Kathy

THE DEPARTMENT OF PHYSICS AND ASTRONOMY

THE UNIVERSITY OF IOWA

Iowa City, Iowa

GRADUATE STUDY IN

PHYSICS AND ASTRONOMY

The Department of Physics and Astronomy at The University of Iowa is a major national and international institution devoted to teaching and research. In the spring of 1992, 29 faculty members, 3 adjunct professors, 2 emeritus professors, 26 Ph.D. research scientists, 74 graduate students, and 71 undergraduate majors were active in the research, teaching, and study of physics and astronomy.

Over the years, the department has achieved particular distinction in space physics. The experimental study of charged particles and electromagnetic fields in space began here and remains a vital area at Iowa today. The Department of Physics and Astronomy has two experiments aboard the Galileo spacecraft to Jupiter and will have experiments on other missions planned for the coming decade. The acquisition and interpretation of data from these missions will insure continued prominence for the department.

In addition to continued vitality in its traditional areas of strength such as space physics, plasma physics, theoretical nuclear physics, and astronomy, the department has recently established vigorous expansion groups in other areas. There are now seven faculty members in experimental and theoretical high energy physics, and departmental researchers participate in experiments at laboratories throughout the world. The department also has established a state-of-the-art laboratory in atomic and molecular physics. Descriptions of Iowa's programs and resources can be found on the following pages.

The department features research in a wide variety of areas in theoretical and experimental physics and astronomy. Van Allen Hall, the department's home, has a number of research laboratories, and faculty members and students also conduct experiments and observations at national and international laboratories and observatories, such as Fermilab and the Very Large Array radio telescope.

This vigorous research environment benefits the teaching mission of the department. Graduate students participate in all aspects of research, and the department prides itself on a tradition of including undergraduate students in research programs. It is felt that this research experience, together with sound academic training, has enabled physics and astronomy undergraduate students to go on to graduate study at the most prestigious institutions in the country.

Finally, the department succeeds admirably in attracting external support of research programs. Departmental faculty and research scientists obtain $12 million each year from NASA, the National Science Foundation, the Department of Energy, and various private sources. In addition to the other ways in which this supports research, it permits support of many graduate students on research assistantships and the hiring of undergraduate students for work on scientific projects.

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ASTRONOMY AND ASTROPHYSICS

Research programs in optical and infrared astronomy are carried out at The University of Iowa Observatory near Riverside and at several national observatories. The Riverside observatory is equipped for polarimetric, photometric, and spectrophotometric observations. Current research programs include spectrophotometry of comets, novae, binary stars, and stars with unusual energy distributions. Work on surface photometry of comets and emission nebulae also is in progress.

A survey of interstellar polarization is being conducted to map out the small scale structure of the galactic magnetic field. Work at national facilities includes photometry, spatial interferometry, and spectroscopy of cool stars.

The department has a strong tradition of research in radio astronomy, particularly in investigations using radio interferometry. For many years, the astronomy group operated the North Liberty Radio Observatory, part of the U.S. Very Long Baseline Interferometry (VLBI) network. This radio telescope has been replaced by a superior one on the North Liberty site, operated by the National Radio Astronomy Observatory. Departmental commitment to the VLBI technique remains strong, with several ongoing projects using global VLBI networks (with both Mark II and Mark III recording techniques) as well as the new Very Long Baseline Array (VLBA), which is under construction.

To maintain its strength in training graduate students in the instrumental aspects of radio astronomy, the department is constructing an instructional radio telescope on the roof of Van Allen Hall. The telescope is a 4.5m antenna instrumented at 610, 1420, 1670, and 5000 MHz. With this telescope and its associated receiver laboratory, students can receive experience in basic radio astronomical measurements. It is also planned to use the instrument for studies of radio wave propagation in the atmosphere. Late 1992 is the scheduled completion date for the radio-telescope.

Radio astronomy research involves the imaging of extragalactic and stellar radio sources, polarimetry of radio sources, spectroscopy, and observations of molecular clouds and star formation regions. Infrared, optical, and X-ray studies complement radio observations of stellar radio sources. Research studies also are made of radio wave propagation through the plasma turbulence in the interstellar medium, interplanetary medium, and solar corona.

Theoretical astrophysics research includes study of gas and dust in the circumstellar envelopes of evolved stars. Current topics include computer simulations of radiative transfer in circumstellar mass flows, scattering properties of circumstellar dust shells, and models of OH masers near cool stars. Radio wave propagation properties of the interstellar medium and magnetospheric models of cool stars also are of considerable interest.

The Department of Physics and Astronomy at The University of Iowa, with its strengths in space physics and plasma physics, is particularly well-suited for studies in plasma astrophysics. The proximity of the space and plasma physics groups facilitates study of processes that might be important in astrophysical settings and that can be studied in detail in the solar wind and the magnetospheres of the Earth and other planets. Current investigations in plasma astrophysics are heating of the interstellar medium by dissipation of plasma turbulence and nonlinear generation of radio waves from electrostatic plasma waves.

Recent Publications in Astronomy and Astrophysics

"Superhump Timing in SU UMa Systems: Implications of the Data for the Precessing Disk Model," L.A. Molnar, and H.A. Kobulnicky, *Astrophysical Journal*, 392, 678, 1992.

"Axisymmetric Models of Circumstellar Dust Shells," A.J. Collison, and J.D. Fix, *Astrophysical Journal*, 368, 545, 1991.

"Interstellar Scattering of the Compact Radio Source 2005+403," R.L. Mutel, and J.F. Lestrade, *Astrophysical Journal (Letters)*, 349, L47, 1990.

"Numerical Simulation of the Emission and Motion of Neutral and Charged Dust from P/Halley," T.A. Ellis, and J.S. Neff, *Icarus*, 91, 280, 1991.

"The Dissipation of Magnetohydrodynamic Turbulence Responsible for Interstellar Scintillation and the Heating of the Interstellar Medium," S.R. Spangler, *Astrophysical Journal*, 376, 540, 1991.

Faculty members in the astronomy group, John Neff, John Fix, Robert Mutel, Steven Spangler, and Lawrence Molnar

ATOMIC, MOLECULAR, AND LASER PHYSICS

High-vacuum atomic and molecular beam systems are used to study collision dynamics in simple molecular systems. Conventional and laser high-resolution spectroscopic studies that complement these collision dynamics studies are being carried out simultaneously. In several instances, these molecular systems include either actual or potential laser transitions of considerable promise.

Theoretical work in atomic and molecular physics is concerned primarily with determining atomic and molecular interactions, especially potential energy curves of diatomic molecules. Also of interest are radiative transition probabilities and lifetimes, elastic and inelastic scattering cross sections, corrections to the Born-Oppenheimer separation of electronic and nuclear motion, and the dependence of atomic cluster properties on atomic size.

Lasers are used to probe atomic and molecular processes through high-resolution spectroscopy and various laser pump-probe techniques. Primary emphasis is on the study of excited-state collision dynamics; in many cases these excited-state interactions are important to the development of new laser sources. Similar laser pump-probe techniques are being applied to the study of the kinetics and dynamics of cluster or particulate nucleation and condensation.

Intense laser fields can appreciably modify the dynamics of atomic and molecular interactions. Detailed studies of nonlinear phenomena in this important strong radiation, field-atom coupling limit are also currently under way.

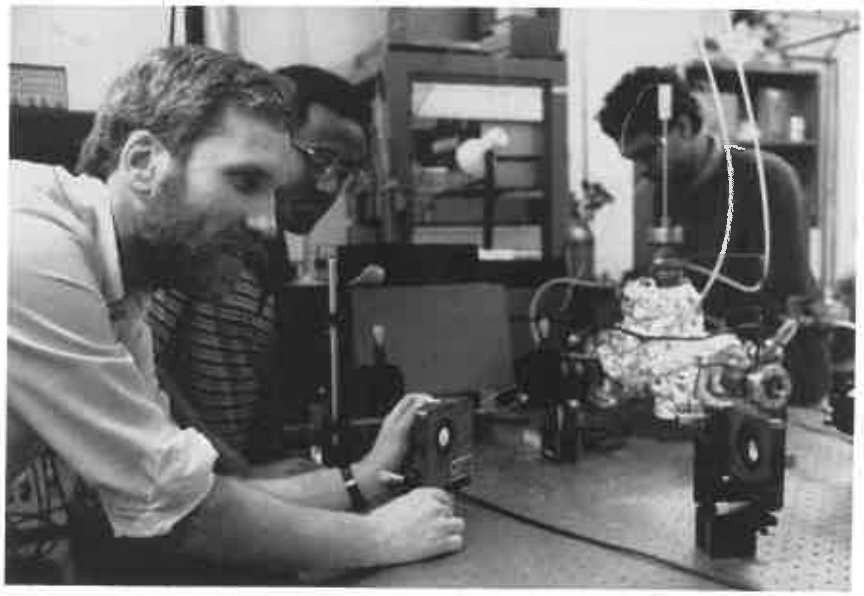
Recent Publications in Atomic, Molecular, and Laser Physics

"Photodissociation of $K_2(X^1\Sigma_g^+-B^1\Pi_u)$", P.D. Kleiber, J.X. Wang, K.M. Sando, V. Zafiropulos, and W.C. Stwalley, *Journal of Chemical Physics*, 95, 4168, 1991.

"State-Selected Photodissociation of the $B^1\Pi_u$ State of K_2 by All-Optical Triple Resonance Spectroscopy," J.X. Wang, H. Wang, P.D. Kleiber, A.M. Lyyra, and W.C. Stwalley, *Journal of Chemical Physics*, 95, 8040, 1991.

"CW All-Optical Triple Resonance Spectroscopy," A.M. Lyyra, H. Wang, T-J. Whang, W.C. Stwalley, and L. Li, *Physical Review Letters*, 66, 2724, 1991.

"Nascent Rotational quantum State Distribution of NaH(NaD) from the Reaction of $Na^*(4^2P)$ with H_2, and D_2 and HD," S. Bililign and P.D. Kleiber, *Journal of Chemical Physics*, 96, 213, 1992.



Professor Paul Kleiber and students adjust experiment for study of atomic collisions

HIGH ENERGY AND ELEMENTARY PARTICLE PHYSICS

EXPERIMENTALWORK

Research in high energy experimental physics currently is being carried out by four professors with a large array of national and international institutions.

Research at Fermilab

An experiment to study the nonleptonic radiative decay modes of hyperons (particles with strangeness) is in progress. This will answer important questions about the weak interactions. A major component of the hardware for this experiment is a state-of-the-art silicon microstrip detection system designed and built at The University of Iowa. A new proposal to study the production and decay of strange charmed particles using a hyperon beam is under way. (Recent experiments indicate that thisapproach is an efficient way to produce and study charmed strange particles.)

Two closely related experiments deal with direct and critical tests of quantum chromodynamics (QCD). The first studies the g-q interaction to provide information on the QCD Compton effect and quark-gluon fusion. It will extract information on the gluon structure function of the proton. The second experiment will study proton and antiproton spin physics at the highest energies to date. QCD predictions have already been seriously challenged by measurements of spin effects, and it is possible that this experiment will provide decisive tests of QCD.

Research at SSC

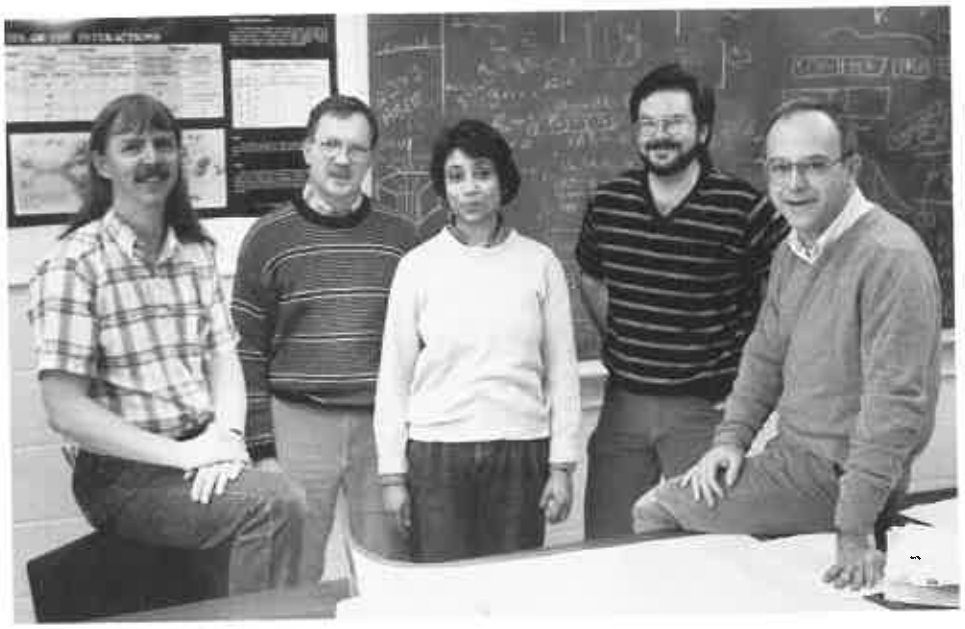
The GEM (Gammas, Electrons and Muons) experiment is one of two major experiments at SSC. When completed it will search for the Higgs boson, technicolor, and supersymmetry in addition to new quarks, leptons, Z's and W's. Currently our main focus in research and development is to develop scintillating fiber calorimetry for the measurement of electromagnetic and hadronic energies.

Research at CERN

Two experiments are presently under way at CERN. The first — the JETSET experiment — will search for gluonic matter and other exotic phenomena. The discovery of glueballs and exotics is essential for the survival of QCD-inspired models as well as for a clear understanding of the confinement mechanism in QCD. The apparatus planned will provide a compact, large-acceptance detector using advanced technology as a model detector for the giant supercollider. A second experiment (spin-splitter) will provide proof of principle for a method of creating high-intensity polarized antiproton beams.

Research at DESY

The world's first electron-proton colliding beam machine, HERA, is located in Hamburg, Germany. This machine will increase the available phase space in deep inelastic scattering by a factor of one thousand. HERA will provide electron or positron beams with 80 percent polarization, enabling sensitive tests of the standard model and probing new physics. ZEUS is a hermetic detector built with state-of-the-art technology. It provides an excellent place to explore physics signatures outside the standard model (right-handed currents, leptoquarks, etc.)



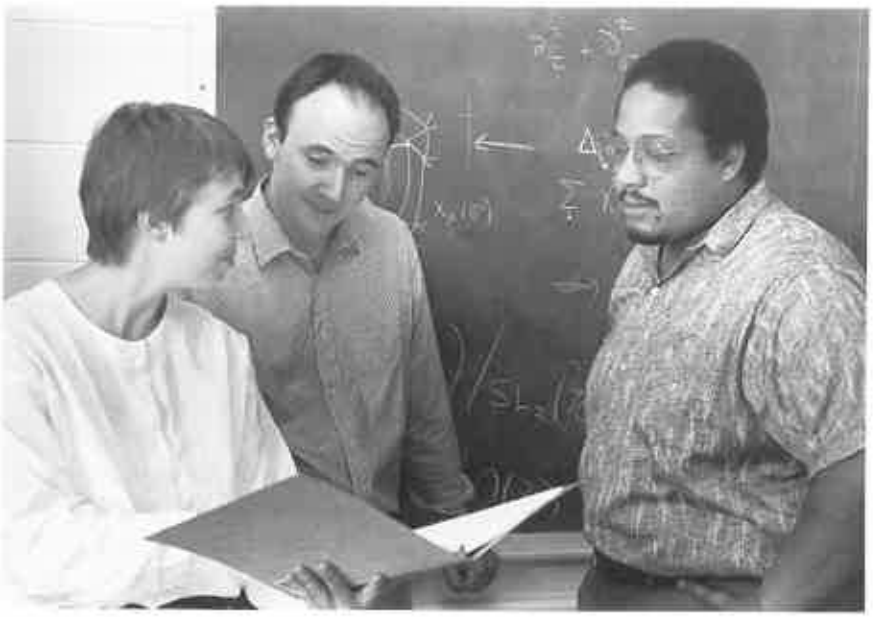
Some of the high energy physics group:
Charles Newsom, Edward McCliment, Usha Mallik, James McPherson (graduate student), and Yasar Onel

Research at SLAC

At SLAC, physics analysis of the data from the "Charm factory," MARK III, is continuing in both weak and strong interactions; data gathering for this experiment is complete.

THEORETICAL WORK

The members of the theoretical particle physics group are involved in a variety of problems in particle phenomenology and quantum field theory. These include perturbative predictions of the electroweak standard model and quantum chromodynamics for the high energy colliders at FNAL, CERN, SLAC and SSC. Field-theoretical aspects that are covered include semi-classical approximations in gauge theory, recursive methods, conformal field theory, quantum gravity, and various applications of the theory of group representations.



An informal physics discussion among part of the high energy physics group: assistant professors Hallsie Reno, Yannick Meurice, and Vincent Rodgers.

Recent Publications in High Energy Physics

"Measurement of the Branching Fractions for $D^0 \rightarrow \pi e^+ \nu_e$ and $D^0 \rightarrow K e^+ \nu_e$ and Determination of $(V_{cd}/V_{cs})^2$," U. Mallik, et. al, *Physical Review Letters*, 62, 1821, 1989.

"High-Precision Measurements of Polarized Σ^- Beta Decay," E. McCliment, C. Newsom, and others, *Physical Review D*, 38, 2056, 1988.

"New Measurement of the Production Polarization and Magnetic Moment of the Ξ^- Hyperon," L. H. Trost, E. McCliment, C. Newsom, and others, *Physical Review D*, 40, 1703, 1989.

"Comparison of Spin Asymmetries and Cross Sections in π^0 Production by 200 GeV Polarized Antiprotons and Protons," Y. Onel, N. Akchurin, et al., *Physics Letters*, B, 261, 201, 1991.

"Symanzik's Field Theory on p-adic Spaces," Y. Meurice, *Physics Letters*, B, 265, 377, 1991.

"W and Z Production at pp Colliders: Parton Showers Merged with $O(\alpha_s)$ Monte Carlo Approach," H. Baer and M.H. Reno, *Physical Review*, D (in press), 1992.

"W_∞ and Anomalies of Selfdual Einstein Theories," V.G.J. Rodgers, *Modern Physics Letters*, A, 6, 1893, 1991.

NUCLEAR PHYSICS

A versatile 6-MV Van de Graaff accelerator is used to study nuclear reactions induced by all stable isotopes of hydrogen, helium, lithium, and beryllium. A unique design allows energies up to 14 MeV for triply charged ions. Special emphasis is given to lithium-ion reactions where three or more particles are produced. Ion beams are also used for measuring the chemical and physical structure of semiconductor materials. Nuclear physics experiments using higher-energy beams are carried out at national accelerator facilities.

Theoretical research in nuclear and intermediate energy physics is directed at understanding the interactions between the elementary constituents of the nucleus. Current research areas include relativistic quark models of the nucleus, few-nucleon models of the nucleus, lepton-nuclear interactions, and symmetry properties of scattering amplitudes. The numerical calculations for this research are done either on computer workstations or on supercomputers located at the national laboratories. The department is engaged in research collaborations with scientists at both Argonne National Laboratory and Los Alamos National Laboratory.

Recent Publications in Nuclear Physics

"Relativistic Hamiltonian Dynamics in Nuclear and Particle Physics," B.D. Keister, and W.N. Polyzou, (edited by J.W. Negele and E. Vogt,) *Advances in Nuclear Physics*, 20, 226, 1991.

"SU(3) Clebsch-Gordan Coefficients with Definite Permutation Symmetry," W.H. Klink, *Annals of Physics*, 212, 1991.

"Nuclear Transition Rates in μ-Catalyzed p-d Fusion," J.L. Friar, B.F. Gibson, H.C. Jean, and G.L. Payne, *Physical Review Letters*, 66, 1827, 1991.

"Multifragment Emission in Reactions Induced by 0.90 and 3.6 GeV ^{3}He Ions on ^{nat}Ag," S.J. Yennello, E.C. Pollacco, K. Kwiatkowski, C. Volant, R. Dayras, Y. Cassagnou, R. Legrain, E. Norbeck, V.E. Viola, J.L. Wile, and N.R. Yoder, *Physical Review Letters*, 67, 671, 1991.

"Observation of a Minimum in Collective Flow for Ar + V Collisions," D. Krofcheck, D.A. Cebra, M. Cronqvist, R. Lacey, T. Li, C.A. Ogilvie, A. Vander Molen, K. Tyson, G.D. Westfall, W.K. Wilson, J.S. Winfield, A. Nadasen, and E. Norbeck, *Physical Review*, C, 43, 350, 1991.

SOLID STATE PHYSICS

Experiments on electrical and magnetic properties of materials are included in the department's solid state program, with current studies focused on preparation and characterization of sulfide analogues of the high-temperature oxide superconductors.

Theoretical work in solid state physics is concerned with application of many-body approaches to the theory of electronic and magnetic properties of condensed matter. Current interests include valence instabilities in rare-earth compounds and related narrow-band phenomena, and nonlinear effects in quasi-one-dimensional models of condensed matter.

Recent Publications in Solid State Physics

"Superconductivity in Yturium-Terbium-Barium-Copper Oxide," J.E. Kasper, L.S. Martinson, W.R. Savage, N.G. Baenziger, and J.W. Schweitzer, *Solid State Communications*, 68, 57, 1988.

"Calculation of the Lifetime of a Davydov Soliton at Finite Temperature," J.P. Cottingham and J.W. Schweitzer, *Physical Review Letters*, 62, 1792, 1989.

"Perturbation Estimate of the Lifetime of a Davydov Soliton at 300K," J.W. Schweitzer, and J.P. Cottingham, in *Davydov's Soliton Revisited*, P.L. Christiansen and A.C. Scott (editors), (Plenum: New York) 1990.

Professor Edwin Norbeck, Lawrence Schroeder (engineer), and Jian-Xin Zhang (graduate student) in the nuclear physics laboratory

Professor John Goree (right) and associates work on laser used for measurements of ion distribution functions in plasmas

PLASMA PHYSICS

Research in plasma physics includes the study of basic plasma properties and the applications of basic plasma phenomena to thermonuclear fusion plasmas, space plasmas, astrophysical plasmas, and plasmas for materials processing.

One class of experiments carried out in the department is designed to simulate, in the laboratory, various plasma processes that occur in the ionosphere. This work is funded by the Office of Naval Research. Topics under investigation include electrostatic ion cyclotron waves and their relation to ion beam and conic formation in the auroral zone, double layers, and ionospheric instabilities. Several plasma devices are available for these studies, including a Q-machine, a coaxial double plasma device, and several multidipole plasma devices. In addition, devices are available for studying plasma phenomena associated with cusp confinement.

Experimental study of the properties of solitons is funded through the National Science Foundation. Experimental research on high-power radio waves in ionospheric plasma is performed at the National Astronomy and Ionosphere Center near Arecibo, Puerto Rico. Other space-related experiments include dusty plasma studies designed to simulate the pre-solar nebula and spacecraft interactions with the plasma environment.

Another experimental area is concerned with applied plasma processing. Department investigations are being made of plasmas used for thin film deposition and etching. Magnetron and radio frequency discharge experiments are conducted in a computer-automated laboratory. Tunable dye lasers are employed for laser-induced fluorescence diagnostics of plasmas, and numerical simulations are carried out to test theoretical models of these discharges.

Theoretical plasma physics uses a combination of analytic and numerical techniques. Two kinds of numerical techniques are used. Nonlinear partial differential fluid equations, which describe a plasma, are integrated numerically; and Newton's laws of motion, together with Maxwell's equations, are solved for systems of one thousand to one million particles. This work concentrates on the study of plasma equilibrium, stability, solitons, nonlinear waves, stochasticity, chaos, and turbulence in laboratory plasmas, fusion plasmas, ionospheric plasmas, magnetospheric plasmas, space plasmas, and astrophysical plasmas. The numerical work is performed on campus computers and on supercomputers in Colorado and Illinois via telephone link.

Turbulence Theory

A research area akin to plasma physics is the study of turbulence. Turbulence is among the most important and outstanding problems in classical physics, and has resisted attempts at a basic understanding for the past century. Previous and current studies at Iowa include behavior of a plasma in a strong magnetic field, transition to turbulence in Couette flow, and cascade of turbulent energy from large to small scales. A problem of particular interest in the department is "self organization" in turbulence, in which large-scale, sometimes ordered, structures form. Problems in turbulence theory are addressed with both analytic and numerical means, and developments from the mathematical theory of deterministic chaos are used.

Recent Publications in Plasma Physics

"Numerical Tests of Weak Turbulence Theory," G.L. Payne, D.R. Nicholson, and Mei-Mei Shen, *Physics of Fluids*, B, 1, 1797, 1989.

"Asymptotic State of the Finite Larmor Radius Guiding Center Plasma," G. Knorr and H.L. Pécseli, *Journal of Plasma Physics*, 41, 157, 1989.

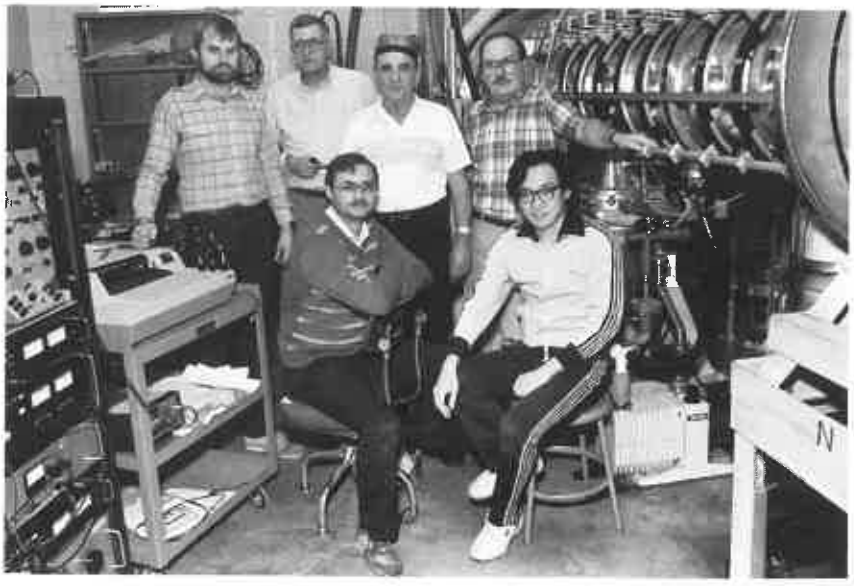
"Laser-Induced Fluorescence Characterization of Ions in a Magnetron Plasma," M.J. Goeckner, J. Goree, and T.E. Sheridan, *Journal of Vacuum Science and Technology*, A8, 3920, 1990.

"Dust Shedding by Objects in a Plasma," T.E. Sheridan, J. Goree, Y.T. Chiu, R.L. Rairden, and J.A. Kiessling, *Journal of Geophysical Research.*, 07, 2935,1992.

"An Experimental Study of Electrostatic Ion-Cyclotron Waves in a Two-Ion Component Plasma," D.M. Suszcynsky, N. D'Angelo, and R.L. Merlino, *Journal of Geophysical Research*, 94, 8966, 1989.

"The Current-Voltage Characteristics and Potential Oscillations of a Double Layer in a Triple Plasma Device," R.T. Carpenter and S. Torvén, *IEEE Transactions in Plasma Science*, 15, 434, 1987.

"Experiments on Korteweg-de Vries Solitons in a Positive Ion-Negative Ion Plasma," J.L. Cooney, M.T. Gavin, and K.E. Lonngren, *Physics of Fluids B*, 3, 2758, 1991.



The Q-machine plasma laboratory, (back) James Johnson (graduate student), Professor Nicola D'Angelo, Albert Scheller (senior machinist), Professor Robert Merlino; (front) graduate students Paul Lovekamp and Bin Song

SPACE PHYSICS

The department conducts a major program of experimental and theoretical space physics. Extensive facilities and an engineering and technical staff are available to design, construct, and test equipment for flight in rockets, spacecraft, and the space shuttle, as well as to perform computerized decoding and analysis of data. Research emphasis is on comprehensive observational and theoretical study of the magnetospheres of Earth, Jupiter, Saturn, Uranus, and Neptune; the interplanetary medium, including the propagation of energetic particles therein; and the galactic cosmic radiation.

The space physics group currently has active instruments on IMP-8; Pioneers 10 and 11, now at over 48 AU and 30 AU respectively from the sun; International Cometary Explorer (ISEE 3); Dynamics Explorer 1; and Voyagers 1 and 2, now at 41 AU and 32 AU respectively from the sun. The Plasma Diagnostics Package (PDP), a comprehensive set of plasma wave and particle detectors, has flown twice on the space shuttle. Two instruments are also on the Galileo spacecraft to Jupiter, launched in October 1989. Four instruments are being developed for the International Solar Terrestrial Physics Program.

Space plasma physics deals mainly with the magnetohydrodynamics, wave-particle interactions, transport, heating, and acceleration of charged particles in planetary magnetospheres and the solar wind. In situ measurements by the instruments described above enable research teams to use planetary magnetospheres as natural laboratories for plasma physics.

In addition to work in experimental and observational space physics, an active program of research in theoretical space plasma physics is carried out by faculty, research scientists, and graduate students in the department. Topics of investigation include the generation of plasma waves by various distribution functions observed in space, nonlinear behavior of plasma waves such as steepening, soliton production and wave collapse, and investigation of a number of topics related to the physics of boundary layers in space plasmas. An example of such a boundary layer is the one which separates the solar wind from the Earth's mangetosphere. Such research programs have been supported by grants from NASA and NSF.

In addition to traditional analytic techniques of solving theoretical problems, investigators in space physics theory employ advanced numerical simulation codes based on magnetohydrodynamic and particle-in-cell models. These codes are run on an extensive network of in-house computers, as well as at NSF supercomputer centers in Illinois and California.

Recent Space Physics Publications

"The Thermal Catastrophe Model of Substorms," C.K. Goertz and R.A. Smith, *Journal of Geophysical Research*, 94, 6581, 1989.

"Ion Beam Generation at the Plasma Sheet Boundary Layer by Kinetic Alfvén Waves," E. Moghaddam-Taaheri, C.K. Goertz, and R.A. Smith, *Journal of Geophysical Research*, 94, 10047, 1989.

"Dynamics of the Near-Earth Magnetotail - Recent Observations," L.A. Frank, *American Geophysical Union Monograph*, 44, 262, 1988.

"Whistlers in Neptune's Magnetosphere: Evidence of Atmospheric Lightning," D.A. Gurnett, W.S. Kurth, I.H. Cairns, and L.J. Granroth, *Journal of Geophysical Research*, 95, 20967, 1990.

"Lightning and Plasma Wave Observations from the Galileo Flyby of Venus," D.A. Gurnett, W.S. Kurth, A. Roux, R. Gendrin, C.F. Kennel, and S.J. Bolton, *Science*, 253, 1522, 1991.

"Relativistic Electrons in Saturn's Inner Magnetosphere and an Estimate of Their Synchrotron Emission," J.A. Van Allen and C.L. Grosskreutz, *Journal of Geophysical Research*, 94, 8731, 1989.

Professor Louis Frank (center) discusses data from the Dynamics Explorer satellite with research scientists John Craven (left) and John Sigwarth

Members of the space plasma wave group discuss diagrams of an experiment: Iver Cairns, Roger Anderson, William Kurth (research scientists), and Professor Donald Gurnett

IOWA'S GRADUATE PROGRAMS

Through The University of Iowa's nationally recognized programs, students master a body of knowledge and ultimately contribute to it through their own scholarship and research.

Iowa's graduate students work closely with a faculty of scholars who are committed to lives of learning. Together, faculty and students work in an atmosphere of academic freedom and intellectual verve that stimulates creative and innovative thinking.

Iowa's graduate programs have both depth and breadth. Iowa's graduate students actively participate in the life of a large and multifaceted university community. They receive specialized attention within their own disciplines while they exchange ideas with people from throughout the University's 10 colleges and more than 90 graduate degree programs.

DIVERSE THOUGHT AND CULTURE

The University of Iowa has a long history of offering learning opportunities for students of all races and backgrounds. In 1879, only 24 years after the University began continuous operation, the first African American in the country to earn a law degree did so at Iowa. Iowa was the first to offer the M.F.A. degree, and the first recipient was an African-American woman. The first Ph.D.'s earned by African Americans in history, music, and political science were at Iowa.

The richness of Iowa's academic environment has resulted in more than 1,500 underrepresented minorities earning degrees at the undergraduate, graduate, and professional level in the last seven years. Recent new efforts directed toward underrepresented groups in higher education have revitalized this endeavor. The University in 1987 established the Opportunity at Iowa program to provide a coordinated effort for the recruitment and retention of minority faculty and students.

American students of Asian, African, Latino, and Native American background find many opportunities for support and cultural identification at the University. For more information about Opportunity at Iowa and its services and support programs for African American, Latino, and Native American students, contact the director of Opportunity at Iowa, Jessup Hall, 319-335-3555, or the Office of Special Support Services, Calvin Hall, 319-335-1416.

EXTENSIVE ACADEMIC SUPPORT

The University Libraries constitute the largest library system of any kind in Iowa and the 28th largest academic/research system in the United States. They contain over 3 million holdings including 93,000 rare books, 470 manuscript collections, and 10,000 catalogued manuscript letters. In addition to the Main Library, there are 12 specialty libraries: art and art history, biology, botany and chemistry, business administration, engineering, geology, mathematics, music, physics, psychology, law, and the health sciences.

University scholars benefit from a number of central research facilities such as the Electron Microscopy Facility, the Image Analysis Facility, and the High Resolution Mass Spectrometry Facility.

The Weeg Computing Center provides versatile computing support for the University's academic community. The main computing hardware serves more than 3,000 computer terminals located throughout the campus. Weeg's Personal Computing Support Center provides comprehensive support to campus microcomputer users on an on-call basis.

The University of Iowa Hospitals and Clinics, the nation's largest university-owned teaching hospital, offers unparalleled resources for study and training in the health sciences.

COMMITTED FACULTY

Iowa's faculty members rate high as teachers, scholars, and researchers. In most University departments and colleges, graduate students work one-on-one with faculty mentors. In studios, libraries, and laboratories, they engage in creative endeavors that build toward independent projects initiated by the students.

Faculty members successfully compete for research support, attracting more than $139 million annually from private and public sources. The University nurtures superior intellectual activity with outstanding facilities, fellowships, and assistantships that attract a critical mass of talented faculty and students.

At Iowa, 60 organized research units complement the activities of academic departments. A few examples are the Center for International and Comparative Studies, the Center for Computer-Aided Design, the Alzheimer's Disease Research Center, the Center for New Music, the Cardiovascular Research Center, the Dows Institute for Dental Research, and the Institute for Economic Research.

FINANCIAL ASSISTANCE

Teaching and research assistantships, available in many departments, offer stipends ranging from $9,000 to $11,000 for academic year, half-time assignments. Additional support for summer sessions is often available. In the Graduate College, students who hold assistantships pay in-state tuition regardless of their residency status.

The Iowa Fellows Program helps attract extraordinary doctoral students to the University. Twenty to thirty fellowships are available each year, awarding $15,000 to $16,000 per year for up to four years plus tuition.

The Graduate Opportunity Scholarship and Fellowship Programs and programs through the Committee on Institutional Cooperation offer valuable assistance for minority students.

The cost of living in Iowa City is moderate and comparable to most midwestern cities. Current financial aid information is available from the Office of Student Financial Aid, Calvin Hall, 319-335-1450.

A LIVELY CAMPUS

The campus caters to pedestrians and bicyclists: it's compact enough to cross in a 20-minute walk. A free ride on a campus bus can halve that time. Entertainment on campus and in Iowa City is geared toward student budgets, with many events offered at no charge.

Iowa City has more book shops, coffee shops, restaurants, record shops, and movie theaters in its downtown area—right next to campus—than you'll find in cities many times its size.

Local service agencies combine with campus programs to provide a wide range of helping services for students and student families.

Hancher Auditorium brings the world's finest musicians, dancers, actors, and entertainers to the University. It is part of the Iowa Center for the Arts, which includes the Museum of Art and cultural/educational programs in music, theatre, art and art history, dance, and literary arts.

Iowa City is alive with festivals and ethnic celebrations. Music, drama, and dance can be found on stage or on street corners. Sculptures adorn campus green spaces and plazas, and work by local artists and craftspeople entice visitors to outdoor markets.

American and foreign film classics are presented at the University's Bijou Theatre at modest rates, and each semester, the University community is energized by a full and diverse schedule of lectures, readings, and discussions that bring world notables to campus to interact with students and faculty members.

The University can help put enthusiasts on board a hot air balloon or a sailboat. Weight lifting, tennis, fencing, the martial arts, handball, soccer, rugby, football, spelunking, horseback riding, gymnastics, or golf—Iowa students do them all.

The University's Macbride Nature Recreation Area, located 15 miles from campus, offers hiking, cross-country skiing, sailing, and canoeing.

The University fields 10 varsity teams each for men and women. Iowa is a member of the Big Ten Athletic Conference, and University teams, from field hockey to football, enjoy fan support from the community and a large region of the state.

WHERE TO LIVE

Campus and community housing options can fit most every need, taste, and budget. University family housing provides efficiency and one- and two-bedroom apartments at affordable rates. Iowa City offers modern apartment complexes, rooms in charming older buildings, trailer parks, and cooperative housing. For off-campus housing information, contact the Campus Information Center, Iowa Memorial Union, 319-335-3055. For information about University family housing, contact the Family Housing Office, Housing Service Building, 319-335-9199.

CHILD CARE OPTIONS

Community Coordinated Child Care, a private, nonprofit agency known as 4-Cs, is a clearinghouse for information about licensed private child care providers, day care centers, preschools, and parent cooperative day care facilities. There are four University-affiliated day care centers overseen by The University of Iowa Student Association Daycare Commission. For information about child care, contact 4-Cs, 202 S. Linn St., Iowa City, IA 52240, 319-338-7684.

UNIVERSITY FACTS AT A GLANCE

Enrollment (1991): 27,881, including 6,714 enrolled in the Graduate College.

Colleges: Business Administration, Dentistry, Education, Engineering, Law, Liberal Arts, Medicine, Nursing, Pharmacy, and the Graduate College.

Degree Programs: More than 90 graduate degree programs; more than 55 leading to the doctorate.

Research Funding: $1.64 billion in external funding since 1966; $139.6 million during the 1990-91 academic year.

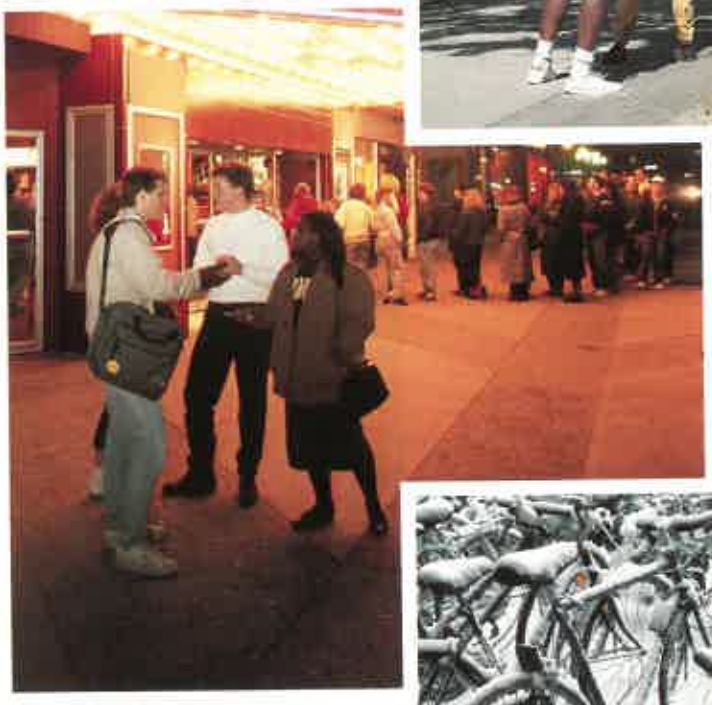
Faculty: 1,647 full-time faculty members.

History: Founded in 1847 as Iowa's first public institution of higher learning. Iowa was the first public university in the United States to admit women and men on an equal basis.

Location: Iowa City is within 300 miles of Chicago, St. Louis, Minneapolis, Omaha, and Kansas City. The Cedar Rapids Airport, served by national and regional airlines, is a 20-minute drive from campus.

For more information about the University or community, write to the chair of the department of interest or to:

Office of Graduate Admissions
Calvin Hall
or call 1-800-553-IOWA



DEGREES GRANTED

The University of Iowa offers two advanced degrees in physics: the Master of Science, with thesis or critical essay; and the Doctor of Philosophy, with research dissertation. One advanced degree is offered in astronomy— the Master of Science, with thesis or critical essay. Students who wish to pursue a program in astronomy beyond the Master of Science level may qualify for a Doctor of Philosophy degree in physics with specialization and dissertation in astronomy or astrophysics. An interdepartmental Ph.D. program is offered in applied mathematical science.

Each graduate student has a faculty adviser who oversees the student's academic work and thesis or dissertation research. A typical Ph.D. program requires five years of graduate work.

The University also offers Bachelor of Science and Bachelor of Arts degrees in both physics and astronomy. Undergraduate students may pursue double majors in these disciplines, and selected juniors and seniors may receive degrees with honors in recognition of research they have done with faculty members.

Instruction in one of the physics laboratories

RESEARCH FACILITIES

Facilities for graduate study and research in physics and astronomy are located in Van Allen Hall. The 195,000-square-foot, completely air-conditioned building houses an excellent library, machine shops, well-equipped laboratories, offices, storerooms, auditoria, darkrooms, classrooms, lecture halls, and seminar rooms. A desk and private study area are provided for each graduate student.

The central machine shop is staffed with skilled instrument makers and machinists, and several electronic and machine shops are available for use by advanced students and research staff.

The department has an extensive computer network. All major computers in the department are networked, and can access all major networks. More than 20 terminals and auxiliary apparatus are provided for student use, and additional computing facilities are available at the University's Weeg Computing Center.

Several networks permit access to supercomputers at the National Magnetic Fusion Energy Computing Center, Livermore, California; the National Center for Atmospheric Research, Boulder, Colorado; the National Center for Supercomputing Applications, Champaign, Illinois; and the Los Alamos National Laboratory, Los Alamos, New Mexico.

Major research facilities in the department are:

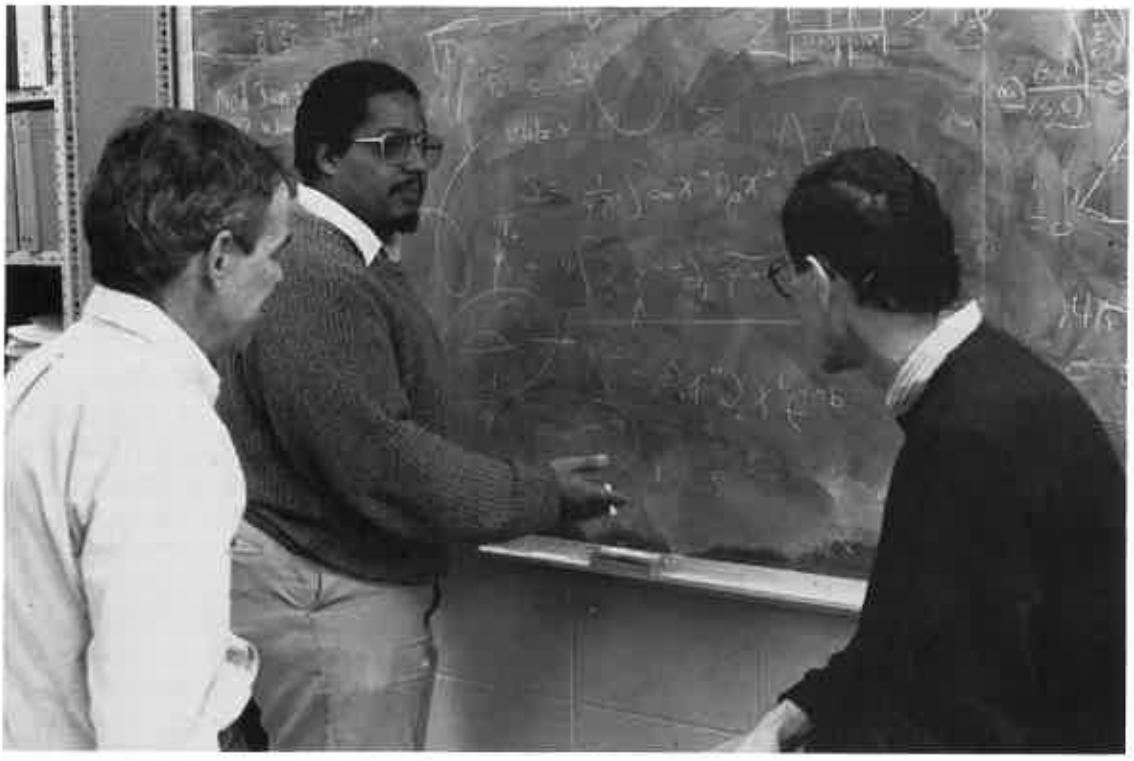
- a comprehensive array of low-energy particle accelerators, electronic test equipment, and environmental test chambers and clean rooms; an optics laboratory for the development, calibration, and proof testing of instruments for space flight;
- a computer-assisted design (CAD) facility;
- a 6-MV Van de Graaff accelerator in a nuclear physics laboratory adjoining Van Allen Hall;
- a fully equipped high-energy physics laboratory for design, construction, and testing of detectors used in experiments at Fermilab and other large facilities around the world;
- 24-inch and 12-inch Cassegrain telescopes at the Riverside Astronomical Observatory, ten miles south of Iowa City;
- a solid-state laboratory with facilities for magnetic susceptibility, resistivity, and Hall effect measurements at low temperatures; facilities for the preparation of experimental materials;
- several plasma physics laboratories, including a 6-kG Q-machine facility; a variety of multidipole plasma devices and associated computer-based diagnostic equipment used for basic plasma physics research, laboratory simulation of space plasma physics phenomena, and applications to plasma processing of materials;
- the Iowa Laser Facility, which houses a wide variety of modern laser instrumentation and related equipment, including several monochromators, with lengths up to 3.4 meters; high-vacuum molecular beam systems; and low-temperature equipment, including a 110-kG superconducting magnet and a helium dilution refrigerator capable of operation at 0.012 K.

Advanced astronomy students also conduct research at the National Astronomy and Ionosphere Center, Arecibo, Puerto Rico; the Very Large Array radio telescope, near Socorro, New Mexico; the Very Long Baseline Interferometry Network; the Very Long Baseline Array; Haystrack Observatory, Westford, Massachusetts; Kitt Peak National Observatory, near Tucson, Arizona; the Infrared Telescope Facility, Mauna Kea, Hawaii; and the International Ultraviolet Explorer, Goddard Space Flight Center, Greenbelt, Maryland.

Students can arrange to do physics research at the following facilities:

- in nuclear physics at the Argonne National Laboratory, Argonne, Illinois;
- in elementary particle physics at the Fermi National Accelerator Laboratory, Batavia, Illinois; the Los Alamos Meson Physics Facility, Los Alamos, New Mexico; the Stanford Linear Accelerator Center, Palo Alto, California; and the Center for European Nuclear Research, Geneva, Switzerland;
- in space plasma physics at the Los Alamos National Laboratory, Los Alamos, New Mexico;
- in ionospheric plasma physics at the National Astronomy and Ionosphere Center, near Arecibo, Puerto Rico.

Work with test equipment in the radioastronomy laboratory



A discussion in theoretical physics by faculty members Gerald Payne, Vincent Rodgers, and William Klink

ASSOCIATED RESEARCH PROGRAMS AT IOWA

In addition to the research programs carried out in the Department of Physics and Astronomy proper, other research and academic programs at The University of Iowa are of interest to physicists. These draw the participation of faculty members in the department, and offer physics and astronomy graduate students the prospect of research and interdisciplinary study.

Iowa Institute of Hydraulic Research

This internationally recognized institute is a leader in research in numerous areas of hydraulic engineering and fluid mechanics, which are of interest to many physicists and astronomers. The institute occupies its own laboratory building with five modern laboratories. Areas of particular interest to students in physics and astronomy are the institute's research in computational fluid dynamics, studies of boundary layers, turbulence and turbulent shear flow, and active involvement in global climate issues.

Analysis of images from the Dynamics Explorer satellite

Laser Science and Engineering Center

The University of Iowa is in the process of expanding its education, research, and outreach activities in the rapidly growing area of laser science and engineering. The Iowa Advanced Technology Laboratories, completed in 1992, includes state-of-the-art laboratory space for faculty members from physics, chemistry, and engineering.

Center for Global and Regional Environmental Research

Perhaps the science issue most relevant to society in the next decade will be modification of Earth's climate by human activity, such as release of carbon dioxide and other "greenhouse gases" into the atmosphere, destruction of the ozone layer, and so forth. Study of this complicated area involves sophisticated problems in physics, chemistry, and engineering as well as interdisciplinary synthesis. In recognition of the importance of this topic, The University of Iowa recently established the Center for Global and Regional Environmental Research. Thirty-one faculty members from the College of Liberal Arts and the College of Engineering participate.

Center-related research in the department includes the use of millimeter wavelength radio measurements for precise measurement of the stratospheric ozone layer. Work by other faculty members in the center consists of measurements of tropospheric ozone and other urban air pollutants, mathematical modeling of atmospheric chemistry, remote sensing of the Earth's surface, and hydrometeorology.

Gerald L. Payne
Chair of the Department of Physics and Astronomy

FACULTY

Carlson, Richard R., Ph.D., Chicago 1951, professor. Experimental low energy nuclear physics.

Carpenter, Raymon T., Ph.D., Northwestern 1962, professor. Experimental plasma physics.

D'Angelo, Nicola, Dr., Rome (Italy) 1953, professor. Experimental plasma physics, experimental space physics.

Fix, John D., Ph.D., Indiana 1969, professor and associate dean for research and development. Observational stellar astronomy, theoretical astrophysics.

Frank, Louis A., Ph.D., Iowa 1964, professor. Experimental space physics.

Goree, John A., Ph.D., Princeton 1985, associate professor. Experimental plasma physics.

Gurnett, Donald A., Ph.D., Iowa 1965, professor. Experimental space physics, and experimental plasma physics.

Kleiber, Paul D., Ph.D., Colorado 1981, associate professor. Atomic, molecular, and laser physics.

Klink, William H., Ph.D., Johns Hopkins 1964, professor and associate chair for physics. Elementary particle physics, and mathematical physics.

Knorr, Georg E., Ph.D., Munich (Germany) 1963, professor. Theoretical plasma physics.

Lonngren, Karl E., Ph.D., Wisconsin 1964, professor (also Electrical and Computer Engineering). Experimental plasma physics.

Mallik, Usha, Ph.D., City College of CUNY 1978, associate professor. Experimental elementary particle physics.

McCliment, Edward R., Ph.D., Illinois 1962, professor. Elementary particle physics.

Merlino, Robert L., Ph.D., Maryland 1980, professor. Experimental plasma physics.

Meurice, Yannick, Ph.D., UCL Louvain-la-Neuve (Belgium) 1985, assistant professor. Theoretical elementary particle physics.

Molnar, Lawrence A., Ph.D., Harvard 1985; assistant professor. Radio astronomy.

Mutel, Robert L., Ph.D., Colorado 1975, professor. Radio astronomy.

Neff, John S., Ph.D., Wisconsin 1961, professor. Observational optical astronomy.

Nelson, Edward B., Ph.D., Columbia 1949, professor emeritus.

Newsom, Charles R., Ph.D., Texas (Austin) 1980, associate professor. Experimental elementary particle physics.

Norbeck, Edwin, Ph.D., Chicago 1956, professor. Experimental low energy nuclear physics.

Onel, Yasar, Ph.D., London (England) 1975, professor. Experimental elementary particle physics.

Payne, Gerald L., Ph.D., California (San Diego) 1967, professor and chair for the department. Theoretical nuclear physics, theoretical plasma physics.

Polyzou, Wayne N., Ph.D., Maryland 1979, professor. Theoretical nuclear physics.

Reno, Mary H., Ph.D., Stanford 1985, assistant professor. Theoretical elementary particle physics.

Rodgers, Vincent G. J., Ph.D., Syracuse 1985, assistant professor. Theoretical elementary particle physics.

Schweitzer, John W., Ph.D., Cincinnati 1966, professor. Theoretical solid-state physics.

Smirl, Arthur L., Ph.D., Arizona 1975, professor (also Electrical and Computer Engineering). Quantum optics, atomic and molecular physics, laser physics.

Spangler, Steven R., Ph.D., Iowa 1975, professor. Radio astronomy, plasma astrophysics, space plasma physics.

Stwalley, William C., Ph.D., Harvard 1969, professor (also Chemistry). Quantum optics, low-temperature physics, atomic and molecular physics, laser physics.

Van Allen, James A., Ph.D., Iowa 1939, professor emeritus. Experimental space physics, astrophysics.

RESEARCH STAFF

Research Scientists

Ackerson, Kent L., Ph.D., Iowa, 1972; space plasma physics.

Anderson, Roger R., Ph.D., Iowa, 1976; interplanetary and magnetospheric plasma waves.

Calvert, Wynne, Ph.D., Colorado, 1962; space plasma physics.

Grabbe, Crockett L., Ph.D. California Institute of Technology, 1977; theoretical plasma physics.

Kurth, William S., Ph.D., Iowa, 1979; interplanetary and magnetospheric plasma waves.

Lyon, John, Ph.D., 1972, Maryland; theoretical space physics.

Associate Research Scientists

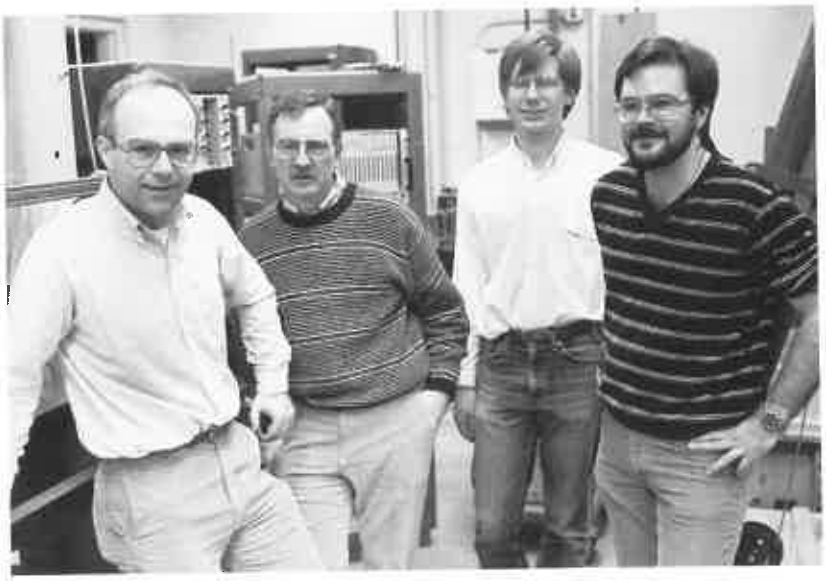
Berman, David, Ph.D., Wisconsin, 1976; optics.

Huang, Cheryl Y., Ph.D., Iowa, 1981; space physics.

Menietti, J. Douglas, Ph.D., 1977, Iowa; experimental space physics.

Nishikawa, Ken-Ichi, Ph.D., Nagoya (Japan), 1981; theoretical space plasma physics.

Randall, Bruce A., Ph.D., Iowa, 1972; magnetospheric physics.



Experimental high energy physics researchers

Assistant Research Scientists

Akchurin, Nural, Ph.D., Iowa, 1991; experimental particle physics.

Bahns, John T., Ph.D., Iowa, 1983; laser spectroscopy.

Bienz, Timothy, Ph.D., Stanford, 1990; experimental elementary particle physics.

Cairns, Iver H., Ph.D., Sydney (Australia), 1986; theoretical astro-physics.

Hansen, Paul J., Ph.D., Iowa, 1983; theoretical plasma physics.

Harrold, Barry G., Ph.D., Iowa, 1990; theoretical space physics.

Lyyra, Marjatta, Ph.D., Stockholm (Sweden), 1979; laser spectroscopy.

Moghaddam-Taaheri, Ebrahim, Ph.D., Maryland, 1986; space plasma physics.

Paterson, William R., Ph.D., Iowa, 1990; experimental space physics

Sigwarth, John B., Ph.D., Iowa, 1989; experimental space physics.

Research Investigators

Kreutzmann, Hubert, Ph.D., 1991, University of Bonn; experimental particle physics.

Post-Doctoral Research Associates

Allan, Graham A., Ph.D., Heriot-Watt (Scotland), 1985; laser physics.

McCallum, David S., Ph.D., Imperial College of Science and Technology (London), 1987; laser physics.

Schroeder, W. A. (Andreas), Ph.D., University of London, 1987; laser physics.

Swoboda, Hans-Erik, Ph.D., University of Kaiserslautern (West Germany), 1989; laser physics.

GRADUATE APPOINTMENTS AND AWARDS

Nearly all students who are admitted to graduate study in physics and astronomy are offered assistantships. Any student who progresses satisfactorily can expect to receive continuing financial support until he or she completes the M.S. or Ph.D. degree, as appropriate. The primary sources of support are teaching assistantships and research assistantships.

Teaching Assistantships

The usual initial appointment for a graduate student is a half-time teaching assistantship, which entails instructing three sections of elementary laboratory under the supervision of the professor in charge of the course. Teaching assistants also serve as tutors and proctors and grade examination papers. Duties are arranged to allow the student to take a full load of course work—up to 12 semester hours—concurrently with the assistantship.

Stipends for the 1992-93 academic year are $11,700 for first-year graduate students and others who have not yet passed the departmental qualifying examination. Increases in stipends are made after students have passed the qualifying and comprehensive examinations and/or with the adviser's approval.

All graduate assistants are eligible for resident tuition rates. The maximum tuition for 1992-93 is $1,239 per semester plus computer fees of $40 and mandatory student health fees of $30. A few teaching assistantships are available during the summer session.

Research Assistantships

Half-time research assistantships are usually available for all students engaged in Ph.D. dissertation research. The duties consist of work on the student's own dissertation and other work contributing to competence in research. Many students are associated with and supported by research groups before beginning dissertation research. Early research experience is desirable if the student is to make an informed choice of a dissertation problem.

The department tries to place new students in a research position during the summer following the first year of graduate study and can occasionally offer a research assistantship starting in June to new graduate students who have accepted teaching assistantships for the following academic year. Applicants who wish to be considered for research assistantships should indicate the particular field in which, and/or the professor with whom they wish to work.

Stipends are similar to those for teaching assistantships, and research assistants are also eligible for resident tuition rates.

Scholarships

The department has been awarded a substantial grant from the U.S. Department of Education to provide full fellowship support of $18,000 per 12 months to a few excellent candidates. In other cases scholarships are awarded to cover part or all of tuition and fees.

Prospective graduate students are encouraged to apply for other non-departmental scholarships and financial assistance as well.

Van Allen Hall, home of the Department of Physics and Astronomy

PLACEMENT OF PH.D. GRADUATES

1987

Ping-Lin Chung, Argonne National Laboratory, Argonne, Illinois; "Relativistic Calculations of Deuteron Form Factors"

William M. Farrell, Goddard Space Flight Center, Greenbelt, Maryland; "An Analysis of the Whistler-Mode Radiation from the Spacelab-2 Electron Beam"

1988

Dirk Morris, Lunar & Planetary Science Lab, University of Arizona, Tucson, Arizona; "Radio Emission from RS CVn Binaries and Similar Systems"

John T. Steinberg, M.I.T., Cambridge, Massachusetts; "Quasi-Static Electric Field Measurements Made with the Plasma Diagnostics Package in Free Flight During Spacelab-2"

Alan C. Tribble, Rockwell International, Seal Beach, California; "The Large-Scale Wake Structure of the Shuttle Orbiter: Plasma Density, Temperature, and Turbulence"

Robert E. Johnson, Tri-State University, Angola, Indiana; "Point Contact Spectroscopy Measurement on Ceramic Superconductors"

Scott A. Boardsen, Marshall Space Flight Center, Huntsville, Alabama; "Dynamics Explorer-1 Satellite Study of Electrostatic Ion Cyclotron Waves"

1989

James P. Cottingham, Coe College, Cedar Rapids, Iowa; "Calculation of the Lifetime of a Davydov Soliton at Finite Temperature"

David M. Suszcynsky, Los Alamos National Laboratory, Los Alamos, New Mexico; "An Experimental Study of Current-Driven Electrostatic Ion Cyclotron Waves in a Two-Ion Component Plasma"

Alan L. Fey, Naval Research Laboratory, Washington, D.C.; "VLA and VLBI Angular Broadening Measurements: The Distribution of Interstellar Scattering at Low Galactic Latitudes"

John B. Sigwarth, The University of Iowa, Iowa City, Iowa; "A Search for Small Comets in Consecutive Images Acquired with a Ground-Based Telescope"

1990

James C. Johnson, Department of Physics, Ohio Northern University, Ada, Ohio; "Double Layers Formed by Ion-Beam Injection in a Double-Plasma Device and an Associated Ionization Instability"

Kimball Leland Clark, Department of Physics, Wartburg College, Waverly, Iowa; "A Hybrid Particle-in-Cell Simulation of Ionospheric Heating"

Nural Akchurin, The University of Iowa, Iowa City, Iowa; "Analysing Power Measurements of Coulomb-Nuclear Interference with Polarized Protons at 185 GeV/c and 200 GeV/c"

Matthew John Goeckner, University of Wisconsin, Madison, Wisconsin; "LIF Measurements and Modeling of Magnetron and Filament Discharges"

Barry G. Harrold, The University of Iowa, Iowa City, Iowa; "Resonant Alfven Wave Heating of the Magnetotail Boundary Layers"

William R. Paterson, The University of Iowa, Iowa City, Iowa; "The Inner Edge of the Plasma Sheet, Region-2 Currents, and Electron Precipitation: Plasma Observations from ISEE 1"

Lin-Hua Shan, The University of Iowa, Iowa City, Iowa; "Electromagnetic Effects in Saturn's B Ring"

1991

Alan J. Collison, Naval Research Lab, Washington, D.C.; "Radioactive Transfer in Axisymmetric Circumstellar"

Tracy Alan Ellis, Space Telescope Institute, Baltimore, Maryland; "Numerical Simulation of the Emission and Motion of Neutral and charged Dust from P/Halley"

Bin Song, Columbia University, New York, New York; "Low-frequency Electrostatic Waves in Plasmas with Negative Ions"

Solomon Bililign, University of Utah, Salt Lake City, Utah; "Reaction Dynamics of Na (4^2P) + H_2"

He Wang, Georgia Institute of Technology, Atlanta, Georgia; "Multiple-Resonance Laser Spectroscopy of K_2 and Na_2"

Jiaxiang Wang, Liconix, Santa Clara, California; "Photodissociation Dynamics of K_2 and Na_2"