The Academic Program Review Committee very much appreciates the Department’s hospitality during our visit, and as well as the effort in advance to organize a very busy schedule. We are especially grateful to Department Chair Michael Crenshaw and Professor Douglas Gies, who chaired the Department’s Academic Program Review Committee preparing for our visit, as well as appreciating the tremendous effort of each of the members of this committee in preparing the very comprehensive self-study report. Each of our interactions gave us useful and interesting perspectives on the department, and all of our meetings with faculty and students were both productive and enjoyable. It was a particular pleasure to observe the high level of engagement of all faculty and students in the department and its future.

1 Executive Summary

During our visit to the Department of Physics and Astronomy at Georgia State University, we had the opportunity to meet with faculty, graduate students, and undergraduate students to evaluate the successes of the department and to identify new opportunities to strengthen the department.

- We found the faculty as a whole to be engaged in significant scholarly research, making important contributions in both astronomy and physics and competing effectively for external and internal funding. Several of the department’s active research programs are recognized internationally. This is particularly true for the core collaborative research groups in the department, and these groups provide a model for strengthening other research areas in the department.

- The department has made remarkable progress in its undergraduate program through its initiatives to create a multi-faceted educational experience for students, including career preparation, opportunities for specialization, and a research experience. These initiatives have led to a significant growth in the number of undergraduate majors. Particularly notable is the department’s success in increasing the diversity of its undergraduate majors, a change which, in the future, should hopefully also be reflected in its faculty and graduate students. In addition, we recommend that the department rotate faculty teaching courses for majors so that multiple faculty are available for each course, and that the department implement a peer-observation program in service and majors courses to provide feedback to instructors for continuous improvement in instruction.
• At the graduate level, both the astronomy and the physics graduate programs are strong, but can be improved through increasing graduate student stipends, establishing formal, clear, and shared expectations through graduate student handbooks, reducing time to degree for PhD students, and establishing a more robust advising system for graduate students. We recommend that the department limit further growth in its graduate programs until these issues can be addressed.

Critical to maintaining the department's notable rise in national and international stature in physics and astronomy will be a shared consensus on a comprehensive strategic plan that can guide future department chairs as opportunities appear. We urge the department to undertake this activity.

2 Contributions to the Discipline
2.1 To which subfields of the discipline does the department make the most significant scholarly, creative, or clinical contributions (as appropriate)?

2.1.1 Astronomy
The department continues to make significant scholarly contributions in astronomy, particularly in the areas of extragalactic astronomy, stellar astronomy, solar physics, and high angular resolution imaging.

Professors Bentz, Crenshaw, and Kuzio de Naray, along with emeritus professor Miller, study the properties of galaxies, including the supermassive black holes at their centers and the dark matter and intergalactic medium in which they are embedded. Interactions among the galaxies, the black holes, and the gas and dark matter surrounding them drive the formation and evolution of the galaxies.

Professors Baron Gies, Henry, Lepine, White, and emeritus professor Harold McAlister are each carrying out internationally recognized research in stellar astrophysics, including work on binary stars, nearby stars, stellar properties, and exoplanets. Research with GSU's Center for High Angular Resolution Astronomy has established world leadership in this area, including work on image reconstruction from interferometric observations.

GSU investments in solar physics and astroinformatics are particularly strategic with the 2CI and NextGen initiatives in the area of solar and stellar computational modelling, including Professors Martens, Jefferies, Pratt, and Lepine along with colleagues in Computer Science. GSU is well positioned to take advantage of new space and ground-based facilities in these fields (and the massive datasets they will produce) and has established programs putting GSU in a position of leadership in solar physics and space weather.

2.1.2 Physics
The condensed matter physics program comprises six faculty who study a range of topics that include: theoretical nanoplasmonics and nanophotonics (Apalkov and Stockman, CENO), nanoscience at low temperatures and high magnetic fields (Mani), MOCVD/CVD-grown materials systems (Dietz), magnetism and spintronics (Kozhanov), and optoelectronics (Perera). This group of faculty presently mentors 19 graduate students and produced 10 PhD students over a three-year time period (2013-16). All faculty appear to have well-established research programs with
sustainable funding and do not seem to interact much, except those involved in CENO (Center for Nano-optics). Given that new faculty hires at GSU are linked to strategic clusters, it would be beneficial to build some connections among these faculty so that they were more successful in future hiring and possibly multi-PI research funding.

The nuclear physics program (Connors, He, Sarsour) focusses on studies of nuclear matter at high densities and temperatures and on the parton structure of nucleons. The three faculty members have developed a coherent program, where they supplement each other well. This enables them to take on responsibilities for both data analysis and instrumental development. The group has a stable DOE grant, but with the recent addition of Connors the external funding level should be expected to increase.

2.2 To what extent are the faculty number and composition sufficient to support the research and educational missions of the department?

2.2.1 Astronomy
Each of the Astronomy groups is of sufficient size to form a strong research cluster, and the members of each group share overlapping research interests. Each of these cohesive groups contributes strongly to the research and educational missions of the department, and each group is able to contribute more than the sum of its individual members. The Astronomy faculty have carved out clear and distinctive areas of leadership in the field that are recognized nationally and internationally.

The department’s astronomy faculty have also taken great advantage of GSU investments in facilities including CHARA, ARC, and SMARTS. CHARA is a gem and GSU’s leadership in high angular resolution astronomy has paid off well. CHARA is a strong, productive facility at the leading edge of this emerging field. The implementation of adaptive optics at CHARA will extend the productivity and reach of this facility greatly. SMARTS and ARC support observational programs for both stellar and extragalactic programs at GSU. All three facilities are well matched to support the research needs for all members of the Astronomy group. The financial model to support these facilities, combining institutional support, F&A return, and grants, appears to be working but will need to be monitored to ensure continued success.

The future of the Hard Labor Creek Observatory is less clear. The return on continued investments at HLCO may not be warranted for research and the facility may be a distraction for faculty. HLCO may have a role in developing new instrumentation for the department’s other facilities, however the priority of that use is unclear. Its value for training graduate students in today’s world is limited, and students will benefit more from a focus on CHARA, SMARTS, and ARC. The astronomy group should develop a strategic plan for HLCO, perhaps focusing on education and outreach, and consider partnering with other institutions with an interest in using the facility to leverage resources.

2.2.2 Physics
With six researchers in condensed matter physics and three in nuclear physics the department has a sufficient number of researchers in these two fields to sustain a strong research program. The condensed matter group seem to have less coherence and internal collaboration than many
comparable programs and any future hires should augment the current program directions. In the other research areas of biophysics, atomic physics and physics education research (PER) the number of people is sub-critical and the department should decide (through a strategic planning process) if further hires in these areas are needed or if other areas should be enhanced.

From an educational perspective, however, there are concerns about the composition of the physics faculty. The PER group has provided important improvements to parts of the physics lower division curriculum, but the staffing to support this effort is limited and has an uncertain future. Oversight of the undergraduate program and advising is carried out to a very significant degree by one motivated faculty member, which leaves the program at risk of a “single point failure” if that person steps out of this role.

2.3 Based on your knowledge of similar departments in the discipline, evaluate the overall strength of the department.

2.3.1 Astronomy
Overall the astronomy program within the department is very strong in its chosen areas of expertise. The faculty have chosen wisely to focus on specific areas, including solar physics, stellar astronomy, astroinformatics, and extragalactic astronomy. In most of these areas the department has achieved international leadership. While astronomy programs are not ranked by U.S. News and World Report, the GSU Astronomy program competes very well with its aspirational and peer programs, and with many of the stand-alone astronomy programs in the U.S.

2.3.2 Physics
The most recent ranking of graduate physics programs by the National Research Council places the department in the group from 75 to 127. The U.S. News and World Report places it as 111 out of 142 programs. These rankings seem reasonable given the current size, publication rates, graduation rates and funding rates of the physics program. Given the general upward trajectory of GSU a ranking in the top 100 at the next academic review is realistic, but any more dramatic increases of the ranking are not likely unless there will be substantial increases in the number of physics faculty and their external funding levels.

3 Quality of the Department’s Undergraduate and Graduate Programs
3.1 Quality of the Undergraduate Programs in Physics and Astronomy
The Physics BS program has grown recently and now enrolls nearly 190 majors and awards approximately 18 degrees per year, with under-represented minority (URM) students receiving more than four per year (2012-2015)—a notable increase from about one per year (2007-2011). The department attributes their undergraduate enrollment growth in part to curriculum changes such as the introduction of a “Gateway to Physics” course, redesign of the advanced laboratory course, expansion of the research capstone project, and introduction of a physics teacher concentration. It is noteworthy that this new concentration (begun 2012) provides teacher certification and was recognized with the PhysTEC “5+ Club” by the American Physical Society.
3.1.1 Evaluate the quality of the undergraduate curriculum in terms of disciplinary standards and trends.

The physics curriculum has a relatively standard core and provides flexibility with the choice of the Standard Program or seven concentrations (Applied Physics, Astronomy, Biophysics, Computer Science, Geology, Pre-medicine, and Teacher Education). The largest number of students have graduated in the Standard Program (19 of 55 graduates over past 3 years); a reasonable number chose the four concentrations of Teacher Education (10), Computer Science (9), Astronomy (8), and Applied Physics (6); and only a few selected Pre-medicine (1), Biophysics (1) and Geology (1).

Although many physics programs across the nation require more upper-division courses in their curricula as compared to GSU, e.g., (6 credit hours in classical mechanics, electricity and magnetism, and quantum mechanics and 3 credit hours in thermal physics and statistical mechanics), the flexibility of the GSU curriculum is well-suited to its diverse student body with a range of career objectives. All concentrations and the Standard Program emphasize student learning outcomes that include core physics principles and gaining expertise in the acquisition and analysis of physical data. Recent assessments show that majors achieve competency in data acquisition and analysis via the Advanced Physics Lab (PHYS 3300) and Research Project/Advanced Research (PHYS 4900/4950). Some students, however, appear to need more core physics training and the department consequently changed the curriculum to include required courses in Mathematical Methods and Computational Physics I/II (PHYS 3550/3560). The department also improved instruction by introducing inquiry-based tutorials led by undergraduate “learning assistants” in the lab curriculum for the calculus-based introductory sequence, as well as piloting “studio” physics in some sections of the non-calculus sequence.

Our recommendations with regard to the curriculum include the following:

- Continue to support the Gateway course since it was highlighted by students as impactful in their introduction to the major and effectively communicated possible career pathways.
- Migrate research-based pedagogies to more courses in the curriculum, e.g., expand the use of studio physics to the calculus-based introductory sequence and introduce more active learning in upper-level courses.
- Coordinate course learning outcomes among the several sections offered in the introductory sequence, since students commented about inconsistency in preparation for upper-level courses.
- Continue to emphasize computational and programming training, since it is a critical skill for job opportunities.
- Maintain the flexibility offered by the seven concentrations for the BS degree, since it appears that the courses necessary for the low-enrollment concentrations are provided by other units and do not impact resourcing in the department.
- Continue to develop the teacher education concentration with PhysTEC to help fill the critical need for well-trained physics teachers.
- Explore the possibility of connecting the curriculum to service learning opportunities in the metropolitan area, particularly given the success of the teacher education concentration.
3.1.2 Evaluate the quality of both incoming and graduated undergraduate students. Are the enrollment, retention, and graduation rates appropriate? How to improve?

The enrollment and graduation numbers for the GSU BS physics degree program have increased over the past years due to departmental initiatives and nationwide trends. The number of incoming freshman majors is currently robust (45 in Fall 2016); the total number of physics majors more than doubled over a period of seven years to approximately 180 (Fall 2016); and the number of Physics BS degrees tripled to over 20 (Fall 2016). For comparison, AIP data (2014) indicate that the average and median number of bachelors degrees awarded by departments that have PhD programs was 20.4 and 15, respectively. Therefore, GSU is now on par with other PhD-granting departments.

With respect to the quality of incoming students, the entering freshman class in 2016 had an average SAT score of 1213 (150 points higher than GSU average), indicating that the program continues to attract high quality students as it has grown. Regarding the quality of graduates and their employment outcomes, the 33 BS degree recipients who responded to surveys (of 63 students contacted) provided the following data: 39% reported obtaining employment in technology companies, 24% enrolled in graduate programs, 33% are certified teachers, and one entered the military. Although these data are not comprehensive, the relative proportions appear to be consistent with the flexibility of the bachelors program to provide options other than the national norm of roughly half of graduates going on to graduate school (AIP 2017). In addition, the survey of undergraduates indicates that students are generally satisfied with the program and responded with high scores for “preparing me for my career or future educational goals.” The department therefore appears to be doing well with respect to the quality of both incoming and graduated students.

As stated in the APR report, the 6-year graduation rate for GSU physics majors is only 28% for cohorts beginning in 2002-2010, which is lower than other GSU programs. This low rate has been attributed in part to the number of students transferring to engineering programs outside GSU. The department recognized these low rates and has been addressing them by improving advising, making changes to the curriculum as discussed earlier, and better coordinating the course schedule for timely completion. Regarding advising, the undergraduate director connects with students in the Gateway to Physics course and during the calculus-based sequence, as well as contacts them when necessary. The GSU Society of Physics Students (SPS) also serves as a faculty contact point and peer-mentoring group. As a consequence, the 4-year retention rate has increased from 36% (2002 to 2010 cohorts) to 51% (2011 and 2012 cohorts), and the 4-year graduation rate has increased from 9% (2002 to 2010 cohorts) to 17% (2011 and 2012 cohorts). Such improved rates indicate that the department is making substantial progress on their retention and graduation rates.

Another important aspect of the student body in the bachelor program is its demographic profile, particularly in the less representative discipline of physics. Over the last three years, about 20% of GSU physics majors and 16% of BS degree recipients were female, which is reasonable in comparison to the national average of 20% female degree recipients (AIP, 2014). The department recently established a Women in Physics group to improve its retention rates and female representation. With regard to URM populations, over the last three years 18 of 55 (or 33%) of GSU BS degree recipients identified as under-represented minority groups, including 20% as African American, 9% as Hispanic and 5% as Native American. Such demographic representation is
significantly higher than national averages for physics graduates (~5% for African American and 2% for Hispanic, AIP 2012/2013), although not higher than the GSU undergraduate student body (42% and 10%, respectively). Therefore, there is the possibility of increased representation of URM students in the program with some concerted effort.

Our recommendations in this area include the following:

- Continue to focus on improving gender and URM diversity in the program, so that representation is comparable to or better than national (gender) and GSU (URM) profiles.
- Consider the possibility of mandatory advising for upper-level students, since students may be delayed if they do not anticipate the offering of courses for their concentration.
- Institute a more robust advising effort among faculty in the department given that only one undergraduate advisor currently serves about 190 majors.

3.1.3 Are there appropriate resources and support structures for the department’s educational undergraduate programs?

The undergraduate program has grown over the past decade and also generates more than 17,000 credit hours per year due to its service mission. The number of degrees awarded annually per T/TT faculty was 0.68 in AY 2015 and is higher than the median of 0.46 for peer departments.

Our recommendations regarding resources and support structures include the following:

- Explore the possibility of optimizing teaching resources by increasing course section sizes for introductory service courses in an appropriate manner.
- Rotate instructors among the upper-division courses to ensure a robust program with multiple instructors for each course.
- Consider introducing peer observations in service and majors courses to provide feedback to instructors for continuous improvement.
- Maintain the SPS room for undergraduates and consider identifying additional space for enhanced peer interactions outside the classroom.

3.2 Quality of the Graduate Programs in Physics and Astronomy

The Department of Physics and Astronomy at Georgia State University offers three graduate degrees, including an MS in Physics, a PhD in Physics, and a PhD in Astronomy. ~76 graduate students are enrolled, and the Department graduates typically 9-10 MS students (mostly on the way to obtaining a PhD) and 9 PhD students each year. The number of graduate students has grown by 29% since 2012.

3.2.1 Evaluate the quality of the graduate curriculum in terms of disciplinary standards and trends.

The MS program in Physics requires the basic and appropriate courses consistent with disciplinary standards in Physics, including a course in mathematical physics, two courses in classical mechanics, two in quantum mechanics, two in electricity and magnetism, and one in statistical mechanics. Students may take additional courses appropriate to their focused research areas and complete a master’s thesis or research paper.
More advanced courses in traditional areas of physics are required for the PhD plus an additional 12 (or more) hours of advanced coursework. Overall the quality and currency of the coursework is consistent with disciplinary standards, but the number of courses students must take is high, and limits students’ ability to engage in research early in their graduate careers. The heavy course load also contributes to a long time-to-degree compared to other institutions.

Only a PhD is offered in Astronomy, although MS students can follow an astronomy track in Physics. The course requirements were recently revised to allow completion of coursework in the first two years and is now consistent with disciplinary norms. The curriculum is traditional, with a stronger emphasis on stellar astrophysics than is found in many doctoral programs. This emphasis is consistent with the research interests of the faculty and the students’ dissertation research areas.

We do not recommend the implementation of a professional master’s program in Physics. Similar initiatives have been tried at other institutions, often without success in attracting students. One option, however, might be to work with local partners in the private sector to provide industry-specific training at the master’s level.

3.2.2 Evaluate the quality of both incoming and graduated graduate students. Are the enrollment, retention, and graduation rates appropriate? How to improve?

Since 2012, the number of applicants has increased by about 20% while the percentage of applicants offered admission has declined from 41% to 26%. Of those offered admission, the percentage enrolling has increased from 22% to 64%, suggesting that the department is increasingly able to attract students. The number of students enrolled per year has slightly more than doubled since 2012. The verbal and quantitative GRE scores for enrolled students have declined during this period but remain consistent with discipline-specific national norms with verbal percentiles in the mid-40s and quantitative scores in the low 70s, especially given the large number of international students in the Physics program.

3.2.3 Based on your professional experience, are the enrollment, retention, and graduation rates in the graduate program appropriate? If not, what changes might the department make to improve them?

Graduate enrollments in the PhD programs in Astronomy and Astrophysics have increased from 22 to 28 since 2012, while the number of PhD students in Physics has increased from 33 to 47 during the same period. The current graduation rate of typically 9 PhD students per year is consistent with typical enrollments in the period prior to 2013. Retention shown in B2.4 for the 2009 entering cohort suggests that 7 of 10 entering students have graduated by 2017, with three not retained. In Astronomy, two of the four students in the 2009 cohort had graduated by 2017 while two left the program during the first three years. Given the small sample statistics, enrollment, retention, and graduate rates are appropriate.

However, the ratio of graduate students per tenure/tenure track faculty is relatively high at 3.3, noticeably above the median ratio of 2.7 for peer schools. Of greater concern is the high time-to-degree of 6.2 years for Physics and 7.7 years for Astronomy. The department should consider limiting further growth in the number of PhD students to avoid increasing the student/faculty ratio further.
3.2.4 Are there appropriate resources and support structures for the department’s educational graduate programs?

Resources and support structures for the department’s graduate programs have not kept up with the growth of the graduate program, and we identified a number of areas that need work.

- Foremost is the need to increase the formality and structure of the graduate program, including a graduate handbook with clear expectations for student milestones and progress and a shared student-faculty understanding of degree and course requirements, rules, the content of the qualifying exam, and opportunities available to students.

- Student advising in Physics should be formalized and shared among the faculty. A departmental graduate student advising committee that advises all students during their first two years should be considered by the department.

- The time-to-degree in both the Astronomy and Physics PhD programs is excessively long and the department should consider practices that encourage students’ timely progress. One example is to institute mandatory annual meetings of the students’ research committees. The Astronomy Graduate Program Director indicated that steps are being implemented to enhance the ability of students to complete the PhD within a more reasonable timeframe of 5.5 to 6 years.

- A more formal orientation program should be instituted to assist new students joining the department. This function seems to be handled effectively within the Astronomy PhD program, but not within the Physics program. The orientation program should include training for new TAs on how to teach the lab sections, both at the general level and for specific labs. Training for teaching the “studio” labs is especially needed.

- The department should work to improve career information and guidance for graduate students. During the committee’s conversations with the graduate students a reoccurring theme was the students’ lack of awareness concerning further career options after having obtained their PhD. This was in stark contrast to the undergraduates, who seemed much more knowledgeable about their career options. In particular, better information on career options outside academic research should be provided to students. Connections with companies and laboratories in Atlanta can be important partners in providing career guidance to students. Fortunately, improved graduate career information is part of the department’s goals as described in the self-study.

- Graduate student stipends of ~$20K for 12 months are too low to be competitive, especially at an urban campus with a high cost of living. The suggested increase of 5% over two years seems inadequate. Only 39% of the funding for the graduate program is derived from external grants, whereas the rest comes from GSU internal sources like salaries for GTAs and internal competitions for stipends. In addition, the graduate students seem to be GTAs most or all of their graduate career and are thereby receiving tuition waivers from GSU. So the cost per student for each research group is low compared to most other graduate programs. The department and the research groups should consider increasing the graduate stipends based on increased contributions from external grants. This strategy might lead to a slight decrease in the number of graduate students, but an increase in the quality. The department should decide on the wisdom of such an approach as part the development of a comprehensive strategic plan.
These changes will go a long way toward alleviating many of the concerns and issues that are affecting the morale of graduate students in the Physics program.

3.2.5 The potential for growth of the department’s graduate programs
Given the current student faculty ratio we cannot recommend that the graduate program continue to increase at the rate it has been increasing. The department should instead stabilize the program at its current size, increase graduate student stipends, reduce the time to degree, and formalize department practices and policies for the graduate programs.

4 Quality of the Department’s Research Culture
4.1 Based on your knowledge of the discipline, what is your assessment of the quality of the department’s faculty?
The quality of faculty overall is very good as reflected in publications, success in securing extramural funding, participation in internationally prominent collaborations, and involvement in professional service at the national level. The addition of high profile senior faculty as part of an interdisciplinary cluster hire is a notable and positive development.

4.2 From a disciplinary perspective, what is your assessment of the research areas in which the department is already strong, and areas with the potential for further growth?
Within astronomy the department has built successful groups in stellar, solar, and extragalactic areas, with enabling expertise in high angular resolution observations and analysis of large data sets. The extragalactic group is observational in focus and would potentially benefit from the addition of theoretical expertise. From a strategic perspective, the areas of research connect with major questions in the discipline and can be expected to maintain substantial intellectual vitality for the foreseeable future. GSU’s sustained commitment to high angular resolution astronomy through CHARA and new investment in interdisciplinary approaches to big data places the department in a strong position to engage successfully with these increasingly important aspects of the field.

Within physics the department has established research programs in nuclear physics, condensed matter physics, atomic physics, biophysics, neurophysics, and physics education. The nuclear program is based on faculty participation in a large international experimental collaboration, and functions successfully as an interactive and coherent group. The condensed matter faculty individually provide important expertise but appear to engage in only limited collaboration or interaction among themselves. The condensed matter group has an opportunity to achieve greater success if the members can find a basis for greater intellectual exchange and active collaboration; based on examples at other institutions, increasing such interaction could benefit extramural funding and student culture.

The areas of atomic physics, biophysics, and neurophysics are represented by a single faculty member in each case. There appears to be little impetus in the long term for maintaining a presence in atomic physics. The biophysics and neurophysics faculty benefit from collaborations extending beyond the department, and it would be helpful if opportunities could be found to increase interaction with other faculty in Physics & Astronomy. The research areas represented in the department are sufficient to enable engagement with a broad cross section of important topics.
in the discipline. The department research culture would benefit from a greater sense of intellectual common purpose among its physics faculty.

Georgia State University is to be commended for supporting physics education research, although with current staffing the program appears to be in a tenuous state. If the department is committed to maintaining this effort, it will likely need to consider additional investment in the future. Differences in the scholarly methods and publication venues for physics research per se versus physics education research can introduce challenges in departments hosting both, but in-house expertise in forefront pedagogical techniques can be valuable for achieving improved student outcomes. The Physics & Astronomy Department has seen some benefit of this type but it appears that significant opportunity remains for the department to incorporate the findings of physics education research in its instructional methods.

4.3 What is your assessment of the support structures for faculty and student research (e.g., grant-writing support, travel grants, laboratories, student funding, administrative support, etc.)?

The Physics & Astronomy Department overall benefits from a healthy system of administrative support structures. Institutional support is particularly impressive for astronomy observational access, via direct funding and F&A allocation. The Physics & Astronomy Instrument Shop provides essential support for experimental programs. While members of the department have expressed concerns about availability of lab space, the committee’s impression is that the current space is sufficient and can accommodate more activity if allocation and use of the space is optimized; this could involve sharing of physics lab space for similar or related activities by more than one faculty member.

4.4 Do you have any recommendations for improvements in the department’s research culture, productivity, and results?

The department’s research culture would benefit from several changes. Graduate student stipends are low relative to those at other institutions and it seems that competitive stipends can be achieved through a restructuring of funding allocations for stipends. A question was raised as to whether computer support was sufficient for observational astronomy researchers, which may bear consideration. Programmatic activities that lead to increased interaction between researchers in condensed matter, as well as within physics more broadly and the department as a whole, could potentially benefit the research culture and diminish the current fragmentation of activity.

5 Goals

5.1 Are the goals the department has outlined in its self-study appropriate for the unit?

As part of the self-study exercise the department has developed four strategic goals which (somewhat simplistic) can be described as:

1) make the graduate program better,

2) make the undergraduate program better,
3) build multi-disciplinary teams to increase external funding,
4) increase the engagement with the local, urban community and the global community.

These goals are aligned with the overall strategic goals of GSU. However, they are also somewhat generic and do not differ much from what most other departments at GSU might have as goals.

5.2 Are they in accord with disciplinary trends?
Overall the goals are in accord with disciplinary trends. In particular, the emphasis on multi-disciplinary research teams and stronger engagement with local and global communities are seen in many physics and astronomy programs.

5.3 Are the priorities reasonable?
Overall the priorities are well selected. In particular, the goals of increasing graduate stipends (3.b.1.1), increasing efforts to support graduate students in career development (3.b.1.2), increasing retention rates (3.b.2.3), as well as the goals of increased emphasis on multi-disciplinary research teams (3.a.3) and external engagement (3.a.4), seem very appropriate and well-chosen for this department’s particular situation. Conversely, the review committee is not recommending an increase in the graduate program, so the goal of increasing the graduate recruitment efforts (3.b.1.3) might either be de-emphasized or redirected towards attracting higher quality students.

5.4 Are the resource needs realistic?
The self-study does not really provide sufficient information on how the department envisions to implement the various goals and it is therefore difficult to judge if there are sufficient human and financial resources available. Overall, the review team was impressed with the level of central support available to the department, especially for astronomy research and the graduate programs.

5.5 Are any changes or additions warranted?
The review committee would have liked to see a more comprehensive strategic plan for the departments than the 2-1/2 pages in the self-study. Most departmental strategic plans contain specific hiring priorities that guide the departmental leadership in their interactions with the university administration. Currently, it appears that the critical decisions on what positions to pursue are made by the Chair after more or less intense lobbying efforts by the various groups separately.

We encourage the department to develop a comprehensive strategic plan that contains goals like those briefly outlined in the self-study, more detailed implementation plans for these goals, and a description of the hiring and funding priorities resulting from the strategic goals.

6 Additional issues
6.1 Departmental Governance
As discussed in section 5.5, the department has not developed a comprehensive strategic plan.
Typically, such a plan is developed through a process where all people in the department are given an opportunity to voice their opinion and where hopefully a broad-based consensus is developed. According to the information we were given, the department has not had a retreat for the faculty for at least 5 years. Furthermore, nearly all of the faculty members we talked with were not aware of the three-year departmental hiring plan provided to the Dean and, as far as we were informed, the hiring had not been discussed or been approved by the faculty. In contrast, we were informed that decisions of what searches to pursue were done by the Chair after a somewhat informal process where individual faculty members or groups could try to lobby the Chair through individual meetings.

A more open departmental decision process is recommended, where search priorities are developed through open, public discussions and where faculty approval of the final priorities are part of the process.

6.2 Faculty Development

Based on the information in the self-study, the faculty seem to be well adjusted and do not seem to lack development opportunities. Nevertheless, the review committee found it noteworthy that the department does not appear to have a formal mentoring process whereby all new faculty members are allocated one or several more experienced professors to mentor them through to tenure or even further during the associate professor period. Most peer institutions have strong formal mentoring programs and we strongly recommend that the department implement such a program. In particular, as the faculty hopefully will increase its diversity, social science research has shown that URM faculty (gender and well as race) especially benefit from careful mentoring.

The committee is also encouraged to learn that GSU is now developing diversity training for its faculty in connection with faculty searches. Given GSU’s very diverse undergraduate population, the P&A faculty seems much less diverse, and a strong emphasis on increasing faculty diversity should be a cornerstone in any strategic plan.

7 Summary and Recommendations

7.1 Summarize the department’s major strengths and challenges.

The committee was impressed with the substantial improvements the department has shown in nearly all areas since the last program review. Some of the most important positive findings were:

1. A strong growth of both the undergraduate and graduate programs.
2. A strong focus on retention in the undergraduate program that has resulted in impressive gains.
3. A diverse undergraduate population with respect to ethnicity/race.
4. External as well as internal funding levels are good as compared to peer institutions.
5. Recent curriculum innovations and changes that reflect the needs of incoming students with less formal preparation in math and physics.
6. An impressive provision for all undergraduate majors to participate in a research experience.
7.2 List your recommendations.

The justification for the following recommendations are contained in the main body of this report, so here we only provide a summary of our most important recommendations:

1. Develop a comprehensive strategic plan for the department. It should be created through strong faculty involvement and, in addition to the normal issues addressed in strategic plans, it should also address the following issues:
   - Should the Physics and Astronomy department be one unified department, two separate Physics and Astronomy departments, or have increased formal autonomy for the Astronomy and Physics.
   - Research directions for Physics with a plan for creating more synergy in the condensed matter program.
   - Hiring plan emphasizing long term goals with research focus on a few key areas in both Physics and Astronomy and with groups sharing research goals.

2. Develop a stronger emphasis on diversity for faculty and graduate students.

3. Increase the synergy in the physics research program.

4. Develop a formal mentoring process for faculty.

5. Introduce peer observation of faculty teaching and send all new faculty to the AAPT program for young faculty.

6. Increase the rotation of instructors in the various classes to renew and refresh teaching efforts.

7. Increase the use of research-based teaching methods in the undergraduate program.

8. Develop a Graduate Handbook so the students understand the rules, requirements and opportunities better.

9. Develop better career orientation for the graduate students.

10. Develop more faculty advising/mentoring in the undergraduate programs to avoid a “single point of failure” issue with essentially only one faculty member doing the majority of the work.

11. Develop a stronger fundraising process, in collaboration with industrial partners in Atlanta.