December 1, 2017

To: Dean Sara Rosen, College of Arts and Sciences
   Dr. John Duffield, Director of Assessment and Review, OIE
From: D. Michael Crenshaw, Chair, Physics and Astronomy
Re: Department of Physics and Astronomy 2017 Self-Study Report

The Department of Physics and Astronomy’s 2017 Self-Study Report was prepared by the Self-Study Committee chaired by Regents’ Professor Doug Gies and approved by the faculty of the department. I appreciate the hard work of the committee and the contributions of other faculty members, staff, and students. The report is an accurate description of the progress made by the department over the 2014 – 2016 study period as well as the last 5 years during which I had the privilege of being chair. I agree with the committee’s assessment of areas to target for improvement, current resources and those needed for current and future growth, the department’s goals for the future and its priorities, and their general plans for achieving these goals.

Below, I give my perspectives on the department’s accomplishments, goals, and future needs in light of the university’s and college’s strategic initiatives.

1) Become a national model for undergraduate education. Maximize academic and career success.

   The department has made great strides in this area. The number of B.S. in Physics degrees at GSU has tripled over the last 5 years to about 20 per year, placing the program in the top 20% of U.S institutions. The number of underrepresented minorities (URM) receiving these degrees continues to increase, putting GSU near the lead in this crucial STEM area. The fraction of degrees awarded to women is only slightly higher than average and the department is working on improvements, including the establishment of a Women in Physics mentoring group. In collaboration with our colleagues in the College of Education, the department is proud of our role in GSU’s selection to the American Physical Society’s PhysTEC 5+ Club by producing at least 5 graduates with high-school physics teacher certifications in three of the last four years, satisfying a critical need in the state of Georgia.

   An important objective is to increase undergraduate retention and graduation rates. Recent efforts include revising the curriculum and scheduling to increase flexibility, developing a significant research experience for each student, and creating the Gateway to Physics course to establish an early connection between students and
faculty. Future plans include better tracking of each major to identify their needs and stumbling blocks and intervening with advice and assistance. The department will work with industry, national facilities, and other institutions to create more internships and collaborate with GSU’s Career Services to identify job fairs, guest speakers, networking through alumni, and other career opportunities for our majors.

The department supports the university’s core curriculum through its introductory physics (algebra and calculus based) and astronomy lab science courses, including required physics courses for STEM majors. Faculty have developed a number of innovative teaching techniques including studio physics (combining lectures, demonstrations, peer instruction, and lab exercises) and “flipping” courses (lectures are done by videos and problems are solved in class). The department intends to increase the immersive and experiential activities in our courses and continue to grow and modernize our teaching laboratories and equipment.

Our accomplishments in undergraduate education have been fueled by the research, teaching, and leadership of our Physics Education Research group. Hiring an experienced and well-known faculty member in this area would bring critical mass, large-scale funding, national recognition, and new innovations to our educational initiatives. Collaboration with and support from the university, college, and the Center for Excellence in Teaching and Learning is critical for obtaining the funding and space we need for modern physics and astronomy teaching labs and facilities.

2) Strengthen and grow distinctive graduate and professional programs to develop the next generation of researchers and societal leaders.

Combined enrollment in our physics and astronomy graduate programs has increased by 29% in the last 5 years. Increased applications, decreased acceptances, and increased enrollments indicate our programs continue to grow while becoming more selective. Women comprise 44% of our current graduate students, which is significantly higher than the national averages for physics and astronomy. While the department has a large number of Asian (mostly international) graduate students, the number of URM is low (reflecting a national problem) but growing. Additional outreach to undergraduate institutions is needed, particularly to local HBCUs.

The department’s top overall priority is to increase financial support of our graduate students. Nearly all of our graduate students are on Ph.D. tracks and all of these are supported by assistantships or full-time employment. Our graduate student stipends have been frozen for many years and are no longer sufficient to meet their financial needs; most have to rely on loans to make ends meet. Although our beginning stipend ($20K) is the same as the median from peer and aspirational programs, our students are required to pay fees ($3K for those taking classes) and health insurance ($1.9K), and they live in an area with a higher cost of living than most. Department faculty contribute more to grad student stipends than nearly all other departments at GSU, so this is a difficult problem to solve. The department will work with the college and university to identify new funds and creative ways to increase or supplement student stipends and offset student costs, beginning with fees for first and second year
students. It will provide guidance and training for seeking external fellowships.

The department understands that we are not just training our replacements for research university faculty positions. We need to provide more career assistance, training, and networking opportunities for our graduate students, so that they can compete for rewarding jobs in industry, teaching, and government facilities. We will work with GSU’s Career services, our alumni, and colleagues outside of academia to bring more information, seminars, invited speakers, and training to our students.

3) **Become a leading public research university and increase impactful research.**

External research funds awarded to department faculty and staff increased dramatically, by a factor of 3.7 over the last 5 years, due primarily to a focus on large collaborative and often interdisciplinary research proposals and programs. The establishment of the University’s Center for Nano-Optics (CeNO) and successful large proposals in the College’s Center for High Angular Resolution Astronomy (CHARA) contributed heavily to the increased funding. Additional large increases came from renewed efforts by existing faculty and the hiring of new faculty primarily through successful proposals to GSU’s Second Century Initiative (2CI) and Next Generation programs to form the Stellar Astrophysics and Astroinformatics cluster in conjunction with the Department of Computer Science. The increased scientific and public impact of our research and our leadership in the scientific community are well documented in the self-study report.

Strategic hires to bolster groups in departmental areas of strength over the past 5 years have increased the number of tenure-track faculty members from 18 to 25 (14 physicists and 11 astronomers) and total faculty members from 23 to 31. The department is currently searching for a junior faculty member in condensed matter physics and a senior member in nano-optics. Given the department’s success in translating new faculty hires to significant growth in research funding, graduate enrollment, and undergraduate education and physics degrees, we will continue to submit internal proposals and find creative ways to hire new faculty to build critical mass in our research groups for large collaborative and interdisciplinary proposals and projects. These areas include high resolution imaging in astronomy and other sciences, nano-optics materials and devices, theoretical nuclear physics, galactic dynamics and high-performance computing, and physics education research.

The department’s rapid growth has resulted in increased demand for resources, including office and research lab space, business and technical support, and financial support for new faculty start-up costs. The college and university, including the Vice President for Research, have been helpful and supportive in meeting these challenges over time. Our most critical need is for more research laboratory space for new hires under recruitment and expanding research programs of existing faculty. We also seek to build one or more core facilities, such as one in nanophysics, and increase the capabilities of our valuable instrument shop. A long-term goal is to bring all faculty together into one location to foster even more collaborative projects.
4) **Understand and address the complex challenges of cities.**

Outreach to the city of Atlanta, surrounding communities, and the state of Georgia is a growing part of the department’s mission. In addition to our regular public observatory nights at HLCO, other stargazing events, public debates, and participation in the Atlanta Science Festival and Science Olympiad, we continue to look for ways to sponsor or support large public events such as the 2017 Solar Eclipse Festival at Rabun Gap-Nacoochee School, which drew 10,000 people. We bring significant attention to GSU through these events and through our numerous featured stories and press releases on the university, college, and department webpages, in local radio and TV programs, and in various GSU media including cover stories in the GSU magazine.

The department aims to include alumni and other supporters in these events and form a Board of Visitors to translate the visibility and successes of our programs into a more concerted effort to raise funds for our priorities, in conjunction with the college and university development offices. These priorities include endowed faculty positions, scholarships for physics majors in need, a departmental fund for recruitment and support of new faculty, annual student awards, and support for new research or teaching facilities (such as a student planetarium).

5) **Globalize the university through research, learning experiences, and outreach.**

Department faculty members have a vast number of international collaborations that we use to build and often lead large research programs and proposals, attract international students to our graduate programs, and bring visibility to GSU as a major research university. Partnerships with national and international institutions though CHARA, CeNO, ARC, SMARTS, and Brookhaven National Laboratory are major components of our research activities, development, and infrastructure. The department and individual faculty members sponsor travel of both graduate and undergraduate students to facilities (observatories, research labs, conferences, etc.) to participate in these collaborations.

The department has sponsored several international conferences and workshops at GSU in the last few years and plans to continue these efforts. We have had several dual graduate degrees and exchanges of students from France, and are working on a dual degree program with an Italian institution. Development of new international partnerships and enhancement of current partnerships that foster student participation is an important objective for the department. Increasing global outreach and scientific leadership in the scientific community will bring more international recognition to GSU.