SURF

SUMMER UNDERGRADUATE RESEARCH FELLOWSHIPS

California Institute of Technology

Annual Report 1999

The 1999 SURF program is dedicated to Ward Whaling, Professor of Physics, Emeritus, in recognition of his many contributions to the program and to the education of Caltech students. Over SURF's 21 years, Ward has served as a mentor, has reviewed proposals, read student papers, and provided cogent advice on a variety of issues. He has been an enthusiastic and committed supporter of SURF in many ways. Through this dedication, we are proud to honor Professor Whaling's significant contributions to SURF and its students.

SURF HAS BEEN DEDICATED TO THE FOLLOWING PEOPLE:

1985	Dr. Ernest Swift
1986	Dr. Lee A. DuBridge
1987	Dr. Robert P. Sharp
1988	Dr. Ray D. Owen
1989	Dr. Hans W. Liepmann
1990	Dr. Fredrick H. Shair
1991	Dr. Lew Allen, Jr.
1992	Dr. John D. Roberts
1993	Dr. Robert E. Bacher
1994	Dr. Edward C. Posner
1995	Mr. Samuel P. Krown
1996	Dr. Edward B. Lewis
1997	Dr. Harold Brown
1998	Dr. Thomas E. Everhart
1999	Dr. Ward Whaling

COVER

Photographs of the ocean on the cover and on the inside front and back covers were taken by Terry Cole.

Congratulations to the Summer Undergraduate Research Fellowships Program on the completion of another successful season! Since its founding twenty-one years ago, SURF has become an integral part of the academic experience of most Caltech undergraduates. The program allows students to experience the struggles, frustrations, and joys of research, and to apply their classroom knowledge to the real-life world of the lab. It has also played a key role in maintaining the Institute's position as a leader in research and education. The wealth of opportunities SURF offers undergraduates to work with world-renowned mentors on projects at the forefront of science and engineering was an important factor in *U.S. News & World Report's* ranking us first among American universities.

The visiting committee of the Western Association of Schools and Colleges (WASC), the organization that certifies Caltech's accreditation, affirmed SURF's important role in the education of our students, and congratulated the Institute on this outstanding program. WASC recommended that the Institute continue its efforts to increase the endowment for the SURF program, and we take that charge very seriously. We continue to move toward our goal of fully endowing the SURF program.

SURF depends upon the personal and financial commitment of a dynamic group of more than 1,000 individuals—mentors and the members of their research groups, donors, alumni, Associates, JPL, and support staff. I am convinced that our community's investment in SURF will be repaid many times over in the future, as today's talented undergraduates begin to make the discoveries and inventions that will have impact on the world. I thank each of you for your participation in and support of SURF. You help ensure that our students will continue to have the rich research experiences that are so vital to a first-class education.

David Baltimore
President, California Institute of Technology

FROM THE SURF BOARD

Fredrick Shair
Chair

Nearing the year 2000 presents a special opportunity to reflect and to dream. SURF was conceived and has matured with the encouragement of many individuals in the Caltech community. We have much to celebrate.

During the 1920s Professor Ernest Swift orchestrated the summer work of dozens of Caltech undergraduates to assist him in the development of his *Qualitative Analysis* text which was used throughout the world. When SURF began, Dr. Swift recommended that we find ways to make undergraduate research available to all students and faculty across the Institute. He also encouraged us to establish an endowment to avoid a withering of undergraduate research when the economy takes a downturn, as it did in 1929. We took Dr. Swift's wise counsel seriously.

Other important advice came in the early '80s from Ed Baum, a senior development officer, and Samuel Krown, SURF's founding donor. They established the SURF Board to help develop financial support for the fledgling program. The SURF Board was established as a voluntary support organization consisting of individuals who are dedicated to the educational values of undergraduate research at Caltech, and who, through their advice, encouragement, and financial support, contribute to the vitality, continuity, and effectiveness of the SURF program. The Board has worked diligently over the past 17 years and has helped to put SURF on a robust financial footing.

This year we welcomed three new members to the SURF Board: John Gee, Carel Otte, and Warren Schlinger.

It is fitting that the SURF Team celebrates the contributions that SURF has made to Caltech and to humankind. However, as throughout life, celebration is accompanied by sorrow. We are deeply saddened by the deaths of three members of the SURF Board.

Marcella Bonsall was a charter member of the SURF Board. Her vibrant curiosity made strong connections across the generations, and her interest in and commitment to the students was deep and genuine. She established the Marcella and Joel Bonsall SURF prize for technical writing to provide an incentive and recognition for students' outstanding written communication. This endowment will honor her and her husband's memory.

Ralph Jones, a Caltech alumnus and long-time member of the SURF Board, brought to the SURF program great wisdom and insight. He asked deep questions that brought strength to the program. He sometimes challenged our decisions, and his comments were always constructive. Ralph helped SURF and the SURF Board reach the maturity it now enjoys.

We are also deeply saddened by the death of Terry Cole, Chair of the SURF Administrative Committee. Along with Lew Allen, Terry led the expansion of SURF to JPL for which hundreds of students and JPL technical staff will be forever grateful. Terry was a friendly warrior who loved people, music, art, science, and engineering. As

noted by many, Terry knew a lot about a lot. He made good things happen and was a true Renaissance person with whom everyone loved to interact. He will be greatly missed.

This year I end my term as SURF Board Chair. It has been personally rewarding to participate in and contribute to SURF and to work closely with the SURF Board. I am delighted that Bob Perpall has agreed to assume the chairmanship. Bob brings his enthusiasm, commitment to the program, and ideas to the position. I look forward to working with him.

The SURF Board will continue its efforts to help raise funds for SURF, especially endowment funds. Last year Caltech prepared a self-study report in anticipation of the periodic accreditation review by the Western Association of Schools and Colleges (WASC). The report noted that the SURF program is now an essential part of the Caltech undergraduate research experience and therefore its future must be assured and it recommended "that the endowment for the SURF program be substantially augmented." The WASC Visiting Committee agreed with the self-study recommendation and "suggests that efforts be continued to increase the endowment of the SURF program." The Board is committed to helping the Institute meet this challenge.

It takes a community to ensure that our students have excellent undergraduate research experiences. SURF continues to prosper because of the vision, dedication, and sustained help from hundreds of individuals. The SURF team includes mentors, donors, alumni, and support staff as well as the Student-Faculty Programs Office, the SURF Board, the SURF Administrative Committee, and the SURF Student Advisory Council. The legacy this community leaves will certainly be appreciated by generations to come, most of whom are yet to be born.

In closing my valedictory SURF Board report, I'd like to expand upon an excerpt from Hans Liepmann's Caltech commencement address from 1982. I believe these are the traits that the SURF experience helps to engender in our students; these are the things to which we aspire; and these are our dreams for future generations.

May you strive for excellence and achievement
— but avoid the pitfall of arrogance.
May you develop integrity
— but avoid the pitfall of pomposity.
May you develop fortitude
— but avoid the pitfall of becoming hardened.
May you broaden your appreciation of scholarly activities
in fields other than your own.
In a world that tends to polarize along many dimensions,
may you not permit scholarship to divide you.
May you reduce pain and suffering, and appreciate all living things.
May you know.
May you know what to do.
May you do.
May you understand what was done
and reflect upon the implications of your results.
May you not only to take time to reflect
— but may you also dream.
May you dream of what is possible for humankind.
Then may you act.
Finally, may you develop a sense of humor and never lose it.

SURFSAC

Strengthening the community of researchers is the main goal of the SURF Student Advisory Council. We endeavored to accomplish this by serving as liaisons between the 306 SURFers, their mentors, and the Student-Faculty Programs office. We also planned weekly social events both on and off campus so that the students could take a break from lab work to get to know each other. It was very important to SURFSAC to welcome the non-Caltech and Caltech Award SURFers to the Caltech community and the Los Angeles area. To facilitate these introductions, we organized events that included trips to the Getty Center, Mt. Wilson, Pasadena Ice Skating Rink, Santa Monica Pier, and Universal Studios.

Left to right: Aron Meltzner, Candace Chang, Jason Chua, Sophia Xiang, Chris Kurtz, and Rui Wang

Our most popular events were the SURFSAC Suppers. Each Wednesday, three mentors were invited to dine with a dozen SURFers at a local restaurant. The faculty and students were able to converse in an informal environment, sharing experiences and interests with each other. These opportunities remind us how intimate the Caltech community is. SURFSAC would like to thank the twenty-two professors that accepted our invitations, especially Dr. Fred Shair, Prof. Steven Frautschi, and Prof. John D. Roberts who provided us with the funding for eight fantastic suppers. We hope you enjoyed the dinners as much as the students did!

Throughout the academic year, SURFSAC will continue to work toward improving the experiences of SURFers for future years. In addition to evaluating the past summer, we will be speaking to incoming freshmen, prospective students, and undergraduates at other colleges to encourage further expansion of the SURF program. In addition, we will edit and publish the *Caltech Undergraduate Research Journal* which will include the winning papers from the Marcella and Joel Bonsall SURF prize for technical writing made possible by Dr. Marcella Bonsall's generous endowment to SURF.

I really enjoyed working with the eleven other members of the council and would like to express my appreciation for their hard work. SURFSAC is very grateful to Ryan Tischler, Cheryl Gause, Carol Casey, and of course, Carolyn Merkel for helping us make this year the best yet for SURF!

Candace Chang
Chair

DIRECTOR'S REPORT

Carolyn Merkel

We have completed the last SURF program of the 1900s, SURF's 21st year! And it was a banner year! SURF was conceived in 1979 by then-Professor of Chemical Engineering Fred Shair to introduce undergraduate students to research, identify and encourage research creativity, and to give students the opportunity to work in a collegial relationship with faculty. Eighteen students in the first SURF class have increased 17 fold to 306 in the 21st class. The program has expanded to include JPL, small local companies, and students working at colleges and universities in the US and abroad. Students from other institutions worldwide come to Caltech to participate in SURF. Some of them become graduate students here. The milestones and accomplishments of the students and the program are remarkable.

SURF 1999

- We were deeply saddened by the deaths of Terry Cole, Marcella Bonsall, and Ralph Jones this summer. All three made notable contributions to SURF and to the SURF team. They were part of the pantheon of enthusiastic SURF supporters. We are richer for having known them, and we will miss them all.

- Frances Arnold, Professor of Chemical Engineering and Biochemistry, has assumed the role of SURF Administrative Committee chair. Frances has been involved with SURF as an AdComm member and mentor of many SURF students. She is committed to undergraduate research as an important aspect of education and to maintaining the high quality experiences we seek for SURF students.

I have a much better idea of where I'm going after I graduate and I will write my senior thesis on this SURF.

— *Kacie E. Shelton*
Samuel P. and Frances Krown SURF Fellow

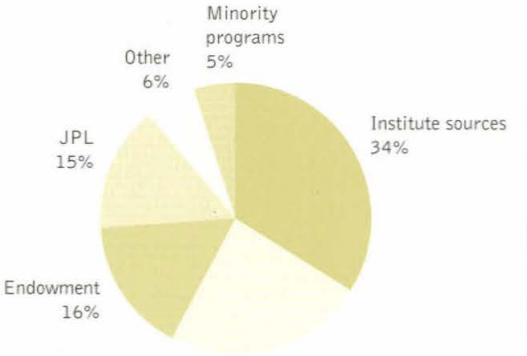
- Fred Shair completes his term as chair of the SURF Board. As SURF's founder, Fred brought his vision, commitment, and enthusiasm to the role. It has been a pleasure to work with Fred through the early days of SURF and during SURF's maturity.

- Robert Perpall has agreed to succeed Fred as chair of the SURF Board. I look forward to working with Bob as we move into SURF's third decade.

- We are delighted to announce that George and MaryLou Boone have made arrangements through their estate plan to provide for a gift to SURF of $1 million. This generous addition to the SURF endowment will advance the SURF program significantly toward its goal of raising an endowment of $10 million. We thank the Boones for their foresight and their investment in the futures of the students who will eventually benefit from this gift.

- Anthony Skjellum (BS '84, MS '85, PhD '90) did a SURF in 1983 with then-Professor of Theoretical Physics Geoffrey Fox on "Solving Problems in Classical Physics With Microcomputers." This year Tony established two SURF endowments in memory of his parents, Øistein and Rita A. Skjellum. One endowment will support a student working on creative use of computing in the sciences to recognize Tony's own SURF experience. The second endowment is unrestricted. Tony is the first former SURFer to establish an endowment. We thank Tony Skjellum for this legacy.

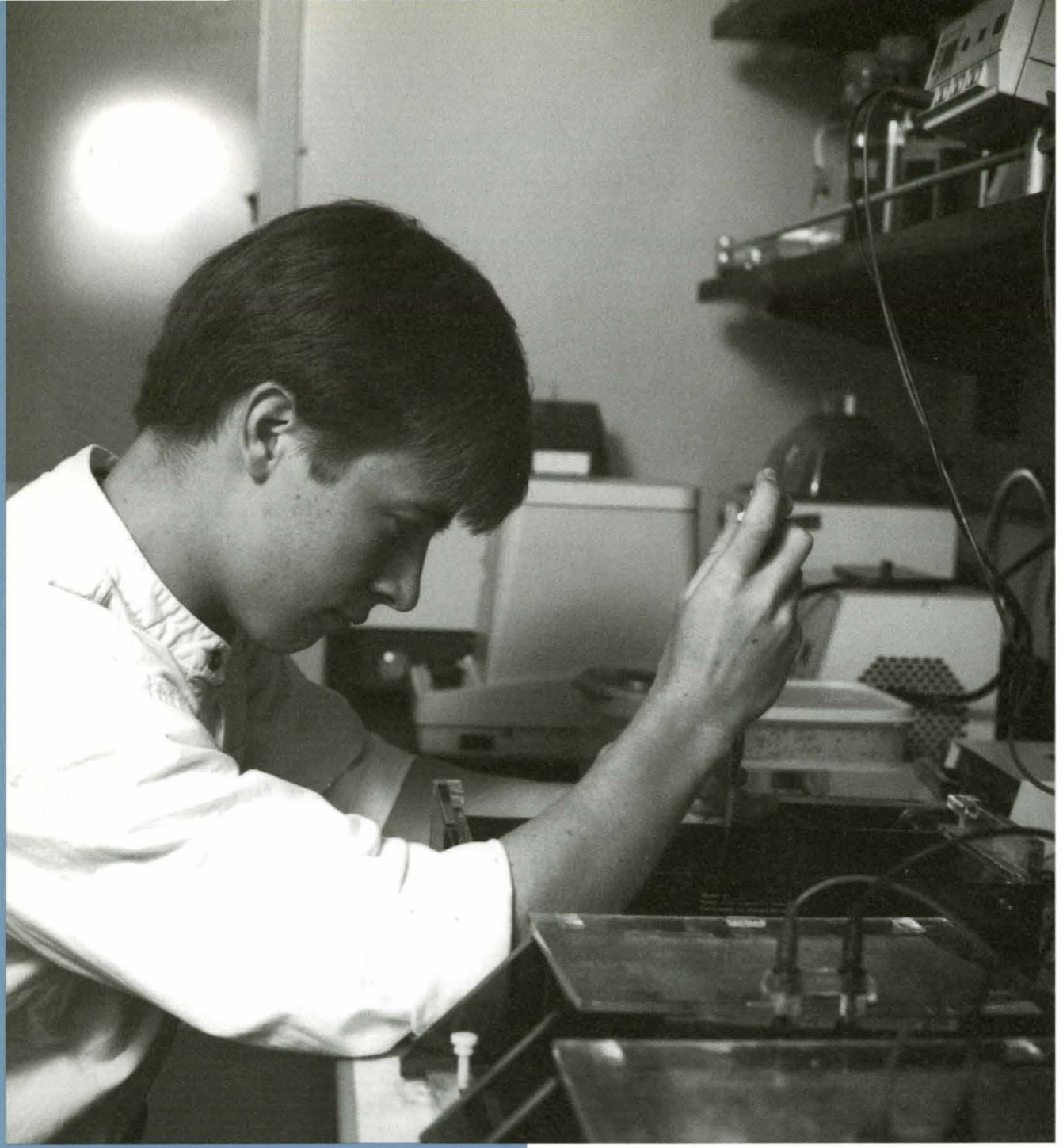
- An endowment was established anonymously to recognize and honor J. Kent Clark, Professor of Literature, Emeritus. This endowment will support a student working in the humanities each year. The J. Kent Clark SURF Endowment will give Caltech students the rich opportunity to broaden their academic experiences by applying their technical skills to research in the humanities. We are deeply grateful for this endowment.



PROFILE OF SOURCES FOR SURF STUDENT STIPENDS

- Marcella Bonsall provided a generous gift, the Marcella R. Bonsall SURF Fund, in her estate plans. During the past year, she also established the Marcella and Joel Bonsall SURF prize for technical writing to encourage students to develop excellent written communication skills. Mentors nominated their students' papers for the prize and faculty reviewers evaluated the submissions. We are delighted to announce the first three Bonsall prize winners: Jenny Phend, Jason Meltzer, and Robert Bao.

- We also thank almost 300 other donors—individuals, corporations, and foundations—who have contributed generously to SURF '99. The support of SURF's many friends provides funds required for student stipends. Since Caltech pays the administrative costs of SURF, 100% of funds contributed are used for the students.



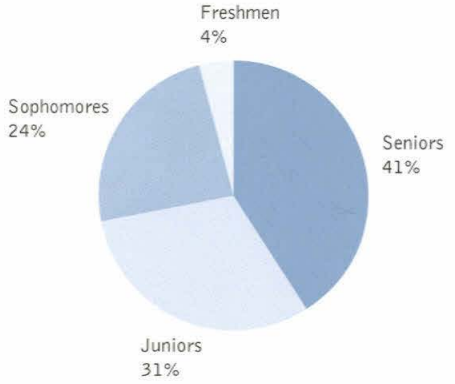
Caltech had its ten-year accreditation review by the Western Association of Schools and Colleges last fall. The visiting committee evaluated undergraduate research opportunities at the Institute and commended Caltech on the strength of the SURF program and the experiences it affords students. The visiting committee applauded the Institute's commitment to sustaining SURF and recommended continued effort to increase the endowment for the SURF program.

- Caltech developed exchange programs with University of Cambridge and the National University of Singapore (NUS) this year. Four Cambridge students participated in SURF this summer, and four Caltech students spent a term at Cambridge last winter. We welcomed two NUS students to SURF while two Caltech students did research with faculty at NUS this summer.

- It is notable that over 22% of the living alumni who received their BS degrees at Caltech are former SURF students. To date, 2,726 students have participated in SURF.

PROFILE OF THE 1999 SURF CLASS

Division	*Total Number of Students*	*Caltech Students*	*Non-Caltech Students*	*Research Mentors*
Biology	50	31	19	25
Chemistry and Chemical Engineering	44	34	10	22
Engineering and Applied Science	65	46	19	31
Geological and Planetary Sciences	17	13	4	10
Humanities and Social Sciences	5	4	1	4
Physics, Mathematics, and Astronomy	57	39	18	25
Jet Propulsion Laboratory	45	19	26	30
Off Campus	8	8	0	8
International	14	14	0	14
Other	1	1	0	1
Total	306	209	97	170



Women 37%

Minorities 10%

Median Grade Point Average 3.5/4.0*

Average Grade Point Average 3.37/4.0*

* *Caltech students only, excluding pre-frosh and freshmen*

Working in the lab was about more than discovery; it was about developing an independent philosophy for thinking."

— *Sophia Xiang*
Howard Hughes Medical Institute
SURF Fellow

Seminar Series:

Each Wednesday at noon during the summer, members of the faculty or JPL technical staff gave an overview of their areas of research. Speakers and topics this year were:

ARDEN L. ALBEE, *Professor of Geology and Planetary Science; Dean of Graduate Studies*
New Insights Into the Red Planet

DAVID BALTIMORE, *Nobel Laureate; President; Professor of Biology*
A Permanent Marker for Memory T Cells

BARRY C. BARISH, *Ronald and Maxine Linde Professor of Physics; Director, Laser Interferometer Gravitational-Wave Observatory Laboratory*
Catching the Waves With LIGO

JACQUELINE K. BARTON, *Arthur and Marian Hanisch Memorial Professor and Professor of Chemistry*
The Chemistry of DNA

PATRICIA M. BEAUCHAMP, *Leader, Center for* in situ *Exploration and Sample Return (CISSR)*
Establishing Robotic Outposts on Earth and in the Solar System

MELANY L. HUNT, *Associate Professor of Mechanical Engineering*
Understanding an Hourglass (and Other Granular Flows) in Under an Hour

JULIA A. KORNFIELD, *Associate Professor of Chemical Engineering*
Making Them Bend Without Breaking: The Physics of Semicrystalline Polymers

ALISON WINTER, *Associate Professor of History*
Is There Such a Thing as Pseudoscience? Lessons From the History of Mesmerism

JAMES F. WOODWARD, *Professor of Philosophy*
Misconduct in Science

Each Friday, members of the JPL staff presented seminars giving an overview of their research to the JPL SURF students. Speakers and their topics this year were:

MARY BOTHWELL, *Solar System Exploration Program Office and Observational Systems Division*
Discovery Missions: How Individual Scientists Define and Fly Their Own Solar System Missions

JOHN CALLAS, *Astrophysics Research Element Section, Earth and Space Science Division*
The Current Exploration of Mars

CHEICK DIARRA, *Education and Public Outreach Office, Mars Exploration Directorate*
The Mars Pathfinder Story

SABRINA GRANNAN, *Device Research Applications Section, Avionic Systems and Technology Division*
MECA: A First Step Toward Sending Humans to Mars

DEBORAH JACKSON, *Spacecraft Telecommunications Equipment Section, Telecommunications Science and Engineering Division*
Privacy and the Internet

MELORA LARSON, *Science and Technology Development Section, Mechanical Systems Engineering and Research Division*
Low Temperature Physics in Space

PETER MASON, *Low Temperature Science and Engineering, Observational Cosmology Group, JPL and Caltech*
Boomerang: Exploring the Cosmic Background From Antarctica

GENE MCDONALD, *Astrobiology Research Element Section, Earth and Space Sciences Division*
Molecular Biogeochemistry at JPL

STEVE UNWIN, *Interferometry Systems and Technology Section, Observational Systems Division*
Stellar Cartography

Having been involved in research for a little over two years—experiencing all the frustrations of trial-and-error, the disappointments of failed experiments and the joys of clean data—I have a much clearer idea of what I want to do with the rest of my life.

— *Katherine T. Noyes*
Carolyn Merkel SURF Fellow

PROFESSIONAL DEVELOPMENT SERIES

The Professional Development series is a popular, informative, and interactive program to help students address the issues and questions they will encounter as they launch their careers or apply to graduate school. The theme of this year's program was Careers: Credentials and Communication. This series was created and developed by Dr. William Whitney, a Caltech alumnus (BS '51) and Division Technologist at JPL. Parts of the program have been presented at national conferences and at other universities.

Credentials and Communication
Bill Whitney, Dr. Bruce Murray, and undergraduate students Ming Chen, Derek Shannon, Kartik Srinivasan, and Aron Meltzner.

Creating Your Community: Networking and Mentoring
Joan Horvath, Business Alliances Manager, JPL; Dr. Steve Unwin, Deputy Project Scientist for SIM, JPL; and Dr. James Rooney, Manager, Technology Affiliates Program, JPL.

Your Stake in Intellectual Property
Dr. Richmond Wolfe, office of technology transfer; Dr. Bassil Dahiyat (PhD '98), President of Xencor; Scott Carter (PhD '99), McCutchen, Doyle, Brown, & Emerson LLP.

Inventing Your Futures
Dr. Julia Kornfield (SURF '81, BS '83, MS '85), Associate Professor of Chemical Engineering; John Davis (SURF '91), graduate student, electrical engineering; Dr. Charles Budney (SURF '85, BS '88), Science Lead, Advanced Projects Design Team (Team X), JPL.

Applying to Graduate School: The Nuts and Bolts
Jonie Watanabe, Career Counselor, Career Development Center; Keith Brown (MURF '92), graduate student in biology; Ellis Meng (SURF '94, BS '97), graduate student in electrical engineering; Tashica Williams, graduate student in chemistry; and Cynthia Lee Hunt, graduate student in materials science.

Scientists as Speakers
Dr. Steven Koonin, Vice President and Provost; Professor of Theoretical Physics

SPECIAL EVENTS

George and MaryLou Boone arranged an interesting and informative tour of the Huntington Library, Art Collections, and Gardens for the SURF students. Following the tour, the Boones hosted a reception in their sculpture garden. We thank the Boones for this excellent event and for helping the students expand their academic and research experiences by introducing them to the fine collections at the Huntington and for strengthening the links between these two world-class institutions.

We thank Dr. Robert Jastrow, Dr. Arthur Vaughan, Mr. Donald Nicholson, and the staff at the Mt. Wilson Institute for the excellent tour of the observatories at Mt. Wilson. These facilities have great significance in Caltech's history, and the students appreciated the opportunity to see the instruments and enjoy an evening on the mountain.

TECHNICAL COMMUNICATION

In 1998, Marcella Bonsall established the Marcella and Joel Bonsall SURF Prize for technical writing to encourage students to develop excellent technical writing skills. Three prizes were awarded to 1998 SURFers Jenny Phend, Jason Meltzer, and Robert Bao. Mentors nominated their students' papers for the prize. A faculty committee reviewed the submitted papers and recommended papers for the award. The SURF AdComm made the final decision. Criteria for awarding the prizes include clarity of writing; demonstrated understanding of the ongoing work of the laboratory and how the student's project relates to it; accurate and clear discussion of research results and their significance.

In 1994, Robert Perpall (BS '52 and member of the SURF Board) established the Doris S. Perpall SURF Speaking Award in memory of his late wife as an incentive for students to prepare excellent oral presentations on SURF Seminar Day. Students giving the best presentations advance to a second round of the competition. Winners are selected from a final round held in January. Last year's winners were Ming Chen, David Tytell, and Kartik Srinivasan.

CONFERENCES

SURF Seminar Day: The 21st SURF seminar day was held October 16, 1999. Students present the results of their research at this symposium modeled on a professional technical meeting. Seminar day attendees include mentors, students, JPL staff, donors, alumni, parents, and other friends of the SURF program.

National Conference on Undergraduate Research (NCUR): Each year the finalists in the Perpall speaking competition attend NCUR. NCUR brings together over 2000 students from colleges and universities nationwide to present the results of their work. The conference is multidisciplinary including the sciences, engineering, math, humanities, and the arts. It is an excellent opportunity for students to learn how research is conducted and reported in different disciplines. This year's

FORMER SURF STUDENTS

- Percentage of 1999 graduates who participated in SURF: 54%
- Percentage of graduating SURF students receiving Honors at graduation: 47%
- Percentage of prizes awarded at graduation won by SURF students: 73%
- Since 1985, 623 non-Caltech students have participated in SURF. Thirty-five have become graduate students at the Institute.

conference was held at the University of Rochester. SURF student participants included Candace Chang, Ming Chen, Elizabeth Hong, Russel Howe, Daniel Levy, Shayan Mookherjea, Jaideep Singh, Kartik Srinivasan, and David Tytell. Caltech hosted NCUR in 1991.

Southern California Conference on Undergraduate Research (SCCUR): Cal Poly Pomona hosted the sixth annual SCCUR conference in 1998. SCCUR is modeled on NCUR and gives students in the region the chance to participate in a stimulating exchange of information and ideas across the disciplines. SCCUR was started at Caltech in 1993.

THE SURF TEAM

This year brought transition in the Student-Faculty Programs Office. Susie Clark took a new position in another department after nine years assisting SURF. She made outstanding contributions to the programs and to the office. We welcome Cheryl Gause and Ryan Tischler to the staff. Together with Carol Casey, these new SURF staff members have become the backbone of the administrative operation, and a Tiffany team it is. They demonstrate unfailing good humor and perseverance in the midst of the flurry of questions, e-mail, paperwork, and telephone calls engendered by 306 students and their mentors. Their caring and creativity make the office a comfortable environment for students, mentors, donors, and other visitors.

Special thanks to Bill Whitney for all he does for the SURF program. He serves as SURF's JPL point of contact, coordinates the professional development series, reads SURF proposals, recruits seminar speakers, and counsels students. We all deeply appreciate his dedication and hard work. SURF has richly benefited from Bill's many contributions.

Not only has SURF enabled me to work directly with a professor in an intensive research environment, it has also allowed me to go into much greater depth with my projects than I could have during the school year.

— *Jennifer Taggart*
Richter Scholar

OUSAMA M. ABUSHAGUR
Sophomore, ECE; University of Alabama in Huntsville

New Technology Developments for Free Space Optical Communication Systems

Mentor: Payman Arabshahi, *Member of the Technical Staff, JPL*

FRANCISCO M. ACEVEDO
Senior, Eng/Ph; Embry-Riddle Aeronautical University

Characterizing Actuators for Accurate Optical Control for the Keck Observatory Interferometer

Mentor: Gautam Vasisht, *Member of the Technical Staff, JPL*

JONATHAN S. ACORN
Junior, EE; Worcester Polytechnic Institute

Experimental Assessment of the Tuning Characteristics of a Coupled Oscillator Array for Phased Array Antenna Control

Mentor: Ronald J. Pogorzelski, *Technical Group Supervisor, JPL*

OWEN P. AFTRETH
Junior, Ay

A Possible Cluster at Redshift 1.47

Mentor: Baruch T. Soifer, *Professor of Physics; Director, Space Infrared Telescope Facility*

DAVID AKHAVAN
NSF REU SURF Fellow
Junior, Bioengineering; University of California at Berkeley

Measuring the Micro-Creep Limit of High-Tensile Metal

Mentors: Kenneth G. Libbrecht, *Professor of Physics* and Riccardo DeSalvo, *Staff Member in Physics*

ORKUN AKIN
Richter Scholar
Junior, Bi

Identification of Novel Neural Crest Genes in *Xenopus laevis*

Mentor: Marianne Bronner-Fraser, *Professor of Biology*

EUNICE ALLEN-BRADLEY
The James Irvine Foundation MURF Fellow
Junior, Aerospace Engineering; Syracuse University

Homodyne Detection Velocimetry Using Laser-Induced Thermal Acoustics

Mentors: Hans G. Hornung, *C.L. "Kelly" Johnson Professor of Aeronautics* and Stefan Schlamp, *Graduate Student in Aeronautics*

MARITZA ALVARADO
Howard Hughes Medical Institute MURF Fellow
Junior, Neurobiology/Psy; University of California at Berkeley

Multi-Unit Recording From the Cerebellum: Probing Neuronal Activity

Mentor: James M. Bower, *Professor of Biology*

JOSE ZANDRO C. AQUINO
Howard Hughes Medical Institute MURF Fellow
Senior, Ch; San Francisco State University

A Tandem Ring-Opening Metathesis Polymerization (ROMP)-Atom Transfer Radical Polymerization (ATRP) Approach to Triblock Copolymers

Mentors: Robert H. Grubbs, *Victor and Elizabeth Atkins Professor of Chemistry* and Christopher Bielawski, *Graduate Student in Chemistry*

LAURA ARCE
Amgen MURF Fellow
Senior, Bi; California State University, Fullerton

Induction of Interleukin-2 via Ras V12 Effector Loop Mutants

Mentors: José Alberola-Ila, *Assistant Professor of Biology* and Micheline Laurent, *Postdoctoral Scholar in Biology*

MARK C. ARNESEN
Flintridge Foundation SURF Fellow
Junior, Ay

A Search for High-Redshift Quasars

Mentor: S. George Djorgovski, *Professor of Astronomy*

PASCAL A. BABUSIAUX
Senior, Oceanography; ENSIETA

SCDTrades

Mentor: Joel C. Sercel, *Visiting Associate in Mechanical Engineering; Lecturer in Aeronautics*

TOM W. BAEHR-JONES
Richter Scholar
Junior, APh

Dynamic Simulation of Laser Gain in Photonic Crystals

Mentor: Axel Scherer, *Professor of Electrical Engineering, Applied Physics, and Physics*

VIJAYANTHI BALARAMAN
Ford Motor Company SURF Fellow
Sophomore, CS

Interactive Methods for Constructing Finite Automata

Mentor: James R. Arvo, *Associate Professor of Computer Science*

ONUREENA BANERJEE
Arthur E. Lamel SURF Fellow
Senior, EE

Multi-Resolution Rate-Distortion Theory

Mentor: Michelle Effros, *Assistant Professor of Electrical Engineering*

XIAOYAN BAO
Richter Scholar
Senior, Bi

Observation of Transcription at the Single Molecule Level

Mentor: Stephen R. Quake, *Associate Professor of Applied Physics*

ZHAOSHENG BAO
Richter Scholar
Sophomore, CS

Measurement and Analysis With the GIOD Prototype System: A Study of Network Demands

Mentor: Harvey B. Newman, *Professor of Physics*

JEFFREY E. BARRICK
Samuel P. and Frances Krown SURF Fellow
Junior, Ch

Optimization of the Selection of N Peptides Using mRNA-Peptide Fusions

Mentor: Richard W. Roberts, *Assistant Professor of Chemistry*

LEON M. BELLAN
Caltech Award SURF Fellow
Freshman

Development of a Multiprocessor Multilayer Optimization Code for Use in the Design of X-ray Telescopes

Mentor: Fiona A. Harrison, *Assistant Professor of Physics*

RAPHAEL P. BELLIER
Senior, Pyrotechnics; ENSIETA

SCDTrades

Mentor: Joel C. Sercel, *Visiting Associate in Mechanical Engineering; Lecturer in Aeronautics*

DIEGO BENITEZ
Senior, Ch; Universidad Nacional Autonoma de Mexico

Elucidation of the Conformational Preferences of γ-Dimethylamino Acids in Various Solvents by Correlation of NMR Vicinal Coupling Constants and Dihedral Angles

Mentor: John D. Roberts, *Institute Professor of Chemistry, Emeritus*

CHRISTOPHER D. BERGER
Senior, EAS

Tokugawa Population History, 1716–1868

Mentor: James Z. Lee, *Associate Professor of History*

DAVID BERNS
NSF REU SURF Fellow
Senior, Ph/EE; Tufts University

Drawing High Strength Fused Silica Fibers for Suspending LIGO 2 Test Masses

Mentors: Kenneth G. Libbrecht, *Professor of Physics* and Phil Willems, *Staff Member in Physics*

PAUL BEST
Senior, AMa; University of Cambridge

A Study of Some Properties of Relativistic Shock Waves Relevant in Theoretical Models of Gamma Ray Bursts

Mentor: Peter M. Goldreich, *Lee A. DuBridge Professor of Astrophysics and Planetary Physics*

VIDYA M. BHALODIA
Howard Hughes Medical Institute SURF Fellow
Senior, Bi

Modeling the Effects of Transient Magnetic Stimulation on Neurons

Mentor: Shinsuke Shimojo, *Professor of Biology*

BARIS BINGÖL
Howard Hughes Medical Institute SURF Fellow
Senior, Molecular Biology and Genetics; Bilkent University

eat-16 Knockout and Supressors of *eat-16*; sag-1 Double Mutation

Mentor: Paul W. Sternberg, *Professor of Biology; Investigator, Howard Hughes Medical Institute*

JUSTIN S. BOLAND
Senior, Ph; University of Texas at Dallas

Web Site for Displaying Quantitative Measurements of the Propagation of Radio Waves

Mentor: David B. Rutledge, *Professor of Electrical Engineering*

AGEDI N. BOTO
Sophomore

Mathematical Modelling of Quantum Gyroscope Sensitivity

Mentor: Jonathan P. Dowling, *Senior Research Scientist, JPL*

ABELARDO BOURBOIS
Caltech Award SURF Fellow
Freshman

Exploring Parametric Modulation of the Generalized Harmonic Oscillator

Mentor: Daniel P. Weitekamp, *Associate Professor of Chemical Physics*

NICHOLAS F. BREEN
Senior, Ch

Computational Modeling of Rodcoil Molecules

Mentor: William A. Goddard III, *Charles and Mary Ferkel Professor of Chemistry and Applied Physics*

JESSICA C. BROWN
Howard Hughes Medical Institute SURF Fellow
Sophomore, Molecular Biology; Pomona College

Yeast Two Hybrid Analysis of Yeast Proliferating Cell Nuclear Antigen and Polymerase Epsilon

Mentor: Judith L. Campbell, *Professor of Chemistry and Biology*

NATHAN S. BROWN
Sophomore, Ay

Rapid Trajectory Optimization for Low Thrust Spacecraft

Mentor: Joel C. Sercel, *Visiting Associate in Mechanical Engineering; Lecturer in Aeronautics*

SASKYA E. BYERLY
Caltech Award SURF Fellow
Freshman

Monarc Simulations of Networked Systems and Object Data Transfer

Mentors: Harvey B. Newman, *Professor of Physics* and Julian J. Bunn, *Visiting Associate in Physics*

SASCHA B. CALKINS
Sophomore, ME/Bi

A Lunar Transient Event in Cobrahead

Mentor: Bonnie J. Buratti, *Research Scientist, JPL*

EMANUELE CAMERA
Senior, Aerospace Engineering; Politecnico di Milano

Laser-Induced Thermal Acoustics

Mentor: Hans G. Hornung, *C.L. "Kelly" Johnson Professor of Aeronautics*

SCOTT H. CARNAHAN
Senior, Ma

Crossing Number of Complete Bipartite Graphs

Mentor: Richard M. Wilson, *Professor of Mathematics*

JOEL E. CARRANZA
Ford Motor Company SURF Fellow
Sophomore, CS

Exploring the Use of 2D Interface Elements Within the Responsive Workbench

Mentor: James R. Arvo, *Associate Professor of Computer Science*

DEANNA M. CARRICK
Richter Scholar
Junior, Bi

Determination of Minimum Activation Sequence of SpHobx12

Mentors: Eric Davidson, *Norman Chandler Professor of Cell Biology* and Paola Oliveri, *Postdoctoral Scholar in Biology*

COLLEEN L. CARY
Howard Hughes Medical Institute SURF Fellow
Senior, Bi; University of Colorado

Identification and Analysis of TIMP-2 Homologues in *C. elegans*

Mentor: Paul W. Sternberg, *Professor of Biology; Investigator, Howard Hughes Medical Institute*

EMILIO CASTAÑO
Lester Lees Aeronautics SURF Fellow
Sophomore, Ae

Egyptian Wind Power: Using Kites to Erect Egyptian Obelisks

Mentor: Morteza Gharib, *Professor of Aeronautics*

ELISA K. CHAN
Bristol-Meyers SURF Fellow
Sophomore, Bi

Iron Metabolism: Studies of Proteins That Bind to the 3' Untranslated Region (3' UTR) of a Novel Form of Ferritin Heavy Chain mRNA and Effects of These Interactions

Mentors: Maire Ede Percy, *Associate Professor of Physiology, University of Toronto* and Alexander Varshavsky, *Howard and Gwen Laurie Smits Professor of Cell Biology*

CANDACE C. CHANG
Beckman Scholar
Senior, Ch

The Temporal Response of Polymer/Carbon Black Composite Resistors to Organic Vapors

Mentor: Nathan S. Lewis, *Professor of Chemistry*

JOSEPH Y. CHANG
Arthur Rock SURF Fellow
Junior, EE

3-D Stereoscopic Vision

Mentor: Glen A. George, *Lecturer in Computer Science and Electrical Engineering*

MING M. CHEN
Beckman Scholar
Senior, Ch

Exploring the Structure of the Enzyme Oligosaccharyl Transferase via a Novel, Localized Cross-Linking Reaction

Mentors: Harry B. Gray, *Arnold O. Beckman Professor of Chemistry* and Barbara Imperiali, *Professor of Chemistry, Massachusetts Institute of Technology*

STEPHEN W. CHEN
Howard Hughes Medical Institute SURF Fellow
Sophomore, Neuroscience; Brown University

Modulation of Inflammation Affects Plaque Numbers

Mentor: Paul H. Patterson, *Professor of Biology*

XUEJING CHEN
Caltech Award SURF Fellow
Freshman

Interface Between Mechanical and Orbital Environments

Mentor: Robert C. Carnright, *Member of the Engineering Staff, JPL*

TYLER C. CHEUNG
Junior, Molecular Biochemistry and Biophysics; Yale University

Investigations of Biogenic Gases in a Photochemically Active Atmosphere

Mentor: Yuk L. Yung, *Professor of Planetary Science*

CHIA-K'AI CHNG
Junior, Mechanical and Production Engineering; National University of Singapore

Absolute and Differential Measurements of Water Vapor Supersaturation Using a Modified Commercial Hygrometer

Mentor: Kenneth G. Libbrecht, *Professor of Physics*

PAUL J. CHOI
Caltech Award SURF Fellow
Freshman

Infrared Spectroscopy and ^{95}Mo NMR Studies of Molybdenum N-Heterocyclic Carbene Complexes

Mentor: Robert H. Grubbs, *Victor and Elizabeth Atkins Professor of Chemistry*

HERMAN CHOW
Arthur R. Adams SURF Fellow
Sophomore, Ph

The Aging Study of the Scintillator and Optical Fiber

Mentor: Hwi Y. Kim, *Postdoctoral Scholar in Physics*

FARIA R. CHOWDHURY
General Motors SURF Fellow
Junior, EE

Design and Construction of a Sample Probe for Electrical Impedance Measurements

Mentor: Sossina M. Haile, *Assistant Professor of Materials Science*

JASON H. CHUA
Arthur R. Adams SURF Fellow
Junior, Bi

Tracing Development of the Midline Structure in *Drosophila*

Mentor: Barbara J. Wold, *Professor of Biology*

HELEN C. CLAUDIO
Paracel, Inc. SURF Fellow
Junior, EAS

Introns and Hidden Markov Models in Exon Searching

Mentor: Glen A. George, *Lecturer in Computer Science and Electrical Engineering*

ANDREW J. COE
Samuel P. and Frances Krown SURF Fellow
Sophomore, Ma

Correlations for Spiral Galaxies Between Neutral Hydrogen Gas Distribution and 21-cm Velocity Dispersion Profiles

Mentor: Barry F. Madore, *Director, NASA Extragalactic Database*

NALINI A. COLACO
Sophomore, Bi

Searching for Autosomal and X-Linked Suppressors of Polyglutamine Toxicity in *Drosophila*

Mentor: Seymour Benzer, *James G. Boswell Professor of Neuroscience, Emeritus*

KRISTEN L. COOK
Sophomore, PISc

Graceful Labeling of Graphs

Mentor: Richard M. Wilson, *Professor of Mathematics*

JAMES E. COOLEY
Junior, Ph

Miniaturizing a Hemispherical Electrostatic Ion Energy Analyzer

Mentor: Dennis J. Fitzgerald, *Member of the Technical Staff, JPL*

LISA A. COWAN
Applied Materials SURF Fellow
Junior, ChE

The Effects of Cation Substitution on Super-Protonic Phase Transitions

Mentor: Sossina M. Haile, *Assistant Professor of Materials Science*

GARY W. CRISP
JPLUS SURF Fellow
Senior, Eng; Harvey Mudd College

Study of Optical Detectors for Deep Space Communication

Mentor: Gerardo Ortiz, *Member of the Engineering Staff, JPL*

ELIZABETH R. CUTLER
Richter Scholar
Junior, CS

Animated Algorithms

Mentor: Glen A. George, *Lecturer in Computer Science and Electrical Engineering*

MICHELLE C. CYRIER
Senior, Ch; University of California at Berkeley

EPR Polarimetry

Mentor: Emlyn W. Hughes, *Professor of Physics*

LUSINE DANAKIAN
Arthur A. Noyes SURF Fellow
Sophomore, Bi/Ch

Site-Directed Mutagenesis of Taq Polymerase

Mentors: John H. Richards, *Professor of Organic Chemistry and Biochemistry* and Curtis R. Bloom, *Postdoctoral Scholar in Chemistry*

KESHAV M. DANI
Senior, Ph

Decoherence in Two Qubit Conditional Dynamics

Mentors: Simon C. Benjamin, *Research Fellow, University of Oxford* and John P. Preskill, *Professor of Theoretical Physics*

SANDIP P. DARJI
Professor Fredrick H. Shair SURF Fellow
Senior, ChE

Characterization and Testing of Artificial Extracellular Matrix Proteins: Behavior of Cultured Endothelial Cells in Response to Shear Stress

Mentor: David A. Tirrell, *Ross McCollum-William H. Corcoran Professor and Professor of Chemistry and Chemical Engineering*

ROSEMARY G. DE ANTONIO
Junior, Ma; Wofford College

Specification Patterns: A Rigorous, Multi-Level Framework for Reuse of Formal Specifications

Mentor: John Kelly, *Principal Engineer, JPL*

MICHAEL E. DE SALVO
Junior, ME

Synthesis of Bismuth Telluride in Opal Nanotemplates

Mentor: G. Jeff Snyder, *Staff Scientist, JPL*

DAVID J. DE VAULT
Senior, EAS

Do Eye Movements Reflect Visual Imagery in the Tower of Hanoi Puzzle?

Mentor: Alan H. Bond, *Lecturer in Computer Science*

HEATHER L. DEAN
Thomas E. Everhart SURF Fellow
Senior, EE

Olfactory Conditioning of the Locust: Nonassociative and Associative Components of the Response to Odor and the Effect of Picrotoxin on the Response to Odor

Mentor: Gilles J. Laurent, *Associate Professor of Biology and Computation and Neural Systems*

RACHEL J. DEXTER
Sophomore, Ch

A Proton Spin Manipulation for Improved FDMR Resolution

Mentor: Daniel P. Weitekamp, *Associate Professor of Chemical Physics*

ERIK A. DILL
Ernest H. Swift SURF Fellow
Junior, Ch

Electron Transfer Through DNA Crossover Junctions

Mentor: Jacqueline K. Barton, *Arthur and Marian Hanisch Memorial Professor and Professor of Chemistry*

AMY C. DUELLO
Donald S. Clark SURF Fellow
Junior, ME

Construction and Characterization of a High-Temperature Mechanical Testing System

Mentor: Ersan Üstündag, *Assistant Professor of Materials Science*

CHRISTOPHE P. DUFEŸ
Senior, ME; ENSIETA

Caltech Parameter Exchange Tool (C-PET)

Mentor: Joel C. Sercel, *Visiting Associate in Mechanical Engineering; Lecturer in Aeronautics*

NICHOLAS F. DUMMER
Howard Hughes Medical Institute SURF Fellow
Junior, Ch; University of Wales

A Study of the Mechanism of Zeolite Synthesis

Mentor: Jesse L. Beauchamp, *Professor of Chemistry*

VICTOR DURÀ VILÀ
Senior, Ch; Imperial College

Conformational Analysis of 3-Methylpentanedioic Acid by Nuclear Magnetic Resonance

Mentor: John D. Roberts, *Institute Professor of Chemistry, Emeritus*

SAMVID H. DWARAKANATH
Junior, Ph/CS; Duke University

Computational Analysis of Helium-3 Data Taken in the Vicinity of the Critical Point

Mentor: Martin Barmatz, *Research Scientist, JPL*

BRYAN K. EASTIN
Professor Ward Whaling SURF Fellow
Junior, Ph

Simulating the Galaxy for Cosmic Rays

Mentor: Mark Wiedenbeck, *Research Scientist, JPL*

KJERSTIN I. EASTON
Senior, EE

MMX-Optimized Real-Time Stereo Robot Vision

Mentor: Yalin Xiong, *Senior Staff, JPL*

LAURA J. EVANS
Sophomore, ME; Northwestern University

Mars Data Analysis

Mentor: Matthew P. Golombek, *Research Scientist, JPL*

JOSEPH D. FASSLER
Richter Scholar
Sophomore, Ch

Arene-Perfluoroarene Interactions in the Solid State

Mentor: Robert H. Grubbs, *Victor and Elizabeth Atkins Professor of Chemistry*

MARC FAVATA
Samuel P. and Frances Krown SURF Fellow
Senior, Ph

Energy Localization and Tidal Heating in General Relativity

Mentor: Kip S. Thorne, *Richard P. Feynman Professor of Theoretical Physics*

ROBERT D.W. FERGUS
Senior, Eng; University of Cambridge

Unsupervised Learning of Models for Car Recognition

Mentor: Pietro Perona, *Professor of Electrical Engineering*

MICHAEL D. FISCHER
Senior, EE; University of Victoria

Differential Phase and the Development of an Atmospheric Dispersion Compensator for the Palomar Testbed Interferometer

Mentor: Braden E. Hines, *Supervisor, Realtime Interferometer Software Group, JPL*

MICHAEL P. FITZGERALD
Senior, EAS

Fringe Tracking in the Keck Interferometer

Mentor: Gautam Vasisht, *Member of the Technical Staff, JPL*

NATHAN E. FLOWERS-JACOBS
Junior, Ph

Aeneas Mercury Orbiter: Spacecraft Configuration and Structural Elements

Mentor: Lloyd C. French, *Systems Architect, JPL*

JENNIFER A. FONG
Samuel P. and Frances Krown SURF Fellow
Junior, ChE

Construction of a Flow Reactor for Use in the Study of Chemical Kinetics of Stratospheric Reactions

Mentor: Mitchio Okumura, *Associate Professor of Chemical Physics*

CHERYL A. FOREST
Dr. and Mrs. George N. Boone SURF Fellow
Junior, Bi

An Overexpression/Misexpression Screen to Identify Genes Involved in Axon Guidance

Mentor: Kai G. Zinn, *Associate Professor of Biology*

NANCY K. FORSBERG
Senior, Ge/ME; Hofstra University

Mapping and Analysis of Far Field Rocks Around the Mars Pathfinder Landing Site

Mentor: Matthew P. Golombek, *Research Scientist, JPL*

PETER J. FREESE
Toshi Kubota Aeronautics SURF Fellow
Junior, ME/Ec

Granular Flow in a Vertically Vibrating Hopper

Mentor: Melany L. Hunt, *Associate Professor of Mechanical Engineering*

ROBIN S. FRIEDMAN
General Motors SURF Fellow
Junior, Ch

SDK_UNIQUAC: A Module for the Estimation of Liquid-Vapor Equilibria of Complex Chemical Mixtures

Mentor: Mario Blanco, *Director, Process Simulation, Materials Simulations Center*

CRISTAL I. GAMA
Howard Hughes Medical Institute MURF Fellow
Senior, Bioch; California State University, Los Angeles

Identification and Characterization of SPLAYED in *Arabidopsis thaliana*

Mentors: Elliot M. Meyerowitz, *Professor of Biology* and Doris Wagner, *Senior Research Fellow in Biology*

BENJAMIN A. GARCIA
Howard Hughes Medical Institute MURF Fellow
Senior, Ch; University of California, Davis

Studies of Non-Covalent Complexes in the Gas Phase Using Mass Spectrometry

Mentor: Jesse L. Beauchamp, *Professor of Chemistry*

JANE GARRITY
Richter Scholar
Junior, Bi

Characterization of the Molecular Components Involved in the Chemotactic Response of *Shewanella oneidensis*

Mentor: Kenneth H. Nealson, *Faculty Associate in Geobiology and Environmental Engineering Science; Lecturer in Environmental Engineering Science; Senior Scientist, JPL*

PETER M. GERDES
Richter Scholar
Junior, Ma

Recursively Enumerable Equivalence Relations

Mentor: Su Gao, *Harry Bateman Research Instructor in Mathematics*

CAROLINE M. GIBBS
Edward W. Hughes SURF Fellow
Sophomore, Ch

Study of the Nicotinic Acetylcholine Receptor Binding Site via Tethered Agonists

Mentor: Dennis A. Dougherty, *Professor of Chemistry*

YURY M. GOLDFELD
Richter Scholar
Sophomore, CS/AMa

Fitting Subdivision Surfaces to CSG Models

Mentor: David Breen, *Assistant Director, Computer Graphics Laboratory*

JAVIER T. GONZALEZ-RIVERA
Howard Hughes Medical Institute MURF Fellow
Junior, ChE; University of Puerto Rico, Mayagüez

Brownian Dynamics of Attractive Particle Systems

Mentors: John F. Brady, *Chevron Professor of Chemical Engineering* and Johan B. Bergenholtz, *Postdoctoral Scholar in Chemical Engineering*

RACHEL F. GRAY
Samuel P. and Frances Krown SURF Fellow
Senior, Bi

Isolation of Genes Regulated by Iron Concentration in *M. magnetotacticum*

Mentor: L. Elizabeth Bertani, *Visiting Associate and Lecturer in Biology*

ANTHONY GUERRERA
Richter Scholar
Sophomore, Ph/Ch

Determining the Conformational Equilibrium of 2-aminoethylpyridine as a Function of Solvent and pH

Mentor: John D. Roberts, *Institute Professor of Chemistry, Emeritus*

NICHOLAS D. GUISE
Caltech Award SURF Fellow
Freshman

Optimization of a Low Velocity Intense Source for Production of a Bose-Einstein Condensate

Mentor: Lute Maleki, *Principal Member of the Engineering Staff, JPL*

ENCARNACION GUTIERREZ
JPLUS SURF Fellow
Junior, Eng; Los Angeles Valley College

Integration of Advanced Spacecraft Design Tools

Mentor: Joel C. Sercel, *Visiting Associate in Mechanical Engineering; Lecturer in Aeronautics*

JEANETTE C. HAGAN
Sophomore, Ph

High-Redshift Quasars

Mentor: S. George Djorgovski, *Professor of Astronomy*

SEAN A. HARTNOLL
Junior, Ma; University of Cambridge

Iron Lines From Warped Accretion Discs in Active Galactic Nuclei

Mentors: Eric Blackman, *Postdoctoral Scholar in Physics* and E. Sterl Phinney III, *Professor of Theoretical Astrophysics*

DERRICK P. HASTEROK
Mrs. Vernon L. Barrett SURF Fellow
Junior, Geophysics

Comparison of 3-D Vp and Vs Velocity Models With Geological Structures and Seismicity for Southern California

Mentor: Egill Hauksson, *Senior Research Associate in Geophysics*

JOHN W. HATFIELD
Richter Scholar
Senior, Ph/AMa

A Method for the Removal of Self-Intersections From Invariant Manifolds Generated by Numerical Calculations From a Discretized Velocity Field

Mentor: Stephen R. Wiggins, *Professor of Applied Mechanics*

ERIC W. HAYNE
JPLUS SURF Fellow
Junior, Ay; Pasadena City College

High Accuracy Astrometry of Asteroids

Mentor: William M. Owen, Jr., *Member of the Technical Staff, JPL*

GARRETT C. HEFFNER
Sidney R. and Nancy M. Petersen SURF Fellow
Sophomore, Bi

Determining Eph Receptor Clustering Activity Using Fluorescence Resonance Energy Transfer

Mentor: Scott E. Fraser, *Anna L. Rosen Professor of Biology*

AREN N. HEINZE
Junior, Ay

Volatile Transport on Pluto

Mentor: Bonnie J. Buratti, *Research Scientist, JPL*

JESSICA P. HELLER
Sophomore, ChE

The Conformation of 1,3-diamino-2-hydroxypropane as a Function of pH and Solvent

Mentor: John D. Roberts, *Institute Professor of Chemistry, Emeritus*

RICHARD HELMS
NSF REU SURF Fellow
Senior, Ph; Vanderbilt University

Characterization of the Optics Used in LIGO's Input Optics System

Mentors: Kenneth G. Libbrecht, *Professor of Physics* and Haisheng Rong, *Staff Member in Physics*

CLIFFORD W. HICKS
Senior, Ph

Magnetic Traps for Cavity QED Experiments

Mentor: H. Jeff Kimble, *William L. Valentine Professor and Professor of Physics*

CHRISTOPHER M. HIRATA
Richter Scholar
Junior, Ph

Computer Simulation of a Gamma Ray Imager

Mentor: Fiona A. Harrison, *Assistant Professor of Physics*

JUSTIN S. HO
Sophomore, ChE

Development of an *in vitro* Paradigm for Observing Brain Mast Cell-Neuron Transgranulation

Mentors: Ann-Judith Silverman, *Professor, Department of Anatomy and Cell Biology, Columbia University* and Paul H. Patterson, *Professor of Biology*

CUONG G. HOANG
Richter Scholar
Sophomore, ChE

Modeling Atmospheres With Rotation and Levitation of a 2-cm Soap Bubble

Mentor: Morteza Gharib, *Professor of Aeronautics*

MICHAEL J. HOCHBERG
Sophomore, APh/CS

In situ Growth of Freestanding Aluminum Oxide Membranes

Mentor: Axel Scherer, *Professor of Electrical Engineering, Applied Physics, and Physics*

LOREN K. HOFFMAN
Mr. and Mrs. Fred M. Wells SURF Fellow
Sophomore, Ph

Radioactivity Analysis of Neutrino Detector Components

Mentor: Robert D. McKeown, *Professor of Physics*

ELIZABETH J. HONG
Warren and Katharine Schlinger SURF Fellow
Sophomore, Bi/APh

Screening for the Amyloid Precursor Protein γ-Secretase in *Drosophila*

Mentor: Bruce A. Hay, *Assistant Professor of Biology*

VIT HRADECKY
Junior, Ph/Ay

Mass-to-Light Ratios of Groups and Clusters of Galaxies

Mentors: Christine Jones, *Senior Astrophysicist, Harvard-Smithsonian Center for Astrophysics* and S. George Djorgovski, *Professor of Astronomy*

CINDY H. HSU
Howard Hughes Medical Institute SURF Fellow
Sophomore, Bi/Psychology; Johns Hopkins University

Biological Effects of IL-6 in Focal Ischemic Stroke

Mentor: Paul H. Patterson, *Professor of Biology*

KATHERINE L. HUG
Senior, Bi; Reed College

The Cultural Bacteria Community of Mono Lake, California

Mentor: Alexandre I. Tsapin, *Research Scientist, JPL*

MATTHEW R. HUGHES
Caltech Award SURF Fellow
Freshman

Fabricating Nanowires From DNA

Mentor: Stephen R. Quake, *Associate Professor of Applied Physics*

FRANK J. HUMPHREY
Senior, Ae; Iowa State University

Aeneas Mercury Orbiter: Command and Data Handling

Mentor: Lloyd C. French, *Systems Architect, JPL*

WOOK J. HWANG
Junior, Ph

Gas Drag Enchancement of the Capture Cross-Section During Planetary Accretion

Mentor: David J. Stevenson, *George Van Osdol Professor of Planetary Science*

DANIELA A. IONITA-ARITON
Sophomore, Ph

Imaging and Analysis of Protoplanetary Nebulae Using Pictures Taken With the Hubble Space Telescope

Mentor: Raghvendra Sahai, *Research Scientist, JPL*

TANIM S. ISLAM
General Motors SURF Fellow
Junior, Ph

Parity Violation in $B \to \gamma K \pi\pi$ Decays

Mentor: Alan J. Weinstein, *Associate Professor of Physics*

ALEKSANDAR M. IVANOVIC
Senior, Electronics; University of Belgrade

Modeling the A.C. Electrical Response of Ionically Conducting Materials

Mentor: Sossina M. Haile, *Assistant Professor of Materials Science*

RYAN P. JACKSON
JPLUS SURF Fellow
Junior, EE; Chaffey College

Aeneas Mercury Orbiter: Communications

Mentor: Lloyd C. French, *Systems Architect, JPL*

JOHN A. JOHNSON
NSF REU SURF Fellow
Senior, Ph; University of Missouri-Rolla

A Study of the Strength of Hydroxide Catalyzed Fused Silica Bonds

Mentors: Kenneth G. Libbrecht, *Professor of Physics* and Phil Willems, *Staff Member in Physics*

SARAH M. JOSEPH
Senior, Ae; University of Michigan

Aeneas Mercury Orbiter: Systems Engineering and Management

Mentor: Lloyd C. French, *Systems Architect, JPL*

TED E. JOU
Caltech Award SURF Fellow
Freshman

Development of an EPICS-Based Vacuum Control System for the Caltech 40-Meter LIGO Prototype Upgrade

Mentor: Alan J. Weinstein, *Associate Professor of Physics*

HYUNAH KANG
Sophomore, ME

Characteristics of Wave Propagation in Nonuniform Granular Chains

Mentors: Jongbae Hong, *Professor of Physics, Seoul National University* and Melany L. Hunt, *Associate Professor of Mechanical Engineering*

RICHARD A. KARNESKY, JR.
NSF REU SURF Fellow
Sophomore, Ph

Investigation of the Bonding Techniques for the Test Masses of LIGO Interferometers

Mentors: Kenneth G. Libbrecht, *Professor of Physics* and Haisheng Rong, *Staff Member in Physics*

ANNE E. KELLY
Mr. and Mrs. Robert L. Noland SURF Fellow
Senior, Ph

Simulating the Large Scale Structure of the Universe

Mentors: John Peacock, *Professor of Astronomy, University of Edinburgh* and S. George Djorgovski, *Professor of Astronomy*

HANNA KIM
J. Kent Clark SURF Fellow
Senior, Bi

Economics and Politics of the Human Body in Modern Medicine: Then and Now

Mentor: Alison Winter, *Associate Professor of History*

ILJIE J. KIM
Mrs. Downie D. Muir SURF Fellow
Junior, Bi/Lit

Response of Semicircular Canal Afferents in the Vestibular System of *Opsanus tau*, the Oyster Toadfish

Mentors: Stephen M. Highstein, *Senior Scientist, Marine Biological Laboratory, Woods Hole; Professor of Otolaryngology, Anatomy, and Neurobiology, Washington University* and James M. Bower, *Professor of Biology*

MICHELLE I. KINGHAM
NSF REU SURF Fellow
Junior, Ph; Louisiana State University

What Happens When the Mirrors on a Mode-Cleaner Move?

Mentors: Kenneth G. Libbrecht, *Professor of Physics*, Biplab Bhawal, *Senior Postdoctoral Fellow in Physics*, and Hiroaki Yamamoto, *Member of the Professional Staff in Physics*

BRENT M. KIOUS
Beckman Scholar
Senior, Bi

Cloning and Characterization of the Peripheral Nervous System Marker EPM4

Mentor: Marianne Bronner-Fraser, *Professor of Biology*

NICHOLAS A. KNOUF
Software Technologies SURF Fellow
Sophomore, Bi/CNS

Pattern Rivalry in a Modified Flash Suppression Paradigm

Mentor: Christof Koch, *Professor of Computation and Neural Systems*

KATHARINA KOHLER
Sophomore, Ay

Search for Active Galactic Nuclei

Mentors: Stefan Wagner, *Associated Professor of Astrophysics, Landessternwarte Heidelberg-Konigstuhl* and Charles C. Steidel, *Professor of Astronomy*

JUNA A. KOLLMEIER
Senior, Ph

Investigating the Structure of the Interstellar Medium in Galaxies Along Lines of Sight to Distant Quasars

Mentors: Stephane Charlot, *Astrophysicist, Institut D'Astrophysique* and S. George Djorgovski, *Professor of Astronomy*

BARBARA K. KRAATZ
Richter Scholar
Sophomore, Bi

Transcriptional and DNA-Protein Binding Studies on the Regulation of the *cbb* Operons (CO_2 Assimilation) in *Ralstonia eutropha*

Mentors: Botho Bowien, *Professor of Microbiology, Georg-August-Universitaet* and Alexander Varshavsky, *Howard and Gwen Laurie Smits Professor of Cell Biology*

MIRIAM O. KRAUSE
Senior, Ge; Pomona College

The Distribution of Magnetic Sources on Mars as Related to Surface Geology

Mentor: Martha S. Gilmore, *Postdoctoral Research Associate, JPL*

GERAUD P. KRAWEZIK
Senior, Electronics Engineering; ENSIETA

DrawCraft: A Spacecraft Design Tool for Solidworks

Mentor: Joel C. Sercel, *Visiting Associate in Mechanical Engineering; Lecturer in Aeronautics*

MICHAEL KUHLEN
Senior, Ph

Photometric Redshifts of Distant Galaxies

Mentor: Charles C. Steidel, *Professor of Astronomy*

BENJAMIN J. KULICK
Mr. and Mrs. Fred M. Wells SURF Fellow
Junior, Ph

Low Frequency Gravitational Waves From White Dwarf MACHO Binaries

Mentors: William A. Hiscock, *Professor of Physics, Montana State University; Director, Montana Space Grant Consortium* and Rochus E. Vogt, *R. Stanton Avery Distinguished Service Professor and Professor of Physics*

MAX P. KULLBERG
Richter Scholar
Senior, Ph

The Androgen Receptor's Role in Prostate Cancer

Mentor: Faye A. Eggerding, *Director, Cancer Genetics Laboratory, Huntington Medical Research Institute*

CHRISTOPHER E. KURTZ
Mr. and Mrs. John E. Young SURF Fellow
Senior, Ch

Simple Techniques for the Characterization of Protein Folding

Mentor: Richard W. Roberts, *Assistant Professor of Chemistry*

SOLOMON J. KUTNICKI
William H. and Helen Lang SURF Fellow
Sophomore, EE

Scientific Visualization Using 3-D Volumetric Morphing

Mentor: David Breen, *Assistant Director, Computer Graphics Laboratory*

AARON A. KUZIN
Shirley and Carl Larson SURF Fellow
Senior, Bi

Regulation of Neuronal Gene Expression by NF-κB

Mentor: David Baltimore, *President; Professor of Biology*

FRENÉ D. LACOUR
Howard Hughes Medical Institute MURF Fellow
Senior, Bi; Florida A&M University

Effect of Ectopic Expression of Growth Factors on Neural Crest Cells

Mentors: Marianne Bronner-Fraser, *Professor of Biology* and Sara Ahlgren, *Postdoctoral Scholar in Biology*

PHUONG-NGHI K. LAM
Sophomore, ChE

Determining the Interactions Between the DNA-Binding/Oligomerization Domain and the Activation Domain of the Yeast Shock Factor

Mentor: Carl S. Parker, *Professor of Biochemistry*

LILY L. LAN
Howard Hughes Medical Institute SURF Fellow
Junior, Microbiology and Molecular Genetics; University of California, Los Angeles

Isolation and Characterization of New Molecular Tools to Study Aging in the Fruit Fly *Drosophila melanogaster*

Mentor: Seymour Benzer, *James G. Boswell Professor of Neuroscience, Emeritus*

GWELTAZ T. LAVANAN
Senior, Pyrotechnics Engineering; ENSIETA

SCDTrades

Mentor: Joel C. Sercel, *Visiting Associate in Mechanical Engineering; Lecturer in Aeronautics*

JOSE A. LAZOFLORES
Senior, Engineering Physics; Embry-Riddle Aeronautical University

Redistribution of Mass in the Oceans and Simulated GRACE Data

Mentor: Victor Zlotnicki, *Research Scientist, JPL*

PIERRE LE BRIS DU REST
Senior, Electronics; ENSIETA

SCDTrades

Mentor: Joel C. Sercel, *Visiting Associate in Mechanical Engineering; Lecturer in Aeronautics*

ANDREW S. LEE
Junior, AMa; Brown University

A Molecular Migration Simulation for Ganymede

Mentor: Yuk L. Yung, *Professor of Planetary Science*

BENJAMIN G. LEE
Richter Scholar
Sophomore, APh

Fabrication of Diffractive Optical Elements Using Electron-Beam Lithography

Mentor: Axel Scherer, *Professor of Electrical Engineering, Applied Physics, and Physics*

CHRISTINA O. LEE
Senior, Astrophysics; City College of San Francisco

Observations of Comets and Asteroids

Mentor: Paul R. Weissman, *Senior Research Scientist, JPL*

MELVIN B-T. LEOK
Mrs. Hannah Bradley SURF Fellow
Senior, Ma

Symplectic Integrators for Mechanical Systems With Symmetry

Mentor: Jerrold E. Marsden, *Professor of Control and Dynamical Systems*

DANIEL L. LEVY
Beckman Scholar
Senior, Bi/Ch

Characterization of the Putative Zinc Finger (ZF) Domain of Yeast DNA Polymerase ε and the Finding That the ZF Domain, and Not the Catalytic Domain, is Essential for Viability

Mentor: Judith L. Campbell, *Professor of Chemistry and Biology*

CAROLINE LIM
Junior, Bi

Xenopus DNA2 and Interacting Proteins

Mentor: Judith L. Campbell, *Professor of Chemistry and Biology*

JENNIFER M. LINDSAY
Howard Hughes Medical Institute MURF Fellow
Sophomore, Ch; Harvey Mudd College

Determination of the Conformations of Succinic Acid as a Function of Solvent Polarity via NMR Spectroscopy, Quantum Mechanics, and the Altona-Haasnoot Equation

Mentor: John D. Roberts, *Institute Professor of Chemistry, Emeritus*

MICHAEL J. LIU
Samuel P. and Frances Krown SURF Fellow
Sophomore, CS

Optimizing Trajectories for Low-Thrust Spacecraft

Mentor: Joel C. Sercel, *Visiting Associate in Mechanical Engineering; Lecturer in Aeronautics*

YI-PING LIU
Senior, EAS

Kinetics of Uranium Released From Aqueous Suspensions Containing Sorbed and Precipitated Uranium Phases

Mentor: Janet G. Hering, *Associate Professor of Environmental Engineering Science*

DOMINIC G. LUCCHETTI
Senior, EE

Autonomous Visual Discovery

Mentor: Michael C. Burl, *Senior Member of the Technical Staff, JPL*

FRANCIS A. MACDONALD
Richter Scholar
Senior, Ch

The Thermal History of the Martian Meteorite ALH84001 and the Paleointensity of the Martian Magnetic Field

Mentor: Joseph L. Kirschvink, *Professor of Geobiology*

KATHERINE J. MACK
Caltech Award SURF Fellow
Freshman

Measurement of ^{3}He Gas Density Using Laser Absorption Spectroscopy

Mentor: Emlyn W. Hughes, *Professor of Physics*

SARAH J. MAHONEY
SURF Alumni SURF Fellow
Sophomore, Bi

A Screen for Male Mating Mutants

Mentor: Paul W. Sternberg, *Professor of Biology; Investigator, Howard Hughes Medical Institute*

HOWEN MAK
J. Weldon Green SURF Fellow
Junior, ME

Micromachined Check-Valved Diaphragm Pump

Mentor: Yu-Chong Tai, *Associate Professor of Electrical Engineering*

SAMUEL MAKONNEN
Sophomore, EE/Ph

Seismic Wall Measurements

Mentors: Kenneth G Libbrecht, *Professor of Physics* and Eric Black, *Postdoctoral Scholar in Physics*

SAM MANDEGARAN
Senior, EE

LIGO Core Optics Simulation Using End to End Model

Mentors: Kenneth G. Libbrecht, *Professor of Physics*, Biplab Bhawal, *Senior Postdoctoral Fellow in Physics*, and Hiroaki Yamamoto, *Member of the Professional Staff in Physics*

ELITZA N. MANEVA
Junior, CS/Ma

Two-Way Entanglement Purification Protocols

Mentors: John A. Smolin, *Research Staff Member, IBM Corporation* and John P. Preskill, *Professor of Theoretical Physics*

CHRISTOPHE A. MAQUESTIAUX
Sophomore, Ay

Optical Interferometry for Measuring Displacement in Tight Places

Mentor: Daniel P. Weitekamp, *Associate Professor of Chemical Physics*

JASON A. MARSHALL
Senior, Astrophysics; University of California, Los Angeles

Adaptive Optics: Understanding the Results

Mentor: Richard Dekany, *Senior Engineer, JPL*

MICHAEL T. MASSEY
Arthur R. Adams SURF Fellow
Sophomore, AMa/EAS

The Capacity of Input-Constrained Noisy Channels With Applications to Optical Communications

Mentor: Robert J. McEliece, *Allen E. Puckett Professor and Professor of Electrical Engineering*

MARIO L. MATA
Center for Neuromorphic Systems Engineering MURF Fellow
Senior, Neurobiology; University of Texas at San Antonio

The Effects of Visuospatial Attention on Performance Asymmetries

Mentor: Christof Koch, *Professor of Computation and Neural Systems*

VIVEK C. MATHRANI
Senior, Ch

Survey of Arsenic Levels in Groundwater in a West Bengal Village

Mentors: Dipankar Chakraborti, *Director, School of Enviromental Studies, Jadavpur University* and Janet G. Hering, *Associate Professor of Environmental Engineering Science*

KEVIN B. MCCARTY
Senior, Ph

Data Analysis Software for Reconstruction of Particle Trajectories in the CLEO III Detector

Mentor: Alan J. Weinstein, *Associate Professor of Physics*

ALICE A. MEDVEDEV
Senior, Ma

Definable Sets of <Z, +>

Mentors: Jindrich Zapletal, *John Wesley Young Instructor of Mathematics, Dartmouth College* and Alexander S. Kechris, *Professor of Mathematics*

PANKAJ MEHTA
Senior, Ma

The Jovian Winds and Their Effect on Jupiter's Magnetic Field

Mentor: David J. Stevenson, *George Van Osdol Professor of Planetary Science*

GEOFFREY W. MEISSNER
Richter Scholar
Junior, Bi

Differential Display Screening of Gene Expression in the Mouse Amygdala

Mentor: David J. Anderson, *Professor of Biology; Investigator, Howard Hughes Medical Institute*

CARLOS D. MELENDEZ
Howard Hughes Medical Institute MURF Fellow
Senior, ChE; University of Puerto Rico, Mayagüez

Optimization of Enzyme Production in Recombinant *E. coli*

Mentors: Frances H. Arnold, *Professor of Chemical Engineering and Biochemistry* and Oliver May, *Postdoctoral Scholar in Chemical Engineering*

JASON T. MELTZER
Mr. and Mrs. Robert L. Noland SURF Fellow
Junior, ME

Automated Recognition of Galaxies

Mentor: S. George Djorgovski, *Professor of Astronomy*

ARON J. MELTZNER
Robert L. Blinkenberg SURF Fellow
Senior, Ge

Aftershocks of the Great 1906 California Earthquake

Mentor: David J. Wald, *Visiting Associate in Geophysics*

GAVIN F. MENDECK
Senior, Ae; Texas A&M University

Aeneas Mercury Orbiter: Mission Design and Propulsion

Mentor: Lloyd C. French, *Systems Architect, JPL*

FLORIAN T. MERKLE
Hugh F. and Audy Lou Colvin International SURF Fellow
Sophomore, Bi

Analysis of Neuronal Activity During Binocular Rivalry Using a Hidden Markov Method

Mentors: Nikos K. Logothetis, *Professor of Biological Cybernetics, Max Planck Institute* and Christof Koch, *Professor of Computation and Neural Systems*

SARAH M. MILKOVICH
Senior, PISc

Aeneas Mercury Orbiter: Science and Instrumentation

Mentor: Lloyd C. French, *Systems Architect, JPL*

WREN B. MONTGOMERY
Mrs. W. E. Zisch SURF Fellow
Senior, Ph

Improving the Force Field of Triaminotrinitrobenzene (TATB)

Mentor: William A. Goddard III, *Charles and Mary Ferkel Professor of Chemistry and Applied Physics*

ERIC MORGANSON
NSF REU SURF Fellow
Sophomore, Ph

Developing an Earth-Tides Model for LIGO Interferometers

Mentors: Kenneth G. Libbrecht, *Professor of Physics* and Frederick J. Raab, *Member of the Professional Staff in Physics*

JASVINDER S. NANGIANA
Howard Hughes Medical Institute SURF Fellow
Junior, Molecular Biology; University of California at Berkeley

Design and Preparation of Transferrin Receptor Mutants to Localize the Transferrin Binding Site

Mentor: Pamela J. Bjorkman, *Professor of Biology; Investigator, Howard Hughes Medical Institute*

SUHAS R. NAYAK
Sophomore, Ch

Investigating Long-Range Electron Transfer Processes

Mentors: Michael N. Paddon-Row, *Scientia Professor of Chemistry, University of New South Wales* and Rudolph A. Marcus, *Arthur Amos Noyes Professor of Chemistry*

PATRICK NERCESSIAN
AstroTerra SURF Fellow
Junior, EE

Laser Tracking as a Means of Error Minimization in TerraLink Wireless Networks

Mentor: Glen A. George, *Lecturer in Computer Science and Electrical Engineering*

NHIEN H. NGUYEN
Junior, Bi

Disruption of Endogenous N-Cadherin at the Synaptic Junction by the Expression of 390

Mentor: Erin M. Schuman, *Associate Professor of Biology; Assistant Investigator, Howard Hughes Medical Institute*

PETER T. NGUYEN
William N. Lacey SURF Fellow
Junior, ChE

Directed Evolution of a Hydantoinase Towards a Variety of Substrates

Mentor: Frances H. Arnold, *Professor of Chemical Engineering and Biochemistry*

KRISTINE E. NIELSON
Senior, Ge

Chemotaxis in *Shewanella*

Mentor: Kenneth H. Nealson, *Faculty Associate in Geobiology and Environmental Engineering Science; Lecturer in Environmental Engineering Science; Senior Scientist, JPL*

KATHERINE T. NOYES
Carolyn Merkel SURF Fellow
Senior, Bi

Long Range Oxidative Damage in Nucleosomes

Mentor: Jacqueline K. Barton, *Arthur and Marian Hanisch Memorial Professor and Professor of Chemistry*

ROGER C. O'BRIENT
Richter Scholar
Junior, APh

Designing a Mode-Locked Fiber Laser

Mentor: Amnon Yariv, *Martin and Eileen Summerfield Professor of Applied Physics*

RYAN C. OGLIORE
Senior, Ph; Claremont McKenna College

Determining the Geomagnetic Cutoff for Galactic Cosmic Ray Particles Using the SAMPEX Satellite

Mentor: Richard A. Mewaldt, *Senior Research Associate in Physics*

JENNIFER M. OKADA
The James Irvine Foundation MURF Fellow
Senior, Ph/CS; University of Hawaii, Hilo

In Search for Low-Surface-Brightness Galaxies

Mentor: S. George Djorgovski, *Professor of Astronomy*

IVELISSE ORTIZ HERNANDEZ
Ford Motor Company MURF Fellow
Senior, ChE; University of Puerto Rico, Mayagüez

Reverse Selectivity for CH_4:CO_2 Separation Over Porous Glass Membranes

Mentors: George R. Gavalas, *Professor of Chemical Engineering* and Huanting Wang, *Postdoctoral Scholar in Chemical Engineering*

KIM PAGE
NSF REU SURF Fellow
Junior, Ph; University of Leicester

Investigation Into Magnetic Levitation for LIGO Test Masses

Mentors: Kenneth G. Libbrecht, *Professor of Physics* and Eric Black, *Postdoctoral Scholar in Physics*

BRIAN A. PALMER
Sophomore, Ch

Analysis of DNA-Nanodevice Based on B-Z Transition

Mentor: William A. Goddard III, *Charles and Mary Ferkel Professor of Chemistry and Applied Physics*

LANDI M. PARISH
Junior, Ma; Massachusetts Institute of Technology

Stochastic Simulation of the Hoffman, Magee, Johnston Ion Channel Kinetic Scheme

Mentors: Christof Koch, *Professor of Computation and Neural Systems* and Michael Herzog, *Postdoctoral Scholar in Biology*

ELEANOR J. PARK
Arthur R. Adams SURF Fellow
Senior, ChE

Aerosol Degradation Applications of Photocatalysis on Titanium Dioxide Coated Surfaces

Mentor: Michael R. Hoffmann, *James Irvine Professor of Environmental Science*

CURTIS W. PEHL
Sophomore, Ph

A Piezoelectric Test Bed for Light Scattering From Nanostructures

Mentor: Daniel P. Weitekamp, *Associate Professor of Chemical Physics*

AMY R. PETERSON
Mrs. Vernon L. Barrett SURF Fellow
Junior, EAS

Heavy Tails Resulting From Stock Market Risk Management

Mentor: John C. Doyle, *Professor of Electrical Engineering*

DENIS S. PETROVIC
NSF REU SURF Fellow
Senior, Ph; University of Belgrade

Identification of Stationary Non-Gaussian Components in LIGO 40m Data and Their Visualization

Mentors: Kenneth G. Libbrecht, *Professor of Physics,* Albert Lazzarini, *Member of the Professional Staff in Physics,* and Thomas A. Prince, *Professor of Physics*

MATTHIEU M. PIERRET
Senior, ME; ENSIETA

Caltech Parameter Exchange Tool (C-PET)

Mentor: Joel C. Sercel, *Visiting Associate in Mechanical Engineering; Lecturer in Aeronautics*

PETER P. PLAVCHAN
Junior, Ph

Studies in the Mid-Infrared of IRC+10216

Mentor: Michael W. Werner, *Senior Research Scientist, JPL*

SINEAD E. QUIN
NSF REU SURF Fellow
Senior, Physics With Astrophysics; University of Leicester

Investigation Into Magnetic Levitation for LIGO Test Masses

Mentors: Kenneth G. Libbrecht, *Professor of Physics* and Eric Black, *Postdoctoral Scholar in Physics*

DAVID A. RAHMLOW
Richter Scholar
Sophomore, Ph

Construction and Use of a Solar Tracker for Studying Atmospheric Composition

Mentor: Paul O. Wennberg, *Associate Professor of Atmospheric Chemistry and Environmental Engineering Science*

TIMOTHY D. RAUB
Dr. and Mrs. Lew Allen, Jr. SURF Fellow
Sophomore, Ge/Bi

Is Utah's Belly-Button an Innie or an Outie?

Mentor: Joseph L. Kirschvink, *Professor of Geobiology*

NEAL S. REEVES
Mr. and Mrs. Victor V. Veysey SURF Fellow
Junior, AMa

Analysis of Crossover Voting in the 1998 California Primary Election

Mentor: R. Michael Alvarez, *Associate Professor of Political Science*

CHRISTIAN L. REICHARDT
Richter Scholar
Junior, Ph

Triple Probe Diagnostic of Spheromak Plasma

Mentor: Paul M. Bellan, *Professor of Applied Physics*

MICHAEL R. REID
Senior, Molecular Biology; University of California, San Diego

Diversity of Bacterial Fauna at Freshwater Interfaces of Mono Lake Using 16s rDNA Analysis

Mentor: Alexandre I. Tsapin, *Research Scientist, JPL*

DENA A. RICHARDSON
Senior, ME; California Polytechnic State University, San Luis Obispo

Aeneas Mercury Orbiter: Thermal Protection

Mentor: Lloyd C. French, *Systems Architect, JPL*

SANDRA L. RICHARDSON
The James Irvine Foundation MURF Fellow
Senior, Ma; Dillard University

Mathematical Modeling of the Spacecraft Design Process

Mentor: John O. Ledyard, *Professor of Economics and Social Sciences*

KEVIN P. RICHBERG
Mr. and Mrs. John E. Young SURF Fellow
Senior, Ch

Improving DNA Sequencing Through Site Directed Mutagenesis of Taq Polymerase

Mentor: John H. Richards, *Professor of Organic Chemistry and Biochemistry*

LEFTY A. RIVERA
Center for Neuromorphic Systems Engineering MURF Fellow
Junior, Computer Engineering; University of Puerto Rico, Mayagüez

Experimental Assesment of a Computational Approach to Visual Recognition

Mentor: Pietro Perona, *Professor of Electrical Engineering*

QUINCY R. ROBERTSON
NSF REU SURF Fellow
Senior, Ph; Southeastern Louisiana University

Surface Binding Energies of Residual Gases in the LIGO-Livingston Beam Tubes

Mentors: Kenneth G. Libbrecht, *Professor of Physics* and Mark Coles, *Member of the Professional Staff in Physics*

DAVID E. ROBISON
NSF REU SURF Fellow
Senior, EE/CS; Massachusetts Institute of Technology

A Suspension Controller for the LIGO Thermal Noise Interferometer

Mentors: Kenneth G. Libbrecht, *Professor of Physics* and Jay W. Heefner, *Staff Member in Physics*

DANIEL K. ROGSTAD
Robert M. Abbey SURF Fellow
Senior, Bi

Vaccine Ideas for Hepatitis C Virus

Mentor: James H. Strauss, *Ethel Wilson Bowles and Robert Bowles Professor of Biology*

ALAN M. ROSENWINKEL
Howell N. Tyson SURF Fellow
Senior, ME

Characteristics of Liquid Immersed Collisions

Mentor: Melany L. Hunt, *Associate Professor of Mechanical Engineering*

NITZAN C. ROTH
Caltech Award SURF Fellow
Freshman

Estimates of N_2 Abundances in Dark Molecular Clouds

Mentor: Geoffrey A. Blake, *Professor of Cosmochemistry and Planetary Science and Professor of Chemistry*

SARAH E. ROTHENBERG
JPLUS SURF Fellow
Senior, AMa; University of California, Los Angeles

Federal Budget Trends and the Implications for Space Research

Mentor: Richard O'Toole, *Manager, Legislative and International Affairs, JPL*

GRAY A. RYBKA
Sophomore, Ph/CS

Tools and Techniques for Analyzing Neural Data From Multi-Electrode Arrays

Mentor: Steven M. Potter, *Senior Research Fellow in Biology*

DOMINIKA RYTWINSKA
Richter Scholar
Junior, ChE

Crystallization of Mutant Protein $P450_{cam}$

Mentor: Frances H. Arnold, *Professor of Chemical Engineering and Biochemistry*

MA KATRINA T. SABATER
Amgen MURF Fellow
Junior, Biological Chemistry; Saint Peter's College

In trans Cleavage Analysis of Alphavirus nsp2 Between Two Alphavirus Species: Sindbis and Semliki Forest

Mentor: James H. Strauss, *Ethel Wilson Bowles and Robert Bowles Professor of Biology*

VERONICA A. SAVU
Richter Scholar
Senior, Ph

Target Density Studies

Mentor: Robert D. McKeown, *Professor of Physics*

RORY A. SAYRES
Senior, Bi

Expression of Chimeric trp/trpl Constructs in Cell-Line and *in vivo* Photoreceptors of *Drosophila*

Mentors: Roger C. Hardie, *University Lecturer in Anatomy, University of Cambridge* and Gilles Laurent, *Associate Professor of Biology and Computation and Neural Systems*

MICHAEL M. SCHEIN
Junior, Ma

Determination of the CP-Violating Electric Dipole Moment and Spin Correlations of the Tau Lepton

Mentor: Alan J. Weinstein, *Associate Professor of Physics*

STEVEN E. SCHELL
Mr. and Mrs. Ralph Jones SURF Fellow
Junior, ME

Experimental and Analytical Characterization of the Dynamics of the Caltech Low Turbulence Water Tunnel Test Facility

Mentor: Christopher E. Brennen, *Professor of Mechanical Engineering*

ADAM L. SCOTT
Junior, Ph

Modeling a Liquid Hydrogen Target

Mentor: Cathleen E. Jones, *Senior Research Associate in Physics*

KATHERINE J. SCOTT
Caltech Award SURF Fellow
Freshman

Aeneas Mercury Orbiter: Power System

Mentor: Lloyd C. French, *Systems Architect, JPL*

ISAAC SEE
Caltech Award SURF Fellow
Freshman

Cation-π Interactions and Their Role in Protein Thermostability

Mentors: Henry A. Lester, *Professor of Biology* and Justin P. Gallivan, *Graduate Student in Chemistry*

NATHANIEL T. SENCHY
Dr. Chandler C. Ross SURF Fellow
Sophomore, ME

Mechanical Modeling of Carangiform Fish Locomotion and Maneuvering

Mentor: Joel W. Burdick, *Associate Professor of Mechanical Engineering*

ADRIAN P. SEYMOUR
Northern California Associates SURF Fellow
Senior, PlSc

Multispectral Analysis of MASTER Airborne Simulator Data From Volcanic Regions of Baja California, Mexico

Mentor: Joann M. Stock, *Professor of Geology and Geophysics*

DEREK M. SHANNON
The Associates SURF Fellow
Sophomore, Geobi/Ae

Paving the Way for Mars Polar Lander: The Southern Polar Region of Mars as Revealed by Mars Global Surveyor

Mentor: Bruce C. Murray, *Professor of Planetary Science and Geology*

DENIS A. SHCHERBAKOV
Applied Materials SURF Fellow
Junior, ChE

Design of User Interface Tools for Plasma Emission Measurements and Electron Spectroscopy of Semiconductor Thin Films

Mentor: Konstantinos P. Giapis, *Associate Professor of Chemical Engineering*

KACIE E. SHELTON
Samuel P. and Frances Krown SURF Fellow
Senior, Ph

Calibrating the Angular Resolution of the Boomerang Experiment

Mentor: Andrew E. Lange, *Professor of Physics*

STEPHEN V. SHEPHERD
Senior, Bi/CNS

Transcranial Magnetic Stimulation of the Visual System in the Human Brain

Mentor: Shinsuke Shimojo, *Professor of Biology*

CARRIE SHILYANSKY
Richter Scholar
Junior, Bi

Regulation and Kinetics of Activity-Regulated Cytoskeleton-Associated (Arc) Protein in Hippocampal Neurons

Mentor: Erin M. Schuman, *Associate Professor of Biology; Assistant Investigator, Howard Hughes Medical Institute*

RYAN M. SIMKOVSKY
Junior, Bi

Characterization of the Molecular Components Involved in the Tactic Behavior of *Shewanella oneidensis* (Formerly *Shewanella putrefaciens* MR1)

Mentor: Kenneth H. Nealson, *Faculty Associate in Geobiology and Environmental Engineering Science; Lecturer in Environmental Engineering Science; Senior Scientist, JPL*

AARON W. SIMONS
Sophomore, Ph/Ma

New Representations and Applications to Field Theory

Mentors: Heinrich Saller, *Associate Professor of Particle Physics, Max Planck Institute of Physics* and John H. Schwarz, *Harold Brown Professor of Theoretical Physics*

JAIDEEP SINGH
Senior, Ph

The Use of Potassium in the Nuclear Spin Polarization of Noble Gases

Mentor: Emlyn W. Hughes, *Professor of Physics*

MICAH S. SITTIG
Junior, Ph

Near-Infrared Modelling of Saturnian and Jovian Satellite Spectra

Mentor: Bonnie J. Buratti, *Research Scientist, JPL*

ALEKSANDRS L. SLIVKINS
Richter Scholar
Senior, Ma

Interleaving Schemes on Circulant Graphs

Mentor: Jehoshua Bruck, *Professor of Computation and Neural Systems and Electrical Engineering*

JENNIFER C. SMITH
Howard Hughes Medical Institute SURF Fellow
Senior, Psy/Political Science; Dalhousie University

The Role of LIF and IL-6 in the Pathological and Cellular Changes That Follow Seizure

Mentor: Paul H. Patterson, *Professor of Biology*

THOMAS M. SNYDER
Arthur R. Adams SURF Fellow
Sophomore, Ch

Use of Psoralen Cross-Linking in the Formation of RNA-Protein Fusions

Mentor: Richard W. Roberts, *Assistant Professor of Chemistry*

RALF H. SOCHER
JPLUS SURF Fellow
Senior, Ae; University of California, Irvine

Aeneas Mercury Orbiter: Attitude and Control System

Mentor: Lloyd C. French, *Systems Architect, JPL*

ALI A. SOLEIMANI
Junior, Ph/Ma

Quantum Error Correction Using Concatenated Codes

Mentor: John P. Preskill, *Professor of Theoretical Physics*

LILACH SOMBERG
Senior, Ch

Models of Gallium Nitride Surfaces and Reconstructions

Mentor: William A. Goddard III, *Charles and Mary Ferkel Professor of Chemistry and Applied Physics*

BRIAN A. STALDER
SURF Alumni SURF Fellow
Junior, Ph

Optical Identification of FIRST Radio Sources Using DPOSS

Mentor: S. George Djorgovski, *Professor of Astronomy*

NATHAN D. STEIN
General Motors SURF Fellow
Junior, APh

Characterization of Vitreous Alloys

Mentor: William L. Johnson, *Ruben F. and Donna Mettler Professor of Engineering and Applied Science*

SHANNON F. STEWMAN
Peter A. Lindstrom SURF Fellow
Junior, Ch

Conformational Analysis of Hydroxy Acids

Mentor: John D. Roberts, *Institute Professor of Chemistry, Emeritus*

NARU SUNDAR
Junior, EE

Source Independent Universal Multi-Resolution Codes

Mentor: Michelle Effros, *Assistant Professor of Electrical Engineering*

ANONGPAT SUTTANGKAKUL
Sophomore, Bi

Map-Based Positional Cloning of *MOB* (MODIFIER OF B FUNCTION) Gene

Mentor: Elliot M. Meyerowitz, *Professor of Biology*

CHIEMI D. SUZUKI
Howard Hughes Medical Institute SURF Fellow
Senior, Bi; Bryn Mawr College

A New Animal Model of Mental Illness

Mentor: Paul H. Patterson, *Professor of Biology*

ERIKA R. SWANSON
Howard Hughes Medical Institute SURF Fellow
Senior, Ch

Crystallization of Membrane Channel Proteins

Mentor: Douglas C. Rees, *Professor of Chemistry*

IAN D. SWETT
Mr. and Mrs. Richard M. Rosenberg SURF Fellow
Senior, Ec

Optimal Strategies for Combinatorial Markets

Mentor: John O. Ledyard, *Professor of Economics and Social Sciences*

JENNIFER C. TAGGART
Richter Scholar
Sophomore, Bi

Identification and Characterization of Loss of Function Mutants in DIAP2

Mentor: Bruce A. Hay, *Assistant Professor of Biology*

ALEX K.W. TAN
Senior, Electrical and Information Sciences; University of Cambridge

Signal Processing for Ionospheric Radio Wave Propagation

Mentor: David B. Rutledge, *Professor of Electrical Engineering*

HAREEM TARIQ
Junior, Physics With Astrophysics; King's College, London

Assessment of Radiation Hazards in Space Due to Heavy Ions Accelerated in the Solar Energetic Particle Events

Mentor: Richard A. Mewaldt, *Senior Research Associate in Physics*

STEPHEN W. THRASHER
Sophomore, Ae

Collisions, Dynamical Wormholes, and the Demise of Shoemaker-Levy 9

Mentor: Jerrold E. Marsden, *Professor of Control and Dynamical Systems*

EDWARD J. THRELFALL
Junior, Ph; University of Cambridge

Gravitational Scattering in the Early Solar System

Mentor: David J. Stevenson, *George Van Osdol Professor of Planetary Science*

BRYAN E. TIEDEMANN
Class of '36 SURF Fellow
Sophomore, Ch

Solar Energy Conversion

Mentor: Harry B. Gray, *Arnold O. Beckman Professor of Chemistry*

KATHRYN G. TODD
Richter Scholar
Junior, Ph/Lit

Developing Science Curricula for Middle School Students

Mentor: Jerry Pine, *Professor of Physics*

JENNIFER P. TUNG
Sophomore, Bi

Determining the Accuracy of Model Actinic Radiation Calculations by Comparison With UV Direct Measurements

Mentor: Yuk L. Yung, *Professor of Planetary Science*

ERIC P. TUTTLE
Richter Scholar
Junior, APh

DNA Nanowire Fabrication

Mentor: Stephen R. Quake, *Associate Professor of Applied Physics*

KAMRAN VAKILI
Richter Scholar
Senior, Ph

Precise Measurements of the Critical Properties of Liquid Helium Using a High-Q Superconducting Cavity - A Numerical Study

Mentor: Nai-Chang Yeh, *Professor of Physics*

AL G. VALDIVIA
Sophomore, Bi

Developmental Control in *Arabidopsis thaliana*

Mentors: Xuemei Chen, *Assistant Professor of Genetics, Rutgers University* and Elliot M. Meyerowitz, *Professor of Biology*

LISA VAN HOOZER
Richter Scholar
Junior, Ch

Mutagenesis, Expression, and Purification of Variants of Taq DNA Polymerase Designed by Computer Modeling

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Source Coding for Packet Based Networks

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Design and Construction of a Fourier Transform Spectrometer to Characterize Novel Superconductive SIS and Hot Electron Bolometer Mixers for FIRST

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Mentors: Kenneth G. Libbrecht, *Professor of Physics* and Riccardo DeSalvo, *Staff Member in Physics*

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Efficient Remeshing of Surfaces With Arbitrary Connectivity

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The Genetic Mapping of the *TARANTULA* Gene and the Characterization of a Putative *tarantula* Allele in *Arabidopsis thaliana*

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EAS	Engineering & Applied Science
Ec	Economics
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