A Circuitous Route from Hodgin Hall to PAÍS: History of the Department of Physics & Astronomy at the University of New Mexico, 1892-2021

Originally started by John R. Green, continued and amended by Daniel Finley and Bernd Bassalleck

The Beginning: 1892

From the very beginning, the school that has grown to be the University of New Mexico has had the goal of providing its students with worthwhile training in physics. The catalog of 1892 states:

"A well-fitted laboratory will be arranged for the classes in Physics and Chemistry where students will be required to do practical work."

UNM sits alone on the so-called East Mesa (i.e. east of Old Town) in the early 1890s. This building would later become Hodgin Hall, and housed the physics lab until 1900.

Setting up: 1893

The next year, the catalog of 1893 has the following statement under "Physical and Chemical Laboratories":

"Both of these laboratories will be fitted up this coming year, and the students will be given the opportunity of doing practical work in both Physics and Chemistry. It is now expected that over $1000 will be expended for apparatus this coming year, and the latest and best appliances will be added from time to time as funds are provided."

During these early years, it was possible to obtain the BS degree by having a concentration of mathematics and chemistry, and with physics being taken in the senior year.

There was considerable turnover in the professorial staff in the beginning and, on occasion, even later. In 1892 Marshall R. Gaines is listed as Professor of Latin, Greek, and Natural Sciences. In 1894 his title was changed to Professor of Latin, Greek and Natural History, while William A. Zimmer came in as Professor of Chemistry, Physics, Geology and Botany and was also in charge of the School of Pharmacy. In 1895 Professor Zimmer became Professor of Natural History and remained in charge of the School of Pharmacy. From 1896 through September 1898, Randolph W. Tinsley was Professor of Natural Science, and the original "Elementary course in Physics for

beginners" was upgraded to include both the junior and senior years with some "advanced" work being included in the senior year.

“The work done in Physics has been of an elementary nature, consisting of recitations and experiments. Most of the experiments were shown from the desk, as the amount of apparatus on hand at present will not permit laboratory work in this branch. No one having applied for advanced work, there have been no advanced classes this year. About $200 worth of physical apparatus has been added this year.” -- UNM Yearbook *Mirage*, 1898

Edward Childs: 1898 - 1902

From September 1898 through 1902, Edward P. Childs expanded the scope of the physics offerings while serving under a variety of titles: Director, then Dean of the College of Science, Literature and Arts, Professor of Physics and Mathematics, Director of the Laboratories of Chemistry and Physics, and Professor of Mathematics. By 1900 the offerings in physics had grown to the point that freshmen could take General Physics, including laboratory work, and then go on to courses in Electricity and Magnetism, Heat and Light, Mathematical Electricity and Magnetism, Analytical Mechanics, and Advanced Laboratory.

Physics Lab 1898

Hodgin Hall: 1892-1900

Until 1900 the laboratories were held in the basement of the only building on campus, which was later to be named Hodgin Hall. In the basement of Hodgin Hall, then, along with the heating and ventilating apparatus, there were at first two, then four large rooms that were used for the laboratories. The chemistry laboratory was originally to be on the top (third) floor apparently with the hope that the fumes would be less objectionable from that location; but then later it was down in the basement together with the physics laboratory. In 1898 the concern of the physics professor for his students is apparent from the statement in the catalog: "the Laboratory is open at all times to students taking the course."

Hadley Hall: 1900

In 1899-1900 thanks to the generous personal gift of Mrs. Walter C. Hadley, the original Hadley Hall was constructed at a cost of over $20,000 to the east of Hodgin Hall. The new building is described as "a commodious laboratory for climatological study" and was also used to house "the several laboratories." In 1901-02, Professor Childs was in charge of physics and meteorology in the Hadley Climatological Laboratory, which had as its purpose the study of "the influence of the climate of arid and plateau regions of the United States on disease."

Carl E. Magnussen, Professor of Physics and Mathematics for 1902-03, was succeeded by Martin F. Angell, who was in charge of physics until 1913 except for the year 1904-05 when he returned to the University of Wisconsin for his MS degree. Walter E. Rowe took his place during that year. Professor Angell was originally Professor of Physics and Mathematics, but in 1908 that was changed to Professor of Physics and Electrical Engineering. Then in 1909 he became Dean of the College of Science and Engineering. These changes in title not only implied changes in orientation and emphasis but also reflected changes in academic organization. In 1908-09 physics was in the College of Letters and Science, which offered "courses leading to the degree of AB"; but then in 1909-10, that college became the College of Letters and Arts. Physics consequently became part of the School of Science within the College of Science and Engineering, which at that time offered the degrees of BA, MA, or EE, CE, or ME. During Professor Angell's tenure, the offerings of the physics department increased from seven courses to 18, including two entitled "thesis work."

Engineering Hall: 1910-1922

From the completion of Hadley Hall in 1900, the physics department was comfortably situated on the second floor of that building. In the catalog of 1903-04, however, there is the comment: "At present there is an urgent need for funds for carrying out effectively work in this line (i.e., the influence of New Mexico's arid climate on disease) and it is hoped that adequate resources may be provided at an early date." But then on May 23, 1910, disaster struck. Hadley Hall was completely destroyed by fire, and for the moment the College of Science and Engineering was effectively wiped out. Temporary quarters were found, however, in the Gymnasium and in the Administration Building (Hodgin Hall); and construction was started at once on a new science building. This was a one-story, largely concrete structure that housed the physical laboratories as well as the offices for the science departments. This building was called the Engineering Hall (or Building) until 1922, when it was renamed Science Hall as a result of the "New Engineering Building" being built to the west. Whatever the name, however, this was the home of the physics department until 1935.

In 1912-13 the physics department was back in the College of Letters and Science. In 1913-14 physics was the charge of Vernon A. Suydam, who was Professor of Physics and Electrical Engineering as well as Director of the School of Applied Science. For the period 1914-17, Jesse L. Brenneman took over as Associate Professor, then Professor of Physics and Electrical Engineering. In 1916 the physics laboratories in the Engineering Hall were described as being particularly effective in illustrating electricity and magnetism since "twenty five electrical meters, eight galvanometers, five resistance boxes in addition to the engineering rheostats give good facilities for experimentation." In 1916-17 the physics department was part of the College of Arts, Philosophy and Science. Up to this time the department had offered a minor, but not a major in physics.

From 1917 to 1920 there were rapid turnovers in the physics department, with Ward L. Ray there for 1917-18, Lawrence McCarty together with Raymond Duhadway for 1918-19, and then

George H. Bardsley for 1919-20. Despite these short tenures, progress was made because by 1918 it was possible to obtain a major or a minor in physics with a degree of BA or BS, depending on the program taken. By this time there were 19 courses offered by the department, including nine for advanced undergraduate or graduate students. In 1919 the physics department was part of the College of Arts and Sciences, and was planning on equipping laboratories for advanced work in heat, light, and electricity and magnetism "as funds become available."

The Graduate School of the university was started in 1918. Even though the various professors of physics were members of the graduate faculty and certain of the more advanced physics courses were available for graduate credit, there was no graduate degree offered in physics until some time later.

Robert Rockwood: 1920-1933

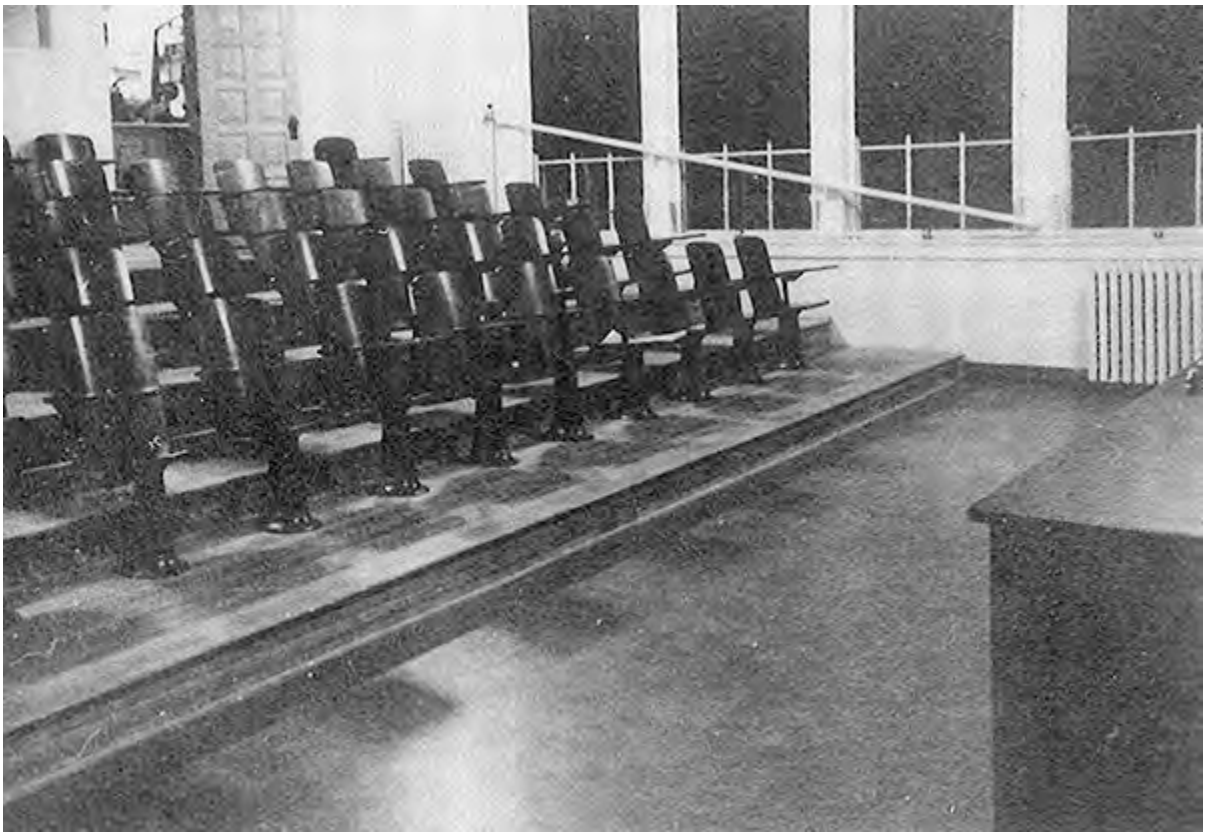
In 1920 Robert S. Rockwood took over the physics department and remained in charge until his death in the spring of 1933. In 1920 there were 14 course offerings in physics, including "Household Physics," which survived for many years. There were also advanced laboratories in heat, light, and electricity and magnetism as had been hoped earlier. In 1926 "Atomic Structure" was added to the curriculum, and in 1927 "Einstein's Theory of Relativity" was added for graduate credit.

Lecture Hall: 1927

Science and Lecture Hall, 1928-1984

In 1927 the new Lecture Hall, which was eventually demolished in 1985, was under construction. This proved to be an excellent facility, both because of its size (about 250 students) and because of its remarkably good acoustics. Who was to have primary use of this hall

developed into a contentious point between the physics department and such disparate departments as music (they needed the front area cleared for band and orchestra rehearsals and also did not want chairs with writing arms because chorus members would slouch on them) and anthropology (because of the size of their beginning classes).



Science and Lecture Hall, interior

Members of the physics department have always believed in the importance of lecture demonstrations, particularly in the beginning classes. The theoretical treatment that many students meet for the first time is so abstract that it is important to maintain some connection with the ordinary world. There were two small rooms on either side of the front of the lecture hall in which equipment could be stored and brought out on practically an instant's notice for use in the hall; whereas, it would have been quite impractical to set up demonstrations in one of the ordinary lecture rooms on campus. At one time it seemed that the completion in 1972 of the new physics lecture and laboratory building, Regener Hall, would resolve the scheduling difficulty. But the fact that the new lecture hall with its capacity for 300 students is practically unique on campus has also led to continuing controversy over its use.

1927-1931

Even though Professor Rockwood had additional help in teaching the physics courses from 1927, the biennial report of 1929-31 has this statement with regard to the physics department: "This department is in serious need of additional personnel, housing and equipment. It cannot at present function in accordance with the importance of physics in modern life." There must also have been a problem in filling the course on Einstein's Theory of Relativity because in 1929 this course was dropped from the catalog. There was, however, a favorable step taken in 1931 when

the Graduate School announced that the MA degree was to be offered with a major or minor in physics. Unhappily, it was to be ten years before the first graduate degree was given in physics.

Aerial view of the campus in 1932, looking north-east, Hodgin Hall near the bottom-right.

E.J. Workman: 1933-1946

Upon the death of Professor Rockwood, E.J. Workman came in as Associate Professor of Physics, later becoming Professor and Head of the Department of Physics until 1946. Physics continued as a two-man department with S. B. Lippincott for 1930-34, Francis F. Coleman for 1934-36, and Robert E. Holzer for 1935-36, until finally in the 1940s real growth began for the department. In 1941 both Gene Pelsor and Herschel Snodgrass joined the department, and then in 1942 John Breiland joined to give a staff of five.

Scholes Hall: 1935

Scholes Hall, 1960s

The circumstances of the physics department improved greatly in 1935 as a result of the construction of the new Administration Building (now Scholes Hall) with the help of a loan and grant of $250,000 from the Works Progress Administration. The physics department was allotted the whole east half of the second floor of the new building. This amounted to four large laboratory rooms, a large and a small lecture room (35 and 20 students), four offices, one of which was large enough to serve also as a research laboratory, and a reasonably well equipped shop with ample storage space. Even though some of the larger machines in the shop could not be used while classes in anthropology were meeting in a classroom on the first floor beneath the shop, the availability of machining facilities in the department greatly enhanced the possibilities for research. At this time the physics department offered ten lower-division, ten upper-division and two graduate (Problems, Thesis) courses, and now could also offer the MS degree.

Meteorology: 1937

The research interests of the department at this time were in meteorology. In 1937 the department added a minor study in meteorology with a number of new courses in atmospheric physics, and in 1940 the Graduate School announced that a new MS in physics with a major in meteorology would be added. This came about because of research work that was already underway investigating thunderstorms and associated meteorological phenomena of particular interest to aeronautics. This work was sponsored by the National Advisory Committee for Aeronautics and by the Weather Bureau. It was as a result of this work that the department awarded its first MS degree in 1941 to Herschel Roy Snodgrass, whose thesis was "A generating voltmeter of wide sensitivity range for measuring atmospheric potential gradient."

World War II

With the coming of World War II, unexpected demands were placed on the small physics department. At the request of the Army Air Forces, a pre-meteorological program under R. E.

Holzer was designed to fill an urgent need for trained weather observers and forecasters for military operations. From March 16, 1943, to September 1943, the department taught over 400 students in pre-meteorology, Navy, and civilian classifications.

When political and military events in Europe heated up, the War Department began to build installations immediately east of the city's new airport. The importance of military aviation at Kirtland Field played a part in constructing an addition to the Engineering Building designed especially for the study of aeronautical engineering and pilot training. The university's Physics Department and meteorology program were also involved in the training of many Army Air Corps officers.

Of particular interest was the participation of UNM Physics professor Everly John "Jack" Workman in the war effort. The National Defense Research Committee, a group created to support scientific research on war-related projects, selected Workman and his staff to team with researchers from Columbia University, Johns Hopkins University, Princeton, and the University of Michigan to develop and test a variable timing fuse, otherwise known as a proximity fuse. This top-secret project (not made public until September 1945) was, by the end of the war, a key component in stopping the lethal Nazi V-2 rocket attacks on Britain.

“Workman was instrumental in acquiring more than 30,000 acres south of the airport and along the foothills of the Manzano Mountains to create the New Mexico Proving Ground. The land, comprised of former livestock ranches and state land held in trust for the university, became home to testing facilities that played a major role in the development of this critical defensive weapon.” *From "The University of New Mexico: A Historical Narrative", by William A. Dodge, PhD. August 2006*

On September 29, 1944, a certificate "in recognition of meritorious service rendered the Army Air Forces Training Command during World War II" bearing the signatures of Maj. Gen. J. E. Chaney, commanding general of the Air Forces, and Lt. Gen. B. K. Yount, commanding general of the Training Command at Ft. Worth, Texas, was awarded the university. Judge Sam G. Bratton of the U.S. Circuit Court of Appeals, then president of the university's board of regents, presided over the special ceremony, while James P. Zimmerman, then president of the university, accepted the certificate.

Victor Regener: 1946

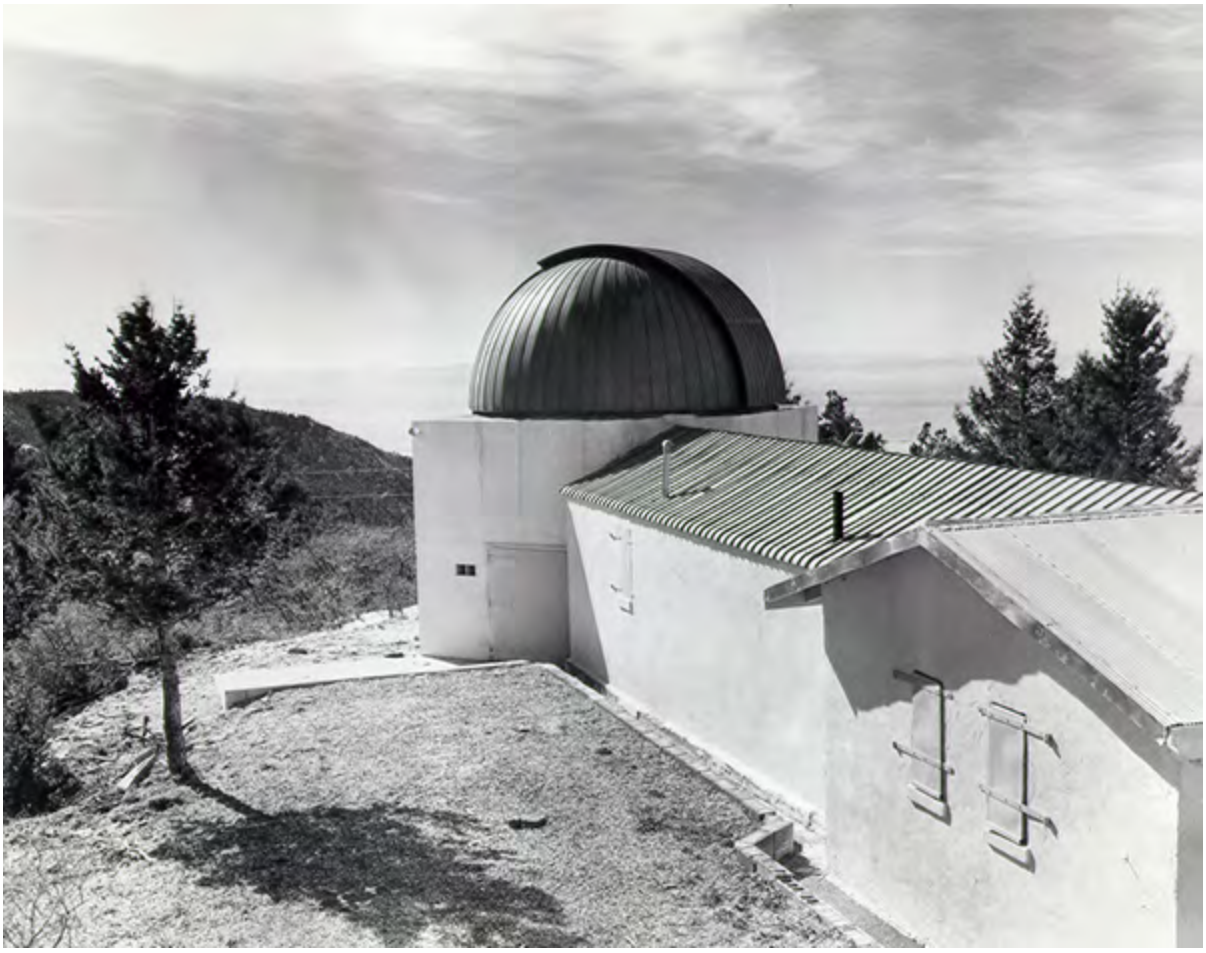
In 1945-46 a disagreement over the proper role of sponsored research on campus led to E. J. Workman's leaving the university and going to the New Mexico Institute of Mining and Technology, where he became the president. There was much reorganization of the department when Victor Regener came in 1946, becoming Chair in 1947. He had previously worked with Arthur Compton at the University of Chicago, after earlier leaving Germany and later Italy (where he had worked under Bruno Rossi, the leading cosmic ray physicist of his time) during the Hitler and Mussolini era, respectively. New courses such as "Experimental research methods" and "Introduction to contemporary physics" were added. Research contracts were obtained from the United States Air Forces to support research in atmospheric physics and from the Research Corporation of New York for cosmic ray research. It is particularly worth noticing that none of the work proposed was confidential. Therefore, it would all contribute toward the graduate research program of the department. Through the years the philosophy of the department has been that the function of a university is to discover and disseminate knowledge. This same principle has been followed in later cooperative arrangements with Los Alamos

Scientific Laboratory (now Los Alamos National Laboratory), the Sandia Corporation (now Sandia National Laboratories) and Kirtland Air Force Base. Theses and dissertations submitted in partial fulfillment of the requirements for higher degrees have always been unclassified, even though the research itself may have been carried out in classified areas.

L-R: Faculty, Gerald Bowen, Raymond Grenchik, John Breiland, Department Head Victor Regener, Norris Nereson, Frederick Martens, Richard Runge, from the 1947 UNM Mirage

Victor Regener was skillful in taking advantage of the support money that was available from governmental agencies and other sources just after World War II and later. The active research programs he instituted and encouraged in others served to attract able graduate students and additional faculty who would in turn extend the research opportunities of the department by finding further funding. A corollary of all this was the expansion and upgrading of the course offerings of the department.

Capilla Peak Observatory: 1947-1951



Capilla Peak Observatory

Starting with overnight camping trips in 1947 and continuing with picnics in 1950-51, the faculty, staff and students gradually built a high altitude observatory on Capilla Peak at 9,200 ft. in the Manzano Mountains. Victor Regener was the main architect of the observatory and its initial telescope. This observatory has had continuous use for experiments in cosmic rays, Zodiacal light, airglow, pulsars, binary star systems, Gegenschein (counterglow) and extragalactic imaging. It ended up being used, on and off of course, into the early 2000s.

First PhD: 1950

In July of 1950, David Pomeroy received the first PhD degree given by the department. His dissertation was entitled "Investigation of Hard Showers in Cosmic Radiation."

In late 1951 at the request of the Air Force Institute of Technology, the department offered a new meteorological program directed by John Breiland. This involved an accelerated course in a number of meteorological subjects for 119 cadets. The success of this program led to a further program at a more advanced level for 58 Air Force Reserve officers. Both of these programs involved setting up a complete weather station for making observations as well as extensive facilities for plotting and analyzing weather maps.

Also in 1951, at the request of the Sandia Corporation and Kirtland Air Force Base, the department rearranged its class schedule so that courses required for the various degrees were offered early in the morning or late in the afternoon into the evening. This proved to be

unsatisfactory both to the faculty and to the regular students because of the extraordinarily long day that resulted for many of them. Eventually a compromise was reached in which Sandia and Kirtland personnel were allowed greater freedom in taking classes during the day. After all, it was indisputable that the presence of the university and the possibility of obtaining a degree in physics and other fields was an important inducement in recruitment of new employees.

1919 Lomas NE: 1952

A new physics building of 10,000 square feet was completed in the summer of 1952 at the location north of Lomas Boulevard, with an estimated cost of $250,000. This location was selected even though it was rather far from the main campus activities because it provided ease of access and especially because it allowed convenient launching of balloon flights, which were involved in the study of atmospheric ozone. The new building was used only for advanced courses and upper division laboratories as well as for graduate research.

Victor Regener, far left, preparing a balloon for atmospheric data collection

The lower division laboratories remained in the administration building, while all lower division courses were still taught in Lecture Hall because of its location near the engineering buildings. Thus the dispersed teaching functions of the department provided the faculty with an opportunity for gentle exercise that continues to this day.

Los Alamos Collaboration: 1952

An important innovation in 1952 was the beginning of the MS program in cooperation with Los Alamos. This arrangement enabled students to use the facilities at Los Alamos while requiring originally that 15 units of courses be taken on campus. This small beginning was expanded and altered over the years to lead to full-scale graduate programs not only at Los Alamos, but also at Holloman Air Force Base starting in 1955. Faculty members taught two to three courses each semester at Los Alamos starting in 1957, and one to two courses at Holloman starting in 1958. The program at Holloman was not so rewarding, however, as the one at Los Alamos. As of 1984 the program at Los Alamos had resulted in 17 PhD degrees being awarded to students from there. Roy Thomas contributed to the success of the Los Alamos program as well as other educational programs at Kirtland and Sandia by teaching a large number of advanced and specialized courses.

National American Physical Society Meeting, 1953

The physics department was host for the western national meeting of the American Physical Society on September 2 to 5 in 1953. This proved to be one of the largest meetings held in the western United States up to that time. Participants said that they had come not only because of the contents of the meeting but also because of the proximity of Los Alamos and the Sandia Laboratories and even more because of the location of the meeting in the "Land of Enchantment", which most of them had never visited before. This meeting was followed by the "International Conference on Motions in the Upper Atmosphere", which met on September 7 to 9.

The department has always realized the desirability of being able to reward its better students, and in 1954 two special scholarships became available for this purpose.

- The William Sterling Parsons Memorial Scholarship in Nuclear Physics of $400 was established for an undergraduate physics major and was awarded twice.
- The Westinghouse Achievement Scholarship of $500 for a senior in physics was awarded for seven years beginning in 1955.
- The department also was able to award a handbook donated by the Chemical Rubber Company to the best beginning student in physics for many years. The award frequently went to an engineering student. On the other hand, a few engineering students changed their major to physics and proved to be excellent students.

Also at this time a real beginning in the development of a modern physics laboratory was undertaken by Robert Brown and Norman Seaton. They devised student projects in the advanced laboratories to construct apparatus and circuitry that were eventually used in a regular laboratory course in modern physics. Because of the pressure of increasing enrollments, the Dean of Arts and Sciences gave the department a special allocation to increase by one-third the equipment used in the sophomore laboratories.

President Tom Popejoy, with the approval of the regents, instituted in 1955 a new policy allowing extra remuneration of faculty members having sponsored research. There had been for some time a rule that a faculty member should be able to consult for an organization outside the university provided that the time involved would amount to no more than one day per week. No notice was taken of the amount of money involved. Engineering faculty were not the only ones to take advantage of this, but were joined by faculty from such fields as, for example, geology, economics, sociology, and so on. This was thought to be comparable to the rewards received by faculty members of other departments, such as the humanities, as a result of profitable publication of books and articles. The new policy allowed that an additional remuneration of up to ¼ of a faculty member's academic year salary could be paid through the university if the sponsoring agency approved. Some did, some did not. For example, the Air Force Office of Scientific Research allowed additional payments during the school year, while the National Science Foundation would allow salary payments only during the summer. Los Alamos approved payment of a bonus for courses, which were considered part of the faculty member's departmental teaching load, taught at Los Alamos. This consideration together with generous expense allowances helped make the teaching program at Los Alamos as successful as it proved to be.

The arbitrary division of those who were rewarded and those who were not depending on the whim of the sponsor, even though the effort expended might be the same, led inevitably to unhappiness. The contracts for the physics department for 1963-64 marked the end of this policy. In addition to merit increases the new contracts incorporated an addition of 25% to the base

salary for all members of the department. The new plan was brought about through the joint efforts of Victor Regener and Hoyt Trowbridge, Dean of the College of Arts and Sciences, and was based on the assumption that the department would collectively be successful in obtaining sponsored research, the overhead from which would justify the higher salaries. The administration approved the plan with the proviso that it be reviewed after two full years of experience. The review must have been positive as no further mention was ever made.

NSF Physics Teachers Summer Institute, 1955

The summer of 1955 saw the first "Summer Institute for Teachers of Physics" directed by John Green with support from the NSF (National Science Foundation). This institute brought together high school and college teachers of physics with stars such as Hans Bethe, William Parker and George Pake. It had the goals of improving the training of teachers in the subject matter of physics, expounding the latest advances in physics, and fostering interactions between teachers of physics at the different academic levels. In connection with the program, an upper division course, "Physics for Secondary School Teachers," was added that could count for graduate credit in the College of Education although not for physics majors. This scheme has since been followed in a few other physics courses because of the conviction of the department that the subject matter of physics is best taught by physicists, but that it would be unfair to expect students outside of physics to compete in courses that are largely designed for aspiring professional physicists. The summer institutes continued with major emphasis on secondary school teachers under the sponsorship of the NSF with Dr. Philip A. Macklin of Miami University taking over the directorship and teaching function from 1957 through 1962.

Support for the department has frequently been forthcoming from nearby institutions and has been gratefully received by the department in furthering its instructional and research goals. In 1956 Los Alamos lent the department a 10-MeV betatron for use in the advanced modern physics laboratory and also a streak camera that was used by Jack Katzenstein to investigate wires exploded by sudden large currents. The betatron was housed in the Research Center Building, where the Computer Center was later located, because that is where the upper division laboratories were then located. This meant that the activities of the department were now spread over four widely separated locations on campus. The following year, the Sandia Corporation made a long-term loan to the department of a large quantity of surplus equipment, some of which found useful places in the advanced laboratories and in research work.

In 1957 Victor Regener resigned as chairman of the department, and went to NM Highlands University. This was the result in part of his refusal to follow the orders of the administration to muzzle Professors Roy Thomas and John Green, who were being injudiciously vocal in their criticism of some of the policies and actions of the administration. Such a clear-cut and forceful reaction had not been anticipated, so the new honorific title of Research Professor was created and bestowed on Professor Regener after his resignation as an expression of the administrations' genuine appreciation of his valuable services to the university. There followed a period of some uncertainty, sometimes referred to as the “Interregnum”. Despite this, however, the department continued to grow with John Breiland as acting chairman for 1957-58 and again in 1961-62, Christopher Leavitt as acting chairman for 1958-60, and Walter Elsasser as chairman for 1960-61. Finally, in 1962, Professor Regener agreed to resume the chairmanship and remained in that position until his retirement in 1979, after having served as Chair for an astounding 27 years! Some tributes to him can be found at the following link
http://physics.unm.edu/pandaweb/history/regener.php

Space for the lower division laboratories, which were still on the second floor of the Administration Building, posed an ever-increasing problem until the completion of Regener Hall. In addition to the three large rooms that were used for laboratories, it had become necessary to block off the central portion of the hallway on the second floor to make an additional laboratory room. Equipment was also a continuing problem, and in 1958 the department was given a special allocation of $10,000 for the sophomore laboratories.

Having a sufficient number of graduate and teaching assistantships had also been a continuing concern of the department over the years. Although sponsored research does contribute to the financial support of some graduate students, the assistantships had been and continue to be a traditional and important means of encouraging and supporting graduate students. In addition, the graduate students gain knowledge and understanding that would be hard to come by otherwise as they grade tests for the various courses and even more as they teach in the undergraduate laboratories. The department at the same time has always realized the importance of having expert supervision of the laboratory instruction, particularly at the lower division level. Prof. Derek Swinson fulfilled this supervisory task from 1970 until a year or two before his retirement in 1995, when Prof. John Panitz and Mickey Odom took over these duties.

Liquid Scintillators: 1957

The wisdom of having the physics building placed on what was then the outskirts of the campus was clear in 1957 when Buildings and Grounds had plenty of space to erect a small building just north of the main building to house two ten-foot liquid scintillators in the form of a vertical telescope with provisions for water or lead absorbers being placed between them. Later three three-foot scintillators were placed in cabañas, each 30 feet from the scintillator telescope. All this was for Prof. John Green to carry out a number of investigations of extensive air showers in the cosmic radiation with the support of the Air Force Office of Scientific Research.

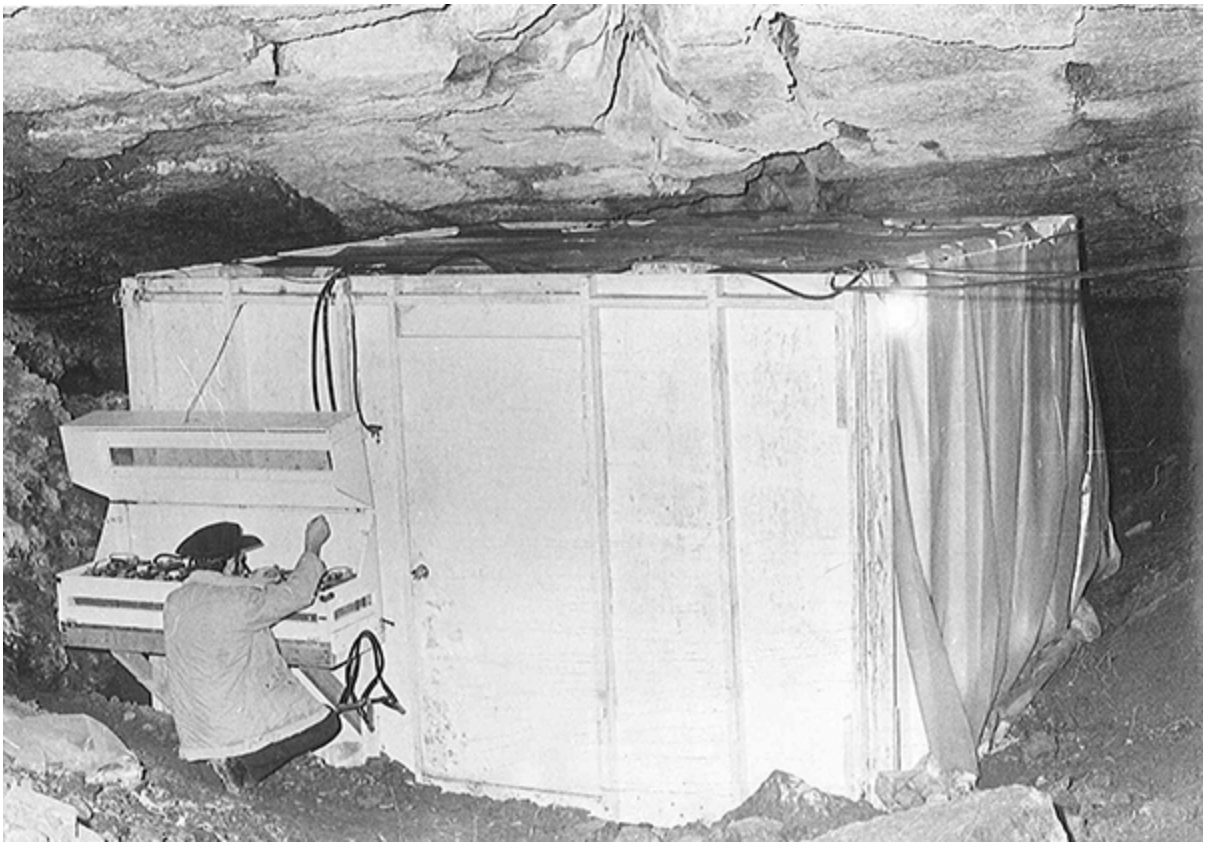
John Linsley's vehicle for Volcano Ranch and fellow researchers, 1950s-60s

There were further developments in the cosmic ray research in 1958. John Linsley came from Bruno Rossi's group at MIT in a cooperative venture with the physics department that involved establishing and running for many years a huge array of plastic scintillators at the Volcano Ranch west of Albuquerque for the purpose of studying extremely high-energy extensive air showers.

Bolivia Collaboration, 1959

Cosmic Ray Mine Experiment, Mt. Chacaltaya, Bolivia 1957-58

Also at this time cooperation was established with the Laboratorio de Física Cósmica de Chacaltaya in La Paz, Bolivia, whose director, Dr. Ismael Escobar, was Visiting Professor of Physics during the spring of 1959. James Kenney, who received his PhD from the department in 1957, represented the department and Professors Regener and Green by conducting a cloud chamber experiment on cosmic rays at the high altitude station on Mt. Chacaltaya in 1957-58 under the sponsorship of the International Geophysical Year and the National Science Foundation.



Embudo Cave (Sandia Mountains) Cosmic Ray (Muon) Station, courtesy Elliott Bailey

At the same time he set up an experiment in a mine using Geiger counters for a long-term investigation of time variations of the hard component of the cosmic radiation. Professor Regener later converted to plastic scintillators and with the help of Professor Swinson had a number of operating stations: on Chacaltaya from 1965 to 1994, in the Embudo Cave in the Sandia Mountains beginning in 1964, in Socorro from 1968, and in the Grand Canyon Caverns from 1979. These experiments concluded in 1984 in Grand Canyon Caverns and in 1995 for the others, prior to Professor Swinson's retirement that year.

The following link provides access to some videos (late 1980s & early 1990s, courtesy of long-time Building & Operations Manager Elliott Bailey) of summer and winter trips to the Embudo Cave and the Capilla Peak locations.

https://www.youtube.com/playlist?list=PLqHzgjCkpX3likbzOl3qwpgxHJAj6UiBk

Physics Outreach, 1958-1963

Following Sputnik, three new educational programs came in quick succession. In 1958-59 the department joined in the Continental Classroom TV course put on by the National Broadcasting System and the American Association of Colleges for Teacher Education. This was a nation-wide program called "Physics for the Atomic Age," and students in the College of Education could receive graduate credit by enrolling in Physics 152TV, viewing the programs and taking tests. In 1959-60, the Academic Year Institute for High School Teachers was started by Prof. Donald Skabelund and then continued through 1963 by Prof. Howard Bryant. The department also cooperated with the Sandia Corporation in implementing its Technical Development

Program. Two new courses at intermediate level, "Atomic and Nuclear Physics" and "Physics of Matter," were developed and continued for several years in support of the program.

In 1960 Professor Leavitt made a formal request in his annual report as acting chairman that the teaching load be reduced from 12 to 9 hours each semester. This was not a matter that could be settled offhand by the administration of the university since the Board of Educational Finance and possibly even the State Legislature would also be involved. Eventually formulæ were worked out so that a more realistic appraisal was made of the time spent by faculty members in generating and carrying out sponsored research, which does produce considerable overhead for the university, and in supervising the thesis and dissertation work of graduate students. Typical of this period was 5000 student credit hours for the year and 70 graduate students with seven faculty members! Added to the regular load were the special programs. For example, in the summer of 1962 five hours were offered for the Radiation Biology Institute sponsored by the NSF and the Atomic Energy Commission, while during the 1962-63 academic year there were 15 hours offered for Sandia's Technical Development Program, eight hours for the Academic Year Institute for High School Teachers sponsored by the NSF, and 25 hours of upper division and graduate work at Los Alamos, of which seven hours were taught by faculty of the department.

Physics merges with Astronomy, 1963

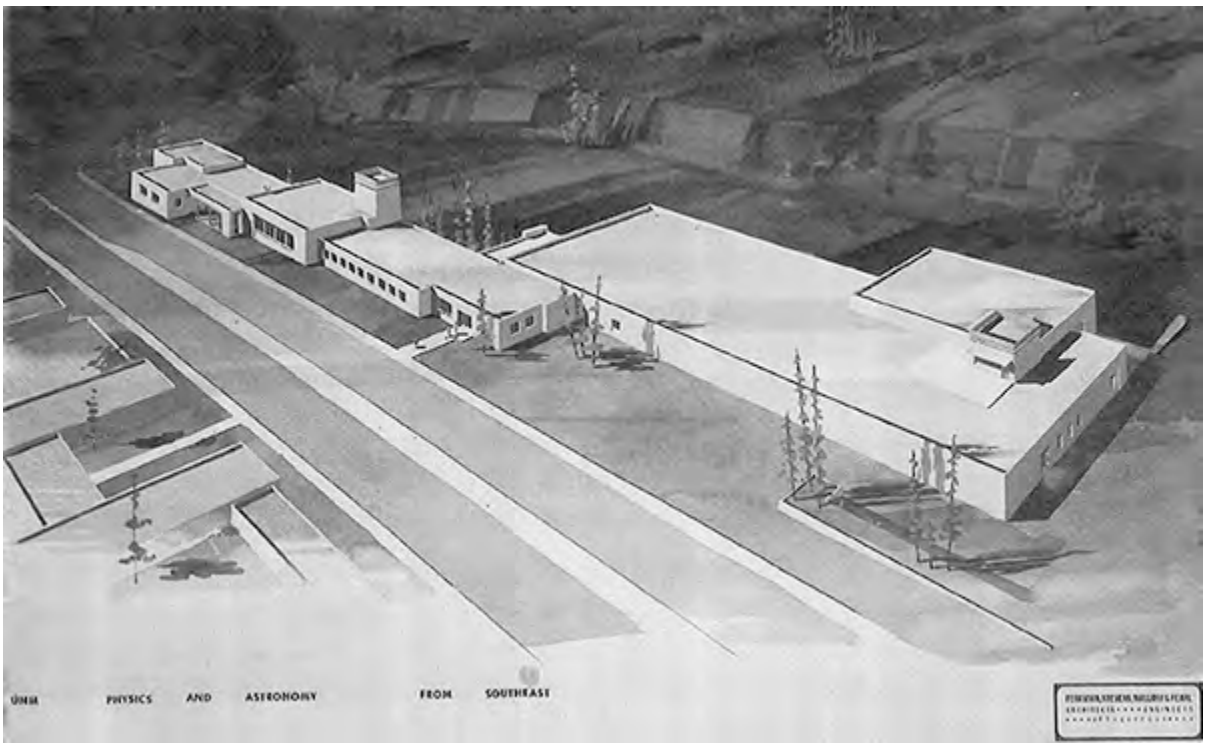
There were other big changes in 1962-63 because at that time the department took over from the Department of Mathematics all responsibilities for astronomy and so became the Department of Physics and Astronomy. Included in the transfer was the observatory to the northwest of the physics building. In addition to serving for research purposes and as a laboratory for astronomy classes, the observatory allowed Prof. David King to develop the popular Thursday night open house for viewing by the general public. (In the 1980s this open house was changed to Friday night.) The 1963-64 catalog lists for the first time a new major and minor in astronomy and physics in addition to the long standing major and minor in physics. This was later changed in 1967-68 to a major and minor in astrophysics, with the first BS in astrophysics being awarded in May 1975.

A new program of the Sandia Corporation (started in 1962-63 and still continuing), and later continued by Sandia National Lab, offered seed money to faculty members to help them get started in new lines of research. Prof. Christopher Leavitt took advantage of this to start a program to measure the neutron albedo at balloon altitudes that was later taken up by the National Aeronautics and Space Administration. Prof. John Green switched fields in starting a new program to investigate various physical properties of plastic solid organic crystals that was later funded by the National Science Foundation. Prof. Charles Beckel obtained a start in two programs for studying ionized diatomic molecules that was later funded by the National Aeronautics and Space Administration and indirectly by the Air Force Office of Scientific Research. Prof. Seymour Alpert received money to start a project on the scattering of light that was picked up by the National Science Foundation. Much later, in the1980s, there was support for Prof. Nebojsa Duric for his work on image processing, for Prof. Sudhakar Prasad for work on nonlinear optics, and for Prof. Bernd Bassalleck for experimental work in Strangeness Nuclear Physics, among other recipients over the years.

In 1962-63 the department also began participation in the Visiting Scientists Program in Physics that was sponsored by the National Science Foundation. Faculty members were given travel money and a small honorarium to go to different high schools in the state for a day in an attempt

to make students aware that there was such a subject as physics and possibly to interest some of them in studying it. This program continued for two more years.

Physics Building Extension, 1963



1919 Lomas NE Extension, 1963

1963 was the year in which application was first made for the extension of the physics building. Eventually in 1963-64 the National Science Foundation gave the department a grant of $350,000 to help in the construction of a Graduate Level Research Building that in all wound up costing $1,060,599. While negotiations were going on there was some talk of offering the department a location for a new building on part of old Zimmerman Field about where Ortega Hall now stands. Such a central location would have much to make it attractive. It was finally decided, however, simply to add the new building on to the old one north of Lomas Boulevard in part because it was clear that it would be easier to obtain outside funding support for a graduate research building than for a general physics building. This again proved to be a wise decision. Shortly after the addition was completed, Victor Regener was able to erect just north of the new building his pyramid on top of which he located a parabolic antenna for receiving signals from balloon-borne apparatus to measure the vertical distribution of atmospheric ozone.

Prof. Howard Bryant's Solar Ponds

Later yet, Howard Bryant had lots of clear space to construct solar ponds for a study of their operation and characteristics. In addition to these practical considerations, the view from the faculty offices along the north side of the building was very pleasant. Furthermore for a number of years Howard Bryant and some of the graduate students had a productive vegetable garden just north of the east receiving dock. The view started with the nearby Campus Wash with its natural greenery and abundant wildlife, next came the golf course, and it ended with a practically unobstructed view of the Sandia Mountains in the distance. As time went on, however, the continuing expansion of university medical facilities obliterated more and more of this once-fabulous view until in 2006 it no longer existed.

New Research, 1964

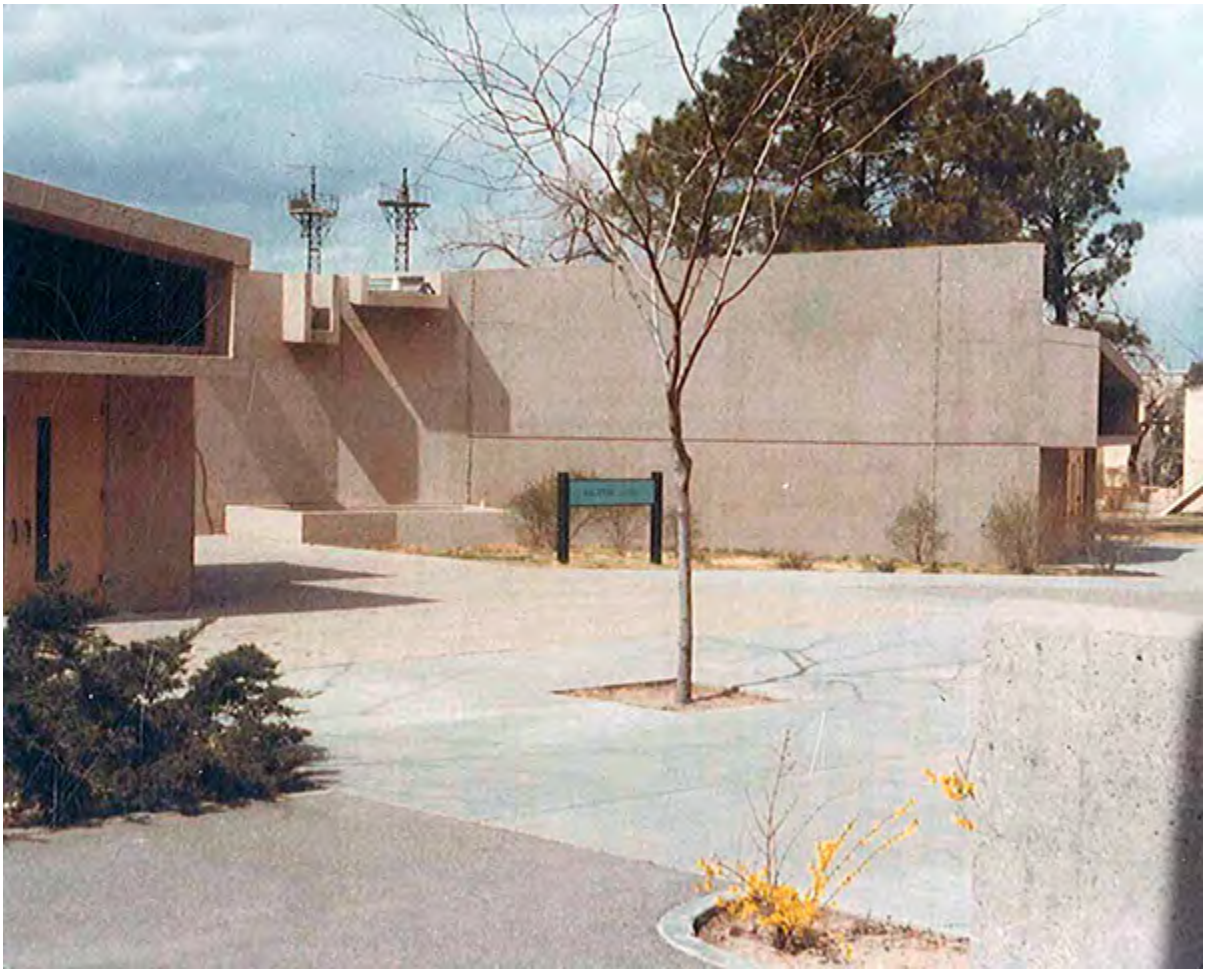
The department hosted the International Ozone Symposium on August 31 to September 4, 1964. Also at that time an addition to the faculty, John Howarth, introduced an entirely new line of research involving the effects of radiation on animals. The completion of the addition to the physics building in November 1965 increased greatly the room available for research projects. For a number of years the department had been requesting increases in faculty to handle the increasing load of special courses that were being added to the normal course offerings as well as to allow the faculty to carry out the many research projects that were underway. Authorization for increasing the number of positions obtained in 1963-64 together with the space now available for research led to a further rapid growth of the department. Derek Swinson came to add to the research in cosmic rays, David King brought new areas of research in astrophysics, Colston Chandler and Charles Beckel strengthened the theoretical arm of the department, and Alan Peterson returned to the department to undertake, among other studies, research using the 24-inch astronomical telescope that had just been installed at Capilla Peak with the help of the National Science Foundation.

Further additions to the faculty over the next few years included A. G. D. Philip in astronomy, Seymour Alpert then in physical optics and later in the energetics of animal bodies, Philip Campbell with radiative transfer of energy, Mohammad Shafi in geomagnetic field studies, Charles Hyder in solar, astrophysical and environmental studies, and James Daniel Finley III in

general relativity. Harjit Ahluwalia, who had been at the Laboratorio de Física Cósmica at Mt. Chacaltaya since 1962 and who was its scientific director from 1965 through 1967, joined the department in 1968. Another appointment during this time was that of John Evans as adjunct professor. This marked the strengthening of cooperative relations between the department and the observatory at Sacramento Peak. During this period, with all the additions to the faculty, there was extensive overhauling of the physics curriculum with many additions and much strengthening of the programs in astronomy, astrophysics and space physics.

Regular weekly colloquia, in addition to seminars and occasional public talks started in 1971.

Regener Hall, 1972



Regener Hall at the University of New Mexico

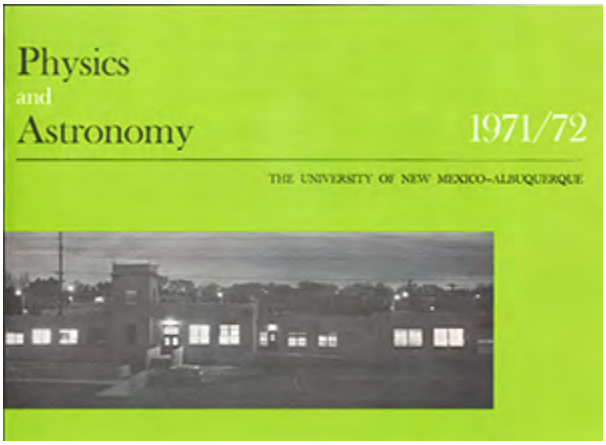
The new physics lecture and laboratory building, later named Regener Hall, was built during the 1971-72 school year, and was first put in use in the fall of 1972. The lecture hall, thanks to the insistence of the department, wound up with excellent acoustics. Even though it is one of the larger halls on campus, seating 300 students, there was a time of swelling enrollments in engineering that strained its capacity and eventually required doubling the lectures for the beginning courses. The new underground laboratories proved very successful with their controlled environment, although at first the prospect of having the rooms completely underground had little aesthetic appeal. However, again the insistence of the department that the underground corridor be spacious and that the stairways be generous in size resulted in very pleasant surroundings. Thus it was that the lower division laboratories, with the enthusiastic

concurrence of the administration, at long last moved out of the quarters they had occupied in Scholes Hall since 1935.

One of the features of the new building is the large area for storing and preparing demonstrations. As was mentioned earlier, the department has always been convinced of the importance of demonstrations. Professor Regener was very strong in this belief, and over the years he designed and had built many large and striking demonstrations. Another unusual feature was the installation of a heliostat that allows projection of the solar disc or the solar spectrum in the lecture hall.

Shortly after Regener Hall came into use, the department developed a whole new grouping of courses under the heading "General Interest Courses in Physics and Astronomy" that are open to any interested student and that have no prerequisites. This group has come to include introductions to astronomy, physics, and musical acoustics, meteorology (no longer offered), light, and a two-semester course dealing with physics and society, later reduced to a one-semester course. Except for the course on physics and society, all of the others have associated optional laboratories that have been especially designed to arouse the interest of the students. For many years Chuck Williams oversaw all the equipment for those various labs as well as the demonstration apparatus in Regener Hall. He had been hired initially by Victor Regener as an ombudsman.

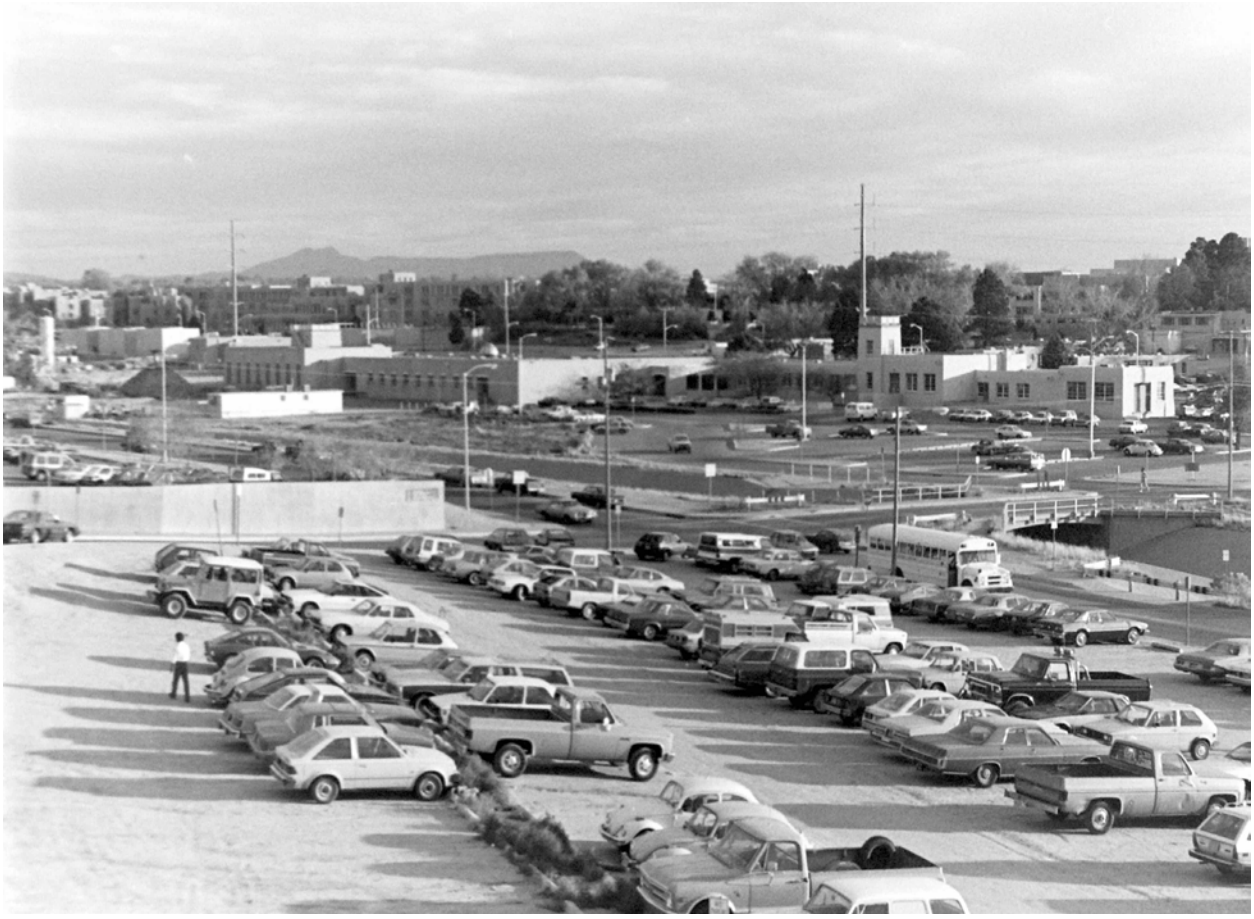
New faculty, 1970s



Meanwhile new additions were made to the faculty. Byron Dieterle and David Wolfe strengthened nuclear and particle physics. William Davey was a visiting professor in astrophysics for one year. Lois Kieffaber, who received her PhD in physics from the university in 1973, in addition to carrying out research in zodiacal light and airglow, became a most effective teacher, especially in the lower division courses. Michael Zeilik not only added to the astronomy contingent, but also was active in developing new concepts in teaching astronomy with the sponsorship of the National Science Foundation. John Linsley regularized the connection he had had with the department for many years by becoming a research professor. McAllister Hull (who had participated in the Manhattan Project at Los Alamos during WW II) came in as a professor of physics and also as provost of the university. Claude Amsler became a research assistant professor specializing in particle physics. David Clark became a research associate professor and Gerald Stevenson became an adjunct professor of physics with both of them specializing in nuclear physics.

In 1978 the approaching retirement of Professor Regener in 1979 caused the department to undertake an extensive search for a new chairman. Since it was a department of physics and astronomy, it seemed only fair to advertise for either a physicist or an astronomer, although with the size of the physics program outweighing that of astronomy, expectations were that it would be a physicist. That proved to be an incorrect expectation because the department chose R. Marcus Price, an astronomer then at the headquarters of the National Science Foundation, to be its next chairman.

Departmental computer with paper tape reader, late 1970s.



The Old P&A Building before the UNM Hospital Expansion immediately to its east

National Lab Collaborations

One of the main factors that helped in building the physics department has been the vicinity of Los Alamos and Sandia National Laboratories, and Kirtland Air Force Base. The generous cooperation and assistance of these organizations has made available to the faculty and students of the department a wide range of experimental facilities that even a large, wealthy university could scarcely afford. As examples, David King made extensive use of the Los Alamos computers, while Charles Beckel used the computers at Kirtland, Los Alamos and Sandia with papers resulting that were coauthored by researchers at the latter two organizations. Byron Dieterle, Christopher Leavitt, David Wolfe and Howard Bryant were all active at Los Alamos with various experiments in nuclear and particle physics. John Green and Christopher Leavitt were involved in experimental work at Kirtland and Sandia that was used for purposes of theses and dissertations. The formation of the new Institute for Modern Optics was facilitated by the existence of cooperative work with Kirtland, Sandia and Los Alamos.

More distant laboratories have also been utilized. Here important examples are the case of David Wolfe and Bernd Bassalleck (hired at the beginning of 1982), carrying out experiments in nuclear and particle physics at the Brookhaven National Laboratory on Long Island, NY. Even farther away, David Wolfe and Bernd Bassalleck were also involved in research programs at CERN in Geneva, Switzerland. The astronomers also were not idle. Marc Price, Jack Burns, Michael Zeilik and Charles Hyder were making extensive use of the facilities at Sacramento Peak, Kitt Peak, the Very Large Array Radio Telescope, and even the observatory at Cerro

Tololo, Chile. As well, all the astronomers made extensive use of the computing capabilities at Kirtland and Sandia.

Institute for Modern Optics, 1980

A major development occurred in 1980 with the formation within the department of the Institute for Modern Optics (IMO), under the founding directorship of Marlan Scully. He had been lured to UNM from the University of Arizona, at least partly with this promise and prospect of the IMO. The IMO proved to be extraordinarily successful in obtaining funding to maintain a high degree of activity in various fields of modern optics. Around 1983 an offshoot of the IMO began its operation, the Center for Advanced Studies (CAS), a center that would prosper for many years to come, under various directors. The CAS initially focused on various aspects of modern/quantum optics, as had the IMO. With the establishment of UNM's Center for High Technology Materials (CHTM, see below) in 1983, the members of Marlan Scully's initial IMO group got to choose between membership in CHTM and CAS. Because of the provisions for joint appointment with the department, the IMO brought in many new faculty members and research staff such as Gerald Moore, Weng Chow, James Small, William Sweatt, James Harvey, Kenneth Jungling, John McNiel, John Bellum and Jack McIver. In addition a large number of research associates and research scientists became associated with the department, partly because of expansion of the department's own research efforts.

The department also continued to grow with regular academic appointments of astronomer Jack Burns (1980), theoretician Kevin Cahill (1981) and experimental nuclear & particle physicist Bernd Bassalleck (1982).

Colloquia and Lecture Series, 1980s

The relative isolation of the physics department, especially in previous years, led the department to sponsor a colloquium series to bring in speakers whose expertise lies in a wide variety of fields so that the graduate and even undergraduate students would have the opportunity of hearing of advances in different fields. A further extension of this idea was the Distinguished Lecture Series, sponsored jointly by the University and Sandia National Laboratories, in which distinguished scientists were brought to the university to give a general presentation of their research specialty for the public as well as more technical talks for the scientific and student communities. These programs proved to be very successful as shown by the fact that in 1981-82 there were 45 speakers at the weekly colloquium series and two speakers in the Distinguished Lecture Series, Dr. Peter Van Nieuwenhuizen and Nobel Laureate Dr. Martin L Perl.

The department continued to sponsor scientific meetings. The 157th meeting of the American Astronomical Society was hosted by the department in January 1981 with some 600 astronomers from the United States, Canada and Mexico in attendance. This was followed by a two-day meeting in the spring of 1981 of the Southwest Regional Conference on Astronomy and Astrophysics. Some 300 astronomers from all over the world attended the Symposium #97 of the International Astronomical Union in August, 1981. In the spring of 1984 the Institute for Modern Optics with the assistance of the Center for High Technology Materials sponsored two conferences on the foundations of statistical physics; the first, a two-week updating course, and the second, which was held in Santa Fe and sponsored also by NATO, attracted experts from all over the world. In 1990 the AAS met again in Albuquerque, with UNM as host.

CHTM (Center for High Technology Materials, 1983 and beyond) and OSE (Optical Science & Engineering) PhD Program (1984 and beyond)

UNM's Center for High Technology Materials (CHTM), housed on South Campus, was first established as one of five Centers of Technical Excellence (CTE) by the New Mexico legislature, with an initial infusion of approximately $10M in funding that was spread over the years from 1983 to 1988. Its initial research focus was set as high-power laser diodes, but over the years and decades its research program broadened significantly and the center grew substantially. From its inception CHTM has maintained very active contact with researchers in this department. In 1986 the center began a regular program of supporting several new graduate applicants for the department's optical science PhD program. This PhD program represented a very important development for the department. In fall of 1984 final approval by the Board of Educational Finance was received for the PhD program in Optical Science & Engineering (OSE). The program had already been attracting graduate students since the establishment of the Institute for Modern Optics in 1980. The degree has been offered since the fall of 1985, and has remained one of the most important and successful components of P&A's graduate programs.

The Center for Advanced Studies, 1985

In 1985, the Center for Advanced Studies (CAS) was re-vitalized by its director, Marlan Scully. Although research in the CAS at that time was concentrated primarily in theoretical optics and lasers, there was also interest in general relativity, the theoretical foundations of quantum measurement theory, and some connections with medieval history and poetry via the departments of English and Philosophy. The CAS was an extremely active participant in the departmental colloquium, seminar, and visitor program. During its existence the CAS averaged over 30 visitors a year. Quite a few of these spent considerable time in the department, giving series of seminars on special topics, including Nobel Laureate Julian Schwinger and David Pines.

Institute for Astrophysics, 1985

A 230-ton Very Large Array radio antenna

In a similar fashion, the growth of research in astrophysics led, in 1985, to the establishment of the Institute for Astrophysics. Although the institute consisted only of members of this department, it coordinated much work being done at a large number of observing locations, facilitated interactions between the department and researchers elsewhere, and was an important partner in the task of establishing new observing facilities in the state and implementing usage of the ARC consortium telescope due to come on line in 1990 (the principal local user being NMSU). The location of the VLA (Very Large Array radio telescope) in 1975 and later of the VLBA (Very Long Baseline Array) facilities near Socorro were important factors in this growth.

The membership of the institute was furthered by the hiring, in 1986, of Nebojsa Duric and Belva Campbell. Prof. Duric had been very instrumental in working with the department's Capilla Peak Observatory. Prof. Campbell was particularly interested in those astronomical situations that arise at the birth of new stars. Both of these additions were very interested in observations made at the VLA. Prof. Campbell added an extra distinction to the department, being its first female regular faculty member.

In addition, the revenues from state bonds earmarked for research and instructional equipment at the universities were used to update instrumentation in areas of research such as atomic physics and intermediate energy particle physics. Another important use of these revenues was upgrade of equipment in the instructional laboratories, especially at the junior and senior level. There was still one major continuing problem with these laboratories in that no provision existed for technical support in setting up, maintaining and troubleshooting the experiments. All of this had always been done by the professor in charge. In view of increasing demands on professorial time for instruction and research, the demand grew for adding a technical staff member to handle these aspects. The department managed to effect significant upgrading and extension of computer terminals for both faculty and students in using the main campus computer facilities.

Albuquerque Public Schools Collaboration, 1983-84

Over the years the department showed a continuing interest and involvement in science education at all levels. In addition to the Visiting Scientists Program and the many institutes for teachers of physics discussed earlier, individual members of the department were active in visiting science classes in the Albuquerque Public Schools. In 1983-84 a new program of enrichment lectures and visits to science classes was instituted with the Albuquerque Public School System as well as cooperative work to develop proposals and programs for in-service updating in science developments and for teacher cross-training.

Within the university the department had long been aware that many of the students in beginning physics needed special help in learning how to solve problems and in understanding the principles of physics. The latest attempt to address this problem was the establishment of the Tutorial Center in Regener Hall in 1980. Faculty members were devoting many hours each week in support of this program. In 1984 the program was abandoned, primarily because there seemed to be no official recognition in terms of teaching load of the time spent on the program. However, the Tutorial Center was re-opened in the fall of 1987. The department also again tried to make its degree programs more available to students working full time by offering each semester one of the required intermediate courses after 4:30 pm. But again, any gain was more than offset by the inconvenience to regular students as evidenced by losses in enrollment, so regular scheduling was resumed. More successful was the scheduling after 4:30 pm of many courses that would be interesting to the local scientific community, including most of the advanced optics courses.

Departmental Retreats Begin, 1982

With an almost explosive growth of the department and the complexity of its operations, Professor Price thought it would be good to begin a series of departmental retreats. The day-long meetings allowed extended discussions of many issues concerning the department's development that were not possible in the shorter faculty meetings held during the year. The first of these was held in May 1982, on the campus of St. John's College in Santa Fe, the second in May 1983, at

the South Golf Course, and the next several again at St. John's College, followed by the Bishop's Lodge in Santa Fe.

Drawing by Prof. Howard Bryant of P&A Faculty Retreat in 1986

The increased size of the department brought a large increase in administrative chores. The efforts of Professor Finley in assisting to carry out these services for the two previous years were finally recognized officially in 1983, when he was appointed Associate Chairman of the Department. When Professor Price agreed to become Associate Vice President for Academic Affairs, in July 1985, Professor Finley was selected to take over the chores of the chairmanship.

Campus Observatory

Already in the mid-1980s one of the pressing needs of the department for the near future was the construction of new space, both for increased space for graduate and faculty research, and for a new campus observatory. Student enrollment in courses involving observing was greatly restricted because of the limited facilities of the existing observatory. Even worse was the interference to good seeing presented by the street lights and the lights of the parking lots which by then surrounded the observatory. The observatory at Capilla Peak was upgraded under the direction of Professor Zeilik which greatly enhanced the capabilities for extragalactic astronomy. In 1986 a technical support person for the observatory was officially appointed, in the person of Tom Williams. In 1989 this support person was picked up by the university in the form of a state-budget line item for the Institute for Astrophysics.

Optics Research

The upsurge in activity brought about by programs of the Institute for Modern Optics and by expanding programs within the department itself made existing office and research space of the P & A building quite inadequate, even though every effort was made to utilize as effectively as possible the available space. An additional wing was requested for the building, but there was pressure to have Physics and Astronomy join other science and engineering departments in the southwest quadrant of the campus. In 1986, with the hiring of Jean-Claude Diels, a world-renowned expert in femtosecond laser technology and its applications, the department finally began to be able to expand its optics activities more seriously into the experimental regime.

Just prior to that, Jack McIver had decided to take the need for experimental activities into his own hands. Even though his training had been in theoretical optics, he opened a laser laboratory for student training. (Professor McIver had originally come to UNM as 2/3 postdoc and 1/3 faculty, but was officially hired as a regular faculty member in 1984.) In 1988, the department

hired Daniel McGraw, also working in experimental optics with dye lasers. As well, in 1988 the department was able to move John Panitz from his many years of established research in surface physics and high-field ion-microscopy at Sandia National Laboratory to UNM. Although Professor Panitz brought with him quite a legacy of expertise and equipment, the department's space problem hit a grinding "crunch" at that point. Happily, the building had originally been planned (by Chairman Regener) with a large basement for storage. The department, with significant financial support by the Dean, spent the fall semester (and a portion of the spring) of 1988 converting this basement into new laboratory facilities for Professors Panitz and McGraw (astronomy). Prof. Panitz's lab, including its high-quality lab furniture, was ultimately taken over by Research Prof. Paul Schwoebel when Prof. Panitz retired in 2004.

(There had already been three medium-size laboratories created in the original basement area back in 1982-3. In 1988 two of those laboratories were being used by Professor Diels for experiments in laser optics, with the other being used by Charles Beckel for work on the effect of simultaneous electric and magnetic fields on living cells.) Nonetheless, the department's need for space remained preeminent among all of the items on its list of needs and wants.

The department was also able to add faculty with expertise in theoretical optics. In 1985, when John Bellum left the university for industrial opportunities, Sudhakar Prasad was hired as a beginning Assistant Professor, with an extremely varied set of interests, including nonlinear optics, squeezed optical states, hydrodynamics, and quantum field theory. In 1986, when Weng Chow also left the department for industrial opportunities, Wilhelm Becker was hired, as an Associate Professor, with a distinguished background in theoretical calculations in very-high-field quantum electrodynamics, especially as applied to laser physics.

Visiting Faculty, mid-1980s

The department was able, beginning approximately in 1983, to start having visiting faculty positions available, to spread out the teaching of departmental classes and to bring in outside expertise and experience for the mutual benefit of everyone involved.

- Professor Gyula Bencze from the Central Research Institute for Physics in Hungary was an early such visitor, returning several times, spanning a couple decades.
- In 1986, Professor Gerard Stephenson, from Los Alamos National Laboratory and long associated with the department, was able to spend a sabbatical-year visit with us.
- In 1985, Professor Jerzy Plebański from the Centro de Investigaciones y Estudios Avanzados del lnstituto Politecnico Nacional in Mexico City (and on leave from the University of Warsaw in Poland) visited for a semester and gave lectures in General Relativity based on questions from the audience; and the following year, Dr. Jerry Kristian, an expert in many aspects of observational astronomy came from the California Institute for Technology for a semester. He delivered a very interesting set of lectures on some of the observational foundations of our current understanding of cosmology.
- Dr. Janos Bergou, also from Hungary and an expert in laser theory, visited for 2½ years.
- Professor Krzysztof Wodkiewicz from Warsaw, Poland, had been visiting twice for a month and came in the fall of 1989 for a year, continuing to come after that every other year for a year.
- Miguel Orszag visited (and taught courses), coming from the University of Santiago, in Chile.
- Also in 1989, we had Professor Paolo Grigolini, an international expert in stochastic processes from the University of Padua spend the spring semester in P&A.

- During the fall of 1989, Professor Piskarskas from Lithuania visited and lectured on nonlinear optics.
- Professor Joel Fontaine, from France, spent the entire year 1990 in the department, and assisted with many aspects of the experimental laser optics program.

The department also contributed to visitors in reverse. Harjit Ahluwalia spent most of the calendar years 1986-88 as a program monitor at NASA, on leave from the department. Howard Bryant spent a year, in 1986/87, as the director of HIRAB (High Resolution Atomic Beam Facility) at Los Alamos National Laboratory, while David King spent 1988/89 and 1989/90 at the same laboratory, working on a project to better be able to adjudge the intensity of nuclear explosions, working with Los Alamos and Soviet scientists.

Industry Alliances, 1980s

The department had already established ties with local and national industries with the goal of having research assistantships, equipment, seed money for research, and support for faculty members provided by industrial partners. Support for one graduate student had already been given by three firms in Albuquerque: CVI Laser Corporation in 1982, Tetra Corporation in 1983, and International Laser Systems in 1985. In 1986 and 1987 Hughes Laser Systems made small donations for the use of the graduate program in optics. In mid-1988, in memory of a physicist working there, and an Adjunct Professor with the department, Tetra Corporation established an endowed scholarship for the department's use in honoring undergraduates who do exceptionally well in their courses of study. The proceeds from this Eoin W. Gray Scholarship are used each year (still ongoing as of 2021) to honor the best graduating seniors, who have elected to take "Physics Honors" in their senior year.

With the idea of finally beginning to become part of (and to take advantage of) the large quantities of local (laboratory) expertise in condensed matter physics, the department hired V. M. (Nitant) Kenkre in early 1985. Coming from Rochester University, Professor Kenkre was a recognized expert in transport problems in theoretical condensed matter physics and became quite involved in setting up collaborative efforts with researchers at Sandia and Los Alamos National Laboratories. He also brought with him continuing collaborations with faculty in several different countries of the world. An outgrowth of this was his establishment of the "nu" seminar series, a weekly seminar on some aspect of condensed matter physics (or other portion of physics with applications in this area) given by different visitors every week. During these years, the interest of condensed matter physics also brought Charles Beckel into serious work on special aspects of this area. His and Professor Kenkre's work on boron and boron carbides caused them to have a series of international conferences on this subject. In 1989, Professor Beckel's work (with collaborators David Emin at Sandia National Laboratory and others in California) was recognized by the Department of Energy as the very best work of its sort performed by any of its contractors during that year. In the fall of 1989 the department hired David Dunlap as an addition to the department's effort in theoretical condensed matter physics.

The department, together with the Institute for Modern Optics faced the future with every expectation and assurance of the growth and increasing quality of the various educational and research programs. Especially encouraging was the assessment of research-doctoral programs in physics in the United States made in 1982 by the Conference Board of Associated Research Councils. This study, sponsored by the American Council of Learned Societies, the American Council on Education, the National Research Council, and the Social Science Research Council,

rated our department third in the country in terms of the improvement achieved in its graduate programs during the previous five years.

In the same vein, the department underwent a graduate program review in the fall of 1987, under the auspices of the Office of Graduate Studies. The panel members were distinguished physicists and astrophysicists (selected with the help of the department) representing all major fields of effort within the department, and headed by Dr. Hermann Feshbach from MIT. Large quantities of data and descriptions were amassed by the department for the review committee. Their report was very promising, indicating that the department was in a state of transition. The introduction to the review states that

“Its goal is to become a first class research department. It has made a great deal of progress. Recent appointments to the faculty have been excellent. The quality of the graduate students has improved. Advantage has been taken of the existence of excellent federally funded research organizations in New Mexico. The academic administration should be congratulated on its perceptive support of the department. If these developments continue, the future of physics and astronomy at the University of New Mexico is very bright.”

As part of the university's Centennial celebration campaign, in 1988-89, the department had two inter-related activities. The first was a Physics and Astronomy Centennial Lecture Series, with a very distinguished list of visiting speakers, on subjects ranging from the (fairly) recent supernova explosion to the latest efforts in trying to understand information science, this last being delivered by Nobel Laureate Murray Gell-Mann. Along with Dr. Gell-Mann's series of talks, the department held its first-ever student reunion, with invitations out to all students who had ever received a degree (undergraduate or graduate) from the department. This reunion involved tours of the departmental buildings, the facilities at CHTM, talks by Dr. Gell-Mann, and a banquet, where there were over 100 in attendance, establishing it as a great success.

Front Office Staff & Prof. Finley (Chair at the time) around 1988/89

Moving into the decade of the 1990s

At the turn of the new decade Prof. Daniel Finley remained Chair. He had assumed this position in July 1985, and would remain Chair until 1991.

1990 was marked by several important scientific conferences being held in Albuquerque (primary P&A personnel in parenthesis):

International Workshop on the Structure of the H-ion (Prof. Howard Bryant)

Workshop on Aperture Synthesis Observations of Spiral Galaxies (Prof. Nebojsa Duric)

Foundations of Quantum Mechanics (Prof. Marlan Scully)

Annual Summer Meeting of AAS, the American Astronomical Society, attended by approximately 1000 astronomers (Prof. Harjit Ahluwalia).

During the 1989/90 academic year our departmental staff started a nice new tradition. Individual faculty were invited to give a talk and/or slide show at a monthly luncheon meeting, on topics from research to travel. This was found to be a very good approach to building better communication and to having a more personal rapport with the individual faculty members.

The department embarked upon a new public school outreach program, involving meetings with high school (and middle school) physics teachers, encouraging them to make better use of departmental resources (equipment, materials, knowledge and time).

The tradition of the department having its own Convocation ceremony (on UNM's Commencement day) had been started in spring of 1989, and has continued ever since. Each year a speaker is invited to give a short address, usually someone from outside the department or even UNM.

During 1989/90 collaborations in experimental condensed matter physics developed with two Sandia National Laboratory staff members, Dr. Robert Duncan (low temperature physics), and Dr. Paul Schwoebel (microscopy, collaborating with Prof. John Panitz). Both would later transfer as faculty members into P&A.

In 1990 Prof. Marlan Scully received the Elliott Cresson Medal, in a ceremony at the national memorial to Benjamin Franklin in Philadelphia. The medal is one of the oldest and most distinguished American awards for achievements in science and engineering, and cites Dr. Scully "for his theoretical study of lasers, his contributions to many-body theory, general relativity, and to biological engineering."

In the late 1980s overall enrollment (undergraduate service courses, undergraduate major courses, and graduate courses) was relatively stable, with a slight increase in Student Credit Hours, not including summers, from below 14,000 to about 15,000. Hidden within this slight increase were dramatic increases of around 45% for upper division major courses and graduate courses. During the decade of the 1980s the number of graduate students enrolled in the department nearly doubled, reflecting greater availability of funding for assistantships and an improving departmental reputation.

Special efforts were made to lessen the attrition rate between the sophomore and junior physics courses. The first two junior courses, Physics 301, Heat and Thermodynamics, and Physics 303, Analytical Mechanics, instituted one-hour weekly problem sessions. This proved to be successful enough to later be implemented in all core 300 and 400 level courses.

Already by the end of the 1980s it seemed impossible to compile a Departmental Annual Report not pointing out that the department was critically short of space for offices, research labs, and for instruction. And yet it would take until 2018 (!) for the construction of a new building to

start! Countless hours were spent by multiple successive Chairs negotiating with and pushing UNM's upper administration to recognize our needs and make a new building a high enough priority for the university. Over several decades various temporary remedies were implemented to help with the space needs. For instance, by early 1991 two double-wide (28ft x 60ft, each) trailers, already well comported for offices, were acquired and attached directly to the eastern end of the building.

In the early 1990s, in the context of construction for the SSC (Superconducting Super Collider) having begun in Waxahachie, Texas, the department decided on a significant expansion in the area of experimental particle physics. Jointly sponsored by UNM and LANL (Los Alamos National Laboratory), a proposal for the "New Mexico Center for Particle Physics (NMCPP)" was compiled. It officially started in 1991, with financial aid from the Texas Accelerator Commission and a Personnel Loan Agreement with LANL. During the same year three new faculty members were hired in this research area, one at the senior level (Prof. John Matthews), and two junior (Profs. Sally Seidel and Michael Gold). Significant initial salary support for all three was provided by LANL, as well as some travel support. While various successful collaborations with LANL and by the NMCPP survived for many years, even decades, the SSC was of course ultimately canceled by the US Congress in 1993.

During 1989/90 Prof. Jack Burns, who had been at UNM since 1980 and was the founding director of the Institute for Astrophysics (IfA), decided to accept the offer of the Chair of the Department of Astronomy at New Mexico State University, a considerable loss for the department.

Another identified departmental faculty need in the area of experimental optics and its applications to semiconductor technology, biophysics, and spectroscopy was filled during the 1990/91 academic year with the arrival of Prof. Wolfgang Rudolph from the famous optics laboratories in Jena, Germany. This represented a significant addition to our experimental optics program.

Additional staff hires (funded by various sources such as state, overhead return, extra departmental funding, and outside research funding) resulted in a graduate secretary to handle all aspects of that program, a maintenance person to handle the servicing of the department's far-flung stations (two cosmic ray telescopes, one in a mine near Socorro and one in a cave at the top of the Sandia Mountains, and our Capilla Peak Observatory in the Manzano Mountains), a new machinist, and by 1991 also a new electronics design technician to support several new faculty hires in experimental physics & optics areas. Supporting all these staff positions entirely out of state funding remained a priority for years and multiple Chairs.

By 1990 the number of B.S. degree recipients had reached the level of about one dozen per year, a number considered quite reasonable for our department.

During 1990/91 two conferences involved P&A faculty in leading roles: the 37th International Field Emission Symposium, sponsored jointly between UNM and SNL, co-chaired by Prof. John Panitz, and the conference On the Foundations of Quantum Mechanics, co-sponsored by the Office of Naval Research and UNM, and chaired by Prof. Marlan Scully.

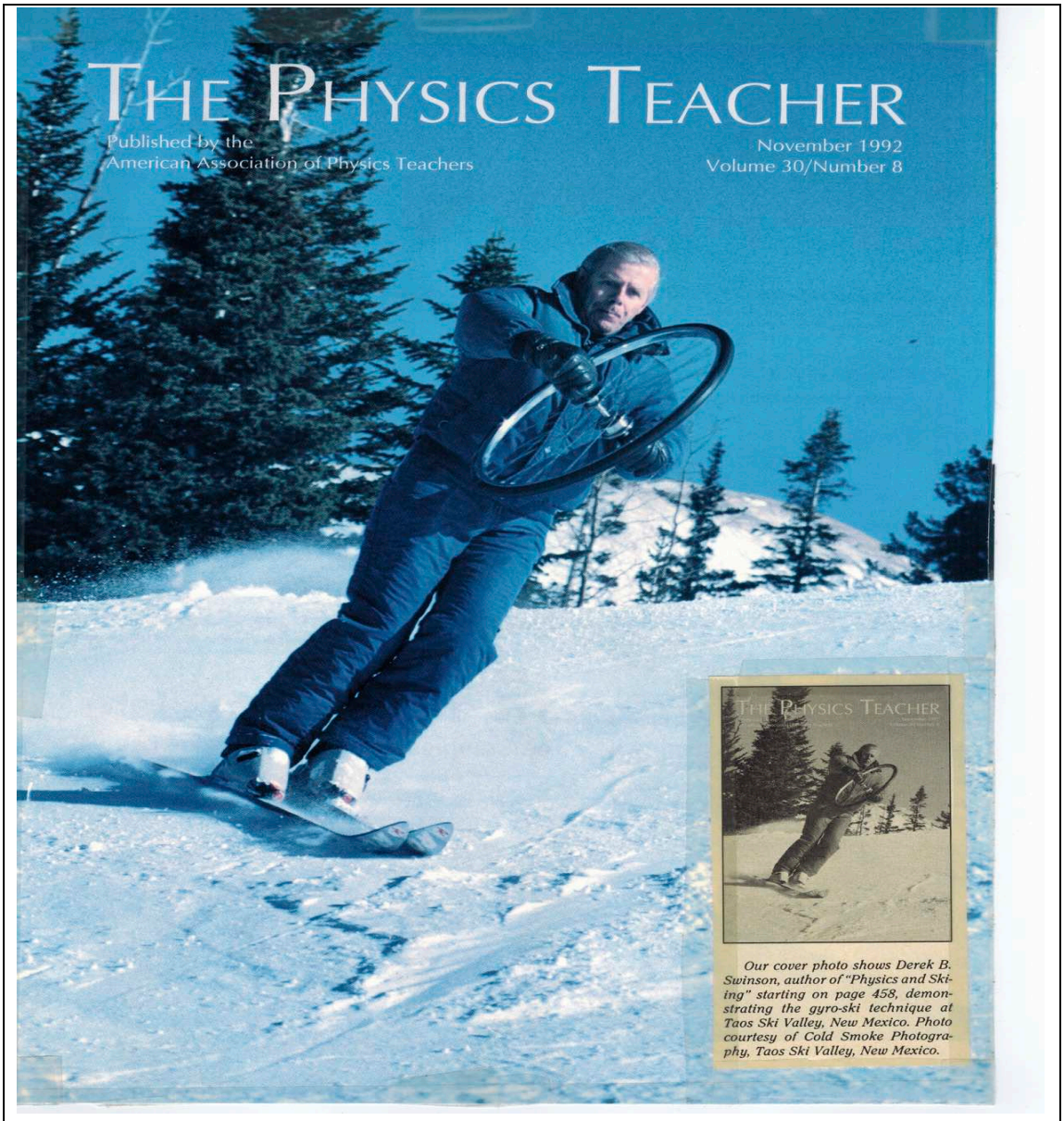
During the summer of 1991 Prof. David Wolfe took over as Chair from Prof. Daniel Finley, who had served since 1985. Prof. David Wolfe would serve until 1997.
The undergraduate advising scheme was changed in such a way that physics majors now had to consult with their advisor each semester before being able to register for the next semester.

Apart from the two aforementioned double-wide trailers, attached to the eastern end of the building in early 1991, UNM received a report from Architectural Research Consultants, Inc. and the UNM Department of Facilities Planning, concerning the space needs of all the science and

engineering departments on campus. Perceived locally and in a comparison with models established by the University of California system, the percentage increase in space required by P&A came out to be the second highest, among the 9 departments under consideration by the survey. On the university's "Capital Projects List" a projected need for a $10 million addition of “a major research complex for graduate level programs in physics" and a $1.5 million "new updated observatory located on North campus" showed up. Needless to say, neither materialized.

By 1991 the department had reached 30 FTE tenure-stream faculty. Even at that size the feeling among the faculty remained strong that not every branch of our science could or should be represented in the department. Over the previous few years research and recruitment efforts had been primarily aimed at four fields: astronomy, optics, material science, and experimental particle physics. In several of these areas synergy with activities at our two national labs featured prominently.

During 1991/92 Prof. John McGraw, previously at the Steward Observatory of the University of Arizona, was hired as the new director of the IfA (Institute for Astrophysics). The Center for Advanced Studies (CAS), still under the leadership of Prof. Marlan Scully, had achieved certain national and international renown in theoretical areas. In spring 1992 the department attracted Prof. Carlton Caves from USC, specializing in quantum optics and quantum information theory.



Prof. Derek Swinson demonstrating the "gyro-ski" technique at Taos Ski Valley

During the departmental commencement the Durward Young, Jr. Award for the best Ph.D. dissertation was awarded for the first time (by the mid 2010s, after its endowment was depleted, it became the "Chair's Award", supported by the Chair's discretionary account).

Total student credit hours (undergrad & grad, not including summer) remained around 15,000.

During the same year (1992) an electronics shop was started, and the department instituted its own accounting system. This was triggered by inadequacies in several services that should be provided by the administrative side of the University, leading for instance to financial losses to the department. This departmental accounting system finally allowed real time checks on expenditures, prevent over-expenditures, and plan budgets in a rational manner. One and a half staff positions continued to be supported by overhead return funds due to a shortage of state money.

By 1992/93 funded research had grown by approximately 50% over just a couple of years. Main emphasis continued to focus on the following major research areas and centers: the Institute for Astrophysics (IfA), Optics and the Center for Advanced Studies (CAS), the New Mexico Center for Particle Physics (NMCPP), and Condensed Matter Physics.

During 1992/93 the IfA was reorganized under the leadership of Prof. John McGraw. The concept of high-resolution astronomy was chosen as the major area of specialization for the institute.

Following the departure of the founding director of the CAS, Prof. Marlan Scully, to Texas A&M, Prof. Carl Caves assumed the directorship of the CAS, broadening its horizons and widening faculty participation in the center. This also led to more overlap with research done at the Santa Fe Institute.

Partly due to the tremendous start-up expenses our department has historically not engaged much in experimental condensed matter physics. On the other hand, our national labs in NM have traditionally invested vast sums in superb equipment for this work, resulting in facilities unmatched anywhere else.

DYNAMX (1990s):

During 1992/93 a collaboration began with Dr. Rob Duncan at Sandia, who would later (1995/96) join the P&A faculty. He had successfully proposed a flight experiment to NASA called "Critical Dynamics in Microgravity (DYNAMX)", which explored how non-equilibrium conditions modified the superfluid transition in helium-4 at temperatures near absolute zero. This experiment was initially proposed to be flown on the Space Shuttle in 1997, but various delays and restructuring within NASA resulted in a plan to fly DYNAMX on the Japanese Experiment Module / Exposed Facility (JEM/EF) of the International Space Station in 2004. A major restructuring of NASA following the re-entry disaster on the Space Shuttle Columbia in 2003 resulted in the cancellation of all Microgravity Science Missions within NASA, including DYNAMX. At this point, DYNAMX had passed their Critical Design Review (CDR), and had received Authority to Proceed (ATP) to space flight. DYNAMX represented the first liquid helium physics / quantum fluids research conducted within P&A. Over $7M was spent on the DYNAMX science and engineering at UNM.

Although DYNAMX was cancelled along with all other NASA Microgravity Science experiments in 2004, substantial scientific results were obtained at UNM and collaborating institutions (Caltech & Stanford) in the associated ground-based research efforts. In the 2010s, after a decadal survey by the National Academy of Sciences NASA re-instituted the Fundamental Physics in Space program at the Jet Propulsion Lab, and that effort continues as of this writing (2021).

The LodeStar Project (mid-1990s)

In 1993 Congress allocated $17.5M to AFOSR (Air Force Office of Scientific Research) "to stimulate science and technology interest in students to promote an increase in mathematics and science professions…" in "… areas of the nation that have lower than average representation in the science and technology field." The implementation mechanism was "establishment of a science center …, especially if located in areas with population characteristics where the specific school comprehensive standardized tests show below normal comparability that could be enhanced." Prof. John McGraw realized that NM met all the criteria, and established a consortium, "The LodeStar Project". This consortium included various NM educational institutions as well as our major research labs. The underlying philosophy was to "do research in front of people".

The successful NM proposal included creation of the LodeStar Astronomy Center in

Albuquerque, Enchanted Skies Park near Grants and Acoma Pueblo, and a Dark Skies observing site at New Mexico Tech. Enchanted Skies Park was designed to be a US astronomy research site, with the first research instruments to be a 1.8-m diameter sky survey instrument and the Georgia State University CHARA interferometer incorporating six 1-m telescopes. Because of the educational emphasis and the revenue-generating sites, the State of NM allocated $12M to this project. During the 5-year planning phase for these facilities the LodeStar Project employed several dozen students and UNM professionals.

In collaboration with the NM Department of Cultural Affairs the LodeStar Project built an astronomy-oriented wing of Albuquerque's NM Museum of Natural History and Science, which included a 140-seat planetarium, and a motion simulation theater. This LodeStar Astronomy Center opened in December 1999. For several years an evening Astro-101 course was taught in the planetarium by Prof. McGraw. Effective July 1, 2007, the LodeStar Astronomy Center was transferred from UNM to the Museum. It remains an important legacy of P&A's LodeStar efforts.

The Planetarium and Astronomy Wing at the NM Museum of Natural History and Science

Despite various unique design features of Enchanted Skies Park in Cibola County, and an exceedingly dark site with excellent astronomical image quality on top of a flat mesa, LodeStar suffered a sad ending in that the project was not fully implemented, neither its educational nor its commercial plans of action. The reasons are multiple and complicated, including interagency and interpersonal politics, as well as serious problems with the environmental impact study for Enchanted Skies Park in its dealings with the local citizenry and the Acoma Pueblo. Ultimately, by 2001 UNM unfortunately felt compelled to return $5.6M to the funding agency.

Other Mid-1990s Developments

A complete discussion of the department's undergraduate curriculum during the 1992/93 academic year resulted in a series of final recommendations that were adopted by the faculty. The recommendations were put into the syllabi of the various courses---freshman, sophomore, and junior---for our majors. They mostly had to do with trying to close the gap that majors found in going from the sophomore-level classes, taught also with engineering majors, to the junior-level classes.

During 1993/94 Prof. Seymour Alpert retired and Prof. Trish Henning joined the astronomy faculty, resulting at that time in the following 9 IfA members: Ahluwalia, Campbell, Duric, Gregory, Henning, McGraw, Price, Swinson, and Zeilik. In optics Prof. Mansoor Sheik-Bahae was hired. In addition UNM landed its only Nobel Laureate in Prof. Murray Gell-Mann. He retired from Caltech, relocated to NM and the Santa Fe Institute, and accepted a position as University Professor. Starting in 1995 he taught one seminar per year.

In experimental particle physics the demise of the SSC (officially canceled by Congress in October 1993) meant the end of the Texas Accelerator Commission and hence of the funding

they supplied. Nonetheless, our group (Profs. Matthews, Gold, and Seidel) succeeded in maintaining their position and in securing their own DOE funding.

By 1993/94 outside funding for research had grown by 80% during the previous three years.

As approved by the faculty previously, restructuring of undergraduate courses continued, including additions and modifications to the freshman labs. A new upper division introductory Subatomic Physics course was taught for the first time in spring of 1994. A graduate review was also begun that year.

For the first time in living memory, the department set out to develop a long-range plan during 1994/95. Involving a great deal of introspection, discussion, soul searching and a difficult, but obviously necessary, balancing of interest, a five year program for the direction of the department was set out.

By December 1994 Prof. Charles Beckel retired. Before retiring in December 1995, Prof. Derek Swinson decided to terminate the operation of our cosmic ray telescopes at Embudo Cave in the Sandias and near Socorro at the end of December 1994. These telescopes had monitored cosmic rays ever since they were implemented by Victor Regener in the late 1950s. Before his retirement, Derek recorded the following songs for “cosmic ray conferences and other occasions”:

https://physics.unm.edu/pandaweb/webpages/swinson/

Given the importance of the Lodestar project a new position in Astrophysics had been given the highest priority in the five year hiring plan. As a consequence, in August 1996 Prof. Richard Rand joined the faculty from the University of Maryland.

In 1994 the Division of Particles and Fields meeting of the American Physical Society was hosted by UNM, with Prof. Sally Seidel serving as chair of the local organizing committee. Large AAS (American Astronomical Society) meetings were held in Albuquerque in 1990 and 2002, with the local organizing committee chaired by Prof. Harjit Ahluwalia in both cases.

Profs. Diels and Rudolph became the first group at UNM to be awarded a grant from the Keck Foundation, to establish the Keck Microscopy Laboratory with research emphasis on femtosecond laser pulses and their applications. The collaboration they initiated between Main Campus and the Health Sciences Center resulted in many millions of research dollars being secured by UNM over subsequent decades.

During 1995/96 the Commission for the Study of Women in Physics of the American Physical Society evaluated our department. Afterwards Judy Franz, the chair of this committee, made the following comment: "When women ask me where to go to graduate school, I say University of New Mexico.” A wonderful comment indeed.

By 1996 the CAS (Center for Advanced Studies) had come under the direction of Prof. Nitant Kenkre, thus incorporating Condensed Matter Theory more strongly. In addition to some support for our various centers the university also provided some multi-year support for prominent senior research faculty visitors, such as Profs. Wodkiewicz (Warsaw, theoretical optics) and Lowe (Birmingham/UK, experimental nuclear & particle physics, working with Prof. Bassalleck), thereby enhancing the department’s research output and visibility considerably.

The desperately needed office space in our new North Wing addition had now (1996) been occupied, relieving some of the immediate space pressure. Nevertheless, this did not represent a long-term solution since the department still had no new research lab space. And such new research lab space would not materialize until 2019!

Around 1996/97 the department realized it was facing a serious financial situation, a

significant (5-figure) debt in the seriously over-spent departmental overhead return account. Until the department hired its own accountant during that year the full extent of the problem was not obvious. Accusations existed that UNM was not able to survey research accounts adequately, as a result of which, for instance, start-up accounts could easily be overspent considerably. Another contributing factor was a negative Code-3 review, forcing the department to “swallow” the start-up over-expenditure. There was also a conscious decision by the department leadership to invest in people, i.e. hire staff and faculty, even though there wasn’t always sufficient state support for those positions. Effectively money was "up-fronted" to ensure growth.

During 1996/97 the number of tenure-stream faculty reached an all-time high of 31. This included Prof. Brad Johnson, who was hired in August 1996, but resigned in May 1997. Prof. Howard Bryant, a renowned high-energy atomic physics experimentalist retired in December 1997, after a long and productive career. Among his many significant career achievements, his extensive, multi-year experimental research program on the H^- ion at LAMPF (Los Alamos Meson Physics Facility) resulted in 16 P&A PhD dissertations.

By 1998 the faculty size was back down to 28, a typical number for that decade and well into the new century.

When Prof. John K. McIver took over from Prof. David Wolfe as Chair in summer 1997 three important goals were established: the development and implementation of a plan to control spending in the department and manage the debt in the overhead account, development of a plan to modernize the undergraduate laboratories, and a review of the centers within the department.

A major point of contention in the department had been for some time the structure of the three centers within the department, the Center for Advanced Studies (CAS), the New Mexico Center for Particle Physics (NMCPP), and the Institute for Astrophysics (IfA). The center directors reported directly to the Dean of the College of Arts and Sciences and enjoyed enhanced overhead return, partially at the expense of the department. The faculty reviewed these centers during the fall semester 1997. This review, its recommendations and the follow-on conversations between the dean, the chair, and the center directors resulted in a restructuring of all three centers. The new arrangement did much to relieve the feelings of inequity that were prevalent amongst the faculty under the previous operational plan.

One of the most pressing tasks during 1997/98 was to develop a plan for managing the debt that the department had accumulated in its overhead account. As of 1 July 1997 this debt was approximately $316 K, already reduced from an all time high of nearly $443 K the previous year. An exhaustive review of all expenditures, reimbursements and allocations that had occurred on the overhead account since FY 1991 was undertaken, and completed as well as could be expected considering the deplorable state of record keeping and bookkeeping that were prevalent in the department and the university during much of this period. A number of cost-saving measures were immediately put in place, mostly involving a reorganization of the staff, not filling vacant positions, and particularly moving as many staff salaries (or fractions thereof) from overhead to the state account as possible. All together the various cost saving measures reduced the overhead debt to approximately $255 K by July 1998.

The department also spent a significant amount of time reviewing the undergraduate laboratories associated with the introductory courses, first steps of this review having begun in 1996/97 already. These laboratories had suffered from antiquated equipment and general neglect. Given the importance of this task to the department and because of the amount of work involved, a full-time faculty member, Prof. John Panitz, was assigned to this task and appointed Associate Chair with responsibility for undergraduate laboratories. His explicit instructions were to develop a plan to modernize and renovate all the laboratories associated with our 100 and 200 level

courses. A staff member, Bill Miller, was also assigned to these laboratories. A multi-year plan for upgrading and modernizing the laboratories was developed. Portions of the laboratories for the 150 and 160 series were to be taken from established curricula used in other universities while the rest was to be developed from current experiments. In addition, a new laboratory course corresponding to Physics 161 (E&M) was to be created. The laboratories associated with Physics 102, 106 and 108 were to be upgraded on a one-experiment-at-a-time basis until more funds became available. Permission was also received to search for a permanent undergraduate laboratory supervisor.

Following a nationwide trend the number of undergraduate majors had dropped significantly by 1997/98. Prior to that year the undergraduate committee had already taken a number of steps to reverse this trend. These steps included better advisement, closer interaction between the department and potential majors as well as devoting more time and money to advertisement and community activities. In addition, a BA program was started, attracting some students that would otherwise not be interested in a physics degree.

On April 4, 1998 a UNM water main broke near the building. The ensuing flood water flowed into the laser laboratories in the basement, resulting in 3" of water standing, 100% humidity, significant damage, and shorting out the electrical wiring for the building for about 24 hours. In addition, during power restoration vandals were able to enter the building, smashing cabinets in the lobby and stealing various objects from there. The total loss and damage estimate was over $36K.

Under the direction of Prof. V. M. Kenkre the Center for Advanced Studies continued its program of research, international visitors, and multiple workshops attracting scientists from around the world. Also spearheaded by Prof. Kenkre, a new initiative for building a Consortium of the Americas for Interdisciplinary Science was started with strong support from the Associate Provost for Research, the Dean of Arts and Science, several Department Chairs, from LANL, Sandia, and from over a dozen universities in Brazil, Argentina, Chile and Mexico. This Consortium lasted for 16 years, attracting more than 150 visitors from six Latin American countries, and arranged or supported over 50 workshops. It had a twin mission, to perform interdisciplinary research with the tools of physics, and to encourage and support collaborations of UNM researchers and researchers in the neighboring National Labs, with scientists from Latin America. The Center was strongly supported by the National Science Foundation (NSF), and served as a pilot for some of NSF's international projects.

During 1998/99 Mr. Boye M. Odom was hired as a Lecturer to supervise the undergraduate laboratories in Regener Hall and oversee their modernization.

Space continued to be a major problem in the department, particularly adequate research lab space. In fact, the department was fast approaching the point of being unable to accept further research projects if they were to be housed in the existing building. As it was, the building was already unsuited to some forms of experimental research because of the inability to properly control dust and temperature, as well as poor vibration isolation.

The department continued to concentrate on several issues, implementation of the plans for upgrading and improving the undergraduate physics laboratories and the development of a plan to improve the astronomy laboratories, development of a long term plan for the future of the department, implementation of the graduate assessment program, and undergraduate and graduate recruitment and retention. An aggressive advertising campaign for the graduate programs was also started, including using our web page as the major source of information for the outside world.

Assisted by Boye M. Odom and Bill Miller, Prof. John Panitz continued his supervision of the undergraduate lab upgrades. The first laboratory course, 151L, in the algebra-based sequence and

the first course, 160L, in the calculus-based sequence were completely revamped and modernized, replacing various antiquated equipment. Computers were introduced as an aid to data collection. 161L was re-created from scratch using the novel idea of a focused-concept laboratory, and taught for the first time in the fall of 1999. This lab course was unique at the time. Called "Visual E&M", it received the first NSF grant for undergraduate education at UNM.

Early phases of developing a plan for the future of the department focused on trying to understand where the department was at the end of the 1990s, and how it had gotten there. Without sacrificing or skimping on undergraduate education, P&A was going to remain for the foreseeable future primarily a graduate department. Most research programs were considered to be strong with relatively high funding levels, particularly in optics. In order to strengthen this area further, a proposal was developed to introduce a Master's program in Optical Sciences and Engineering, to complement the existing doctoral program. This idea was strongly endorsed by local industry and the government laboratories.

As a result of the review of all centers housed within P&A, the Center for Advanced Studies was directed by the Dean to emphasize interdisciplinary studies. Therefore its charter had to be revised and new strategies developed. Prof. Kenkre was appointed as Director for an additional year, and additional members from outside the department were added to the steering committee.

Professors C. Caves and I. Deutsch were hosts for the first workshop organized under the auspices of SQuInT, a new collaborative network of Southwestern universities, national laboratories, and industry in the area of "Quantum Information Science and Technology". This was the beginning of a long and successful annual sequence of such workshops.

Some Statistics Summarizing the Decades before and after the Turn of the Century

Before continuing with historical developments as the department moved into the new century, below we list some representative statistics summarizing the period from around 1990 to 2020:

By 1990 the size of the tenure-stream faculty had reached 28. In fact, from then and for the first two decades of the new century that number of 28 regular faculty represented our average, fluctuating between 25 and an all-time maximum of 31 during the 1996/97 academic year (to be reached again during 2020/2021). Typically around 90% of them were involved in outside-funded research. The department also employed 2-3 lecturers during those decades.

The number of research faculty, paid by outside grants or contracts, was typically in the range of 5-10. In addition, there tended to be a couple research staff as well as postdocs.

The annual number of BS (physics, astrophysics, and BA) degree recipients averaged around 12 between 1990 and 2019, with significant year-to-year fluctuations (low of 5, and high of 23). Over the same period the average annual number of PhD recipients (including optics) was around 11, although for the second decade of the new century it was closer to 15.

The number of staff positions funded by I&G (the Instruction & General budget provided by the College) typically ranged from 12 to 16 FTE. Over the years it declined a bit, partly due to budget decreases and also due to IT positions being partly moved into the College.

By the turn of the century the number of graduate students had increased to around 100, including those registered in the Optical Sciences Program. There were also around 100 declared physics or astrophysics major, with larger yearly fluctuations. By 2012/13 the number of graduate students had increased to about 130, then dropped again to about 115 by 2019/20.

Research activities in the department can of course be measured via various metrics. Partly due to faculty size increase, but also as a result of increased research productivity research expenditure increased from about $2M per year around 1990 to between approximately $4M and $8M per year in the first two decades of the new century. These numbers do not include P&A

faculty in CHTM, the Center for High Technology Materials. In the decade of the 2010s in particular we had several such P&A CHTM faculty members, as a result of which the overall research expenditure of P&A faculty was higher in a given year by between about 15% and 30%. Another important research metric for the department is the overhead generated by the research activities, and particularly the fraction of the overhead returned to the department. That fraction is of course subject to the whims of the upper administration, i.e. they decide what fraction of the overall overhead generated is retained by the Office of Research and the College of A&S. Total annual overhead generated by our department in the period 2000 – 2020 fluctuated between about $1.1M and $1.8M. During the first decade of the new century the annual overhead return to P&A ranged from about $160K to about $190K. Partly as a result of changes in UNM's overhead distribution across various units that amount decreased during the 2010s from over $180K to a low of only $55K for FY19 (after the previous 60:40 split between the College and P&A was changed to 80:20, to the detriment of the department).

The following two figures show our proposal submission and award history. The substantial drop in 2014 in the number of new awards was preceded by a below average submission of new proposals. There were certainly external forces at work such as the tightening of federal grant budgets and grant opportunities, but internal causes, like aging of the faculty, could not be excluded as a factor.

Figure 1: *P&A's Proposal and Award History (without P&A's CHTM Faculty)*

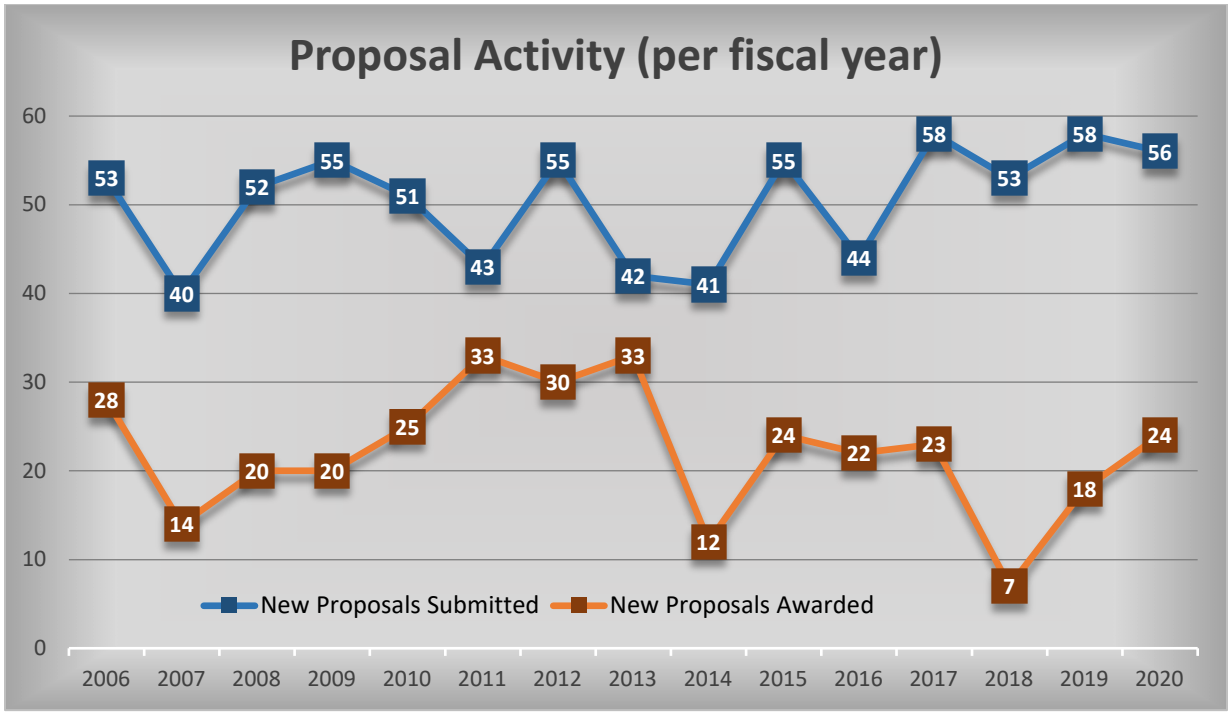
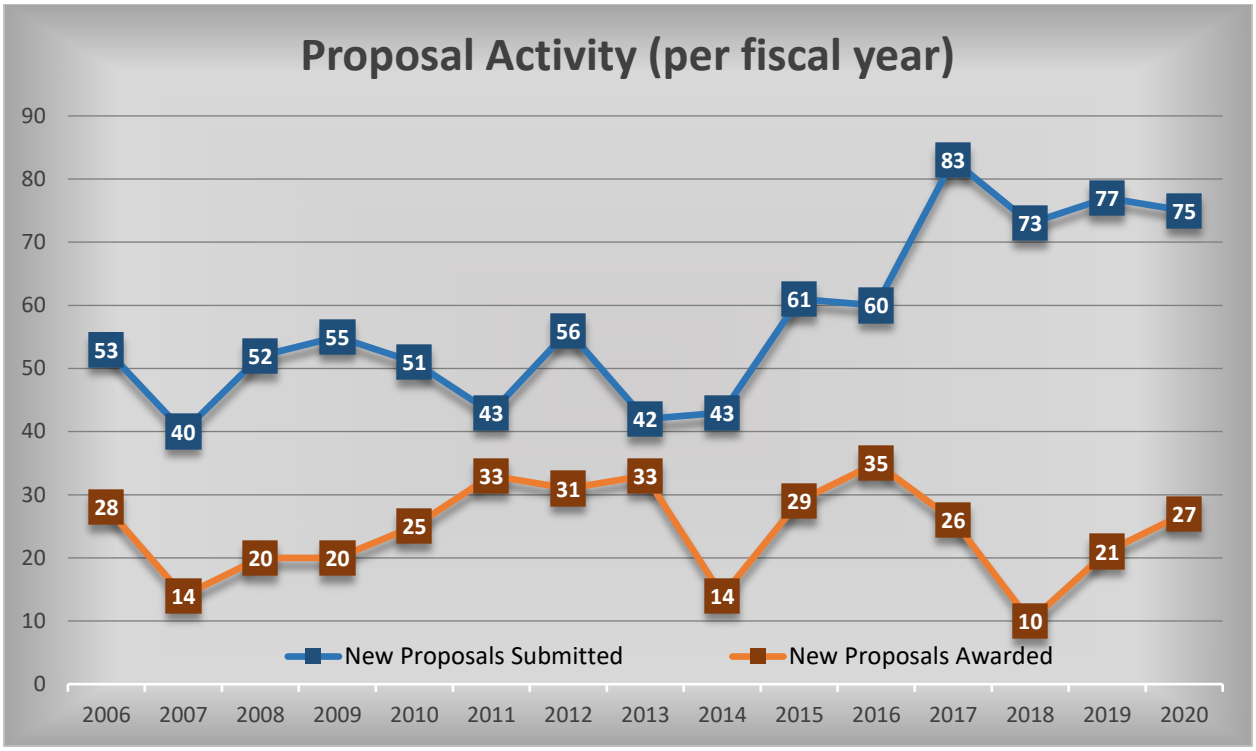


Figure 2: *P&A's and P&A's CHTM Faculty's Proposal and Award History*



Into the new century, onwards to a <u>New Building</u> (finally achieved by 2019)

At the turn of the century (1999/2000) Prof. John McIver remained Chair. Our two full-time lecturers were responsible for the undergraduate laboratories in Regener Hall (Mr. Odom) and for teaching several of the 100-level classes (Mr. Caffo).

Once again the Chair's annual report listed space as a major problem. Several renovations were undertaken or started, such as graduate student offices, and some labs including two major renovations in order to comply with dust standards imposed by the research projects. The majority of these renovations were financed with departmental funds. The biggest concern remained the abatement of asbestos ceiling tiles. Inadequate cooling and heating was exacerbated by lack of access to many of the pipes, valves and blowers since such access required removal of the tiles which couldn't be done until the tiles were abated and replaced.

Aging of the faculty remained a major problem. During 1999/2000 only two assistant professors remained.

Significant amounts of time and money continued to be spent on revamping undergraduate labs. The introduction of the novel 161L course, mentioned earlier, necessitated a restructuring of the following course in the sequence, Phys 262L. Most of the upgrades and restructuring of the 150 and 160 sequence of laboratory courses were completed during that year. Overseen by Prof. Neb Duric the astronomy 101L labs were completely redone. This included the purchase of new computers and the implementation of a web-based curriculum. Afterwards requests from several other universities were received to use the new laboratory course at their institutions. Enrollment records showed a significant decrease in the Musical Acoustics course, 108, over several years. As a consequence it was decided to re-design both 108 and 108L.

After an initial trial period web-based homework was introduced in the service courses. One benefit was a reduction in the number of TA hours that needed to be assigned for grading these courses.

A completely redesigned departmental web page was brought on line in the summer of 2000.

This was done so that the academic programs and research in the department were more clearly explained.

In the years leading up to 2000 a new undergraduate advisement scheme had been instituted and a comprehensive database had been developed. A significant increase in the number of undergraduate majors and their retention was directly attributed to this new advisement scheme. The advisement process assigned each declared major to one of a carefully chosen set of faculty advisors. Each student had to meet with his or her advisor before registering. This was guaranteed to occur because a lock was put on each student's registration, which could only be removed by the advisor. During this meeting, the advisor could access the student database, which not only contained demographic information on the student, but also the grades and comments enter by the advisor or the academic coordinator. Another key to the successful operation of this program was the new academic advisor, Mary DeWitt. She kept the database up to date, and insured that each student was in compliance with the department and university regulations. From 74 majors in fall 1998 that number increased to 120 in summer 2000. This successful undergraduate advising scheme has been used ever since its inception.

During 1999/2000 a new program to grant a MS in Optical Sciences and Engineering was completed and received overwhelming endorsement from the Departments of Physics and Astronomy and Electrical and Computer Engineering. The program had also received strong support from the Air Force Research Laboratory, Sandia and Los Alamos National Laboratories, and a wide range of industries as well as the New Mexico Optical Industry Association.

Profs. Wolfe and Dunlap held a *Research Experience for Undergraduates* (REU) grant from NSF. This grant sponsored a summer research experience for undergraduates in the department. In addition to the principals, five faculty members not only worked with these undergraduates in this program, but also supplied funds to support their stipends.

Effective January 1, 2001, Prof. Jack McIver became Interim VP for Research at UNM, and Prof. Marc Price agreed to take over as Interim Chair initially, being elected and confirmed as Chair by summer 2001. This was his second tenure as Chair, and he would serve until fall 2002, when Prof. Bernd Bassalleck took over as Chair, lasting until summer 2012.

Early in the new century reorganization and staffing of the department office continued to be a challenge, partly due to financial constraints (see the next paragraph) and partly due to prevailing Human Resource policies. Among other issues, financial support for a technician at our Capilla Peak Observatory in the Manzanos was lost. Scientific use of this observatory came to an end in the early 2000s, after more than half a century.

The biggest challenge of the academic year 2001/02 was the reconciliation of the past finances of the department, i.e. the debt in the departmental overhead account once again raised its ugly head. This was part of a college wide audit conducted by the new Dean of Arts and Sciences, Reed Dasenbrock. The department had paid down essentially all of the recognized past debt under the previous Chair. However, the discovery of unmet start-up fund commitments and other factors added additional debt to be paid out of our indirect costs (research overhead) return. Additionally, the department was now expected to deal with the significant debt of the Institute for Astrophysics (IfA). This debt was allegedly at least partly due to LodeStar, and had been accumulated while reporting to the previous Dean.

We were awarded a grant from the National Science Foundation in response to the IGERT (Integrative Graduate Education and Research Traineeship) program. The proposal had been submitted by an interdepartmental group headed by Prof. Wolfgang Rudolph. Two new faculty lines were to be established within UNM (not necessarily in P&A), focused on applications of optical techniques to other research areas. Discussions were held on which area of optics research should be strengthened, with biophysics or medical physics rising to the top.

Planning for what would become known as our northwest wing (directly connected to our north wing) started in 2001/02. This was triggered by expansion plans of the University Hospital and Health Sciences, requiring removal of our east wing trailer offices. And of course longer term, the need for a new building had not diminished, planning efforts started to be considered, hoping for a time frame of five to ten years – in the end this took well over 15 years.

Effective August 1, 2001, Prof. Douglas Fields started as an Assistant Professor. He was the first of several target-of-opportunity hires over the following decade. In his case the Japanese-funded RIKEN research center at Brookhaven National Laboratory (BNL) in NY agreed to pay two thirds of his academic year salary for a period of five years. In return Prof. Fields was expected to carry out research in experimental nuclear physics at BNL facilities. Associate Prof. Belva Campbell left P&A and UNM, effective June 30, 2001.

During the fall semester 2002 the department had to select and elect a new Chair since the previous Chair, Prof. Marcus Price, was stepping down. Prof. Bernd Bassalleck was elected by the department faculty and accepted by the Dean (Reed Dasenbrock), with an official starting date of Nov. 1, 2002.

Going into 2003 functioning of the departmental office staff left something to be desired, and overall morale among faculty and staff were at a fairly low point. The last official Department Administrator had left in spring 2001. She was finally replaced in summer 2003 (by an outstanding DA, Chelsea (Beth) Walker), followed over time by significant improvements in full staffing, morale, and operational efficiency of the office staff.

As mentioned earlier, unmet start-up fund commitments over many years had resulted in yet another departmental debt. A plan was worked out with the Dean to repay this debt out of the departmental overhead return, with the goal to be out of debt by July 1, 2004. This was helped considerably by the fact that the overhead return for CY02 was 46.6% higher than for CY01, a sign of strong and improving research vitality of the department. The remaining problem of the debt of the Institute for Astrophysics (IfA), accumulated while reporting to the previous Dean, was postponed for the time being.

The departmental network was upgraded to gigabit capacity. In Regener Hall, our large (300 seats) lecture hall was instrumented with an electronic keypad system. Using this system students could answer questions and quizzes electronically, and the results could be evaluated on-line and displayed in real time. More and more of the large introductory physics and astronomy classes were using this powerful system.

By the summer of 2003 the department's Long Range Planning committee (consisting of nine faculty members and now chaired by Prof. Carl Caves) had made great progress. This plan was the most serious and most comprehensive such Long Range Plan that the department had ever undertaken. It was both a critical self-assessment document and a planning document for the subsequent 5-10 years, including a faculty hiring plan. In addition, it was very much meant to be a living (and governing) document in the sense that the Chair and his/her Advisory Committee were now tasked with implementing this plan as well as reviewing and updating it regularly.

In spring of 2003 construction started for a new wing of the building, immediately to the west of the north wing. This approximately 5000 sq ft wing was designed to contain office space for faculty, research staff, and graduate students. It was a replacement for various trailers and was financed by the UNM Hospital/Health Sciences Center, since they needed the space occupied by our trailers for the pending expansion of the UNM Hospital. Both the north and the northwest wing were relatively simple and cheap constructions, a temporary fix for additional office space, given the more and more obvious and serious needs for an entire new building. Once again the June 2003 UNM plan for Capital Outlay Projects showed planning money for a replacement P & A building during FY05. Needless to say, once again nothing happened during FY05, and the

seemingly never-ending push for a new building would continue for quite a few more years.

Among several faculty the interest in biophysics grew, and in summer 2003 the first biophysics faculty member was hired, Prof. Jim Thomas, joining us from Columbia University. Start-up funding for this position was partially supported by the aforementioned interdepartmental National Science Foundation IGERT grant, headed by Prof. Wolfgang Rudolph.

Another departmental need, this one in the rapidly expanding area of experimental cosmology, was filled via the initial spousal hire of Research Assistant Professor Dinesh Loomba, converting to Assistant Professor in August 2002.

By the summer 2004 morale among the office staff, as well as their operational efficiency had improved markedly. In addition, as of July 1, 2004, the department was finally out of debt. This was helped considerably by the office of the VP for Research (matching our debt repayments for several years), and by the fact that departmental overhead return had remained strong. Not having to contribute to debt reduction anymore allowed the department to invest more in its future, such as in start-up costs for new faculty.

The new northwest wing of the building was completed in fall 2003, approximately 5000 sq ft office space for faculty, research staff, and graduate students. Also in 2003/04 the entire building was equipped with wireless network access.

The comprehensive departmental Long Range Plan (http://panda3.phys.unm.edu/pandaweb/PPRot/LRP/04report/04final.pdf) was adopted by the faculty in 2004, truly a major milestone for P&A. This planning document with a 5-10 year time horizon included a (un-prioritized) faculty hiring plan. Consensus on top future faculty hiring was achieved, and resulted in an immediate search for an Assistant Professor in Experimental Quantum Information/Quantum Optics. For years to come this faculty hiring plan served the faculty well in its annual deliberations on hiring priorities for the following year.

Three faculty members retired during the summer of 2004: Profs. Colston Chandler, John Panitz, and Michael Zeilik.

In the summer of 2005 Prof. Ivan Deutsch assumed directorship of the Center for Advanced Studies (CAS) from Prof. Sudhakar Prasad. The CAS director continued to report to the Dean of Arts & Sciences.

During 2004/05 the departmental office staff focused on improved cross-training as well as continual training in and (significant) struggles with the new Project LINK/Banner administrative software at UNM.

During the summer of 2005 Prof. Marc Price retired. Emeritus Prof. Roy Thomas died on 3/18/05. He was a doctoral student of J. Robert Oppenheimer, and had taught in P&A from 1948 until his retirement in 1980.

In August 2005 three new faculty members were hired: Prof. Ylva Pihlström, Prof. Gregory Taylor (both in observational radio-astronomy and the latter at the Associate Professor level), and Prof. JM Geremia (experimental quantum information/optics). A faculty search conducted by UNM's Center for High Technology Materials (CHTM) in spring 2006 resulted in the hire of Prof. Steve Koch in biophysics. Salary and start-up support for this new faculty position came from CHTM, while his tenure home was our department, and he also taught in P&A.

In spring 2006 Prof. Steve Gregory (astronomy) retired, and in June 2006 our building & operations manager Elliott Bailey retired, after 40 (!) years, and a truly remarkable career. His unsurpassed dedication to the department and its needs were acknowledged and praised by many. Former Chair Prof. Victor Regener died on January 20, 2006. He had joined the faculty in 1946 and retired in 1979, after having spent a total of 27 (!) years as Chair: 1947-1957 and again

1962-1979, an astounding achievement. UNM's Regener Hall is of course named after him.

Also in 2006, Prof. Harjit Ahluwalia and his wife endowed a Presidential Scholarship in honor of his parents. It is for a minority female student from a High School in the Albuquerque/Rio Rancho area with a GPA > 3.75, to study physics and/or astronomy at UNM.

Two of our faculty were promoted to the rank of Distinguished Professor, Prof. Nitant Kenkre in 2005 and Prof. Carl Caves in 2006. In addition, the department continued its enviable record of having its faculty members be awarded the UNM Annual Research Lecture, UNM's highest research honor:

1958 Lincoln LaPaz (Astronomy, at that time still part of the Math department)
1960 Victor Regener
1985 Howard Bryant
1987 Marlan Scully
2005 Nitant Kenkre
2006 Jean-Claude Diels
2014 Ivan Deutsch

Continuing to rely on the departmental Long Range Plan the department was able to successfully replace retirements with new, young faculty. In January 2007 Prof. Keith Lidke started as a joint hire with the UNM Cancer Center, an exciting opportunity for the department. Together with Profs. Jim Thomas and Steve Koch he formed the new group in optical biophysics. In Prof. Lidke's case the Cancer Center agreed to contribute half his academic year salary for his first three years. In fall 2007 the department welcomed Prof. Rouzbeh Allahverdi, a theorist specializing in the intersection between subatomic and astrophysics/cosmology. He joined us from the Perimeter Institute in Waterloo/Ontario/Canada. Given that the departmental overhead account became debt-free as of July 1, 2004, start-up commitments to new faculty as well as remaining start-up obligations could easily be met. During 2007 the need for an additional staff member for grant support (pre- and post-award) and some accounting help was identified. Funding for this new position for 07/08 was secured in consultation with the Dean.

Overall grant activity remained healthy, especially considering the significant ongoing federal funding hurdles for the physical sciences.

While internal functioning of the departmental staff continued at a very strong level, unfortunately the demands on the departmental admin staff imposed by the upper administration continued to increase, without giving the department sufficient resources. Complaints about inconsistent and sometimes even contradictory responses from different branches of our upper administration (to questions by departmental staff about processes or procedures) reached new levels. The Banner system also remained a source of considerable frustration for the staff.

The new grant support (pre- and post-award) staff member was hired in early 2008. Salary support for this vital new position in 2008/09 was not available in A&S, and therefore the position was 100% supported by the departmental overhead account.

The retirement of Lecturer II John Caffo, effective July 1, 2008, and the departure (for a position at Cornell) of Lecturer III Kathy Dimiduk at the end of July 2008 left a gaping hole in the teaching roster. They had been teaching very effectively in P&A since 1990 and 1994, respectively. In both cases significant and increasing bureaucratic burdens in the teaching of large introductory classes at UNM contributed very significantly to the departure of these two outstanding Lecturers.

In spring 2008 the faculty decided that it was time for a revision of the earlier departmental Long Range Plan. At the end of the 07/08 academic year Professor Jack McIver (Interim VP for Research) left UNM for the position of VP for Research at the University of Idaho, and Professor

Rob Duncan left to assume the Vice Chancellorship for Research at the University of Missouri in Columbia/MO.

The end of this decade was characterized by constantly increasing demands imposed by the upper administration on departmental admin staff as well as on Chair and Associate Chairs, as well as serious budget woes within UNM and the College, leading among other issues to mid-year budget rescissions. While these were clearly difficult and painful, P&A was able to manage them better than some other departments.

Research in the department and therefore overhead return to the department remained relatively healthy. Unfortunately, starting in 2008 the department received only 10.5% of total F&A generated, as opposed to the previous 13.2%. And by 2008/09 the funding climate for most subfields of the physical sciences had deteriorated significantly, although P&A had not yet been impacted much.

During 08/09 the faculty started to update the 2004 departmental Long Range Plan, a plan which had served the department well, for instance in faculty hiring decisions. This update was being undertaken in conjunction with preparations for an outside Academic Program Review in February 2010. The 2009 Long Range Plan and Self-Study can be found at

http://panda3.phys.unm.edu/pandaweb/PPRot/LRP/09report/09plan.pdf. The prevailing financial climate in those days made it exceedingly difficult to obtain new faculty position. Therefore any possible target of opportunity, such as joint hires with a National Lab, was aggressively pursued. One such opportunity was lined up with Sandia National Lab during 08/09, but unfortunately the candidate decided in the end not to move to Albuquerque for personal reasons.

Replacement of the third Lecturer and the ongoing push for a new building remained high priority. Needless to say, the state budget shortfall and its implications for UNM and for the department remained a crucial issue, after this beast had raised its ugly head during 2008/09.

In fall 2008 the Statistical Research Center of the American Institute of Physics (AIP) posted four lists of universities that were the largest producers of physics degrees earned by Hispanic Americans and African Americans over the last decade. P&A made one of those lists, the one for most physics bachelors to Hispanic Americans. Universities on this list conferred 15 or more BS physics degrees to Hispanic Americans between 1998 and 2007.

During June 2009 the US Particle Accelerator School was held in Albuquerque, sponsored by UNM and the department. Profs. Sally Seidel and Doug Fields were instrumental in preparations for this successful event.

In fall 2009 Prof. Kevin Malloy joined the department from the ECE department, his faculty slot remaining with CHTM. At the end of December Prof. JM Geremia resigned. During spring 2010 there was an external Academic Program Review (APR), and a successful faculty search for another astro-particle theorist, leading to the hire of Prof. Huaiyu Duan, effective August 2010. Given the difficult financial situation at UNM the department was particularly happy to have succeeded in hiring Prof. Duan from Los Alamos. His hire represented a successful example of a target of opportunity. His academic year salary plus fringe benefits was paid during his first three years by a grant from the Department of Energy's Division for Nuclear Theory, as part of a Topical Collaboration in Neutrino and Nuclear Astrophysics, involving colleagues from the LANL Division of Nuclear Theory and other academic institutions. Both LANL and DOE were also instrumental in securing start-up funding for this new faculty position.

With the hiring during 2009/10 of a new accountant (Lindsay Rogash) and a new grant support person (Julie Morrison) the important long-term goal of an effective, well-functioning staff with high morale had finally been achieved. The department managed and survived the 09/10 budget woes in relatively reasonable shape, absorbing the mid-year rescission via the positive balance in

the operating budget.

While federal stimulus money helped here and there, the overall funding climate for most subfields of the physical sciences including astronomy remained challenging.

Triggered by UNMH expansion plans, in spring 2008 serious planning started for a new building for our department, with a most likely location on main campus and possibly with the incorporation of Regener Hall facilities from the very beginning. The needs assessment for our research and teaching mission, as well as the initial programming phase for a new building (but no detailed architectural planning), proceeded at a remarkable pace during spring & summer of 2008. However, subsequently UNMH decided that the next phase of the hospital expansion would proceed west of University Boulevard, and not in the P&A location. This decision unfortunately brought the new building planning process to a stop. The spring 2009 NM legislative session did not approve the $500K planning money, which had been on UNM's priority list. All the department could do was to continue the fight for a badly needed new building. The need for a new building was also one of the cornerstones of the already mentioned 2009 Long Range Plan and Self-Study report for the Academic Program Review (APR) in February 2010, and this need was strongly re-affirmed in the final report of the visiting external review team: http://panda3.phys.unm.edu/pandaweb/PPRot/assessment/APR 2010/UNM_PANDA_report_2010.pdf

As of summer 2010 a new building for our department seemed to have made it into the top group of UNM's major capital project needs, and there was some hope for a push for serious planning money to be proposed to the next UNM legislative session in early 2011. Within P&A the frustration with the old building and the lack of modern laboratory research facilities continued to grow.

With sadness the department mourned the death (Aug. 13, 2009) of Emeritus Prof. Charles Beckel, at the age of 81. He served on our faculty from 1966 to his retirement in 1994. He was a theorist working in atomic/molecular/condensed matter physics, later on also in biophysics.

During 2009/10 UNM’s College of Arts and Sciences and the College of Optical Sciences at the University of Arizona established the Center for Quantum Information and Control. CQuIC was founded on a three-year, $1.26 million grant from the National Science Foundation's Physics at the Information Frontier program.

Prof. Doug Fields served as President of the Faculty Senate during 09/10.

Into the 2010s, culminating (at long last!) in our new building

Attention to staff needs and staff support for faculty over a number of years paid off in that at the beginning of the new decade there was a general feeling that the staff was an excellent group, effective, efficient, and functioning well together. Morale remained high, despite serious budget rescissions and cuts during the previous couple years and the incessant demands on the staff (and the Chair) by the university's upper administration.

The external Academic Program Review (APR) in February 2010 focused the department’s attention on writing a self-study document (as mentioned on the previous page), in which the 2004 departmental Long Range Plan was carefully updated. This self-study was very well received, with strong, positive comments by UNM administrators as well as by the external review team (see the link above). The departmental response to the APR team's recommendations combined with our suggested action plan was submitted to the College of A&S in July 2010, but no feedback was received until one year later, and the follow-on meeting with upper level administrators finally took place during fall 2011. However, independent of that delay the department had tackled and completed several recommendations by the review team

quickly, for instance a complete revamp and update of the website or instituting a math methods course for undergraduate majors. Of course the most prominent recommendation by the external APR team, a new building, required yet several more years of lobbying, arguing, and pushing.

During 2010/11 we mourned the death of Emeritus Professor and former UNM Provost McAllister Hull. As a young man he had served during World War II in the Manhattan atomic bomb project in Los Alamos. Starting with the spring semester 2011 Prof. Mousumi Roy joined our department from the Department of Earth & Planetary Sciences, thus adding an important Geophysics component to the department's research portfolio. Effective June 30, 2011, former Chair Prof. Daniel Finley retired, after an amazing 42 (!) years on our faculty.

During the 2011/12 academic year Prof. Wolfgang Rudolph was selected as the next Chair, taking over from Prof. Bernd Bassalleck, effective August 1, 2012. A successful faculty search resulted in the hire in fall 2012 of a new Assistant Professor in Quantum Information Theory, Prof. Akimasa Miyake. At the same time Dr. Mark Morgan-Tracy (from CNM) started as a Lecturer III. Despite difficult financial times, the department was able to maintain its faculty strength fairly well. Assistant Prof. Steve Koch's tenure and promotion case unfortunately ended with a negative recommendation by the College and subsequent negative decision by the Provost, despite a positive recommendation by the department.

The department was able to absorb the 3.3% budget cut for FY12 primarily by severely cutting back the departmental operating budget. In addition, two TA lines had to be eliminated and the budget for undergraduate student helpers was cut in half. Earlier prudent planning, resulting in an operating budget surplus from previous years allowed sustaining the basic operations of the department for the time being. Continued lack of recurring I&G (state) salary support for the extremely valuable grant support staff member (Julie Morrison) and for a fraction of the Department Administrator's salary required both to be supported by the departmental overhead account. A pause & hold on staff replacements at the time prevented the replacement of the Electronics Shop Technician John Behrendt, who retired in 2008. Unfortunately this resulted in some damage to our research effort and to our reputation with colleagues at other institutions, incl. the National Labs.

A long-standing tradition of the department has consisted of opening and staffing (grad students & one faculty member) the Campus Observatory for public night viewing every Friday evening during the academic year, weather permitting of course. This has traditionally happened in collaboration with the Albuquerque Astronomical Society. Another tradition has been the annual Open Houses for prospective graduate students (every spring the best domestic applicants are invited, expenses paid), as well as an Open House for high school students and first or second year undergraduates already at UNM. These Open Houses include research laboratory tours and interactions with various faculty members.

Particularly successful were the astronomical outreach activities at the Campus Observatory in connection with the annular solar eclipse in May 2012 and the Venus transit in June 2012. They focused a lot of positive attention on UNM and on the department. An estimated 3000 people attended the eclipse event, photos of which were posted on the department webpage. Visitors came from at least as far away as Kentucky. The AP did a story, and a video interview with Prof. Richard Rand was picked up by the Washington Post, ABC news, Yahoo news, salon.com, The Huffington Post, and other websites. Our own specially created website got nearly 10,000 views, and the internet feed of live eclipse images was particularly appreciated by people as far away as Italy. The Venus transit (in front of the Sun) event at the Campus Observatory was attended by an estimated 1000 people, and also considered a great success story. An e-mail received from someone in Elgin/Illinois:

"As I sat in my living room west of Chicago tonight, I was able to see the transit of Venus thanks to the live feed from your telescope. Thank you so very much for making this opportunity available to the general public. I am not an astronomer (only an amateur stargazer), but I was fascinated by these pictures and felt part of a most important happening, celestially speaking! I Facebooked and E-mailed every friend I could think of and passed this link along so that they could share as well. Please extend my heartfelt thanks to your staff at the telescope for this beautiful gift! What an experience!"

Another chapter in the history of P&A commenced in summer of 2012 when Prof. Wolfgang Rudolph took over as Chair from Prof. Bernd Bassalleck who had served for almost ten years. This new chapter would end up being dominated by the historical achievement of construction and completion in 2019 of a new building for the department.

A successful faculty search in the spring of 2013 resulted in the hire of Prof. Francisco Elohim

Becerra-Chavez (from NIST Gaithersburg), an experimenter in quantum/nano optics, effective with the fall semester 2013. Asst. Prof. Steven Koch completed his terminal contract with an end date of 5/31/13. Prof. Bernd Bassalleck stepped down to 0.5 FTE effective Fall 2013. Prof. John McGraw took over for one year the interim position as UNM's VP for Research, and returned to the department on July 1, 2013.

By 2013 and with support from the Dean's office significant progress was finally made in the quest for a new building, i.e. the department was now (finally!) firmly on the radar screen of the UNM leadership and the NM Legislature. The latest needs assessment was quasi-finalized in May 2013 and the President's office decided to make a case for the construction of an ~$85M building replacing the facility on Lomas Blvd, and including new space for interdisciplinary research projects. It clearly helped that the need for a new building had been one of the cornerstones of the Academic Program Review (APR) in spring of 2010, strongly re-affirmed in the final report of the visiting external review team, and that the department had failed twice in the recent past to attract new, excellent experimental faculty members due to sub-standard features and significant research infrastructure deficiencies of the existing antiquated building. The new Chair, Prof. Wolfgang Rudolph, assisted by Prof. Doug Fields, was going to spend inordinate amounts of time and effort on a weekly basis on new building design and space issues.

During 2013/14 Prof. Ivan Deutsch won UNM's 59th Research Lectureship Award, and Prof. Mansoor Sheik-Bahae was promoted to Distinguished Professor. Prof. Harjit Ahluwalia retired in May 2014 after 46 (!) years of service at UNM. Web and general IT support within the department were re-structured, with some such support moving to the College, resulting in an overall 0.5 FTE reduction. For the fall semester 2014 Prof. Arash Mafi was appointed associate professor with tenure from the University of Wisconsin, Milwaukee. He occupied a CHTM position and his labs were at CHTM. Our former colleague, Prof. Emeritus Seymour Alpert passed away on March 11, 2014. He had joined UNM in 1966.

Modest F&A funds were used to augment staff salaries in cases where the university imposed salary increase would have led to a reduction in take-home pay as a result of a steep increase in health insurance.

During the earlier budget rescission the department returned about 40% of the I&G (state) operating budget. Since that time this account had been overspent by about $20-30K per year, which was absorbed by savings carried forward from earlier years and course buyouts. I&G spending had been reduced to a bare minimum, for example no more faculty travel support. In Fall 2012, the department applied successfully for course fees for all of the introductory courses (100 and 200 level). These funds helped to pay for much-needed upgrades and maintenance of the instructional facilities at Regener Hall (RH) and pay for part of the salary of the lab technician in RH. These "salary savings" were applied toward the compensation of the contract and grant administrator Julie Morrison. For AY 2014/15 the Dean agreed to partially back-fill the I&G budget with $20K and to allocate an additional $14K for faculty development.

While the push for the new building continued, unfortunately the anticipated $3M from the Legislative Session in early 2014 was not approved. Instead, about $750K were contributed by individual legislators toward the planning of the Interdisciplinary Science Building (ISB), eventually called PAIS – Physics & Astronomy and Interdisciplinary Science. This allowed continued planning and design, albeit at a slower pace. The department collectively spent an immense amount of time providing feedback and input for the needs assessment. A final document, however, was still not in hand.

The research enterprise continued doing well, especially considering the overall funding situation for the physical sciences and the budget turmoil and uncertainty in Washington, D.C.

The department continued to participate in various UNM recruitment activities such as Senior

Day, Hispanic Student Day, School-to-World Day, Star Scholar's Reception, and the staffing of the Campus Observatory for public night viewing every Friday evening during the academic year, weather permitting of course - a very long established tradition of the department, in collaboration with the Albuquerque Astronomical Society.

Once again in spring 2014 the department invited the best domestic applicants (expenses paid), for the Graduate Student Open House. The long weekend included an extensive program presentation, laboratory tours, interactions with various faculty members and a field trip to Tent Rocks National Monument. Typically close to 50% (5 out of 11 in 2014) of outstanding attendees have accepted our offer and enrolled in a graduate doctoral degree program.

In the fall an evening Open House for high school students and first- or second-year undergraduates already at UNM showcased the research activities with demonstrations and short laboratory tours given by faculty and graduate students. Over 100 students typically attended this event every year.

The long and winding road toward a new building took more turns in 2013/14. The UNM leadership continued its support for a new P&A building plus new interdisciplinary research space. A refined assessment yielded a cost estimate of $77.5M for the project (down from $85M a year earlier).

Aging of the faculty was becoming an issue – 60 was the average age of the 18 full professors in 2014. To keep the faculty number stable (less than what was aimed for in the Long Range Plan) at least one hire per year would be required. Failing that, the number of MS and PhD graduates would almost certainly drop and the level of externally funded research could not be maintained. Signs of the latter were already appearing in the number of grants and F&A (overhead) production.

At the same time both the College and UNM suffered under serious budgetary constraints. What was needed was a coherent plan and vision for the whole university on how to develop UNM into a highly competitive research university in a time of shrinking federal and state resources. The old strategy of waiting until times got better had failed. The department still benefited from the fact that in the late eighties and early nineties 6 senior faculty members were hired, a feat not likely to happen again. For 2014/15 an opportunity to search for an optics theorist opened up. However, to make that happen the department had offered one academic year salary for this person. A proposal for an experimentalist in astro-particle physics was also submitted in 2014. Such a person was needed to sustain the sizeable and successful efforts in the area of subatomic physics, where several faculty members were close to retirement and the youngest was well past 50. The increase in start-up packages in experimental physics and astronomy was exceeding inflation by far. Depending somewhat on the research area candidates that the department was trying to attract could demand $800K or even more. Top institutions were offering twice as much and more.

The hire of a dedicated staff support person for the upper division teaching labs (Michael Hasselbeck) and the course fees for intro level courses put the department in a good position to begin to revamp these upper division labs, something that had been recommended by the external academic program review in 2010. The first two online courses were developed and taught successfully (Profs. Thomas/Bassalleck – Physics 102, Prof. Rand – Astro 101). A new course was introduced – Physics 140 – developed and taught by our lecturer, Dr. Morgan-Tracy. Its purpose was to ease the transition from high-school physics and mathematics to the college level. The future of this course within the departmental offerings was going to depend on the results of a thorough assessment.

Recruitment of top graduate students remained a high priority. More departmental resources were devoted to this effort – financial and personnel. The graduate committee was split in two so

that one group could focus entirely on recruitment and admission. Some success was noticed fairly quickly, and several overdue program changes were also made. A graduate astrophysics concentration proposal was approved in 2014. It started in fall of 2015, after which students interested in astro generally followed this track. By fall of 2014 the BS program included three possible concentrations: in Optics (since fall 2006), in Biophysics, and in Earth & Planetary Science (both effective with the fall semester 2014).

Physics and Astronomy research at UNM in quantity (number of papers published) and in quality (citation impact) was fairly highly ranked in the US (for current numbers, see www.excellencemapping.net/#physicsandastronomy). Student and graduation numbers for 2 previous years were compared to those of physics departments in our peer group, shown in the following table.

Table 1: *Average (AY 2010/11 and AY 2011/12) graduation numbers per faculty member and year of our department and our peers*

Institution	# faculty	# grad students	BS/fac/yr	MS/fac/yr terminal	PhD /fac/yr	Degree /fac/yr	#grad /PhD/yr
P&A UNM	29	120	0.48	0.19	0.38	1.05	11
Peer average	30	84	0.47	0.11	0.36	0.92	7.7

At the time the department had a considerably larger number of graduate students compared with the peer average. This also reflected the fact that grant productivity was higher, allowing the department to support these students. The overall degree production in the department per faculty member was also about 10% greater than the average. The last column suggests that, despite efforts, the department had problems attracting good students. The larger number there indicates considerable loss of students on their way to PhD. Those students who graduate with a PhD did so in an average time frame (~6.5 years for a physics department).

Dr. Victor Acosta from UC Berkeley started as an assistant professor in January 2015. He occupied a CHTM position and his labs were at CHTM. A successful faculty search in the field of Theoretical Light-Matter Interactions led to the hire (effective August 2015) of Dr. Alejandro Manjavacas from Universidad Complutense de Madrid/CSIC, Spain. Lecturer Dr. Jeffery Saul's contract ended in May 2015 and was not renewed. Another successful search resulted in a new lecturer, Dr. Leandra Boucheron from UC San Diego, who started in January 2016.

2014 Faculty Retreat

During the academic year 2015/16 progress towards a new building picked up considerable speed, architect teams and contractors were hired, and the conceptual design was started. Prof. Henning accepted the position as Interim Associated Vice President for Research, and one year later (August 2017) in a regular, full-time role. Prof. Mafi accepted the position as Interim Director of CHTM, and on 2/1/2018 became its regular director.

Prof. Bernd Bassalleck retired on 12/31/15, and became a .25 FTE working retiree on 1/1/16. Prof. Kevin Malloy (CHTM position) also retired effective 1/1/16. Prof. Vasudevan "Nitant" Kenkre retired on 6/30/16, and became a .25 FTE working retiree on 8/15/16.
Prof. Ivan Deutsch was chosen as one of three new Regents' Professors in the College of Arts and Sciences (2015-2018). Julie Morrison was hired as the Department Administrator on 6/13/16, replacing Lina Sandve, who retired in July 2016. Prof. Christopher Leavitt passed away on 11/30/15. He joined P & A in 1956 and was a member of the department for 37 years.

By October 2016 the 24" telescope at the Capilla Peak observatory had been auctioned off and

removed. A demolition estimate was obtained, but funding for the demolition was not immediately available. The telescope ended up in the "Astronomical Lyceum" in Magdalena, to be used by the public, as well as (reportedly) for some research.

At the departmental retreat in January 2017 the faculty approved a new long-range hiring plan, http://panda3.phys.unm.edu/pandaweb/PPRot/FacultyRetreat/2017/Hiring Plan.pdf.

Part of this strategic planning exercise was another critical self-assessment of the department. In addition, various data were collected from about 20 peer institutions. Interestingly, averaged over the period 2008-2014 the ratio of the number of graduate degrees to number of faculty for our department was the highest among all peer institutions. UNM-P&A also had the highest graduate student-to-faculty ratio, about 1.7 higher than the average of the remaining institutions. This high graduate productivity with a relatively small faculty size attested to the department's continued commitment to graduate-student retention and graduation, providing additional context for the proposed hiring plan.

Effective June 2017 both departmental IT staff positions (incl. the Web person) went from 0.5 FTE to 1.0 FTE as part of the IT Department. However, both remained stationed in P & A.

Prof. Ylva Pihlström was one of ten scientists to receive a 2017 Women in STEM award. Effective with the end of the 2017-2018 academic year Profs. Carlton Caves, John McGraw, and Sudhakar Prasad retired. Principal Lecturer Mickey Odom retired at the end of CY 2018. Prof. Gregory Taylor was promoted to Distinguished Professor in July 2018.

A new REU (NSF Research Experience for Undergraduates) was granted in 2017 to Profs. Rand and Dunlap, and started in summer 2018. In 2019 this was paused because of the anticipated move into the new building. The annual fall recruitment Open House was replaced by a demo show in Regener Hall, run twice per year by Prof. Dunlap and a crew of able and willing majors. By fall 2019 it was refocused mostly to middle school audiences.

P&A held an open house at the UNM Campus Observatory for the eclipse on Monday, August 21, 2017. Nearly 1,000 people and two local TV stations attended. The second annual UNM Physics Day, a conference dedicated to undergraduate research, was held in April 2018, and the third one in April 2019. Students gave talks, toured research labs, and these events were deemed a great success.

The academic year 2017/18 represented an extraordinarily successful faculty hiring season. The following four new faculty members were hired (in parentheses where they came from, research area and starting date):
Darcy Barron (Berkeley, astrophysics, August 2018)
Elizabeth Crosson (Caltech, Quantum Information, September 2018)
Francis-Yan Cyr-Racine (Harvard, astro-particle physics/cosmology, August 2019)
Diana Dragomir (MIT, astrophysics/exoplanets August 2020)
In addition, since fall 2019 Prof. Tara Drake has occupied a CHTM (Center for High Technology Materials) faculty slot, with her tenure home being P&A.

Prof. Wolfgang Rudolph stepped down as Chair effective 12/31/2018, and Prof. Richard Rand took over the chairmanship on 1/1/2019. University Professor and Nobel Prize recipient Murray Gell-Mann, a giant of 20th century physics, passed away on May 24, 2019. Profs. Bernd Bassalleck's and Nitant Kenkre's last day as a 0.25 FTE working retiree was on 12/31/2018 and

6/30/2019, respectively.

A new telescope (Celestron EdgeHD 14") with German equatorial mount for better tracking was installed at the Campus Observatory. Included was also updated automation for better alignment, which had been problematic with the previous Meade 14" telescope.

In 2019 UNMH informed us of approved plans to build a mobility clinic on the north side of the campus observatory. Construction was to begin in 2020, and included a realignment of Yale Blvd near the observatory. It was felt that, by working with the UNMH representatives, the impact was manageable. But more construction by UNMH was on its way, with an impact on the observatory considered fatal by the department. A new hospital, potentially rising to nine stories, was planned for the area to the south of the observatory along Lomas, and a new parking garage several stories high was to be built immediately to the east of the observatory. The light pollution and probable impact on sightlines, along with the observatory's aging and poorly function infrastructure, led the department to conclude that a new observatory was absolutely needed. The Richardson hospital and the Yale parking garage constructed several years earlier had already added significantly to light pollution. Prof. Ylva Pihlström began to draft a needs assessment in 2020.

A UNM alumnus in aeronautical engineering from 1955, Robert Young, passed away and left a ~$2M endowment to the department, intended to support research in astrophysics and cosmology. Late in his life, Mr. Young had become fascinated by the origin of the universe and wanted to support research with an endowment (he also left one for UNM's School of Engineering). Prof. Richard Rand played a key role in securing the astrophysics endowment even though Mr. Young had originally intended it for another institution. Mr. Young passed away a few months later. Two endowed funds were created according to his wishes. The Origins of the Universe Chair Fund (~$1.5M) will be used to create the department's first endowed University Chair for a faculty member working in the area of cosmology and astrophysics, expected to be filled by fall 2022. The Origins of the Universe Program Fund (~$0.5M) will be used to support student and faculty research in cosmology and astrophysics.

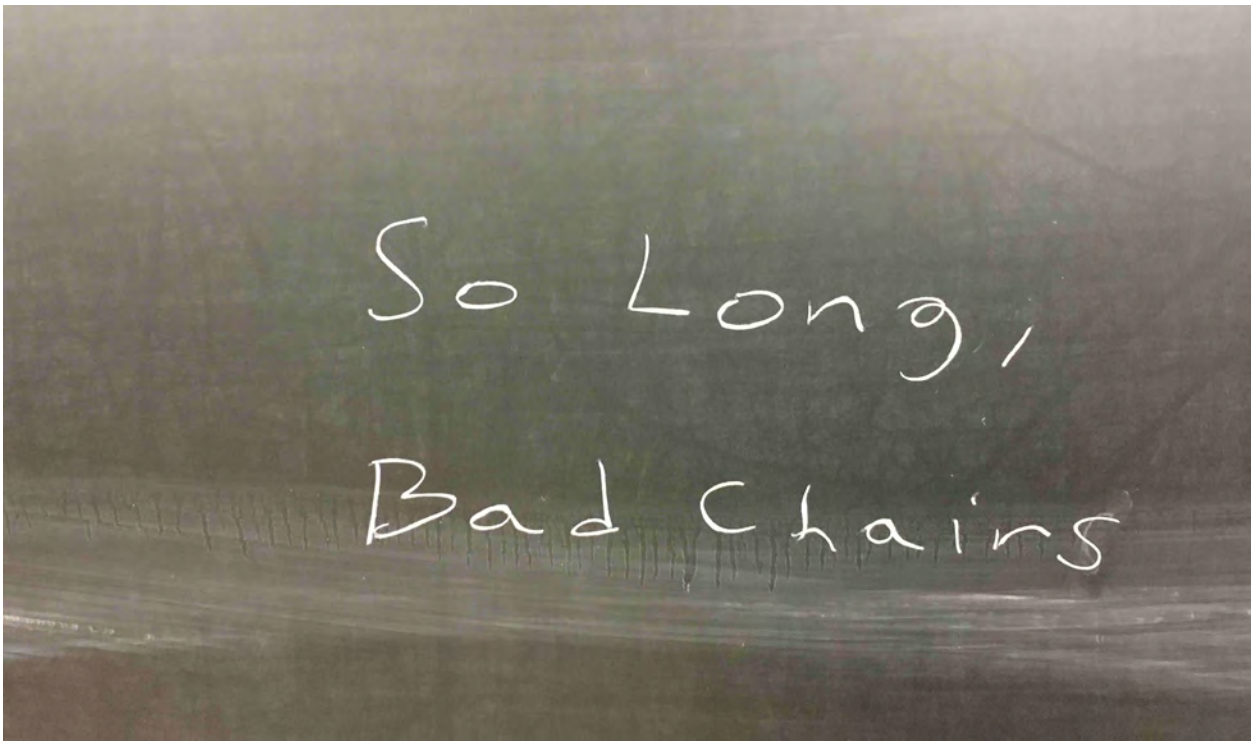
2019: Finally a New Building for P&A – "PAIS" (Physics & Astronomy & Interdisciplinary Science)

The exhaustive, detailed, multi-year planning process for our long-awaited and long-overdue new building had started earlier in the decade of the 2010s, after the UNM administration was finally convinced by more than one P&A Chair that a new facility was essential for the survival of our research enterprise. Emphasis was on state-of-the-art research labs (good control of temperature, humidity, dust, electrical noise, and sufficient vibration isolation) and the inclusion of significant lab space for several interdisciplinary research efforts from other science and engineering departments, resulting in a considerably larger building than initially planned. The chosen location was on main campus, replacing the old water reservoir, immediately west of Popejoy Hall, along Redondo Drive.

The end result was an impressive, modern building of approximately 137,000 sq ft. For comparison, our old building was approximately 67,000 sq ft (gross footage including the north and the northwest office wings, net assignable in the old main building were around 45,000 sq ft). Apart from excellent new research labs the new building included offices, many meeting and seminar rooms of various capacities, upper division teaching labs, and several classrooms, including a 200-seat auditorium. Regener Hall remained in use for most of the introductory classes and our demonstration equipment.

PAIS ended up as the largest science investment in New Mexico in the state's history, with a total price tag of around $66M. About $27M came from NM taxpayers, a General Obligation Bond that was passed by the voters in November 2016, with 63 percent of the votes in favor. Approximately $1.5M were contributed by individual legislators from Santa Fe. The remainder, a substantial amount after all, was provided by 2017 UNM institutional bonds, i.e. effectively student fees. Both undergraduate and graduate student bodies had voted "yes" in support. The original project consisted of two phases, including a second phase of replacing Regener Hall, but without the Interdisciplinary Science portion of PAIS, at a cost estimate of around $81M. As a result of the subsequent change the long-term future of Regener Hall remained uncertain.

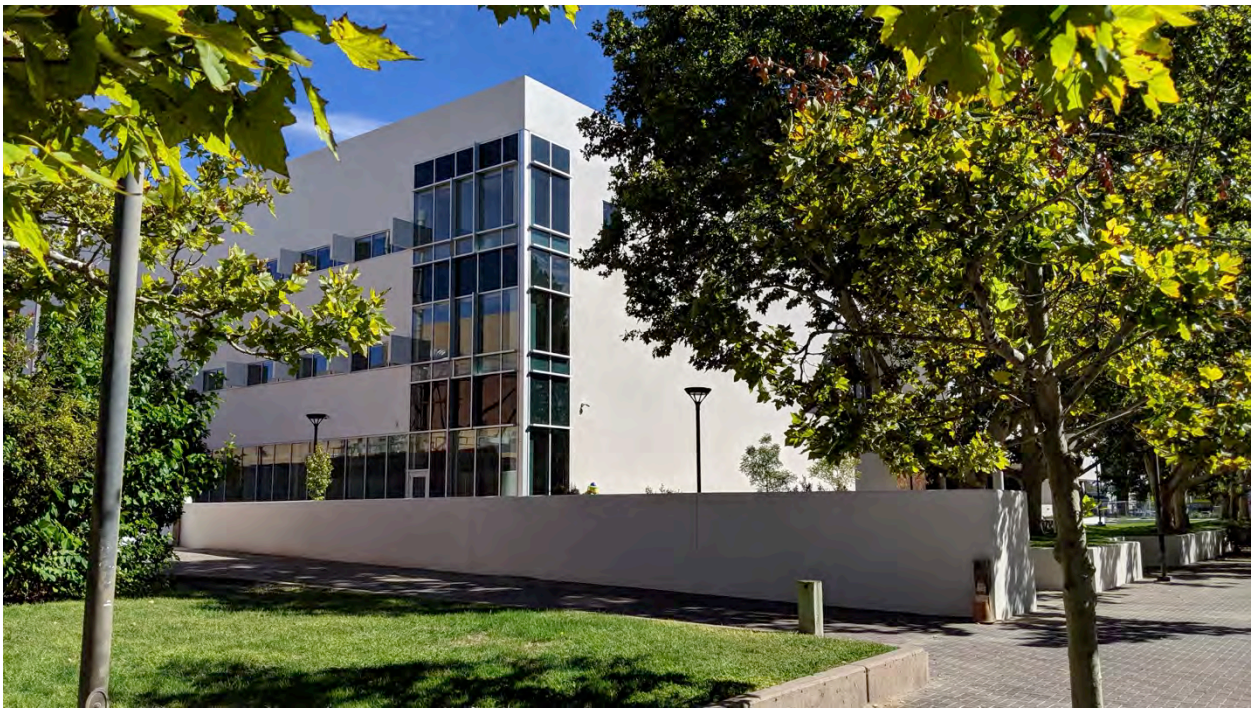
A major roadblock occurred when the Regents disapproved the request to close Redondo Drive in front of the building for regular car traffic. This required a re-design and caused delay. The official ground-breaking happened on March 20, 2018, and the construction was completed by late summer 2019. This was followed by the complicated logistics of moving the entire P&A department over several months during the fall of 2019.



Remember the (physical, not administrative!) chairs in room 184 of the old P&A building?

The 2020s

As we entered the decade of the 2020s Prof. Richard Rand was Chair, and the department very much enjoyed finally being in a wonderful, spacious new building, **see the following photos of PAIS – Physics & Astronomy & Interdisciplinary Science (completed fall 2019)**.



A new emailed Alumni Newsletter was started with the specific purpose of fundraising, but also generally to forge better connections with our alumni. This goes out twice a year and features notable events and achievements. (There had been some previous Alumni Newsletters, but not issued in any consistent fashion over multiple years.)

A highlight of the spring semester 2020 was the election of Distinguished Prof. Emeritus Carl Caves into the National Academy of Sciences, a significant honor for him and for the department. In addition, in fall 2020 the Micius Foundation (named after an ancient Chinese philosopher) named Prof. Caves as one of three recipients of the Micius Quantum Prize 2020,

which focuses on the broadly defined field of quantum metrology,

Otherwise the spring semester 2020 turned out to be one of the most traumatic and challenging for UNM and the department. The reason was the COVID-19 corona virus pandemic, which about half-way through that semester forced major changes to daily operations and instruction across the entire university. The spring break was extended by two weeks in order for instructors to work on changing as many classes as possible to some form of online instruction. Needless to say, to accomplish this in such a short time posed many headaches and challenges for the faculty. The campus became eerily empty for the entire rest of the semester as almost everybody, except for very few people deemed essential personnel, were required to work from home and practice "social distancing". The research effort also suffered substantial interruptions and delays. Graduate students were not allowed to be in labs, delaying their PhD research by months in some cases. Only by later in the summer were restrictions to campus access slowly eased, but the fall looked to provide as many challenges as the spring, just with more time to plan for them.

Students were able to resume laboratory research, but in the fall larger classes were taught remotely, and, beginning the week of Thanksgiving, all classes moved to a remote format as the situation in New Mexico worsened. Staff continued to work almost entirely from home, and department business was conducted remotely. PAIS continued to be sparsely occupied. There were three cases of COVID-19 in the department but they were quickly isolated. Spring 2021 began with one week of fully remote instruction, before reverting to the same pattern as the fall. In an attempt to make up for the damaging lack of interaction amongst the faculty, a "virtual retreat" was held in January, mainly in order for the faculty to inform each other of ongoing activities and initiatives, and for younger faculty to engage more in the culture and mission of the department. It was hoped that vaccines for COVID-19 would be sufficiently available to allow normal instruction to resume in Fall 2021.

Two faculty hires were made in the spring semester 2020: Tonmoy Chakraborty, in biophotonics, and Jessica Dowell, a Lecturer in charge of introductory lab classes, replacing Mickey Odom. Along with the earlier (2017/18) extremely successful hiring season, there were now 31 tenure-stream faculty for fall semester 2020, tying our all-time record during 1996/97. Including our Lecturers, ten of the 34 faculty were women, almost twice the national average for PhD-granting institutions.

Also in fall 2020 Gary Harrison, our Facilities Operations Manager, won UNM’s Gerald W. May Outstanding Staff award, a much deserved recognition for someone who for years had been extraordinarily dedicated to maintaining and overseeing all operations in our old buildings. He was also instrumental in helping with the planning for and the ultimate, very non-trivial move into the new PAIS building.

An anticipated challenge for the future, especially given the NM budget crunch as a result of the COVID-19 pandemic, was figuring out how to fund faculty start-ups in certain, high-priority areas of experimental physics, such as optics and quantum optics, where they often exceed $1.5M. Targets of opportunity, combined with a lot of groundwork, were deemed to be the only way these will happen.