

**University of North Carolina at Wilmington**

**Department of Physics and Physical Oceanography**

**Strategic Planning Document**

**March, 2005**

### **1. Describe the Department Mission**

“The Department of Physics and Physical Oceanography is committed to, and values excellence in teaching, scholarship, and service. The Department provides quality programs leading to the B.S. and B.A. degrees through courses that stimulate intellectual curiosity, imagination, rational thinking, and thoughtful expression, and through opportunities for student participation in the scholarly activity of its faculty. The Department further supports the College mission by providing service courses in the natural sciences that acquaint beginning students with the laws of nature and develop their abilities to reason and think critically. The Department serves as a resource to the University and community by providing professional services at the local, regional, and global levels.”

Department curricula are developed for the explicit purpose of educating students in the fields of physics, astronomy, and physical oceanography. The Department of Physics and Physical Oceanography regards its teaching mission to be principally aimed at training undergraduates for further, graduate-level, studies in physics. The B.S. degree track reflects that emphasis, and is the program of choice for students who seek a higher degree in physics; the B.A. degree is ideally suited to students planning to teach at the secondary school level, or others who may not plan to become professional physicists but who desire an interdisciplinary program with a physics emphasis. At the same time, the department also operates large service-oriented courses for students in the allied sciences.

### **2. What is the current level of success in fulfilling these mission elements?**

For AY 2003-04, the Department produced 3017 student credit hours of instruction, up slightly (~1%) from the previous year and an increase of about 4% since AY 2001-02. The number of students declaring the Physics major currently stands at about 24, nearly twice what it was just two years ago. The Department awarded 7 degrees in AY 2003-04. The record shows that UNCW physics graduates frequently gain acceptance to the nation’s premier graduate programs. In recent years, physics graduates have been accepted to Brown University, UNC Chapel Hill, San Francisco State, Carnegie-Mellon University, North Carolina State University, Southern Illinois University, Wake Forest University, and the University of Virginia. Such acceptances to top-notch schools both in and outside North Carolina suggest that the Department’s undergraduate program is healthy, and providing excellent preparation for advanced studies. Furthermore, the placement rate for all UNCW graduates in physics has reached 100% in the last few years, further evidence that programs are fulfilling their objectives and the demand for technologically oriented graduates is high.

The Department traditionally has been blessed with individuals committed to good teaching, but the retirement in 1999 of two long-time faculty members afforded a rare opportunity to pursue more research-oriented appointments. Nationwide searches to fill these positions culminated with the acquisition of two highly respected experimentalists in the nuclear physics field, who joined the staff in 1999 and 2001. The level of research productivity in the Department has risen dramatically since then: figures for the 2003-04 AY show \$1,091,877 in new awards and 12 peer-reviewed faculty publications.

An increased level of faculty research creates more opportunities to involve undergraduate students in the research enterprise. Currently, physics majors can participate in oceanographic research aboard ocean-going research vessels, and conduct nuclear physics experiments at several off-campus venues: North Carolina State University, Triangle Universities Nuclear Laboratory (TUNL), the National Institute of Standards and Technology (NIST), and Jefferson Laboratory (JLAB). Over the last two years, physics undergraduates presented

results of their research to several professional audiences: the Triangle Undergraduate Research Symposium, Duke University; the 70<sup>th</sup> Annual Southeastern Section Meeting of the American Physical Society (SESAPS), Wrightsville Beach, NC; and the 2004 CAA Undergraduate Research Conference, University of Delaware.

On the service front, our highest profile venture is the Physics Colloquium Series, which brings noted scientists to the UNCW campus to share their latest discoveries on topics at the “cutting edge” of current knowledge. Typically the Department hosts 12-14 such talks each year, delivered by experts in a variety of physics and physics-related disciplines.

### 3. *What impedes your ability to fulfill these mission elements?*

Curricular offerings are severely limited. Courses in support of our degree programs must strike a balance between ensuring in-depth preparation in a few key areas (the core) and providing for sufficient exposure to a broader range of more specialized topics. This is especially challenging in a department where faculty numbers are small and physical resources limited. We have begun to offer advanced topics like Optics, Nuclear, and Solid State Physics on an alternate-year schedule, thus ensuring that every student has an opportunity to enroll in each course prior to graduation.

Physics majors are in short supply. Having undergraduate majors in sufficient numbers to guarantee a ‘critical mass’ for the vigorous exchange of ideas, both in and out of the classroom, is essential to program quality. Class sizes for upper level courses taught in the major ideally would be somewhere in the range 10-15, large enough to ensure the ‘critical mass’ necessary for healthy interactivity and peer learning, yet small enough to allow all viewpoints to be heard freely. This figure translates directly into the ideal number of physics graduates per year, and a total population in the major (over three years) of 30-45. The Department has not seen numbers that high since 1997 (and then only briefly).

Space needs are critical and wide-ranging: more space for undergraduate labs to bring us closer to the ideal of two students per table, dedicated space for the Advanced Laboratory (currently shared with one faculty member’s research lab), and more storage space for instructional lab equipment and demonstration apparatus to relieve the current overcrowded conditions in the physics stockroom. Faculty office space is exhausted; even if enrollments could support additional hires, there is simply no place to put them.

Scientific instruction is costly, yet the Department base operating budget has been flat the past three years. Funds available to replace outdated equipment or repair damaged items have not kept pace with need. Within the next three years, the Department estimates it will have to spend more than \$49,000 to replace equipment in the instructional labs that has fallen into disrepair or outlived its usefulness (see Table 1). This figure exceeds our entire annual operating budget!

**Table 1: Scientific Equipment Replacement Schedule**

Description	Life Span of Equipment (in years)	Anticipated Replacement Date	Anticipated Future Cost of Equipment
Optical bench assemblies (quantity = 10)	15	1 year	\$5,400
laboratory lasers (quantity = 10)	7	ASAP	\$7,200
nuclear spectroscopy lab	10	ASAP	\$4,500
Celestron Telescope	15	3 years	\$3,500

e/m measurement apparatus	7	ASAP	\$3,000
centripetal force apparatus (quantity = 10)	10	2 years	\$5,000
velocity of light apparatus	10	ASAP	\$3,500
turbo pump (quantity = 2)	10	ASAP	\$15,000
desktop computers (quantity = 2)	4	2 years	\$2,700
			\$49,800

Support staff and facilities are nonexistent. The department needs a qualified technician to organize, oversee, and repair scientific equipment used in support of the instructional function; currently, those tasks fall to full-time faculty in their 'spare' time, with some paid student help. The technician could be a joint appointment with another science area or combined with a lecturer position to eliminate the Department's reliance on part-time or overloads. Finally, machine shop facilities (and the space to house them) would be helpful in fabricating specialized items for research-related activities in the Advanced Laboratory and independent, student-oriented projects (DIS).

#### **4. *What is the faculty's vision of the future (5 years) in regard to instruction, research and service?***

A strong emphasis on undergraduate research and close faculty-student interaction can offset the disadvantages of a small program and make it more competitive in attracting the best students. Cultivating new student research opportunities and expanding existing ones, particularly in the area of nuclear and particle physics, will continue to be a top priority in the years ahead. These efforts would receive a natural boost from an M.S. degree program also being contemplated (see below).

Further initiatives aimed at increasing the number of physics majors will be pursued. Realizing 32+ majors by 2009 is a realistic target. To reach that goal, the Department must take a more active role in seeking ways to improve the educational experience provided by its service courses, both to increase course enrollments and to better advertise physics as an interesting and exciting major. Other, less conventional approaches also must be pursued. UNCW's proximity to the coast and resident faculty expertise in oceanography represent unique program strengths that are currently underutilized. Pending a successful outcome of a search for a senior physical oceanographer that is now underway, we envision a degree concentration in physical oceanography that can be marketed to prospective students. This curricular option would draw heavily from course offerings in other departments, thus requiring few extra resources. Another program option that holds promise for boosting the number of physics majors is a 3+2 program in cooperation with NC State. For the first three years, students would complete courses to meet physics requirements at UNCW, then transfer to NCSU to finish the last two years in a suitable engineering program. The student would receive a degree from UNCW and a degree from NCSU. No additional resources are anticipated for this endeavor.

Lastly, we will explore the idea of instituting a Master's level degree program in physics, as a logical 'next step' in the evolution of the Department. The level and quality of current faculty research would seem to warrant this action, which is bolstered by the observation that Physics currently is the only UNCW science department absent a graduate program. Emphasis areas likely would be nuclear physics and ocean science (both experimental) and atomic physics (theoretical). The program would be the only one of its kind in southeastern North Carolina.

To be viable, it will require modest commitments from the University in terms of additional faculty lines, more office and classroom space, and increased financial support in the form of teaching assistantships. Failing that, we will explore the possibility of developing a joint M.S. degree program with another academic area (Mathematics?).

**5. *What elements of this vision relate directly to the University's current set of Strategic objectives?***

The University is committed to “*excellence in teaching combined with a research university's opportunities for student involvement in significant faculty scholarship*”. The Department's continuing emphasis on undergraduate research as a way of distinguishing UNCW physics from competing programs elsewhere underscores this pledge as it relates to a physics education.

The Department already supports the University's emphasis on marine science through its curricular offerings in physical oceanography. We aim to build upon this foundation by identifying a course of study having a decided oceanography slant while satisfying all requirements for a B.S. degree in physics. This new curricular option, as well as the contemplated 3+2 program combining physics at UNCW with engineering at NCSU, both fit nicely with the University's stated objective to “*Encourage creative educational, research, service and administration initiatives*”.

Finally, a Master's level degree program in physics is wholly consistent with the University's strategic vision to “*promote and engage in high-quality scholarship and in master's-focused graduate education...*”

**6. *What departments or programs do you identify as peer or aspirational, both in the UNC system and regionally or nationally?***

The Physics Department at UNC Wilmington is unusual in two respects, both of which harbor the potential to turn what is now a sound program into an elite one. First, its proximity to the coast affords the Department a prime opportunity to develop unique programs of study in oceanography and environmental science that are firmly grounded in the principles of physics. Two (of eight) UNCW physics faculty have expertise in these areas. Second, the newly acquired expertise and vitality in nuclear physics, in the form of two young assistant professors, is remarkably strong for a department this size, and positions UNC Wilmington as an up-and-coming leader in this field.

That said, all physics programs leading to the bachelor's degree have similar degree requirements and core course offerings. What sets them apart are the breadth and depth of their offerings in the peripheral areas of study, the availability of research opportunities for majors, and their coexistence (or not) with graduate programs. UNCW Physics peer programs will be relatively small ( $\leq 10$  faculty), grant only the baccalaureate degree, and engage in a modest level of service teaching; aspirants will be somewhat larger and grant the M.S. degree, with recognized program quality at all levels.

Table 2 below compares summary program data for UNC Wilmington with its self-identified peers (P), those to which it aspires (A), and several other competitors in the southeast region (O). As expected, the data show little variation in B.S. degree requirements. The wider range for the B.A. reflects subtle differences in program philosophy, with UNCW requirements falling closer to the lower end of this range. The B.S. in Applied Physics (B.S.A.P.) option is

designed to provide a solid background in basic physics while maintaining the flexibility to prepare students for immediate entry into industry or government-sponsored research.

**Table 2: Comparison Of Selected Physics Baccalaureate Programs**

Institution	Degree	Required Hours in Discipline	Total Hours	Fall '03 Majors Jr/Sr	Degrees Awarded AY 02-03	Graduate Degree Programs
UNCW	B.A.	25	45	14	4	None
	B.S.	38	64			
Appalachian State (A)	B.A.	36	59	53	7	M.S
	B.S.	32	62			
Dartmouth College (A)	B.A.			38	9	M.S. Ph.D.
East Carolina University (O)	B.A.	19	36	15	2	M.S. Ph.D.
	B.S.A.P.	28	51			
	B.S.	40	63			
Francis Marion University (P)	B.S.	32-36		5	5	None
Norfolk State University (P)	B.S.	48	73	14	4	None
North Carolina A.&T. State (A)	B.S.	47	76	17	2	M.S.
North Carolina State University (O)	B.A.	27	56	57	16	M.S. Ph.D.
	B.S.	36	68			
UNC Asheville (P)	B.S.A.P.	33	65-68	11	3	None
	B.S.	32	52-55			
UNC Charlotte (O)	B.A.	27	51	18	3	M.S.
	B.S.A.P.	30	66			
	B.S.	36	63			
UNC Greensboro (P)	B.A.	28	54	19	3	None
	B.S.	37	63			
James Madison University (P)	B.S.A.P.	42	66	33	9	None
	B. S.	39-43	67-71			
Wake Forest University (O)	B.A.	25	36	18	8	M.S. Ph.D.
	B.S.	38	54			
Washington & Lee University (P)	B.S.	34	61	10	8	None

**7. What objectives for departmental development must be in place to implement the five year “vision”? What actions, in what time frame, and at what cost, must be taken to achieve these objectives?**

Objective	Actions	When	Costs
Continued emphasis on undergraduate student participation in faculty research.	Encourage faculty to seek funding support for research projects.  Recognize DIS and Honors Thesis activity in faculty workload.	Immediate, and ongoing. Workload adjustment subject to CAS approval.	0.2 × SCH (as per CAS policy)
Degree concentration in physical oceanography.	Identify supporting courses taught by other departments.	6 – 12 mo.	None –additional manpower to come from new hire AY '05-

3 + 2 Physics/Engineering Program with NCSU	Develop and offer (alternate years) at least one new course: "Physics of Fluids" Negotiations with representatives from NCSU (2 + 2 Engineering Program Director).	Negotiations to begin immediately and continue as necessary. Approvals should take anywhere from 24–30 mo.	'06 (search in progress).
Lecturer/Technician position	Approvals from CAS Dean and Faculty Senate. Negotiations with CAS Dean	Subject to CAS approval.	None
M.S. degree program initiative	Feasibility study to gauge interest and resources; curriculum development.  Approvals from Faculty Senate, UNCW and UNC officials.	Feasibility studies may take up to 24 mo. Gaining the necessary approvals at all levels could take as long as 60 mo.	Salary / benefits estimated at \$43,000 to start, with annual merit adjustments.  Rough estimates: 2 faculty lines, 5 TA positions annually.