Molecular Biophysics

Chair, Graduate Program
José Rizo-Rey, Ph.D.

Degree Offered
Doctor of Philosophy

Faculty

Professors
Joseph P. Albanesi
Ph.D., Duke University, 1980

David R. Corey
Ph.D., University of California, Berkeley, 1990

Johann Deisenhofer
Ph.D., Technical University of Munich and Max Planck Institute for Biochemistry, Germany, 1974

Kevin H. Gardner
Ph.D., Yale University, 1995

Elizabeth J. Goldsmith
Ph.D., University of California, Los Angeles, 1972

Nick V. Grishin
Ph.D., UT Southwestern Medical Center, 1998

Youxing Jiang
Ph.D., Yale University, 1997

Ege T. Kavalali
Ph.D., Rutgers University, 1995

Craig R. Malloy
M.D., University of California, San Francisco, 1977

Ralph P. Mason
Ph.D., University of Cambridge, England, 1986

E. Sally Ward Ober
Ph.D., University of Cambridge, England, 1985

Zbyszek Otwonowski
Ph.D., University of Chicago, 1989

Margaret A. Phillips
Ph.D., University of California, San Francisco, 1988

Rama Ranganathan
Ph.D., M.D., University of California, San Diego, 1992, 1994

Associate Professors

Steven J. Altschuler
Ph.D., University of California, San Diego, 1990

Paul Blount
Ph.D., Washington University School of Medicine, St. Louis, 1990

Yuh Min Chook
Ph.D., Harvard University, 1994

José Rizo-Rey, Ph.D.
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José Rizo-Rey
Ph.D., University of Barcelona, Spain, 1988

Michael Rosen
Ph.D., Harvard University, 1993

Elliott M. Ross
Ph.D., Cornell University, 1975

Philip J. Thomas
Ph.D., University of South Dakota, 1988

Diana Tomchick
Ph.D., University of Wisconsin, Madison, 1990

Hongtao Yu
Ph.D., Harvard University, 1995

Molecular Biophysics

- biological chemistry • biomedical engineering
- cancer biology • cell regulation • genetics and development • immunology • integrative biology • molecular microbiology • neuroscience
Hanzhung Lu  
Ph.D., Johns Hopkins University, 2004

Lani F. Wu  
Ph.D., University of California, San Diego, 1990

Hong Zhang  
Ph.D., University of Illinois at Urbana-Champaign, 1994

ASSISTANT PROFESSORS

Dominika Borek  
Ph.D., Birkbeck College, University of London, UK, 2001

Chad A. Brautigam  
Ph.D., Yale University, 1998

Min Chen  
Ph.D., UT Austin, 2006

Zhe Chen  
Ph.D., UT Southwestern Medical Center, 2002

Qiu-Xing Jiang  
Ph.D., Yale University, 2002

Xin Liu  
Ph.D., University of Pennsylvania, 2007

Xuelian Luo  
Ph.D.,Tufts University, 1997

Arun Radhakrishnan  
Ph.D., Stanford University, 2002

Luke Rice  
Ph.D., Yale University, 2000

Daniel Rosenbaum  
Ph.D., Harvard University, 2005

Xuewu Zhang  
Ph.D., Albert Einstein College of Medicine, 2003

OBJECTIVES

The Molecular Biophysics Graduate Program offers a vibrant environment for students interested in studying biology from a quantitative, physical perspective. The Program is highly interdisciplinary, comprising more than 30 faculty with diverse backgrounds and interests, ranging from mathematics and theoretical physics to neurobiology and genetics. Using a wide range of biophysical techniques, including X-ray crystallography, NMR spectroscopy, electron microscopy, light spectroscopy/microscopy, and computational modeling, among others, these labs investigate in atomic detail how proteins and other macromolecules function individually or as part of biological systems. Neurotransmitter release, cytoskeletal dynamics, cellular signaling, nuclear transport, ion channels, transporters, photosensors, T-cell receptors, and G-proteins are among the many areas of interest.

A highly interactive atmosphere – catalyzed by Journal Clubs, an annual retreat, and the celebrated Molecular Biophysics Discussion Group seminar series – offers all members of the Program the opportunity to learn from each other and to gain expertise in many varied subjects, well beyond their own areas of research. Ultimately, the mission of the Program is to provide students with conceptual tools and research experiences that will prepare them to apply the principles and techniques of the physical sciences to biomedical problems.

SPECIAL REQUIREMENTS FOR ADMISSION

In general, conditions for admission to the Program are good academic standing within the Division of Basic Science of the Graduate School and an interest in pursuing a research and training program in molecular biophysics. Students with strong backgrounds in the physical sciences and mathematics will be well prepared to join the Program, but such backgrounds are not required.

Students ordinarily apply for formal admission to the Program in the middle or at the end of the fall semester, but they are encouraged to participate in the Program informally at any time after admission into the Division of Basic Science. It is not necessary that a student within the Program choose a dissertation research mentor who is a member of the faculty of the Program, provided the student has sound reasons for this choice.

CURRICULUM

Biophysics is a field defined by its application of physical principles and techniques to investigate key biological problems. Optimal training for a career in molecular biophysics includes exposure to the theoretical basis for physical properties and interactions of biological molecules, the technical approaches that are available to investigate biological systems, and the results of studies in which biophysics has contributed to an understanding of the biological characteristics of system behavior. The Molecular Biophysics Graduate Program includes course work in each of these three areas.

CORE COURSE

The first-year Core Course, required of all students in the Division of Basic Science, offers training in the broad issues faced by contemporary biological science. This course provides four hours of course credit toward the minimum of 30 hours required for the first year. Students are also required to take two courses on Professionalism, Responsible Conduct of Research, and Ethics (2 credit hours).

ADVANCED COURSES

Beginning in the second half of the fall semester of the first year, physical approaches to contemporary biology are considered in a series of advanced courses. Elective courses from other Programs can also be chosen. First-year students in the Division of Basic Sciences take 12 credit hours in fall and spring, and six credit hours in the summer semesters; these include 14 credit hours of laboratory rotations and research. In subsequent years they are enrolled in nine credit hours in fall and spring, and six credit hours in the summer. Typically, didactic coursework is completed in the first year, and in subsequent years students are enrolled in dissertation research and a combined works-in-progress seminar (WiPS)/journal club totaling full-time enrollment equivalency. Advancement of the student to Ph.D. candidacy is dependent upon successful completion of all coursework and the qualifying examination, which takes place in the second year.

All students in the Molecular Biophysics Graduate Program are required to take two courses: Protein Structure and Folding and Quantitative Biology I. Students must choose one of the following: Modern Methods in Structural Biology or Spectroscopy. In addition, students are required to choose one more advanced course from the Molecular Biophysics Program among the following:

- Modern Methods in Structural Biology
- Spectroscopy
- Computational Approaches in Protein Science
- Advanced NMR Spectroscopy
- Practical X-ray Crystallography
- Quantitative Biology II

Two additional electives can be chosen among these courses or any course offered within the Division of Basic Science. Students are encouraged to take the Core Curriculum–Cells course as an elective.

Although the second and subsequent years will be devoted largely to research on a dissertation topic, students may take additional graduate courses. Course descriptions are listed in the Division of Basic Science section.

BIOPHYSICS JOURNAL CLUB AND DISCUSSION GROUP

The Biophysics Journal Club offers students an opportunity to keep abreast of recent research results in the literature, to sharpen critical acumen, and to develop public-speaking skills. Every student in the graduate program is expected to attend the journal club and to participate actively. In addition, each student is required to present one journal article or work-in-progress per year.

Students also are strongly encouraged to attend meetings of the Molecular Biophysics Discussion Group and presentations of interest to biophysicists occurring in the numerous seminar series offered by UT Southwestern and its various basic science departments. The Molecular Biophysics Discussion Group and the annual Molecular Biophysics Research Symposium provide forums for presentation of the students’ own research, as well as acquainting them with recent research results from other laboratories on campus and from invited speakers.
Qualifying Examination

Admission to candidacy for the Ph.D. requires that students prepare and defend a written research proposal, modeled on an NIH-R01 grant proposal. A student may choose a topic that is related to his or her own prospective dissertation research or may select an unrelated biophysical topic. The student is expected to write a hypothesis- or question-driven proposal. Students who choose to defend an invention or new method must devise suitable controls to demonstrate feasibility. Proposals based on anticipated dissertation research are expected to address fundamental issues; these may, in some cases, extend beyond those encompassed by the dissertation itself. Both the written proposal and the oral defense will be judged for clarity and originality of thought and for the degree of mastery of experimental design and analysis of data expected for a student at the end of the second year of Graduate School. During the oral examination, the student also is expected to respond to questions of general knowledge in molecular biophysics.

The ad hoc examination committee is composed of three faculty members, at least two of whom belong to the Molecular Biophysics Graduate Program. The student’s mentor is not eligible to serve on the committee. Committee members and the committee chair will be chosen by the chair of the Molecular Biophysics Student Evaluation Committee in consultation with the student’s mentor. These choices are based primarily upon expertise in the field of study to be examined.

Dissertation Committee

Following successful completion of the qualifying examination, the student proposes a dissertation committee comprising at least four members of the faculty, at least two of them members of the Molecular Biophysics Graduate Program. The constitution of the dissertation committee must be approved by the Program chair.

Within 30 days after forming the dissertation committee, the student presents to the committee a written summary of his or her proposed topic and preliminary research progress toward the project’s goals. This initial meeting generally involves a 30-minute oral presentation by the student, followed by discussion and suggestions from the members of the committee.

Every student must hold at least one meeting of his or her dissertation committee each year. After the third year, meetings are held every six months. Additional meetings may be called at any time by the student or by the committee. The dissertation committee monitors the student’s progress based on research accomplished, course grades, and journal club and other presentations.

Dissertation Defense

A complete copy of the dissertation must be approved by the dissertation committee before a public dissertation defense can be scheduled. The defense is composed of a public lecture describing the main observations of the research, followed by an oral examination by the dissertation committee. Attendance during the oral examination is restricted to faculty of the Graduate School, and participation is restricted to the examination committee.