

Institute for Quantum and Complex Dynamics
Annual report, 2005-2006
Director's statement

This is the first annual report for the Institute for Quantum and Complex Dynamics (IQCD). This Organized Research Unit (ORU) was previously known as the Institute for Quantum Engineering, Science and Technology (iQUEST). IQCD remains the only ORU at UCSB with a broad focus on the so-called "physical sciences." In the richly collaborative atmosphere of UCSB, IQCD administers interdisciplinary research involving scientists from the Departments of Chemical Engineering; Chemistry and Biochemistry; Ecology, Evolution and Marine Biology; Electrical and Computer Engineering; Materials; Mathematics; Molecular, Cellular and Developmental Biology; and Physics.

IQCD changed its name in order to better reflect its unique role in the dynamic and rapidly evolving research landscape at UCSB. The main intellectual focus is now on dynamics, the ways in which systems move or evolve in time. Dynamics is a central part of every discipline. Many experimental and theoretical methods and techniques to study dynamics are shared among disciplines, and it is thus natural to have an interdisciplinary institute focused on dynamics at UCSB. The systems under study by many researchers are highly complex (for example, proteins) and/or sufficiently small as to require quantum mechanics for an accurate description (for example, electrons in semiconductor devices), hence the name Institute for Quantum and Complex Dynamics.

IQCD's administrative staff contributes to the academic and research missions of UCSB with uniformly excellent and highly efficient service in the pre-and post-award administration of contracts and grants. In the 2005-2006 academic year, a staff of five administered 96 awards worth a total of \$39M, and submitted 111 proposals. Rather than waiting for monthly reports, principal investigators access up-to-date financial information about their awards any time of day or night using a simple web-based system that was introduced by IQCD and is now being emulated by other units on campus. Excellent and timely service enables researchers to devote more of their time and energy to research and the undergraduate, graduate and post-graduate education that is entailed in this research.

Educational outreach is a growing part of IQCD's mission. IQCD now manages the QUESTBoards project, which provides hands-on activity materials for students in grades 4 - 12 to investigate principles of electricity, magnetism, electromagnetism, electronic circuits, optics, light, and lasers. Teachers are provided with accompanying curriculum materials, which are aligned with state educational standards. QUESTBoards are used in a wide variety of settings and are available for outreach activities directed by IQCD as well as other units on campus (for example the Physics Department, Materials Research Lab, or CNSI). Activities range from campus visits by teachers and/or students to family science nights at schools to sessions in school classrooms. A graduate student at IQCD maintains and manages the QUESTBoards. Other outreach activities flowing from grants administered by IQCD this year include Dr. van Koppen's Chemistry Outreach program, in which over 1200 fifth grade students, parents and teachers participated this year.

Many major research discoveries were made by IQCD researchers over the course of 2005-2006. I highlight just one discovery made in the group of Jeff Bode, an Assistant Professor in the Department of Chemistry and Biochemistry. Prof. Bode is internationally recognized as one of the most outstanding chemists in his young cohort. In 2005-2006 alone he won an AstraZeneca Excellence in Chemistry Award, a Cottrell Scholar Award from the Research Corporation, a Beckman Young Investigator Award, an Amgen Young Investigator Award, and was chosen as the first Richard and Leslie Anderson Scholar. Bode's group reported a breakthrough in the synthesis of polypeptide chains. Polypeptide chains, like proteins, consist of a sequence of amino acids. Polypeptides hold great promise for new drugs as well as basic science applications like understanding protein function. Prof. Bode's group has made a breakthrough in the direct chemical synthesis of polypeptide chains that does not require the complex apparatus of a living organism, and thus gives researchers much more flexibility and the possibility of producing relatively large amounts of polypeptide at a reasonable cost. The reaction discovered by Bode's group proceeds in water, does not require any catalyst, and is "green" in that its by-products are only CO₂ and water. This discovery was written up as a Chemistry Highlight for 2006 in Chemical and Engineering News, the leading trade journal for Chemistry and Chemical Engineering.