Planning for Excellence –
Strategic Plan for the Chemistry Department at Stony Brook University

Summary

The mission of the Stony Brook University Department of Chemistry is to carry out world-class research and education in the molecular sciences and to apply new knowledge to improve our quality of life. Based on this mission, a strategic plan, with emphasis on enhancing our current strengths and exploring new growth opportunities, was composed based on peer comparison, quantitative data, faculty discussions, and the input of the experienced members of the administrative staff.

Overall, the department has continued to grow in terms of faculty reputation, external research funding and the quality of the undergraduate program despite the tough economic challenges we have faced in the past few years. In the past decade, there was a significant turnover of faculty positions (retirements and hires) that has largely redefined the research emphasis of the Department. These changes reflect trends in interdisciplinary science, federal funding trends, and regional opportunities provided by Brookhaven National Laboratory. Opportunities for growth in biological, computational and materials chemistry that could further enhance the Chemistry Department's research standing are being pursued. The disproportionate growth of undergraduate enrollments in entry level chemistry courses, coupled with the recent financial contraction of the SUNY system, however, has also created additional stresses on the Department that need to be confronted in order to sustain our current strengths.

Today, Stony Brook Chemistry is a top 40 graduate program as rated by the 2010 National Research Council (NRC) rankings. The strength of this department reflects the high-caliber of our faculty, many of whom have obtained international recognition (two National Academy of Sciences members and one National Academy of Engineering member). With more than $18 million in external funding and state-of-the-art facilities, the department offers an outstanding environment for chemical research and education, training the chemists of the future. With this strategic plan, we envision Stony Brook Chemistry will become a top 20 to 30 graduate program in the next few years. C&E News has just published the NSF R&D spending rankings, and the department has now moved to #24 (2008 data) from #28 (2007 data).

Current Status of the Department

Faculty Size

The Chemistry Department currently consists of 36 faculty members (25 full professors, 5 associate professors, and 6 assistant professors) with 27 full-time tenured or tenure-track faculty lines (27 FTE). In specific, the faculty consists of 23 FTE, 6 joint-appointment faculty with Brookhaven National Laboratory (3 FTE), 1 joint-appointment faculty with the Department of Physics and Astronomy (0.5 FTE), 1 joint-appointment faculty with the Chemistry Department at Cambridge University (0.5 FTE), 5 joint-appointment faculty with the Department of Biochemistry and Cell Biology, the Department of Geosciences, the Department of Materials Science and Engineering and the Department of Pharmacological Sciences (0 FTE). Augmenting

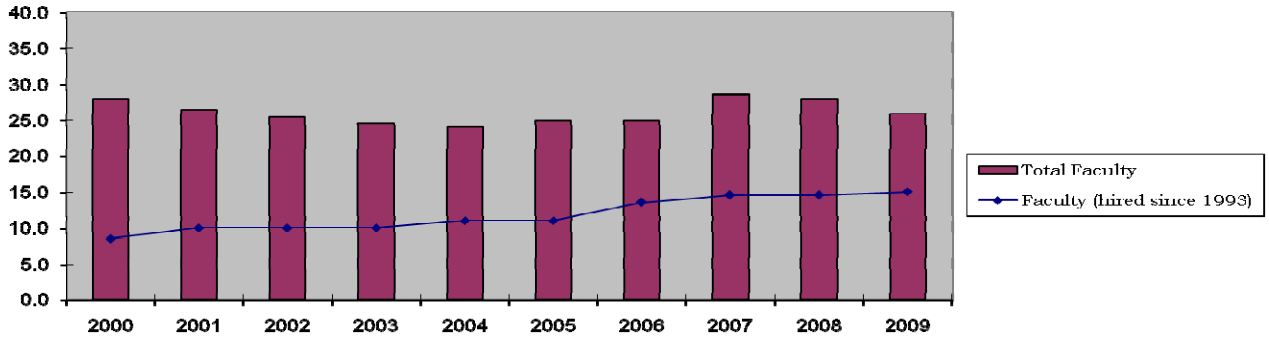
this faculty are seven full-time lecturers (7 FTE) and two full-time laboratory technicians (2 FTE), whose primary responsibilities lie in support of our large undergraduate teaching laboratories in general and organic chemistry. The current list of the Chemistry faculty and their joint affiliations are summarized as follows.

Katherine Aubrecht	Jiangyong Jia[1]	John Parise[5]
Elizabeth Boon	Francis Johnson[2]	Kathlyn A. Parker
Isaac Carrico	Philip M. Johnson	Daniel P. Raleigh
Benjamin Chu	Eric Kaler[3]	Jonathan G. Rudick
Ken Dill	Peter Khalifah[1]	Nicole S. Sampson
Dale G. Drueckhammer	Stephen A. Koch	Orlando D. Schärer[2]
Frank W. Fowler	Roy A. Lacey	Trevor Sears[1]
Nancy S. Goroff	Joseph W. Lauher	Carlos Simmerling
Robert B. Grubbs[1]	Erwin London[4]	Peter J. Tonge
Clare P. Grey	Andreas Mayr	Jin Wang
David M. Hanson	Michelle Millar	Michael G. White[1]
Benjamin Hsiao	Iwao Ojima	Stanislaus Wong[1]

1. Joint with Brookhaven National Laboratory
2. Joint with Department of Pharmacological Sciences
3. Joint with Department of Materials Science and Engineering
4. Joint with Department of Biochemistry and Cell Biology
5. Joint with Department of Geosciences

The gender balance of our faculty (36) is currently, 29 male and 7 female. By ethnicity the faculty consists of 29 Caucasian, 1 African-American and 6 Asian members. The Department is strongly committed to promoting diversity in the hiring of faculty.

For comparison, we note that the current number of 27 FTE is down from 28 FTE in 2000 and in 2008, and from 28.5 FTE in 2007 (see chart below). The variation from 2005-2010 is the net result of considerable faculty turnover due to retirements (John M. Alexander, Robert F. Schneider and Arnold Wishnia), the recruitment of senior faculty (Robert Grubbs, Ken Dill) and junior faculty (Katherine Aubrecht, Elizabeth Boon, Isaac Carrico, Jiangyong Jia, Peter Khalifah and Jonathan G. Rudick). Based on the current NRC rankings and NSF R&D spending rankings, Stony Brook Chemistry can become a top 30 to 20 graduate program in the U.S., **if the faculty size can be maintained at full 30 FTE** (reasons to be given below).



Strong Ties with Brookhaven National Laboratory

A unique success of our Department is the first implementation of joint faculty appointments with Brookhaven National Laboratory, which were developed cooperatively by Prof. Iwao Ojima (Chemistry Department Chair, 1997-2003), Dr. Robert McGrath (SB Provost and V.P. for BNL Relations) and Dr. Peter Paul (BNL Deputy Laboratory Director). In 2000, the Departmental need for physical chemistry faculty resulted in the conversion of one senior faculty recruitment line to three joint positions, one junior (Wong) and two senior (Suits, White). These arrangements were the first formal cost-sharing appointments in which BNL committed to offset academic salary (50%) and start up costs (dependent on individual). Joint BNL-SB faculty are formally employed at Stony Brook for tenure purposes, but have full status as scientific staff at BNL. Although half-time teaching positions, these three joint-appointments greatly expanded our physical chemistry efforts and attracted a significant number of graduate students for Ph.D. study. In addition, DOE program officers have responded very favorably to the Chemistry model of joint appointments and both Suits and Wong started new DOE-funded programs in the BNL Chemistry and Materials Science Departments, respectively, enjoying strong BNL administrative support (White was already DOE funded).

Today, we have 6 joint appointments (4 at the senior level: Grubbs, Sears, White, Wong, and 2 at the junior level: Khalifa and Jia) with Brookhaven National Laboratory. BNL has committed the majority of start-up costs for the recent joint hires (Grubbs, Sears, Khalifa and Jia). In fact, BNL has invested over $3 M in the SBU/BNL joint faculty since 2001. The joint faculty currently generate about $2.1 M research funding annually (SBU and BNL), provide unique research opportunities for graduate students (total of 39 Ph.D. graduate students, past and present), and have helped develop regional and national strengths in energy sciences (materials, nuclear and synchrotron).

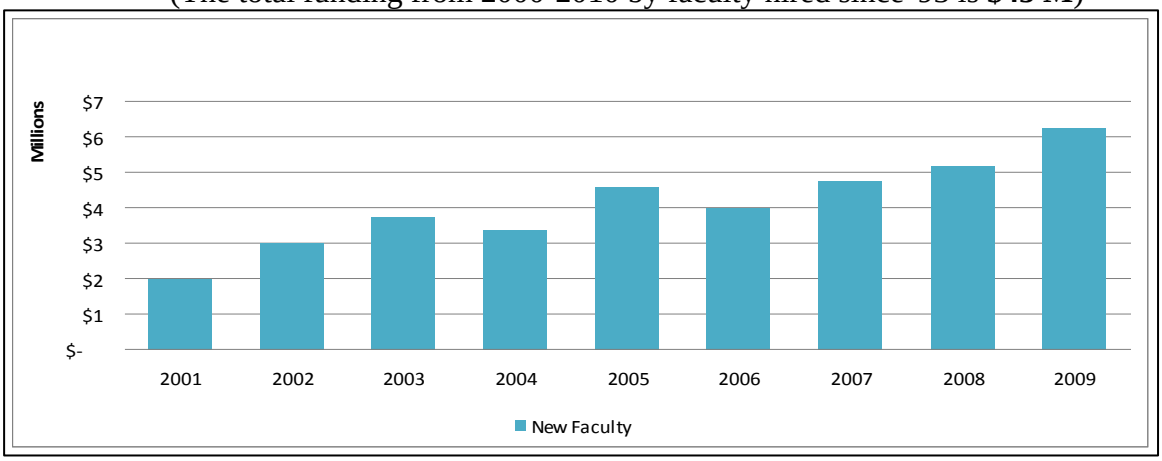
Faculty Funding

In the last ten years (2000-2010), the Chemistry faculty has achieved an impressive record of research funding. The total external research funding of the Chemistry Department in 2008 has exceeded $18 million for the first time (the Department is ranked #24 nationally based on the 2010 NSF R&D spending rankings). The funding sources include major federal funding agencies (e.g. National Institutes of Health (NIH), National Science Foundation (NSF), Department of Energy (DOE), Department of Defense (DOD), with NIH being the largest funding source), private foundations and industry (chemical and pharmaceutical). Of the public universities just above Stony Brook in total R&D expenditures in 2008, there are 10 institutions in the $18-19M range, *e.g.* Univ. of California, San Diego (#15), University of Washington, Seattle (#17), University of Colorado (#19), Texas A&M (#20), Indianna University (#22) and University of Michigan (#23), the faculty size of Stony Brook Chemistry is significantly smaller than those in these top ranked public universities. With the addition of 3 FTE to our faculty, including some joint BNL/SBU senior hires, Stony Brook Chemistry can easily add another $1M of R&D expenditures thus moving the Department into top 20 positions.

Since 1993, 15 new faculty members have been recruited into the Chemistry Department. All of these faculty members those hired prior to 1993 have won major research grants from

NIH, NSF, DOE and DOD with over 10 NIH/ONR/NSF Young Investigator Awards. The total research funding from 2000-2010 by faculty hired since 1993 is now more than **$45 million** (this amount does not include the BNL funding by 6 joint SBU/BNL appointments). Without question, the Department has excellent track record in recruiting and retaining high caliber faculty.

Annual funding by faculty hired since 1993
(The total funding from 2000-2010 by faculty hired since '93 is **$45 M**)



Faculty Awards and Recognitions

The strength of the Chemistry Department is a reflection of our high-caliber faculty, many of whom have obtained international recognition. The most notable example is the work of our former faculty, Prof. Paul Lauterbur (deceased in 2008), who shared the 2003 Nobel Prize in Physiology and Medicine with Sir Peter Mansfield for his pioneering studies of 3-dimensional imaging with NMR. These experiments, which are recognized as the foundation of modern MRI imaging, were devised and performed while Lauterbur was a member of the SB Chemistry Department (1962-1985). This award marks the first Nobel Prize awarded to an individual for research performed at Stony Brook. Lauterbur's contributions to MRI are commemorated by a permanent display in the Chemistry building lobby. Based on this work, Stony Brook Chemistry received the Citation for Chemical Breakthrough Award for "The Invention of Magnetic Resonance Imaging" in 2008. In addition, the American Chemical Society will designate Stony Brook Chemistry as an ACS National Historic Landmark in 2011.

Notable major awards won by faculty members include the National Medal of Science (Joanna Fowler), two members of National Academy of Sciences (Joanna Fowler and Ken Dill), one member of National Academy of Engineering (Eric Kaler) and the Presidential Early Career Award for Scientists and Engineers (PECASE, Elizabeth Boon).

Joanna Fowler-National Medal of Science (2009)

Elizabeth Boon – PECASE (2009)

Other major awards won by the faculty include ONR/NSF Young Investigator Awards, DOE Ernest O. Lawrence Award, Alfred P. Sloan Fellowships, John Simon Guggenheim Fellowships, Camille and Henry Dreyfus Foundation Awards, Humboldt Awards, Pew Scholars, Cottrell Scholars, Teacher-Scholar Award, DuPont Young Professor Awards, ACS Cope Scholar Awards, American Association for the Advancement of Science Fellowships, American Academy of Arts and Sciences Fellowships, American Physical Society Awards and Fellowships, American Chemical Society Awards and Fellowships, and Optical Society of America Fellowships. The total number of awards won by the Stony Brook Chemistry is consistently ranked top 20 among its peers in the country (by Academic Analytics).

Graduate Program

Currently, faculty research supports the efforts of 196 graduate students enrolled in both Ph.D. program (171 PhD students) and Master program (25 MS students), with an annual recruitment of about 35 new PhD students depending on external (e.g., visa issues, acceptance rates) or internal (e.g., faculty and Departmental resources) circumstances and of about 15 Master students who pay their own tuition fees. Over the last three years, the incoming class was composed of about 45% domestic and 55% international students with the majority of the international students coming from prominent universities in China (e.g., Fudan, Peking, Nanjing, USTC) and smaller numbers from Korea, Taiwan, India, and Turkey. Incoming students are primarily oriented towards synthetic and biological chemistry, although our international reputation in polymer chemistry also attracts a few students each year. We have also noted an increased interest in materials and nano-related chemistry, which is consistent with the increased visibility of these fields in chemistry. The current distribution of graduate students indicates that the largest fraction is performing research in chemical biology and bioorganic chemistry, including computational studies. The next largest group is that roughly defined as materials, including polymer, solid-state, supramolecular and nano-related chemistry.

Since its inception, the Department has launched more than 600 Ph.D. and 400 master's degree graduates into successful careers in industry, teaching, and research in academic and government institutes. The average time for a Ph.D. student to graduate is 5.2 years, which suggests that our program strikes the right balance of coursework, instructional training (TA) and

independent research. Our graduate program was ranked about mid-thirty in the 2010 National Research Council Report on US doctoral research programs.

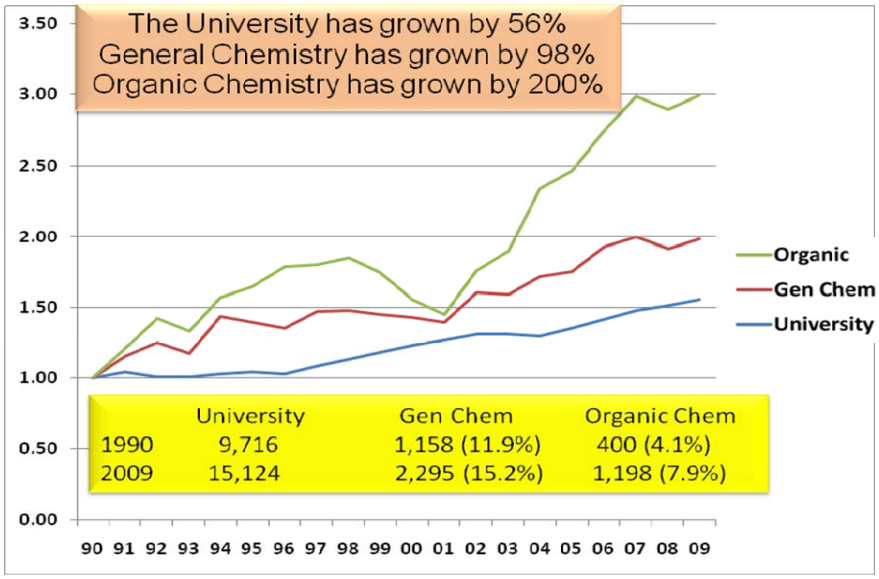
With technology evolving at an expanding rate, it is critical for prospective and current employees to be at the forefront of scientific developments. To meet these challenges the Chemistry Department is expanding its graduate program in Master of Science. Currently, this program offers five tracks: Five-year BS/MS, MS, MS with Research concentration, MS with Professional concentration and MAT in Chemistry. In the last two years, the department has attracted about 15 MS students per year (up from about 5 MS students per year) into this program. Some unique features of this program are:

- A strong academic foundation in traditional disciplines taught by nationally recognized faculty.
- Specialized topic and seminar courses that engage students in current research challenges, developments and methodologies.
- Extensive research opportunities in a broad range of disciplines.
- Internships that allow students to engage in the development of evolving technologies within industrial and governmental laboratories.

Undergraduate Program

In the past twenty years (1990-2010), the University full-time undergraduate population has increased by 56%, while enrollments in General Chemistry have grown by 98% and in Organic Chemistry have grown by 200%. The net result of higher student/faculty ratios in Chemistry is to stretch our teaching resources by requiring more faculty to cover the large enrollment introductory and organic lecture/lab courses. Another consequence is the loss of flexibility to provide faculty release time for research, curriculum development, or departmental or university service.

Growth of full time undergraduate students *vs.*
General Chemistry and Organic Chemistry students

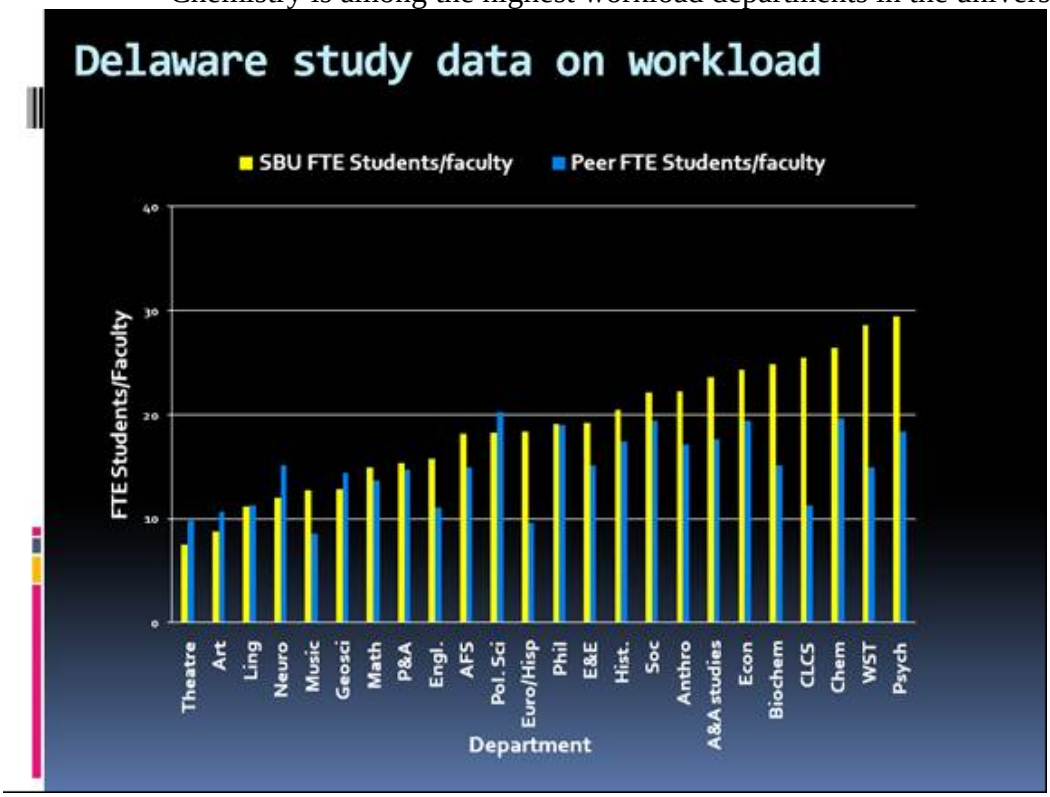


To be specific, undergraduate enrollment in all Chemistry courses now exceeds 4000 students per year, with the majority of students taking courses in introductory chemistry (lecture and laboratory courses) and organic chemistry (lecture and laboratory courses). The enrollment in the introductory chemistry lecture courses (CHE 131 and 132) typically represents more than half of the incoming class to the University and our first term organic lecture class is the largest 300-level course at the University (CHE 321). The high enrollment in these introductory chemistry courses compared to the total undergraduate population reflects the high percentage of Stony Brook students with biological, engineering, and health-related majors. By way of comparison, the number of students enrolled in the freshman chemistry lecture course at better ranked public universities is usually less than that in our introductory chemistry course (CHE 131) for a total freshman enrollment that can be substantially larger than that of Stony Brook and with a significantly larger number of faculty. For example, in 2009, UC Berkeley had 24,462 undergraduate students vs. Stony Brook's 15,525 undergraduate students. But Stony Brook had more students in first semester general chemistry (2,149) than UC Berkeley (2,048). Unmet demand for these courses during the academic year is addressed in part by offering introductory and organic chemistry courses during the summer sessions.

Although the Chemistry Department has been recognized as one of the departments with highest workload (based on Delaware Study on Workload) in the university, it has a long tradition of stressing excellence and innovation in undergraduate education. These efforts have been recognized by SUNY and Stony Brook through teaching awards to several faculty including the President's and Chancellor's Awards for Excellence in Teaching (Fowler, Kerber, Lacey, Lauher, Schneider) and granting the title, SUNY Distinguished Teaching Professor, to Robert Kerber in 2002 and Joe Lauher in 2009. As an example of curriculum development over the last 10 years, we have revamped our general chemistry lecture courses to include segments on organic, bioorganic and macromolecular chemistry. This is in response to the increased importance of molecular level descriptions in biology and medicine and the fact that this is the last chemistry course for many students. As noted above, the enrollment in these general

chemistry courses is quite high and we are now using team teaching in the lecture (2 per semester; CHE 131) and lab (2 per semester; CHE 133-134) courses in order to spread the load among faculty. This approach provides a high level of instruction at the most basic level, but it is stretching our faculty resources to the limit. In particular, this high concentration of faculty effort in introductory courses is impacting our ability to place faculty in upper division courses where their research expertise is desirable (e.g., organic lecture and lab, physical chemistry laboratory). We have also added mandatory recitation sections to help students taking our large organic chemistry lecture course (CHE 321). These recitations required addition of TA positions (primarily advanced chemistry graduate students). However, the allocation of sufficient TAs in the College of Arts and Sciences has become a routine struggle every year due to budget reductions.

Chemistry is among the highest workload departments in the university



Outreach Activities

The Chemistry Department interacts with the community, especially the science education community of Long Island, in a number of ways. The undergraduate and graduate (M.A.T.) teacher preparation programs produce well-prepared graduates with state teaching certifications, who frequently take employment as teachers in school districts in Nassau and Suffolk Counties. Linda Padwa, the interim director of the Science Education Program, is an experienced chemistry teacher, who has also participated in educational research with Prof. David Hanson and Dr. Troy Wolfskill of this Department. The Department routinely offers in-service courses for high school chemistry teachers.

A remarkable number of students from local high schools make contacts with faculty and participate in intensive research here, with the intent of participating in Intel or Siemens Science research competitions. Over the last few years, Profs. Chu, Goroff, Hsiao, Ojima, Simmerling, and Tonge have accommodated in their labs high school students who became Intel semifinalists. Students working with Ojima, and Simmerling progressed to the Finalist stage of the Intel and Siemens competitions, and received substantial scholarships. The Chemistry faculty usually mentored 15-30% of Intel/Siemens semifinalists produced by the University.

Intel Talent Competition*

Year	**# of Intel Semifinalists at SB**	**SB Chemistry**
2009-2010	33	10 semifinalists
2008-2009	25	6 semifinalists /2 finalists
2007-2008	28	5 semifinalists
2006-2007	22	3 semifinalists
2005-2006	30	5 semifinalists
2004-2005	36	5 semifinalists

2009 Top 10 Award Winner (8th) Preya Shah/MENTOR: Iwao Ojima

Siemens Science Competition*

Year	**# of Siemens Semifinalists at SB**	**SB Chemistry**
2009-2010	31	8 semifinalists/1 finalist
2008-2009	34	5 semifinalists
2007-2008	30	7 semifinalists/1 finalist team
2006-2007	41	9 semifinalists
2005-2006	28	6 semifinalists

2009 Grand Prize (individual) -Ruoyi Jiang/MENTOR:Carlos Simmerling
2007 Grand Prize (team) -Janelle Schlossberger/Amanda Marinoff- MENTOR:Iwao Ojima
* About 300 semifinalists nationally

Vision for the future

The human population is expanding rapidly. This rapid growth will inevitably strain the natural resources, pollute the environment and generate more diseases. Chemistry, as a central science in an interdisciplinary approach, will provide solutions to many emerging challenges. We envision that the Stony Brook Chemistry Department, with core strengths in several areas, will become a leader in tackling these challenges. These core strengths include education innovation and research in the areas of chemical biology, computation, materials (e.g., for energy and water applications), photon and nuclear sciences.

Education Innovation

Stony Brook University is a premier academic institution for both scientific education and research. As a consequence of Stony Brook's excellent science reputation, we have a disproportionately large number of undergraduate students who require science courses to achieve their career goals. One of every four undergraduate students at SBU is enrolled in a chemistry course and one of every two is enrolled in a physical or life science course.

At Stony Brook, as at other large public universities, the majority of these students are taught in large enrollment lecture classes. However, instructors and students along with administrators have become very disenchanted with the effectiveness of this approach (i.e., the sage on the stage) for providing a quality education in the basic sciences. Alternative educational approaches to the traditional lecture have emerged. All of these depend on the students actively participating in their own education with the instructor playing the role of the guide on the side. For example, Drs. Dave Hanson and Troy Wolfskill at Stony Brook have developed Process-Oriented Guided-Inquiry Learning, (POGIL). This work has culminated in a $3.5M NSF grant (joint to Stony Brook and Franklin & Marshall College) to support the various activities (national workshops: 350, faculty participants: 6,500, students engaged: 150,000). These programs have been peer reviewed, funded by the National Science Foundation, and recognized nationally as being tremendously successful. Active learning is a proven method for science education.

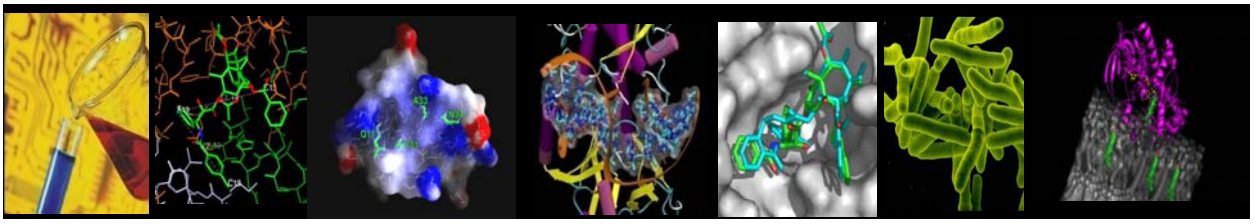
It is clear that the methods of active learning, using new technologies, can now be adapted to large enrollment courses. However, current facilities at Stony Brook are not suitable for active learning in large enrollment courses nor are any such facilities planned. Here we seek the resources to build a *Seawolf Active-Learning Center* at Stony Brook University. The two-story building will have flexible learning space that will provide 12 classrooms that can be combined and configured to seat groups ranging from 45 to 400 students. The classrooms will contain technology that enables the instructor to engage students in learning and problem solving with appropriate real–time feedback on their work. The proposed Center program will achieve the multiple benefits of improving the educational experience at Stony Brook, advancing research on educational methods in active–learning, and providing SBU undergraduates with a 21st century education that will equip them with life-long learning skills and expand their professional and career opportunities.

Institute of Chemical Biology & Drug Discovery

The primary objective of the Institute of Chemical Biology & Drug Discovery (ICB&DD) is to establish a world-class "Center of Excellence" in chemical biology and drug discovery at Stony Brook University. The rapid and impressive advancements in chemical biology during the last decade have clearly demonstrated that solutions for a vast majority of medical problems rely on the understanding of the molecular basis of diseases, therapeutic targets, drug actions, and drug resistance. ICB&DD promotes highly productive interdisciplinary and collaborative research among chemists, biologists, medicinal chemists, pharmacologists, and physicians to attack major biomedical problems to find solutions including the discovery of novel therapeutic drugs.

ICB&DD complements Stony Brook's Centers for Molecular Medicine (CMM) and significantly contributes to the establishment of a truly comprehensive biomedical research enterprise from molecular science to clinic at Stony Brook. Fundamental biological research often fails to include drug discovery, which is one of the most important and beneficial scientific contributions to mankind. Thus, drug discovery is included in the scope of ICB&DD together with chemical biology. The Center for Structural Biology (CSB), the Center for Infectious Diseases, and the Long Island Cancer Center (LICC) in CMM are greatly benefited by ICB&DD to promote translational and experimental therapeutics research. In addition, ICB&DD bridges chemical biology to immunology, infectious disease, and research on aging. It is already well perceived that chemical biology covers genomics and proteomics, which already have a strong presence in pharmacological sciences, biochemistry, biophysics, and microbiology departments at Stony Brook. One of ICB&DD's strengths is that it has been founded by reorganizing existing exceptional talents on campus, and thus the core of the institute is a well-proven entity with an excellent track record.

Under the leadership of its founding director, Distinguished Professor Iwao Ojima of the Department of Chemistry, the ICB&DD continues to embrace the spirit of its inception as a university-wide interdisciplinary research institute. Since its inauguration in fall of 2004, the Institute has expanded and will continue to expand the number of participating faculty from many departments including Chemistry, Biochemistry and Cell Biology, Medicine, Molecular Genetics and Microbiology, Pharmacological Sciences, Physiology and Biophysics, as well as from the Centers for Molecular Medicine (CMM), Institute for the Conservation of Tropical Environments (ICTE), and Brookhaven National Laboratory.



Laufer Center for Physical and Quantitative Biology

The Louis & Beatrice Laufer Center, established with a generous gift from the Laufer family and supplemented with funds from Stony Brook University, will play a key role in

achieving the University's goals for interdisciplinary and translational research in the 21st century. The Center is expected to achieve these goals by establishing new research and graduate training programs and by creating opportunities that encourage and support interdisciplinary collaboration among faculty at Stony Brook University, Brookhaven National Laboratory and Cold Spring Harbor Laboratory.

Dr. Ken A. Dill, Distinguished Professor of Biophysics and Pharmaceutical Chemistry, and Associate Dean of Research in the School of Pharmacy at the University of California, San Francisco, has been named Founding Director of the Laufer Center for Physical and Quantitative Biology. Dr. Dill is a member of the National Academy of Sciences and a past president of the Biophysical Society. He is known internationally for his pioneering work on the physical forces that give rise to the structures and properties of protein molecules. Dill holds a joint appointment between the Department of Chemistry and the Department of Physics and Astronomy. The Associate Director of the Center is Dr. Carlos Simmerling, Professor of Chemistry, a renowned expert in computational chemistry and pioneer in physics-based computer modeling of proteins and DNA.

The endowed Center will be a prime facilitator of interdisciplinary research and graduate training in quantitative biology; support the research of 3 new hires; provide a physical presence for the many computational biology teams at SBU and their extensive network of collaborators at the University and its Medical Center. In addition, the Center will provide collaboration opportunities to enable combination of many data modalities on high-impact biological problems in an exceptionally synergistic manner, give greater visibility for SBU's computational biology efforts, and improve our ability to recruit new researchers from the graduate to the faculty level.

The Northeastern Center for Chemical Energy Storage

In 2009, Prof. Clare Grey was awarded a DOE-EFRC grant ($17 million over five years) to establish the Northeastern Center for Chemical Energy Storage (NECCES) at Stony Brook University, involving a team of experimentalists and theorists from Stony Brook University, Brookhaven National Laboratory, Rutgers University, Binghamton University, MIT, Lawrence Berkeley National Laboratory, University of Michigan, Argonne National Laboratory, and University of Florida.

The mission of NECCES is to identify the key atomic-scale processes, which govern electrode function in rechargeable batteries, over a wide range of time and length scales, via the development and use of novel characterization and theoretical tools, and to use this information to identify and design new battery systems. Four thrust areas have been established, two cross-cutting (diagnostics and theory) and two systems (intercalation and conversion reactions), in order to achieve the Center's goals. In specific, scientists in the NECCES plan to investigate a series of key fundamental research issues that directly impact the ability to use lithium ion batteries in a wider range of applications - particularly in combination with new renewable energy sources and in the field of transportation. At Stony Brook, in addition to synthesizing new materials, the teams proposes to develop new diagnostic tools to determine how batteries function and why they sometimes fail, so as to use this information to help design the next generation of lithium ion batteries.

Proposed Water Research Center at Stony Brook for Purification of Global Water Supply

Water is the most important substance on earth, essential for the survival of all known forms of life. Although we recognize water as the most precious natural resource, we often take it for granted as being unlimited in quantity and often pollute rivers, lakes, ground water, and oceans without thinking. With population increases and global climate changes, the shortage of usable water will become an increasingly geopolitical issue, no less pressing than clean energy. It is estimated that nearly 1.5 billion people worldwide lack safe drinking water, and at least 5 million deaths per year can be attributed to waterborne diseases.

In the past few years, Prof. Ben Chu and Ben Hsiao have developed a new class of nanofibrous membranes with water permeability greater than 10 times that of existing membranes for water purification. Very recently, they further discovered that they can use inexpensive and environmentally friendly methods to fabricate ultra-fine polysaccharide (e.g. cellulose and chitin) nanofibrous scaffolds (fiber diameters ~ 5 nm) from sustainable biomaterials. This step represents another breakthrough discovery, as filters composed of layered, extremely safe and inexpensive ultra-fine cellulose nanofibers can now be fabricated with substantially lower cost than commercially available filters of comparable quality.

Together with several colleagues in Chemistry, Materials Science and Engineering, Biomedical Engineering, Consortium for Inter-Disciplinary Environmental Research (CIDER), Advanced Energy Research & Technology Center (AERTC) at SBU, and Center for Functional Materials (CFN) and National Synchrotron Light Source (NSLS) at BNL, they are proposing a new research Center to foster innovative and interdisciplinary approaches to create and evaluate new classes of sustainable nanostructured biomaterials (e.g., cellulose- and chitin-based ultra-fine nanofibers and functional nanoparticles) for energy-efficient water purification. Such biomaterials will be ideal for eliminating harmful contaminants in water, such as bacteria, viruses, organic pollutants, water-soluble inorganic pollutants and radioactive compounds through size separation and/or chemical adsorption. The long term objective of the project is to develop energy-efficient, low-cost water purifiers with a performance/price ratio over orders of magnitude better than existing commercial systems, a feat that would be capable of removing most of the common water-borne diseases that are prevalent in Third-World regions of the planet at an affordable cost.

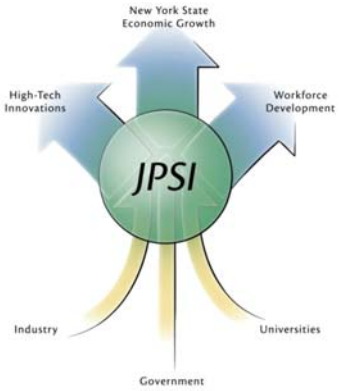
Joint Photon Sciences Institute

The Joint Photon Sciences Institute (JPSI) aims to exploit the properties of advanced photon sources to address the nation's most critical scientific, technical and training problems. In particular, JPSI will explore the opportunities offered by the unprecedented brightness of the National Synchrotron Light Source II (NSLS-II) under construction at nearby Brookhaven National Laboratory (BNL) and managed by BNL's Photon Sciences Directorate (PSD).

In specific, JPSI programs will integrate with the resources and expertise of PSD in BNL to create and enhance research programs, strengthen core competency in photon sciences and help bridge the training gap that accompanies the commissioning of next generation facilities.

SBU's JPSI in collaboration with PSD will attract world-class scientists, including those in training (i.e. graduate students).

The Chemistry Department will assist JPSI to explore high risk/high payoff photon-based research that will help build completely new world-class basic research programs. The Department will also work with JPSI to provide training for the next generation of synchrotron researchers. These educational activities are a real partnership between BNL and SBU that can offer a unique opportunity for graduate students to become involved in an enterprise that will expand greatly over the next years as the light sources of the BNL PSD continue to lead in Photon Science research worldwide. Through these programs, JPSI can help to expand the usage of the light sources by SBU faculties and students, promote interactions between SBU faculties/students and BNL staff and lead to more students working at BNL, and attract a more diversified student body to SBU and workforce to BNL.



Finally, JPSI will take advantage of being affiliated with both BNL and SBU to create a suite of education and training programs to increase the usage of advanced photon sources by SBU faculties, providing a pipeline of future researchers for BNL.