

SURF



As I complete my tenure as President of Caltech, I have reflected upon the outstanding individuals, projects, and programs that make the Institute a world leader in research and education. SURF is one of those programs. Bright and talented students working with Caltech faculty and JPL technical staff provide the necessary ingredients for excellent undergraduate research. Together with the enthusiastic support and work of donors to the program, the SURF Board, Administrative Committee, and staff, the SURF team is a dynamic group of individuals that provides exceptional experiences for our students. I extend my personal thanks to each member of this extraordinary team.

Undergraduate research challenges students to grapple with the unknown, to unravel the secrets of nature and design new devices and processes under the guidance of an experienced mentor. Research helps to integrate the knowledge students have gained in the classroom with real-world problems. Research teaches students to ask skeptical, probing questions and trains them to analyze data and draw conclusions; all experiences that help prepare them for their future careers. The requirement for the oral and written presentation helps SURF students to bring the project into focus. The fact that about 20% of SURF students become co-authors of published articles demonstrates the high caliber of work done through SURF.

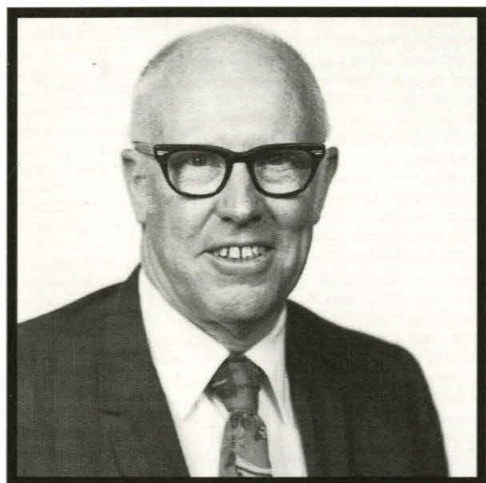
SURF has made great strides during the past ten years, and I am delighted that I was able to help this process. I have enjoyed working with the SURF Board, the Administrative Committee, and the SURF staff. The students' oral presentations have improved greatly, thanks to mentoring and the incentive provided by the Doris S. Perpall SURF speaking award. In short, the SURF program is one in which Caltech can and should take justifiable pride.

Thomas E. Everhart
President
California Institute of Technology

Dedication

The 1997 SURF program is dedicated to Harold Brown, President, California Institute of Technology, 1969-77, in recognition of his strong support of undergraduate research.

This year's SURF program has provided many satisfactions. We had 234 students working with 146 mentors. Fund raising for SURF '97 began with a slight surplus from the previous summer, and next year will commence with a handsome balance. Efforts to build the SURF endowment continued. We have taken steps to increase our support group. The Orientation Day barbecue was well attended by all the students and a number of our supporters. Again, this year, we had a very enjoyable donor/student dinner organized by Joanna Muir. It has been a successful year!



Douglas B. Nickerson

Our program is expanding with the addition of Teaching and Interdisciplinary Education (TIDE), a government-supported program to develop enhanced teaching methods through use of technology. This program has been folded into the SURF family primarily because of the success of our administration. Carolyn Merkel should take a great deal of the credit for that.

My successor will be the founder of SURF, Fred Shair. He has not lost any of his original enthusiasm and I look forward to his innovations. One of them, the JPL Undergraduate Scholars program, will provide outreach to the community colleges in the Southern California area. Fred has an idea a minute; we are going to be pressed to keep up with him! With his inspired leadership we can look forward to continued evolution of SURF.

SURF '98, which officially begins on October 19, 1997—the day after SURF Seminar Day—will be the twentieth anniversary of the program. We have had a brainstorm session about how to celebrate. We plan an exciting publicity program to capture the imagination of the Caltech community, the city of Pasadena, and the nation.

In conclusion, I want to thank all the members of the SURF Board for their contributions to our outstanding year. It has been a pleasure to work with Tom Everhart, Jerry Nunnally, and David Goodstein. Thank you to the staff—Carolyn Merkel, Susan Clark, and Carol Casey provide outstanding support to the SURF Board and the program. As I retire, I want to thank you all for this opportunity. I am looking forward enthusiastically to SURF's twentieth anniversary celebration and to the bright future of this innovative program.

The SURF Administrative Committee sets the academic policies of the SURF Program, oversees the intellectual standards and advises the Caltech Administration on long term plans for development of SURF and programs relating to SURF. The committee consists of faculty from each of the Institute's academic divisions, senior members of the JPL technical staff, student representatives, and members of the Caltech administrative staff, including the SURF Director. All of the faculty members of the committee are or have been SURF research advisors.



Terry Cole

In addition to overseeing and planning, the Committee participates in SURF directly. Its members review all of the students' research proposals, more than 300 this year. Members of the committee participate in judging the competitors at the Doris S. Perpall SURF Speaking Awards and often participate in SURF Seminar Day.

During the past academic year the AdComm discussed and approved an increase of the student stipends from \$3600 to \$4000 to keep up with inflation. This is the first increase in stipend in five years and represents an increase of only 2% per year.

Professor Nate Lewis has received an NSF grant to initiate a new program entitled Teaching and Interdisciplinary Education (TIDE) with the objective of fostering Institute-wide

development of computer-based teaching tools which would eventually benefit the Caltech undergraduate curriculum. The AdComm approved a proposal to have the SURF Office handle the infrastructure of the TIDE program as it now does for the MURF program. The Committee feels that this new initiative will be a valuable adjunct to Caltech undergraduate programs and is pleased that it will be associated with SURF.

The AdComm continues to discuss ways that SURF might offer a few well chosen opportunities for Caltech undergraduates to have research experiences in local industrial research and development laboratories. An ad hoc subcommittee was appointed to investigate this matter but no final conclusion has been reached.

This year's SURF Student Advisory Council (SURFSAC) dedicated its efforts to creating a stronger and more cohesive SURF community through programs fostering interaction among all SURF's constituencies—students, mentors, alumni, and staff.

On Orientation Day, SURFSAC helped to lead portions of the orientation to give participating students a peer connection. Each member of SURFSAC worked with a small group of students and acted as a

liaison between the students and the SURF administration. This gave students another option for dealing with any problems or conflicts that arose and provided a support system for SURFers visiting from other universities.

SURFSAC has tried to make the experience for students participating in the SURF program more than just ten weeks spent working in a lab or at a desk. Time spent out of the lab can be just as valuable for the SURF experience as time spent at the bench. We created several opportunities for students to come together to discuss different scientific points of view or to have a chance to step away from their research and enjoy themselves. From trips to the LA Laserium or the beach to weekly movies or parties, SURFSAC tried to provide the students with a wide range of opportunities. It was our hope that this would help ensure that each student's summer experience served to promote personal as well as professional growth.



The SURF Student Advisory Council Officers
Sudipta Bardhan, Minoree Kohwi, and Carol Wu

One of the more unique activities conducted by SURFSAC was the student-mentor dinner program. We feel that one of the most important parts of the SURF experience is the opportunity to build a relationship with one's mentor. Over the course of the summer, SURFSAC invited several Caltech faculty members and JPL researchers to have dinner with small groups of SURF students in a casual, off-campus environment. These dinners provided a forum in which the students could interact with both their own mentors as well as other members of the Caltech science family. The multidisciplinary aspect of the gathering made for interesting conversation. Mentors and students exchanged ideas; students learned about different areas of science from leaders in the field and got advice about careers or graduate school.

Another responsibility of SURFSAC is the publication of the *Caltech Undergraduate Research Journal* (CURJ), an annual multidisciplinary journal of the ten best papers generated from undergraduate research conducted at Caltech. We hope that this year's journal, the third annual CURJ, will be the best yet. We expect to publish a wider variety of articles than last year, and the CURJ committee is geared up to produce another high quality journal.

Our commitment to help build a strong SURF community continues throughout the year. During the academic year, we will speak to high school students visiting Caltech, prospective SURF students, and admitted freshmen. We will assist with program planning for SURF's 20th anniversary next summer.

SURF enjoyed an excellent summer with 234 students working on projects with Caltech faculty, JPL staff, and off-campus mentors. Students expressed enthusiasm and interest in program activities. The 1997 program brought new ideas, opportunities, and experiences.

SURF HIGHLIGHTS

It has been a pleasure to work with Doug Nickerson the past two years in his capacity as Chair of the SURF Board. Doug, a charter member of the Board, brought his long commitment to SURF, his energy, and his determination to strengthen SURF's financial position. We are delighted that he will continue to lend his enthusiasm and dedication to the Board.

We are extremely pleased that Fred Shair has agreed to chair the SURF Board, returning to the post he created when he founded SURF 19 years ago! We look forward to working with him. Fred's enthusiasm for SURF and his passion for creating excellent student opportunities will inspire the Board and enrich the program.

Two new programs have been spawned this year from SURF. The Teaching and Interdisciplinary Education (TIDE) program was created with a grant from the National Science Foundation to develop computer-based teaching tools. The proposal, which won an NSF award for innovative educational programs, was written by Nathan S. Lewis, Professor of Chemistry and creator of the Chemistry Animation Project; David L. Goodstein, Professor of Physics and Applied Physics, Frank J. Gilloon Distinguished Teaching and Service Professor; Charles J. Brokaw, Professor of Biology; and Barry M. Simon, International Business Machines Professor of Mathematics and Theoretical Physics. TIDE is structured like SURF but is focused on education. Nineteen students participated in the first program this summer.



Carolyn Merkel

Fred Shair, Manager of the Educational Affairs Office at JPL, created the JPL Undergraduate Scholars (JPLUS) program to recognize and encourage outstanding potential in community college students majoring in engineering, math, computer science, and physical science. The program awards scholarships during students' community college years; students may compete for a SURF following their junior year at a four-year university.

The SURF Administrative Committee voted to raise SURF stipends this year to \$4000, the first increase in five years. From their stipends, students pay housing and food costs, personal expenses, and those on financial aid must save a significant portion toward their fall fees. This stipend increase makes SURF competitive with wages students receive for technical work at the Institute.

SURF undertook a pilot program this year to give students the opportunity to meet informally in small, discipline-based groups convened by a faculty member. The colloquium groups give students a forum to talk about their research and the issues and questions that arise. This experience will help students become more fluent in thinking and talking about their work and will assist in the preparation of their final oral presentations.

Grants from NASA and General Motors made it possible to expand the Minority Undergraduate Research Fellowships (MURF) program into other divisions.

We heartily thank the SURF team of mentors, graduate students and postdoctoral scholars, sponsors, the SURF Board, Administrative Committee, and the administration for enthusiastic support for our students and the SURF program. SURF could not succeed without this large cadre of dedicated supporters. Thank you!

PROFILE OF 1997 SURFERS

| | |
|-----------------------------|----------|
| Sophomores | 19% |
| Juniors | 35% |
| Seniors | 46% |
| Women SURFers | 30% |
| Minority SURFers | 13% |
| Median Grade Point Average | 3.5/4.0* |
| Average Grade Point Average | 3.4/4.0* |

**Caltech students only, excluding freshmen*

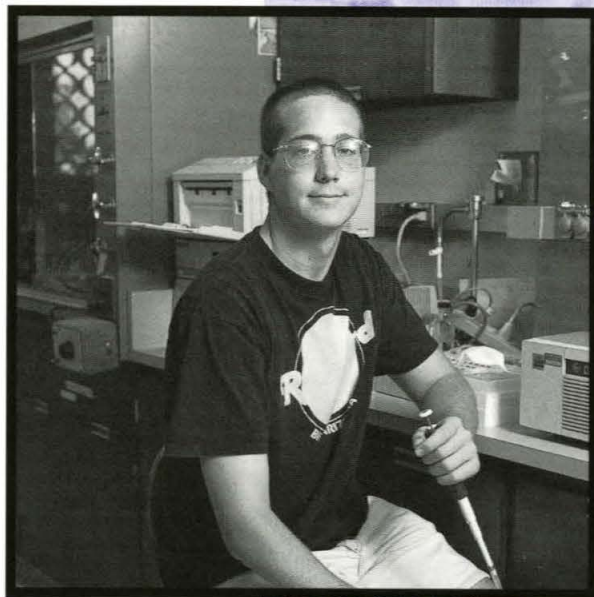
This year saw a significant increase in the number of students SURFing off campus. Fourteen students worked at other institutions, including institutions in Sweden, Switzerland, France, and Scotland.

SURFers Win Awards!

At Commencement 1997:

- 59% of the students receiving their BS degrees had completed a SURF
- 67% of the students graduating with Honor were former SURFers
- 61% of the students receiving prizes at Commencement were SURF students

We are proud of these extraordinary students!
Congratulations SURFers!



SURF IS AN EXCELLENT OPPORTUNITY.

IT HAS GIVEN ME A LOT OF EXPERIENCE IN

A LABORATORY SETTING. ONE OF THE

MUTANTS I HELPED GENERATE LOOKS VERY

PROMISING. I FIND THIS PROCESS OF

RESEARCH VERY REWARDING.

Christopher Bisbee

Mrs. Hannah Bradley SURF Fellow

PROFILE OF 1997 SURF PARTICIPANTS

| <i>Division</i> | <i>Total Number of Students</i> | <i>Number of Caltech Students</i> | <i>Number of Non-Caltech Students</i> | <i>Number of Mentors</i> |
|--------------------------------------|-------------------------------------|---|---|------------------------------|
| Biology | 32 | 19 | 13 | 19 |
| Chemistry and Chemical Engineering | 37 | 27 | 10 | 20 |
| Engineering and Applied Science | 38 | 30 | 8 | 26 |
| Geological and Planetary Sciences | 9 | 8 | 1 | 9 |
| Humanities and Social Sciences | 3 | 3 | 0 | 3 |
| Physics, Mathematics, and Astronomy | 48 | 40 | 8 | 26 |
| Jet Propulsion Laboratory | 43 | 10 | 33 | 25 |
| Small Business Industrial Associates | 5 | 5 | 0 | 3 |
| Off-Campus | 14 | 14 | 0 | 14 |
| Education SURFs | 5 | 2 | 3 | 1 |
| | 234 | 158 | 76 | 146 |

Minority Undergraduate Research Fellowships (MURF) Expanded

Through grants from NASA and General Motors, the Minority Undergraduate Research Fellowships program was expanded by six positions this year to include students in earth sciences, mechanical engineering, environmental science, and space sciences, both at Caltech and JPL. MURF has traditionally been limited to students in the Divisions of Biology and Chemistry and Chemical Engineering.

The MURF program provides support for talented non-Caltech undergraduates to spend a summer doing research in a laboratory and is aimed at improving the representation of African Americans, Hispanics, Native Americans, Puerto Ricans, and Pacific Islanders. Once accepted to the MURF program, students participate in all aspects of the SURF program.

We are extremely pleased that The James Irvine Foundation has given support for the expanded MURF program for three years commencing in 1998.

SURF FUNDING

Each year we depend upon the contributions from SURF's many friends—individuals, foundations, and corporations—to help us build a robust financial base. These gifts enable us to match stipend funding for Caltech students working with faculty on the campus. They help ensure that students can continue to have the unparalleled opportunity to engage in undergraduate research. SURF is unique among undergraduate research programs in the country in that at least half of stipend funds are raised from external, non-federal sources. Each student receives a stipend of \$4000 for the ten-week summer period, a total stipend budget of \$936,000 for the 234 participants this year.

Donor Relations

Donors contributing the amount of a student stipend, or more, by annual gifts or through endowment, are listed in all SURF materials and other references with the names of the students supported. They receive a written introduction to the student and may have the opportunity to meet her or him at special events. The donor-student dinner is a popular, informal event to give contrib-

utors the opportunity to meet with the students supported by their gifts. All donors are listed on pages 33–35 of the annual report.

1997 Funding Profile

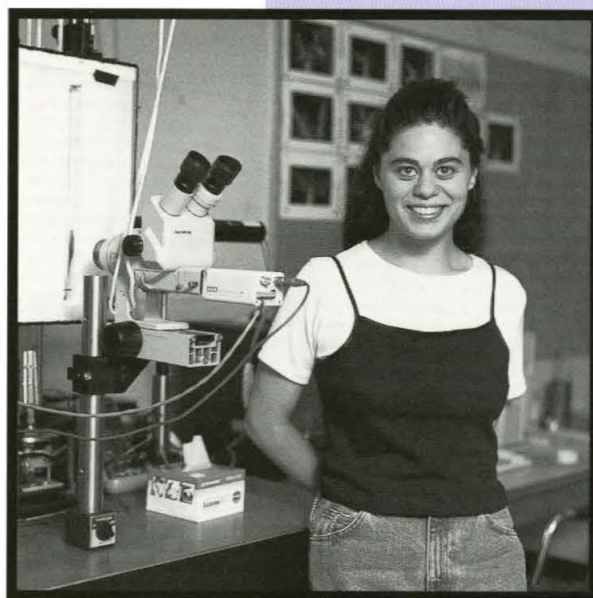
| | |
|--|-----|
| Faculty grants, mentors, and Institute sources | 36% |
| JPL | 14% |
| Endowment | 12% |
| Individuals | 12% |
| Foundations | 11% |
| Corporations | 9% |
| Minority programs | 6% |

1997 SURF PROGRAM AND ACTIVITIES

SURF Colloquium Groups

This year SURF started a pilot project to give students the opportunity to discuss their research with a small group of their peers. Eight colloquium groups were convened by faculty. The groups met weekly or biweekly to give students the chance to talk about their work with peers and faculty, to raise questions and issues, and to describe their work to others. The purpose of the discussions is to help them become fluent in the language and concepts of their disciplines. The sessions should help students with their final oral presentations since they will have talked through parts of their presentations. We learned many lessons from this pilot project to help with planning for the 1998 summer.

We thank this summer's conveners: Andrew Ingersoll and Joann Stock in earth sciences; Bruce A. Hay and Ray Deshaies in biology; Jacqueline Green and Joan Horvath at JPL; Jim Bower in biology; Mary Dickinson in biology and chemistry;



SURF HAS GIVEN ME THE OPPORTUNITY TO EXPLORE AREAS OUTSIDE MY MAIN FIELD OF STUDY. AS A RESULT OF MY EXPERIENCES THIS SUMMER, I WILL ENTER MY SCIENTIFIC CAREER WITH THE ADDED CONFIDENCE THAT I AM WELL EQUIPPED TO CHOOSE THE RESEARCH PROJECTS I ENJOY THE MOST.

Victoria M. Tanusheva

Mr. and Mrs. Downie D. Muir III SURF Fellow

Melany Hunt in mechanical engineering; Mike Shumate in electrical engineering and applied physics; Emlyn Hughes in physics.

SURF Student Advisory Council

The SURF Student Advisory Council (SURFSAC) led their SURF peers with enthusiasm this summer. SURFSAC chair Sudipta Bardhan organized five faculty-student dinners, and attendees expressed great appreciation for this informal forum for exchange between students and mentors. She also took charge of a trip to the L.A. Laserium. Andrew Strauss publicized and selected videos for Movies@Moore each Tuesday and Thursday evening which was regularly attended by 30-40 students. Juna Kollmeier organized two beach trips. Brian Collins, Carol Wu, and Minoree Kohwi organized an ice cream social. Koen Verbrugghe took charge of a trip to Disneyland. Chris Bisbee organized a group to attend a Dodger game. Sudipta also chaired the 1997 *CURJ* committee; the second *CURJ* will be published in October.

Caltech Undergraduate Research Journal

The second *Caltech Undergraduate Research Journal (CURJ)* containing the nine best student research papers will be published by SURFSAC and SURF this fall. Papers authored by Caltech undergraduates or non-Caltech students who did their research at the Institute are eligible for submission. Each paper received three reviews, the first by the student review board and two by faculty reviewers. The *CURJ* review board members were Sudipta Bardhan (SURF '95, '96, and '97), Christianto Liu (SURF '96 and '97), Christopher Chang (SURF '95 and '96), James Quallen (SURF '95 and '96); John M. Allman (Biology), Bruce A. Hay (Biology), Jerrold E. Marsden (Engineering), Ray D. Owen (Biology), John H. Richards (Chemistry), John D. Roberts (Chemistry), Paul W. Sternberg (Biology), Zheng Gang Wang (Chemical Engineering), Harold Zirin (Astronomy).

The third *CURJ* will be published in April. The committee will be chaired by Minoree Kohwi.

Professional Development Series

William M. Whitney (BS '51), Division Technologist, Observational Systems Division, JPL, conceived, planned, and executed the highly successful professional development series. The informal sessions encourage students to make their short-term career decisions in the context of long-term life and career goals. The topics address a variety of issues students will encounter as they enter graduate school or the workplace.

Bill has presented the core of this message at the National Conference on Undergraduate Research and at the Southern California Conference on Undergraduate Research this year. This summer's sessions and their participants were:

Communication in Careers — Mary Ann Smith, President, Applied Leadership Systems

Career Paths From a Science and Engineering Base — Sally Asmundson, Director, Career Development Center; Warren Goda (BS, EE, '86); Debra Tuttle (BS, Lit, '93); and James Quallen (BS, Ch, '97)

Career Planning: Can It Be Done? Logic vs.

Reality — Bill Whitney and Julia Kornfield, Associate Professor of Chemical Engineering; John Davis, graduate student, EE

The Power Principle — Ann Bussone, Director, Employee Relations and Staff Affirmative Action; Helen Hasenfeld, Ombudsperson; David Wales, Professor of Mathematics and Master of Student Houses; Tom Lloyd, graduate student, environmental engineering science; Selena Forman, graduate student, environmental engineering science

Intellectual Property — Michael Keller, Director, Patents Office; John D. Baldeschwieler, Professor of Chemistry; Jennifer Schlickbernd, Software Evaluation and Dissemination, Technical Affiliates Office, JPL

Scientists as Speakers — Albert Hibbs, JPL Senior Scientist, Retired, and Terry Cole, Chief Technologist, JPL

Graduate School — Amy Seidel Malak, Career Counselor, Career Development Center; and graduate students John Davis, Delwin Elder (chemistry), Chantal Morgan (chemistry), Carlos Herrera (CNS)

Seminar Series

Each Wednesday during the summer, SURF students and other members of the Caltech community attend research seminars given by faculty. Speakers this summer were:

Harry B. Gray, Arnold O. Beckman Professor of Chemistry, *Solar Fuel*

Michael C. Gurnis, Professor of Geophysics, *Plate Tectonics and Mantle Convection*

Fiona A. Harrison, Assistant Professor of Physics, *The Mystery of Cosmic Gamma-Ray Bursts*

Janet G. Hering, Associate Professor of Environmental Engineering Science, *"Chinatown" Revisited: Arsenic and the Los Angeles Water Supply*

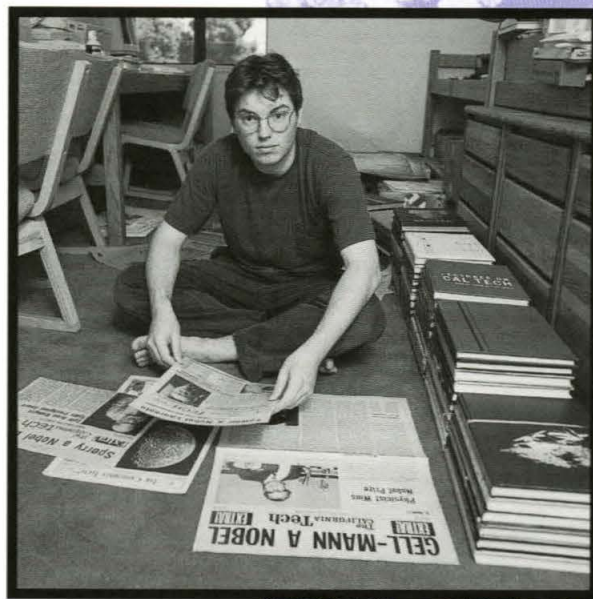
James Z. Lee, Associate Professor of History; Cameron Campbell, Assistant Professor of Sociology, University of California, Los Angeles, *Fate and Fortune in Rural China*

Robert C. Ritchie, W.M. Keck Foundation Director of Research, Visiting Associate in History, *Research at the Huntington*

Erin M. Schuman, Assistant Professor of Biology, *Learning How the Brain Learns*

Donna Shirley, Manager, Mars Exploration Directorate, Jet Propulsion Laboratory, *Mars Exploration Program*

Yu-Chong Tai, Associate Professor of Electrical Engineering, *Micromachining and Micromachines*



**THE INTENSE ATMOSPHERE OFFERED BY
THIS INSTITUTE ALLOWS ME TO PURSUE
BOTH FACETS OF EDUCATION: THEORETICAL
STUDY DURING THE REGULAR ACADEMIC
YEAR AND EXTENSIVE RESEARCH DURING
THE SUMMER.**

Andrew Strauss

Dr. Marcella Bonsall SURF Fellow

Each Friday at noon the JPL SURF students attend seminars presented by JPL technical staff. This year's presentations were given by:

- John L. Callas, Earth and Space Sciences Division,
The Mars Surveyor Program
- Frank Grunthaner, Avionic Systems and
Technology Division, *Looking for Signs of Life*
- Matthew K. Heun, Mechanical Systems
Engineering and Research Division, *Planetary
Aerobots for In-situ Planetary Exploration*
- John C. Kelly, Office of Engineering and Mission
Assurance, *Formal Methods/Analytical Verification
for Software*
- Deronda Mayes, Earth and Space Sciences Division,
Table Mountain: A Learning Experience
- Jennifer A. Miller, Observational Systems Division,
Martian Soil Simulation
- Joseph I. Statman, Telecommunications
Engineering and Science Division, *Galileo's
Telecom Using the Low-Gain Spacecraft Antenna*
- Steven A. Stolper, Avionic Systems and Technology
Division, *Independence Day: Earth Invades Mars*
- Michael J. Turmon, Information Systems
Development and Operations Division,
*Identification of Solar Features via Markov Random
Fields*

Doris S. Perpall SURF Speaking Awards

Sebastian Maurer, Steven Bennett, and Fay Peng won the fourth annual Doris S. Perpall SURF speaking competition. The final decisions came after a three-round competition judged by faculty members, JPL staff, alumni, and graduate students. The judges this year had a particularly difficult job and expressed their opinion that each of the finalists gave outstanding presentations. Robert C. Perpall (BS '52, MS '56) endowed the prizes in memory of his late wife as an incentive for students to give excellent presentations.

Conferences

SURF Seminar Day

The nineteenth SURF Seminar Day was held Saturday, October 18, 1997. Patterned after a professional technical meeting, this symposium gives students the chance to present the results of their research in 21 parallel sessions to audiences of mentors, students, JPL staff, donors, alumni, and parents. Students may give either oral or poster presentations. All SURF students are required to give this presentation. Preparing the talk helps the student review the details of the work to gain the overview of the project. Clearly communicating the nature and substance of one's work is critical, and this requirement gives students experience that will be useful throughout their lives.

SURF Seminar Day is the first round in the Doris S. Perpall SURF speaking competition, and the best speaker in each session—selected by the session chairs and judges—advances to the semi-final round.

National Conference on Undergraduate Research (NCUR)

Mat Barnet, Christopher Chang, Brian D'Urso, Fay Peng, and Saurabh Saha represented Caltech at the eleventh National Conference on Undergraduate Research held at the University of Texas at Austin in April. More than 2100 students, faculty, and administrators from colleges and universities nationwide attended this conference with approximately 1800 students presenting their research. The conference is multidisciplinary including the sciences, humanities, mathematics, business, and fine and performing arts. Often for the first time, students discover how research is carried out and reported in disciplines other than their own. Caltech hosted NCUR in 1991.

Southern California Conference on Undergraduate Research (SCCUR)

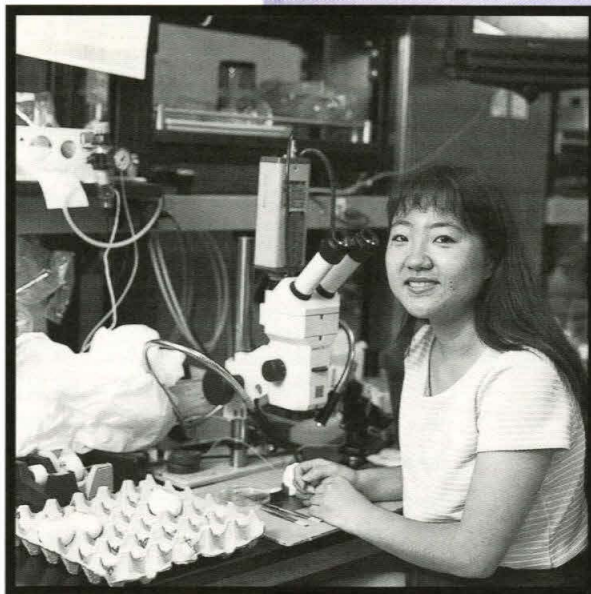
Occidental College hosted the fourth SCCUR in November 1996. More than 400 students, faculty, and administrators from colleges and universities in the region, including a delegation of Caltech students, attended the conference. SCCUR, like NCUR, is multidisciplinary, giving students the occasion to discover how research is carried out and reported in fields other than their own. The SURF team started the conference in 1993 to enable local students to participate in a multidisciplinary conference of their peers without the expense of traveling to NCUR which is held in other parts of the country. Caltech hosted the first two SCCUR conferences.

Field Trips

We thank Dr. and Mrs. George Boone for arranging a fascinating VIP tour of the Huntington Library and Art Museum and for hosting the SURF group at a reception in their beautiful sculpture garden following the tour. The students were very enthusiastic about this event, and many planned to visit the Huntington again with other friends.

Eldar Noe Dobrea organized a tour of NASA's Goldstone Deep Space Communications Complex. More than 40 students and staff had the opportunity to see the antennae used in tracking satellites and spacecraft. They heard a talk about the Deep Space Network and viewed the impressive 70-meter antenna used to communicate with spacecraft at the edge of the solar system.

Bill Whitney arranged an "E-ticket" tour of JPL for about 15 students. Students saw the Observational Instruments Laboratory, Space Flight Operations Facility, Microdevices Laboratory, Mars yard and Corporal and Sargent missiles, the Spacecraft Assembly Facility, and the space museum.



SURF PROVIDED A WONDERFUL OPPORTUNITY FOR ME TO BE A RESEARCH INVESTIGATOR AND TO EXPLORE SCIENCE HANDS-ON. I DISCOVERED A WORLD THAT TEXT-BOOKS WOULD HAVE NEVER SHOWN ME.

*Minoree Kohwi
Richter Scholar*

SURF TEAM

We thank the large cadre of mentors, donors, alumni, administration, and staff for their hard work and enthusiasm for undergraduate research at Caltech. The success of SURF depends upon this large group of more than 500 individuals. For each student, there are at least two or three other people working to ensure that the student has a good experience.

I thank President Everhart for his ardent support of SURF over the past ten years. President Everhart pledged funds to underwrite SURF stipends at a critical time in SURF's history, taking a long stride towards building a robust financial base for SURF stipends. I thank David Goodstein for his good advice, wise counsel, and attentive ear to the needs of the SURF program. I have enjoyed working this year with Terry Cole, Chair of the AdComm, and all the members of the committee. I appreciate the hard work and commitment of the SURF Student Advisory Council this year in their efforts to strengthen the SURF community.

Special thanks to Carol Casey and Susan Clark for their outstanding effort, expertise, and dedication to the SURF students and the program. SURF would not function without their hard work, creativity, and loyalty. I want to express deep gratitude to Bill Whitney for his tireless work on behalf of SURF. Bill spends countless hours each year meeting with students, coordinating the professional development sessions, arranging the JPL seminar series, serving as JPL's point of contact for SURF, serving on both the AdComm and SURF Board, and volunteering to help with many other SURF activities.

SURF INDEX OF STUDENTS AND MENTORS

| STUDENT | TOPIC | MENTOR |
|--|---|--|
| Nasim Afsarmanesh Junior, Bi Dr. and Mrs. George N. Boone SURF Fellow | Theatrical Surgeries | Alison Winter Assistant Professor of History |
| Reginald Ajakwe University of Redlands Senior, Ch/Bi MURF | Interaction of Pro-Amnion and Neural Tube Induces the Formation of Neural Crest Cells in Early Embryos | Marianne Bronner-Fraser Professor of Biology |
| Viktor Y. Alekseyev Sophomore, CCE | Quantitative Studies of Various Factors Contributing to Sequence-specific DNA Binding by Metallointercalator $\Delta\alpha$ - [Rh[(R,R)-Me ₂ trien]phi] ³⁺ | Jacqueline K. Barton Arthur and Marian Hanisch Memorial Professor and Professor of Chemistry |
| Kyle J. Alvine Junior, Ph General Motors SURF Fellow | A Broad-Band Study of Metallic Nanocrystals in the Microwave Region | Brent T. Fultz Professor of Materials Science |
| Valerie L. Anderson Junior, Ph Richter Scholar | Further Investigation of Large Piezoelectric Effect in Strontium Titanate at Low Temperatures | Allen M. Goldman Institute of Technology Professor of Physics, University of Minnesota Thomas A. Tombrello William R. Kenan, Jr. Professor and Professor of Physics |
| Dan E. Angelescu Senior, Ph Samuel P. and Frances Krown SURF Fellow | Study of the Energy Relaxation of a Mesoscopic Cavity - Quantum Effects in Energy Relaxation | Michael C. Cross Professor of Theoretical Physics |
| Monica M. Aponte-Alequin University of Puerto Rico, Mayagüez Senior, Ge NASA Minority SURF Fellow | Localized Slip on the San Cayetano Fault, Ventura Basin, California | Andrea Donnellan Member of the Technical Staff, JPL |
| Noah Arribas-Layton Junior, Ch Warren and Katharine Schlinger SURF Fellow | Potential New Media for Electrophoresis | Robert H. Grubbs Victor and Elizabeth Atkins Professor of Chemistry Michael Harrington Member of the Beckman Institute |
| Michael D. Astle Junior, CS Sidney R. and Nancy M. Petersen SURF Endowment | View-Dependent Terrain Refinement for the Responsive Workbench | Peter Schröder Assistant Professor of Computer Science |
| Charles M. Atkin Junior, EE Arthur Rock SURF Endowment | Building a Robotic Cat | John Hallam Senior Lecturer, Department of Artificial Intelligence, University of Edinburgh Yaser S. Abu-Mostafa Professor of Electrical Engineering and Computer Science |

STUDENT**TOPIC****MENTOR**

Michael J. Baier
Junior; APh
Mr. Robert M. Abbey SURF
Fellow

GAMCIT II: Low-Energy Spectroscopy of
Gamma-Ray Bursts

Fiona A. Harrison
Assistant Professor of Physics

Sudipta Bardhan
Senior; Bi

An Analysis of the Potential Regulatory
Regions of the Interleukin 2 Gene

Ellen V. Rothenberg
Professor of Biology

Jason W. Barnes
Senior; Ay

The Composition and Thermal Structure of
the Venus Lower Atmosphere

Victoria Meadows
Scientist, JPL

Mat E. Barnet
Junior; ChE
Allied Signal SURF Fellow

Toward Alkane-Oxidizing Molecular Sieve
Catalysts

Mark E. Davis
Warren and Katharine Schlinger Professor of
Chemical Engineering

Amy C. Barr
Sophomore; Ge
Mr. and Mrs. Clayton H.
Englar SURF Fellow

Evolution of Ganymede and Callisto

David J. Stevenson
George Van Osdel Professor of Planetary
Science

Sara A. Beaver
Senior; Ch/Hist
Arthur R. Adams SURF
Fellowship

Capacity of New York Emergency Food
Programs to Absorb Funding Cuts: A Closer
Look at Hunger in Albany, Brooklyn, and
Buffalo

Ronald Deutsch
Associate Director, SENSES
J. Morgan Kousser
Professor of History and Social Science

Klejda Bega
Junior; Ph

Polarization of Noble Gases at Low Densities

Emlyn W. Hughes
Associate Professor of Physics

Mark S. Bentley
University of Leicester
Senior; Ph

Power Subsystem Design Tool

Joel C. Sercel
Senior Engineer, JPL; Lecturer in Jet
Propulsion

Ronak J. Bhatt
Junior; Ph
Samuel P. and Frances Krown
SURF Endowment Fund

Relativistic Pulsar Winds

E. Sterl Phinney III
Professor of Theoretical Astrophysics
Andrew Melatos
Research Fellow in Theoretical Astrophysics

Ralph E. Biggins
University of Leicester
Senior; Ph

Advanced Spacecraft Design Tool
Development Spacecraft Mechanical and
Thermal Tool Development

Joel C. Sercel
Senior Engineer, JPL; Lecturer in Jet
Propulsion

Christopher Bisbee
Senior; Ch
Mrs. Hannah Bradley
SURF Fellow

Site-Directed Mutagenesis of the R660 and
E681 Locations of Taq Polymerase

John H. Richards
Professor of Organic Chemistry

Sibani L. Biswal
Junior; ChE
Mr. and Mrs. Robert L.
Noland SURF Fellow

Zincosilicate Materials

Mark E. Davis
Warren and Katharine Schlinger Professor of
Chemical Engineering

Liubomir A. Borisov
Senior; Ph

Realistic Simulation of Higgs Boson Searches
With the CMS Detector at the LHC

Harvey B. Newman
Professor of Physics

| STUDENT | TOPIC | MENTOR |
|---|---|--|
| Tammy L. Bosler <i>Temple University</i> <i>Senior, Ph</i> | Animation and Visualization of the LIGO Interferometer Sensing and Readout Signals | Rochus E. Vogt <i>R. Stanton Avery Distinguished Service Professor and Professor of Physics</i> Robert Spero <i>Member of the Professional Staff in Physics</i> |
| Khari H. Bridges <i>Morehouse College</i> <i>Senior, Bi</i> <i>MURF</i> | Characterization of the fin Mutation in <i>Arabidopsis thaliana</i> | Elliot M. Meyerowitz <i>Professor of Biology</i> |
| Joshua D. Brown <i>Carleton College</i> <i>Senior, Ch</i> | Electron Transfer Through Cyano Bridging Ligands | Harry B. Gray <i>Arnold O. Beckman Professor of Chemistry</i> |
| Gina M. Buccolo <i>Sophomore, Ay</i> <i>Richter Scholar</i> | Development of Pulsed Discharge Nozzle Technology for the Synthesis of Potential Carriers of the Diffuse Interstellar Bands | Geoffrey A. Blake <i>Professor of Cosmochemistry</i> |
| James F. Buckwalter <i>Junior, EE</i> <i>Richter Scholar</i> | Implementation of Analog VLSI Vision Chips | Christof Koch <i>Professor of Computation and Neural Systems</i> Charles M. Higgins <i>Postdoctoral Scholar in Biology</i> |
| Jonathan O. Burrows <i>Junior, APh</i> <i>General Motors SURF Fellow</i> | Metallic Glass in Microfabrication Processes | William L. Johnson <i>Ruben F. and Donna Mettler Professor of Engineering and Applied Science</i> |
| Jonathan E. Byers <i>University of North Carolina at Asheville</i> <i>Senior, Ph</i> <i>NASA Minority SURF Fellow</i> | Near-Earth Asteroid Tracking: Earth Trojans | Eleanor Helin <i>Planetary Scientist, JPL</i> |
| Hanna Cai <i>Junior, EE</i> <i>Northrop Grumman SURF Fellow</i> | Genetic Database Searching Utilizing Special Purpose Processors | Glen A. George <i>Lecturer in Computer Science and Electrical Engineering</i> |
| Jessika L. Canizalez <i>Sophomore, ME</i> <i>Richter Scholar</i> | Leaf Mutants in <i>Arabidopsis thaliana</i> | Elliot M. Meyerowitz <i>Professor of Biology</i> Jennifer C. Fletcher <i>Research Fellow in Biology</i> |
| Juancarlos N. Chan <i>Junior, APh</i> | Parasitic Intensity Noise Control in a Michelson Interferometer Locking System | Rochus E. Vogt <i>R. Stanton Avery Distinguished Service Professor and Professor of Physics</i> Seiji Kawamura <i>Member of the Professional Staff in Physics</i> |
| Candace C. Chang <i>Sophomore, Bi/Ch</i> <i>Doris Everhart SURF Fellow</i> | Directed Evolution of para-Nitrobenzyl Esterase | Frances H. Arnold <i>Professor of Chemical Engineering</i> |

STUDENT**TOPIC****MENTOR**

Ming M. Chen
Sophomore, Bi/Ch
Dr. Edward W. Hughes
SURF Fellow

Overexpression of Potential *Saccharomyces cerevisiae* Oligosaccharyl Transferase Subunits in *Pichia pastoris*

Barbara Imperiali
Professor of Chemistry

Yeng-Long Chen
Senior, ChE

A Study of Triphase Separation of Triblock Copolymers

Julia A. Kornfield
Associate Professor of Chemical Engineering

Jim M. Cheng
Sophomore, Ch

The Effect of pH and Hydrogen-Bonding on the Rotational Conformation of 1,3- Diamino-2-Hydroxypropane

John D. Roberts
Institute Professor of Chemistry, Emeritus

Alwin Y. Chi
Junior, EE/Ec

Research on Short Frame Turbo Code

Tsz-Mei Ko
Assistant Professor, University of Science and Technology
Robert J. Mc Eliece
Allen E. Puckett Professor and Professor of Electrical Engineering

Albert Chiu
Senior, ChE
Allied Signal SURF Fellow

Molecular Dynamics Simulation of the Reaction Between Aluminum and Silicon Dioxide

Julia A. Kornfield
Associate Professor of Chemical Engineering
William A. Goddard III
Charles and Mary Ferkel Professor of Chemistry and Applied Physics

John D. Chodera
Junior, Bi
Bristol Myers Endowment Fellowship

Development of a Monoclonal Antibody-Based, Enzyme-Linked Immunosorbent Assay for Murine and Human Leukemia Inhibitory Factor

Paul H. Patterson
Professor of Biology

Ryan T. Chornock
Junior, Ph

Cosmological N-body Simulations

Charles C. Steidel
Associate Professor of Astronomy

Daniel H. Chou
Sophomore, Ma
Samuel P. and Frances Krown SURF Endowment Fund

Scaling of Thermal Noise in the LIGO Interferometers

Kenneth G. Libbrecht
Professor of Astrophysics

John F. Christensen
Senior, ChE

Methanol Fuel Cell System Modeling

Gerald Halpert
Assistant Program Manager, JPL

Tiffany M. Churukian
College of William and Mary
Senior, Ph

The Completion of the Reduction and Compilation of Ground-Based Near-Infrared Imagery of the Giant Outer Planets

Glenn S. Orton
Senior Research Scientist, JPL

Brian A. Collins
Junior, Ge
Mrs. Edwin L. Cline SURF Fellow

Inversion of Tensile Fractures From Wells in Java Suggests the Best Fitting Stress State is Degenerate

Joann M. Stock
Associate Professor of Geology and Geophysics

Christopher W. Connor
University of Cambridge
Senior, EE

Dust Opacity of the Martian Atmosphere

Terry Z. Martin
Member of the Technical Staff, JPL

| STUDENT | TOPIC | MENTOR |
|--|--|--|
| Nicolle A. Cumberland <i>University of Southern California</i> Senior, Psychology/Political Science MURF | The Effect of Isoluminant Stimuli on Size Contrast and Size Constancy Phenomena | John M. Allman <i>Hixon Professor of Psychobiology and Professor of Biology</i> |
| Brian R. D'Urso Senior, Ph Thomas E. Everhart SURF Fellow | Coupled Triangular Semiconductor Lasers With 2-D Photonic Bandgap Crystal Mirrors for Optical Switching | Axel Scherer <i>Professor of Electrical Engineering, Applied Physics, and Physics</i> |
| Donna Mae Daigdigan <i>Mt. Saint Mary's College</i> Senior, Ch MURF | A Comparative Analysis of Inductive Detection and Force-Detected Nuclear Magnetic Resonance Spectroscopy | Daniel P. Weitekamp <i>Associate Professor of Chemical Physics</i> |
| Eric M. Dennis Senior, Ph Richter Scholar | Accuracy Threshold for Toric Codes | John P. Preskill <i>Professor of Theoretical Physics</i> |
| Teo Der-Stepanians Junior, EE Allied Signal SURF Fellow | High Efficiency Class-E Power Amplifiers | David B. Rutledge <i>Professor of Electrical Engineering</i> |
| Neelendu Dey <i>Harvard University</i> Junior, Biochem | Solvent Effects on the Conformational Preference of a Relatively Polar Molecule | John D. Roberts <i>Institute Professor of Chemistry, Emeritus</i> |
| Oliver E. Dial Junior, Ph Hughes Aircraft Company SURF Fellow | Exploring Resolution Limits in Electron Beam Nanolithography | Axel Scherer <i>Professor of Electrical Engineering, Applied Physics, and Physics</i> |
| Francisco J. Dias Lourenco Junior, CE Richter Scholar | Earthquake Related Telluric Currents | Thomas H. Heaton <i>Professor of Engineering Seismology</i> |
| Ryan R. Dieckmann Junior, Ch Richter Scholar | Cobalt Selectivity Utilizing Peptide-Like Sequences | Barbara Imperiali <i>Professor of Chemistry</i> |
| Benjamin L. Diedrich <i>University of Washington</i> Senior, Ae | Solar Sail Subsystems in the Spacecraft Design Tool | Joel C. Sercel <i>Senior Engineer, JPL; Lecturer in Jet Propulsion</i> |
| Sheng Ding Junior, Bi/Ch | Synthetic Approach to Study the Photochemical Properties of Benzoin Esters | Sunney I. Chan <i>George Grant Hoag Professor of Biophysical Chemistry</i> |
| Joanna L. Dodd Junior, ChE Hugh F. and Audy Lou Colvin SURF Endowment Fellowship | The Effect of Shear on Crystallization of Isotactic Polypropylene | Julia A. Kornfield <i>Associate Professor of Chemical Engineering</i> |

STUDENT**TOPIC****MENTOR**

Timothy M. Doyle
Senior, EAS
Richter Scholar

Volume Morphing Using Distance Transform

David Breen
Assistant Director, Computer Graphics
Laboratory

Patrick J. Drew
Junior, Bi
Howard Hughes Medical
Institute SURF Fellow

Activity in Field L2a During Vocalization of
the Adult Zebra Finch

Masakazu Konishi
Bing Professor of Behavioral Biology

Rachel J. Drummond
University of Kent
Sophomore, Ph
Idealab SURF Fellow

Creating Educational Software for the
Internet

James M. Bower
Professor of Biology

Alexander R. Dunn
Senior, Ch
The Associates SURF Fellow

The Synthesis and Applications of
Fluorinated Triphenylenes

Robert H. Grubbs
Victor and Elizabeth Atkins Professor of
Chemistry

Lael L. Erskine
Senior, Ch
Howard Hughes Medical
Institute SURF Fellow

Fabrication of Three Dimensional Structures
Using Two-Photon Initiated Polymerization
and Studies of the Polymerization Kinetics

Seth R. Marder
Member of the Beckman Institute

David W. Farnham
Senior, Ph
Dr. and Mrs. Lew Allen, Jr.
SURF Fellow

Simulating the LIGO Signal

Rochus E. Vogt
R. Stanton Avery Distinguished Service
Professor and Professor of Physics
J. Kent Blackburn
Senior Systems and Software Engineer in
Physics

Marc Favata
Sophomore, Ph
Richter Scholar

Study of Spin-Up/Spin-Down Torques on
Accreting X-ray Pulsars

Thomas A. Prince
Professor of Physics

Juan C. Fernandez Diaz
Universidad Nacional
Autonoma de Honduras
Senior, EE

The Study of Galileo Near Infrared Mapping
Spectrometer (NIMS) Data of Europa

Robert Carlson
Member of the Technical Staff, JPL
Adriana Ocampo
Research Scientist, JPL

Henry C. Fu
Harvard University
Sophomore, Ch

Proteolytic Mapping of Particulate Methane
Monooxygenase from *Methylococcus*
capsulatus (Bath)

Sunney I. Chan
George Grant Hoag Professor of Biophysical
Chemistry

Gonzalo Galvan
California Polytechnic
University at Pomona
Senior, Civil Engineering
MURF

Analysis of Recorded Earthquake Motions in
Buildings

James L. Beck
Professor of Applied Mechanics and Civil
Engineering

Benjamin D. Gebhardt
University of California, Los
Angeles
Junior, EE

Observations of Distant Comets

Paul Weissman
Senior Research Scientist, JPL

Dipasri Ghosh
Sophomore, Ch

Dye Sensitization of Nanocrystalline Titanium
Dioxide

Nathan S. Lewis
Professor of Chemistry

| STUDENT | TOPIC | MENTOR |
|--|--|---|
| Emma E. Goldberg <i>Junior, Ay</i> <i>Samuel P. and Frances Krown</i> <i>SURF Endowment Fund</i> | Polarization of Noble Gases | Emlyn W. Hughes <i>Associate Professor of Physics</i> |
| Tim Gollisch <i>Universitat Heidelberg</i> <i>Junior, Ph</i> | Simulation of the LIGO Signal | Rochus E. Vogt <i>R. Stanton Avery Distinguished Service</i> <i>Professor and Professor of Physics</i> J. Kent Blackburn <i>Senior Systems and Software Engineer in</i> <i>Physics</i> |
| David P. Gomes <i>University of Cambridge</i> <i>Senior, Eng</i> | Advanced Spacecraft Design Tool, Structural Analysis Tool (SAT) | Joel C. Sercel <i>Senior Engineer, JPL; Lecturer in Jet</i> <i>Propulsion</i> |
| Cynthia-May S. Gong <i>Junior, Ch</i> <i>Howard Hughes Medical</i> <i>Institute SURF Fellow</i> | Resolution of the Aldehyde Ferredoxin Oxidoreductase Protein | Douglas C. Rees <i>Professor of Chemistry</i> |
| Laura E. Gossett <i>Junior, Bi</i> <i>Richter Scholar</i> | TWIST Expression in Chicken Embryos | Carlotta A. Glackin <i>Director, Research and Development,</i> <i>Department of Anatomic Pathology, City of</i> <i>Hope</i> Marianne Bronner-Fraser <i>Professor of Biology</i> |
| David M. Goulet <i>Senior, AMa</i> <i>Idealab SURF Fellow</i> | Caltech Pre-College Science Initiative (CAPSI) | James M. Bower <i>Professor of Biology</i> |
| Jason A. Graetz <i>Occidental College</i> <i>Senior, Ph</i> | High Resolution, Low Temperature Magnetostrictive Positioners | Robert Chave <i>Applied Physicist, Cryogenics, JPL</i> |
| Matthew M. Gregori <i>Junior, Ch</i> <i>Idealab SURF Fellow</i> | Development of Educational Software for Internet Delivery | James M. Bower <i>Professor of Biology</i> |
| Joseph W. Haas <i>Sophomore, Ph</i> <i>Dr. David Wei SURF Fellow</i> | Development of a Metal Oxide Film Deposition System | Axel Scherer <i>Professor of Electrical Engineering, Applied</i> <i>Physics, and Physics</i> |
| Eric L. Hale <i>Sophomore, ME</i> | Unmanned Ground Vehicle Navigation and Obstacle Detection | Larry H. Matthies <i>Member of the Technical Staff, JPL</i> |
| Laura J. Hidas <i>Stanford University</i> <i>Junior, Ch</i> <i>Idealab SURF Fellow</i> | Development of Educational Software for Internet Delivery | James M. Bower <i>Professor of Biology</i> |
| Kathryn C. Hill <i>Sophomore, Ay</i> | Lunar Phase Curves | Bonnie J. Buratti <i>Research Scientist, JPL</i> |

| STUDENT | TOPIC | MENTOR |
|--|---|--|
| Sasha Hinkley <i>Reed College</i> Senior, Ph | Characterization of the Galileo Probe Entry Site Through Thermal Infrared Images | Glenn S. Orton <i>Senior Research Scientist, JPL</i> |
| Roy L. Hogstedt <i>California State University, Long Beach</i> Senior, ME | ACS Design Tool and Rapid Prototyping | Joel C. Sercel <i>Senior Engineer, JPL; Lecturer in Jet Propulsion</i> |
| Albert Hsiao <i>Sophomore, Bi/CS</i> | Biophysical Plant Growth Models | Frank Zee <i>Member of the Technical Staff, JPL</i> |
| Grace K. Hsu <i>State University of New York, Stony Brook</i> Senior, Bi/CS <i>Howard Hughes Medical Institute SURF Fellow</i> | Evolving Parallel Computation | Christoph Adami <i>Senior Research Fellow in Computation and Neural Systems</i> |
| Mark G. Jackson <i>Duke University</i> Junior, Ph/Ma | Development of Data-Acquisition Software for Microwave Processing and Measuring the Complex Dielectric Constant | Martin Barmatz <i>Technical Group Leader, JPL</i> |
| Nicole M. Jackson <i>Occidental College</i> Senior, Ch | Electrochemistry of Intercalators Bound to DNA-Modified Electrodes | Jacqueline K. Barton <i>Arthur and Marian Hanisch Memorial Professor and Professor of Chemistry</i> |
| Robert D. Jackson <i>San Jose State University</i> Senior, Ch MURF | Novel Synthesis of Alpha Methyl Asparagine | Erick M. Carreira <i>Associate Professor of Chemistry</i> |
| Scott I. Jackson <i>Brown University</i> Junior, Eng | Saturn's Rings During 1995 August Earth-Saturn Ring Plane Crossing | Glenn S. Orton <i>Senior Research Scientist, JPL</i> |
| Joanne W. Jang <i>Junior, Bi/Ch</i> <i>Howard Hughes Medical Institute SURF Fellow</i> | Anaphase Exit Pathway | Raymond J. Deshaies <i>Assistant Professor of Biology</i> |
| Gregory S. Jefferis <i>University of Cambridge</i> Senior, Natural Science <i>Howard Hughes Medical Institute SURF Fellow</i> | Biophysical Modeling of a Neuronal Multiplication Process | Fabrizio Gabbiani <i>Senior Research Fellow in Biology</i> |
| Patrick D. Jewell <i>Senior, Ph</i> | Characterization of a Micro-Machined Vibratory Microgyroscope | Tony K.T. Tang <i>Member of the Technical Staff, JPL</i> |
| Kay Y. Jhum <i>Junior, ChE</i> <i>William N. Lacey SURF Endowment Fund</i> | Monomers for Photopolymers in Holography | Julia A. Kornfield <i>Associate Professor of Chemical Engineering</i> |
| Griffith R. John <i>University of Cambridge</i> Senior, Ph | Modeling the Infrared Spectra of Hydrogen Pressurized Ammonia and Methane | Glenn S. Orton <i>Senior Research Scientist, JPL</i> |

| STUDENT | TOPIC | MENTOR |
|---|--|--|
| William C. Jones <i>Princeton University</i> <i>Senior, Ph</i> | Map Reconstruction in Multifrequency CMB Observations | Charles R. Lawrence <i>Research Scientist, JPL</i> |
| Shareen Joshi <i>Reed College</i> <i>Senior, Ma/Ec</i> <i>Idealab SURF Fellow</i> | The Development of Web Based Software for Internet Delivery | James M. Bower <i>Professor of Biology</i> |
| Daniel D. Kaplan <i>Junior, Ma.</i> <i>Samuel P. and Frances Krown</i> <i>SURF Endowment Fund</i> | Fair Division Problem (Computational Models Using Evolutionary Game Theory) | Richard M. Wilson <i>Professor of Mathematics</i> |
| Emil P. Kartalov <i>Senior, Ph</i> | A Search for High Redshift Quasars | S. George Djorgovski <i>Professor of Astronomy</i> |
| Tatsuki Kashitani <i>Junior, Ae</i> <i>Richter Scholar</i> | The Optimization of the Observation Frequencies for the Sunyaev-Zel'dovich Infrared Experiment | Andrew E. Lange <i>Professor of Physics</i> |
| David R. Kent IV <i>Texas A&M University</i> <i>Senior, Ch/Ph</i> | Are Two Like Charges In Solution More Stable In Close Proximity? | John D. Roberts <i>Institute Professor of Chemistry, Emeritus</i> |
| Sophia A. Khan <i>Oxford University</i> <i>Sophomore, Ph</i> | The Galileo PPR Experiment | Terry Z. Martin <i>Member of the Technical Staff, JPL</i> |
| Adam K. Kisor <i>University of California, San Diego</i> <i>Senior, Cognitive Science</i> | The Electronic Nose Experiment | Margaret A. Ryan <i>Technical Team Leader, JPL</i> |
| Minoree Kohwi <i>Junior, Bi</i> <i>Richter Scholar</i> | Neural Crest Cells and Molecules That Control Their Migration Pattern | Scott E. Fraser <i>Anna L. Rosen Professor of Biology</i> <i>Mary Dickinson and Rusty Lansford</i> <i>Postdoctoral Scholars, Biology</i> |
| Juna A. Kollmeier <i>Sophomore, Ph/Ay</i> <i>Richter Scholar</i> | Optical Identification of Radio Sources: A Search for Radio-loud Quasars | S. George Djorgovski <i>Professor of Astronomy</i> |
| Suzanne S.K.L. Komili <i>University of British Columbia</i> <i>Senior, Ph</i> | Visual Cortex Response Study | Christof Koch <i>Professor of Computation and Neural Systems</i> |
| Viswanathan Krishnan <i>University of Cambridge</i> <i>Junior, Ph</i> | Thermal Wave Structures in the Jovian Troposphere | Glenn S. Orton <i>Senior Research Scientist, JPL</i> |
| Aik-Meng Kuah <i>Carnegie Mellon University</i> <i>Senior, Ph/CS</i> | Evaluation of a Prototype Digital Control System for Maintaining Precise Laser Path Lengths | Rochus E. Vogt <i>R. Stanton Avery Distinguished Service</i> <i>Professor and Professor of Physics</i> <i>Dale Ouimette</i> <i>Senior Electronics Engineer</i> |

| STUDENT | TOPIC | MENTOR |
|--|---|--|
| Michael Kühlen <i>Sophomore, Ph</i> | Experiments and Data Analysis in Nuclear Physics | Robert D. Mc Keown <i>Professor of Physics</i> |
| William Y. Kung <i>Junior, Ch</i> | Spectral Analysis of Linear Differential Operators | Barry M. Simon <i>International Business Machines Professor of Mathematics and Theoretical Physics</i> |
| Jacob P. Lacouture <i>Sophomore, EE</i> | Optimization of the LIGO End to End Modeling Program | Rochus E. Vogt <i>R. Stanton Avery Distinguished Service Professor and Professor of Physics</i> Hiroaki Yamamoto <i>Senior Scientist in Physics</i> |
| Tai A. Lam <i>Senior, Ph</i> <i>Richter Scholar</i> | Measurements of the 535 nm and 1283 nm Absorption Spectra of Thallium | Norval Fortson <i>Professor of Physics, University of Washington</i> Thomas A. Tombrello <i>William R. Kenan, Jr. Professor and Professor of Physics</i> |
| Nicholas A. Larsen <i>Carleton College</i> <i>Senior, Ph/Ch</i> | Stratospheric Circulation on Jupiter | Robert A. West <i>Research Scientist, JPL</i> |
| Diana A. Lavelly <i>Junior, Ph</i> <i>Richter Scholar</i> | Finding a LIGO Core Optics Cleaning Procedure | Rochus E. Vogt <i>R. Stanton Avery Distinguished Service Professor and Professor of Physics</i> Dennis Coyne <i>Member of the Professional Staff in Physics</i> |
| Renee G. Lee <i>Sophomore, EAS</i> <i>Arthur R. Adams SURF Fellowship</i> | Arsenate Removal by Anion Exchange Chromatography | Janet G. Hering <i>Associate Professor of Environmental Engineering Science</i> |
| Luis Lesmes <i>University of Southern California</i> <i>Senior, Psychobiology/Ch</i> <i>MURF</i> | The Effects of Pictorial Depth Cues on Size Perception | John M. Allman <i>Hixon Professor of Psychobiology and Professor of Biology</i> |
| Yi Li <i>Senior, Ph</i> | Numerical Simulation of the Scanning Microwave Microprobe | Nai-Chang Yeh <i>Associate Professor of Physics</i> |
| Angela Lin <i>Junior, Env</i> <i>Richter Scholar</i> | Kinetics and Mechanism of the Sonolytic Degradation of MTBE: Intermediates and Byproducts | Michael R. Hoffmann <i>James Irvine Professor of Environmental Science</i> |
| Andrew S. Ling <i>Junior, EE</i> | Land Classification of Satellite Images of the Earth | Roy D. Williams <i>Senior Scientist, Center for Advanced Computing Research</i> |
| Christianto C. Liu <i>Junior, EE</i> <i>AstroTerra Corporation SURF Fellow</i> | Protocols for Highly Variable Rate Networks | Eric Korevaar <i>President, AstroTerra Corporation</i> Glen A. George <i>Lecturer in Computer Science and Electrical Engineering</i> |

| STUDENT | TOPIC | MENTOR |
|--|--|---|
| Rowena B. Lohman Senior, Ge Mrs. Vernon L. Barrett SURF Fellow | Using InSAR to Examine Isostatic Rebound | Mark Simons Assistant Professor of Geophysics |
| Joseph C. Lucas Sophomore, Ph Richter Scholar | Measurement of the Non-gaussian Noise in the Suspension Wire | Rochus E. Vogt R. Stanton Avery Distinguished Service Professor and Professor of Physics Seiji Kawamura Member of the Professional Staff in Physics |
| Daisy Mah Mt. Saint Mary's College Senior, Biochemistry MURF | Electron Transfer Reactions With DNA, Proteins, and Metal Complexes | Jacqueline K. Barton Arthur and Marian Hanisch Memorial Professor and Professor of Chemistry |
| Milan L. Masanovic University of Belgrade Senior, EE | An Absolute Radiance Reduction Algorithm for Astronomical Data: Application to an Interactive Widget-Driven Data Reduction Environment: DRM - The Data Reduction Manager | Glenn S. Orton Senior Research Scientist, JPL |
| Ryan L. Mc Corvie Junior, Ma Arthur E. Lamel Memorial SURF Fund | The Geometry of Halfspace Decision Lists | Jehoshua Bruck Associate Professor of Computation and Neural Systems and Electrical Engineering |
| Enrique Meira University of Florida Senior, Env MURF | Partitioning of Organic Compounds in the Atmosphere | Richard C. Flagan Professor of Chemical Engineering |
| Aron J. Meltzner Sophomore, GeoPh J. Weldon Green SURF Endowment | Historical Earthquake Studies to Aid in the Modern Understanding of Earthquakes | David J. Wald Visiting Associate in Geophysics |
| Jeffrey M. Mendez Junior, Ch Samuel P. and Frances Krown SURF Endowment Fund | Photo and Thermally Stable Functionalized Chromophores for Electro-Optic Application | Seth R. Marder Member of the Beckman Institute |
| Jose F. Mendez Senior, EAS Dr. Chandler C. Ross SURF Fellow | High Frequency Vibration of Granular Materials | Melany L. Hunt Associate Professor of Mechanical Engineering |
| Steven S. Michael Senior, APh Mr. and Mrs. Fred M. Wells SURF Fellow | Behavior of Extended Single Molecules of DNA | Stephen R. Quake Assistant Professor of Applied Physics |
| Natasa N. Miladinovic University of Belgrade Senior, Astrophysics | A Galaxy Collision Model for the Jets of NGC 1097 | E. Sterl Phinney III Professor of Theoretical Astrophysics |
| Sarah M. Milkovich Sophomore, PISc | Mars Global Surveyor | Andrew P. Ingersoll Professor of Planetary Science |

STUDENT

Gabriel A. Miller
Junior, Bi/Ch
Howard Hughes Medical
Institute SURF Fellow

Svjetlana Miocinovic
Sophomore, Bi/CS
Howard Hughes Medical
Institute SURF Fellow

Christina Molodowitch
Senior, Ch
Howard Hughes Medical
Institute SURF Fellow

Shayan Mookherjee
Junior, EE
New Focus SURF Fellow

Terence R. Moran
Senior, Bi

Mary L. Mosier
Senior, Bi
Richter Scholar

Eric M. Moskun
Occidental College
Senior, Ph

Vale Murthy
Senior, ChE
First Quadrant SURF Fellow

Steve Na
Junior, APh
Applied Materials SURF
Fellow

Bradley J. Nakatani
Senior, Bi/Ch
Arthur A. Noyes SURF
Endowment Fund

Sidney N.N. Ngone
University of Cambridge
Senior, ME

TOPIC

Visualization and Quantification of Dendritic
Spines Following Mossy Fiber Sprouting in
the Adult Rat Hippocampus

Investigating the Neural Mechanisms of
Visual Perception With Virtual Reality

Analysis of Promoter Function in Living
Drosophila Embryos

Improving LED Efficiencies by Incorporation
of Buried/Monolithic Refractive Microlenses

Seeking a Hidden Human Magnetic Sense
Used in Navigational Intuition

What Role Does the Amygdala Have in
Mediating Social Interactions in Nonhuman
Primates?

Path Instability of Rising Gas Bubbles in a
Hele-Shaw Cell

A Comparison Between Sequential Speciation
and Sharing

Large-Grained Germanium on Glass

Secondary and Super-secondary Structure
Prediction of Near-native Protein
Conformations

LIGO End-to-End Modeling

MENTOR

Erin M. Schuman
Assistant Professor of Biology
Adam N. Mamelak
Postdoctoral Scholar in Biology

John M. Allman
Hixon Professor of Psychobiology and
Professor of Biology

Carl S. Parker
Professor of Chemical Biology

Amnon Yariv
Martin and Eileen Summerfield Professor of
Applied Physics

Joseph L. Kirschvink
Professor of Geobiology

David G. Amaral
Professor, Department of Psychiatry and
Center for Neuroscience, University of
California, Davis
John M. Allman
Hixon Professor of Psychobiology and
Professor of Biology

Morteza Gharib
Professor of Aeronautics
Mingming Wu
Assistant Professor of Physics, Occidental
College

David Leinweber
Managing Director, First Quadrant
David Porter
Visiting Associate in Economics

Harry A. Atwater, Jr.
Associate Professor of Applied Physics

William A. Goddard III
Charles and Mary Ferkel Professor of
Chemistry and Applied Physics

Rochus E. Vogt
R. Stanton Avery Distinguished Service
Professor and Professor of Physics
Hiroaki Yamamoto
Senior Scientist in Physics

| STUDENT | TOPIC | MENTOR |
|--|---|--|
| Martin A. Nguyen <i>Sophomore, EAS</i> | An Open Inventor Interface for the Responsive Workbench | Peter Schröder <i>Assistant Professor of Computer Science</i> |
| Sun B. Nguyen <i>Texas A&M University</i> <i>Senior, Aerospace Engineering</i> | The Advanced Spacecraft Design Tool and Parametric Trades Model Link to the Satellite Orbit Analysis Program | Joel C. Sercel <i>Senior Engineer, JPL; Lecturer in Jet Propulsion</i> |
| John P. Niccolai <i>Junior, Ma</i> <i>Richter Scholar</i> | The Mathematics of Juggling: Siteswaps, Drops, and Cycle Permutations | Richard M. Wilson <i>Professor of Mathematics</i> |
| Ivana D. Nikolic <i>Junior, ChE</i> <i>Dr. Fredrick H. Shair SURF Fellow</i> | Tissue Adsorbing Polymers | Jeffrey A. Hubbell <i>Professor of Chemical Engineering</i> |
| Eldar A. Noe Dobrea <i>Cornell University</i> <i>Senior, Ay</i> | Ground Based Observations of Jupiter in the Mid-Infrared: Support for Galileo G8 and C9 Encounters Using SpectroCam-10s | Glenn S. Orton <i>Senior Research Scientist, JPL</i> |
| Steven P. Notari <i>California Polytechnic University at San Luis Obispo</i> <i>Senior, Bi</i> <i>MURF</i> | Chronic Olfactory Bulb Recordings in the Behaving Rat | Gilles J. Laurent <i>Associate Professor of Biology and Computation and Neural Systems</i> |
| Reuben W. Ogburn IV <i>Junior, Ph</i> <i>Sidney R. and Nancy M. Petersen SURF Endowment</i> | Quantum Computation with Nonabelions | John P. Preskill <i>Professor of Theoretical Physics</i> |
| Yongkai Ow <i>Junior, ChE</i> <i>Richter Scholar</i> | The Directed Evolution of Thiolsubtilisin for Higher Esterase Activity in Non-aqueous Solvents | Frances H. Arnold <i>Professor of Chemical Engineering</i> |
| Siddhartha Padmanabha <i>Senior, Bi</i> <i>Richter Scholar</i> | Examination of IgM Accessories (CD79a and CD79b) in Chronic Lymphocytic Leukemia | Thomas Kipps <i>Professor of Medicine, University of California, San Diego School of Medicine</i> Jean-Paul Revel <i>Albert Billings Ruddock Professor of Biology</i> |
| Eleanor J. Park <i>Sophomore, ChE</i> <i>Richter Scholar</i> | Synthesis and Study of Oligomers of N-Substituted Glycines | Annelise E. Barron <i>Assistant Professor, Northwestern University</i> Douglas C. Rees <i>Professor of Chemistry</i> |
| Kevin L. Parkin <i>University of Leicester</i> <i>Junior, Ph</i> | Advanced Spacecraft Design Tool, Structural Analysis Tool (SAT) | Joel C. Sercel <i>Senior Engineer, JPL; Lecturer in Jet Propulsion</i> |
| Anthony H. Payne, Jr. <i>Junior, CS</i> <i>Dr. Edward C. Posner SURF Fellow</i> | ProVision: A Tool for Program Visualization, Algorithm Animation, and Debugging | Glen A. George <i>Lecturer in Computer Science and Electrical Engineering</i> |

STUDENT**TOPIC****MENTOR**

Hiranya V. Peiris
University of Cambridge
Senior, Ph

The Galileo PPR Experiment

Terry Z. Martin
Member of the Technical Staff, JPL

Peter P. Plavchan
Sophomore, CS/Ph

Studies of the Galactic Center: The Search
for a Mid-Infrared Counterpart to the Radio
Source Sagittarius A*

Michael Werner
Senior Research Scientist, JPL

Tze-Lei Poo
University of Cambridge
Sophomore, Eng

Simultaneous Solutions of Cloud and
Thermal Sounding of the Jovian Atmosphere

Glenn S. Orton
Senior Research Scientist, JPL

Amy W. Poon
University of California, Davis
Senior, Genetics
Howard Hughes Medical
Institute SURF Fellow

Studies of Neuronal Response to
Conditioning Lesion

Scott E. Fraser
Anna L. Rosen Professor of Biology

Mason A. Porter
Senior, AMa
Class of '36 Endowment Fund

Diffusion-Limited Aggregation: A Study in
Unstable Equilibrium

Nikolai G. Makarov
Professor of Mathematics

Colin A. Reed
Senior, EE
Richter Scholar

A Simple Single-Chip Asynchronous RF
Transceiver

Alain J. Martin
Professor of Computer Science

Joseph M. Renes
Junior, Ph
Richter Scholar

A Ring Imaging Cherenkov Detector
for HERMES

Bradley W. Filippone
Professor of Physics

Kevin P. Richberg
Sophomore, Ay

Redshift Determination for Galaxies in the
Hubble Deep Field

Judith G. Cohen
Professor of Astronomy

Kimberly D. Robinson
West Chester University
Senior, Ge
NASA Minority SURF

The K / T Boundary - Asteroid or Comet?

Kenneth A. Farley
Associate Professor of Geochemistry

Lori Robison
Sophomore, EE

A Digital Servo Loop for Alignment Sensing
and Control at the 40 Meter Interferometer

Rochus E. Vogt
R. Stanton Avery Distinguished Service
Professor and Professor of Physics
Jay Heefner
Project Engineer in Physics

Victor Rodriguez, Jr.
University of Idaho
Senior, Env
NASA Minority SURF

Arsenate Sorption by Ca-Fe Alginate Beads
Under Varied Conditions

Janet G. Hering
Associate Professor of Environmental
Engineering Science

Elizabeth H. Roemer
Emory University
Junior, Psychology

Vapor Pressure and Odor Quality

James M. Bower
Professor of Biology

Raphael Y. Rubin
Sophomore, CS

Wavelet Analysis of LIGO Data

Thomas A. Prince
Professor of Physics

| STUDENT | TOPIC | MENTOR |
|---|---|---|
| Elliott Rushing <i>Tennessee State University</i> Senior, EE General Motors Minority SURF Fellow | Particulate Flows Inside of Fluidized Beds | Melany L. Hunt <i>Associate Professor of Mechanical Engineering</i> |
| Keri L. Ryan <i>Senior, CE</i> Mr. and Mrs. Ralph W. Jones SURF Fellow | Seismic Response of Tall, Flexible Structures Supported with Base Isolations | John F. Hall <i>Professor of Civil Engineering</i> |
| Melissa Saenz <i>Senior, Bi</i> Ford Motor Company SURF Fellow | A Study on the Visual Perception of Balance | Pietro Perona <i>Professor of Electrical Engineering</i> |
| Antonio J. Salazar <i>Junior, EE</i> | Cultured Neuron Probe | Jerome Pine <i>Professor of Physics</i> |
| Glenn M. Sammis <i>Stanford University</i> Junior, Ch | Efforts Toward Ring Opening Methathesis Polymerization of Norbornene Derivatives with Nucleotides as Pendant Groups | Robert H. Grubbs <i>Victor and Elizabeth Atkins Professor of Chemistry</i> |
| Rory A. Sayres <i>Sophomore, Bi</i> | Use of a Caged Tyrosine Residue to Probe Structure/Function Relationships in the Nicotinic Acetylcholine Receptor | Henry A. Lester <i>Professor of Biology</i> |
| Wendy A. Schafer <i>Wofford College</i> Senior, CS/Ma | Integrating Object-Oriented and Formal Method Technologies | John C. Kelly <i>Member of the Engineering Staff, JPL</i> |
| Amanda M. Schaffer <i>Sophomore, EE</i> SURF Alumni SURF Fellow | Cross-talk Noise in Wavelength-multiplexed Volume Holographic Storage Recorded with an Extended Reference | Claire Gu <i>Assistant Professor, Pennsylvania State University</i> Demetri Psaltis <i>Thomas G. Myers Professor of Electrical Engineering</i> |
| Frank P. Seelos IV <i>Wofford College</i> Junior, Ph/Ma/CS | The Use of Formal Methods in the Creation of a Quaternion Library | John C. Kelly <i>Member of the Engineering Staff, JPL</i> |
| Simeon K. Sessley <i>Morehouse College</i> Senior, Ma NASA Minority SURF | Frequency Stability Measurement Through a Three Counter Board System | Lute Maleki <i>Member of the Technical Staff, JPL</i> Charles A. Greenhall <i>Member of the Technical Staff, JPL</i> |
| Ian R. Shapiro <i>Sophomore, Ch</i> Northern California Associates SURF Fellow | Phosphorylation of the Brain Isozyme Homodimer of Human Creatine Kinase | Patricia C. Babbitt <i>Assistant Professor, University of California, San Francisco</i> Douglas C. Rees <i>Professor of Chemistry</i> |
| Jonathon D. Shlens <i>Swarthmore College</i> Junior, CS/Ph | Predicting Time-Series with Artificial Neural Networks | Rodney M.F. Goodman <i>Professor of Electrical Engineering</i> |

| STUDENT | TOPIC | MENTOR |
|--|---|--|
| Miles M. Shuman <i>Sophomore, Ph</i> <i>Richter Scholar</i> | Cataloging Clusters of Galaxies With the Second Palomar Observatory Sky Survey (POSS-II) | S. George Djorgovski <i>Professor of Astronomy</i> |
| Michael D. Shumway <i>Senior, APh</i> <i>AstroTerra Corporation</i> <i>SURF Fellow</i> | Four-Wave Mixing in Microspheres | Eric Korevaar <i>President, AstroTerra Corporation</i> Kerry J. Vahala <i>Professor of Applied Physics</i> |
| Aleksandrs L. Slivkins <i>Sophomore, Ma</i> | Multiplicity in the Length Spectra of Hyperbolic Surfaces | Igor Rivin <i>Olga Taussky - John Todd Instructor in</i> <i>Mathematics</i> |
| Daniel Song <i>Sophomore, Bi</i> <i>William H. and Helen Lang</i> <i>SURF Endowment Fund</i> | Directed Evolution of a Cold-Water Enzyme | Frances H. Arnold <i>Professor of Chemical Engineering</i> |
| Joseph B. Soriaga <i>Junior, EE</i> | Autonomous Visibility Monitoring for Laser Communication | James R. Lesh <i>Supervisor, Optical Communications, JPL</i> |
| Kartik A. Srinivasan <i>Sophomore, EE</i> <i>Richter Scholar</i> | Coating Strain Induced Distortion in LIGO Optics | Rochus E. Vogt <i>R. Stanton Avery Distinguished Service</i> <i>Professor and Professor of Physics</i> Dennis Coyne <i>Member of the Professional Staff in Physics</i> |
| Geoff D. Staneff <i>University of Washington</i> <i>Senior, Ceramic Eng</i> | The Influence of Cation Non-Stoichiometry on the Properties of Undoped and Ytterbia- Doped Strontium Cerate | Sossina Haile <i>Assistant Professor of Materials Science</i> |
| Kathryn A. Stofer <i>Senior, Bi</i> <i>Mr. and Mrs. Robert L.</i> <i>Noland SURF Fellow</i> | Effect of Explicit Test Instructions on Pictorial Recognition in Older Adults | Daniel L. Schacter <i>Professor and Chair of Psychology, Harvard</i> <i>University</i> Erin M. Schuman <i>Assistant Professor of Biology</i> |
| Andrew K. Strauss <i>Junior, CNS</i> <i>Dr. Marcella Bonsall</i> <i>SURF Fellow</i> | The Hovses: A Study of Undergraduate Life | William F. Deverell <i>Associate Professor of History</i> |
| Erik W. Streed <i>Junior, Ph</i> <i>Richter Scholar</i> | Surface Characterization of Quartz Microspheres Used for Quantum Optics | H. Jeff Kimble <i>William L. Valentine Professor and Professor</i> <i>of Physics</i> |
| Advoquita P. Stude <i>Senior, Env</i> | Lichen Health as a Bioindicator of Air Pollution | Michael R. Hoffmann <i>James Irvine Professor of Environmental</i> <i>Science</i> |
| Julius T. Su <i>Senior, Bi/Ph</i> <i>Thomas Hunt Morgan</i> <i>SURF Endowment Fund</i> | Screening for Modifiers of Cell Death in <i>Drosophila</i> | Bruce A. Hay <i>Assistant Professor of Biology</i> |

| STUDENT | TOPIC | MENTOR |
|--|---|--|
| Winston Y. Su <i>Stanford University</i> Junior; ME | Electrostrictive Confinement of Superfluid Liquid Helium | David L. Goodstein <i>Professor of Physics and Applied Physics;</i> <i>Frank J. Gilloon Distinguished Teaching and Service Professor</i> |
| Brian S. Taba <i>Junior; EE</i> <i>Ford Motor Company</i> SURF Fellow | A Cellular Approach to Robot Control | Rodney M.F. Goodman <i>Professor of Electrical Engineering</i> |
| Tammy Tam <i>Occidental College</i> Junior; Ph | Small High Resolution Thermometer | Pierre Echternach <i>Member of the Technical Staff, JPL</i> |
| Xiaoyi Tang <i>Junior; EE</i> <i>General Motors Minority</i> SURF Fellow | An Adaptive Modem for Simultaneous Voice and Data Transmission Over Wireless Fading Channels | Andrea J. Goldsmith <i>Assistant Professor of Electrical Engineering</i> |
| Victoria M. Tanusheva <i>Senior; Ma</i> <i>Mr. and Mrs. Downie D. Muir III SURF Fellow</i> | Investigation of the Growth and Morphology of Snow Crystals | Kenneth G. Libbrecht <i>Professor of Astrophysics</i> |
| Jelena M. Tesic <i>University of Belgrade</i> Senior; EE | Functional Requirements for Robust Interactive Astronomical Data Reduction: Application to Variety of Observations of Jupiter for Visualization of Atmospheric Features | Glenn S. Orton <i>Senior Research Scientist, JPL</i> |
| Louis K. Thomas <i>Senior; CS</i> <i>Samuel P. and Frances Krown</i> SURF Endowment Fund | 3D Painting | Peter Schröder <i>Assistant Professor of Computer Science</i> |
| Devi M. Thota <i>Junior; ME</i> | Multi-Electrode Array Characterization of Spontaneous Electrical Activity in Hippocampal Cultures of Neurons | Jerome Pine <i>Professor of Physics</i> |
| Yingzhong Tian <i>Senior; Bi</i> <i>Howard Hughes Medical Institute SURF Fellow</i> | Olfactory-dependent Behavior of the Locust | Gilles J. Laurent <i>Associate Professor of Biology and Computation and Neural Systems</i> |
| Hai-Xin Tie <i>Junior; EE</i> | Colorimetry and Thermal Transport at the Quantum Limit | Michael L. Roukes <i>Professor of Physics</i> |
| George K. Tofaris <i>University College London</i> Junior; Medicine <i>Howard Hughes Medical Institute SURF Fellow</i> | LIF but Not IL-6 May Act as an Anti-Inflammatory Cytokine Following Cortical Brain Injury | Paul H. Patterson <i>Professor of Biology</i> |
| Ricky T. Tong <i>Sophomore, ChE</i> <i>Howard Hughes Medical Institute SURF Fellow</i> | DNA-mediated Quenching Reactions Between Os(II) and Ru(II) Complexes | Jacqueline K. Barton <i>Arthur and Marian Hanisch Memorial Professor and Professor of Chemistry</i> |

| STUDENT | TOPIC | MENTOR |
|--|---|--|
| James M. Turner <i>Senior, Ch</i> <i>Ernest H. Swift SURF</i> <i>Endowment Fund</i> | Pyrrole/ β -alanine and β -alanine/ β -alanine Pairings Expand the Binding Site Size for Polyamide-Hairpins in the Minor Groove | Peter B. Dervan <i>Bren Professor of Chemistry</i> |
| David E. Tytell <i>Junior, Ay</i> <i>Flintridge Foundation</i> <i>SURF Fellow</i> | Determining the Cause of Elliptical Cratering on Mars | William F. Bottke, Jr. <i>Research Associate, Cornell University</i> Stanley G. Love <i>Staff Engineer, JPL</i> |
| Andreas C. Tziolas <i>University of Leicester</i> <i>Junior, Ph</i> | HST Data Reduction in Support of the Galileo Mission | Glenn S. Orton <i>Senior Research Scientist, JPL</i> |
| Kamran Vakili <i>Sophomore, Ph</i> <i>Donald S. Clark SURF</i> <i>Endowment Fund</i> | Spatially Resolved Spectroscopy Studies of High-Temperature Superconductors Using a Low-Temperature Scanning Tunneling Microscope | Nai-Chang Yeh <i>Associate Professor of Physics</i> |
| Stephen D. Van Hooser <i>Senior, AMa</i> <i>Richter Scholar</i> | Towards Analyzing Recordings of Multiple Neurons | James M. Bower <i>Professor of Biology</i> |
| Luis Vazquez <i>University of Puerto Rico</i> <i>Senior, Bi</i> <i>MURF</i> | Interaction Between a PDZ Domain of PSD- 95 and the t-SXV Motif of Citron | Mary B. Kennedy <i>Professor of Biology</i> |
| Daniel Velez <i>Senior, ChE</i> | Philberth Probe Modification for Use in European Exploration | Joan C. Horvath <i>Business Alliances Manager, JPL</i> |
| Koen J.C. Verbrugghe <i>Junior, Bi</i> <i>Shirley and Carl Larson</i> <i>SURF Fellow</i> | Identifying Cell Death Regulators in <i>Drosophila</i> | Bruce A. Hay <i>Assistant Professor of Biology</i> |
| Christopher I. Walker <i>Senior, APh</i> <i>Applied Materials SURF</i> <i>Fellow</i> | Agglomeration in Thin Copper Films | Harry A. Atwater, Jr. <i>Associate Professor of Applied Physics</i> |
| Alfred Wang <i>Junior, Bi</i> <i>Howard Hughes Medical</i> <i>Institute SURF Fellow</i> | Molecular Studies on the Signal Transduction of the Plant Hormone Ethylene in <i>Arabidopsis</i> <i>thaliana</i> | Elliot M. Meyerowitz <i>Professor of Biology</i> |
| Louis M. Wang <i>Senior, EAS</i> | CAI: Computer Assisted Instruction | Glen A. George <i>Lecturer in Computer Science and Electrical</i> <i>Engineering</i> |
| Yale R. Wang <i>Senior, EAS</i> <i>First Quadrant SURF Fellow</i> | Dynamic Mutation Rate in Genetic Algorithms | David Leinweber <i>Managing Director, First Quadrant</i> David Porter <i>Visiting Associate in Economics</i> |

| STUDENT | TOPIC | MENTOR |
|--|---|---|
| D. William Ward <i>Principia College</i> Senior, Ch/English | Spectroscopy and Detonations | Joseph E. Shepherd <i>Associate Professor of Aeronautics</i> |
| Shawn M. Watts <i>Junior, Ma/CS</i> <i>Richter Scholar</i> | Colored Quasiperiodic Tilings | Michael C. Cross <i>Professor of Theoretical Physics</i> Ron Lifshitz <i>Division Research Fellow in Physics</i> |
| Andrew N. Westhead <i>Imperial College</i> Senior, Ma | Stability of Gas Bubbles Rising in an Inviscid Fluid - 3 Dimensional Solutions | Daniel I. Meiron <i>Professor of Applied Mathematics</i> |
| David K. Whedon <i>Harvey Mudd College</i> Senior, Eng | Photodiode Amplifier for Wavefront Sensing on the LIGO Project | Rochus E. Vogt <i>R. Stanton Avery Distinguished Service Professor and Professor of Physics</i> Jay Heefner <i>Project Engineer in Physics</i> |
| Grant S. Williams <i>Junior, APh</i> | The Lasercommunications Test and Evaluation Station | Keith E. Wilson <i>Task Manager, JPL</i> |
| Travis J. Williams <i>Junior, Ch</i> <i>Peter A. Lindstrom SURF Fellow</i> | Mechanistic Analysis of the Desilation of Olefins | Erick M. Carreira <i>Associate Professor of Chemistry</i> |
| Paul G. Withers <i>University of Cambridge</i> Senior, Ph | Stability of Wave-like Pulsar Winds | E. Sterl Phinney III <i>Professor of Theoretical Astrophysics</i> Andrew Melatos <i>Research Fellow in Theoretical Astrophysics</i> |
| Irene C. Wong <i>Senior, ChE</i> <i>Avery Dennison SURF Fellow</i> | Sticky Stuff | Chan Ko <i>Research Associate, Avery Dennison</i> Julia A. Kornfield <i>Associate Professor of Chemical Engineering</i> |
| Jim Y. Wong <i>Sophomore, Bi</i> | Isolation and Cloning of the <i>CLV3</i> Gene in <i>Arabidopsis thaliana</i> Through Lambda Library Screening | Elliot M. Meyerowitz <i>Professor of Biology</i> |
| Carol C. Wu <i>Senior, Bi</i> <i>Howard Hughes Medical Institute SURF Fellow</i> | Analysis of the Structure of a Natural Killer Cell Inhibitory Receptor and Its Interaction With Human Leukocyte Antigen | Pamela Bjorkman <i>Associate Professor of Biology; Associate Investigator, Howard Hughes Medical Institute</i> |
| Gary I. Wu <i>Senior, CS</i> | Direct Manipulation in Multiresolution Mesh Editing | Peter Schröder <i>Assistant Professor of Computer Science</i> |
| Sophia S. Xiang <i>Sophomore, Bi</i> <i>Howard Hughes Medical Institute SURF Fellow</i> | Ear Development of Chick Embryos | Marianne Bronner-Fraser <i>Professor of Biology</i> |

STUDENT**TOPIC****MENTOR**

Jennifer C. Yang
Sophomore, Bi
Howard Hughes Medical
Institute SURF Fellow

Identifying Cell Death Regulators in
Drosophila

Bruce A. Hay
Assistant Professor of Biology

Richard C. Yeh
Senior, Ph
Hugh F. and Audy Lou
Colvin International
Fellowship Endowment

Magnetic Flux Pinning in an Untwinned
 YBa₂Cu₃O₇ (YBCO) Superconducting Single
 Crystal

Marcin Konczykowski
Directeur de Recherche, Laboratoire des
Solides Irradies, Ecole Polytechnique
 Nai-Chang Yeh
Associate Professor of Physics

Maria Yocum
University of California,
Los Angeles
Senior, Psychology
MURF

Neurotrophin-3 Induced Potentiation and
 the Possible Role of Trk B and Trk C
 Receptors

Erin M. Schuman
Assistant Professor of Biology

Alan H. Yue
Senior, Ph
Uni-Star Industries, Inc.
SURF Fellow

Investigation of CP Violation in B Meson
 Decay

Alan J. Weinstein
Associate Professor of Physics

Amalia M. Zacher
Junior, GeCh
Northern California Associates
SURF Fellow

Geochemical Processes in the Low Salinity
 Zone of the Gulf of Bothnia

Per S. Andersson
Senior Researcher, Swedish Museum for
Natural History
 Donald Porcelli
Associate Scientist in Geology

Amy M. Zheng
Senior, Bi/History
Dr. and Mrs. George N. Boone
SURF Fellow

Visualizing the Human Body: Art and
 Medicine in Philadelphia, 1740-1890

Jennifer G. Tucker
Mellon Postdoctoral Instructor in History

Legend

Ae Aeronautics
 AMA Applied Mathematics
 APh Applied Physics
 Ay Astronomy
 Bi Biology
 BioPh Biophysics
 CE Civil Engineering
 EhE Chemical Engineering

CNS Computation & Neural Systems
 CS Computer Science
 EAS Engineering & Applied Science
 Ec Economics
 EE Electrical Engineering
 Eng Engineering
 Env Environmental Engineering
 Ge Geology

GeoCh Geochemistry
 Lit Literature
 Ma Mathematics
 ME Mechanical Engineering
 Ph Physics
 Psy Psychology
 PlSc Planetary Science
 SS Social Science

SURF Endowments

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SURF's mission supports Caltech's educational purpose: to train the creative type of scientist or engineer urgently needed in our educational, governmental, and industrial development. SURF provides a new dimension to the process of undergraduate education; program participants apply knowledge gained in the laboratories and classrooms toward finding solutions to problems at the frontiers of science and technology. SURF graduates, with their sophisticated and practical knowledge of how to conduct research, have a marked advantage as they begin their careers, apply to graduate schools, or look for jobs in industry.

SURF draws upon the world-renowned research resources and expertise available at Caltech. Indeed, it is the seasoned faculty and technical advisors working with outstanding students who have helped to make SURF the excellent program that it has become since its beginnings in 1979.

On the cover: SURFer Candace Chang and Postdoctoral Scholar Lori Giver in the laboratory of Frances H. Arnold. Photo by Bob Paz

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