UNLV

UNIVERSITY OF NEVADA, LAS VEGAS

Program Review Self-Study

Program Reviewed: Physics

Degrees: B.S.

Program Chair or Director: Dr. Stephen Lepp

Dean: Dr. Eric Chronister

Date of Report: March 2019

GENERAL INSTRUCTIONS

1. **Please complete the program review self-study using this template**.
2. If this review is covering several degree levels, please be sure to address ***each level*** in your responses to the questions.
   - Dr. Rainier Spencer, Vice Provost for Academic Affairs: rainier.spencer@unlv.edu, 702-895-5833.
   - Nora Carroll, Academic Programs Analyst, eleonora.carroll@unlv.edu, 702-895-1888.
3. **Self-study submission:**
   - Send completed self-study electronically to rainier.spencer@unlv.edu and eleonora.carroll@unlv.edu.

I. Program Description

A. College/Department/Program

1. College or School: College of Sciences
2. Unit: Web Address: http://www.physics.unlv.edu/
3. Program being reviewed:
   a) Degrees and their abbreviations: B.S. Physics

B. Primary individual completing this worksheet

1. Name: Stephen Lepp
2. Title: Chair
3. Date of self-study: 2/1/19
4. Campus phone number: 895-4455
5. Mail stop: 14
6. E-mail: lepp@physics.unlv.edu
7. Fax number: 895-0804

C. Other faculty involved in writing this report:

None. The office manager and staff helped fill in some of the data.

D. Catalog Description

Please insert the most recent catalog description(s) of the program(s). Due to display complications, the description must be typed into this form and not pasted from the catalog.

The Bachelor of Science in Physics provides students with preparation for governmental or industrial positions or for graduate studies in physics or related areas.

1. Is this description correct? If not, what needs to be changed?
   Yes, no changes needed.

II. Centrality to Mission

A. Department/Program Mission

What is the program's mission statement (or the department's if the program does not have one)?

The mission of the Department of Physics and Astronomy is to provide programs of the highest possible quality in instruction, research, advising and service in the disciplines of Physics and Astronomy. We strive to provide an environment emphasizing the importance of coherent and integrated approaches to teaching, research and service. In this friendly environment both students and faculty can foster and develop a broad base of scientific knowledge, skills, principles and competence. This will enable students to implement the technological problem solving skills needed in industrial, academic and governmental research careers in physics or astronomy. The

department's mission is reflected in the degree programs it offers: B.S. Physics, M.S. Physics, M.S. Astronomy, Ph.D. Physics and Ph.D. Astronomy.

B. Department/Program Mission Alignment

Briefly describe how this program is aligned to the mission of the University as described in the most recent mission statement, UNLV Mission https://www.unlv.edu/toptier/vision, and how it supports achievement of the institution's mission:

The mission of the Department of Physics and Astronomy aligns with that of the University, particularly in fulfilling traditional areas of study with research at national and international levels. Our programs also fulfill the University mission by preparing students for graduate studies and producing graduates ready to enter the workforce.

C. Core Themes

Briefly describe how this program supports UNLV's Core Themes (the core themes can be found at: https://www.unlv.edu/provost/nwccu/core-themes):

The department is fully involved in in expressing the mission through the core themes, particularly those of Student Learning and Success and of Research, Scholarship, and Creative Activity. The department is one of the most research active on campus and we strive to include our students in these activities.

D. Excellence

List and briefly describe five highlights or areas of excellence of the program:

Our department has many high quality research programs as is shown in publications and grants. A publication list is attached to this report and it is one of the best in the university. In the last 10 years our department has brought in approximately two million dollars per year in grant money.

We encourage students to get involved with research projects. In addition to our capstone course, which requires each graduate do a project in collaboration with an active researcher, we have many students who get involved in research with our faculty throughout their time at UNLV. We find this helps both in education and in retention of our majors.

We have several recent hires who have shown to be very high quality, productive researchers. These include Rebecca Martin, Jason Steffen, and Zhaohuan Zhu, with research in astronomy, as well as Ashkan Salamat and Qiang Zhu with research in condensed matter physics. These tenure-track professors have brought a new young active contingent to the department and have been very productive in publishing and obtaining grants. Zhaohuan Zhu, one of our tenure-track faculty won a Sloan Fellowship, the first such winner in the state of Nevada.

We have been very successful at getting our majors accepted into top graduate programs around the country with students who did their graduate work at University of Colorado, Cal Tech and Harvard.

We have produced several books on subjects such as cosmology, computational physics, gamma ray bursts and quantum computing and information.

III. External Demand for Program

A. Stakeholders

1. Who are the main local and regional stakeholders of your educational programs, i.e., employers and entities benefiting from these programs, hiring the graduates, or admitting them to graduate and/or professional programs?

There is a need for physics graduates at the Nevada National Security Site (NNSS) and for teaching within the Las Vegas valley, but the market for physics graduates is primarily national and our graduates end up all over the country. A significant fraction of our graduates continue to graduate school and this also is a national market.

2. What are specific stakeholder needs for graduates?

To have graduates demonstrate a basic understanding of undergraduate physics, the ability to formulate and solve problems and to think independently.

B. Needs for Graduates and Future Plans

1. What are the anticipated needs for program graduates over the next 3-5 years? Please cite sources of information.

The Bureau of Labor Statistics Occupational Outlook Handbook states "Overall employment of physicists and astronomers is projected to grow 14 percent from 2016 to 2026, faster than the average for all occupations". Note: The growth projected for all occupations is 7%, so this is double the average.

2. What changes to the program will those require?

We will have to prepare for additional numbers of majors.

C. Success of Graduates

1. What steps does the department take to facilitate the success of graduates (e.g., internships, career fairs, employment talks, etc.)?

Only informally, each major is assigned an advisor in the department.

2. Discuss the placements of recent graduates:

Currently, we have only anecdotal information. Our graduates seem to be successful at getting into graduate school or finding a job.

3. If the department or program does not have placement information on graduates, what is the plan to implement gathering that information?

We conduct an exit interview with each of our graduates. We will add a question to the exit interview to ask for contact information from our graduates (their UNLV email gets disabled when they graduate). This will allow us to do a systematic study on how our graduates are doing.

4. Do placements match stakeholder needs as identified above in A of this section?

We have no reason not to think so, our stakeholders are people who want graduates trained in physics, a market which is expected to grow.

5. If not, please explain:

6. Does the program assess whether the graduates are meeting employer's needs?

We don't currently.

7. If not, what will the program do to place this NSHE-required assessment in place and by what date?

Again with contact information from our graduates, we will be in a better position to assess this.

8. Additional comments:

IV. Program Resources

A. Faculty Time

1. Faculty and GA Resources

	Fall 2015	Spring 2016	Fall 2016	Spring 2017	Fall 2017	Spring 2018
Number of Full Time Faculty	18	18	18	17	17	16
Number of State-Supported GA lines	18	18	17	17	18	18
Number of PTIs	7	7	10	9	8	6

Number of FIRS & Visiting Faculty	1	1	1	1	2	2

	Fall 2015	Spring 2016	Fall 2016	Spring 2017	Fall 2017	Spring 2018
Percent of Classes Taught by Full Time Faculty	20%	20%	15%	21%	16%	14%
Percent of Classes Taught by Number of State-Supported GA lines	43%	38%	35%	34%	40%	41%
Percent of Classes Taught by Number of PTIs	33%	38%	45%	40%	36%	36%
Percent of Classes Taught by Number of FIRS & Visiting Faculty	4%	5%	4%	4%	9%	9%

	Fall 2015	Spring 2016	Fall 2016	Spring 2017	Fall 2017	Spring 2018
Student Credit Hours Taught by Full Time Faculty	42	9	33	45	39	39
Student Credit Hours Taught by Number of State-Supported GA lines	30	25	25	24	32	32
Student Credit Hours Taught by Number of PTIs	26	31	42	32	31	29
Student Credit Hours Taught by Number of FIRS & Visiting Faculty	9	9	9	9	21	21

2. For other non-major courses – e .g., upper division for the college or university, estimate the unit's resources allocated to them: We have extensive courses offered in the lower division as service courses for the university. These courses fall into two categories. The first are courses required by other programs: Phys 151, Phys 152, Phys 180, Phys 181, Phys 182 and associated lab sections. The second are courses that meet the science requirement: Ast 103, Ast 104, Phys 108, Phys 115 and associated labs.

B. Budget

1. Please fill in the table with three years of financial expenditures to be used to respond to questions 2 and 3 below.

Budget category	FY 15–16	FY 16–17	FY 17–18
State Operating (2101)	$96,110.72	$104,968.02	90,557.62
Student Fees	$32,639.77	$31,484.52	$28,953.99
Indirect Cost Recovery	$50,061.76	$39,151.26	$23,569.91
Self-supporting	$	$	$
Total Allocations	$178,812.25	$175,603.80	$143,081.52

Number of Graduate Assistantships (including GAs on grants)	21	32	31

2. Are these resources sufficient to meet the degree program's instructional and scholarship needs?
   Through retirements and administrative assignments, we are currently down four faculty from a few years ago. This has stretched our ability to offer all of our courses and programs in the department. In particular, we do not currently have sufficient resources to offer as many upper division elective courses as would be optimal, or as the students would like. This will be alleviated as we hire replacement faculty for those who left.
3. If not, approximately what line items and amounts would be needed?

C. General Education

1. If your program or unit offers General Education courses, please estimate what portion of the unit's resources are allocated to this area:
   About 20% of our course offerings are for General Education and approximately 50% for Service courses for other programs.
2. Does the combined load from A and B above affect your unit's ability to offer courses for its major? If so, please describe:
   Our main challenge now in offering courses for our majors has been recent retirements. The fact that Service and General Education courses must be offered, indirectly affects our ability to offer our major courses, especially electives.

D. Other Funding and Resources

1. Is funding from other sources sufficient to assist the program in achieving its outcomes? Other sources to be considered include: differential tuition, grants and contracts, endowment income, and one-time gifts for student scholarships, other one-time gifts.
   The Department of Physics and Astronomy receives a significant portion of its funding from federal grants. We have been very successful at bringing in outside funding, with a funding level of approximately 2 million dollars a year over the last 10 years. Unfortunately, a significant fraction of this funding came from a single grant, the High Pressure Science and Engineering Center, which we were notified last year would not be renewed. A challenge for the department over the next few years will be replacing this funding. Fortunately, we still have a large number of smaller grants in the department.
2. If not, which funding streams could most reasonably be increased to help the program attain its outcomes?

3. Has any new donor revenue been generated since the last program review?
   We have had some donor revenue since the last review. We have funding for a "Russell Frank Astronomy Lecture Series" as well as a Russell Frank Scholarship.
4. Has the unit engaged in fundraising activities to support the program over the last 5 years? If no, please explain why not:
   In addition to his direct donations, Russell Frank has been trying to find additional donors for the department, but beyond that the department does not engage in significant fundraising activities.
5. What has been the result of these fundraising activities?
   None.
6. Review the space data for your department and comment on its amount and quality. These data will need to be accessed by an individual with Archibus® access.
   The space in the department may be divided into three categories: Teaching Space, Laboratory Space, and Office Space. Teaching Space is adequate for our current needs, we occasionally need to schedule labs on weekends, but are able to offer all needed sections. Laboratory Space is

adequate for our current needs. All active researchers have some lab space and we have additional space earmarked for our current hires. It is desirable to have more lab space, but our current amount is sufficient for current needs. It will be challenging for the department to find space as we make future hires, though. Office space is a bit less then what is needed. Currently, we have several postdocs who need to double and triple up in offices, which is not ideal. We are currently able to house all our faculty, postdocs and students, but with continued growth it will be challenging for the department to find space for them.

7. Is the quality and quantity of available consumable materials and supplies (e.g., office supplies or lab supplies) adequate and if not, explain why not:
   It is adequate.
8. Is the quality and quantity of available technology resources, such as computers adequate and if not, explain why not:
   The availability of technology is adequate.
9. Is the quality and quantity of available equipment (other than computing) adequate and if not, explain why not:
   It is adequate.
10. Is the quality and quantity of available library and information resources adequate and if not, explain why not:
    It is adequate.
11. Staffing
    a) Are available department staff resources sufficient to attain the program's outcomes?
       The current staffing levels are adequate.
    b) If not, what additional staff resources are needed and how would they be funded?

12. Additional comments:

V. Size of Program

1. Below are headcount, course enrollment, and degrees conferred data from Decision Support.

Academic Level Key	
Undergraduate (UGRD):	Graduate (GRAD):
10 – Freshman	GR - Graduate
20 – Sophomore	PHD – PhD
30 – Junior	
40 – Senior	
50 – Post Bacc Undergrad	

Headcount:
Headcount declared majors in Physics BS

Plan code 'PHYBS'

Term	Freshmen	Soph.	Junior	Senior	Senior+
Fall 2010	20	11	15	24	0
Spring 2011	14	13	16	19	0
Fall 2011	33	21	8	20	7
Spring 2012	23	19	13	19	10
Fall 2012	20	21	26	19	7

Plan code 'PHYBS'

Term	Freshmen	Soph.	Junior	Senior	Senior+
Spring 2013	13	22	18	23	8
Fall 2013	19	19	23	28	4
Spring 2014	15	21	17	29	5
Fall 2014	20	12	19	27	4
Spring 2015	16	15	13	35	4
Fall 2015	22	19	18	33	6
Spring 2016	13	18	18	31	5
Fall 2016	23	14	17	34	5
Spring 2017	17	13	22	32	4
Fall 2017	21	15	20	35	5
Spring 2018	9	20	21	35	5

Source: PeopleSoft Table PS_LV_CNR_STDNT_CR
PS_LV_CNR_STDNT_CP
Office of Decision Support, July 2018

Course Enrollments:
Department of Physics and Astronomy enrollments by course subject

Enrollments in **PHYS** lecture courses by course level

Term	Level - 100	Level - 200	Level - 300	Level - 400
Fall 2010	804	0	0	47
Spring 2011	712	0	0	74
Fall 2011	663	0	10	67
Spring 2012	672	0	0	82
Fall 2012	659	0	5	86
Spring 2013	619	0	0	59
Fall 2013	708	5	4	68
Spring 2014	688	0	0	75
Fall 2014	732	0	0	61
Spring 2015	693	0	0	55
Fall 2015	862	0	0	63
Spring 2016	760	0	0	73

Enrollments in **PHYS** lecture courses by course level

Term	Level - 100	Level - 200	Level - 300	Level - 400
Fall 2016	918	0	8	52
Spring 2017	889	0	0	67
Fall 2017	1027	0	7	65
Spring 2018	903	0	0	66

Source: PeopleSoft Table PS_LV_CNR_ENRL
Office of Decision Support, July 2018

Enrollments in **AST** lecture courses by course level

Term	Level - 100	Level - 300
Fall 2010	951	0
Spring 2011	851	7
Fall 2011	817	0
Spring 2012	723	0
Fall 2012	720	0
Spring 2013	685	7
Fall 2013	720	0
Spring 2014	764	0
Fall 2014	782	0
Spring 2015	703	0
Fall 2015	736	0
Spring 2016	634	13
Fall 2016	641	0
Spring 2017	630	0
Fall 2017	693	0
Spring 2018	509	0

Source: PeopleSoft Table PS_LV_CNR_ENRL
Office of Decision Support, July 2018

Degrees Conferred:
Degrees Conferred by Academic Year (July to June)

Plan code 'PHYBS'

Academic Year	Degree Count
2008-09	4
2009-10	4
2010-11	4
2011-12	3
2012-13	8
2013-14	9
2014-15	9
2015-16	15

Source: PeopleSoft Table PS_LV_CNR_DEGREES
Office of Decision Support, July 2018

2. Discuss the headcounts from the last five years, i.e., are the trends in line with projections in your unit's strategic plan?
   The headcounts reflect a slow growth in the number of students and the number of degrees conferred over the years. It is hard to make too much of this, as it is small number statistics. We believe this reflects the departments desire to move toward a higher number of graduates per year. We would like to be at about 10 graduates per year and it looks as if we are close.
3. If not, why not?

4. Does your program's enrollment trend differ from national trends?

   According to the American Institute of Physics, the number of Physics Majors graduating each year has been growing by about 5% per year since 1999. The median number of undergraduate majors per department is 5 and the median number of undergraduate majors for a PhD granting institution is 15. The larger number from PhD granting institutions primarily reflects larger departments. Our numbers are a bit below those for PhD granting institutions, but our numbers are climbing and perhaps approaching this.

5. If yes, please discuss the reasons why:

6. Additional comments:

VI. Retention, Progression, Completion

A. Major Course Offerings

1. Are enough courses offered to meet enrollment demands?
   Currently we are down four faculty from retirements and faculty moving up to administration. This has presented a significant challenge to cover and offer enough courses for our programs. We are currently searching for two new faculty and as new faculty join the department this problem will be solved.
2. How many major courses have been added or eliminated in the last 5 years?

__2___Added _____Eliminated

3. Why were the actions taken?
   Faculty developed new elective courses that were topical, Physics of Global Warming, and Quantum Computing and Information. The core of the Physics undergraduate education has remained unchanged over time.
4. After reviewing the program, what additional actions should be taken to improve retention, progression and completion?
   With replacement faculty resources we could offer alternative tracks for our core courses, starting both in the Fall and Spring. This action would make it easier for our students to complete their programs on time.
5. Are there any courses that students routinely have difficulty getting enrolled in, that slow progression and/or graduation? If so, please identify them:
   We have had a few core courses fill, but again this would be solved by having two tracks, one in Fall and one in Spring.
6. If last question was answered yes, what steps can be taken to reduce "bottle-necks" in these courses. Please indicate *both* financially-based and non-financially-based solutions.

7. Can any changes in sequencing of courses be made to facilitate graduations?

B. Curriculum

1. Is the program's curriculum aligned with current developments in the field?
   The undergraduate physics curriculum consists of core, basic physics and mathematical concepts and remains largely unchanged by current developments in the field.
2. If not, what needs to be done to make the curriculum current?

C. Graduation Rates

Program graduation numbers and rates are summarized below.

Graduation Rates:
Graduation rates for Fall Cohorts

First-time, Full-time College Students declaring Physics BS and graduating within 6 years

Plan code 'PHYBS'

Cohort Term	Cohort Size	Degree in Plan	Degree % Plan	Degree in Dept	Degree % Dept	Degree any Dept	Degree % any
Fall 2010	10	1	10.0	1	10.0	3	30.0
Fall 2011	21	2	9.5	2	9.5	8	38.1
Fall 2012	11	2	18.2	2	18.2	3	27.3

Source: PeopleSoft Table PS_LV_CNR_DEGREES
PS_LV_CNR_CP
PS_LV_CNR_CR
Office of Decision Support, July 2018

Using the data in the tables above, please answer the following questions:

1. Are trends in 6-year cohort graduation close to the University's goals (UNLV's undergrad goal is 50%)?

It is small number statistics, but the numbers above reflect that our incoming students graduate at rates exceeding UNLV's goals. Many of our majors get their final degrees in either another department or another college. This may reflect the heavy demands of a physics major, however many students still graduate within six years. We have ongoing efforts, limited by resources (mostly faculty lines) to try and streamline the process so more of our majors can finish in 6 years (for example we try and offer two tracks for the core courses when resources permit).

2. If not, what is being done to reach the goal?

3. Discuss how and why the graduation rate is changing.
   Too small of numbers to draw any significant conclusions.
4. Additional comments:

VII. Relationship to Other Programs

1. What relationship does your program have to other programs (e.g. articulation, transfers, collaborations, partnerships) in the NSHE system?
   Very little.
2. What the relationship does this program have to other programs at UNLV (e.g., collaborations, partnerships, affiliated faculty, General Education requirements, etc.)?
   This department provides service courses for every department in the College of Sciences, every department in College of Engineering, as well as many other departments throughout the University.
3. Additional comments:

VIII. Impact

1. What impact has this program had or will have in the following areas:
   a) University
   The Physics and Astronomy department impacts the University through the conduct of high quality research, service, and production of high quality graduates in fields with increasing worldwide demand.

   b) Community
   The unit provides many outreach efforts to the community, including public lectures and school visits.

   c) Field
   The department provides other educational institutions with well-qualified research active faculty. We also contribute graduates at the undergraduate and graduate levels to corporations in private industry and to government agencies seeking well trained scientific and technical individuals.
2. What are the benefits to the institution of offering this program?
   The Department of Physics and Astronomy provides UNLV with a department doing high quality basic and applies research in important strategic fields, as well as educating the next generation of students in Physics and Astronomy. We also provide both service activities and substantial general education courses for the university.
3. Provide examples of the integration of teaching, research, and service (e.g., faculty mentoring leading to student presentations at conferences, service learning classes, community service activities involving students, or other student activities and/or achievements that you think are noteworthy).
   All of our undergraduate majors are encouraged to get involved with research programs within the department and all are ultimately required to do a research project to graduate.
4. Additional comments:

IX. Productivity

1. Please provide an indication of faculty productivity appropriate for your unit (lists of publications by type, grants by type, performances by type, installations by type, etc.):

   A partial list of publications and a partial list of grants is listed are listed in the appendix. The lists are incomplete in that they only capture publications and grants from current members of the department and not people who have left. The Department of Physics and Astronomy is one of the most productive departments at UNLV both in publications and grants.
2. Additional comments:

X. Quality

A. Admission and graduation requirements

1. Please insert program admission requirements from the current UNLV catalog. Due to display complications, this description must be typed into this form and **not** pasted from the Catalog.
   The admissions requirements for UNLV undergraduates are: 3.0 GPA in 13 core units (English, Math, Social Science and Natural Science) or 1120 SAT Score or 22 ACT score OR Nevada Advanced High School Diploma.
2. Are there any updates that need to be made to the catalog and if so, what are they?

   There has been some discussion of a math requirement for the College of Sciences.

3. How many full-time advisors are available at the college level?

   Eight advisors at the college level and each student is assigned an advisor in the physics and astronomy department.

B. Outcomes and Assessment

1. Student Learning Outcomes and Program Assessment Plans and Reports by program concentration are listed at http://provost.unlv.edu/Assessment/plans.html. Please attach the most recent assessment report in the Appendix.

   The most recent assessment report is included in the appendix.
2. Describe specific program changes made based on the program's evaluation of its assessment reports:

   Our major change based on assessment was to institute an "exit interview" with each student graduating. Going forward we plan to use this interview to collect contact information to help us contact our graduates for systematic study of their success.
3. Has the program revised its curriculum such as changing prerequisites, adding or eliminating required or elective courses, or co-curricular experiences for the degree(s) in the last 5 years?

   No.

   a) If yes, what changes were made and why?

4. Has the program revised course content or instructional approaches (pedagogy, technology) in the last 5 years?

   The department has added fully online sections in introductory, algebra-based physics and their associated laboratory sections.

   a) If yes, what changes were made and why?

5. Describe any other changes made in the last 5 years (for example, advising) based on assessment reports:

   None.
6. List and describe two specific improvements in student learning outcomes and why they represent forward movement.

7. Additional comments:

XI. Conclusions, Self-Assessment

A. Faculty Review of self-study

1. On what date did the program and/or department faculty review this self-study?
   3/8/19
2. What were the results of the faculty review?
   The faculty approved the self study with minor revisions.
3. What are the top 3 priorities and/or needs for the future development of the program?
   1) More faculty. Currently we are down four faculty with retirements and administrative assignments, and additional faculty will lead to additional research supervisors, additional elective courses (both undergraduate and graduate) and the ability to offer alternate tracks of some bottleneck courses in the undergraduate program. More faculty would allow us to grow the program to expected needs for a field for which job grown is expected to be 14%, double the average over the next ten years.
   2) More GA's. The physics department currently uses most of its GA's to teach laboratory classes for the undergraduate program. Most physics departments do both laboratory and recitation sections for their service courses. This helps in both retention (more people passing these courses) and it would allow us to accept more students. Currently our number of applications is up significantly and many are high quality students.
   3) More Space. As we get more faculty and more students we will start to run out of space for our programs. The department will need more space, both office and laboratory, going forward.
4. What are the strengths of the program?
   High quality faculty, working with high quality students to produce high quality research.
5. What are the challenges facing the program?
   One of our biggest challenges is to increase the research funding in the department, particularly from federal grants. The department has been very successful at bringing in research money, but must continue to pursue this funding. It is a particular challenge going forward, as we have lost one of our big grants (the HiPSEC grant lost at the end of 2017), but we have already started to fill in the loss with over a million dollars in new grants starting in 2018.
6. What recent additions, corrections, or other changes have been made to the program that reflect changes or developments in the field?
   The programs in physics and astronomy are very stable and have changed little over time. We have updated our teaching methods and experimented with online courses. We have also introduced new courses at both the undergraduate and graduate level in climate change, in quantum computing and information and at the graduate level in solar system formation.

B. Other comments

1. Is there anything else you would like to discuss about the program?