Physics and Astronomy Department Strategic Plan
March 1, 2011

Executive Summary

The Department of Physics & Astronomy performs world-class research and provides state-of-the-art training for students in astronomy, astrophysics, and gravitational physics; atomic/molecular/optical physics, quantum optics, and quantum computing; condensed matter physics and materials science; medical and health physics; and nuclear and particle physics. In 2009-2010, sponsored research awards from state, federal, and private sources amounted to over $10.1M, an increase from $5.4M in three years.

- The Department's current research effort is sufficient to accept approximately 50% more graduate students than are currently enrolled in the program. A significant increase in the size of the Department's graduate population would have a major positive impact on research productivity, which in turn would lead to increased funding and recognition. The graduate enrollment has increased from 82 in Fall 2008 to 108 currently. A top priority of the Department is to recruit more and higher quality graduate students.
- The number of undergraduate majors in the Department has increased from 54 in Fall 2008 to 98 currently. A second priority is to increase the advanced course offerings needed to produce both undergraduate and graduate students capable of competing with the best students from across the country.
- A third priority is to redesign the sequence of introductory courses, in particular the calculus-based courses taken by Engineering students.
- The Department has built up an excellent and experienced support staff and instructor corps which must be maintained even in the light of limited resources.
- In order to maintain the Department's strength and continue the positive trajectory of the past several years, the Department intends to continue to recommend faculty hiring in areas of critical need and exceptional promise, with the intent to continue to serve the State and our students, relying on the strength of our research program to help carry us through tight budget times.
- The Department values CAMD and CCT, and expects to continue to partner with both to produce important new research and student training opportunities.

Mission: The mission of the Department of Physics & Astronomy is the advancement of knowledge and training of students through innovative, high quality fundamental research, graduate education, and undergraduate instruction. Excellent teaching and the training of quality teachers in the sciences are natural components of this mission, as are efforts to inform the public of exciting and new scientific developments. A department strong in both teaching and research lends strength to all of higher education in Louisiana and will provide a stimulus to help attract hi-tech industry, thereby contributing to the State's economic development.

Vision: The Department's vision is to use its unique world-class science to train its students to think creatively, flexibly, and analytically; to prepare increasing numbers of students to produce new knowledge and to be productive citizens of Louisiana and the nation; to utilize and expand its research capabilities to enhance Louisiana's, LSU's, and the Department's national reputations; to attract increased external funding to support its programs and its students; and to contribute to the development of Louisiana's technical infrastructure and workforce.

Overarching department goals: The Physics & Astronomy Department's specific goals align with the overall goals of the College of Science and Flagship 2020 in the broad areas of

- Discovery (strengthening our current program of fundamental and applied research, building on our existing strengths to directly benefit the citizens of Louisiana and the nation – Goals 1, 4, 5, and 6);
- Learning (providing challenging learning experiences for our undergraduate and graduate students and the community, coupling our research and our teaching to develop critical thinking skills and advanced training – Goals 2, 3, 4, and 7);
- Diversity (promoting a diverse student, faculty, and staff community and providing outreach and training opportunities for a wide and diverse community – Goals 8 and 9); and
- Engagement (strengthening our programs and ties with the local, state, and national community, with industry, and with alumni – Goal 9).

Goal #1: The Department's current research effort is sufficient to accept approximately 50% more graduate students than are currently enrolled in the program. A significant increase in the size of the Department's graduate population would have a major positive impact on research productivity, which in turn would lead to increased funding and recognition. ***A top priority of the Department is to recruit more and higher quality graduate students, in particular domestic students who can serve as Teaching Assistants.*** Excellent graduate students are essential for a productive research effort, for the health of our undergraduate instructional program, and for the success of a first-rate department. The Department currently has sufficient grant funding to support 50% more graduate students than we have currently enrolled. The rate of acceptance of our MS and PhD program offers is high (over 50% for US applicants), but there are an insufficient number of high quality applicants to the program.

- ➔ **Performance indicator:** We will aim to increase the number of high quality candidates joining our graduate program by 10 students per year above the current numbers, i.e., to approximately 35 - 40 new students per year.
  - ➢ ***Numerical indicators of 5-year performance:***
    - 25 PhD graduates per year
    - 150 PhD students
    - 20 Medical Physics MS students
    - Rate of graduation of entering students within 6 years to reach 90%
    - Availability of teaching assistantships and fellowships for 35-40 entering students per year

- ➔ **Strategy: a)** A major goal is to improve our graduate recruiting and publicity, including identifying candidates (in particular domestic candidates), soliciting them individually, increasing the quality and quantity of our recruiting materials, upgrading our web presence, providing better response to inquiries and communications from potential applicants, and establishing a presence at scientific meetings and other potential recruiting venues. Funding for an additional 10 students per year (50 students over 5 years), with each student supported for his/her first two years as a Teaching Assistant at $20,000 and thereafter on grant-funded research assistantships or fellowships, will require $400,000 additional in graduate assistantship funds. Two of these assistantships will be used to support students to work with our Graduate Admissions and Recruiting Committee chair and department staff on recruiting and publicity. **b)** The summer REU program needs to be continued and expanded, and good summer REU students need to be actively recruited into the Department's graduate program. **c)** Requirements for the Medical Physics concentration will be modified to be more competitive with the top PhD in Medical Physics programs nationally.

Goal #2: The number of undergraduate majors in the Department has increased from 54 in Fall 2008 to 98 currently. The graduate enrollment has increased from 82 in Fall 2008 to 108 currently, and grant funding is in place to increase this further. ***In order to attract additional and higher quality students, a second priority is to increase the advanced course offerings needed to produce both undergraduate and graduate students capable of competing with the best students from across the country.***

- ➔ **Performance indicators: a)** We have established a sequence of required and elective courses to be taught regularly at the undergraduate and graduate level. Teaching these courses on a regular sequence will be an indicator of success in establishing an appropriate curriculum for our students. **b)** Hiring an additional two instructors will be an important aspect of this.
  - ➢ ***Numerical indicators of 5-year performance:***
    - o A regular sequence of 20 4000- and 7000-level Physics and Astronomy courses taught each semester.
    - o Increasing number of instructors in the Department from 3 to 5
- ➔ **Strategy:** In order to teach the necessary advanced courses, additional faculty manpower must be made available. **a)** A search for a new Astronomy instructor is currently underway. **b)** An additional Physics instructor is also needed.

Goal #3: A third and related priority is to redesign the sequence of introductory courses, in particular the calculus-based courses taken by Engineering students, in order to both improve learning outcomes and enable us to offer a more comprehensive selection of advanced courses for our undergraduate majors and graduate students. Increased enrollment in our first year service courses has led to high class sizes and a large number of faculty engaged in teaching these courses at the expense of more advanced courses.

➔**Performance indicators: a)** Assessments of learning performance (D-F-W grades and performance on course final exams) will be used to evaluate student learning outcomes. **b)** We will plan to reduce class sizes and/or add tutorial/ recitation sections to the large lecture courses.

- ***Numerical indicators of 5-year performance:***
  - D-F-W rates in introductory physics courses below 15%.

➔ **Strategy:** In order to address both the quality of the education we provide our students and the need to free up faculty from teaching these courses in order to teach the advanced courses needed by our undergraduate majors and a larger population of graduate students, we are discussing a revision of the course structure. Initial discussions with the College of Engineering have been productive. We are investigating the possibility of instituting tutorial sections using undergraduate tutors and building on the highly successful Supplemental Instructor program run by the Center for Academic Success. We are also looking at the Learning Assistant model developed at the University of Colorado. Funding requirements are not yet definite, although we have already begun looking for external funding. We expect to have a detailed proposal by Spring 2011 for a revised Engineering sequence (replacing PHYS 1100-2101-2102) and plans to address both pedagogy and manpower issues in our first year courses, including detailed funding needs and potential sources of funding.

Goal #4: As a result of increased grant activity and increasing student numbers, the Department's staff is stretched thin. In addition, several key staff are approaching retirement. Searches for at least two positions must be initiated during Spring 2011. ***Future budget cuts cannot be allowed to further reduce an experienced, excellent, but already short-handed staff, and high priority will be given to maintaining our departmental staff support. This includes maintaining the strength of our essential corps of experienced non-tenure track instructors.***

➔ **Performance indicators:** Total number of instructors and support staff will be maintained and, if possible, increased.

➔ **Strategy: a)** Permission will be requested to conduct searches for at least one staff position during Spring 2011. **b)** A search will be conducted during Spring 2011 to fill an astronomy instructor position, and permission will be requested to fill a physics instructor position for Fall 2011.

Goal #5: In order to continue moving in the direction of national and international prominence and continue building Louisiana's and LSU's reputation, contributing to the training of a skilled scientific and technical workforce, and producing new scientific and technological results which will help develop and expand the State's economy, continued faculty hiring in strategic, high priority and high opportunity areas is essential. The Department's faculty include Fellows of the National Academy of Sciences, American Association for the Advancement of Science, American Physical Society, American Society for Therapeutic Radiology and Oncology, and the Optical Society of America; a corresponding member of the Mexican and Argentinian Academies of Sciences and the Latin American Academy of Sciences; winners of prestigious national

prizes and awards; and winners of Dept. of Energy Presidential Early Career awards and National Science Foundation CAREER awards. Our 2008 Strategic Plan identified specific high priority needs for faculty. Our hires in 2009 and 2010 were in accordance with the discussion in that 2008 Plan, and our faculty hiring priorities remain largely unchanged since then. We will search energetically for external funding to assist these new searches. We have recently initiated searches in 1) Nuclear Physics and Radiation/Health Physics funded by the US NRC and DOE and by Entergy and 2) a joint search with Mary Bird Perkins Cancer Center for a new Medical Physics Program Director, and plan on searches in the near future for two additional Medical Physics faculty to handle the teaching required to maintain CAMPEP accreditation and allow the Medical Physics PhD program to grow.

➔ **Performance indicators: a)** Total number of research-active faculty will be increased **b)** The Department will steadily increase the level of externally funded research. **c)** The Department will improve its National Academy of Sciences ranking to the top 50 in the next National Academy review cycle. **d)** Number of graduate students supported on Research Assistantships will increase.

- ***Numerical indicators of 5-year performance:***
  - External grant funding to increase to $15M
  - Number of professional society fellows will increase to 50% of the faculty

➔ **Strategy:** In order to maintain the Department's forward momentum and progress in addressing the goals of the University's Flagship Agenda, the Department intends to continue to recommend faculty hiring in areas of critical need and exceptional promise, with the intent to continue to serve the State and our students, relying on the strength of our research program to help carry us through tight budget times. Especially in view of the University's constrained budgets, we will continue looking energetically for external support for the new faculty positions needed to address our critical needs – and our active and productive external grant-funded research program provides us with optimism that we will be able to continue moving in the direction of national and international prominence and continue building Louisiana's and LSU's reputation, contributing to the training of a skilled scientific and technical workforce, and producing new scientific and technological results which will help develop and expand the State's economy. **a)** Hiring at least one additional tenured or tenure-track faculty member will be recommended each year in order to continue moving the Department forward in the direction of national and international excellence, increased research activity and funding, and service to the University, State, and Nation. The Department will maintain the strength of its active programs by adding approximately one faculty member per year in critical areas of condensed matter (first principles condensed matter theorist), astrophysics (supernova theorist, high energy astrophysics experimenter), subatomic physics (Auger experimenter, neutrino experimenter, theoretical nuclear/particle physics), medical physics (medical imaging, health physics), and atomic/optical/quantum computing (AMO experimenter) and replace retiring faculty in order to maintain existing strength and funding. **b)** The Department will continue to promote its

faculty as professional society fellows and officers, agency advisory panel members, journal editors, and award winners. **c)** MBPCC will continue supporting the joint Medical Physics Program by partial funding for the Program Director and by increasing MBPCC's number of academic medical physicists to assist in teaching and mentoring PhD students.

Goal #6: CAMD and CCT are keys to our department's research success and student training mission. The Department values CAMD and CCT, and expects to continue to partner with both to produce important new research and student training opportunities.

➔ **Strategy:** Continued University support for CAMD will be essential for a number of our major grant programs in Condensed Matter/Materials and Medical/ Health Physics. A renewed direction for CCT under a new Director, replacement of key departed personnel, and commitment of CCT resources to attract and recruit active, prominent computational faculty has the potential of adding tremendously to the vigor of the department's and University's research productivity.

Goal #7: The number of undergraduate majors in Physics & Astronomy needs to be increased. An active recruiting effort has succeeded in increasing the number of majors in the past two years from 54 to 98. The number of graduating seniors now needs to be addressed.

➔ **Performance indicators:** Total number of graduating seniors in Physics & Astronomy needs to be increased.

- ***Numerical indicators of 5-year performance:***
  - 20 BS graduates per year
  - 150 BS students
  - 75% of Department's undergraduate majors involved in research

➔ **Strategy: a)** PHIOS, an active Student Physics Society, a renovated departmental library which provides a place for undergraduates to gather and study together, and efforts by the Associate Chair and Undergraduate Advisor to advise the students have made an impact on student retention. PHIOS has operated for two summers, and this needs to be continued and expanded. A new SPS advisor must be assigned, who will work energetically with the undergraduate majors. These efforts need to be maintained. **b)** We will set up a seminar program for undergraduates, including discussions about jobs and careers, graduate schools and standardized test preparation, etc. **c)** The Physics and Secondary Education concentration associated with Geaux Teach has not been successful at recruiting significant numbers of students. The Physics & Astronomy Department's experience in the Geaux Teach program has been noticeably less successful than the experience in Math, Biology, and Chemistry. The Secondary Education curriculum needs to be revisited to enable students to enter in their second year and still complete the requirements for a Physics major and teacher certification. The program needs to be better described on the Department's web pages and better advertised in order to recruit additional students into science teaching careers. The number of students in the Secondary education concentration needs

to be increased without subtracting from the enrollment in the Department's other curricula. **d)** An effort needs to be initiated to recruit high performing students from the introductory PHYS 2001-2002, 1100-2101-2102, and ASTR 1101-1102 sequences.

Goal #8: The Department has active programs aimed at diversity. The Joint Faculty Appointment Program shares two faculty with Southern University. The PACER balloon program brings teams of students from HBCUs to campus each summer to design, build, and fly their experiments on high altitude balloons. The Louisiana Space Consortium (LaSPACE) program operates several minority/ diversity programs: the MoonBuggy Team at Southern University, the Minority Research Scholars program for undergraduates, the Research Initiation Grants with a minority focus, and the PACER summer intern program. The Department faculty includes six females, three Hispanics, but no African-Americans. ***The Department will increase the number of females and African-Americans in our programs.***

➔ **Performance indicators:** Increase the total number of African-American and female students and faculty.

- ***Numerical indicators of 5-year performance:***
  - Number of minority students and faculty in Department will increase by 20%.

➔ **Strategy: a)** We will increase graduate recruiting efforts targeting Southern, Xavier, and other historically black institutions. **b)** We will increase the number of Southern students actively engaged in research with LSU faculty through the LSU-Southern JFAP program and maintain and continue the existing summer programs (e.g., PACER) for minority students. **c)** We will be aware of the need to recruit and attract a diverse faculty, will consider this to be a priority during each search, and will look for special opportunities to attract additional minority faculty.

Goal #9: The Department conducts an active outreach program which informs, educates, and excites the public about science and about the role and value of LSU. The Highland Road Park Observatory continues to provide important educational opportunities to the community with weekly programs designed and managed by Physics & Astronomy faculty and staff. The Physics & Astronomy Department together with the Cain Center have purchased a portable planetarium which has been used together with the recently acquired Mobile Astronomy van to conduct visits to local schools. The Saturday Science lecture program regularly brings over a hundred high school students to campus for monthly lectures about science developments at LSU. The Department's involvement in the Masters of Natural Science Program has provided training to local science teachers and enabled the Department to experiment with hands-on inquiry-based teaching methods. ***The Department will maintain, expand and publicize its programs in public and community engagement that provide benefits for the public and the University The department will increase its engagement with alumni and industry for the purpose of increased fund raising.***

➔ **Performance indicators: a)** Maintained and expanded number and size of the current outreach programs. **b)** Increased fund raising dollars and publicity. **c)** Additional alumni recruited for the Dean's Executive Committee and College Hall of Distinction.

- ***Numerical indicators of 5-year performance:***
  - Amount of corporate, foundation, and alumni fund raising will increase by 50%.

➔ **Strategy: a)** Use the Nuclear Power Workforce Development program to strengthen ties with Entergy, as measured by increased industrial funding, contacts with industry representatives, and jobs and internships for LSU students in the nuclear power industry. **b)** Maintain involvement in the outreach programs at the Highland Road Observatory, LIGO Science Education Center, and CAMD; increase the number of students attending summer REU programs; maintain the number of high school students attending the Saturday Science lecture series; and maintain the level of involvement in LaSPACE and MNS. **c)** Working with the College Development Office, expand fund raising. This will involve increased publicity and outreach to alumni, together with expanded involvement with local industry. The Nuclear Power program and plans to improve instruction for Engineering students offer two initial areas for industrial involvement. **d)** Identify Physics & Astronomy alumni for the Dean's Executive Committee and College Hall of Distinction. **e)** Expand publicity and public relations efforts, including an improved web presence and graduate student recruiting. Given the expectation of tight budgets for the near future, this will be done using graduate students rather than additional permanent staff.