Feb. 25, 2009

Physics Program

Program Review
2008-2009 Academic Year

Program Chair:	David Chappell, Ph.D.
Department Chair:	Michael Frantz, Ph.D.
Natural Sciences Division Chair:	Robert Neher, Ph.D.

Feb. 25, 2009

Feb. 25, 2009

Table of Contents

Executive Summary

The physics program offers B.S. and B.A. degrees in physics, provides supportive courses required by other science programs, and offers courses that satisfy both physical science and interdisciplinary general education requirements. Over the last five years the number of physics majors averaged 5.8 students and increased by an average of 5% per year. The graduation rate during this period was the highest it has been over the history of our institution. Approximately half of graduating physics majors are accepted into graduate physics or astronomy programs. The vast majority (>95%) of the supportive and majors courses are taught by full-time faculty members. Course offerings and degree requirements are similar to our comparison institutions, but several improvements to the curriculum have been proposed (see below).

The learning outcomes for the physics major include a foundational knowledge of theoretical principles, the ability to apply that knowledge through problem solving, skills in experimental methods, and preparation for graduate school or careers in physics.

The assessment procedures included analysis of alumni surveys, course enrollments, senior exit exams, senior projects, course evaluations, course syllabi, and programs at our peer institutions.

The findings suggest the following:

1. Students receive a solid background in most areas of physics. Statistical mechanics/thermodynamics and experimental methods are the areas most in need of improvement.

2. Student feedback and a survey of other physics programs suggest several changes to the physics degree requirements including: the addition of a lab to accompany Modern Physics, adding differential equations as a supportive requirement, and the replacement of Science Seminar with a Physics Seminar course.

3. The majority of students gain acceptance into graduate physics/astronomy or education programs. Thus, our graduates appear to be prepared for careers in physics.

4. A poll of science majors revealed interest in a physics minor. A minor could potentially increase enrollments in the upper-division courses.

5. Space is required to establish an interdisciplinary computational research center and a laboratory for spintronics and nanophysics research.

6. A laboratory/stockroom manager is needed. Compensation for the program chair’s additional duties is needed.

7. Students expressed a desire for more information and counseling on careers and internships in physics.

The specific recommendations for action are as follows:

1. Obtain a stockroom/laboratory manager position.

2. Implement the proposed changes to the major adding an Advanced Lab as a core course, adding Differential Equations as a supportive requirement, and replacing Science Seminar with a Physics Seminar course.
3. Implement the proposed requirements for a physics minor.
4. Establish an interdisciplinary center for computational research in Physics, Mathematics, Computer Science and Chemistry.
5. Establish an experimental laboratory for nanophysics research.
6. Introduce an Advanced Laboratory course and purchase the needed equipment.
7. Introduce a Thermodynamics/Statistical Mechanics course.
8. Introduce a Solid State Physics Course.
9. Institute a dedicated lab section for the Engineering Physics course.
10. Continue to modernize the General Physics laboratory
11. Improve our advising of students particularly with regards to career opportunities.
12. Continue to explore new opportunities for student internships
13. Explore the possibility of establishing a 3-2 program with a local engineering program.
14. Improve the program’s website to include information about student career opportunities, student internships, faculty research, course information etc.
15. Recruit new physics majors so that upper division courses have larger enrollments.
16. Work with students to establish a local chapter of the Society of Physics Students.
17. Secure compensation or release time for the physics program chair.

I. Program Mission

The mission of the Physics Program is to provide students with rigorous training in theoretical and experimental physics in order to prepare them for graduate school or careers in teaching or industry.

II. Program Goals and Learning Outcomes

Graduating physics majors will:

1. Acquire a solid foundation in the theory and application of Mechanics, Electricity and Magnetism, Thermodynamics/Statistical Mechanics, and Modern Physics.

2. Develop skills in experimental design and data analysis.

3. Become informed physics citizens possessing excellent written and oral communication skills and the ability to independently research the primary physics literature.

4. Secure physics-related jobs and/or gain acceptance in graduate programs.

5. Receive excellent academic and career advising from faculty members.

III. Program Description

A. Organization

The physics program offers B.S. and B.A. degrees in physics. It is housed within the Department of Math, Physics, and Computer Science, which, in turn, is part of the Natural Science Division of the College of Arts and Sciences. While budgetary matters are managed at the department level, the physics program is essentially autonomous with respect to academic advising and the design and implementation of courses, degree requirements, etc.

B. Faculty and Staff

The physics program currently has two full-time faculty members, both of whom have doctoral degrees. Dr. David Chappell (hired in 2000) is a computational astrophysicist whose research focuses on theoretical and computational problems related to star formation in galaxies. Dr. Vanessa Preisler (hired in 2007) is an experimental physicist whose research focuses on spintronic devices, diluted magnetic semiconductors and quantum dots.

The last five years brought significant change to the physics faculty. The previous program chair, Dr. Sarah Johnson, took a two-year leave of absence beginning in the fall of 2005 and then resigned her position in the spring of 2007. Dr. Chappell assumed the physics chair position in 2005 and a two-year interim replacement, Dr. Jusak Tandean, was hired. Dr. Preisler was hired in 2007 to fill the tenure-track position vacated by Dr. Johnson.

At present, the physics program does not have a laboratory stockroom manager despite continual requests by the department chair, Dr. Michael Frantz. The task of repairing broken equipment, setting up and taking down laboratory experiments, preparing demonstration apparatuses, maintaining equipment inventories, purchasing, and managing student workers is shouldered largely by the two full-time faculty members. Student workers are hired as teaching assistants to help run the labs. The absence of a lab/stockroom manager was flagged as an area of concern during the previous program review in 2003.

The physics program also lacks dedicated secretarial support. The Natural Science Division shares a single secretary to service 15 full-time faculty members. Most secretarial work must be handled by the faculty themselves.

Finally, it should be noted that the physics program chair currently does not receive any form of compensation (either monetary or release time) for managing the program.

C. Courses and course enrollments

Courses offered by the physics program may be divided into three categories: upper-division courses for physics majors, lower-division courses that are mostly supportive requirements for other science majors, and General Education courses that service the broader ULV student population. Appendix A summarizes the courses taught by faculty in the physics program. Appendix B presents the five-year enrollment history of physics classes. Appendix C distills some of the major trends from Appendix B to give a set of summary statistics. Overall, the average class size of the physics program over the last five years was 12.8 students. The program enrolled an average of 203 students per year and 59% of the classes had 10 or more students.

While enrollments in upper-division courses have increased over the last five years, enrollments in supportive courses and General Education courses have been on the decline (see Appendices B and C). The increase in the upper-division courses is a result of the growing numbers of physics majors. The decline in enrollments in the supportive courses is tied largely to the declining populations of the Biology, Chemistry, and Computer Science majors. Similarly, the decline in enrollments in the General Education courses is likely driven by the falloff of the overall ULV student body population. The sharp reduction in the physical science class NASC 102 resulted from a decision by the California Commission on Teacher Credentialing to drop physical science as a requirement. As a result, the number of liberal studies majors taking NASC 102 have dramatically declined.

The full-time faculty teach all the upper and lower division courses for physics majors as well as the majority of general education and supportive courses offered by the program. Currently, two part-time instructors are teaching physics and physical science courses.

D. Majors

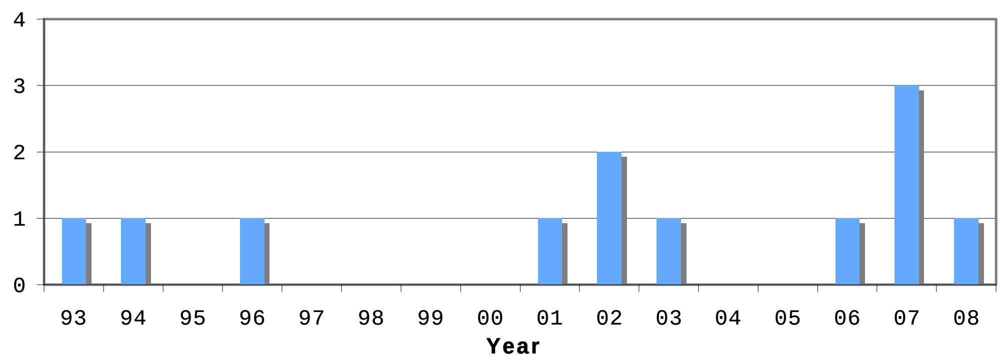
The number of physics majors is on the rise. Table 1 below shows the increase in both declared majors and graduates over the last six years. Over the last five years the population of physics majors averaged 5.8 students and experienced an average growth rate of 5% per year. The number of physics graduates in the last five years was larger than in any other five-year period over the history of our institution. The 15-year trend in the number of physics graduates is shown in Figure 1.

Table 1: Enrollment and Graduation Numbers for ULV Physics Majors

	2002/3	2003/4	2004/5	2005/6	2006/7	2007/8
Majors*	1	5	5	7	6	6
Graduates	1	0	0	1	3	1

*Unduplicated undergraduate headcount
Source: ULV fact book

Figure 1: Fifteen-Year History of Graduation Rates for ULV Physics Majors



Source: ULV registrar's office

The B.S. degree in physics requires completion of 43-46 semester hours of physics courses and an additional 17 semester hours of supportive requirements in math and chemistry (see Appendix D). Thus, students majoring in physics must take a total of 60-63 semester hours of math and science classes. The B.A. degree requires one less upper-division course, resulting in a total of 56-59 units. Both degrees require students to conduct a senior research project (PHYS 499) and pass a senior exit exam. A representative program of study for a physics major receiving a B.S. degree is given in Appendix E.

Appendix F shows a comparison of the ULV requirements for a degree in physics with those for a sample of our comparison institutions. ULV's physics major is similar to those of the five selected comparison institutions in terms of total number of units necessary to complete the major and in terms of the required core and supportive classes in the major. A few differences are noteworthy:

- Most programs offer a course in Thermal and Statistical Mechanics
- Most programs offer laboratory course in Modern Physics (Our Atomic and Nuclear Physics course lacks a laboratory compoent)

- Most programs require a supportive course on differential equations
- Four out of five of our comparison programs offer a physics minor (ULV currently does not).

We are in the process of updating our major requirements. Appendix G presents our proposed changes. Our motivations for these changes will be discussed in Findings section of this report.

We are also in the process of formalizing the requirements for a minor in physics (see appendix H). A discussion of the motivation for these changes is also given in the Findings section of this report.

E. Advising

All physics majors (including both traditional-aged and CAPA students) are advised by full-time faculty. Because of the small size of the physics program, physics majors have exceptionally open access to the faculty and are in constant contact with their advisors.

F. Facilities

The physics program is housed with the other science programs in the Mainiero (MA) building. Our facilities consist of the following:

Faculty Offices	MA 64 and MA152 C (total 450 sq. ft.)
General Physics Lab	MA 60 (600 sq. ft.)
Two Stock Rooms	MA 58 and MA 62 (total 640 sq. ft.)
Optics Lab	MA 54B (140 sq. ft.)
Machine Shop	MA 59 (300 sq. ft.)

We feel our greatest space needs are for additional research and teaching laboratories:

Research Labs
At present, the physics program has few experimental research facilities apart from those shared with the other science programs (such as the scanning electron microscope and the nuclear magnetic resonance instrument). Dr. Vanessa Preisler. who was hired in the fall of 2007, is eager to establish a research lab to continue her work in spintronics and nanophysics. Currently, she is collaborating with UCLA to use their facilities, but the importance of establishing a nanophysics lab at the University of La Verne cannot be overstated. An experimental lab is not only vital to one of our faculty to maintain her professional activity, but would also enhance the reputation of the university as a research institution and attract more students interested in physics. The faculty in the Math/Physics/Computer Science Department have been working on a proposal to establish an interdisciplinary computational center. The center would house high performance computers dedicated to faculty and student research.

General Physics Lab
The General physics lab (MA 60) is only large enough to safely handle 12 students in a laboratory setting. In order to conduct laboratory activities with our larger classes, such as PHYS

230: Astronomy or NASC 102L: Physical Science Laboratory, which have typical enrollments of 20 students, we must use either the General Chemistry laboratory (MA 57) if available or, MA 156, which is used extensively by the Biology department.

Funding for equipment is provided by two sources: laboratory fees paid by students taking lab classes (General Physics, Engineering Physics, and Introductory Astronomy) and equipment funds allocated by the university to the Natural Science Division. The majority of expenditures are used to purchase laboratory equipment and supplies for the lab classes. Some funds are also used to purchase demonstration equipment for the physics classes. An inventory of the program's major equipment assets is given in Appendix I. Appendix I also lists our projected equipment needs over the next five years.

The physics program has limited research-grade experimental equipment largely because, until last fall, both faculty members were theorists. The program does have a scanning-tunneling electron microscope, a relatively advanced optics laboratory, and access to the chemistry department's nuclear magnetic resonance (NMR) spectrometer and the biology department's scanning electron microscope (SEM). The program plans on establishing an interdisciplinary computational research center and a nanophysics laboratory within the next five years.

IV. Assessment Procedures

The following methods were used to assess the physics program learning outcomes:

1. **Alumni Survey & Senior Exit Survey**
   Seven out of the eight alumni who graduated from 2001 to 2008 were contacted and asked to fill out a survey on the strengths and weaknesses of the physics program. We received a 100% response from those contacted. Since only one student graduated in 2008, we combined her senior exit survey with the alumni surveys. A copy of the survey is included in Appendix J. An analysis of both the numerical rankings and written responses supervised by Aghop Der-Karabetian is included in Appendix K.

2. **Physics Course Enrollments**
   Appendix B lists the enrollments for all courses taught by physics faculty from 2003-2008. Appendix C summarizes the enrollment trends according to several criteria.

3. **Senior Exam Performance**
   Graduating seniors are required to pass a comprehensive exit exam. Scores for each problem for each of the seven exams administered between 2003-2008 are given in appendix M. Student performance was also categorized by subject area.

4. **Senior Project Analysis**
   Appendix N.

5. **Program Comparison with Peer Institutions**
   ULV's physics program was compared with those of five peer institutions. Appendix F presents a table comparing ULV physics program's core and elective classes, supportive classes and total units required with those of the comparison institutions.

6. **Facilities and Equipment Inventory**
   An inventory of the physics facilities, research equipment, laboratory equipment, computer resources, and demonstration tools was conducted. The results are presented in Appendix I.

7. **Curriculum Map**
   Courses for physics majors were analyzed to produce a curriculum map that shows course coverage of the different learning objectives. The curriculum map is given in appendix O.

8. **Course Evaluation Analysis**
   Dr. Aghop Der-Karabetian supervised a team of Psy. D. doctoral students to produce a content analysis of student evaluations for a randomly selected set of student responses in Fall 2006 to Spring 2007 physics courses. Their report is given in Appendix P.

V. Findings

Findings for each of the five learning outcomes will be discussed in turn.

A. Learning Outcome: Physics majors will acquire a solid foundation in the theory and application of mechanics, electricity and magnetism, thermodynamics and statistical mechanics, and modern physics.

A review of the Physics curriculum shows that the majority of the subject areas outlined in this learning outcome are integrated into the major courses in an appropriate manner with sufficient rigor and coverage. The **Curriculum Map** (Appendix O) provides a visual means of quickly assessing the coverage of these subject areas. The **Comparison Institutions** table (Appendix F) shows that ULV's total number of required units (63) for a physics degree is well within the range of other programs (50-80 units).

Overall, the written responses on the **Alumni Survey** (Appendix K) show that the alumni feel our program offers a quality education and individual attention. Typical comments include "I feel the ULV physics program offers a quality education and caters to a variety of interests and student backgrounds." and "A student can always find a professor to talk to about assignments, project, or other school business." Alumni ranked the variety of upper division courses as 4.00/5, with 50% of the responses being "very satisfied." The average rating for how well the program prepared them in the theoretical foundations of physics was 4.14 out of 5, with 14% indicating that they were very satisfied. These statistics may be an indication of how students perceive their preparation through coursework or how they perceive their preparation for the physics exit exam and/or the physics GRE.

Over the last six years, the average performance on the **Senior Exit Exam** (Appendix M) was 56%. Since the exam was created in-house, it is not possible to calibrate these scores to a national standard. However, the consistently low exam scores do suggest either a lack of student preparation or inadequacies within the test itself. Conversations with students reveal that very few study for the exam. One of the alumni, who is now in graduate school, suggested that more emphasis could be placed on the exam to encourage students to better prepare for it. We are presently investigating standardized exit exams such those produced by ETS that could be used to calibrate student performance to a national standard.

Several subject areas will now be discussed in turn:

Mechanics
Students are first exposed to mechanics in the lower-division course, PHYS 203 Engineering Physics I, and then introduced to more advanced topics such as Lagrangian and Hamiltonian dynamics in the upper-division course, PHYS 342 Analytical Mechanics. A requirement of one upper-division course on mechanics is typical of our comparison institutions (see Appendix F). Students consistently score highest on the mechanics portion of the Senior Exit Exam (with an average of 66% compared to the overall exam score of 56%). We feel that mechanics is adequately covered by the current physics curriculum.

Electricity and Magnetism
Students are first exposed to electricity and magnetism in the lower-division course, PHYS 204 Engineering Physics II, and then introduced to more advanced topics in the upper-division course, PHYS 322 Electricity and Magnetism. A requirement of one upper-division course on electricity and magnetism is typical of our comparison institutions (see Appendix F), although the University of Redlands requires two upper-division E&M courses. Students' scores on the electricity and magnetism portion of the Senior Exit Exam rank second of the four subject areas (with an average equal to the overall exam score of 56%). We feel that electricity and magnetism is adequately covered by the current physics curriculum.

Thermodynamics and Statistical Mechanics
This subject is the area most in need of improvement. Four out of the five comparison institutions require a course on thermodynamics or statistical mechanics (see Appendix F). We feel that this subject should eventually be better-covered by the La Verne Physics program. This feeling was echoed by at least one student on the alumni survey (Appendix K).

The lower-division Engineering Physics sequence does not currently cover thermodynamics. Expansion of the introductory sequence to include a third semester would provide the necessary time, however this option is not currently practical since the majority of majors taking this course are not physics majors. Were a third semester created for physics majors, it is unlikely that it would have sufficient enrollments to be offered on a yearly basis. Furthermore, the math, computer science, and chemistry programs, whose students take Engineering Physics, are unlikely to require a third semester of physics.

The existing two-unit course, PHYS 355 Thermodynamics, has not been taught for at least ten years. Instead, interested students are encouraged to take the upper-division chemistry course CHEM 411 Physical Chemistry I, which covers thermodynamics and statistical mechanics. This solution has provided a satisfactory (and cost effective) short-term solution.

Since thermodynamics is not a required subject, it is not surprising that students score lowest on that section of the Senior Exit Exam. The average score is 33%.

Modern Physics

For historical reasons, the modern physics topics that are usually included in an introductory physics sequence are taught in a separate course at La Verne, PHYS 360: Atomic and Nuclear Physics. Four out of the five comparison institutions offer a similar course, three of which also require a laboratory component.

Beyond the Atomic and Nuclear course, students are required to take one semester of Quantum Mechanics. Four out of the five comparison institutions have a similar requirement, with one program requiring two semesters of quantum. Students performed only slightly below average on the quantum section of the Senior Exit Exam, receiving a 50%. Some alumni reported a desire for a second semester of quantum. Beginning in the spring of 2009, a special topics course on Solid State physics will be offered, which will provide a wide array of applications of quantum mechanics. This course is expected to help bridge the gap between the theoretical study of quantum mechanics, and its application to material science.

Supportive Requirements

Physics students must take one semester of General Chemistry, and three semesters of Calculus. Most of our comparison institutions also require a semester of Differential Equations. We acknowledge the need for this course and are proposing to include it as an additional supportive requirement beginning the Fall of 2009. One alumnus independently suggested adding Differential Equations as a requirement. Three of our comparison institutions require a Mathematical Methods course. In the past, we have offered Mathematical Methods as a special topics course when students express interest.

B. Learning Outcome: Physics majors will develop skills in experimental design and data analysis.

Experimental methods in physics are taught in the lower-division lab courses PHYS 201L and 202L, some upper-division courses such as Optics, Electronics, and Atomic and Nuclear Physics, and as part of the senior research project if the student chooses an experimental project. The lower-division lab sequence consists of 24 labs that cover mechanics, fluids, waves, electricity and magnetism, optics, and modern physics. The labs utilize mechanical equipment (such as the ballistic pendulum), analog devices (such as multimeters and oscilloscopes), and computer-based data acquisition systems. A lab practical exam is given at the end of the spring semester. Students typically score well on their lab reports. The students are given detailed instructions and have access to instructors and TAs during the lab session.

Labs are occasionally included in upper-division courses, but none of these courses have explicit lab designations. PHYS 311 Electronics for Scientists is built around a series of eight to ten electronics labs. Often, PHYS 360 Atomic and Nuclear Physics and PHYS 350 Optics each include several laboratory experiments. Most of the other upper-division courses are strictly theoretical with no laboratory component.

It is acknowledged that students would benefit from more laboratory experiences. In the **Alumni Survey** (Appendix K), alumni ranked their preparation in experimental physics as one of the weakest areas with a score of 3.28 out of 5. However, they ranked their access to equipment and facilities higher (4.00/5). Our **Comparison Institutions** (Appendix F) appear divided on their dedication to advanced laboratory courses. Three of the five institutions require both a modern lab and an electronics course. The other two institutions require neither.

We are proposing to convert PHYS 360 Atomic and Nuclear Physics into a lab class by adding a one-unit, three-hour lab component. The physics program already has the facilities for measuring the speed of light, the photoelectric effect, gamma-ray spectroscopy, and x-ray diffraction (see the **Inventory** in Appendix I), all of which are topics covered by the course. Eventually, we would also like to develop an upper-division experimental methods course, where students are exposed to more advanced topics on experimental design and data analysis.

C. Learning Outcome: Physics majors will become informed physics citizens possessing excellent written and oral communication skills and the ability to independently research the primary physics literature.

At present, students are generally introduced to the primary physics literature when they begin work on their senior research projects (see Appendix N). The addition of LINK+ to Wilson library greatly enhanced the access of faculty and students to the physics literature. Students learn to access physics databases, retrieve articles, and use citation links to explore related articles. The extent to which a student utilizes primary sources varies depending on the nature of the project. Additional library resources are still needed in physics and astronomy. The most common journals such as the Astrophysical Journal and Physical Review are not accessible through the current databases.

As mentioned above, we are proposing to create a one-unit Physics Seminar course that would replace the current one-unit Science Seminar. Science Seminar is a required course for juniors and seniors in biology, chemistry and physics. It consists of a series of lectures from all scientific disciplines, which means that only one or two lectures are typically given by physicists. The proposed Physics Seminar would provide an opportunity for faculty and students to attend regional physics lectures, discuss senior research projects, and invite outside speakers to talk about career opportunities in physics. It would also be a venue to start a journal club in which students read and research a journal article and then make a presentation to seminar class. We feel that this seminar course may improve students' exposure to the primary physics literature and help prepare them for their senior project.

Self-reporting by students on the Alumni Survey (Appendix K) shows that they generally feel that they possess good scientific literacy skills, including written and oral communication skills, library research, fluency with physics literature, etc.

D. Learning Outcome: Physics majors will secure physics-related jobs and/or gain acceptance in graduate programs.

Of the eight alumni and graduating seniors who participated in the **Alumni Survey** (Appendix K), three are currently enrolled in graduate physics or astronomy Ph.D. programs, two are in teacher credentialing/masters programs, one is working in industry, and one is a home-school teacher. The one alumnus who we were not able to contact was in a Ph.D. program for medical physics two years ago. Thus, two-thirds of our graduates went on to pursue graduate degrees in physics or education. The student who went into industry was a CAPA student that returned to school to advance his education. He holds an upper management position in a fortune 500 energy company. We feel that this learning outcome is currently being met.

E. Learning Outcome: Physics majors will receive excellent academic and career advising from faculty members

All physics majors are advised by full-time faculty and have exceptionally open access to their advisors. Alumni rated academic advising positively, with a score of 4.00/5 and a 43% very satisfied rating. Career advising was similarly ranked, with an average score of 4.00/5 and a 33% very satisfied rating. We are working to further improve the delivery of career and internship opportunities to our students. We are in the process of developing a webpage on the department website to provide information and links about job opportunities, careers, internships, summer research opportunities, etc. At present such information is distributed to students by email. We plan on helping students establish a La Verne chapter of the Society of Physics Students. It is hoped that such an organization would provide a venue in which faculty and outside speakers could informally discuss diverse career options open to physics majors. As part of a restructuring of Science Seminar in Fall 2008, biweekly meetings were established in which the chair of the physics program met with the physics majors as a group to discuss senior research projects, internship opportunities, and careers in physics. These meetings seemed to be both an efficient means of sharing career information and promoting bonding between physics students.

VI. Progress on Five-Year Goals from 2002-03 Program Review

1. Both day and evening classes in General Physics and/or Engineering Physics will be offered to accommodate CAPA and traditional age students. Engineering physics will be offered on a yearly basis.

Engineering Physics is now offered on a yearly basis, due in large part to the Mathematics program requiring its majors to take the calculus-based Engineering Physics rather than the algebra-based General Physics. Evening sections of General Physics are no longer being offered due to the lack of demand by CAPA students in Computer Science and because of pedagogical reasons. The evening physics course was taught one night per week for four hours. The instructors found that students were not able to concentrate on the lectures and demonstrations for such long periods even when multiple breaks were included.

2. Students will have access to more kinds of help in learning through the Wilson Library and the Learning Enhancement Center: tutoring, electronic aids (CD-ROM, etc.), Internet, expanded journal and book collections, videos.

The physics resources at Wilson Library are slowly being expanded. The introduction of LINK+ has greatly helped students and faculty gain access to texts and journal articles, even though additional library resources are still needed in physics and astronomy. The most common journals such as the Astrophysical Journal and Physical Review are not accessible through the current databases.

3. Internship programs will be available.

The physics program initiated a partnership with JPL in the fall of 2008 to participate in the Student Research Intern (SIRI) Program. ULV students may now apply to dozens of research projects at JPL across a broad range of fields.

4. Student enrollment will be large enough to offer at least one intermediate or advanced level physics course taught in the classroom each semester.

An average of one to two upper division courses are now being offered each semester.

5. The laboratory time put in by the instructor will receive full workload credit; time will be available to do advising, committee work, help students individually, and to carry on a small research program.

The instructor now receives full workload credit for the first section of each laboratory class. If an instructor teaches multiple sections of the same lab, then he/she receives 50% of the credit hours for each additional section.

6. Students and faculty will make greater use of the Internet in teaching and communicating course assignments, suggesting reference materials, turning in homework, and researching relevant topics.

As the internet continues to exponentially expand, its influence in the classroom naturally increases. Online simulations, databases, news articles, etc. are now regularly incorporated into most classes. One of the physics faculty founded a website flashphysics.org that presents interactive simulations of physics and mathematics problems. In addition, students now have access to solutions sets, homework assignments and other course documents on line via Blackboard. Finally, we are in the process of incorporating the MASTERINGPHYSICS program into PHYS 203 and 204 courses. MASTERINGPHYSICS is an online physics homework system with automatic grading and adaptive tutoring features. The newly redesigned astronomy labs utilize many online databases of images and spectra in the laboratory exercises.

7. Faculty will have adequate laboratory space for advanced laboratory courses and faculty/student research. In particular, we will have space for the optical tables and equipment acquired from the Optical Engineering Program of the AAIC.

An optics laboratory was established in the back part of MA 54 in 2003. A 4x8’ optics table was installed and the bulk of the optical equipment from the Optical Engineering Program (including lasers, lenses, active optics devices, mechanical positioning equipment, etc.) was saved. The optics laboratory now serves as a lab space for all our advanced laboratory experiments.

8. Recruit more quality students interested in the physics major, minor, or in the physical science teaching waiver program.

Recruitment continues to be one of our top priorities. The rise in course enrollments and graduation rates suggests that we are on the right track.

9. Laboratory experiments will be performed using modern, functional equipment. In particular, five more atomic and nuclear physics experiments will be added to the existing Atomic and Nuclear course to make it a laboratory course and the laboratory equipment for NASC 102 Physical Science will be upgraded.

We have obtained six upper-division experiments and we are proposing to create 1-unit laboratory course attached to the Atomic and Nuclear course beginning in Fall 2009.

10. Improve the department's presence on and use of the World Wide Web.

Both physics faculty members have personally built webpages with information on their current research projects and courses they are teaching. The department's website continues to elicit less-than-rapturous responses. It still needs to be updated.

11. Have Engineering Physics required by more majors to increase the enrollment.

The mathematics program now requires its math majors to take Engineering Physics. The physics program continues to gently urge the chemistry department to follow suite.

12. Introduce an intermediate level course in Math Methods in Physics and require it of our physics majors.

Rather than introducing a new course on Math Methods, we believe that instituting Differential Equations as a supportive requirement would be more beneficial and cost-effective for the department. We are proposing to add Differential Equations as a supportive requirement starting in the Fall semester of 2009.

13. Expand astronomy facilities and equipment for senior research opportunities, physical science courses, astronomy courses and public outreach opportunities.

In 2006, a laboratory component was added to the astronomy course. Existing telescopes and laboratory set-ups were used for the laboratory section. A 24-seat lab license for Starry Night Pro was purchased, but no other major expenditures were made. Eventually an observatory and planetarium would greatly enhance our educational and public outreach possibilities.

14. Introduce a Special Topics in Physics course.

Done. The Special Topics course designation is PHYS 409.

15. Have separate, dedicated laboratory space for NASC 102L Physical Science Laboratory course and other large physical science GE courses such as Astronomy, Geology and Introduction to Physics.

Not done. But still needed.

16. Physics program director will receive extra compensation for extra duties in the form of money or release time.

The physics program chair remains uncompensated.

17. Introduce an Astrophysics course.

An astrophysics course was introduced as a special topics class. It has been taught three times since 2001. It has yet to be added to the catalog as an independent course.

18. Modernize the General Physics laboratory to accommodate courses that use computer-based learning experiments.

The General Physics lab has seven computers that are used for digital data acquisition and data analysis. They are also used for numerical projects in many upper-division math and physics courses. An LCD projector and sound system was installed in 2008. No formal curriculum using computer-based learning experiments has been developed, however.

VII. Recommendations for Action

18. Obtain a stockroom/laboratory manager position.

19. Implement the proposed changes to the major adding an Advanced Lab as a core course, adding Differential Equations as a supportive requirement, and replacing Science Seminar with a Physics Seminar course.

20. Implement the proposed requirements for a physics minor.

21. Establish an interdisciplinary center for computational research in Physics, Mathematics, Computer Science and Chemistry.

22. Establish an experimental laboratory for nanophysics research.

23. Introduce an Advanced Laboratory course and purchase the needed equipment.

24. Introduce a Thermodynamics/Statistical Mechanics course.

25. Introduce a Solid State Physics Course.

26. Institute a dedicated lab section for the Engineering Physics course.

27. Continue to modernize the General Physics laboratory

28. Improve our advising of students particularly with regards to career opportunities.

29. Continue to explore new opportunities for student internships

30. Explore the possibility of establishing a 3-2 program with a local engineering program.

31. Improve the program's website to include information about student career opportunities, student internships, faculty research, course information etc.

32. Recruit new physics majors so that upper division courses have larger enrollments.

33. Work with students to establish a local chapter of the Society of Physics Students.

34. Secure compensation or release time for the physics program chair.

Appendix A

Courses Currently Offered by the Physics Program

Course Number	Course Title	Credit Hours	Ave Enrollment per * class	Ave Enrollment per * year	When Given Odd Year Fall	When Given Odd Year Spr	When Given Even Year Fall	When Given Even Year Spr	Core**/ Elective	Prereq. Courses	Text Commonly Used (Author Only)	Gen. Ed. Status*
NASC 102	Physical Science	3	11	23	✓	✓	✓	✓	GE		Hazen & Trefil	GEPS
NASC 102L	Physical Science Lab	1	11	23	✓	✓	✓	✓	GE			GEL
CORE 340/320	Various Interdisciplinary	4	12	10	✓		✓		GE			Core
PHYS 105	Introduction to Physics	4	21	30	✓		✓		GE		Hewitt	GEPS
PHYS 201	General Physics I	5	19	35	✓		✓		Supp	algebra & trig.	Cutnell & Johnson	GEPS-L
PHYS 202	General Physics II	5	18	14		✓		✓	Supp	algebra & trig.	Cutnell & Johnson	GEPS-L
PHYS 203	Engineering Physics I	5	9	9	✓		✓		Core	MATH 201	Halliday & Resnik	GEPS-L
PHYS 204	Engineering Physics II	5	9	9		✓		✓	Core	MATH 202	Halliday & Resnik	GEPS-L

Appendix B: Class Enrollments (2003-2007)

		units	2003-2004				2004-2005				2005-2006				2006-2007				2007-2008				Ave/	
			Fall	Jan	Spr	Sum	Fall	Jan	Spr	Sum	Fall	Jan	Spr	Sum	Fall	Jan	Spr	Sum	Fall	Jan	Spr	Sum	class	Year
General Education																								
NASC 102	Physical Science (sect 1)	4	19		18	5	9		19	7	13		13	9	7		8	4	8		10		11	23
NASC 102	Physical Science (sect 2)	4	22		20		8				11		10		6									
NASC 201	Geology	4			5								4										5	2
NASC 370	Science Seminar	1			27																		27	5
PHYS 105	Introduction to Physics	3			19			22	24		21	28				30			5				21	30
PHYS 230	Astronomy	4	19	27			15		11		18		16		19		22		11		21		18	36
CORE 340	Interdisciplinary Classes	4	15					8							15				10				12	10
Total Enrollment			75	27	89	5	32	30	54	7	63	28	43	9	47	30	30	4	34		31			128
Average Class Size			25	27	18	5	11	30	18	7	16	28	11	9	16	30	15	4	11		16			15
Lower Division																								
PHYS 201	General Physics I (sect 1)	5	23				21				32				24				19				19	30
PHYS 201	General Physics I (sect 2)	5					13				8				12									
PHYS 202	General Physics II	5			13				22				23				18				14		18	18
PHYS 203	Engineering Physics I	5	10				13				9				6				9				9	9
PHYS 204	Engineering Physics II	5			12				11				10				6				8		9	9
Total Enrollment			33		25		47		33		49		33		42		24		28		22			67
Average Class Size			17		13		16		17		16		17		14		12		14		11			14.6
Upper Division																								
PHYS 311	Electronics for Scientists	4													4								4	
PHYS 322	Electricity and Magnetism	4											5										5	
PHYS 342	Analytical Mechanics	4									4												4	
PHYS 350	Optics	4											5										5	
PHYS 355	Thermodynamics	2																					0	
PHYS 360	Atomic and Nuclear Phys.	4					2								5								4	
PHYS 368	Quantum Mechanics	4							3								3				1		2	
PHYS 409	ST: Astrophysics	4									5										3		4	
Total Enrollment							2		3		9		10		9		3				4			8
Average Class Size							2		3		4.5		5		4.5		3				2			3.6
Totals for All Classes																								
Total Enrollment for All Classes			108	27	114	5	81	30	90	7	121	28	86	9	98	30	57	4	62		57			203
Average Class Size			22	27	16	5	12	30	15	7	13	28	11	9	12	30	11	4	12		10			12.9
Total Enrollment by Year			254				208				244				189				119					203
Average Class Size by Year			19				16				14				15				11					12.9

Appendix C

Summary Statistics of Course Enrollments

Total Enrollment

	2003-04	2004-05	2005-06	2006-07	2007-08
GE	196	123	143	111	65
Supportive	58	80	82	66	50
Upper-division	0	5	19	12	4
Total	**254**	**208**	**244**	**189**	**119**

Average Class Size

	2003-04	2004-05	2005-06	2006-07	2007-08
GE	18	14	14	14	11
Supportive	15	16	16	13	13
Upper-division	0	3	5	4	2
Total	**19**	**16**	**14**	**14**	**11**

Number of Classes with More than 10 Students

	2003-04	2004-05	2005-06	2006-07	2007-08
GE	9	5	8	4	4
Supportive	4	5	3	3	2
Upper-division	0	0	0	0	0
Total	**13**	**10**	**11**	**7**	**6**

Number of Classes with Less than 10 Students

	2003-04	2004-05	2005-06	2006-07	2007-08
GE	2	4	2	4	2
Supportive	0	0	2	3	2
Upper-division	0	2	4	3	2
Total	**2**	**6**	**8**	**10**	**6**

Number of Independent Study and Senior Project Classes

	2003-04	2004-05	2005-06	2006-07	2007-08
Ind. Study/s.r. Proj	3	0	3	2	1

Appendix D

Physics Degree Requirements (Fall 2008)

Core Requirements:		Credit Hours
PHYS 203	Engineering Physics I + Lab	5
PHYS 204	Engineering Physics II + Lab	5
PHYS 322	Electricity and Magnetism	4
PHYS 342	Analytical Mechanics	4
PHYS 360	Atomic and Nuclear Physics	4
PHYS 368	Quantum Mechanics	4
NASC 370	Science Seminar (4 sem.)	1,1,1,1
		30

Electives:
A minimum of 8 semesters hours for the B.A.
A minimum of 12 semester hours for the B.S.

PHYS 311	Electronics for Scientists	4
PHYS 350	Optics	4
PHYS 355	Thermodynamics	2
PHYS 409	Special Topics in Physics	4
CHEM 411	Physical Chemistry I	4
		8-12

Supportive Requirements:

CHEM 201	General Chemistry	5
MATH 201	Calculus I	4
MATH 202	Calculus II	4
MATH 211	Calculus III	4
		17

Culminating Requirement:

PHYS 499	Senior Project	1-4
Comprehensive examination		0

Total units for a B.S. = 60-63
Total units for a B.A. = 56-59

Appendix E

Representative Program of Study for a Physics B.S.
Fall 2008

Course	Course Title	Course Designation	Credit Hours	Year and Semester	
PHYS203	Engineering Physics I	Core	5	Freshman	Fall
MATH201	Calculus I	Supportive	4	Freshman	Fall
PHYS204	Engineering Physics II	Core	5	Freshman	Spring
MATH202	Calculus II	Supportive	4	Freshman	Spring
PHYS360	Atomic and Nuclear Physics	Core	4	Sophomore	Fall
CHEM201	General Chemistry I	Supportive	5	Sophomore	Fall
MATH311	Calculus III	Supportive	4	Sophomore	Fall
PHYS342	Analytical Mechanics	Core	4	Sophomore	Spring
PHYS322	Electricity and Magnetism	Core	4	Junior	Fall
CHEM411	Physical Chemistry I	Elective	4	Junior	Fall
NASC371	Science Seminar	Core	1	Junior	Fall
PHYS368	Quantum Mechanics	Core	4	Junior	Spring

NASC370	Science Seminar	Core	1	Junior	Spring
PHYS311	Electronics for Scientists	Elective	4	Senior	Fall
NASC370	Science Seminar	Core	1	Senior	Fall
PHYS350	Optics	Elective	4	Senior	Spring
PHYS499	Senior Project	Core	1–4	Senior	Spring
NASC370	Science Seminar	Core	1	Senior	Spring

Appendix F

Degree Requirements at Comparison Institutions

	ULV	Azusa	Redlands	Cal Lutheran	Westmont	Pepperdine
Faculty	2	4	5	2	3	2
Minor	no	yes	yes	yes	yes	no
CORE AND ELECTIVES						
- Engineering physics	10	10	12	10	10	10
- Atomic and Nuclear	4	3		4	5	3
- Analytical Mechanics	4	6	4	3	4	4
- E&M	4	3	8	3	4	6
- Quantum	4	3	4	3	8	4
- Science Seminar	4	1	4			
- Modern Lab		2	3			2
- Electronics	4	3	4	4		3
- Physical Chemistry I	4	x				
- Optics	4			3	4	
- Thermal &Statistical			4			3
- Thermodynamics	[2]	3		[3]	4	
- Special Topics	[4]		3			
- Senior Project	4		2	4		
Subtotal	*46*	*34*	*48*	*34*	*39*	*35*
SUPPORTIVE						
- Calculus I	4	5	4	4	4	4
- Calculus II	4	4	4	4	4	4
- Calculus III	4	4	4	4	4	4
- Differential Equations		4	4	4	4	
- Linear Algebra			4			
- Numerical Analysis			4			
- Probability			4			
- Mathematical Physics		3		[3]	4	4
- General Chemistry	5	4	4		8	4
- Computer Science		3	[4]			3
Subtotal	*17*	*27*	*32*	*16*	*28*	*23*
TOTAL UNITS	63	61	80	50	67	58

Electives are in green
Electives not used in unit calculations for this sample study are in brackets

Appendix G

Physics Degree Requirements (Proposed for Fall 2009)

Core Requirements:		**Credit Hours**	**Changes**
PHYS 203	***Fundamentals of Physics I*** + Lab	5	Name change only
PHYS 204	***Fundamentals of Physics II*** + Lab	5	Name change only
PHYS 322	Electricity and Magnetism	4	
PHYS 342	Analytical Mechanics	4	
PHYS 360	***Modern Physics + Lab***	***5***	Name change, lab added
PHYS 368	Quantum Mechanics	4	
PHYS 370	***Physics Seminar***	1, 1, 1, 1	Replaces Science Seminar
		31	Increases by 1 unit

Electives:
A minimum of 8 semesters hours for the B.A.
A minimum of 12 semester hours for the B.S.

PHYS 311	Electronics for Scientists	4	
PHYS 350	Optics	4	
PHYS 355	***Statistical mechanics***	4	New course
PHYS 375	Astrophysics	4	
PHYS 380	***Solid State Physics***	4	New course
PHYS 409	Special Topics in Physics	4	
CHEM 411	Physical Chemistry I	4	
		12 (8 for BA)	

Supportive Requirements:			
CHEM 201	General Chemistry	5	
MATH 201	Calculus I	4	
MATH 202	Calculus II	4	
MATH 211	Calculus III	4	
MATH 315	***Differential Equations*** (B.S. only)	***4***	New requirement
		21 (***17*** for BA)	Increases by 4 units

Culminating Requirement:			
PHYS 499	Senior Project	1-4	
Comprehensive examination		0	

Total units for a B.S.	**65-68**	Increased by 5 units
Total units for a B.A.	**58-61**	Increased by 1 unit

Appendix H

Physics Minor Requirements (Proposed for Fall 2009)

2 Lower-Division Courses:

PHYS 203 & 204	Fundamentals of Physics I & II	5, 5
	OR	
PHYS 201 & 202	General Physics I & II	5, 5

3 Upper-Division Courses (1 of which must be a core physics course)

Core Courses:

PHYS 322	Electricity and Magnetism	4
PHYS 342	Analytical Mechanics	4
PHYS 360	Atomic and Nuclear Physics	5
PHYS 368	Quantum Mechanics	4

Electives:

PHYS 311	Electronics for Scientists	4
PHYS 350	Optics	4
PHYS 355	Statistical Mechanics	4
PHYS 375	Astrophysics	4
PHYS 380	Solid State Physics	4
PHYS 409	Special Topics in Physics	4
CHEM 411	Physical Chemistry I	4

2 Supportive Requirements:

MATH 201	Calculus I	4
MATH 202	Calculus II	4

Total units for the minor = 30-31

Appendix I

Equipment Inventory

Facilities		
Faculty Offices	MA 64 and MA 152C	450 sq. ft.
General Physics Lab	MA 60	600 sq. ft.
Two Stock Rooms	MA 58 and MA 62	640 sq. ft
Optics Lab	MA 54B	140 sq. ft
Machine Shop	MA 59	300 sq. ft.

Computer Resources				
	Student Computer Labs			Faculty
Computer Software	MA 60 7 computers	FH 206 12 computers	FH 207 24 computers	Offices
Mathematica	✓	✓	✓	✓
MATLAB	✓	✓	✓	✓
Derive	✓	✓	✓	✓
Maple	✓	✓	✓	✓
Origin				✓
Igor Pro				✓
Starry Night	✓	✓	✓	✓
E&M Field	✓			✓
Raytrace	✓			
Interactive Physics	✓			✓
Data Studio	✓			✓
MS Office	✓	✓	✓	✓

Research-Grade Equipment
Scanning Tunneling Microscope (STM)
0.3 T Electromagnet
Liquid Nigrogen Cryostat & temperature controller
Optics Lab
4x8' optics table
lasers (HeNe, HeCd, Yag)
interferometry
active optics
Scanning Electron Microscope (Shared with Natural Science Division)
Nuclear Magnetic Resonance Spectrometer (Shared with Natural Science Division)

Long-Term Equipment Needs	
Nanophysics Lab	
Photoelastic modulator (PEM)	$6,000
Superconducting Magnet & Cryostat	$100,000
CCD Camera	$10,000
Computational Lab	
Parallel computer network	$30,000
Observatory	$500,000
Planetarium	$250,000

Advanced Labs
Speed of light
X-ray diffraction
Gamma-ray spectroscopy
Photoelectric effect
Interferometry
Holograpphy
Chaotic pendulum

General Physics II Lab Inventory
January 28, 2009

Multi-purpose equipment	location	#/lab	good	broken	Required Repairs
Multimeters	58R		12	1	needs fuse
DC Power Supply	58C		8	0	
Oscilloscope	58D		4	2	2 old scopes
Signal generator	58R		3	2	loose connection, brken stand
Low Voltage Pasco Power Supply	58B		4	0	
HIgh Voltage Pasco Power Supply	58B		6	0	
Optical Spectrometer	58D		5	2	2 missing stuff
-diffraction grating			5	3	3 scratched
-diffraction grating holder			7	0	
-prism and holder			5	0	
-magnifying glass			7	0	

Plotting electric Field Lines	location	#/lab	good	broken	Required Repairs	
Field Line kit	58C	1	6	0		
- 3 carbon paper sheets						
- silver conducting pen (5/6)						
- tacks						
- wire cables						
- instruction manual (in most)						
DC Power Supply	58C	1	8	0		0
Multimeters	58R	1	12	1	needs fuse	
Total Number of complete labs	**6**					

Electric Circuits						
AC/DC electronics laboratory	58C	1	9	0		
- connecting wires						
- inductor core (metal + plastic)					one setup missing metal core	
- 4 resistors (in baggie)					5 sets of baggies, 4 needed	
DC Power Supply	58C	0	8	0		0
Multimeters	58R	0	12	1	needs fuse	
Total Number of complete labs	**5**					

Electrolysis						
New Electrolysis Apparatus	62Q	1	0	4	need new rubber hose	
Old electrolysis apparus	62Q	1	0	2	needs new rubber hose	
DC Power Supply	58C	0	8	0		0
stopwatches	62C	1	12	0	3 need batteries	
Total Number of complete labs	**0**					

The Oscilloscope					
Oscilloscope	58D	0	4	2	2 old scopes
Signal generator	58R	0	3	2	loose connection, brken stand
Transformer		1	0		
baggie: diode, 10k res, 4.7mF cap		1			only 3 cap
Total Number of complete labs	**0**				

Digital Logic Gates				
Digital Lab Circuit Evaluator	58C	1	6	
7400 IC chip	58C	1	6	
7402 IC chip	58C	1	4	need 2 more
connecting wires	58C	1	6	
schematic NAND & NOR sheets	58C	1 each	6	
Total Number of complete labs	**4**			

e/m of Electron						
e/m apparatus	58 L&N	1	5	1	one doesn't work	
HIgh Voltage Pasco Power Supply	58B	1	6	0		0
DC Power Supply	58C	0	6	0		0
Multimeters	58R	2	12	1	needs fuse	
Total Number of complete labs	**5**					

Diode Characteristics						
baggie		4				
- silicon diode			5			
- tri-color LED			3			
- 1000 ohm resistor			5			
Proto board	1	1	7			
Oscilloscope	58D	0	4	2	2 old scopes	
Multimeters	58R	0	12	1	needs fuse	
DC Power Supply	58C	0	8	0		0
Signal generator	58R	0	3	2	loose connection, brken stand	
Total Number of complete labs	**3**					

AC Circuits					
AC/DC electronics laboratory	58C	1	9	0	
- connecting wires					
- inductor core (metal + plastic)					one setup missing metal core
- 100 muF Cap, 10 O Res in baggie					5 sets of baggies, 4 needed
Multimeters	58R	0	12	1	needs fuse
Signal generator	58R	0	3	2	loose connection, brken stand
Total Number of complete labs	**4**				

Appendix J

Survey for ULV Physics Alumni

Survey for ULV Physics Alumni

1. Overall, how do you feel about the physics program at ULV?

2. What are its strengths?

3. What are its weaknesses?

4. What is your current occupation? What are your career plans for the next five or ten years?

5. Do you feel that your physics education prepared you adequately for the job market and/or graduate school?

6. Why did you choose to study physics at the University of La Verne?

7. Were your expectations met? If not, why not?

8. Would you recommend adding or removing any courses from the major?

9. If you could change anything about the program, what would it be? ______________________________

____

____

____

____

10. How do you feel about what you learned in the program regarding the following? (Circle number that reflects best how you feel.)

a) Theoretical foundations of physics
Very Dissatisfied 1 2 3 4 5 Very Satisfied
Comments: ____

b) Experimental physics (i.e. laboratory work)
Very Dissatisfied 1 2 3 4 5 Very Satisfied
Comments: ____

c) Critical thinking and problem solving skills
Very Dissatisfied 1 2 3 4 5 Very Satisfied
Comments: ____

d) Library research skills such as doing journal searches, accessing databases, etc.
Very Dissatisfied 1 2 3 4 5 Very Satisfied
Comments: ____

e) Communication skills (verbal and written).
Very Dissatisfied 1 2 3 4 5 Very Satisfied
Comments: ____

f) How satisfied were you with the academic advice you received from faculty as a student?
Very Dissatisfied 1 2 3 4 5 Very Satisfied
Comments: ____

g) How satisfied were you with the career advice you received from faculty as a student?
Very Dissatisfied 1 2 3 4 5 Very Satisfied
Comments: ____

h) How satisfied were you with the availability of courses?
Very Dissatisfied 1 2 3 4 5 Very Satisfied
Comments: ____

i) How satisfied were you with the course load?
Very Dissatisfied 1 2 3 4 5 Very Satisfied
Comments: ____

j) How satisfied are you about your preparation and readiness to secure a job after graduation?
Very Dissatisfied 1 2 3 4 5 Very Satisfied
Comments: ____

I) How satisfied are you about your preparation and readiness to secure admission in a graduate program in physics?
Very Dissatisfied 1 2 3 4 5 Very Satisfied
Comments: ____

Once again, *thank you very much* for your participation. If you have *any other comments* that you wish to add, *please feel free* to write them out below or on a separate sheet of paper and attach it to this form.

Appendix K

Summary of Alumni Survey
Compiled by Aghop Der-Karabetian and Michelle Alfaro

Written Responses: Survey for Graduating Physics Seniors and Physics Alumni Combined:

Overall, how do you feel about the physics program at ULV?
All Comments:
- The physics program is good. University of La Verne needs to not have to many CORE and general ed requirements so that more major classes can be taken.
- I feel the ULV physics program offers a quality education and caters to a variety of interests and student backgrounds.
- I loved everything about the physics program. After having some experience at a large school and watching students spend weeks trying to reach a professor, I would never think of recommending anything other than ULV to a fellow student.
- I had a great experience in the program. When I was in the program for the most part things went smoothly.
- I think the program is great. I really enjoyed studying at ULV.
- It is a small liberal arts-oriented science degree. While instruction is individualized it can be more rigorous.
- It is a good program. Needs more students and professors. Program has potential.

Main Themes:
- Program is good
- Great experience at ULV
- Individual treatment
- More Rigorous

What are its strengths?
All Comments:
- Small class sizes. Availability of professors. Access to lab.
- Student/teacher ratio. Allow students to get help they need. Professor backgrounds (variety of knowledge and specialties are a great resource for students) – classes/electives offered provides students with a well-rounded education.
- Teacher/student ratio. Knowledgeable professors. A student can always find a professor to talk to about assignments, projects, or other school business. Closeness between fellow students and professors that can only be found at a small school.
- When I was a student the interaction with the other departments was a great strength. The advising and mentoring were also very strong. The

department's strength of the department has always been its devotion to bettering itself, whether through advising, mentoring, teaching lab techniques, etc…

- The size. The personal attention was great.
- The senior project, small classes and individual attention, the exit exam
- Teacher to student ratio

Main Themes:

- Small class size
- Knowledgeable professors
- Advising and mentoring
- Size of classrooms and school

What are its weaknesses?

All Comments:

- No help outside professors for example, no tutors or other resources. Science seminar totally needs to be reformed or removed. Sometimes it can be too laid back.
- Research materials and funds are limited and therefore may cause students to seek outside resources for help and research opportunities
- Limited number of subjects that students can choose from when doing their senior projects, if they desire to work one on one with a professor. This is not avoidable when attending a small school
- I really feel that the comprehensive exam needs to be pushed more toward those who want to pursue a graduate career. I also strongly believe quantum mechanics and thermodynamics should be emphasized more. Also, the physics majors should be encouraged to interact and work together more often. Importance of science seminar should be focused more.
- When I attended, the lack of faculty was a strain. We lost Dr. Arnold and that was terrible, he was amazing.
- Directed studies for the upper division classes should be discouraged. The physics curricula could be more rigorous.
- Discipline

Main Themes:

- Research is limited
- Small faculty
- Remove science seminar
- Encourage students to interact

What is your current occupation? What are you career plans for the next five or ten years?

All Comments:

- Graduate teaching assistant, pursuing PH.D in physics
- Home-school teacher, mom, I have no idea

- I am currently starting my last year in graduate school at the U. of Wyoming in pursuit of a PHD in astrophysics. My ultimate goal is to work at the Propulsion lab in Pasadena, and teach here at the ULV.
- I returned to college through the CAPA program and finished a degree in physics that I started 25 years ago. I am in upper managements with a Fortune 500 company.
- Still a student

Main Themes:

- No Future plans
- Attending graduate school
- Returned to school after a couple of years

Do you feel that your physics education prepared you adequately for the job market and/or graduate school?

All Comments:

- Yes, but more emphasis could be placed on upper division rigor
- Not especially, but that could just be me. I feel like the GRE is hideously hard.
- For the most part, however, I do feel that if more research opportunities were available at ULV, I would be more prepared
- Yes, it is amazing how much I learned. It comes back to me when I need it. I was overqualified for my previous job, which helped me to be promoted quickly and earn respect from the professors I worked for.
- When I entered graduate school I had some weak or lacking areas in my education including thermodynamics and computer programming. I also wasn't prepared for the large jump in effort required for grad school. However, I was able to get through my first year.
- Even though I was 45 when I returned I learned a lot. Just exercising my brain made me a better manager. Now I help my children with their classes.

Main Themes:

- Yes, program did prepare student
- Not always prepared, especially for graduate school exams
- Did learn a lot to use in everyday use
- Some areas the student feels inadequate in

Why did you choose to study physics at the University of La Verne?

All Comments:

- Individualized attention, small department
- Came to ULV for basketball, physics was an after thought. Thought it would be interesting and allow for a variety of job opportunities
- I chose ULV for academic scholarship offers and the small campus.
- At first I was a different major, but after taking engineering physics 2 with Dr. Chappell, I became a physic's major. I still enjoy telling others the things I learned in that class.

- As a student at Cal Poly Pomona, I was drowning in the large number of students and the severely lacking student professor interaction. ULV promised to be the opposite of that environment
- I needed the close attention. The small department was very attractive and when I met Dr. Arnold, I knew it was the right place for me.

Main Themes:
- Individual attention
- Enjoy learning new things
- Close attention for the students
- Academic Scholarships being offered

Were your expectations met? If not, why not?
All Comments:
- Yes
- I feel inadequate in my abilities but that could be normal and not so much a result of a lack of education
- ULV exceeded my expectations in terms of classes, electives, I was able to take as well as student work opportunities and the role I was able to play within the program
- Yes, I received excellent instruction that I can recall if necessary. I enjoyed my 3.5 years with the department, and I can use my skills in the job market and teaching my brother physics
- Yes, Dr. Arnold and Dr. S. Johnson were very encouraging and helpful while still exposing me to the rigorous class material. I also had access to research opportunities that I would have had to fight for or not known about at Cal Poly Pomona
- All of my expectations were met

Main Themes:
- ULV exceeded my expectations
- Received excellent instruction
- Faculty was encouraging
- Many opportunities

Would you recommend adding or removing any courses from the major?
All Comments:
- No
- A second semester of QM and E&M should be added. A graduate lab course should be added.
- Adding more upper division courses or choices of upper division classes. Definitely make differential equations a requirement. Statistical mechanics would be good too. And more quantum.
- I feel all of the classes were beneficial to the education
- Yes, I would recommend to have taken another quantum class. I other universities offer two semesters.

- Thermodynamics is a must. I would also recommend a useful programming course such C++. I do not recommend removing any courses

Main Themes:

- Add a semester of Quantum
- Add more upper division
- Programming course

If you could change anything about the program, what would it be?

All Comments:

- Increase in funds so that students may enhance their research skills.
- More upper division classes. 2 semesters of quantum. 2 semesters of atomic and nuclear statistical mechanics. No science seminar
- Add physics lectures to science seminar
- Better web site, more research grants, more students
- The problem is that one of the strengths of the department is that it is small, however, the variety of classes available. I wouldn't sacrifice the intimacy f the department for more classes. I guess I wouldn't change anything.
- During my time here I would have recommended more interaction between physics majors and emphasis on one on or two comprehensive exams.

Main themes:

- More upper division courses
- Better web site
- Better variety of classes

What are your career plans or the next five to ten years?

All Comments:

- I hope to begin work on my PHD in the fall of 2009. Afterwards, I hope to work for NASA
- Next two: masters program, PHD, not sure

How do you feel about what you learned in the program regarding the following?

All Comments:

a. Theoretical foundations of physics
    - Quantum and thermodynamics weak

b. Experimental physics
    - Not a lot of lab work
    - The number of labs
    - Labs for engineering physics very good
    - Strong in the beginning, weak later

c. Library research skills such as doing journal searches, accessing databases, etc.
    - Internship is the way to go
    - Only during my senior year was I exposed to this

d. How satisfied were you with the academic advice you received from faculty as a student?
    - Dr. Arnold and Dr. Johnson were great

e. How satisfied were you with the career advice you received from faculty as a student?
    - My career was established

f. How satisfied were you with the availability of course?
    - This is the issue with a small department
    - I wish I could have had less difficultly classes the second semester of my senior year

g. How satisfied are you about your preparation and readiness to secure a job after graduation?
    - I think the kids around me were well prepared

h. How satisfied were you with the course load?
    - Need to have more homework in the lower division courses

i. How satisfied are you about your preparation and readiness to secure admission in a graduate program in physics?
    - I don't intend to attend grad school as a physics major, but I know I could
    - I feel not as prepared as I think I should be

Any other comments…
<u>All Comments:</u>
- I had a great experience here all around and definitely recommend mot of the program here to anyone
- The department needs a better website
- The department should attract more students of high caliber, possibly through scholarships
- More research grants should be raised
- I never studied under Dr. Chappell but he seems like a good teacher. We have spoken on several occasions and I know the department is still on solid ground. Please ask Dr. Chappell what he needs to succeed and act as if it came from me.

<u>Main Themes:</u>
- Great overall experience
- More research opportunities
- Solid department

Table 1: Survey for ULV Physics Alumni and Physics Seniors Combined

Sample Size, Means, Standard Deviations, and Percentages of Participants Response to the overall satisfaction of the Physics Department (5-point scale, 5=very satisfied)

Item	N	M	SD	% Very Satisfied
10a. Theoretical Foundation of physics	7	4.14	.37	14%
10b. Experimental Physics	7	3.28	.48	29%
10c. Variety of courses in your major	2	4.00	1.41	50%
10d. Senior Project	2	2.5	.70	50%
10e. Access to equipment, instruments, facilities, etc…	2	4.00	1.41	50%
10f. Critical thinking and problem solving skills	7	4.57	.53	57%
10g. Library research skills such as doing journal searches, accessing databases, etc…	7	4.14	1.06	43%
10h.Communication Skills	7	4.42	.53	43%
10i. How satisfied were you with the academic advice you received from faculty as a student?	7	4.00	1.15	43%
10j. How satisfied were you with the career advice you received from faculty as a student?	6	4.00	.89	33%
10k. How satisfied were you with the availability of courses?	7	3.71	.95	14%
10l. How satisfied were you with the course load?	7	4.28	.95	57%
10m. How satisfied are you about your preparation and readiness to secure a job after graduation?	6	3.50	1.04	17%
10n. How satisfied are you about your preparation and readiness to secure admission in a graduate program in physics?	7	3.57	1.39	29%

Appendix M

Senior Exit Exam Results

Senior Exit Exam Scores (2002-2008)

Question #	# points	Class	Topic	A	B	C	D	E	F	G	Ave %
				Student Scores							
1	5	L	Mechanics	5	3	3	5	4.5	3	5	81
2	5	L	Mechanics	3	3	4	3	5	5	5	80
3	5	L	Mechanics	1	2	2	1	5	5	5	60
4	5	L	Mechanics	3	3	3	3	3	2	3	57
5	5	L	Thermodynamics	1	1	0	2	0	0	0	11
6	5	L	Thermodynamics	0	3	5	2	5	2	2	54
7	5	L	Modern	4	0	0	1	0	5	0	29
8	5	L	Mechanics	3	5	5	5	5	4	4	89
9	5	L	Mechanics	2	5	3.5	4.5	5	2	4	74
10	5	L	Mechanics	2	5	2	3.5	5	0	5	64
11	5	L	Mechanics	4	5	5	5	5	3	4	89
12	5	L	Mechanics	4	5	5	4	5	4	3	86
13	5	L	E & M	3	1	4.5	4.5	4.5	4	0	61
14	5	L	E & M	1	3	0.5	3	1	4	0	36
15	5	L	Modern	5	5	5	3	3.5	4	5	87
16	5	L	E & M	5	4.5	4.5	2	5	4	5	86
17	5	U	Modern	2	3	0	1	0	5	0	31
18	5	U	Modern	1	0	5	5	0	2	2	43
19	5	U	Modern	5	4	4	4	0	3	0	57
20	5	U	Modern	5	4	4	5	5	5	2	86
21	10	U	Mechanics	1	3	3	4	1	1	3	23
22	10	U	E & M	2	3	5	6	9.5	1	4	44
23	10	U	Modern	2	4	3	3	0	2	4	26
24	10	U	Modern	5	7	10	7.5	0			59
Total Score				49%	58%	61%	62%	55%	54%	50%	56%

Average Exams Score by Subject

Subject	% of points on Exam	Average Score
Mechanics	39%	66%
E & M	18%	56%
Thermodynamics	7%	33%
Modern Physics	36%	50%

Average Exams Score by Division

Subject	% of points on Exam	Average Score
Lower Division	57%	65%
Upper Division	43%	42%

Appendix N

Senior Project Analysis

Selected Senior Project Abstracts (2003-2008)

Annette Villa: *Production and Separation of Beryllium-7 for a Pure Ion Plasma*

Abstract. Beryllium-7 will be produced, separated, and contained in an ion trap in order to analyze its half-life. The analysis of the half-life of pure Beryllium-7 ion plasma may suggest a better understanding of some mysteries in the field of atmospheric and nuclear astrophysics. Beryllium-7 atoms were created in the laboratory by a 40keV Van de Graaff proton accelerator from the 10B(p+, α)7Be fusion reaction. Once the 7BE is produced, there are a number of possible methods that can be used to separate 7Be atoms from the B4C sample. Some may include vacuum evaporation, vacuum discharge, and pulsed laser deposition. We will begin with the easiest process of separation, which is vacuum evaporation. If the process of evaporation fails to work then the other procedures must be considered. The B4C sample will then be thermally heated until the beryllium isotope has evaporated out. The 7Be will then be ionized and contained in an ion trap trough the process of electron collisions. The half-life of the ionized beryllium isotope will then be analyzed, which is the overall goal for this research project.

Casey Cook: *Modeling the Trajectory of the Curveball Using Numerical Integration*

Abstract. Using Newtonian Physics, Kinematic equations, and computer analysis, the trajectory of the curveball can be shown through graphical data. Encompassing the there main forces acting on a ball, Gravity, Air Drag, and the Magnus Effect, the theories of the curveballs flight are confirmed in a computer simulation. Using Matlab, the Kinematic equations which characterize the forces acting on the curveball are the components which form the resulting program used for graphing the trajectory of the ball. Applying variables such as speed, initial angle, and spin, the program uses numerical integration to calculate final position and travel time. Encompassing the theory that states the batter has approximately three hundred milliseconds of decision time; the program is also set to calculate the position of the ball at this point. Gathering data from the ball's final position and its position at three hundred milliseconds shows varied results of position along the strike zone. While an increase in revolutions per minute expands the final position of the ball, a decrease in initial angle, focuses the ball back towards the center of approximated strike zone.

Stephanie McCutcheon: ***Fe-rich Aureoles in the Murray CM2 Carbonaceous Chondrite: Evidence for In-situ Aqueous Alteration***

Abstract. Determining the timing of the aqueous alteration that occurred in carbonaceous chondrite meteorites has profound implications for understanding early solar system or solar nebula environments. Hanowski and Brearley (2000) provided evidence for the *in-situ* theory of aqueous alteration by analyzing Fe-rich aureoles in CM chondrites. We found evidence for diffusion of Fe from chondrules into the surrounding matrix using the Scanning Electron Microscope (SEM) to image and determine chemical composition of aureoles in the Murray CM3 chondrite. The wight percentages of Fe, Mg, and Si in the aureoles were determined using Energy Dispersive X-ray Spectroscopy (EDS). The results were plotted using the ternary plot to show the relative abundance in each aureole. We found that both aureoles have significantly enhanced Fe abundances over the surrounding matrix. The radial diffusion of Fe into the surrounding matrix is strong evidence for *in-situ* or parent-body alteration because it must have occurred post-accretion.

Jon M. Inouye: ***Runge-Kutta Simulation of Air Droplet Particle Collection Efficiencies***

Abstract. Air purification may be achieved by the removal of aerosols using water droplets suspended within a current of air. A measure of the extent that the aerosols are absorbed by the water droplets is called the "collection efficiency." Formally, the collection efficiency is a ration of the number of particles absorbed by the collector (as determined by a target areal proportional to the square of the radius of the spherical droplet.) Experimentation with particles in the sub-20 micron range is difficult. As a result, interest in computer simulation has come to the force in this area of fluid dynamics. This original research models the collection efficiency of a single particle, single collector system. A single aerosol particle, under influence of different forces, is directed at the collector. The forces influencing the aerosol particle include inertial impaction, "flux forces" (Brownian diffusion, diffusionphoresis and thermophoresis), interception effects, and electrostatic forces. The size of our aerosol particle is in the low micronrange; the size of our water droplet collector is 50 microns. The Reynolds number used throughout the simulation is 9.6. Earlier papers have not simulated collection efficiencies using all these forces simultaneously, and with the conditions present in a wet scrubbing device. Our primary contribution is to incorporate the electrostatic force within the model for the potential flow of fluid motion, and to include the inertial, flux, and interceptions effects simultaneously. The differential equations of motion are integrated using the Range-Kutta algorithm. We concluded that the addition of electrostatic forces increases the collection efficiency. Furthermore, the electrostatic force is the dominant force contributing to particle collection. It is recommended that additional research be conducted to study the effects of electrostatic force on collection efficiency for Stokes flow.

Taylor Harry: Wavelet Analysis of EEG Mu Rhythms

Abstract: Recent advances in cognitive neuroscience have revealed a wide array of complex electropotiental brain functions produced by chemical and biological circuitry. We focused on the primary somatosensory cortex to study the Mu Rhythm, a wicket 8-13 Hz signal that appears sporadically due to the suppression of motor activities and somatosensory stimulation. Because of its irregular appearance pattern and odd shape, it is difficult to locate and analyze using standard Fourier Transform methods. Wavelet Transforms, with their temporal resolution capabilities, may provide a better method of detecting this rhythm. We used the wavelet transform to analyze a series of Electroencephalographic (EEG) measurements taken when a subject was exposed to alternating video clips of motor movement, and a blank screen. With the use of Matlab's wavelet toolbox we were able to apply existing wavelet functions, including the Mexican Hat, Morlet and Gaussian wavelets, to detect the Mu Rhythm. We developed several wavelets to focus on the wicket shape and minimize coefficient power of Alpha. We then compared all the wavelets we developed and used as well as the Fourier methods.

Senior Project Evaluation Summary

General:	Student A	Student B	Student C	Student C	Student D
1. Initiative	5	5	3	5	4
2. Dedication/work ethic	5	5	4	5	5
3. Lab conduct	-	5	-	-	3

Oral Presentation:

1. Demonstrates a firm understanding of subject	4	3	3	5	4
2. Clearly articulates ideas and physical principles	4	3	3	4	4
3. Effective presentation of data through graphs, tables, etc.	5	5	4	3	4
4. Convincing logical arguments used to support thesis	3	2	3	4	4
5. Answers majority of questions accurately	3	3	3	4	3

Thesis:

1. Purpose and motivation are clearly stated	4	4	3	5	4
2. Background literature search is relevant and thorough	4	5	2	3	4
3. Experimental or theoretical methods are clearly explained	3	3	3	5	3
4. Experimental or theoretical methods are sufficient for project	4	3	2	4	4
5. Data are presented in a professional & informative way	4	5	3	3	3
6. Appropriate analysis tools were used to evaluate model	3	4	3	5	4
7. Conclusions logically follow from data and analysis	3	4	3	5	3
8. Thesis follows accepted format (citations, figures, format, etc)	5	5	4	5	4

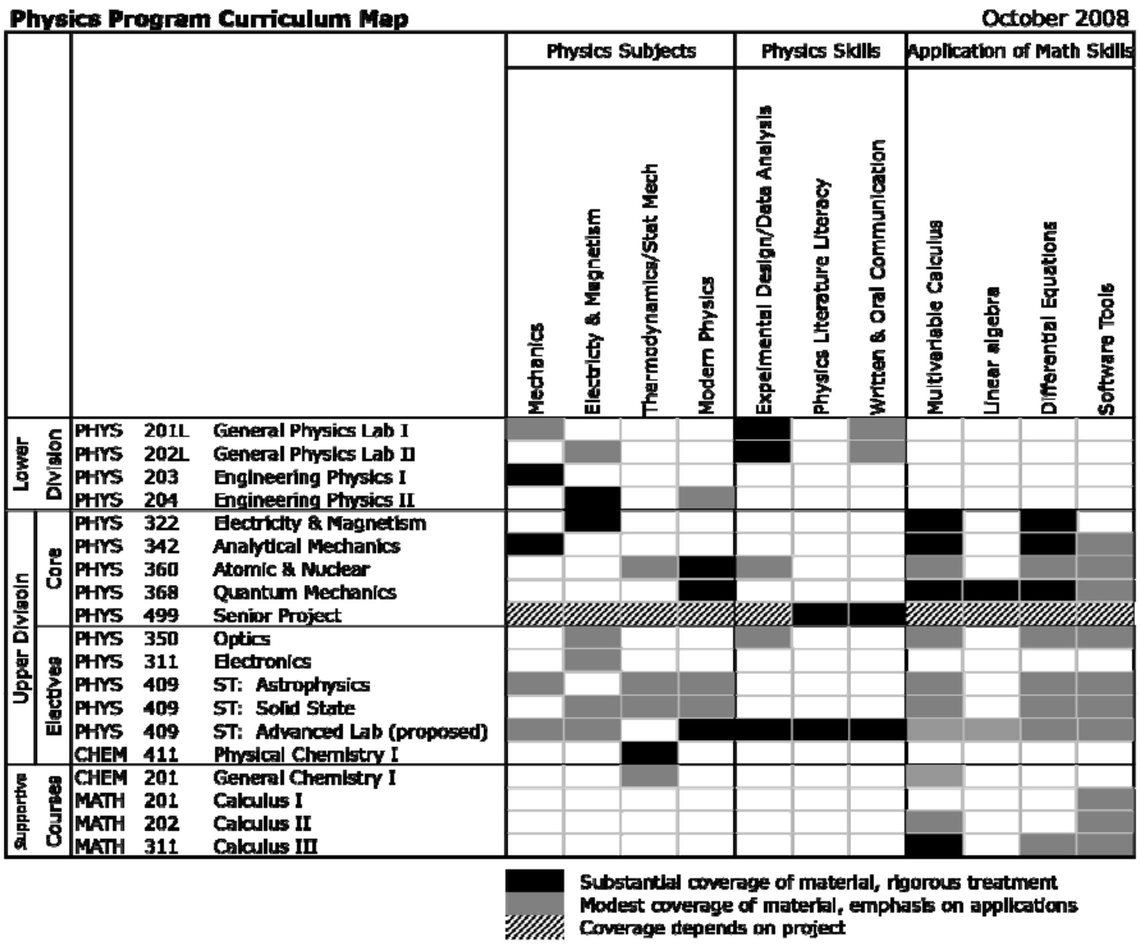
Subject Areas:

1. Classical Mechanics	-	1	4	4	-
2. Electricity and Magnetism	2	3	-	3	1
3. Thermodynamics & Stat. Mech.	-	-	-	-	1
4. Modern Physics	-	3	-	-	4
5. Experimental Physics	3	5	-	-	3
6. Theoretical Physics	1	1	3	3	2
7. Computational Physics	4	-	4	5	-

5 = rigorous treatment, 1 = superficial treatment, “-“ = not applicable

Appendix O

Curriculum Map



Appendix P

Course Evaluation Analysis

Submitted to:
Dr. David Chappell, Chair
November 3, 2008

Prepared by:
Danielle Bryce, Natalie Roweihab and Kasmira Sobkow, Psy.D., Students at the University of La Verne

Supervised by:
Aghop Der-Karabetian

<u>Purpose</u>
The purpose of the analysis of course evaluations in the department of Physics was to assess the quality of teaching and course structure of the courses offered by the department and evaluated anonymously by students at the end of the course.

<u>Method</u>
The course evaluations of the Fall 2006 semester through Spring 2007 semester were used as the sample. Only the responses to the open ended questions were used. These questions provided a variability of responses that were coded according to positive and negative themes related to the students' views of the professor's teaching characteristics, the course structure, possible improvements to the course, and overall view of the course. Codes were assigned to the students' responses after a consensus was reached by three independent coders.

<u>Findings</u>
The results of the evaluation yielded a total of 25 themes. Twelve of the 25 were positive themes, and 13 were coded as negative themes.

- Table 1 reflects the overall percentage of the positive and negative themes of the responses provided by the students. Approximately 2 out of every 3 responses were positive.
- Table 2 illustrates the percentage of positive themes related to the teacher's characteristics in the classroom. Approximately 1 out of every 3 positive themes related to personal teacher characteristics was due to the perception that he or she was "knowledgeable, professional, prepared and [had] high standards".
- Table 3 demonstrates percentage of positive themes related to course structure and presentation. In this category, "effective resource" was identified by 1 of every 3 applicable response.

- Table 4 illustrates the percentage of negative themes related to personal teacher characteristics. The most common response (33%) related to "unprofessional behavior".
- Table 5 presents the percentage of negative themes related to course structure and presentation. The most common response (20%) in the category reflected the theme of "Limited presentation, wish for additional topics, or for topics to be covered more in depth".
- Table 6 shows that 7 out of every 10 response reflected general positive themes regarding the Physics courses.

Conclusion

An analysis of the student course evaluations of the courses offered by the Physics Department between Fall 2006 and Spring 2007 yielded 25 positive and negative themes. Generally, 70% of the responses reflected positive themes. The most frequently identified positive characteristic of the professors was that they were "knowledgeable, professional, prepared and [had] high standards", while the most frequent negative characteristics was "unprofessional behavior". The most frequent positive theme related to course structure and presentation was that it was an "effective resource", and the most frequent negative theme regarded "limited presentation, wish for additional topics, or for topics to be covered more in depth."

Table 1

Percentage of overall combined **positive** and **negative** themes in the evaluations of courses in the Physics Department at the University of La Verne.

	n	%
Negative	74	32
Positive	158	68
Grand Total	232	100

Note: Overall, approximately 2 out of every 3 responses were positive in the evaluations of courses in the Physics Department.

Table 2

Percentage of **positive** themes related to personal teacher characteristics in the evaluations of courses taught by the faculty in the Physics Department at the University of La Verne.

	n	%	% of Grand Total
1. Caring, positive, Nurturing, approachable	13	21	6
2. Enthusiastic and motivating	9	14	4
3. Knowledgeable, professional, prepared, high standards	22	35	9
4. Good communication skills	9	14	4
5. Good personalized attention	10	16	4
Total	63	100	27

Note: Overall, approximately 1 out of every 3 positive themes related to personal teacher characteristics was due to “knowledgeable, professional, prepared and high standards”.

Table 3

Percentage of **positive** themes related to course structure and presentation in the evaluations of courses taught by the faculty in the Physics Department at the University of La Verne.

			% of Grand Total
	n	%	
1. Well organized	2	4	.01
2. Interesting subject matter	6	10	.03
3. Student and class involvement	1	2	0
4. Effective resources	18	32	.08
5. Relevant or applied material	6	11	.03
6. Productive-learned content	15	27	.06
7. Productive-learned skills	8	14	.03
Total	56	100	.29

Note: Overall, approximately 1 out of every 3 positive themes related to course structure and presentation was due to “effective resources”.

Table 4

Percentage of **negative** themes related to personal teacher characteristics in the evaluations of courses taught by the faculty in the Physics Department at the University of La Verne.

	n	%	% of Grand Total
1. Uncaring, critical, unapproachable, biased	4	22	2
2. Lack of knowledge and/or preparation	3	17	1
3. Poor communication skills (monotone, unclear speaking or Unintelligible writing)	5	28	2
4. Unprofessional	6	33	3
Total	18	100	8

Note: Overall, approximately 1 out of every 3 negative responses related to personal teacher characteristics was due to “unprofessional” behavior.

Table 5

Percentage of **negative** themes related to course structure and presentation in the evaluations of courses taught by the faculty in the Physics Department at the University of La Verne.

	n	%	% of Grand Total
1. Inappropriate or unhelpful Assignments	5	9	2
2. Poor organized	7	12	3
3. Subject matter is not Interesting	2	3	.01
4. Lack of student involvement	2	3	.01
5. Poor resources (dull or inappropriate audio/ Visuals, speakers)	9	16	4
5. Overly rigorous course work Or harsh grading, too much Material, too fast a pace	10	17	4
6. Limited presentation, wish for Additional topics or for topics to Be covered in more depth	12	20	5
7. Poor scheduling and timing	10	17	4
8. Irrelevant course material	2	3	.01
Total	59	100	22.03

Note: Overall, 1 out of every 5 negative responses related to course structure and presentation was due to "Limited presentation, wish for additional topics, or for topics to be covered more in depth".

Table 6

Percentage of general **positive** and **negative** themes in the evaluation of courses in the Physics Department at the University of La Verne.

	n	%	% of Grand Total
Negative	17	30	7
Positive	39	70	17
Total	56	100	24

Note: Overall, 7 out of every 10 general responses were found to be positive.