Physics Department 1999 Compact

June 25, 1999

I. INTRODUCTION

Physics is a core intellectual discipline ideally suited to advance North Carolina State University's ambitions for excellence in Science, Engineering, and Technology. NC State's Physics Department aims to educate and train research physicists for industry, academia, and government; to produce broadly educated, versatile baccalaureate graduates for a diverse spread of careers; to produce internationally recognized research of value to the advancement of human knowledge and to the economic development of North Carolina; and to deliver to thousands of students in other disciplines the fundamental knowledge of the physical world and its mathematical representation, to the benefit of engineering, medical sciences, and many other areas.

By straightforward quantitative measures, the Physics Department has had substantial success in research, education of physics majors and graduate students, and education of non-majors. The Physics Department consistently ranks second at NC State in annual research expenditures (FY98: $6.6M with 83% of the tenure-track and tenured faculty receiving external funding), while according to figures from the most recent National Research Council study along with data from the American Institute of Physics, funding per faculty member and citations per faculty member both rank above the 75th percentile nationally. The Department ranks similarly in the number of bachelor's degrees awarded per year, while the junior-senior enrollment of physics majors ranks fifth among our 17 peer institutions. Our 85 graduate students represent one of the largest programs in the Southeast (tenth among the peer institutions). Most importantly for students, graduates of the Department easily find excellent employment: BS recipients in the last two years received average offers of over $40K/yr, and Ph.D's were sought after in industry and elsewhere. Rumors of a poor job market in physics are clearly not borne out by our students' experiences. Bachelor's recipients who choose graduate school do well; our graduates can be found in 10 of the top 20 physics Ph.D. programs in the US. And they are satisfied; 100% of graduates polled in the last two years would choose physics, and NC State, again. In service teaching, the Department ranks 10th nationally in the number of students taught (third among our 17 peer institutions). This is performed efficiently (our faculty size is only 34th nationally) and well (in Spring 1999, 80% of 1500 students polled found the instruction to be generally satisfactory, and 75% would recommend their instructor to other students).

Our Departmental goals, then, are to build on these strengths, with an important metric of our success to be to move into the top rank (top 20%, say) of nationally recognized departments. We plan to hire new faculty in exciting forefront research areas of physics linked to our current strengths, and to develop cross-disciplinary collaborations in which physics is a central component. Concurrently, we shall continue to refine our traditional undergraduate and graduate programs while addressing the needs of a new constituency: students who require broad-based technical expertise but who do not plan to obtain doctoral degrees in Physics. To do this, we plan to diversify and broaden our programs, creating new courses for our new BA program, and developing new tracks for our MS program. In service teaching, we plan to build on our extremely successful Physics Education research initiatives to develop and provide inquiry-based learning and Web-based delivery of educational services.

II. INITIATIVES SUPPORTING UNIVERSITY GOALS

1. Building an inclusive campus community

A major concern at NC State and many other universities is the academic success in basic science courses of female and minority students. Results from the Department's SCALE-UP method of combining lecture and laboratory in an inquiry-based format indicate that all students have substantially improved passing rates, and that female students especially seem to benefit, with failure rates half those in traditional sections. (There are strong hints that the same may be true for minority students though the samples are smaller). We shall continue to expand the SCALE-UP effort as much as possible given infrastructure constraints, primarily specialized classroom space, with particular attention to the success of students from underrepresented groups.

We shall also address the recruitment of underrepresented groups for our faculty. We shall continue our aggressive effort to make sure that female and minority candidates are represented in our applicant pools, by soliciting applications from individuals, identified in any of several generally available databases of women and minorities in science, whose specialization's are at all close to our search areas. *Moreover, we will modify the order of our planned hirings in the event that an applicant from an underrepresented group becomes available in any of the fields in which we plan to search in the next few years.*

Specific plans: Once the classroom under construction under Harrelson Hall is completed, we will train more faculty in the SCALE-UP approach so that more sections of PY 205 and 208 can be offered, while we continue to monitor the academic success of underrepresented groups. We request that the University maintain flexibility in supporting our requests for new faculty positions. The widespread demand for candidates from underrepresented groups means that we will need to offer attractive compensation packages along with substantial startup funds.

Outcomes and assessment: We will serve an additional 800 students in the new SCALE-UP classroom, and will report on success rates of students from underrepresented groups in July 2000. Our success in faculty hiring and recruitment will be documented through standard University procedures.

2. New partnerships

A recent external review found the Physics Department's research programs to be highly effective and visible nationally. The report pointed out that several faculty in the general area of condensed-matter physics are nearing retirement, and that opportunities exist for major new initiatives in that general area of research, building on our current strengths. The report also described the strong Physics Education effort, and encouraged the Department to consider related initiatives. Finally, initial Department moves to examine the field of biophysics were applauded. In response to these recommendations, we plan several specific initiatives in collaboration with various other University units. We shall target Physics Education, High-Performance Scientific Computing, Nanoscale Physics, Polymers, and Neutron Physics/Astrophysics. Our investigation of the general area of biological physics and materials will continue in several avenues: we propose to hire a computational physicist in the area of Complex Materials/Biomaterials, and we will consider possible biological applications in our workshops planned for the Polymer Center and for the Nanoscale Initiative. All these initiatives involve major collaborations with other units inside and outside NC State University.

a. National Collaboration for the Reform of Undergraduate Science, Math, and Engineering Education

We propose a major interdisciplinary science-education initiative. The project will rigorously study and promote the reform of undergraduate education in these three critical areas. PAMS faculty conducting discipline-based education research will work with colleagues in the Colleges of Education and Psychology and Engineering, gathering together all the elements needed to become national leaders in this area. A unique collection of faculty and strong administrative support presents NC State with the opportunity to have a major impact on college-level teaching across the country. Initial collaborations (including team-taught courses and workshops for the INSTEP and IMPEC/SUCCEED projects) have been very fruitful. This Collaboration will require several years to assemble, though the basic framework is in place. PAMS' experience with the Science House and the Department's leadership in the American Association of Physics Teachers will be combined with efforts in other departments to create an outreach across the sciences, math, and engineering. This will benefit us, other universities, and K-12 teachers. Graduate students from many fields will be drawn to the University by the quality of educational research and development. NC State will become known for its systemic approach to the development and study of innovative teaching and will become a model for other institutions implementing the reforms we have found to be most effective.

Specific plans: The SCALE-UP project mentioned earlier and an expansion of our WebAssign initiative (described under Performance Aspirations) will form the core of the Department's involvement with the Collaboration. In addition, we seek authorization to hire an additional faculty member specializing in physics education research, as recommended by our recent external review panel. An annual Symposium and joint grant proposals will be pursued with other departments. If these initial efforts are successful at bringing a diverse body of faculty together to focus on implementing and studying educational reform, the project will eventually need dedicated space as it expands its national presence.

Outcomes and assessment: Our first-year outcomes are straightforward: completion of the SCALE-UP classroom by July 2000, and hiring of a new Physics Education faculty member. Details of WebAssign project outcomes are described later. Further resource requirements will be addressed in the next Compact period. Assessments of the SCALE-UP project effectiveness are regularly published in the educational literature.

b. Center for High-Performance Scientific Computing

The Physics Department currently possesses major strengths in various areas of computational physics and the use of high-performance computing. According to several recent Federal reports, high performance computing (HPC) is one of the key high-visibility IT areas that are expected to undergo a very rapid expansion in the next few decades. We seek to establish a center for High Performance Computing in order to (i) consolidate and further develop the formidable expertise in this area already represented at NC State in Physics, Mathematics, Chemistry, Computer Science, and elsewhere, (ii) nurture interdisciplinary synergistic interactions between the basic and the applied sciences, and (iii) develop and support advanced training and education at the undergraduate and graduate levels. Such a center will also facilitate competitive proposals for large Federal HPC grants. Cross-disciplinary educational tracks will be established for both undergraduates and graduate students, which will include the physical sciences, computer science, and mathematics. The center will also be actively involved in recruitment of students. All NC State faculty with research activities in computational sciences, including the relevant areas of computer science and mathematics, will be encouraged to join the center, exchange ideas, and ultimately team up in pursuit of grants from large-scale government initiatives, such as the Grand Challenge and Stockpile Stewardship competitions.

Initially, the center will be organized along multidisciplinary thrust areas, which will jointly develop a common core curriculum in HPC. The initial thrusts will be in materials/biomaterials and astrophysics, in which we already have enough well-recognized faculty to form nationally competitive teams. However, the

long-term interdisciplinary impact will be greatly enhanced by adding faculty who will apply HPC techniques in various Departments in the College and the University, and by the formation of other thrusts. The center will actively participate in recruiting efforts and work jointly with the relevant Departments. On a longer time-scale, expansion and consolidation of space would allow for sharing of major computational equipment and co-locating of all faculty and students active in HPC, across Departments.

Specific plans: We will hire a junior faculty in Computational Materials/Biomaterials to strengthen the interdisciplinary aspects of this thrust. We also request resources to renovate the fifth floor of Cox Hall, anticipating co-locating current computational-physics researchers (in materials and astrophysics) and providing space for undergraduate and graduate students.

Outcomes and assessment: By July 2000, we will have selected the faculty candidate and will have consolidated the initial HPC faculty into thrusts of the proposed center. We will also develop an educational plan and begin its implementation. Further, a plan for possible additional thrusts in the HPC area will be developed and assessed by consultations with other units. Computational faculty will occupy new consolidated offices in time for the beginning of the Fall 2000 semester. We expect that over the longer term, our efforts in this area will make NC State known as an international center for high-performance computing, anchored in the thrust areas in which we excel. For example, a supernova specialist would cement NC State's status as one of four world-wide centers of excellence attacking this crucial astrophysical problem.

c. Nanoscale Initiative (NI)

Traditional solid state physics increasingly involves structures and phenomena at the Nanoscale (less than one micron) and many NC State research groups are already active in this area. The goal of the NI is to foster emerging research and enhance existing capabilities in the area of nanotechnology, an area identified as a National Budget Priority by the White House. The Nanoscale Initiative will (i) consolidate strong existing efforts in Physics and elsewhere on campus in the areas of electronic materials, surface physics, and tribology, (ii) assure NC State its proper role as a world leader in this emerging area, (iii) develop a new group of courses/degrees at NC State for educating students about nanoscale science and its applications. The Nanoscale initiative will be broadly coordinated across several departments in PAMS (Physics, Chemistry, Mathematics) and the University (Materials Science and Engineering, Electrical Engineering, Chemical Engineering, Botany), as well as MCNC. While detailed planning for this initiative will occur in FY 2000, the following thrusts are now being considered: (i) a multi-departmental center in Nano-Tribology, already proposed to DARPA, emphasizing Micro-Electromechanical Systems (MEMS), (ii) real-time diagnostics, characterization and growth control of electronic materials, (iii) nanoscale and artificially structured materials, and (iv) bioprobes and biosensors, in collaboration with the Cellular and Molecular Imaging Facility (CMIF) in Botany.

Specific plans: During the next year, we will identify and organize existing groups and individual faculty that would likely participate in the NI, sponsor a workshop, and develop a long-term strategy for maintaining and enhancing forefront research in this emerging area. Over the long term, we would anticipate the need for approximately 10 new hires campus-wide, three of them in physics spread over the next 7-10 years.

Outcomes and assessment: Our initial outcome will be a report of the workshop and an ambitious plan for the NI, developed by consultation with other departments, by July 2000. The plan will identify the most promising areas for hiring and expansion in time to benefit from anticipated government initiatives in nanoscale science and technology. The implementation of the NI will have a major campus-wide impact and will assure NC State its proper role as a world leader in this emerging area.

d. Polymer Center (jointly planned with Chemistry and Materials Science and Engineering)

Polymers constitute an integral part of all high technology industries that play a critical role in the economic health of North Carolina (in such fields as electronics, pharmaceuticals, biotechnology, agriculture, textiles). In many applications in these industries, control of structures and morphologies on the submicron scale is crucial for the proper performance of materials. With the increasing success of chemists in synthesizing specific and tailored molecules (block copolymers, dentrimers, and so forth) the use of nano-structured materials based on polymers will further accelerate. This class includes submicron composites, hybrids, membranes, reactors and sensors, as well as drug and insecticide release vesicles. Our understanding of the complex nature of polymers can benefit greatly from advances in high performance computing (see above). Polymers can serve well as model systems to understand biological processes. Faculty from Physics, Chemistry, Chemical Engineering, Materials Science, Forest Resources, Food Science, and Textiles are expected to participate in the Center, resulting in a truly multi-disciplinary education and research environment. Skills represented in the Center will include macromolecular synthesis, catalysis, and characterization.

Specific plans: A comprehensive plan for the participation of the Physics Department in the Polymer Center will be developed. A workshop advancing the scientific program and planning for the Center will be held in the fall of 1999. In addition, Physics seeks resources for laboratory space renovation on either the third floor of Cox or Centennial Campus to provide space for the Center's Physics Co-Director.

Outcomes and assessment: We anticipate the formal approval of the Polymer Center in the near future. We will produce a space and hiring plan and a brief report on the workshop delineating scientific opportunities.

e. Partnerships with Oak Ridge National Laboratory

The Physics Department enthusiastically endorses NC State's participation in the UT-Battelle bid for management of Oak Ridge National Laboratory. ORNL's strengths in nuclear science, materials science, and computational science are well matched to the interests of Physics. Additionally, the completion of the spallation neutron source (SNS) in 2005 will provide unprecedented opportunities for research collaborations using neutron beams. As a member of the core university group, NC State has committed to 5-yr joint positions under a proposed 1/4 university, 1/4 department, 1/2 ORNL funding arrangement. Areas specifically targeted include computational astrophysics, computational materials, polymer science, SNS related fundamental neutron physics, and SNS related biological physics.

Specific plans: If the management bid is successful, the Department will immediately identify potential joint positions with ORNL in accordance with the NC State commitments. We will seek to hire in areas of maximum scientific impact.

Outcomes and assessment: Partnership with ORNL will enhance NC State's position as a national leader in science and technology, and will enhance the Department's national reputation in computation science and neutron science. The success of this partnership will be assessed by the scientific productivity of the new collaborations.

III. UNIT ISSUES AND PRIORITIES

1. Space and Fragmentation Initiative

Our recent external review gave the Department high marks for performance of its basic functions of teaching and research. However, the panel criticized the Department for being physically fragmented across the University. We house faculty and laboratories in Cox, Dabney, and the Bureau of Mines; student laboratories, the Physics Tutorial Center, and graduate teaching assistants in Withers and Daniels; and extensive research efforts in RB2 and RB3 on Centennial Campus. The panel devoted an entire section of the report to this issue: ``The departmental faculty, graduate students, and staff are housed in seven different buildings. ...this makes it difficult to maintain a cohesive spirit..." Elsewhere, the panel reports, ``...the scattered space of the department impairs two important aspects of graduate education: (1) students finding the appropriate faculty member when they need her/him to discuss physics, research opportunities, or career mentoring; and (2) students getting together with each other to discuss physics or request special courses. This spatial isolation hurts the breadth of their training." Finally, the panel makes the following recommendation: ``The external review committee recognizes that reducing geographical fragmentation will be difficult. Nevertheless, consolidation into two or even three locations would be a major step forward. This requires the cooperation of the college and higher administrations." We propose to address this critical problem, which not only impedes our research and teaching efforts, but also hampers our recruiting efforts, as prospective students find the fragmentation unattractive and potentially problematic. Our Departmental space problem may be the single biggest factor impeding our advance into the top tier of Physics Departments in the country.

We propose a major effort toward solving this problem. An ultimate solution will require major resources, either for a new (probably shared) facility on Centennial Campus, or for major renovations of substantial space on North Campus left vacant by other units moving to Centennial. The first step in this effort will be a careful study of the alternatives. Several have been proposed, including an Applied Sciences Building (Physical Sciences Research Center) on Centennial Campus. However, the new compact planning process offers us the opportunity of making the solution of our space problem a high priority.

Specific plans: We will form a strategic planning committee to examine the various options for the Department. This committee will study facilities at our peer institutions and those institutions in the elite group we would like to join. It will assess current and future needs, and evaluate the various alternatives in consultation with potential partners in a new facility. The committee will produce a report including concrete recommendations by July 2000.

Outcomes and assessment: The report will outline the next steps to be taken in co-locating the Department, and required resources and planning resulting from that report will be addressed in the next Compact period.

2. New Faculty Start-Up Resources

New faculty in physics, especially in experimental areas, require substantial start-up resources. Since we require high levels of productivity on short timescales, we owe them the facilities with which to exhibit it. Especially at the extremely competitive level at which we have been hiring recently, the required resources are quite significant.

We shall need start-up and renovation support in the immediate future. First, the Department has hired an outstanding young experimental physicist, Dr. Albert Young, who will be transferring NSF funds from Princeton. He will be arriving in Raleigh around May 2000. Second, in the current Compact we plan to add two more faculty members, in computational materials and in physics education. Start-up requirements for these individuals will not be as large as for Dr. Young, but significant nevertheless. Finally, as mentioned

above in our Diversity initiative, we plan to pursue aggressively any potential faculty from underrepresented groups who might fit into our strategic growth plans, even if they are not in an area we have immediately targeted. Competition for these individuals is extremely intense, and we will need the guarantee that resources will be available for us to make competitive offers whenever the opportunity arises.

Specific plans: We require funds in 1999-00 to transfer Young's NSF support from Princeton, to initiate his atom-trapping program in the BOM and at TUNL, and to support his UCN program at Los Alamos. We will require funds in 2000-01 to renovate space and purchase computer equipment for the new faculty members in Computational Materials and Physics Education.

Outcomes and assessment: New faculty will be productive and will be competitive for Federal research funding within a year of arrival on campus.

3. Infrastructure Support: Networking in Bureau of Mines Building

The Bureau of Mines building contains several groups making heavy use of computer networking. The WebAssign project is centered there, and theoretical work in computational astrophysics, nuclear theory, and other areas requires high-bandwidth communication with the North Carolina Supercomputing Center, NASA centers, and elsewhere. Reliability problems, from power outages to hackers, have plagued the BOM network, causing unacceptable stoppages in essential functions. We request support to implement the Uniform Wiring Plan in BOM.

Outcomes and assessment: Full implementation of the Uniform Wiring Plan will practically eliminate network downtime.

IV. ENROLLMENT PLANNING

1. Undergraduate program

We intend to move into the top 20 physics programs nationally in undergraduate degrees awarded, while preserving the educational and career success our graduates currently enjoy. Physics currently attracts some of the best new students at NC State (over the last two years, the median entering physics major SAT score of 1330 ranked approximately at the 85th percentile of the University as a whole). However, as documented in the Kellogg Commission Report on the Future of State and Land-Grant Institutions, the backgrounds of our students are changing significantly. Maintaining and increasing our enrollment >from new and transfer students will require new initiatives. We intend to address this issue by publicizing the career paths (and the success) of Department alumni on our website and other literature, and by developing our new Bachelor of Arts in Physics program.

The BA track will deliver a sound background in physics, including advanced course and laboratory work, but with less coverage than our BS. It is ideally suited to double majors and to transfer students. For instance, the program can complement a Science Education degree, to provide a simultaneous content-area degree and

teaching certification. In the next year we plan to develop a new course at the 300 level on waves, optics, condensed matter, or computational physics, aimed at students in the BA curriculum, but suitable as an elective for BS students.

Specific plans: We shall prepare a database describing career paths of recent graduates and shall distribute the information both in print and on our Departmental website, including contact information for alumni willing to discuss the program and their careers with potential majors. We shall provide more effective publicity on the Physics BA and possible implementations of it as a second major accompanying various other programs. With appropriate release time, we shall develop an additional 300-level course appropriate for BA students, and begin teaching it.

Outcomes and assessment: We intend to increase the number of entering and transferring physics majors by a factor of 2 in 10 years. In the first year, we will create a new course suitable for the BA, which will be assessed by student and faculty peer evaluation.

2. Graduate Program

Our graduate enrollment is one of the largest in the Southeast. We are confident that we can grow by delivering high-quality professional training in physics to the benefit of the students and the state of North Carolina.

We plan to diversify our programs to serve students from a broader range of backgrounds than the traditional ones, and who require greater flexibility in preparation. We will create new non-thesis MS tracks in several areas of applied physics, with PhD programs to follow. The new tracks will involve the development of additions to the current physics curriculum. Some coursework requirements in place for our current MS and PhD programs would be replaced with applied research under faculty in appropriate fields. Particular areas to be targeted for a possible Instrumentation Physics degree include Optics, Materials Physics, and Solid-State Physics. Finally, Marine, Earth, and Atmospheric Sciences (MEAS) and the Physics Department will expand research in remote sensing of the environment. Coursework for an Instrumentation degree will then involve cross-listing of existing courses with MEAS or the creation of new courses in Physics.

Specific plans: We will identify appropriate requirements for these new tracks, and any new courses we require. The resources for these will be requested in the near future.

Outcomes and assessment: At this planning stage, the outcome will be a report on the planned MS program, to be provided by July 2000.

V. PERFORMANCE ASPIRATIONS

Our students, both non-majors and majors, express strong satisfaction with our programs. However, substantial numbers of students still struggle with introductory physics courses. We have been addressing the effective delivery of instruction at this level for many years, in our Physics Education group, and in our WebAssign project: web-based delivery of homework with instant feedback which has great potential for improving student success rates.

We propose an ambitious extension of WebAssign, to make it an effective tool for instructors of

large-enrollment introductory courses at NC State, including Accounting, Biology, Chemistry, Economics, English, Mathematics, Physics, Psychology, and Sociology. This will be done in partnership with those departments, and with scores of NC middle and high schools, several neighboring universities (Davidson, Duke, North Park University, NC A&T), and textbook publishers. The main tasks are to improve the WebAssign code, to extend the breadth in the question database, to provide teacher training, and to continuously evaluate WebAssign's effectiveness on student learning. The primary evaluation is student WebAssign scores vs. final grade scores. Preliminary results show that students who do well on WebAssign homework get better grades.

This expansion will require the addition of administrative, programming, editorial, training and support personnel. The substantial funding required will need to be provided internally for the first year, but it is expected that user fees and, where appropriate, Education Technology Fee funds, will in later years offset most of the new costs associated with operating the program.

Specific plans: This expansion of WebAssign will require faculty release time, a senior computer administrator, four staff programmers and a consultant, two editorial staff, a trainer, tech support, 11 TAs, travel, and services of evaluators along with ancillary expenses from NC State to match external fund sources under discussion. In addition, to insure that WebAssign meets the needs of all NC State students and faculty, it is proposed that an NC State WebAssign Committee will be established by the provost. The purpose of this committee will be to give overall policy guidance on the deployment of WebAssign to meet the needs of all NC State students and faculty. The membership of the committee will be the heads of all departments in which WebAssign is used. The chair will be the head of the Department of Physics. The director of WebAssign will be an ex officio member.

Outcomes and assessment: We will deliver WebAssign to all 3,000 introductory physics students if requested by the physics instructor, to an additional 18,000 students at NC State by the end of 2000, to 100 middle and high schools in North Carolina, and to 10,000 students at other educational institutions in the US. WebAssign will further expand its partnership with textbook publishers to new titles in new disciplines. We expect to increase student success and retention rates, to provide active, motivational learning, and to provide instructors with an effective, integral tool for use in large classes. These expectations will be assessed through homework and course grades, standardized exams, student surveys and individual interviews and by professional evaluators using established instruments. The assessments will be widely distributed to the educational community via conference talks, publications, and reports.

VI. Summary

1. National Collaboration for the Reform of Undergraduate Science, Math, and Engineering Education: Several additional SCALE-UP sections will be taught in Spring 2000 in the new classroom. We will report the success rates of underrepresented groups in SCALE-UP classes by July 2000. A new faculty member will also have been hired by that time who will specialize in physics education research and work closely with faculty from other departments.

2. High-Performance Computing: We will have hired a faculty member in computational materials/biomaterials by the start of the Fall 2000 semester, and renovations to the fifth floor of Cox Hall should be complete, allowing co-location of associated faculty.

3. Nanoscale Initiative. The planning workshop will be held, and a plan for the NI developed in consultation with other departments. It will be provided by July 2000.

4. Polymer Center. The workshop will be held, and a report provided by July 2000. Renovations for the

Physics Co-Director will be performed.

5. Partnerships with Oak Ridge National Laboratory. If the UT/Battelle management bid is successful, a report on plans for filling the joint positions will be submitted by July 2000.

6. Space and Fragmentation Initiative. A report on alternatives to solve this important problem will be submitted to the Provost by July 2000.

7. Startup Resources. Adequate resources for new faculty will be made available.

8. The Uniform Wiring Plan will be extended to Bureau of Mines.

9. Undergraduate Enrollment. Our improved recruiting materials, including descriptions of enhanced opportunities for transfer students and double majors, will be ready by July 2000. A new 300-level course appropriate for BA students will be designed, and will be taught for the first time either in Spring or Fall 2000.

10. Graduate Enrollment. We will submit a report describing our planned new non-thesis MS degree programs in applied physics by July 2000.

11. We will add faculty, programmers, editorial, training and tech support staff to expand WebAssign use across campus, to North Carolina schools and to other educational institutions.

Appendix I: Enrollment Targets and Drafting Procedure

A. Conservative

Category /Year	1999	00	01	02	03	04	05	06	07	08	09	10
New	15	17	18	19	20	20	20	20	20	20	20	20
Transfer (external)	3	3	3	4	4	4	5	5	5	5	5	5

Transfer (internal)	2	2	3	4	4	4	5	5	5	5	5	5
New MS	5	5	5	5	5	6	6	6	6	6	6	6
New PhD	15	15	15	16	16	16	17	17	17	18	18	18

B. Aspirational

Category /Year	**1999**	**00**	**01**	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**
New	15	17	18	19	20	21	22	23	24	24	24	24
Transfer (external)	3	3	4	5	6	7	8	9	10	10	10	10
Transfer (internal)	2	2	3	4	5	6	6	6	6	6	6	6
New MS	5	5	5	6	6	6	7	7	7	8	8	8

New PhD	15	16	17	18	18	19	20	21	21	22	23	24

Compact Drafting Procedure

Physics faculty have been apprised of the rules of compact planning as these were made available to the Department Head. A framework for discussions, to be led by the Advisory Committee, was set up before the external review committee's visit in mid-May. Faculty were solicited to draft proposed initiatives; these were posted on a secure Department web page for discussion. Several lunch meetings were held at which these initiatives, and others, were discussed and prioritized. The first draft document was assembled from the individual initiative drafts, with priorities reflecting Department consensus. It was distributed to the faculty and discussed at another meeting, after which another round of editing and drafting occurred, resulting in this document. At least 10 faculty contributed in varying degrees to the words in this draft.

Appendix II: Summary and Resources

1. **National Collaboration for the Reform of Undergraduate Science, Math, and Engineering Education.** Several additional SCALE-UP sections will be taught in Spring 2000 in the new classroom. We will report the success rates of underrepresented groups in SCALE-UP classes by July 2000. A new faculty member will also have been hired by that time who will specialize in physics education research and work closely with faculty from other departments. **Required resources:** SCALE-UP Classroom: Total cost $350K for Year 1 (NSF: $200K; University, $150K (E&T funds)). New faculty: One position. Start-up: Negotiable.

2. **High-Performance Scientific Computing.** We will have hired a faculty member in computational materials/biomaterials by the start of the Fall 2000 semester, and renovations to the fifth floor of Cox Hall should be complete, allowing co-location of associated faculty. **Required resources:** Renovations: $200K, University or overhead return. New faculty: One position. Start-up: Negotiable.

3. **NanoScale Initiative.** A report on the workshop, and a plan for the NI, developed in consultation with other departments, will be provided by July 2000. **Required resources:** Workshop: $30K (ARO: $15K; Department, $15K).

4. **Polymer Center.** The workshop will be held, and a report provided by July 2000. Renovations for the Physics Co-Director will be performed. **Required resources:** Workshop: $10K, Department. Renovation: $100K, University.

5. **Partnerships with Oak Ridge National Laboratory**. If the UT/Battelle management bid is successful, a report on plans for filling the joint positions will be submitted by July 2000. **Required resources:** One-quarter faculty position: University.

6. **Space and Fragmentation Initiative.** A report on alternatives to solve this important problem will be submitted to the Provost by July 2000. **Required resources:** To be developed in the report.

7. **Startup Resources.** Adequate resources for new faculty will be made available. **Required resources:** Typical experimentalist: $250K; typical theorist: $100K (Department and University resources).

8. **The Uniform Wiring Plan** will be extended to Bureau of Mines. **Required resources:** $44K, University.

9. **Undergraduate Enrollment**. Our improved recruiting materials, including descriptions of enhanced opportunities for transfer students and double majors, will be ready by July 2000. A new 300-level course appropriate for BA students will be designed, and will be taught for the first time either in Spring or Fall 2000. **Required resources:** Summer Support for Undergraduate Director

10. **Graduate Enrollment.** We will submit a report describing our planned new non-thesis MS degree programs in applied physics by July 2000. **Required resources:** Summer Support for Graduate Director

11. **WebAssign.** We will add faculty, programmers, editorial, training and tech support staff to expand WebAssign use across campus, to North Carolina schools and to other educational institutions. **Required resources:** First-year cost, $587K ($270K, E\&T funds; $200K, external customers; $117K, University).