I. Degree to be Awarded upon Completion of Requirements

Doctor of Philosophy in Astronomy

II. Proposed Date of Implementation

Fall 2003.

III. Description of the Program or Institutional Unit

The Department of Physics (the Department) at the University of Nevada, Las Vegas (the University) provides its students with several undergraduate and graduate programs in this fundamental area of study. Currently the Department offers three undergraduate programs, the Bachelor of Science in Physics, the Bachelor of Science in Applied Physics, and the Bachelor of Science in Computational Physics as well as two graduate programs, the Master of Science in Physics and the Doctor of Philosophy in Physics. The Bachelor of Science in Physics program provides training for students who are interested in governmental or industrial positions as well as graduate studies in physics or related areas. The Bachelor of Science in Applied Physics program is designed for students interested in interdisciplinary areas between physics and engineering that require a significant knowledge of physics. The Bachelor of Science in Computational Physics program is designed for students who would like a profession in using computers to do science. The graduate programs are aimed at training students in physics research and preparing them for academic or other professional positions.

The proposed Doctor of Philosophy degree in Astronomy is intended to train students in modern astronomical science. The students will have a broad and complete understanding of modern astronomical sciences. The students will be able to perform independent research on astronomical problems. The astronomy program will train students hoping to teach astronomy or work at astronomical institutions as well as to prepare students for technical jobs requiring a greater understanding of science than an undergraduate degree.

IV. Statement of Degree Objectives
The objectives of the astronomy degree program are to provide students with knowledge and understanding of astronomy. They will have had an overview of what is known about the universe and stars around us from specific topical courses on interstellar medium, active galaxies, cosmology, and stellar atmospheres. The students will also demonstrate the ability to carry out independent research.

The Physics Department now has five astronomy faculty and it is a good time to expand into offering astronomy degrees as well as physics degrees. An informal survey of departments offering astronomy as well as physics degrees shows that they typically have between 6 and 8 faculty. The department already gets some inquiries from prospective students for astronomy degree programs. It is thought that having astronomy degree option along with changing the name of the the department will attract more and higher quality students.

V. Plan for Assessment of Degree Objectives

The degree objectives of the program will be assessed annually. Several mechanisms will be used to evaluate the success of the program and possible improvements.

Reports on progress, graduates, and other related aspects will be given to the Department. If there are any problems with the program, the Department will take action to address them.

The students enrolled in the program will be asked to comment on their learning, employment prospects, and strengths or weaknesses of the program. Advice will be given to students enrolled in the program to tailor a personalized curriculum of optional courses to meet the need of each individual in the program.

Colleagues in the related programs in the University & Community College System of Nevada (the System) and in other institutions will be consulted and solicited for comments. Potential and existing employers of the graduates of the program will be contacted to determine their needs and ensure the program addresses them.

VI. Contribution and Relationship of the Program Objectives to Others

A. Institutional mission
The University expects a high level of scholarship from its faculty and students, as pointed out by the mission statement in its Academic Master Plan. The requirements in the proposed program are tailored carefully to meet the highest standard among all similar programs world-wide. A significant number of graduate courses in Physics are required while maintaining a flexibility for developing personalized options to ensure that the students enrolled in the program will gain extensive knowledge in astronomy and physics as well as skills in written and oral communication, computing, problem-solving, and working with a team, which are essential for a successful career.

This new program will also help the University in achieving several of its missions. For example, the University has an important role in the Las Vegas metropolitan area, the state of Nevada, and the southwestern United States, in providing general and specialized education to their residents and qualified graduates to the companies, firms, and other organizations in the area. A first-rate astronomy program offering a Ph. D. will provide residents in the area an unprecedented opportunity for advancing their knowledge.

B. Campus academic master plan

One of the goals set in the Academic Master Plan of the University is to seek selective growth in degree programs based on the need and demand of the students, resources available, and state of readiness. The proposed astronomy program is the first of its kind in the state of Nevada and will certainly create a new competitive learning environment in scientific computing, fostering more computational science and computational engineering programs from other departments and colleges in the future.

The University has decided to utilize its existing resources to a better extent, as stated in its Academic Master Plan. The Department has been active in astronomy for many years and has been successful in obtaining extramural funds. Faculty research interests include star formation in galaxies, active galactic nuclei, ring galaxies, clusters of galaxies, large scale structure of the universe, stellar atmospheres, nucleosynthesis and variable stars. The Department is part of the Nevada Space Grant Consortium, the purpose of which is to develop research and educational opportunities in space science in Nevada. The department is also part of a four-college consortium that operates an automated telescope on Mt. Hopkins, near Tucson, Arizona. UNLV astronomers successfully compete for
observing time on the Hubble Space Telescope and at the various national astronomical facilities, such as the National Optical Astronomy Observatory. On-site departmental facilities include a 16-inch computer-operated photometric training telescope mounted on the roof of the Bigelow Physics Building, personal computers and workstations dedicated to digital processing of astronomical images, as well as a Computational Cluster bought with money from the W. M. Keck Foundation.

C. Department and college plan

The Department currently has four faculty members actively supervising graduate students in research in Astronomy and Astrophysics. A program built on their expertise will stimulate more students to participate in an active learning process and to gain first-hand experience by working with these faculty members.

D. Other programs in the institution

We do not anticipate significant impact of this new program on the existing programs in the University since there is not an astronomy program in the University. The required courses in graduate physics are expected to cause an increase in the enrollment of those courses.

E. Other related programs in the System

There is no astronomy program, either degree or research, at University of Nevada, Reno.

F. Articulation issues

The program would coexist with the physics Ph. D. program, supplementing physics courses with those required for an astronomy Ph. D.

VII. Evaluation of Need for the Program

A. Intrinsic value of the program within the discipline

The proposed Doctor of Philosophy in Astronomy is intrinsically valuable because it addresses the needs of students with interests in astronomy desiring to pursue this goal. The curriculum designed for the program takes advantage of the existing Doctor of Philosophy in Physics program to allow students to tailor their physics and astronomy
training to their career needs. Compared with a half dozen such programs across the nation and the world, the program will be extremely competitive, since we already have several active research faculty. Through the offering of this new program, the University will add another high-quality education area to its current programs for better service to Nevada residents and others. Graduates from this program will have a solid background in both physics and astronomy.

The introduction of the program will increase the level of recognition of the University and the Department among other educational institutions and the scientific community. It will increase our ability to train students in an area where we have already had success placing students.

B. Evidence of existing or projected local and/or global need for the program

The Physics Department already receives regular inquiries regarding an Astronomy program. Currently the students either get a Doctorate in Physics and do a thesis which relates to astronomy, or go elsewhere to a University which has an astronomy program. This program will allow us to be more flexible in admitting and designing degree programs for students interested in getting an astronomy doctorate at UNLV. In addition, because physics requirements are replaced by astronomy requirements, this program can be more flexible in accepting students from other disciplines who have an abiding interest in astronomy.

C. Evidence of employment opportunities for graduates

The Physics Department has already graduated a number of M.S. and Ph.D. students who have worked with astronomy faculty and whose theses and dissertations have been on topics of astronomical interest. All these students are fully employed.

D. Student clientele to be served

Future employers of university and college graduates having technical degrees will be looking for communication, computer, problem solving, and team-working skills, according to Dr. Malcolm Cohen, former director of the Institute of Labor and Industrial Relations at the University of Michigan. The proposed program is designed to train students in four of these critical areas. Because the Department has a significant number of faculty
members in astronomy and astrophysics, the students in the program will have a unique opportunity to develop the necessary skills. The nature of the program will also allow close supervision of the students by faculty members and will encourage interactions among the students.

E. Procedures used to arrive at the decision to propose the program

A survey of Departments in the American Physical Society lists suggest that departments offering both physics and astronomy degrees typically have between six and eight professors specializing in astronomy. These relatively small numbers are possible because of the strong overlap between physics and astronomy allowing the program to draw on classes from each discipline. The Department currently has five faculty members who have astronomy related research. This suggests UNLV is ready to add astronomy degree programs to the physics degree programs. bigskip

VIII. Detailed Curriculum Proposal

A. Representative course of study by year

Fall 1:

Introduction to Astrophysics I (AST 700): 3 credits
Quantum Mechanics I (PHY 721): 3 credits
Mathematical Physics (PHY 700): 3 credits
Total: 9 credits

Spring 1:

Introduction to Astrophysics II (AST 701): 3 credits
Observational Astronomy Techniques (AST 710): 3 credits
Mechanics (PHY 702): 3 credits
Total: 9 credits

Fall 2:

Stellar Atmospheres (AST 731): 3 credits
Interstellar Medium (AST 747): 3 credits
Electricity and Magnetism (PHY 711): 3 credits
Total: 9 credits

Spring 2:
Cosmology (AST 727): 3 credits
Astrophysics of Gaseous Nebula and Active Galactic Nuclei (AST 721): 3 credits
Modern Optics (PHY 662): 3 credits
Total: 9 credits

Fall 3:
Dissertation (AST 799): 6 credits
Optional PHY or AST course: 3 credits
Total: 9 credits

Spring 3:
Dissertation (AST 799): 6 credits
Optional PHY or AST course: 3 credits
Total: 9 credits

Fall 4:
Dissertation (AST 799): 6 credits
Optional PHY or AST course: 3 credits
Total: 9 credits

Spring 4:
Dissertation (AST 799): 6 credits
Optional PHY or AST course: 3 credits
Total: 9 credits

B. Program entrance requirements

Applicants must have a minimum grade point average of 2.75 for all undergraduate work or a minimum 3.00 grade point average for the last two years of undergraduate work. In addition, applicants seeking direct admission to the doctoral program without a previously earned Master of Science degree must have a score in the 65th percentile or above on the Advanced Physics portion of the GRE before admission and have a minimum GPA of 3.00 for all undergraduate work or an overall 3.25 GPA for the last two years of undergraduate work. Applicants with a master’s degree must have an overall 3.00 GPA
in their Master’s program and at least 15 credit hours of graduate-level course work in physics or astronomy with a grade of B or better.

C. Program completion requirements

A total of 60 graduate credits past the bachelor’s level is required, including the following:

1. A minimum of 36 graduate-level semester credits in astronomy or related fields (excluding doctoral dissertation and graduate seminar), which must include the following core courses:

   AST 700-701 Introduction to Astrophysics
   PHY 702 Mechanics or PHY 721 Quantum Mechanics
   PHY 700 Mathematical Physics
   and at least 3 courses from
   AST 710 Observational Astronomy Techniques
   AST 721 Gaseous Nebulae and Active Galactic Nuclei
   AST 727 Cosmology
   AST 731 Stellar Atmospheres
   AST 747 Interstellar Medium
   AST 771 Special Topics

Six of the 36 credits must be taken in the fourth or fifth year. Course work used to satisfy the requirements for a master’s degree may be included. A minimum grade of B- is required in each course. An overall grade point average of 3.00 or better is required in all course work which is part of the degree program. Course work taken outside the Physics Department must have departmental approval. Doctoral and Master’s degree candidates take many of the same courses.

2. Six credits of AST 796, Graduate Seminar, including three acceptable presentations by the student.


4. Satisfactory performance on an astronomy qualifying examination on graduate astronomy knowledge. Must be fulfilled by the second year in the program.
5. A dissertation of high quality.

Each student will have a four-member advisory committee, which will carry out an annual review of the student’s progress.

**D. Accreditation considerations**

There is no separate accrediting organization for astronomy programs.

**E. Evidence of approval by appropriate committees of the institution**

This proposal serves as a request for the approval of the program to all the relevant committees of the University.

**IX. Readiness to Begin the Program**

**A. Faculty strengths**

The faculty in the Department are mainly specialized in three major fields, (1) astronomy and astrophysics, (2) atomic, molecular, and optical physics, and (3) condensed matter physics. In each of the three fields, there are faculty members who are experts in computer simulation and modeling.

The Department offers a complete curriculum of physics and astronomy courses that range from algebra-based Introductory Astronomy and General Physics to advanced special topics in current research in physics and astronomy.

The faculty of the Department publish regularly in leading refereed journals and their research projects are widely supported by the National Science Foundation, the Department of Energy, and the National Aeronautics and Space Administration. One of our faculty is on the STIS Instrument Definition Team for the Hubble Space Telescope. Other faculty have received guest observing time on Hubble and other world-class telescopes.
B. Contribution of the program to other programs

The proposed program will provide for astronomy education at UNLV. As the first astronomy program in Nevada, the proposed program will expand the opportunities for students studying in Nevada.

C. Completed prior planning for the development of the program

The “Introduction to Astrophysics”, “Interstellar Medium” “Astrophysics of Gaseous Nebulae and Active Galactic Nuclei”, “Observational Astronomy Techniques”, “Stellar Atmospheres” and “Cosmology” courses have already been developed and offered. The only other courses which need to be submitted are largely administrative courses such as: AST 771 “Special Topics”, AST 777 “Advanced Special Problems”, AST 796 “Graduate Seminar”, AST 797 “Thesis” and AST 799 “Doctoral Dissertation”.

D. Recommendation from prior program and/or accreditation review teams

None.

E. Organization arrangements needed for the program

None.

X. Resource Analysis

A. Proposed source of funds

The program, consisting of both the Astronomy Ph. D. and Astronomy M. S. degrees, will require two new faculty lines. This is both to teach the additional courses required as well as to have additional research opportunities for incoming students. At least one of these must be in place before the program starts. This will allow the astronomers to rotate from teaching the undergraduate astronomy courses AST 103 and AST 104 to teaching graduate courses for the program.
B. Estimated full-time equivalent (FTE) enrollment

The estimated FTE fall enrollment for the first year is about three students, for the third year is about five students, and for the fifth year is about six students.

The estimated total head count for the proposed courses is expected to be higher as Astronomy courses often attract people outside the program with an interest in astronomy.

C. Budget projections for each of the first three years

In addition to the existing Department budget the program will need two additional faculty. At least one of these faculty must be hired before the program can begin.

No additional classified staff members are requested for the program under the assumption that the existing classified staff positions will not decrease or be suspended over time. No additional supporting staff members are requested to begin the program, assuming that the Department will have successfully converted its half-time Computer System Programmer into a full-time position.

No additional operating funds are requested for the program.

The current library holdings are adequate for the program.

D. Estimated budgetary and financial ramifications for the institution

No significant budgetary or financial ramifications are anticipated for the University by introducing this new program because the amount of initial funding requested is relatively small and possible future support is in line with the selective growth of the Academic Master Plan of the University. The Department will also actively seek extramural funds to support the program as it has done for its other programs in the past.

E. Impact of the new program on department’s existing resources

The proposed program will share most of the Department’s resources with other existing programs in the Department. The plan is to better utilize the existing resources and better fulfill the mission of the University within the available resources. The introduction of the program will, however, require the Department to allocate its resources efficiently and divide its efforts among all the programs.

XI. Facilities and Equipment Required
A. Existing facilities
   The main facilities needed for the program are the existing facilities in the Department, including the existing laboratories, teaching facilities, computer rooms, etc.

B. Additional facilities required
   None.

C. Existing and additional equipment required
   None.

XII. Student Services Required
A. Plans to provide student services to accommodate the program
   The general student services provided by the Department to the students in existing programs will also be provided to the students in this new program.

XIII. Consultants
A. Names, qualifications and affiliations of consultant(s) used
   Still needed.

B. Summary of consultant’s comments and recommendations
   Still needed.

C. Summary of proposers response to consultants
   Still needed.

D. Attachment of consultant’s complete report