A real driver for me in reorganizing the College of Science was a redoubling of our efforts to strengthen the basic sciences at NC State. I tell everyone that will listen that Engineering, Agriculture and Textiles cannot be world class if our basic science departments are not world class. We need to continue to push to hire (and retain) key faculty and to provide facilities and support that allows departments like Physics, Chemistry, Mathematics, Statistics, MAES and Biology to increase their rankings and prestige.

Chancellor Randy Woodson
9/5/2013

Physics Department Strategic Plan

The physics department embraces the University's priority to build the College of Science into a world-class, high visibility institution. Over the next decade, this goal can be accomplished by creating a balanced research portfolio containing fundamental and application-oriented programs that will attract the attention of top faculty and top students. By aggressively embracing the need for *basic* science, as emphasized by the Chancellor, the newly formed College of Sciences at NCSU will be poised to tackle the most exciting emerging problems of the 21st century.

A top-rated physics department is a prerequisite to a world-class College of Sciences. Over the next ten years, we plan to greatly increase the visibility and leadership of the department in five broad fields where the department already is well positioned to attract top researchers: 1) ***Quantum Science***; 2) ***Physics of the Universe; 3) Biophysics;*** 4) ***Complex Materials and Mesoscale Physics;*** 5) ***Physics Education Research***.

The physics department is well-poised to assume leadership roles in these exciting fields by an injection of new cutting-edge tenure-track faculty, who will be attracted to the well-known research programs that are already in place. However, a *key problem* will soon arise: The physics department faculty currently is top-heavy, so that failing to implement a substantial junior faculty recruitment program over the next five years will have dire consequences for the reputation and long-term survival of the department.

In order to propel the department into the upper ranks of physics departments world-wide, we have therefore constructed our strategic plan around the premise that the department will require a two-fold faster tenure-track faculty growth rate than the specified goals for a university wide increase of 350 new tenure-track faculty by 2020, which would give the physics department just 10 new faculty in the next 5 years. In addition to this growth target, further faculty recruiting will be required to counterbalance the loss of retiring senior faculty and the loss of several key mid-career faculty members in recent years to head-hunting by other institutions. In total, over 10 years this plan requires the hiring of approximately 10 tenure-track faculty members *just to maintain* the steady state levels in the physics department. An *additional* 10-15 new tenure-track faculty members will be required to achieve tenure track faculty *growth* described by the upper administration as needed to establish the new College of Sciences as a world-class academic institution. Such a plan will propel the physics department research reputation to a position of high visibility compared to its peers. This strategy suggests an ambitious plan of 20-25 total faculty hires over the next decade. A large investment in the physics department will enable the research reputation and visibility to expand to the level expected for a first rate College of Science, which will stand as an essential pillar next to a nationally leading Engineering College.

To enhance the impact of the research accomplishments and current activity in the physics department, we plan a strategic focus on hiring tenure track faculty members who reinforce and broaden the existing strengths, as described in the following sections. Further, we plan to promote visibility, productivity, and growth in the next decade by expanding the department infrastructure to enhance all of the research programs.

The strategic plan is organized as follows:

- Description of each of the five broad focus areas.
- Ten-year hiring plan.
- Prioritized hiring plan for the next five years.
- Visibility plan.
- Graduate program enhancement plan.
- Plan for improving infrastructure.
- Space plan for housing new research programs.
- Undergraduate teaching plan.
- Diversity Statement
- Appendices:
  - i) Physics faculty growth at NCSU.
  - ii) Student to faculty ratios.
  - iii) Comparison to peer institutions and rankings.

I. Focus Areas for Physics Research

1) Quantum Science

Quantum physics connects diverse fields of fundamental science and is a microscopic cornerstone for our understanding of nature at multiple length and time scales. Currently, "*Quantum Science,*" which connects fundamental quantum physics with technology, is a central concept receiving wide attention within funding agencies, such as ARO and DOE. DOE has nicely summarized a broad perspective in several *Grand Challenges*:

"*Design, discover, and synthesize new materials and molecular assemblies through atomic scale control; probe and control photon, phonon, electron, and ion interactions with matter; perform multi-scale modeling that bridges the multiple length and time scales; and use the collective efforts of condensed matter and materials physicists, chemists, biologists, molecular engineers, and those skilled in applied mathematics and computer science*."

A well-balanced program in *Quantum Science* must include both purely fundamental research and applied research that connects fundamental physics and technology. Very high visibility is achieved by fundamental advances in single-investigator desk-top experiments, where ground-breaking new concepts are frequently published in *Science* and *Nature Magazines*. Major advances are often the result of strong ties between experiment and computational/analytic theory.

The field of atomic, molecular, and optical (AMO) physics has been especially successful, where eleven Nobel prizes have been awarded since 1997. This field has generated the concepts of quantum information processing and quantum simulation, ultrahigh resolution spectroscopy to test fundamental symmetries, measurement and control of nano-mechanical systems, and ultra-cold atomic gases as models of exotic condensed matter and nuclear matter systems.

Similarly, the field of condensed matter physics has established numerous bridges from fundamental Quantum Science principles governing the properties of matter to world-changing technological innovation. New electronic, optoelectronic, and spin-tronic devices will be founded on basic discoveries in polymer and organic materials, 2D layered materials, and organic-inorganic hybrid structures. These discoveries will be pioneered by NC State physicists working within the Quantum Science theme to create, characterize, model, and predict new quantum properties of condensed matter systems.

A priority for the physics department at NCSU should be to build a strong presence in the broad field of *Quantum Science*. The department is currently well-poised to attract top researchers in this broad field, by building on the atom-cooling group, the computational physics groups, the condensed matter experimental groups, and the nanofabrication capabilities that are already in place at the university.

Hires in the following areas will create a strong *Quantum Science* program by connecting current high visibility research within the Physics department:

- *Organic quantum electronics:* structure, electron spin and charge transport in organic materials. In 2015, we hired a condensed matter experimentalist and a condensed matter theorist, as first step in this direction.
- *Atomic, molecular and optical physics:* connections from ultracold atoms to condensed matter and nuclear matter systems, opto-mechanical quantum systems, quantum information processing, fundamental symmetries.
- *Computational physics:* High performance calculations of structure and physical properties in condensed matter and modeling of many-body cold atom systems.

2) Physics of the Universe

The study of the *Physics of the Universe*, from quarks to quasars, using experiment, observation and theory, continues to be an endeavor strongly associated with the physics department at NC State. In this broad field, present senior faculty members are leaders in their respective fields and the junior faculty show similar potential. The physics department at NC State is well positioned to exploit the new opportunities presented by the general reorienting of this field in recent years and further strengthen the association of NC State with the Physics of the Universe, by unifying well-known groups in nuclear and astrophysics theory with current strength in experimental nuclear physics.

The *Physics of the Universe* has been the subject of considerable attention in recent years. There is much excitement in looking for physics beyond the Standard Model such as neutrino mass, dark matter and dark energy, exploiting new messenger particles such as neutrinos and gravitational waves, searching for the first stars and galaxies, and for pushing deep into the realm of unstable nuclei. Several national advisory committees have included topics such as these as high priorities in their respective fields. For example: the Nuclear Science Advisory Committee's most recent long-range plan identified the three frontiers for the subject to be:

i. Quantum Chromo Dynamics (QCD) and its implications and predictions,
ii. Structure of atomic nuclei and nuclear astrophysics;
iii. Developing a New Standard Model of nature's fundamental interactions.

In addition, the American Astronomical Society's Decadal Survey of 2011 also identified two of its goals to be:

iv. Searching for the first stars, galaxies, and black holes; and
v. Advancing understanding of the fundamental physics of the universe.

Currently, the high-energy physics community is going through a long-range planning discussion and, again, three frontiers have been identified known as the "Energy Frontier", the "Intensity Frontier" and the "Cosmic Frontier." Priorities will certainly include several experiments looking for Dark Matter and neutrinos. Funding agencies are making resources available to follow these plans: for example there is the Jefferson Lab upgrade, the Facility for Rare Isotopes Beams (FRIB), the Long Baseline Neutrino Experiment (LBNE), the Department of Energy's Topical Collaborations theory project, the James Webb Space Telescope, fundamental neutron physics at the Spallation Neutron Source (SNS), the Large Synoptic Survey Telescope (LSST), and much more.

The Physics department at NC State has already begun capitalizing upon these opportunities. Both the nuclear theory and nuclear experimental groups have made recent hires to enhance NC State's efforts at these frontiers. Another experimental hire should be considered as an important step in moving NC State's expertise into this area and in order to further strengthen the Triangle Universities Nuclear Laboratory (TUNL) as a Department of Energy Center of Excellence.

- The most urgent area needing attention is the astrophysics group, which has lost significant strength recently. The astrophysics theory group needs two or more new members urgently, if it is not to suffer long-lasting effects of these losses. The group has a diversity of interests circled around its excellent reputation in computational astrophysics and space-based observation, which is ideal for attracting strong candidates. We fulfilled our first search in 2015, by hiring an observational astrophysicist.

- Further expansion in both theoretical and experimental groups should be considered in the long term, including via bridge positions or joint appointments with Oak Ridge National Laboratory, Jefferson Laboratory, or Brookhaven National Laboratory. As a first step, in 2015, we exploited a bridge appointment with Oak Ridge to add a nuclear experimentalist to our faculty.

Finally, there is also important overlap with the *Quantum Science* focus area of the department, where important features of exotic, strongly correlated quantum fluids in nuclear matter, such as the quark-gluon plasma that comprised the universe just after the Big Bang, are modeled by ultra-cold quantum gases.

3) Biophysics

Biophysics and other quantitative biosciences are growing enterprises in the international research community. The emphasis on quantitative measurements and modeling in studies of biological phenomena is expected to enable accelerating progress in efforts to enhance human health, and thus is likely to see increased funding opportunities. Precise, quantitative research approaches are typical strengths of physicists, providing a robust future for biophysics as an important research area. The NCSU physics department has recently built an active research presence in biophysics. Current expertise in the department includes both computational and experimental programs, centered on molecular level interactions among biological assemblies. To increase the research efforts to even more health relevant topics, we see as priorities adding researchers who bridge studies of nanoscale biological processes to mesoscale biological effects.

- Computational biophysics – Our highest priority is to add expertise to linking nanoscale to mesoscale science. This will address important biological systems composed of multi-molecular complexes of large biological molecules. We seek an expert who can link current excellence in computational simulation of nanoscale systems to biologically significant effects in macromolecular assemblies.

- Our second priority will be to add an expertise in the experimental studies of systems biophysics at the level of living cells. This type of investigation will leverage our current expertise in molecular function to enable studies of the impact on living cells.

4) Complex Materials and Mesoscale Physics

The natural world is full of hierarchical materials with emergent properties: The flexibility and rigidity of living tissues arise from collective properties of organized cells, both plants and animals transport materials and information over networks with multiple length scales, and patterns self-assemble during phase separation and crystal growth. Physicists at NC State seek to discover, quantify, and apply the fundamental physical principles governing emergent phenomena in these complex systems.

Research efforts in this theme span a vast range of materials with applications from biological and geological processes to electronic device fabrication. Current projects in the Physics Department include the study of energy transfer in nanoparticle/polymer composites, packing and dynamics in granular materials, origins of frictional forces, blend morphology in polymer films, bio-inspired materials, and thin film growth dynamics. These many-constituent systems are often far from equilibrium and involve emergent "mesoscopic" length scales intermediate between the atomic and macroscopic. Therefore, these properties push the boundaries of state-of-the-art statistical mechanics.

The traditional approaches of creating new materials from uniform blends of chemicals and fabricating ever-smaller devices, is reaching its limit of productivity. In recognition of this, several high-profile funding programs, such as the White House Materials Genome Initiative and the 2012 DOE Basic Energy Sciences report "*From Quanta to the Continuum: Opportunities in Mesoscale Science*," are spurring intensive activity to open new avenues. The vision is to meta-materials that are self-assembled from discrete elements such as composite nanofibers within a matrix. The choice of these elements, their shapes, the chemical/electrical/mechanical interactions between them, and their geometric configurations will contribute to creating a bulk behavior tuned to optimize a particular application, such as biocompatible tissue scaffolds, optical or vibrational energy harvesting, or ultralight composites for energy-efficient vehicles. Further advances will come from understanding how to design smart materials, which, like biological tissues, change their properties in response to their environment.

The fundamental physics problem in both hierarchical and mesoscale materials is to understand how constitutive elements, such as cells, nanofibers, and colloids, cooperate to generate the behavior of the larger-scale material. Advances in understanding feedback between the constituent elements, their configuration and organization at various length scales, and the bulk response will require that we develop new theoretical tools for scaling up knowledge from the element scale to the continuum scale. In many cases, continuum models are not yet able to predict such systems' response to perturbations, but notions of percolation, networks, fragility, and jamming are likely to lead to new insights, ultimately allowing us to exploit multi-scale structures rather than homogenizing over them.

To aggressively establish the Physics Department as a key player in this field, we should add establish programs in the following areas:

- Experimental Bio-inspired Meta-Materials: This research area exploits analogs of biological processes, such as self-assembly, to develop new materials. It is synergistic with but distinguished from our existing strengths in biophysics, where the object is to understand biological function.

- Theoretical Statistical Mechanics of Meta-Materials. This research is distinct from, but will connect to existing strengths in computational materials modeling, including CHIPS.

- Mechanical Meta-Materials, such biocompatible tissue scaffolds, optical, vibrational energy harvesting, or ultralight composites. These are will have strong connections with the engineering departments and leverage the Additive Manufacturing Center.

5) Physics education research:

The physics department has a world-renowned program in physics education research, which cannot maintain its high impact without expanded faculty. Currently, hundreds of departments world-wide are using the SCALE-UP approach pioneered here. Physics research education therefore provides significant visibility for the department and positively impacts our national and international reputation. Innovations developed through PER efforts benefit our department's mission to educate the next generation of scientists. Physics education research activity enhances the quality of the instruction delivered to undergraduates at the introductory level. The experience of large numbers of students in many departments including engineering and life sciences majors benefit from PER research improving pedagogy, curriculum and technologies for delivery. A particularly intriguing, nascent direction for PER studies is seeking revolutionary approaches to experimental lab education and assessment at all levels, where the focus can range from introductory service courses to "capstone" and "advanced laboratory" experiences that primarily involve our large physics majors program. Our PER graduates are highly sought-after as faculty. Further, we find that the quality of our undergraduate instruction has benefitted greatly from the awareness provided by the Physics Education Research program.

- Senior hires will invigorate the department's effort in this area. Our experience is that an extended time may be required to recruit the best candidates at this level in this field, so that identifying exceptional candidates is not guaranteed within any given year.

- Subsequent junior hires will benefit from the mentoring of the senior faculty.

A. Ten Year Hiring Plan

To achieve the goal of moving the Physics Department to the level of prominence expected for a top-flight College of Science, we propose an aggressive hiring plan over the next decade. Including more experimentalists than theorists in the plan will help to expand the graduate student enrollment, as the experimental groups generally support a large number of students. The breakdown of the proposed new faculty hires is as follows:

1) Quantum Science (6)

- 2 Atomic, molecular, and optical physics experimentalists
- 1 Condensed matter experimentalist
- 2 Organic electronics experimentalists
- 1 Computational condensed matter theorist

2) Physics of the Universe (4)

- 2 Astronomy/Astrophysics
- 1 Nuclear physics experimentalists
- 1 Nuclear theorist

3) Biophysics (3)

- 1 Computational theorist
- 2 Systems biophysics experimentalist

4) Complex Matter/Mesoscale Physics (3)

- 2 Meta- materials experimentalists
- 1 Statistical mechanics theorist

5) Physics Education Research (3)

- 2 Senior faculty
- 1 Junior faculty

B. Prioritized Five Year Search Plan

The initial steps in the ten-year plan require 10-15 new faculty members to be hired in the next five years. This will be accomplished by implementing the *Search Plan* that is tabulated below. Five-year search plans will be revised annually in response to the progress of the searches.

The Guiding Principle for this plan is to organize the concurrent searches for each year into groups of *Three Areas*, each with its own *Advertisement.* The goal is to hire the BEST candidates who emerge, in a manner that is, within reason, independent of the area. This broad search approach will help to enhance the diversity of the department. An added benefit of maintaining three hiring advertisements every year is a greatly increased *visibility* for the Department and the University.

In each of the five years, there also will be an *ongoing search* in *Physics Education Research*, with the initial goal of identifying one talented new senior faculty member as a target of opportunity.

Some of these searches may naturally fit into a *cluster hire,* for example, the area of Biophysics, some areas of Condensed Matter Physics, and some areas of Atomic, Molecular, and Optical physics, naturally cross interdepartmental boundaries. Other searches will not fit cluster hires and must remain focused within the Physics Department.

Concurrent Search Areas

Year	AREA	AREA	AREA	AREA
2015-2016	AMO QO/Fund-Spectroscopy	Condensed Matter Exp	Computational Biology	Physics Education Research
2016-2017	Organic Electronics	Systems Bio-Expt	Astronomy/ Astrophysics	Physics Education Research
2017-2018	AMO QO/Fund-Spectroscopy	Meta Materials Expt.	Stat-Mech Theory	Physics Education Research
2018-2019	Comp Theory Bio/CM	Nuclear Expt.	Systems Bio-Expt	Physics Education Research
2019-2020	Condensed Matter Expt	Nuclear Theory	Astronomy/ Astrophysics	Physics Education Research

II. Visibility Plan

The physics department at NCSU is not as visible as it should be for a department that already has many extremely active, very well-known faculty members. We plan to take several steps to increase the visibility of the department:

- We will exploit our weekly colloquiums as a platform for advertisement. We plan to appoint a two-member colloquium committee to coordinate the schedule and to rearrange our colloquium schedule to contain 6 slots for department heads and directors of graduate and undergraduate studies at other schools, which will help to make our program better known. Further, we will encourage senior faculty to make suggestions and take responsibility for inviting well-known high profile speakers, who can help to get the word out that our department is vibrant.

- We are updating our individual and department websites to be sure that they are current, and to convey the high quality of the research in the Physics department. To aid in this ongoing process, we plan to hire an adept undergraduate or graduate student to visit faculty members individually, to obtain the information needed to incorporate the latest results and research descriptions.

- We will aggressively nominate faculty for external achievement awards. This will be accomplished by a small committee charged with compiling a list of possible awards in each field and relaying this information to the appropriate nominee and potential nominating faculty members.

- We will host workshops and conferences, such as the APS Conference for the Division of Nuclear Physics, which will be hosted at NCSU in 2017.

- We will encourage press releases for high-visibility publications.

- We will employ very visible faculty search processes. As described for the five-year search plan, we plan to advertising for faculty positions simultaneously in several areas, which will increase both the visibility of the search and the diversity of the applicants. In addition to publishing in physics magazines, our ads will be directly disseminated by e-mail to friends and colleagues in physics departments at other universities.

- We will encourage the formation of Department Centers, initially for collaborations that already exist within the department. Branding the Centers by publishing papers with an associated byline will increase the visibility of the research. Associated with each Center will be an invited colloquium presentation by an outside colleague.

- We plan to implement a semi-annual department Newsletter, highlighting current activity and accomplishments of students and faculty.

III. Graduate Program Enhancement Plan

Raising the number and stature of the research programs in the College of Sciences will require recruiting an increasing number of high quality graduate students. In addition to increasing the visibility of the department in general, as outline above, additional efforts are required to generate a greater number of applications, to make the graduate program as attractive as possible, to identify and to enroll the best students. This effort must be department-wide and year-long. We propose a number of possible strategies to generate a greater number of applications:

- We will encourage all faculty members to write to colleagues at other institutions, asking them to encourage their students to apply.
- The Graduate Student Brochure will be sent to SPS and academic advisors at other institutions and appended, when appropriate, when replying to enquiries to the graduate studies program.
- Department faculty giving seminars and colloquia at other institutions will be provided PowerPoint recruitment slides and reminded to obtain them in their Travel Authorization. The presentation can be used to give talks to undergraduates interested in graduate school, encouraging the application to NC State.
- Rising seniors applying to physics department REU programs will be identified and sent an email encouraging them to apply for graduate school.
- We will annually fund a Recruitment Table at the APS March and April meetings and elsewhere. All meeting attendees from NC State will be asked to assist in the recruitment effort.
- We shall continue the Ambassador Program, which sends out parties of physics department graduate students to other institutions to make presentations to undergraduates.
- We shall survey the applicants to our graduate program in order to determine which recruitment tools are the most effective.
- We plan to improve the application information on the department website to make clear that we look at the whole application, not just GRE scores, which are sometimes not indicative of a student's ability.
- We will post a newsletter, including profiles of successful alumnae and current students, on the department Website.
- Graduate Fellowships, to the extent that they are available, will be used as enticements for particularly strong applicants.
- To assist the Director of Graduate Studies during the recruitment period, we have appointed an Associate Director of Graduate studies, who serves as the admissions chair and a recruiting chair. This will enable an increased effort to target graduate students who have strong applications with interests that overlap with those of the department.

Once enrolled at NC State, a well-constructed study and research program is required in order to produce graduates who can go on to further success. Although the Ph. D. program is our primary goal, we plan to examine the needs of students pursuing Masters degrees and undergraduate students who do not go on to Ph. D. programs. A number of possible enhancements to the graduate program have been identified:

- We plan to create a graduate course curriculum and course structure that is optimized to provide a strong background in theory and methods for pursuing aggressive research problems in the focus areas of the department. This will be accomplished in part by streamlining the core course curriculum, to provide time for more specialized courses, focused for example, on cluster hire areas. A curriculum task force will be appointed to investigate the course structure.
- To increase the range of advanced theory courses, we plan to introduce *mini-courses.* These will be five-week, two-credit courses that can be taught enthusiastically, on a volunteer basis, by interested faculty as an add-on to their regular teaching load, without an undue overload.
- We plan to develop a set of practical research-skill courses, which will be an integral part of student training. These will include such topics as electronics, machine shop practices, mathematical methods, including computational methods, and scientific writing. A web-based list of these courses will be created so that students know when they are available.
- The Graduate Student Orientation program for new students will be improved to provide more guidance.
- We plan to implement a new "buddy" system for incoming students, with new students being introduced to a more senior student, who will act as a student mentor. New students will be encouraged to attend the group meetings of the student mentor, which will expose them to research early in the graduate program. The corresponding group leader will act as a faculty mentor. Such an approach will give each incoming student an immediate "home" base and broad source of information. Further, it will encourage students to become involved in research as early as possible.

IV. Infrastructure

Growth in the key focus areas will require a parallel investment in infrastructure to maximize research productivity. This investment must include support staff to help with large enrollment courses and a greatly increased graduate research program, and technical staff to support research.

Permanent staff members are needed to coordinate large enrollment courses to assure consistently high quality. We plan to accomplish this goal by hiring Teaching Assistant Professors, who will help to reduce the course load on research-active faculty and who will provide long-term memory for efficiently implementing the large courses.

Information technology staff members are required to address the increasing need for data management, which is becoming mandatory for work funded by government agencies. Further support is needed for the Education and Research Laboratory, which ideally will be linked to a student electronics shop, where students can learn and practice circuit design and construction. A mechanism for training students in safe and effective machine shop practice also is needed. In addition, support is needed for the administration of grant proposals and contract management.

V. Space Plan

Key to the success of the proposed expansion of the graduate research program at NSCU is a substantial increase in the available office and laboratory space, which is currently a bottleneck for all future growth.

We plan to create a major presence in the fields of experimental and theoretical condensed matter physics, by consolidating our condensed matter program on Centennial Campus. This is an ideal location for a condensed matter physics program, which has substantial overlap with the Materials Science and Engineering programs at NCSU and will foster *collaborative* interactions.

The merging of several condensed matter groups will be accomplished in part by the move of two experimental groups from the Riddick Physics Building to Partners III.

However, our ten-year hiring program requires laboratory space for approximately 10 new experimental groups. With the move of two experimental groups from Riddick and one additional laboratory in Partners III, we have, at present, laboratory space for only 3 new experimental groups.

On a ten-year time scale, we also need new high quality office space for increasing the faculty size by at least 20. This space should include offices for students and post-doctoral associates, and common meeting rooms.

A partial remedy would be to move the Animal Science program out of Riddick, which would free substantial space for new faculty. We will try to identify a small amount of under-utilized space, which can be given back to make room for new research groups. We will also investigate shared space or rented space.

The ideal long-term solution to the space bottleneck is to renovate the Mann building, which neighbors Riddick. This solution would provide nearly contiguous space for Physics and would permanently end the space problem that is currently the bottleneck for substantial long-term growth.

VI. Teaching Plan

The Physics Department is currently very successful in accomplishing our teaching mission at all levels, including service courses, undergraduate major courses and graduate courses. We plan to continue with innovations in our undergraduate majors program. However, in light of the strategic emphasis on enhancement of the research mission, which necessarily requires expansion of the graduate program, we foresee required innovation in teaching focusing mostly on enhancing the graduate level program, as described above. Our undergraduate teaching plan will be based on the following Guiding Principles.

- We will continue to maintain high quality undergraduate instruction, which benefits from connections to Physics Education Research program.
- We will enhance research productivity by developing optimized teaching practices.
- We will advertise Physics courses and make the course contents accessible to Engineering students at all levels, to enhance connections between technology, industry, and fundamental physics.
- We will maintain high quality, innovative undergraduate instruction laboratories.

Our implementation of the undergraduate laboratories can be improved in several ways. We have hired a Teaching Assistant Professor to oversee and provide long-term organization for the large undergraduate courses. We plan to hire a second Teaching Assistant Professor, who will coordinate the laboratories and who will supervise and train the TA graduate students who run the laboratories. This will provide a consistent long-term approach. By implementing PER studies, we plan to find new approaches to experimental lab education and assessment at all levels.

VII. Diversity Statement

The NC State Physics department is committed to ensuring the future health of the discipline of physics by broadly recruiting and supporting a diverse population of students and faculty to serve as and educate the next generation of physicists. We expect all faculty to identify qualified and interested underrepresented minorities, women, and those in other underrepresented groups and recruit them to visit NC State, give presentations as appropriate, and learn about the department. We expect all faculty to act as effective mentors to more junior colleagues including regularly nominating colleagues for awards, as speakers, and for positions of leadership: we particularly expect that faculty will consider those in underrepresented groups when making such nominations.

VIII. Appendices

We include four appendices, substantiating the need for an aggressive increase in the size of the Physics Department at NCSU:

A) Physics Faculty Growth at NCSU—Physics/Math-Statistics.
B) Student/Faculty Ratios.
C) Comparison to Peer Institutions and Rankings.