. This includes studying the mechanism by which vortices are generated in the fluid and their subsequent dynamics. We are also interested in the nature of the symmetry breaking during the phase transition and its relationship to symmetry breaking in the superfluid phase transition in three dimensions. Attempts are now being made to quantize the the two dimensional vortex gass which is present in the superfluid.

High Energy Physics Group

The high energy physics (HEP) group is still in its infancy. The objective is to actively participate and make important contribution to the current and future high energy experiments.

Research activities involved are:

1. Fermi National Accelerator Laboratory (FNAL) CDF experiment,
2. Superconducting Super Collider Laboratory (SSCL) GEM experiment.

一. Fermi National Accelerator Laboratory (FNAL) CDF experiment:

Fermilab Tevatron collider is the highest energy proton-antiproton collider in the world with 1.8 TeV center of mass energy. Various important physics have been obtained since its first operation in 1987.

CDF (Collider Detector at Fermi) is one of the two detector systems at Tevatron collider. A principle goal of CDF is the discovery of the top quark and the measurement of its mass and decay modes. Top quark is the unseen quark in the standard model and is very likely to be found at CDF.

The large luminosity and large b production cross section at Tevatron collider also provide an opportunity for CDF to carry out a rich program for b physics. Information on b production cross section, B lifetime, rare decay modes, B_s mixing and CP violation will be obtained.

Academia Sinica officially joined the CDF collaboration in Feb. 1993. It provides an opportunity for our group to have access to the most unique data on top quark physics.

In order to make a significant contribution to the collaboration, six group members and technicians are stationed at Fermilab to work on the CDF experiment.

Currently our tasks at CDF include:

1. SVX' assembly, test, and installation:
   Due to the radiation damage on the silicon microstrip detector, CDF will replace the current SVX silicon microstrip detector with the SVX' detector. SVX' is scheduled to

be installed in Oct. 1993. Because of our participation, the SVX' preparation is now on schedule.

2. SVX II R&D:
   CDF will once again install a new silicon microstrip detector for Run II runing period. Our group is responsible for the R&D and production of the optical link and data acquisition system.

二. Superconducting Super Collider Laboratory (SSCL) GEM experiment.

The HEP group joined the SSC/GEM collaboration in March, 1992. Our primary task is to perform Monte Carlo simulation to understand the performance of the GEM Central Tracker under various running conditions.

One of the major projects of the HEP group in the past year was the development and upgrade of the Taiwan Code. This is a set of programs for GEANT simulations on the GEM detectors.

The major feature of the Taiwan Code which distinguishes it from the other standard GEANT simulation programs is that it uses the calorimeter for triggers and reconstructs tracks using shower's energies and positions measured in the calorimeter. Thus it does not aim at reconstructing the whole event, as is usually done in standard GEANT simulation. This approach has the following advantages:

(1) Simplify the track-shower matching between the central tracker and the calorimeter. This facilitates physics analysis.

(2) Since only a few tracks need to be reconstructed, the task of simulation can be greatly simplified. For example, at the digitization stage, one only needs to digitize hits along the roads of the predicting tracks. This saves a lot of CPU time. At a luminosity of 10^{33} cm^{-2} s^{-1}, the Taiwan code is 10 times faster than a similar program developed at the Los Alamos Lab. For higher luminosity, eg. 10^{34} cm^{-2} s^{-1}, We could be more than 100 times faster. Thus, the Taiwan Code is able to generate high statistics event samples in short time.

The resolution of the silicon microstrip detector and the Pad chamber of the GEM Central Tracker have been studied using the Taiwan Code. The following physics processes have also been studied in detail:

(i) Higgs $\rightarrow 2\gamma$

This process is the main channel for discovering the Higgs particle if the mass of the Higgs is between 80 and 140 Gev. We studied the background to this process , including 2-jet and Z $\rightarrow ee, \gamma ee$ background. To study the 2-jet background, we generated 60,000 2-jet events. 113 gamma candidates survived after applying calorimeter cuts. The rejection ratio R for the calorimeter is

$$R(\gamma/jet) = (8.7 +- 0.9) * 10^{-4}$$

Additional rejection of 2-jet background can be accomplished using the Central Tracker. By studying the number of hits along the predicting tracks we can distinguish between photons and electrons. After applying Central cut, the number of fake gammas reduces from 113 to 85. The rejection ratio after all the cuts is

$$R(\gamma/jet) = 6.1 * 10^{-4}$$

For the Z $\rightarrow ee, \gamma + ee$ background, the probability of producing fake gammas is less than 1.0%.

(ii) Higgs $\rightarrow$ 4 electrons

This process is an important channel for discovering the Higgs if the Higgs mass is between 140 GeV and 180 GeV. We use the previously generated 60,000 2-jet events to study the probability of a jet an electron. After all the calorimeter cuts and Central Tracker cuts, 26 electron candidates survived. This is about 3 times higher than was reported by a group from Caltech. The sources of these background are being studied. Our results on the signal efficiency is also 3-4 times smaller than was reported by the Caltech Group. It's likely that our simulation results are more realistic. Since the signal efficiency determines the possibility of Higgs detection. A careful study is underway to resolve this important issue.

(iii) Z0' $\rightarrow$ ee

We studied this process to explore the possibility of finding Z0' at high energy. Since this process will be explored at a luminosity of 10^{34}, simulation with ordinary GEANT programs is very CPU time-consuming. On the other hand, the Taiwan Code, who's speed

is weakly dependent on the luminosity, is very suitable to study this process.

We are being requested by the GEM collaboration to release a working version of the Taiwan Code to the GEM collaboration for public usage.

三. Other Research Activities:

A small laboratory has been setup in our institute for detector design, manufacture and test. Prototype proptube and multi-wire proportional chamber have been successfully constructed. Investigation to understand the detector performance under various running conditions, such as gas gain versus gas mixture and high voltage setting, ... etc., is underway.

The design and construction of a gas microstrip detector is in progress. Gas microstrip detector is particularly interesting because of its high rate capability and potential usage in future experiment.

II

List of Ongoing Research

中央研究院物理所執行計劃一覽表

主持人及共同主持人	計畫名稱	執行期間	計劃編號
林爾康	荷電粒子 $^{1}H,^{2}H,^{3}He,^{4}He$ 激發鈷靶K層游離之研究	81.8.1.～82.7.31.	NSC82-0208-M-001-021
王建萬	$^{19}F+^{3}He$ 複核系統在 $E_{\tau}=1.5-4.5$ MeV能量範圍之研究	81.7.1.～82.6.30.	NSC82-0208-M-001-162
江紀成 李　琳	pf層原子核受激態生命期研究(II)：49Ti核構造之研究	81.8.1.～82.7.31.	NSC82-0208-M-007-023
曾詣涵	夸克模型與核成子—反核成子系統	81.8.1.～82.7.31.	NSC82-0208-M-001-014
張志義	重夸克對稱	81.8.1.～82.7.31.	NSC82-0208-M-001-060
鄧炳坤	重夸克稀有衰變之探討(二)	81.10.1.～82.9.30.	NSC82-0208-M-001-528
仲國慶	利用電子計算機對伽瑪能譜模擬之建立	81.8.1.～82.7.31.	NSC82-0208-M-001-050
余岳仲	重元素的L次殼層游離之研究	81.8.1.～82.7.31.	NSC82-0208-M-001-057
黃榮鑑	以雷諾應力模式配合雙層模擬方法預測紊雜紊流場	81.7.1.～82.7.31.	NRICM-8209-E-001-012
黃榮鑑	波浪對於海洋放流影響研究	81.8.1.～82.7.31.	NSC82-0209-E-001-013
曾忠一	散射大氣中輻射傳遞模式的發展與應用(二)	81.8.1.～82.7.31.	NSC82-0202-M-001-109
曾忠一	海溫遙測業務化研究(二)	81.7.1.～82.6.30.	農委會82遙控-01-20
簡來成	以GHB法探討振動與混沌現象	81.9.1.～82.8.31.	NSC82-0208-M-001-017
陳志強	液體表面非線性現象之研究	81.8.1.～82.7.31.	NSC82-0208-M-001-089

主持人及共同主持人	計畫名稱	執行期間	計劃編號
鄭天佐	固體表面原子擴散機制及能量學	81.9.1.～82.8.31.	NSC82-0208-M-001-115
鄭天佐 張嘉升	原子操縱術基本原理之研究	81.7.1.～82.8.31.	NSC82-0208-M-001-117
鄭天佐 陳志強 魏金明	自然處八十二年度中型儀器精密銑床及不斷電系統	81.8.1.～82.7.31.	NSC82-0208-M-001-133
何侗民	矽中鈹雜質之研究	81.8.1.～82.7.31.	NSC82-0208-M-001-090
王唯工	AngII等藥物對鼠血壓波大小及頻譜之影響	81.3.1.～82.7.31.	NSC82-0202-M-001-049
王唯工	以脈診斷協助中醫診斷之可行性研究(二)	81.7.1.～82.6.30.	DOH82-CM-033
王唯工	人參及西洋參對脈波及微循環之影響	81.7.1.～82.6.30.	NRICM-821007
姚永德	磁性合金之高磁場比熱研究(一)	81.8.1.～82.7.31.	NSC82-0208-M-001-120
謝雲生	硫酸鋰銣晶體之拉曼及紅外光光譜研究	81.8.1.～82.7.31.	NSC82-0208-M-001-071
任盛源	鈷—鈀合金之磁伸縮與霍爾效應	81.8.1.～82.7.31.	NSC82-0208-M-001-092
梁乃崇	用電解液原子力和穿隧顯微鏡研究電極表面	81.8.1.～82.7.31.	NSC82-0208-M-001-091
陳洋元	重費子化合物同調性與超導性研究(Ｉ)	81.8.1.～82.7.31.	NSC82-0208-M-001-133
陳洋元	微粒金屬薄膜與氧化釕薄膜溫度計	81.8.1.～82.7.31.	NSC82-0208-M-001-148
劉鏞	鑽石薄膜生長過程中其表面之反應機制及應用	81.8.1.～82.7.31.	NSC82-0208-M-001-114

主持人及共同主持人	計畫名稱	執行期間	計劃編號
劉鏞 張嘉升 魏金明	高溫超導表面晶格動力學之研究—利用高分辨電子能量損失譜儀及其理論模型	81.4.1.～82.3.31.	NSC81-0212-M-001-534 NSC81-0204-M-001-537
胡宇光	光電子激發過程之研究	82.1.1.～82.12.30.	NSC82-0208-M-001-147-T
徐則林	脈波(氧)血流與生理功能間之關係(1/3)	81.8.1.～82.7.31.	NSC82-0412-B-001-006-M01
李世昌	強作用及強相關性系統之研究(二)	81.8.1.～82.7.31.	NSC82-0208-M-001-086
胡進錕	臨界與非線性現象研究(II)	81.8.1.～82.7.31.	NSC82-0208-M-001-058
楊維邦	協變性微分算子可積分系V—代數之研究	81.3.1.～82.7.31.	NSC82-0202-M-001-059
鄭海揚	含有重夸克的重子其它強子非輕弱衰變與ＣＰ破壞現象	81.8.1.～82.7.31.	NSC82-0208-M-001-011
余海禮	強耦合規範場論(II)	81.8.1.～82.7.31.	NSC82-0208-M-001-016
余海禮 Baruch Rosenstein	夸克之拓撲禁閉	81.10.1.～82.9.3.	NSC82-0208-M-001-116
李世炳	二體相對論性方程式與量子場論	81.8.1.～82.7.31.	NSC82-0208-M-001-015
梁鈞泰	非平衡狀態之臨界現象	81.8.1.～82.7.31.	NSC82-0208-M-001-012
吳建宏	奇異夸克物質與中子星	81.12.1.～82.11.30.	NSC82-0208-M-001-131-T

III

Publication List of 1992/1993

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21. M.T. Cheng, and D. Cline, "A Brief Critique of the Search for Neutrino Oscillations with Single Measurement Solar Neutrino Experiments", *Mod. Phys. Lett.*, **A7**, 3731-3738 (1992).

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25. C.Y. Cheung, "Heavy Quark Symmetry and Heavy-Flavor-Conserving Nonleptonic Weak Decays", in *Medium Energy Physics*, edited by K. Goeke, W-Y. P. Hwang, and J. Speth (Plenum Press, 1993).

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IV

Supporting Facilities

圖書室概況

壹、沿革：

中央研究院物理研究所圖書室成立於民國51年（1962），爲一學術性專門圖書館。成立的目的，在爲本所研究人員，國內物理學界人士提供完善的物理學研究的環境。

貳、組織：

隸屬於中央研究院物理研究所，所長爲負責人，設有圖書委員會。委員由所內研究人員組成，協助所長掌理館藏規劃及圖書室政策之審議，並設有專業館員一名，及助理一名處理圖書資料的採訪、編目、典藏、閱覽、流通與參考服務等工作。

參、面積：

位於物理所大樓三樓，共有170坪，內設圖書、期刊閱覽室，研究人員著作陳列室，及閱讀座位21席。

肆、經費：

近二年來（81-82），每年購書經費約台幣650萬，其中85%訂購期刊，15%購買圖書。

伍、館藏：

一、印刷品資料

中、西文圖書25,000餘册（含期刊合訂本10,000餘册）

。期刊近300種（包括國際重要物理期刊如 Physical Review，Review of Modern Physics，Physical Review Letters等）。類別涵蓋物理、數學，及應用科學，大陸出版的科技期刊亦收藏有18種。每年購進的圖書約700種，裝訂成册的期刊約1500册。目前持續訂閱的期刊約200餘種。

二、非印刷品資料

(一)縮影資料（32種期刊的Back Issues）

(二)光碟系統4套

1. SCI（Science Citation Index）
2. INSPEC（Physics Abstract的光碟版）
3. PDF-2 Database（查材料屬性的資料庫）
4. OCLC（OCLC Online Computer Library Center，查西文書目的資料庫）

這些館藏除提供本所同仁使用外，並開放給外界物理研究者使用。

陸、圖書館作業內容：

圖書館作業內容分下列三點說明：

一、技術服務

僅針對資料徵集及資料處理兩方面而言。

(一)資料徵集：

1.由研究人員推薦，經圖書委員會議審議後，提報所長視經費情況採購。

2.資訊的掌握，爲研究工作者的重要課題，本館針對此，時時注意及加強相關資料的收集，收集的途徑如下：

(1)有學術價值的集叢，例如Lecture notes in physics等30餘種，委托國外書商以standing order的方式訂購，以加速資料到館的時效。

(2)單本圖書，委托國內外書商，以一般訂購方式購買。自81年度起，爲改善到館時效，改以空運方式寄送。

(3)研究人員的興趣主題，凡能索贈者，即以索贈方式徵集，例如HTc Update 等資料。

(4)有計劃的補購具有研究參考價值的期刊的 Back issues。

(5)陳列出版商的出版資料，做爲新書介購的參考。

(6)CD-ROM在資訊檢索上較印刷資料快速，除可節省時間外，還可得到較完整的檢索，對資料的收集，助益頗大，本館爲支援研究工作，購有CD-ROM產品（參考上列光碟系統），以提高服務品質。

(二)資料的處理：

徵集到館的書刊資料，爲了方便管理和使用，將它作系統化的組織是必要的。本館資料處理方式如下：

1.編目：

中文採用中國編目規則（CCR），西文採用英美編目規則（AACR II）著錄該資料的題名，作者，出版資料等項目。方便館員或讀者就已知的作者，書名或主題查到所需要的資料。

2.分類：

中、西文資料分別採用中國圖書分類法，美國國

會圖書館分類法分類。經過分類的處理，可讓館員及讀者了解整個館藏資料的類別與性質，各類別資料間的比重及將來館藏發展的方向。資料的組織與整理是一項思考性與判斷性的工作，同時也是一項“勞力密集”的工作。所幸近年來電腦發展快速，利用電腦協助圖書館作業自動化可解決部份勞力的工作。

二、參考服務項目

服務項目分下列六項說明：

㈠閱覽服務：

1.本館資料採開架陳列，本院同仁可憑借書證借閱，院外人士以館內閱覽為原則。

2.每月有二次新書展示，在展示期間接受預約借閱。

㈡參考諮詢服務：

讀者可利用面洽，電話，傳眞或書信向本館查詢資料。

㈢館際合作服務：

本館是“中華民國科技館際合作協會”的會員，除協助本所同仁蒐訪其他圖書館收藏之科技資料外，並供應各合作單位及對物理研究有興趣者所需之資料。最近二年來，每年處理外界向本館申請的館際合作約500件，本館向外館申請的約250件。

㈣資料複印服務：

1.備有影印機二部，閱讀影印機（Reader/Printer）一部，以方便讀者在不侵害著作權益之原則下，影印本館資料。

2.備有傳眞機一部，提供資訊傳眞服務，縮短資料傳送

的時間。

㈤其他：

1.購有PC，CD-ROM Driver及Laser Printer一套，放在圖書室供研究人員檢索資料用。

2.設立讀者意見箱，廣徵各方意見，做為圖書館館務推行的參考。

三、圖書館自動化

爲有效處理本院館藏資料及發揮資訊交流的功能，中央研究院於民國80年引進INNOPAC圖書館自動化作業系統。本館爲聯線圖書館之一，並於80年9月展開自動化作業。目前進行的工作有：

㈠書目與館藏資料的建檔：

爲自動化作業第一階段的重點工作。爲節省人力及加速建檔工作，利用書目光碟片做爲館藏資料回溯的依據及新書編目的參考。目前已完成17,000餘筆館藏資料的建檔。

㈡期刊線上處理：

自81年底起，到館的期刊改由線上及人工雙向處理。期刊的登錄，催缺，裝訂清單的列印均可在線上作業，使用者也可經由INNOPAC系統得知期刊到館的狀況。

㈢圖書流通：

已建有讀者檔80餘筆，陸續要完成的工作是將借書檔與讀者檔連結。完成後，借閱者可經由INNOPAC系統看到自己的借書記錄。

柒、總　結：

提供完善的資訊服務，協助研究工作的進行是本館經營的目標也是本館的任務。爲了發揮此項功能，圖書館需要大家的督導，也需要大家的鼓勵。

技術組工作概況

1. 電子工作室

電子工作室目前的工作是對全所電子儀器設備提供服務。由於實驗的需求，全所的設備包羅萬象，各式的精密儀器更是種類繁多，因此在修護時常常遇到一些問題，例如資料不完整，或稀少性零件增加我們維護上的時間，因此在未來的工作我們須加強努力的方向有：

1. 完整的儀器資料：它包括儀器的操作，維修手册，廠商的資料等等，讓我們在最短時間內了解問題並解決它，或者迅速得到廠商的支援而讓儀器正常的工作。
2. 電子零件的庫存：建立一個完備而常用的電子零件庫房，對於一般性的耗材能迅速提供各研究人員，希望能減少因耗材的欠缺而浪費的時間。
3. 精密測試儀器：目前電子工作室的測試檢查儀器仍尚未完備，爲了能對全所作更廣泛的服務，這方面有待加強。
4. 研究發展自製儀器：現在工作室所能提供的自製儀器水準仍嫌不夠，期望未來在人力、設備、經驗上有發展進步時能製作出一些夠水準的儀器。

電子工作室去年所提供的服務有：

製作方面：

1. 1.5mV至1V電壓微調供應器。（STM表面物理組）
2. 電磁鐵線圈繞製。（ESCA表面物理）

3. 多組式PreAmp線路製作，外
   殼組裝及測試多條式偵檢器 （原子核組）
4. 信號線佈設及安裝。 （原子核組）

修護方面：

1. 加速器電子儀器維護。 （原子核組）
2. PC電源供應器。 （電腦室）
3. 脈波電源供應器。 （生物物理組）
4. 輻射計量計。 （原子核組）
5. 鍍膜機濺鍍電源供應器。 （228鍍膜室）
6. 超音波清洗機。 （431清洗室）
7. RF鍍膜磁鐵。 （低溫實驗室）
8. Ion gauge電源供應器。 （ESCA）

電子工作室在全所的支持下，正不斷地成長中，需要全所同仁們的寶貴意見做爲日後發展參考的依據，使工作室的效用得以充份地發揮。

2. 機械室

技術組機械室成立於81年3月。由謝家和率同林呈應共同負責全所各實驗室機械成品之設計與製作。

機械室目前現有之設備如下：

車床(楊鐵)	一部	手提砂輪研磨機	二部
鋸床(臥式)	一部	手提電鑽	二部
線鋸床(立式)	一部	手提電鋸	一部
鑽床(小型)	二部	花崗岩精密平台	一部
鑽，銑兩用複合機(中型)	一部	精密高度規	一部
電焊機	一部	精密比測台	一部
砂輪機	一部	486電腦	一部
砂輪切斷機	一部		

機械室成立至今自製的成品有：

原子核組實驗室：不鏽鋼準直儀、石墨準直儀、鉛準直儀、陰極濺鍍靶架、饋通夾、陶瓷靶架、不鏽鋼陰極模具、鉭靶架、鋁靶架……等。

固態實驗室：

鄭所長　—陶瓷靶架、鉭靶架修改、隔音箱製作。
何副所長—鋁靶架、鐵靶架。
謝雲生　—不鏽鋼模具，銅靶、壓克力模具、單晶爐白金靶架校正。

姚永德　—X-ray 鋁靶架、不鏽鋼套環、低溫比熱儀腳架。
陳洋元　—鋁密封墊、無氧銅靶架、不鏽鋼模具，濺鍍靶座。
劉　鏞　—石墨靶架、硼靶架、電腦架、不鏽鋼靶架、烤箱加工。
陳悅來　—鉬靶架。
張嘉升　—銅靶架、鉬靶架修改、訊號線接頭、不鏽鋼套筒。
邱錦楨　—不鏽鋼壓模，不鏽鋼靶架。
林鶴南　—不鏽鋼隔音筒。
吳允中　—鐵弗龍靶架。

流力實驗室：
杜其永　—壓克力腔、樣品靶架、試管夾持靶架、低溫罩靶架。
陳自強　—壓克力水流箱。

清大核工所：陶瓷與不鏽鋼靶架。

除此之外尚有一些較為粗製之製品及一般機械性之維修，在此則省略不一一加以舉例。

機械室為配合精密儀器工作室之發展，日前在國科會補助下，新添購永進2# 精密銑床，及富士小型高速鑽床各一部，且預定在83年度添購精密磨床，大型鑽床，及氬焊機，鋸木專用鋸床等設備，又計劃於84年度再添購精密車床，且配合本所各實驗室之發展需求，逐一添購所需之設備，並加強本身技術之訓練，使機械室成為高科技產品製造中心。

3. 真空服務部

真空部服務部目前除了負責原子核組加速器之操作與維修，X光繞射儀操作外，亦支援固態組各實驗室真空設備之保養與維修等工作。

原子核組方面：

原子核組加速器真空一般維持在10^{-8} Torr，所用之真空泵有迴動式泵、渦輪式泵、離子式泵、冷凍吸附式泵等。除真空泵大都由技術組自行維修外，加速器之射束管、散射室、準直儀、靶架、偵檢器基座之設計、組裝、測試亦完全由技術組負責，且皆能符合原子核組諸位研究員之需求。

固態組方面：

固態組X繞射儀目前亦由技術組負責操作管理。

姚永德先生之電弧爐目前由技術組幫忙將其真空管路重新配置，使其真空度在短時間內即2×10^{-3} Torr，且可二部爐子交互使用，使原本一天只能燒結一個試料增加至一天可燒結4至5個試料，其效率顯著增加。陳洋元先生之濺鍍散射室日前亦由技術組幫忙按裝二只CF-100真空閥門以配合其實驗需求。此外，其它各表面實驗室如掃描穿隧式顯微鏡、電子能表面分析儀、掃描電子顯微鏡、薄膜實驗室、電性實驗室、低溫實驗室、磁度實驗室、表面實驗室、鍍膜實驗室等。對其有關真空方面的零件或技術，技術組亦皆一一為其解決困難，使其實驗能順利進行。

技術組研擬84年度預算添購新的眞空泵作爲技術組維修專用泵，並添購一些常用的眞空零組件。且計劃自行設計，製造一些高精度的眞空產品，提昇本組的眞空技術。

電腦室工作概況

(一)目前主要工作項目為：

1.提供研究人員大量資料處理及數值分析之使用，包括工作站及個人電腦等。

2.網路通訊。由於本所網路區屬Internet上的一個點(node)。因此可由本所網路直接遷入網路上任何一部遠端機器（telnet），或使ftp用等檔案傳輸工具，以及E-mail電子郵件服務。

3.行政室行政自動化系統之建立。由於專題計劃缺乏自動化管理程式，故電腦室特派一員對此進行了解並撰寫程式。

4.爲公共資料保存，製作備份。對全所共用之資料，不論系統軟體，系統資料或使用者資料均做維護及保存。

5.提供技術支援。對所內各組或個人提供技術，採購及網路連線之諮詢或支援服務。

而以目前所內所擁有軟、硬體設備及使用狀況而言：

(二)網路現況：

目前所內的區域網路採用乙太網路（Ethernet），共連接24部工作站及數十部PC。整體網路架構詳見於附圖。

對外網路，本所於八十一年六月，透過資訊所提供的Router，以remote bridge及modem相連。藉此可連上教育部之TANET，進而與國際學術網路連接。亦即在所內即可

直接透過網路與國際上各大研究機構直接進行聯繫進行學術交流，並且分享網路上之公用軟體，訊息傳遞等服務。

除此之外，本所對外網路尚有院內之MICOM系統及兩組modem電話號碼。透過MICOM相連，亦可使用本院計算中心所提供的各項服務，及本院之計算機系統，如ETA10超級電腦等，並於八十二年五月配合全院之院區光纖網路，其提供院內傳輸速率達10MB/s，對網路通訊效率而言，可謂大幅提昇。

㈢計算機群（可分為工作站及個人電腦）：

以工作站而言，電腦室目前共有三種工作站。分別爲四部IBM RISC/6000系列工作站，九部SUN SPARC1及SPARC2工作站，及一部VAX 3100工作站。分別詳述如下：

1.IBM RISC/6000工作站爲專門提供本所研究人員數值運算，資料分析處理使用。其作業系統爲IBM AIX 3.2V。並安裝有Fortran Compiler，C Language，及一套ESSL工程科學程式庫等軟體。這四部工作站皆已連上所內區域網路，並和SUN工作站共用網路雷射印表機。

2.SUN工作站群提供全所共用，亦爲所內區域網路之主體。其中有兩部工作站專作網路伺服機（Server），提供網路檔案(NFS)，網路訊息(NIS)，電子郵件(E-mail)，譯名服務(Name Server)，網路印表服務等多項網路服務功能。SUN工作站皆採用Sun OS 4.1.x版本作業系統，此作業統提供Openwin, Sunview兩種視窗環境。且有Fortran ,C, C^{++} 三種程式語言。提供計算繪圖的軟體有Mathematica, MATLAB, MALSYMA等。可做文書處理與報表輸出之軟體有Tex, LaTex, Interleaf等具專業水準的科學排版系統軟體。

SUN工作站群上並有一部雷射印表機專做UNIX網路印表服務。

3.VAX 3100，採用VMS作業系統，除與本所網路(TCP/IP)相連，並以DECnet透過計算中心的VAX8530利用getway的方式，連接國際學術網路。VAX 3100有一部專用之Digital雷射印表機。

個人電腦部份，目前電腦室共使用八部PC，三部麥金塔電腦。另提供五部PC供訪問學人借用。軟體使用包括文書編排處理軟體如PE2, PC Tex, 倚天中文Tex等。程式語言有BASIC, C等。網路軟體如Novell NetWare, PC-NFS等。此外尚有列印軟體，數學軟體等多種應用軟體。

除工作站與個人電腦之外，電腦室亦有十分充足之週邊設備提供全所使用。包括四部雷射印表機，分別支援Apple, PC, UNIX網路, VAX工作站之印表。兩部容量爲150MB之¼″ Tape Drive，一部容量爲2.3GB之8mm Tape Drive。並於八十二年度增添一部HP彩色印表機，一部HP彩色掃瞄機，一部1GB可讀寫光碟機及一部唯讀CD-ROM Drive。

㈣行政室自動化系統部份：

目前行政室以NetWare V3.11這種作業系統爲主，自成一個區域網路。以二部486 PC做爲File Server及Print Server。

這個LAN以Ethernet的星狀網路架構組成，在Print Server上提供Print　Express中文印表管理系統來接收各client送來的job，而以Laser Key印表系統支援中文印表，字型變化及格式轉換等來印出符合工作人員想要的報表。並因應行政工作人員之需要提供了Xerox XP-11專司B4格式中英文印表和HP LJ III專司A4和Letter size的印表。

另外，行政室網路中，我們亦提供了八個MICOM port以利行政室連接到本院計算中心的ICL院內行政作業系統，進行會計、財產管理等電腦連線作業，加快行政作業速度。

(五)備份：

於資料保存，對全所共用之資料，除週期性之維護與備份製做於磁帶上。並於網路，提供一個線上的getmir程式可取回mirror系統上爲使用者所保存之前一天所有的資料，以防止使用者資料被意外的刪除。

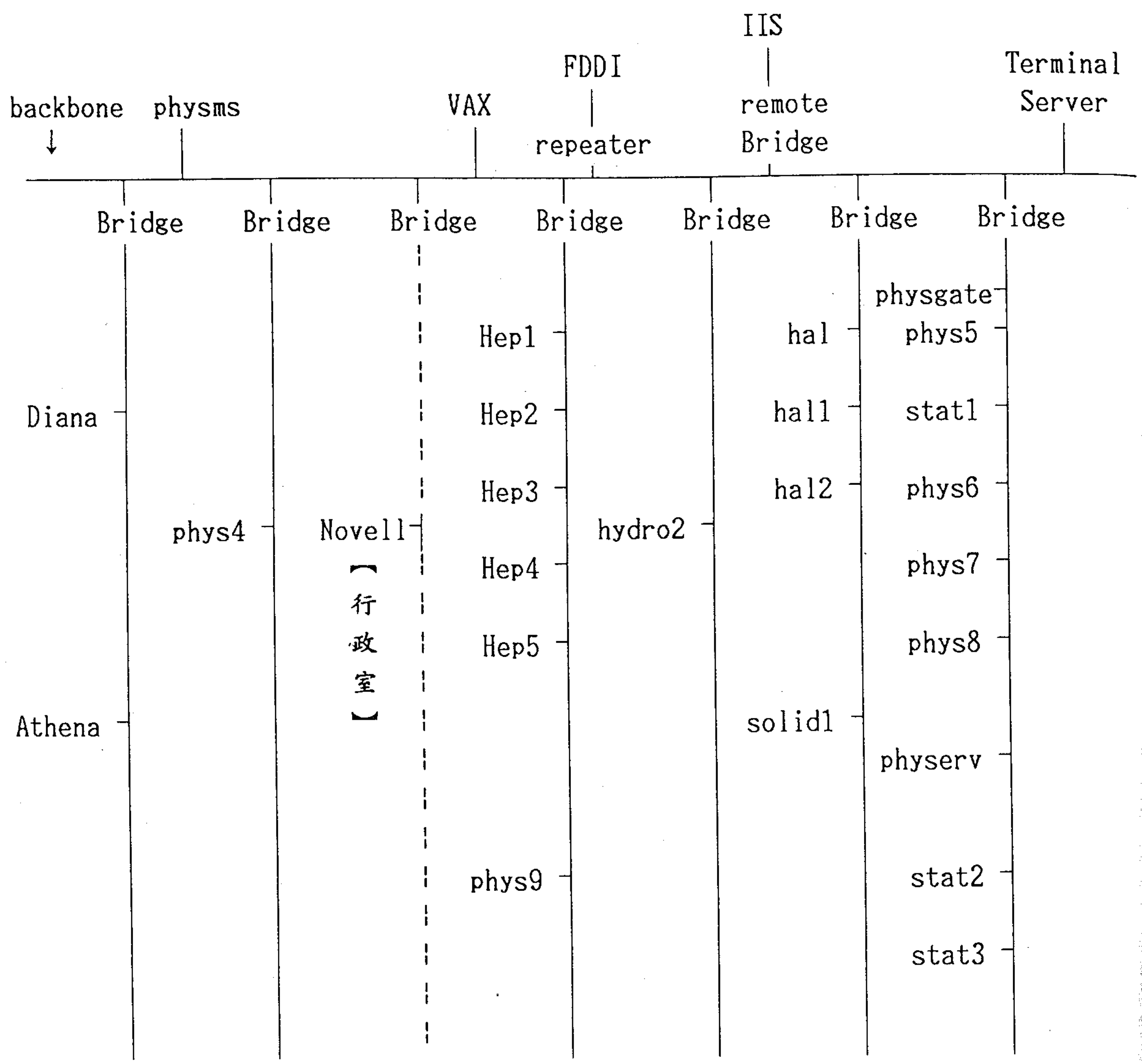
(六)技術支援：

電腦室不但負責全所共用的計算機，網路及行政室，並支援圖書室自動化所需之技術服務和採購服務。對於非公用性如各研究小組之工作站或所內同仁之個人電腦提供網路連接服務，技術諮詢，採購諮詢，資訊蒐集等服務。此外如本所新大樓之建築規劃，對於新大樓電腦室部份，亦提供空間規劃，管線，電腦設計之設計參考。

對於未來的計劃與展望，一方面由於物理所新大樓之

落成指日可待，而電腦室亦將隨之遷入。因此，不論在空間利用及軟、硬體擴充，網路設施加強等各方面，都將跨入一個新的里程而有更完善的發展。目前不但繼續對整個系統做更佳的調整提昇，並且預計將行政室的Novell網路串上所內原有之網路，再完成News及gopher兩系統，將可使所內公文，行政事務，以及網路訊息傳遞更加便利流暢。

物理所電腦網路邏輯圖



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Advisory Committee Report

中央研究院物理研究所

學術諮詢委員報告
（八十一年七月三、四日）

諮詢委員：

楊振寧　李政道
鄭　洪　顏晃徹
沈元壤　高亦涵
傅振民　吳耀祖
汪群從　朱經武
卓以和　胡斑比
鄭天佐

一、學術諮詢委員會（以下簡稱諮委會）於八十一年七月三日至四日在物理研究所開會共一天半（議程見表一），對鄭天佐所長與所內研究與工作人員之盡力合作在此表示謝意。

二、鄭所長是國際知名物理學家，工作嚴謹，學術品味（Taste）極高。他毅然於兩年多前回台灣領導物理所。諮委會對鄭所長的決心與貢獻至表敬佩。

三、七月三日諮委會聽到四項簡短學術報告，各二十分鐘。其中“Heavy Quark Symmetry”，“Low Temperature Specific Heat and Phase Transitions”與“Convection Pattern of the Liquid-Liquid Interface of a Phase Separated Binary Mixture”都留下極好印象。諮委會對近

年來所中年輕研究人員的好成績感到欣慰。

四、諮委會認爲物理所近年來極有起色，可以說是正在經過一次轉型期（Phase Transition）。若能把握時機，物理所有可能於今後十五年內發展成爲世界級的物理研究中心。諮委會建議院方應將此目標列入中研院重點發展計畫。

五、把握時機向新領域進軍，發展突破性（Cutting Edge）的研究工作，並減少經常性（Routine）性的研究，凡此種種皆需要有強力的所長領導。爲此，諮委會建議中研院採取下列措施：

(一)在適當範圍內，所長對所發展的裁決權宜以加大，以打破所中傳統的各組紛爭的平頭主義。

(二)物理所宜在原來已在進行的有前瞻性的物理領域，於今年及明年共增加三位研究人員，使其達到基本人力需求（Critical Size）。此三領域爲：

1. 利用同步輻射線的表面及材料物理。
2. 凝聚態物理。
3. 非線性物理、統計物理及相變等研究。

(三)物理所在粒子物理方面研究已有相當基礎，諮委會鼓勵在這方面繼續發展。

(四)設所長行政助理一名，主持日常所務之工作，人選與任期由所長決定。

六、諮委會認爲物理所以往研究方向有太分散的傾向，所以建議以後多注意有前瞻性及創新性的研究工作。鑒於凝聚態物理對科學與技術發展的重要性，諮委會建議以後對凝聚態物理應加強發展。

七、鄭所長來所接掌以來，積極發展表面物理,而同時所中多方面研究工作均有顯著的進步及增加。原有物理所大樓已不敷使用，迫於日常工作急需，已運用大樓中走廊及平日儲存空間權且做爲辦公及實驗之用。此外，尚必需向地球物理研究所借用約五十坪之房間，暫充裝置重要儀器，然顧及同院同儕情誼，也宜早作歸趙之計。

鑒此目前辦公室及實驗室之匱缺，對科學研究大事實有不可克復之損失。若欲大力挽救此緊急狀況，原定增建大樓之工程，實不宜再作延誤。諮委會敦促堅請院方注意此事，催使新樓早日建成。

八、諮委會極力推薦在所內建立一精工室。

九、此次諮委會開會時之四個學術報告（見上文三）大多甚爲精采。諮委會建議今後諮委會開會時，學術報告部份，應對全所開放，希望全所研究人員均能參加聆聽。主講人員約八名，由物理所自行選出。諮委會設諮委會論文獎，獎金由諮委會委員捐贈（每委員捐贈美金一百元），講演完畢後，由諮委會遴選諮委會論文獎得主。

十、爲了促進所內研究人員的學術交流，及其對物理界不同領域最新動態的了解，諮委會建議成立一個定期午餐會（Journal Club）輪流發表簡短報告。

十一、理論組宜加強與本所其他組（例如凝聚態、統計和非線性物理）合作，培養共同興趣。

十二、物理知識之進展，一日千里。爲擴展見聞及提高物理所之地位，國際間之學術交流及與國內、外其他學術

機構之合作必須受到應有之重視。諮委會建議今後多鼓勵本所研究人員與外間之交流，並經常邀請所外學者專家來所作長期訪問。

以往成功之例子爲康乃爾大學之顏東茂教授來所訪問半年，與理論物理組研究人員合作，取得豐碩之成果。不僅在學術上有所突破，且對研究合作之精神樹立良好楷模。此類合作研究方式應多促進，並持續加強。

中研院物理所八十二年度訪問學人表

訪問人姓名	國籍	訪問期間	備註
陳紹平	中華民國	81.5.1.～81.9.30.	客座專家
郭子斯	美國	81.6.1.～81.8.31.	客座研究正教授
張達文	美國	81.6.15.～81.9.4.	客座專家
喬玲麗	美國	81.7.10.～81.7.21.	短期講學
章禮南	美國	81.7.21.～81.8.11.	短期講學
梁耕三	美國	81.9.15.～81.9.17.	短期訪問
郭漢英	中國大陸	81.9.15.～81.10.14.	短期講學
BARUCH ROSENSTEIN	以色列	81.9.16.～82.9.15.	客座專家
E. A. PASCHOS	德國	81.10.15.～81.10.17.	短期訪問
NICHOLAS P. SAMIOS	美國	81.10.26.～81.11.1.	短期訪問
袁旂	美國	81.11.15.～82.1.30.	短期講學
HENRY TANG	美國	81.12.7.～81.12.8.	短期訪問
薛社生	中國大陸	81.12.10.～81.12.23.	短期講學
鄭志鵬	中國大陸	81.12.15.～81.12.22.	來台訪問
T. OHSUGI	日本	82.1.4.～82.1.9.	短期講學

訪問人姓名	國籍	訪問期間	職稱
司徒國業	加拿大	82. 2. 1.～82. 2. 7.	短期訪問
HORST BREUKER	德國	82. 4. 1.～84. 3. 31.	特聘講座
謝祖蔭	美國	82. 2. 4.～82. 2. 18.	短期講學
IGOR BARTOS	捷克	82. 2. 10.～83. 2. 9.	長期訪問
張肇西	中國大陸	82. 3. 18.～82. 6. 17.	短期講學
謝瑞平	馬來西亞	82. 2. 28.～82. 3. 5.	短期訪問
安徒斯	捷克	82. 3. 1.～83. 2. 28.	教授級學者
撒馬羅克夫	獨立國協	82. 3. 1.～83. 2. 28.	副教授級學者
A. NAKAYASHIKI	日本	82. 3. 1.～82. 4. 7.	短期訪問
A. N. ASOKE	印度	82. 3. 17.～82. 3. 19.	短期訪問
張達文	美國	82. 3. 23.～82. 3. 31.	短期訪問
PETER FEIBELMAN	美國	82. 1. 31.～82. 2. 7.	邀請講席
張元仲	中國大陸	82. 5. 1.～82. 6. 30.	短期訪問
姚若鵬	美國	82. 5. 10.～82. 8. 9.	客座研究正教授
林多樑	美國	82. 5. 12.～82. 5. 14.	短期訪問

訪問人姓名	國籍	訪問期間	職稱
郭子斯	美國	82. 5. 15.～82. 8. 14.	客座研究正教授
陸錦標	美國	82. 6. 6.～82. 6. 15.	短期講學
彭仁傑	美國	82. 6. 6.～82. 6. 24.	短期科學技術指導
YONGMIN CHO	韓國	82. 6. 15.～82. 6. 21.	短期講學
章義鵬	美國	82. 6. 15.～82. 8. 14.	短期講學
張紹進	美國	82. 6. 21.～82. 7. 20.	短期講學
陳謙斌	美國	82. 6. 30.～82. 9. 18.	短期講學

中研院物理所八十二年度演講表

演　講　題　目	演講者姓名	所　屬　機　構	日　期
Stringy On-Shell Ward Identities	李仁吉	交通大學	81.7.2.
Neutrino Index of Refraction in Photon Background	林偉平	中研院物理所	81.7.17.
Chiral Potts Model and Onsager Algebra	阮希石	中研院數學所 訪問研究員	81.7.24.
Theoretical Studies of Metal Interfaces	陳紹平	Los Alamos Nat. Lab.	81.7.31.
Neutrino Mass and Nuclear Double Beta Decay	T.T.S. Kuo	Dept. of Physics, State Univ. of New York at Stony Brook	81.8.5.
First Observation of a Fractional Quantum Hall State at Half Landau Level Filling in Double-Layer Electron Systems	孫允武	Princeton Univ.	81.8.27.
Aerosol Science in Modern Technology	劉揚輝	Univ. of Minnesota	81.9.4.
從正負電子對到τ輕子	趙忠堯	中科院	81.9.15.
Physics of CP Violation	張達文	Northwestern Univ.	81.9.10.
Topological Mass Term in 2+1 Gauge Theory	李湘楠	中研院物理所	81.9.18.
Quantum Groups：Classical and Quantum Deformation Symmetries	郭漢英	中科院理論物理所	81.9.25.
Cosmic Microwave Background Radiation, COBE Results	吳家樂	台大物理所	81.10.2.
Exclusive Rare Decay $B \to K^* \gamma$	董廣貴	中研院物理所	81.10.9.
Present Status of Nuclear Structure Research	吳成禮	中原大學物理系	81.10.2.
理論物理在中國	郭漢英	中國科學院	81.10.8.

演　講　題　目	演講者姓名	所　屬　機　構	日　期
The Higgs Particle as a Quark Condensate	E.A. Paschos	Univ. of Dortmund	81.10.16.
Combustion and Phase Transitions	吳建宏	中研院物理所	81.10.21.
Single Crystal High Tc Films-A Model System for Investigating the Anisotropic Electronic Properties	郭瑞年	AT & T Bell Laboratory	81.10.21.
Boundary-Conditions Induced Transitions in Lattice-Gas Models	梁鈞泰	中研院物理所	81.10.23.
Molecular Beam Epitaxy and In-Situ Processing：A New way to Produce Advanced Materials for Physics and Devices	洪銘輝	AT & T Bell Laboratory	81.10.21.
Strange Baryon Production in e^+e^- Collisions	沈慶春	Univ.of California, Riverside	81.10.24.
Interfacial Phase Transitions at Liquid-liquid Interfaces of the System Water+n^- tetradecane+C_6E_2	陳立仁	台大化工系	81.10.28.
A New Prediction for Parity Violation in Three-jet Production	韋忠輝	中研院物理所	81.10.30.
Simulation of Unsteady Inviscid Flow on an Adaptively Refined Cartesian Grid	蔣佑良	中山科學院	81.11.4.
Epitaxial Growth of KBr onto NaCl(001) by He Atom Scattering	陳　恭	中正大學物理系	81.11.5.
Large Favor Changing Neutral Couplings of the Top Quark	侯維恕	台大物理系	81.11.6.
The Direction, Achievements and the Future of Fusion	斯達開	Argonne National Laboratory	81.11.11.

演　講　題　目	演講者姓名	所　屬　機　構	日　期
半流體化床之混合及應用	黃世傑	清華大學化工系	81.11.25.
Charged Bose Gas	任海滄	Rockefeller University	81.11.6.
Molecular Dynamics Simulation of the Desorption of HF From a LiF(001) Surface	相克東	中研院物理所	81.11.11.
Heavy Particle Effective Theory and its Applications	林貴林	中研院物理所	81.11.13.
Using Neural Networks to Identify Jets	J. Antos	中研院物理所	81.11.16.
天文學之發展與天文干涉儀	張芳男、張良知 張勝聰、施宙聰 等	國科會精儀中心，清華大學物理系	81.11.19.
X-Ray Absorption Fine Structure(XAFS) Studies of $Zn_{1-x}Y_xS$(Y=Mn,Fe,Co) and High Tc Materials	彭維鋒	淡江大學物理系	81.11.19.
Scalar Tensor Theory of Gravitation	吳建宏	中研院物理所	81.11.20.
Drell-Yan Process and Heavy-quark Production in Proton-Nucleus Collision	彭仁傑	Los Alamos National Lab.	81.11.27.
Spectrum Generating Algebras and Dynamics Symmetries in Hadronic Structure	F. Iachello	Center for Theoretical Physics, Yale Unirersity	81.11.27.
天文學家如何了解星球和太陽內部結構	周定一	清華大學物理系	81.12.2.
A Parallel Continuation Algorithm for Stability Problem	簡澄陛	中興大學應用數學系	81.12.2.
Selective Deposition of Diamond Film on Ion Implanted Si(100)	黃振昌	清華大學材料系	81.12.3.
Remarks on QCD Phase Transition	余海禮	中研院物理所	81.12.4.

演　講　題　目	演講者姓名	所　屬　機　構	日　期
Nonequilibrium Dynamics of Hot Electrons in Strong Electric Fields	Henry Tang	IBM(East Fishkill Lab.)	81.12.7.
(1)The Role of Phase in Quantum Theory (2)Chaos in Non-Linear Physical Systems	Stig Olov Lundgvist	Calmers University, Sweden	81.12.9.
Novel Quantum Transport in Semiconductor Manostructure -A Basis for Modern Electronic Devices	趙光安(Koung-An Chao)	Trondheim University, Norway	81.12.9.
QCD Sum Rules and Their Applications to Four-Point Processes	李湘楠	中研院物理所	81.12.11.
流場衍生振動及其抑制	周榮華	成功大學工程科學系	81.12.16.
環保與健康	中華民國環境衛生協會	中華民國環境衛生協會	81.12.10.
The Standard Model中的粒子質量起源	薛社生	義大利核科學院-INFN	81.12.18.
BES/BEPC的新結果	鄭志鵬	BPRC,Beijing	81.12.16.
Self-electro-optic Effect Devices	洪勝富	清華大學電機系	81.12.17.
Laser Induced Image for Velocity Measurements	陳炳輝	台大機械系	81.12.23.
Density Functional Calculation for Solids and Surface	周美吟	Georgia Institute of Technology	81.12.24.
Higgs Search @ L3	張元瀚	MIT	81.12.28.
Research and Technology Developments of Hydrogenated Amorphous Silicon Films：Initiatives for the 1990's	黃惠良	清華大學電機系，兼中興大學電機系主任	81.12.31.
Femtosecond Laser Desorption of O_2 from the Platinum (111) Surface	高甫仁	Cornnel University	82.1.4.

演講題目	演講者姓名	所屬機構	日期
Role of Atomic Size and Valence in Bonding at Metal Surfaces	J. Feibelman	Sandia National Laboratories	82.2.1.
Surface Electromagnetic Fields	J. Feibelman	Sandia National Laboratories	82.2.3.
Making Sense of Surface Atomic Structures	J. Feibelman	Sandia National Laboratories	82.2.5.
Design, Fabrication and Test of Silicon Microstrip Detector(I , II)	T. Ohsugi	日本廣島大學	82.1.7.
Semiempirical Determination of Properties of Nuclear Matter	Hank G. Miller	Univ. of Pretoria, South Africa	82.1.8.
OPAL Jet Chamber	Horst Breuker	歐洲共同加速器中心	82.1.13.
Special Orthonormal Frames and Their Gravitational Applications	James M. Nester	中央大學物理系	82.1.14.
Heavy Top Effects in Vertices with Light Quarks	林貴林	中研院物理所	82.1.15.
Rayleigh-Brillouin Scattering in Optical Glasses	華魯根	輔仁大學物理系	82.1.21.
加速器原理簡介&年度保養須知	王建萬、吳喜成 謝家和	中研院物理所	82.1.15.
Fantasy and Reality of Anyon in FQHE	張富村	University of Cincinnati	82.2.2.
Separation Patterns and Flow Structures about a Hemisphere-Cylinder at High Incidences	謝祖蔭	US Navy Surface Weapon Center	82.2.10.
Kaluza-Klein Cosmologies	吳建宏	中研院物理所	82.2.12.
Molecular Beam Epitaxy (MBE) Focused Ion Beam (FIB) and UHV Series System說明及應用	Ryoh Mimura	EIKO Engineering (Corporation)/Japan	82.2.16.
Scaling Behaviour and Universality Classes of Circle Maps	陳昭安	中研院物理所	82.2.17.

演講題目	演講者姓名	所屬機構	日期
The Large-Scale Structure of the Universe	吳家樂	中研院物理所	82.2.19.
The Growth and Transport Properties of Ultrathin YBaCuO Films	Chi-Chung Chin	Intl. Superconductivity Tech. Ctr., SRL/Japan	82.2.19.
複合粒子表示理論及其在夸克物理、分子物理及核物理中的應用	吳成禮	中原大學物理系	82.2.23.
Scaling Behaviour and Universality Classes of Circle Maps, II	陳昭安	中研院物理所	82.2.24.
Constrained Mean-Field Calculations at Finite Temperature	顏迪佑	中研院物理所	82.2.26.
Renormalization Group and Asymptotics of Partial Differential Equations	梁鈞泰	中研院物理所	82.3.2.
Recent Advances in Particle Physics	M.G.K. Menon	President/ International Council of Scientific Unions (ICSU)	82.3.2.
Forced Nonlinear Waves	吳耀祖	California Institute of Technology ／中央研究院院士	82.3.3.
CP Violating Asymmetry in Flavor-changing Radiative Decay of Quarks	Swee-Ping Chia	Physics Dept./Univ. of Malaysia, Malaysia	82.3.5.
Left-Right Components of Bosonic Field and Electroweak Theory	Kadyshevsky	Director, Joint Institute for Nuclear Research (JINR, Russia)	82.3.8.
Progress and Problems in the 5-Dimensional Projective Unified Theory	Ernst Schumtzer	德國耶拿大學	82.3.9.
A Study of Stability of Some Forced Nonlinear Waves	吳耀祖	California Institute of Technology/中央研究院院士	82.3.10.

演講題目	演講者姓名	所屬機構	日期
Laminar Interaction between Vertical Flows and an Insoluble-or Soluble-surfactant-Contaminated Free Surface	蔡武廷	Massachusetts Institute of Technology	82.3.10.
4-Fermi Interactions and New Universality Classes	B. Rosenstein	中研院物理所	82.3.12.
Unsteady Viscous Flow in an Elastic Artery Model	Da-Ming Wang	Pennsylvania State University	82.3.17.
Experimental Studies of Quark-Gluon Plasma	J. Antos	中研院物理所	82.3.19.
A Local Finite Volume Scheme for Solving Transitional Ballistics Problems	黃貞瑛	輔仁大學資訊工程系	82.4.7.
On the Rupture Process of Thin Liquid Film	黃吉川	中原大學機械工程所	82.4.15.
B介子半輕子分支比之探討與B^0介子之輻射性衰變	姚 珩	師大物理系	82.4.8.
重費米子系統的特異性質	洪在明	清華大學物理系	82.3.11.
Crystal Structure Analysis from Powder X-Ray Diffraction	王素蘭	清大化學所	82.3.25.
Physical Properties of Grafted Polymer Layers	黎璧賢	中央大學物理系	82.3.18.
Ag Film Growth on Pt(110) Surface	沈青嵩	師大物理系	82.4.22.
High Resolution Nonoscillatory Schemes for Computing High Speed Compressible Flows	楊照彥	台大應用力學所	82.4.21.
The Motion of Test Particles in the Galactic Halo	Achilles D. Speliotopoulos	中研院物理所	82.4.16.
Internal Temperature Distributions of Droplets Vaporizing in High-Temperature Convective Flows	林阿成	中正理工學院機械系	82.5.5.

演講題目	演講者姓名	所屬機構	日期
Stablility Analysis and Control of Rotating Stall	廖德誠	交通大學控制工程所	82.5.12.
Correlation Functions of Vertex Models(I),(II)	Atsushi Nakayashiki	The Graduate School of Science & Tech., Kobe Univ. Japan	82.4.2.
Correlation Functions of Vertex Models(III),(IV)	Ausushi Nakayashiki	The Graduate School of Science & Tech., Kobe Univ., Japan	82.4.3.
Transition to Turbulence in Confined Compressible Mixing Layers	黃和順		82.3.24.
釔鋇銅氧薄膜臨界磁場之角相依性物理	楊鴻昌	台大物理系	82.3.18.
Total Widths of Hadrons under Dynamical Breaking of Chiral Symmetry	Asoke N. Mitra	Univ. of Delhi, India	82.3.26.
1.Search for CP and Time Reversal Violations 2.Anomaly, Charge Quantization and Family	耿朝強	Iowa State University	82.4.23.
Decoupling Theorem and its Failures	張肇西	Academia Sinica, Beijing	82.4.30.
Electron-Electron Interaction and Weak Localization Effects in TiAl Alloys	林志忠	台灣大學物理系	82.5.6.
A Direct Numerical Simulation of Transition in a Heated Flow. A General Review of Turbulence Research	莊念祖	台大機械系	82.5.19.
Grafted Polymer Layers : Effect Under Shear Solvent Flow	黎璧賢	中央大學物理所	82.5.26.
Numerical Investigation of A Jet in Supersonic Crosswinds	曾培元	中正理工學院國防科學研究所	82.6.2.

演講題目	演講者姓名	所屬機構	日期
Blocking Transformation and Dynamical Mass Generation in QFT	Sen-Ben Liao	MIT	82.5.5.
New Aspects of QED - Continuum Bound States	James P. Vary	Iowa State University	82.5.18.
1.RKKY Interactions Near Surfaces of Rare-Earth Metals 2.A New Approach to the Critical Temperature of Ising Films	林多樑	SUNY at Buffalo	82.5.13.
Almost Level Crossings and Unexpected Plateau in Edge States	Baruch Rosenstein	中研院物理所	82.5.12.
Generalized Brans - Dicke Theory and Cosmology	張元仲	北京中國科學院理論物理所	82.5.14.
The Compton Profile and Electron Momentum Distribution	張秋男	師範大學物理系	82.5.20.
伽瑪球度量計	李一陽	加州勞倫斯利物墨國家實驗室	82.5.15.
Evidence for Penguins：First Observation of $B \to K^*(892)\gamma$	王正祥	中研院物理所	82.5.21.
Short Distance Analysis of $b \to s + \gamma$	姚若鵬	University of Michigan	82.5.28.
Implications of $b \to s\gamma$ and $B \to \tau\gamma$ Limits on Charged Higgs Bosons	侯維恕	臺灣大學物理系	82.6.4.
Is the Universe Bound？	Amos Yahil	State University of New York at Stony Brook	82.6.4.
Production Polarization and Magnetic Moment of $\overline{\Xi}^+$ and Ω^-Hyperon	陸錦標	Lawrence Berkeley Laboratory and Univ. of Cali. Berkeley	82.6.5.

演講題目	演講者姓名	所屬機構	日期
Search for CP Violation in Hyperon Decays	陸錦標	Lawrence Berkeley Laboratory and Univ. of CA, Berkeley	82.6.8.
超微粒材料之合成與應用	林鴻明	大同工學院材料所	82.6.10.
Perturbative QCD and the Semi-leptonic Decays of B-meson into Light Mesons	姚若鵬	University of Michigan	82.6.11.
Top Quark Physics at Hadron Colliders	袁簡鵬	Michigan State University	82.6.18.
Covariant Nonlocal Effective Action	V.V. Zhytnikov	中央大學物理所	82.6.25.
Hard X-Ray/Gamma-Ray Astronomy	Tuneyoshi Kamae	Dept. of Physics, Univ. of Tokyo	82.6.15.
B Physics at KEK B-factory: Phenomenology and Detector Capability	Tuneyoshi Kamae	Dept. of Physics, Univ. of Tokyo	82.6.17.
Influence of Roughness on Magnetic Surface Anisotropy	張慶瑞	臺灣大學物理系	82.6.17.
(1)Introduction to Theories of Turbulence (2)Quick Review of Conformal Field Theory (3)Polyakov's Theory of 2-D Turbulence (4)Boundary Conditions of Conformal Turbulence (5)Conformal Turbulence Revisited	Soon Keon Nam	Kyung Hee Univ., Korea	82.6.18.
Non-Linear Transport in Mesoscopic Systems	吳大琪	香港科技大學	82.6.28.

中研院物理所八十二年度出席國際會議表

會議名稱	會期	舉辦地點	出席人員	經費來源
十二屆國際稀土磁鐵及應用研討會暨七屆國際稀土合金磁各向異性研討會	81.7.12.～81.7.16.	澳大利亞坎培拉	陳洋元	國科會
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