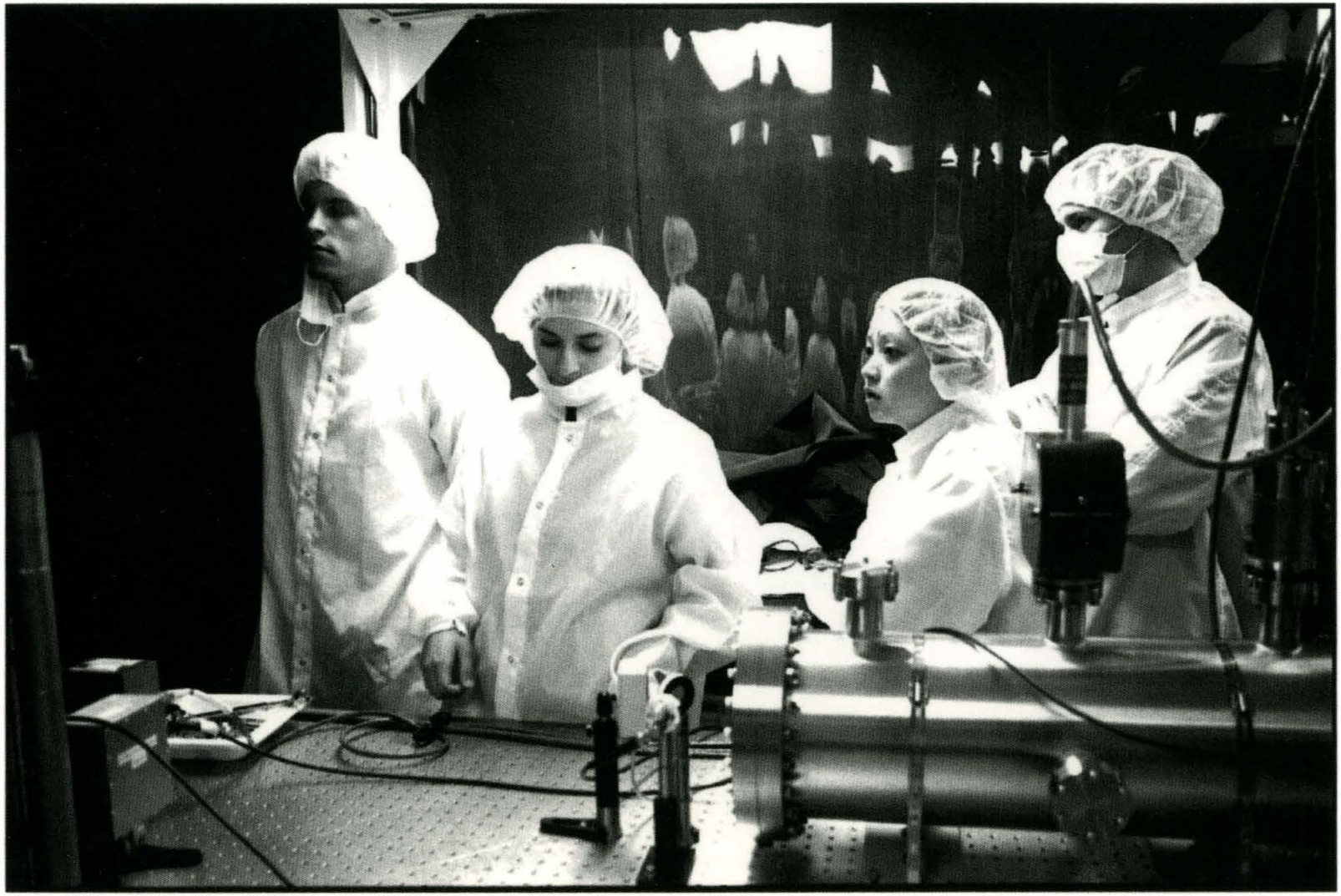
SURF 2002

Summer Undergraduate Research Fellowships

California Institute of Technology



SURF 2002 is dedicated to Dr. Edward C. Stone, David Morrisroe Professor of Physics and former Vice President and Director of the Jet Propulsion Laboratory. This dedication recognizes and honors Ed's passion for science and his unwavering support of undergraduate research and SURF. Under his leadership of JPL, the program flourished with close to 425 students working with technical staff at the lab.

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
2000	Dr. Terry Cole
2001	Dr. William Whitney
2002	Dr. Edward C. Stone

Caltech's mission is to expand human knowledge and benefit society through research integrated with education. We investigate the most challenging, fundamental problems in science and technology in a singularly collegial, interdisciplinary atmosphere, while educating outstanding students to become creative members of society.

SURF helps to unify research and education at Caltech as students become colleagues in the research enterprise. They apply what they have learned in the classroom to the exploration of problems at the frontiers of science and engineering under the guidance of mentors and in collaboration with others in the education continuum—graduate students and postdoctoral scholars. Through these interactions students find their places in the community of researchers and scholars. As one of the foremost undergraduate research programs in the country, SURF helps to prepare our students for graduate school or the work force and for becoming creative members of society. SURF contributes to making Caltech the world-renowned leader in research and education it is.

SURF succeeds because of the investment of time, expertise, and money of many individuals and groups. Faculty, JPL staff, and other members of their laboratories coach the students; over time, most Caltech faculty serve as SURF mentors. Faculty and alumni volunteers take on many important tasks to serve the program. Administrative staff members in many departments campus wide handle the myriad details of the program. Donors—more than 165 this year—contribute funds for student stipends. I personally appreciate the partnership with Caltech and SURF demonstrated by this committed and enthusiastic community.

SURF's 25th program will be held next summer. We will celebrate a quarter century of undergraduate research and student achievement as we also look toward a bright future of rich research experiences for our talented students.

David Baltimore

JOHN H. GLANVILLE

Chairman,
SURF Board

It is my honor to serve as Chairman of the SURF Board and to acknowledge the efforts and support of the many people who make SURF the excellent undergraduate research program it is. SURF is a great idea: it provides hands on (or better put, "brains on") research experience for talented and motivated undergraduate students. The program has successfully scaled the various hurdles of academic rigor, limited resources, and competing interests to arrive at its 24th year with 394 students. It is a tribute to the vision of its founders and the efforts of the students, faculty, post-docs and grad students, administration, staff, and the many volunteers who bring time and resources to SURF.

This year's program is dedicated to Dr. Edward C. Stone, David Morrisroe Professor of Physics, and former Director of JPL, in recognition of his strong support of SURF over many years. The program flourished at JPL during his tenure as director, and we thank him for his commitment to undergraduate education.

SURF Seminar Day, October 19, showcases the results of students' projects. Modeled on a professional technical meeting, students give oral or poster presentations. Students, mentors, staff, prospective students, alumni, and donors participate in the celebration of student achievement.

The Southern California Conference on Undergraduate Research (SCCUR) celebrates its tenth anniversary on November 23, 2002, at Caltech, returning to the place of its origin. One tribute to the success of SURF is the adoption of its means and methods by many other academic institutions. SURF has been at the forefront of defining undergraduate research and Caltech is proud to host this year's SCCUR.

A Little History

Twenty-four years ago with 18 students and 17 mentors, Fred Shair and colleagues launched the first SURF program. Over the years, others have contributed to SURF's development to make it the premier research program for undergraduates. With supportive mentors, undergraduates write proposals, engage in research projects, present their results in oral and written reports, and sometimes even become co-authors of articles in the refereed literature.

The SURF Board came into existence almost 19 years ago with the mission of providing financial support for this outstanding program. Established as a voluntary support organization, it started with individuals dedicated to the educational values of undergraduate research at Caltech. The SURF Board now comprises 28 members representing business and academia, alumni, and members of the Caltech Associates, all of whom provide advice, encouragement, and financial support that makes SURF the vital and effective program it is today.

The SURF Board

This year we welcome two new members to the SURF Board: Bob Roney and Kirk Dawson. We look forward to their support and involvement with SURF. Best wishes on behalf of the Board and the SURF Program to two Board members who have retired this year: Warren Schlinger and Fred Vote. We deeply appreciate their contributions, encouragement, and enthusiastic participation. We look forward to their continued association with the program.

Acknowledgements

A donor who wishes to remain anonymous established an endowment in honor of Professor Ray Owen. This endowment recognizes Ray's long commitment to students and his enthusiastic support of SURF. We are deeply grateful for this gift and value the partnership this donor has established with SURF and with Caltech.

A special thanks goes to John Gee for his efforts to convene two committees, one to enrich and enhance SURF Seminar Day, and the other to plan the celebration of SURF's 25th program next year. Thanks to Sam Vodopia for chairing the SURF 25 committee with committee members Ed Bryan, Carel Otte, Fred Shair, John Wall, and Ward Whaling in planning the festivities and events to mark this important milestone. Thanks, too, to Sean Upchurch, chair of the SURF Seminar Day committee. The committee recruits session chairs from the Alumni Association and is currently developing a network of former SURFers to attend and assist with Seminar Day. Other members of the committee are Michael Hartl, Leslie Maxfield, Carel Otte, and Al Ratner.

I greatly appreciate the advice, wisdom, and assistance given by the SURF Board Executive Committee. John Gee, Fred Shair, and Bob Perpall bring unflagging enthusiasm, imagination, and solid effort to their support of the SURF program. Thank you!

The SURF Endowment and Caltech's Capital Campaign

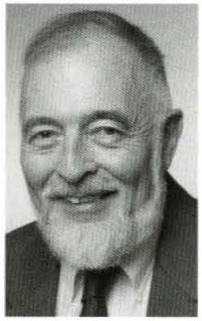
The SURF Board is committed to helping to raise the money for student stipends. Funding for the program comes from several sources, including individual contributions, Caltech, JPL, and various corporations and foundations. I want to extend a heartfelt thank you to all who have contributed this critical element to SURF's success. The endowment is an important source of stipend funding, and the board has set a goal of ensuring SURF's future through full endowment of the program.

In the words of David Baltimore, "SURF is one of the jewels in Caltech's crown." As Caltech embarks upon its Campaign for the New Millennium, the completion of the SURF endowment, an additional $8 million, is one of the campaign priorities. Over the next several years, the board will work tirelessly to secure SURF's future. Building on the long and deep relationships that SURF has built over the years with its donors and supporters, the board seeks to broaden SURF's circle of friends and incorporate new members of the "SURF team."

During the first SURF summer in 1979, 18 students worked with 17 mentors. Since then, SURF has expanded to 394 students working with 213 mentors.

FREDRICK H. SHAIR

Founder, SURF Program
Chair, SURF Administrative Committee



It is my pleasure to return to Caltech as chairman of the SURF administrative committee. As we complete the 24th program, I think of the many years of challenges, successes, and growth that SURF has undergone. It has reached a satisfying maturity, become imbedded in the Caltech culture, and is now nationally recognized. Our obligation is to ensure that the program remains fresh and responsive to the needs of our students, mentors, and the Institute.

The SURF Administrative Committee was established to set the academic policies of the SURF program, oversee intellectual standards, and advise the Caltech administration on long-term plans for the development of SURF and programs relating to SURF. Faculty members from each of the Institute's academic divisions, members of the JPL technical staff, student representatives, and members of the administrative staff comprise the committee. The faculty and JPL members are or have been SURF mentors. The AdComm reviewed more than 400 student research proposals this year, helped to judge the competitors in the Doris S. Perpall Speaking Awards, and reviewed technical papers nominated for the Marcella and Joel Bonsall Prize for Technical Writing.

We continue to monitor the SURF program to ensure that students and mentors have rich, high quality experiences working together. To that end, we held the third annual orientation session for mentors at the beginning of the summer. Melany Hunt, Jack Roberts, and Bruce Murray offered advice and wisdom from their many years of mentoring undergraduates. This orientation was initiated by Frances Arnold to give new and returning mentors encouragement and counsel as they undertake the important task of coaching students.

I am delighted that the Graduate Student Council has taken the initiative to establish a strong connection with the Student-Faculty Programs office and with the AdComm to provide support for graduate students as they undertake their first mentoring experiences. This link to an important constituency can improve mentoring and make the SURF experience even better for our student participants.

Over the past several years, new programs have become part of SURF, taking advantage of the program's administrative infrastructure. These allied programs include MURF, LIGO, JPLUS, USRP, PGGURP, the Caltech-Cambridge Exchange and the Caltech-National University of Singapore Exchange, Beckman Scholars, and Axline SURF. The AdComm monitors these programs to ensure that they adhere to the SURF standards that students should have projects of which they can take intellectual ownership and that have the potential for publication in the refereed literature. We are confident that these programs, which have brought significant growth to the SURF program, do, in fact, give participants the excellent experiences we seek for all SURFers.

We applaud the efforts of Robb Rutledge to craft new SURF writing guidelines that encourage students to write clearly and intelligibly for general audiences. This effort also supports Caltech's writing initiative that includes a requirement as part of the Core Curriculum. I wish to thank Frances Arnold who worked closely with Robb and Ram Srinivasan to develop the guidelines, which the AdComm unanimously adopted. The writing guidelines can be found on the SURF website at www.surf.caltech.edu.

Thank you to all members of the AdComm for their enthusiastic support and thoughtful consideration of the issues that come before it. SURF succeeds because of the dedication of many individuals. It is my pleasure to work with this dynamic and loyal committee to the benefit of the SURF program.

UNDERGRADUATE RESEARCH THROUGH SURF

SINCE 1979, the SURF program has grown from 18 students working with 17 faculty mentors on the Caltech campus that first summer to 394 students and 213 mentors in 2002. The program has also expanded to include students working on campus and at JPL, the addition of non-Caltech student participants, and Caltech students doing SURFs at other universities in the US and abroad. The SURF model with its rigorous application, proposal, and review procedures; its broad range of professional development activities and social events; and its oral and written reporting requirements has been adopted, not only at other institutions, but also within Caltech itself. SURF now comprises nine other programs that provide funding for particular groups. The focus of all the programs under the SURF umbrella is undergraduate research, the collaboration between mentor and protégé.

The MURF (Minority Undergraduate Research Fellowships) program provides support for talented non-Caltech students underrepresented in the sciences and engineering to spend a summer doing research with faculty on the campus. This year 31 students participated in the program.

The Beckman Scholars program, funded by a grant from the Arnold and Mabel Beckman Foundation, awards biology or chemistry students fellowships to do research over two summers and the intervening academic year. The grant also provides money for students to attend conferences and buy the supplies and equipment they need for their research. A faculty committee selects two sophomore students each spring to win this award.

The JPL Undergraduate Scholars (JPLUS) program recognizes and encourages scholarly achievement and creativity in students majoring in engineering, mathematics, computer science, and the physical sciences at 25 local community colleges. The students have the opportunity to apply for a SURF during their undergraduate careers. This summer five JPLUS students participated in SURF.

Eight students participated in the Axline SURF program this summer. The program allows selected incoming freshmen to do research with Caltech faculty or JPL technical staff.

The Laser Interferometer Gravitational-Wave Observatory (LIGO) project in the physics department included 34 students this summer supported by a grant from the National Science Foundation Research Experiences for Undergraduates program.

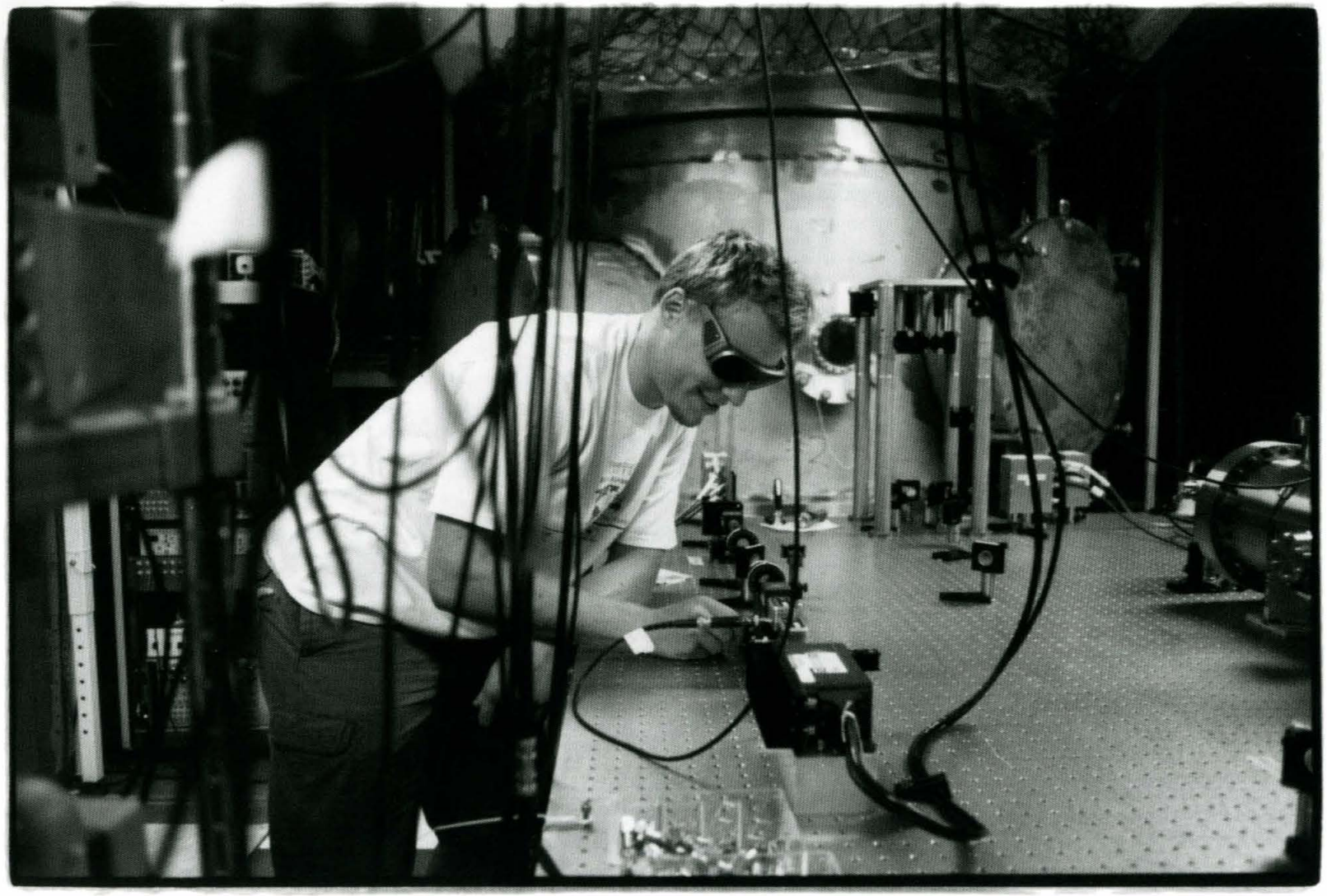
Caltech-National University of Singapore Exchange program allows three Caltech students to do research at NUS and three NUS students to come to Caltech for the summer. Students gain the undergraduate research experience while broadening their perspectives through living and working in another country.

Caltech-Cambridge Exchange brought nine students from Cambridge to the campus this summer. Nine Caltech students attended classes at Cambridge during the 2001-02 academic year.

NASA's Undergraduate Student Research Program (USRP) and Planetary Geology and Geophysics Undergraduate Research Program (PGGURP) offer students from colleges and universities nationwide the opportunity to do hands-on theoretical and applied research with technical staff members at NASA centers. Twenty-one USRP and two PGGURP students were awarded fellowships to work at JPL this summer; they participated fully in the SURF program and its activities.

When then Professor of Chemical Engineering Fred Shair created SURF in 1979, he included important elements that remain at the core of the program.

Students collaborate with mentors to define and develop a project prior to writing a research proposal.



Carolyn Ash Merkel interviewed four groups of mentors and students. These are their stories. They speak to the essence of SURF — the interaction between mentor and protégé.

Professor Kenneth Libbrecht worked with Heather Barber (pictured above) and Samuel Lindsay-Levine.

Physics professor Ken Libbrecht was a student in the first SURF program in 1979 working with then Associate Professor of Physics Steve Koonin. After graduating in 1980, he attended graduate school at Princeton, returning to Caltech in 1984 as an Assistant Professor of Physics. He mentored his first SURF student in 1985 and has worked with students almost every summer since then. Ken directs the Laser Interferometer Gravitational-Wave Observatory (LIGO) Summer Research Program, funded by the NSF, which has supported 104 students since 1997.

Of his own undergraduate research experiences Libbrecht says, "It was great for me to see what I liked and what I was good at. I did a project in theory and a project in experiment, and I really liked experimental research a lot. That is part of the reason I went into experimental physics. It is not clear that I would have figured that out so quickly if I hadn't had the undergraduate research experience."

Making the conversion from student to mentor was easy for Ken since he enjoys working with students. The hard part is finding a project that could reach a conclusion in ten weeks. "It is hard these days because projects get bigger and bigger. But it is a good experience for me as well," he says.

Samuel Lindsay-Levine is a rising junior and physics major at Caltech. He came to Caltech as an Axline Scholar, and did his pre-frosh research with Libbrecht in the summer of 2000. This summer, Sam is growing ice crystals at different temperatures and at different supersaturations. He uses laser interferometry to measure how fast the crystals grow at various temperatures and supersaturations, so he can determine the ice crystal growth mechanisms.

The project is going more slowly than he hoped. The equipment he uses has developed several problems, and each time it fails, he has to tear it apart, fix it, and put it back together. These are not big problems, but when a project is only ten weeks long, it takes a large portion of the time. Sam says that while there are a lot of frustrations and sometimes the work is repetitive, it is wonderful to see the data and to think, "I did that. No one would know that if it were not for me."

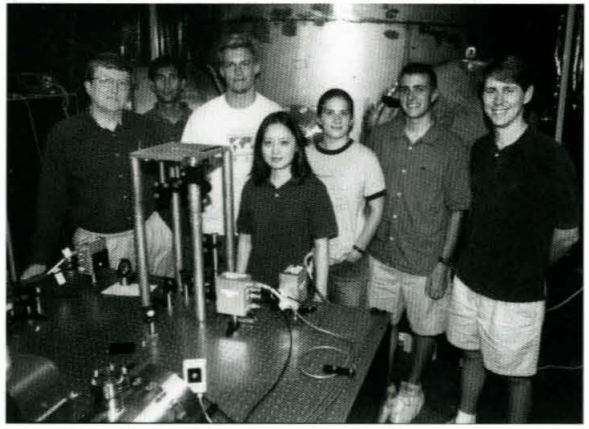
Hailing from England, Heather Barber is a student at the University of Cambridge participating in SURF as part of the Caltech-Cambridge Exchange program. She is working on the development of a novel hygrometer using a capacitive sensor. She laughs when asked how the project is going. "It looks like it is working. It is taking readings I want, but at the moment we are a little bit confused," she says. Ken elaborates that the sensor is doing some strange things they cannot figure out, so they have to go back systematically to try to nail down what is going on. "It has to do with the condensation of water on the sensor. Condensation always behaves strangely," he adds.

Heather did research at a company last summer, but she enjoys this experience more because it coincides with her academic interests. She admits to being somewhat exasperated by not knowing what is going on with the sensor, but that makes the project interesting and has given her determination to carry on to find out more about it. Ken exclaims, "That makes me feel good! I feel like we have been torturing you all summer with something that doesn't work the way it is supposed to, and you say, 'It is interesting!'"

For Heather, it is much more interesting to work

on a real project where no one knows what will happen than it is to do a project for a class and be told, "this is what you should get."

Ken concludes, "Undergraduate research gives students a view of what real science is like. Nobody knows what the answer is. I always tell students to do research for that reason. It is so different from classes. Either you like it or you don't like it. But you don't know until you try it. A good part of one's education here is to see what research is like."



The Black Group in LIGO

Supported by the National Science Foundation, the Laser Interferometer Gravitational-Wave Observatory (LIGO) is a pioneering facility leading the quest to detect cosmic gravitational waves and to make use of these waves in an exciting new branch of astronomy. This summer 34 students participated in the LIGO SURF program, supported by a grant from the NSF Research Experiences for Undergraduates. Four students worked with Eric Black, a lecturer in physics, on the Thermal Noise Interferometer (TNI) for LIGO.

Sharon Meidt just completed her junior year as a physics major at Davidson College. Her project is to measure non-Gaussian noise in the thermal noise interferometer (TNI). "Non-Gaussian noise appears to be very much like a gravitational wave," she says, "and we are trying to identify those sources so we can rule them out to get the signal produced by a gravitational wave." Developing hardware and software, she will soon take data, and she is eager to see whether her program really works.

Adam Bushmaker will be a senior at the University of Wisconsin majoring in engineering physics. He is studying load vibrations on the mirrors and trying to measure how long it takes a vibration to damp out in the material. His project is going well and he expects to get measurements soon.

Kyle Barbary will be a senior in physics at Harvey Mudd College. Part of Kyle's project is to reduce electronic noise in the system. He is also calibrating the TNI so that they will know by how much the thermal noise might change the length of the cavities.

Fumiko Kawazoe will complete her studies at Ochanomizu University in Tokyo next spring. Her project, "Detector Sensitivity Investigations at the Thermal Noise Interferometer," complements research she did at her university, and her professor encouraged her to apply for the LIGO SURF.

The students working in LIGO do not write research proposals as part of their applications like the other students in SURF do, and they note that they did not know what they would be doing when they arrived at Caltech. None of them had contacted their mentor before they came. Sharon comments, "I remember the first day like it was yesterday. We met in room 351 and right away Eric said, 'OK, we will check out the TNI.' We all followed him down there saying, 'What is the TNI?' Then we went up to West Bridge, and he started handing us papers. We were overwhelmed and a little bit excited. We all went home and read, read, read. We came back the next morning ready to go to work. It was fun."

The students enjoy the synergy that comes from working together on various aspects of the TNI, each having a separate but similar project. Sharon says, "We all rely on each other. It has been a great educational situation. We are all learning new things but applying things we already know." Adam concurs, "We all get along really well. For the sort of questions we need to ask and the sort of answers that we get, we can all learn together." Most importantly, they feel that they are making a contribution.

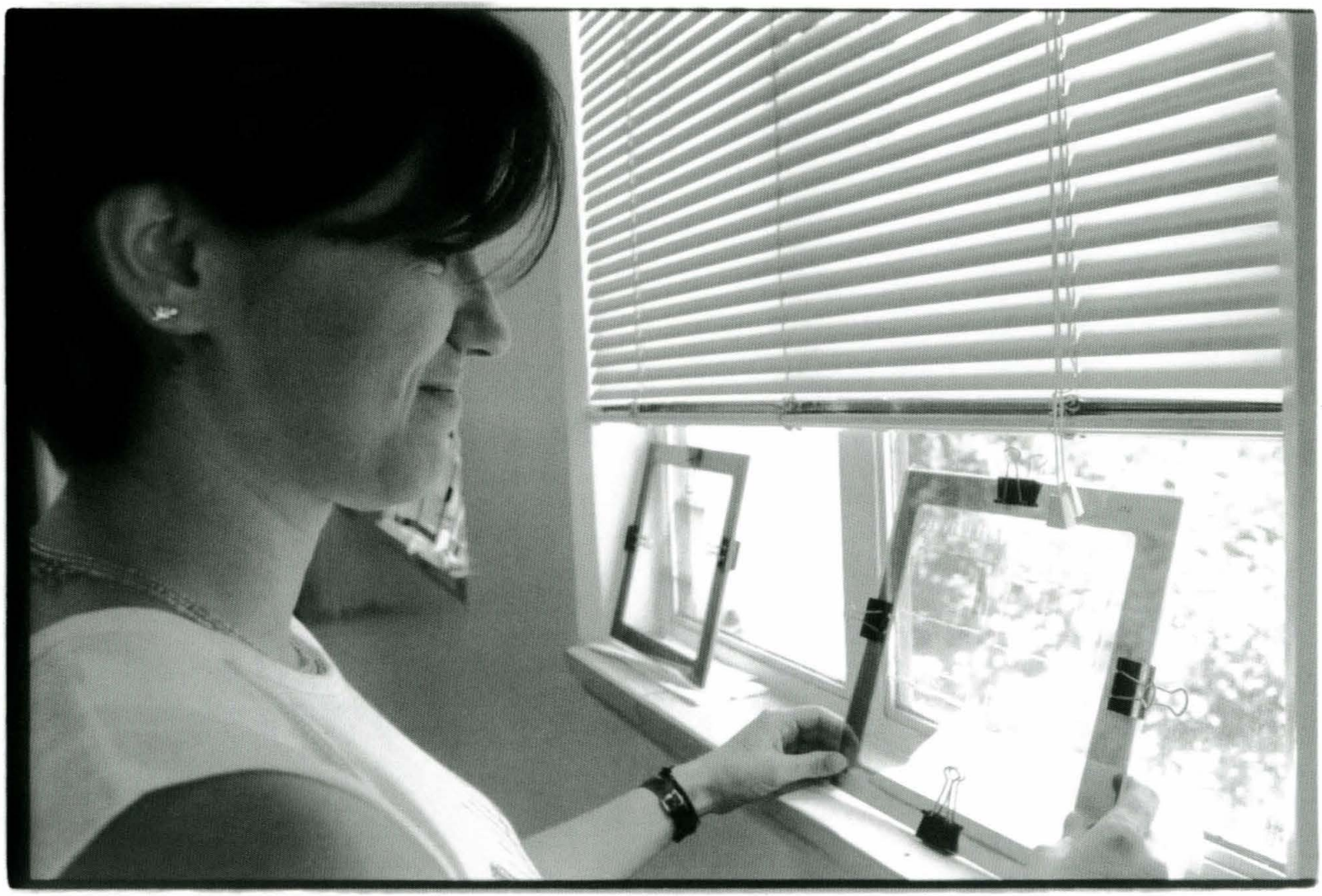
All four students plan to apply to graduate school. "As physics majors, there isn't that much of an option. If you want to do really cool stuff, you have to go to grad school," Sharon says.

Eric Black did undergraduate research at the University of Tennessee. He worked with the only professor doing gravity research. There, Eric helped work on a proposal to design a satellite-based experiment. His interest in experimental general relativity was sparked when he was 13 and read popular books on general relativity and cosmology. "LIGO appeals to me because it uses general relativity to tell us something about the universe, to do a new kind of astronomy, and that excites me to no end."

His transition to mentor naturally evolved from his undergraduate experiences. "I had a lot of freedom as a student. I got used to deciding what direction the project should take and what directions were not useful. I take the same approach with my students. I needed a couple of days to see how an instrument worked or

A faculty committee reviews the proposals and SURF awards are made on the basis of reviewer recommendations and available funds.

Students work on their projects over ten weeks in the summer, and at the conclusion they submit technical papers and give oral presentations.



to think about the math behind the data I was taking, and I give them the same flexibility. I keep an eye on the students to be sure they don't wander too far afield. If they start to wander, I suggest some other alternatives."

Eric has had one SURFer each year since 1998, so supervising four students is a new experience for him. In previous summers he spent most of his time in the lab on his own project and a small amount of time supervising the student. This summer he dedicates himself to coaching these students and does not have his own project. He enjoys the group dynamics, and finds the experience rewarding.

The Bronner-Fraser Group

This summer, four students joined the research group of Marianne Bronner-Fraser, Albert Billings Ruddock Professor of Biology, including biology majors senior Elizabeth Stameshkin and junior Francy Sung from Caltech; MURF student Shiloh Small, a senior biology major from the University of Montana; and from UC Davis, Celia Shiau, a senior in bioengineering.

Celia Shiau was attracted to Caltech because of the strength of the biology program, particularly developmental biology. Caltech was her first choice, supported by several of her professors at UC Davis who received degrees from Caltech and who encouraged her to consider Caltech for graduate school. With her core focus on developmental biology, Celia sees the potential in engineering and medical applications. She previously worked in a yeast genetics lab and has been exposed to the techniques used and questions asked. Genetics, she observes, is a very strong element in developmental biology.

This is Liz Stameshkin's second summer in the Bronner-Fraser lab, and she is glad that her previous experience allows her to be more independent this summer. While she enjoys working in this research group and likes her project, she wants to be more involved in genetics. "Working here has helped me realize I like this side of biology, but I would like possibly to do something more genetics-oriented. It is a really good experience for me."

Shiloh Small learned about the MURF program from her biochemistry professor at the University of Montana. She thinks developmental biology is interesting because the work applies to so many different systems. "It is like putting a puzzle together," she says. Shiloh plans to attend medical school, and she says her MURF experience has given her a better idea of what opportunities exist for professional and graduate school and what she will need to do to apply for them.

This SURF project is Francy Sung's first research experience. She is fascinated by how the things she has read in books are coming alive for her in lab, and she enjoys the daily learning.

Professor Bronner-Fraser reflects about her own undergraduate research experiences in biophysics at Brown University. "It was a very good experience, and I published a paper from it." Later, influenced by a professor and his work in developmental biology, she changed her field to developmental biology.

As for the undergraduate research experience, she says, "The mentoring process is invaluable. While students can learn things on their own, the mentor is a catalyst that allows them to learn much faster. Things become more clear than they would if you had to struggle through it on your own." On the interactions between the students along with the graduate students and postdocs, she points out to the students, "I would not be able to give you the individual attention, and I think you really need it." She pairs undergraduates with postdocs who can devote a lot of time to them, and at the same time the graduate students and postdocs gain mentoring experience.

She believes that through SURF students gain an appreciation of the process of research. "I think you can get this glamorous idea that you will go into a lab, do an experiment, and publish a paper. Instead, you go into lab, do an experiment that doesn't work, do it again, and again, and again. If you do it again enough times, you might get it to work, and eventually you get a publication." She adds that when students get started, things take a long time, but as they get better, work goes faster. "Part of the experience is knowing what you need to do and when you should stop or change. Learning that frustration is part of the process."

Liz agrees that non-technical individuals may not realize how much "busy work" there is. It takes time to set everything up and do the experiments. Pipetting day after day can be tedious. It is much more fun to look at the pretty pictures that come out after a successful experiment. "That can be the one exciting part for a week's worth of work."

Marianne continues, "The irony is that I am doing so much administrative work, I have to go to meetings all the time. And I like the lab work! I miss it!" She concludes by saying that SURF allows students to see what it is like to do science and adds that students benefit from finding out their personal preferences for areas of science they find most interesting.

Liz comments on the value of SURF to her education. The best thing is that students are treated as members of the lab. She considers Marianne and Dr. Laura Gammill, the postdoc with whom she works, her role models. They are both women at different stages of their lives with families and successful careers. "They have made it in science at a time when it was harder for women than it is now," she says. They both provide encouragement and advice when she asks for it. She adds that biology students at Caltech don't have many required labs, and she feels that the combination of taking the core classes and doing research helps her to understand things much better. In class she learns words and concepts, but they take on deeper meaning when she uses them in her research.

Celia observes that doing research is a reality check for her. "Research is more about figuring things out, solving and trouble shooting problems, and you always have obstacles. You learn how to face them or solve them. That whole experience is valuable. We will use those skills in whatever area we go into."

Francy appreciates the donors who support the program. As the Mr. and Mrs. Fred Wells SURF student, she attended this summer's donor-student dinner. She arrived at the dinner anticipating the invisible wall that often separates college students from older adults, but she found it was more like a family gathering. "You sit face to face with the SURF donors, and you actually have a chance to talk with them. They value what we are doing and the experiences we have. I feel touched."

The Tirrell Group

Dave Tirrell's lab bustles with graduate students, postdoctoral fellows, and four SURF students. Their research is largely synthetic chemistry that merges two traditionally separate areas of macromolecular chemistry. For the past decade Tirrell has attempted to express artificial genes in bacterial cells, to make artificial proteins that provide some of the flexibility characteristic of synthetic polymers while retaining architectural control that allows proteins to carry information and do their biological jobs. "It is really a new field," he says. David Tirrell is the Ross McCollum-William H. Corcoran Professor and Professor of Chemistry and Chemical Engineering, and Chairman of the Division of Chemistry and Chemical Engineering.

For Aaron Esser-Kahn, a rising junior and chemistry major at Caltech, this is his first research experience at Caltech, though he worked in a biology lab in high school. "This summer has been much more challenging. I have guidance, but I think Professor Tirrell expects a lot more from me. I really enjoy it. It has been cool to be contributing to something you have been learning about for so long."

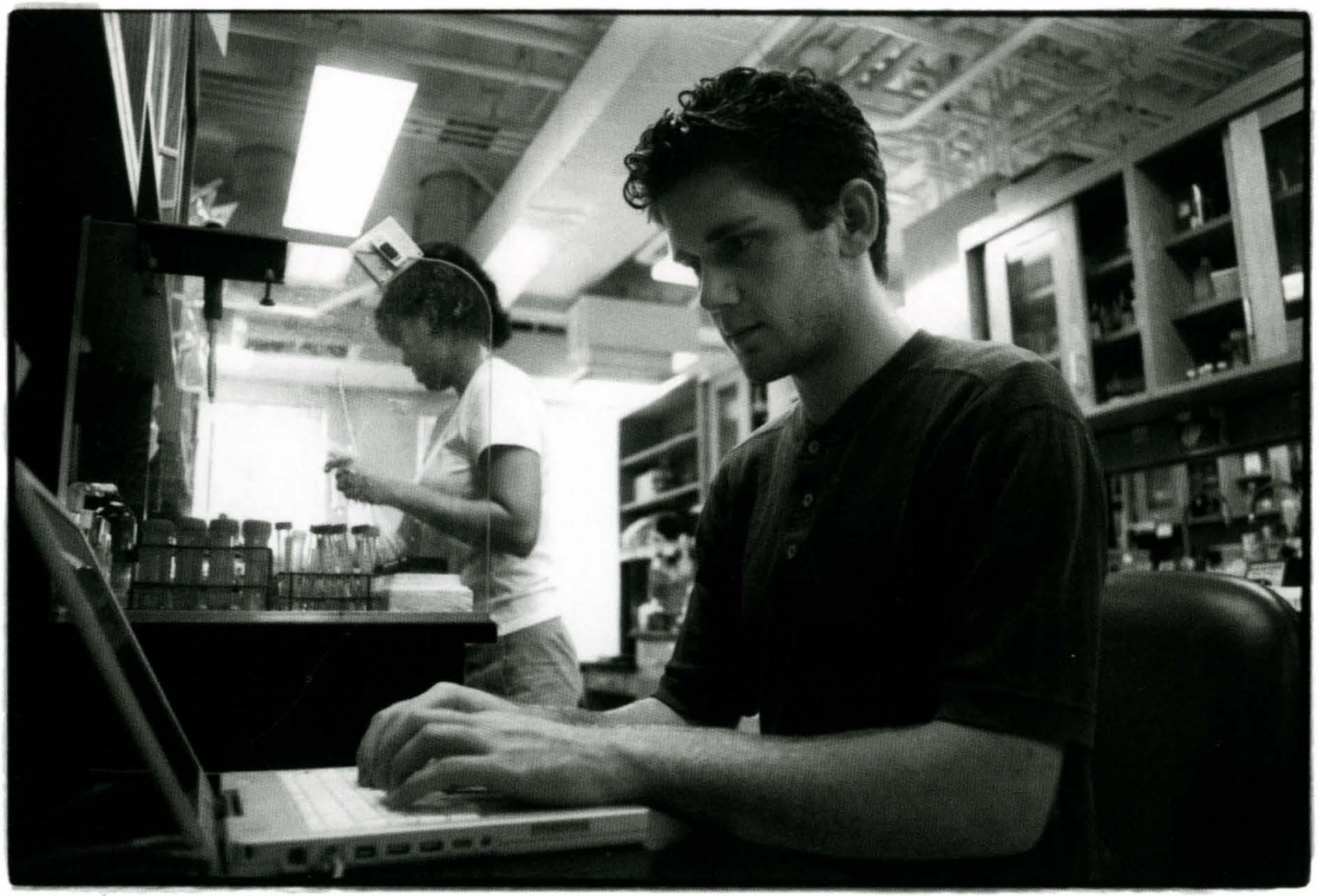
Talmesha Richards, a MURF student from the University of Maryland, Baltimore County, just completed her sophomore year and has a double major in chemical engineering and math. She is one of UMBC's prestigious Meyerhoff Scholars. She did research at UMBC during her senior year in high school, and last summer she worked in a lab at the University of California at Davis. "This has been the best so far because it has been hands on. I have always been in front of a computer, so this is the first time I actually get to measure things and make solutions and all that good stuff," she says.

Yeliz Utku hails from Istanbul, Turkey, where she is a student at Koc University. This is her second summer in the Tirrell lab. She has been doing research at her university since she was a freshman, though it is not common for students to be involved in research at Turkish institutions. When Yeliz expressed an interest in finding a summer project at Caltech, her advisor recommended David Tirrell.

Kevin Nielson, a MURF student and a chemistry major at California State University, Los Angeles, has worked in an organometallics lab at CSULA for the past year. He came to Caltech as part of the collaboration between Caltech and CSULA in the NSF Center for the Science and Engineering of Materials (CSEM).

As an undergraduate at MIT, Dave Tirrell became interested in polymer chemistry when he worked with a faculty member who became a friend and mentor. "Ed Merrill was just one of those teachers who could lead you down any path he wanted you to take. If I had met him as a professor of history or philosophy, I would be an historian or philosopher. Whatever Ed was, I wanted to be. My work with him was a defining experience for me, and I have been doing

The essence of SURF is the tutorial interaction between student and mentor.



polymer chemistry for 30 years now."

Tirrell thinks that students gain a realistic view of what science as a profession is like through undergraduate research. Although the classroom learning is critical, and students really do need to learn the material, they can observe the day-to-day life of a chemist or a chemical engineer in the research enterprise. The personal relationships formed between students and others in the lab may last a long time, and those things are very important as students go through the various stages of their professional and personal lives.

Aaron says that he likes manipulating the world in ways nobody has done before. "Breaking new ground is very exciting," he says. The greatest value he has gained from his undergraduate research experience is confidence. "I am more confident in my ability to express my opinion, work something out for myself, figure things out, and solve problems than I was before." He adds that in the classroom, someone knows the answers. "In research, you kind of expect the answer, but nobody really knows what it is. I get a kick out of that."

Talmesha says that everything is new and exciting for her. When she ran her first protein gel, others in the lab chuckled because she was so excited about doing something that for them had become routine. One of the best things for her is interacting with people who are where she wants to be. "You see people at every phase of the PhD process as well as those who already have their PhDs. You can pick their brains, and they give you advice," she says.

Yeliz likes the process of exploration whether it is in the lab or from articles in the literature. She says that she now knows what she really wants to do. "You come here and you do this research, and you know that you like it, and it satisfies you."

Kevin tells the story about running a gel, and when he finished, nothing was there. "The best thing about research is that you can keep doing it over and over and eventually you get it, and you feel really good about that. You beat whatever miserable opponent was keeping you down. The payoff is exciting for me." Although Kevin enjoys doing research and working with scientists, he plans to go into law. He observes that through working with people along the education continuum from first year graduate students to professors, professors don't seem quite so distant from students anymore. He realizes that he is a part of the scholarly community.

HIGHLIGHTS OF SURF 2002

PROFILE OF THE 2002 SURF CLASS

Women	36%
Minorities	11%
Average GPA	3.57/4.0*

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

Class Level	*No. of Students*	*Percent*
Pre-Freshman	8	2%
Freshman	66	17%
Sophomore	132	34%
Junior	157	40%
Senior	31	8%
TOTAL	394	

SURF STATISTICS FROM THE 2002 GRADUATING CLASS

		percent of Class '02
Total # of graduates	249	
Total # of SURFers	157	63%
Graduates with honors	100	40%
SURFers with honors	73	29%
# of prizes awarded	135	
# of SURFers receiving prizes	109	81%

THE 2002 SURF CLASS BY DIVISION

Division	*Total # of students*	*CIT Students*	*Non-CIT Students*	*Mentors*
Biology	47	29	18	19
Chemistry and Chemical Engineering	52	32	20	25
Engineering and Applied Science	86	58	28	42
Geological and Planetary Sciences	22	18	4	16
Humanities and Social Sciences	11	6	5	8
Physics, Math, and Astronomy	74	42	32	38
JPL	73	23	50	43
Off Campus	24	14	10	19
International	5	5	0	2
Total	394	227	167	213

Caltech Wednesday Seminars

This year, nine seminars were given on Wednesdays at noon by members of the Caltech community, covering areas of their research. The speakers and topics were:

Frances A. Arnold
Dickinson Professor of Chemical Engineering and Biochemistry
Laboratory Evolution of Proteins, Pathways, and Circuits

Morteza Gharib
Professor of Aeronautics and Bioengineering
The Wind and Raising the Obelisk

Janet Hering
Associate Professor of Environmental Engineering Science
Hexavalent Chromium, Hollywood, and Health Goals

Dianne Newman
Clare Booth Luce Assistant Professor of Geobiology and Environmental Engineering Science
A Role for Antibiotics in Mineral Dissolution and Biofilm Physiology

Melany L. Hunt
Professor of Mechanical Engineering
Particle Flows in Nature, Industry, and at Zero-Gravity

Jonas Peters
Assistant Professor of Chemistry
Blazing the Synthetic Trail: Chasing Catalysts for a Brighter Future

Robert C. Ritchie
Director of Research, The Huntington Library, Art Collections, and Botanical Gardens
The Advent of Beach Culture

Gary H. Sanders
Deputy Director of LIGO
The Curtain Rises on LIGO: Listening to Einstein's Gravitational Symphony

Erin Schuman
Associate Professor of Biology; Assistant Investigator, Howard Hughes Medical Institute
Local Control of Brain Synapses

JPL Friday Seminars

Each Friday, members of the JPL staff presented talks to SURF, USRP, and PGGURP students. Speakers and topics this year were:

Charles Elachi
Director, Jet Propulsion Laboratory
A Welcome to JPL

Gindi D. French
Task Manager, Deep Ocean Vent Explorer (DOVE)
Life on Europa: How We Are Preparing to Look for It

Sabrina Grannan-Feldman
Senior Member of the Technical Staff
How to Build a Wet Chemistry Laboratory for Mars

Mitra J. Hartmann
Biological Computing Task
Using High Speed Videography to Build Models of the Rat Whisker System

Deborah Jackson
Quantum Computing Technologies Group
Quantum Key Distribution: A New Paradigm for Internet Security

Rebecca Knudsen
Office of Education and Public Outreach
NASA's Role in Education and Public Outreach

Robert A. Parker
NASA Management Office
The Earth as Seen From Space

Adrian Ponce
Senior Member of the Technical Staff
Longevity of Bacterial Spores

Mitchell Troy
Member of the Technical Staff
Astronomical Adaptive Optics: Removing the Twinkle From Stars

Paul Weissman
Senior Research Scientist
Winning the Cosmic Lottery: Comet and Asteroid Impacts on the Earth

Professional Development Workshops

The weekly professional development workshops help students make short-term educational and career decisions in the context of longer-term life and career goals. Topics covered range from applying to graduate school to workplace issues. Session topics and participants were:

Thinking About Careers: Decisions, Decisions, Decisions!
Dr. William M. Whitney, Deputy Manager, Educational Affairs, JPL
Dr. Jerry Houser, Director, Career Development Center

Communication in Careers
Mr. Munir Bhatti (SURF '87, '88; BS '90) and Mr. Michael Hartl (SURF '94, '95), Graduate Student in Physics

Intellectual Property
Dr. Richmond Wolf, Office of Technology Transfer

Networking, Mentoring, and Resume Writing
Ms. Kathy Harris, Staff Education and Career Development, and Dr. John Davis (SURF '91; PhD '00), Staff Scientist, JPL

What Can You Do With A Technical Background?
Caltech Alumni: Mr. Paul Graven (BS '85), Dr. William Whitney (PhD '51), Dr. Carel Otte (PhD '54), Mr. Dave Rossum (BS '70), Ms. Helen Wheelock (BS '75), and Ms. Bonnie Wallace (BS '92)

Scientists As Speakers
Dr. David Goodstein, Vice Provost, Professor of Physics and Applied Physics, and Frank J. Gilloon Distinguished Teaching and Service Professor

Graduate School: The Nuts and Bolts of the Application Process
Dr. Jerry Houser

Special Events

Every year, Dr. and Mrs. George Boone sponsor SURF students for a behind-the-scenes view of The Huntington Library, Art Collections, and Botanical Gardens. Later, the Boones hosted students to a reception at their residence for more art in their backyard-turned-garden of sculptures that range from

life-size to the minute.

The "Mission Life-Cycle" tour at JPL, given by Dr. William Whitney, allowed students to see facilities and activities associated with the development of missions, from the center where mission and system concepts and designs are created, to areas where hardware is fabricated, tested, and assembled, to the hub of mission operations.

Former astronaut Dr. Robert A. Parker of the NASA Management Office at JPL presented a talk on the Caltech campus called "So You Want to Be an Astronaut?" This was an added event this year which brought in a full room of students that sparked a long and lively discussion.

COMMUNICATION PROGRAM

Awards and Prizes

Robert C. Perpall (BS '52, MS '56) endowed a prize in memory of his late wife, Doris Perpall. The award encourages students to prepare excellent SURF presentations. Last year's 2001 winners were:

Craig Countryman	*1st Prize*
Vincent Auyeung	*2nd Prize*
Elaine Ou	*3rd Prize*

The late Marcella Bonsall, a long-time member of the SURF Board, endowed the Marcella and Joel Bonsall Prize for Technical Writing in 1998 as an incentive for students to develop strong technical writing skills. Winners of the 2001 Bonsall Prize were:

Kathryn Dyl	Robin Stein
Tammy Lam	Bryan Tiedemann
Eric Lawrence	Ben Welander
Michael Rizk	

CONFERENCES

SURF Seminar Day was held October 19, 2002, on the Caltech campus. The SURF program requires students to give either an oral or poster presentation to an audience of peers, faculty, mentors, alumni, donors, families, and prospective students in closed parallel sessions.

National Conference on Undergraduate Research (NCUR) drew over 2,000 undergraduates, faculty, and administrators to the University of Wisconsin at Whitewater in April. Students presented their research, scholarly, and creative activities in oral and poster sessions. Caltech presenters for 2002 were:

Paul Choi	Elaine Ou
Craig Countryman	Lisa Wang
Marie-Claire Siddall	

Southern California Conference on Undergraduate Research (SCCUR) is a multi-disciplinary conference including the sciences, math, engineering, the humanities, social sciences, art, and performance. Students from around the southern California region can discover what research is currently being studied and how it is reported in various disciplines. Presenters for 2001 were:

Misty Richards *University of California, Los Angeles*	Kristina Kurbanyan *Mount St. Mary's College*
Robb Rutledge	Eunice Rivas *Mount St. Mary's College*
Lakshminarayan Srinivasan	Angela Snow
Craig Countryman	Tammy Lam
Kathryn Dyl	Valerie Villareal *California State University, Los Angeles*
Randie Kim	

SURFSAC EVENTS and ACTIVITIES

SURFSAC

The purpose of the SURF Student Advisory Council (SURFSAC) is to complement study and research with social events. In addition, it helps students from abroad and across the nation to acclimate themselves with Caltech and the Los Angeles region. It also provides a liaison between students and the Student-Faculty Programs Office. The Caltech students, who are chosen by their peers, were:

Vincent Auyeung *Movie Coordinator*	Galen Loram *Movie Coordinator*
Jonathan Bird, *Treasurer*	Jonathan So, *Secretary*
Randie Kim	Kevin Tse, *Vice Chair*
Charles La	Jialan Wang, *Chair*
Jennifer X. Li	Lisa Wang, *Secretary*
Janessa Link	Janet Zhou, *Vice Chair*

Each week, the SURFSAC group meets with the Student-Faculty Programs staff to plan and implement activities. Events vary every summer. This year's activities included:

Ice Cream Social	Hollywood Trip
Hollywood Bowl	4th of July Celebrations at Brookside Park and Lacey Park
Getty Museum	Pacific Asia Museum
Soccer Games	Mini-Golf
Zuma Beach Trip	Movies on the Olive Walk
Dance Parties	Magic Mountain
LA Trip	

SURFSAC Suppers

The popular SURFSAC suppers bring students and faculty together each week at local restaurants to converse informally in a relaxed atmosphere. We deeply appreciate the funds provided by the Master of Student Houses to subsidize these suppers.

ANNUAL GIFTS

Gifts to SURF Annual Stipend Fund

Mr. Robert M. Abbey *
Mr. Viktor Y. Alekseyev, SURF '97, '98
Dr. Charles H. Anderson
Mr. & Mrs. Robert E. Anderson *
Mr. & Mrs. Paul L. Armstrong, Jr.
Ms. Carolyn Ash Merkel
Dr. Holt Ashley
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Mr. & Mrs. John N. Barrett
Mr. Mark O. Barrett, SURF '98, '99, '00
Mr. John A. Behr, SURF '81, '82
Mr. & Mrs. Arlen W. Bell
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Dr. & Mrs. Donald L. Blumenthal
Mr. Ned B. Bowden, SURF '92, '93
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Ms. Patricia Burke
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Mr. & Mrs. George L. Cassat
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Dr. & Mrs. Thomas E. Everhart
Mrs. Ruth Frazer
Mr. & Mrs. Russell Faucett
Dr. & Mrs. Gregory J. Galvin
Mr. & Mrs. John D. Gee *

** These individuals contributed the amount of one or more SURF stipends.*

Ms. Joanne Gimbel *
Mr. David L. Glackin
Mr. & Dr. Robert E. Glanville
Dr. Edray H. Goins, SURF '92, '93
Mr. Scott W. Gordon-Wylie, SURF '82
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Mr. Jonathan A. Zingman, SURF '79

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Howard Hughes Medical Institute
Paul K. Richter and Evalyn E. Cook Richter Memorial Funds

Matching Gift
Karl Kirschgessner Foundation

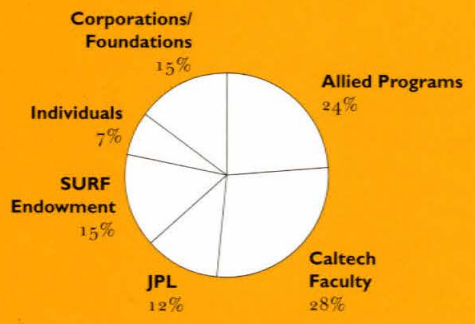
Donations to MURF
Howard Hughes Medical Institute
The James Irvine Foundation
National Science Foundation
Northrop Grumman Corporation

SURF STIPEND FUNDING

For the ten-week fellowship, SURF students receive a stipend of $5,000; stipend funding comes from many sources as shown below. Mentors pay all research-related costs. The total cost of student stipends for the 394 2002 SURF students was $2 million.

The SURF Office, in partnership with the Institute, raises funds to support Caltech SURF students working with faculty on campus or at other universities. Typically faculty mentors pay half the students' stipends, and monies contributed by individuals, corporations, foundations, and the endowment support the other half. We thank the 166 annual donors for their generosity and support. We are also deeply grateful to the individuals, groups, and corporations that have established 44 endowments to support 59 students each summer in perpetuity.

The allied programs (MURF, USRP, PGGURP, Axline SURF, Beckman Scholars, JPLUS, JPL SURF, LIGO) provide the stipend funding for their participants.



ENDOWMENTS

Arthur R. Adams SURF Endowment
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Marcella Bonsall SURF Endowment
Bristol-Myers SURF Endowment
Bob & Carole Chapman Minority SURF Endowment
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Howell N. Tyson, Sr., SURF Endowment
Erika C. Vote SURF Endowment

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Marcella and Joel Bonsall SURF Prize for Technical Writing
Doris S. Perpall SURF Speaking Award

Endowments Through Planned Gifts
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Dr. Paraskeva N. Danailov SURF Endowment

New Endowments
Ray Owen SURF Endowment

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Dr. Anthony J. Skjellum, SURF '83 *

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Dr. Carol J. Vote

SURF VOLUNTEERS

SURF depends upon the assistance of many individuals to review students' proposals and submissions for the Marcella and Joel Bonsall Prize for technical writing. Volunteers serve as session chairs on SURF Seminar Day and they judge presentations for the Doris S. Perpall prize for excellent oral communication. We thank the following people for their help with SURF 2002:

Dr. Jess F. Adkins
Dr. John M. Allman
Dr. J. Milton Andres
Dr. Dimitrios Antsos
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Dr. Paul M. Bellan
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Dr. Michael W. Werner
Dr. William M. Whitney
Ms. Tashica T. Williams
Dr. Richard M. Wilson
Dr. James W. Workman
Dr. Kai G. Zinn

MEGUMI ABE
Mr. and Mrs. Charles J. Pankow SURF Fellow
Sophomore, Ch

Fe and Co Amido Ligand Systems for Group Transfer Chemistry and Small Molecule Activation

Mentor: Jonas C. Peters, *Assistant Professor of Chemistry*

SAFIA ABIDI
Richter Scholar
Junior, SS

Too Big for an Asian Girl: A Comparison of Eating Attitudes Between Korean and Korean-American Women

Mentors: Pamela K. Keel, *Assistant Professor of Psychology*, and Jean E. Ensminger, *Professor of Anthropology*

ANTON ABOUKHALIL
Sophomore, EE; McGill University

Antenna Servo System Study for the Deep Space Network Array Prototype

Mentor: Sander Weinreb, *Faculty Associate in Electrical Engineering; Principal Staff Member, JPL*

ELISABETH R. ADAMS
Hugh F. and Audy Lou Colvin SURF Fellow
Junior, Geoph

Evidence for Intraplate Seafloor Deformation Between Antarctica and Australia

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

NEDA AFSARMANESH
Mr. and Mrs. Robert L. Noland SURF Fellow
Sophomore, Bi

Psychophysical Study of Interaction Between Eye Movement and Emotional Experience

Mentor: Shinsuke Shimojo, *Professor of Biology*

OWEN P. AFTRETH
Marcella Bonsall SURF Fellow
Junior, Bi

Limited Transgenic Expression Using RAG, the Immune Recombinase

Mentor: Ellen Rothenberg, *Professor of Biology*

MUHAMMAD U. AHMED
Senior, Computer Eng; Georgia Institute of Technology

Digital Signal Processing for the Deep Space Network Array Prototype

Mentor: Sander Weinreb, *Faculty Associate in Electrical Engineering; Principal Staff Member, JPL*

MINTA C. AKIN
Ernest H. Swift SURF Fellow
Junior, Ch

Determination of Trace Organics in Cometary Dust Particles by Hypervelocity Impact Ionization

Mentor: Jesse L. Beauchamp, *Mary and Charles Ferkel Professor of Chemistry*

MOHAMED H. ALKORDI
Howard Hughes Medical Institute SURF Fellow
Junior, Applied Sciences; Alexandria University

Conformational Analysis of trans-1,2-cyclohexanedioic Acid as a Function of pH and Solvent Nature

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

MIYA E. ALLEN
Amgen, Inc. MURF Fellow
Junior, Bi; Xavier University of Louisiana

Expression and Purification of Membrane Fusion Protein

Mentors: David C. Chan, *Assistant Professor of Biology*, and Takumi Koshiba, *Postdoctoral Scholar in Biology*

MICHELLE K. ALLIS
NASA USRP
Junior, EAS (Ae)

Cross Section Measurements for Xenon Thrusters

Mentor: Lee K. Johnson, *Research Scientist, JPL*

ERIC K. ANDERSON
Junior, EAS (ME)

Analysis of Sheet Hydroforming Process

Mentor: Sander Weinreb, *Faculty Associate in Electrical Engineering; Principal Staff Member, JPL*

SUMIKO I. ARMSTEAD
Amgen, Inc. MURF Fellow
Junior, Bi; University of Houston

Characterization of Different Unc-103 Potassium Channel Mutations That Cause Spontaneous Muscle Contraction

Mentors: Paul W. Sternberg, *Professor of Biology; Investigator, Howard Hughes Medical Institute*, and Luis R. Garcia, *Postdoctoral Scholar in Biology*

MATHAZIN AUNG
Howard Hughes Medical Institute SURF Fellow
Sophomore, Ph; Pasadena City College

Parallel Computing in Laplace Transform/Potential-Theoretic Numerical Analysis

Mentor: Oscar P. Bruno, *Professor of Applied and Computational Mathematics*

VINCENT C-M. AUYEUNG
Mrs. Ralph Jones SURF Fellow
Freshman, Bi

Spectroscopic Mapping of Conformational Changes in the Nicotinic Acetylcholine Receptor

Mentor: Henry A. Lester, *Bren Professor of Biology*

ALFRED J. BACA
NSF Center for the Science and Engineering of Materials MURF Fellow
Junior, Ch; California State University, Los Angeles

Optimization of the Electrode Composition in Cesium Hydrogen Sulfate Fuel Cell Electrodes

Mentors: Sossina M. Haile, *Associate Professor of Materials Science*, and Feimeng Zhou, *Professor, Department of Chemistry and Biochemistry, California State University, Los Angeles*

BRIAN K. BAIRSTOW
Sophomore, EAS (Ae)

Conceptual Design of Interplanetary Sample Return Missions Using PowerSail and Solar Electric Propulsion Technology

Mentor: Joel C. Sercel, *Lecturer in Aeronautics*

ROBERT BALDOCK
Caltech-Cambridge Exchange
Junior, Eng; University of Cambridge

Computational Study of Microstructure in the Tent-Like Martensitic Structure of Shape Memory Alloys

Mentor: Kaushik Bhattacharya, *Professor of Applied Mechanics and Mechanical Engineering*

KYLE H. BARBARY
Junior, Ph; Harvey Mudd College

LIGO's Thermal Noise Interferometer: Calibration and Electronic Noise Reduction

Mentor: Eric Black, *Lecturer in Physics*

HEATHER A. BARBER
Caltech-Cambridge Exchange
Junior, Natural Sciences; University of Cambridge

Developing a Novel Hygrometer Using a Capacitive Sensor

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

SANGEETA BARDHAN
Beckman Scholar
Junior, Bi

Regulation of *SpFoxA* Gene: A Comparative and Functional Approach

Mentor: Eric H. Davidson, *Norman Chandler Professor of Cell Biology*

JOSEPH C. BARDIN
Senior, EE; University of California, Santa Barbara

Precision Time Transfer Using a Commercial Satellite

Mentor: Sander Weinreb, *Faculty Associate in Electrical Engineering; Principal Staff Member, JPL*

DANIEL D. BAUMANN
Junior, Ph; University of Cambridge

Large Scale Structure Contributions to Cosmic Microwave Background Polarization

Mentors: Marc P. Kamionkowski, *Professor of Theoretical Physics and Astrophysics*, and Asantha Corray, *Sherman Fairchild Senior Research Fellow in Theoretical Astrophysics*

RENAT BEKBOLATOV
Sophomore, Ma

Errors and Error Correction in the Process of DNA Self-Assembly

Mentor: Erik Winfree, *Assistant Professor of Computer Science and Computation and Neural Systems*

LEON M. BELLAN
Victor Neher SURF Fellow
Junior, Ph

Fabrication and Characterization of Electrodes With Nanometer-Scale Spacing

Mentor: Michael L. Roukes, *Professor of Physics*

CHRISTOPHER P. BELNAP
Junior, Bi/Ge; Hartwick College

Identification of Genes Involved in the Entry of a Quinone Electron Shuttling Molecule in *Shewanella oneidensis* Strain AQ-41

Mentor: Dianne K. Newman, *Clare Booth Luce Assistant Professor of Geobiology and Environmental Engineering Science*

JAMES N. BENARDINI
Senior, MicroBi; University of Arizona

Characterization of Heat-Tolerant and UV Radiation-Resistant Microbes Isolated From an Indian Ocean Hydrothermal Vent System

Mentor: Kasthuri J. Venkateswaran, *Member of the Technical Staff, JPL*

MARCUS K. BENNA
Sophomore, Ph; University of Cambridge

Considerations on Dual-Recycled Gravitational Wave Interferometers

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

ILYA BERDNIKOV
Junior, Ph/Ma; Cornell University

Characterization and Commissioning of Digital Suspensions for the 40m Mode Cleaner

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

ROBERT BERRY
Junior, Ph/Ma; Utah State University

Mapping of Synthetic Sapphire Optical Absorption at 1064nm

Mentor: Joseph M. Kovalik, *Staff Member in Physics*

CLARE J. BIGGS
Caltech-Cambridge Exchange
Junior, Natural Sciences; University of Cambridge

Triggered Slip in the Eastern California Shear Zone

Mentor: Mark Simons, *Assistant Professor of Geophysics*

SIDDARAYAPPA A. BIKKANNAVAR
Junior, Ph/Ma; Principia College

Numerical Modeling of Electric and Magnetic Systems

Mentor: Melora Larson, *Senior Member of the Technical Staff, JPL*

MARK BILINSKI
The Associates SURF Fellow
Junior, Ma/Ch

The Crossing Number of K9,9

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

JONATHAN C. BIRD
Mr. and Mrs. Richard M. Rosenberg SURF Fellow
Junior, Ph

Modeling the Evolution of Massive Elliptical Galaxies in Our Universe

Mentor: B. T. Soifer, *Professor of Physics*

JEFFREY A. BLACKBURNE
Alain Porter Memorial SURF Fellow
Junior, Ph

The Morphological Evolution of Galaxies

Mentors: Richard S. Ellis, *Steele Family Professor of Astronomy*, and Christopher J. Conselice, *Postdoctoral Scholar in Astronomy*

CULLEN H. BLAKE
Junior, Astroph; Princeton University

A Search for Period Changes in Delta Scuti Stars With the Super-LOTIS Sky Patrol System

Mentors: Shrinivas R. Kulkarni, *John D. and Catherine T. MacArthur Professor of Astronomy and Planetary Science*, and Derek Fox, *Postdoctoral Scholar in Astronomy*

DAVID BONFIELD
Caltech-Cambridge Exchange
Junior, Ph; University of Cambridge

Characterising the Length Sensing and Control System of the Mode Cleaner in the LIGO 40m Lab

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

JORDAN L. BOYD-GRABER
J. Weldon Green SURF Fellow
Sophomore, EAS

Tagging Applications for Named Entity Identification and Collocations

Mentors: Christiane Fellbaum, *Research Scientist, Princeton University*, and Fiona Cowie, *Associate Professor of Philosophy*

MORIAH J. BRIER
Sophomore, Ec; Yale University

Christopher Isherwood's Spiritual Evolution and Its Impact on His Narrative Technique

Mentor: Alan Jutzi, *Avery Chief Curator, Rare Books, Huntington Library, Art Collections, and Botanical Gardens*

JOSHUA J. BROTMAN
Senior, Bi; Truman State University

Investigating the Role of GCN5-Related N-acetyltransferase (GNAT) in Aging Using *Drosophila*

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

KARI E.R. BROWN
NASA USRP
Junior, Ch; Hollins University

Laser-Induced Breakdown Spectroscopy for Future Use on Mars

Mentor: Soonsam Kim, *Principal Technical Staff, JPL*

MATTHEW R. BUCKLEY
NASA USRP
Junior, Ph; Kenyon College

Construction of a Superconducting Fixed Point Device

Mentor: Melora Larson, *Senior Member of the Technical Staff, JPL*

ADAM BUSHMAKER
Junior, Engineering Ph; University of Wisconsin, Platteville

Detector Sensitivity Investigations at the Thermal Noise Interferometer

Mentor: Eric Black, *Lecturer in Physics*

ERIC J. CADY
Richter Scholar
Freshman, Ph

Composite X-Ray Spectra of ELGs and Broad-Lined AGNs From the SEXSI Survey

Mentor: Fiona A. Harrison, *Associate Professor of Physics and Astronomy*

SIRIN CALISKAN
Sophomore, Ay

Photometric Studies of Stars in Three Young Star Clusters

Mentor: Lynne Hillenbrand, *Sherman Fairchild Distinguished Postdoctoral Scholar in Astronomy*

PATRICK B. CAMERON
Junior, Ph/College Scholar; Cornell University

Study of the Maximum Likelihood Estimator for Amplitude and Phase Modulated Gravitational Wave Signals

Mentor: Gregory Mendell, *Scientist, LIGO Hanford Observatory*

STACY A. CARRIER
NASA USRP
Junior, Ma; Mount Holyoke College

Laboratory Spectroscopy of Carbon Dioxide in the Near Infrared

Mentor: Linda R. Brown, *Research Scientist, JPL*

ROBERT J. CASPERSON
Applied Materials SURF Fellow
Sophomore, Ph; Oregon State University

Growing Biaxially Textured $BaTiO_3$ Films and Determining the Orientation Distribution During Growth Using RHEED

Mentor: Harry A. Atwater, *Howard Hughes Professor and Professor of Applied Physics and Materials Science*

NICHOLAS CASTLE
Sophomore, Ge/Ch; Lehigh University

Martian Rock Shape Studies

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

MARKO CETINA
Sophomore, APh

Design of a Planar Photonic Crystal Air Channel Waveguide

Mentor: Oskar J. Painter, *Assistant Professor of Applied Physics*

LYLE J. CHAMBERLAIN
Howell N. Tyson, Sr., SURF Fellow
Freshman, EAS

A Behavioral Architecture for Strategy Execution in Multiagent Robotic Systems

Mentor: Richard M. Murray, *Professor of Mechanical Engineering*

VINCENT H. CHANG
Freshman, EE

The Fabrication and Development of Thin Film Microinductors

Mentor: Erik Brandon, *Senior Member of the Technical Staff, JPL*

JONATHAN E. CHEN
Richter Scholar
Freshman, Ch

Novel, Enantioselective Synthesis of Amino Acids via Catalytic Metallacyclization

Mentor: Marc M. Baum, *Visiting Associate in Environmental Science and Engineering*

JUDY Y. CHEN
JPLUS SURF Fellow
Sophomore, Ch; Cerritos Community College

Conformational Equilibria of *trans*-2-Aminocyclohexanecarboxylic Acid Studied by NMR Spectroscopy as a Function of pH in D_2O and Stoichiometric Calculations in DMSO

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

XUEJING CHEN
Arthur E. Lamel Memorial SURF Fellow
Junior, ECE/Ma

Rapid Natural Scene Categorization Requires High-Level Visual Processing

Mentor: Pietro Perona, *Professor of Electrical Engineering*

KWUN HUNG M. CHEUNG
Sophomore, Ph

The Effects of Gravity Gradient Noises on Gravitational Wave Detection in the LIGO Livingston Observatory

Mentor: Mark Coles, *Member of the Professional Staff in Physics*

CARL W. CHIN
General Motors SURF Fellow
Freshman, EE

Laser Characterization

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

ANITA S. CHOI
Richard and Dena Krown SURF Fellow
Sophomore, Ch

Controlling Protein Phosphorylation Using Unnatural Amino Acids

Mentor: Dennis A. Dougherty, *George Grant Hoag Professor of Chemistry*

PAUL J. CHOI
Arthur R. Adams SURF Fellow
Junior, Ch

Single Molecule Studies on the Facilitated Diffusion of the EcoRI Restriction Enzyme

Mentor: Charles P. Collier, *Assistant Professor of Chemistry*

KYLE CHRYSTAL
Freshman, EAS (ME)

Mesoscale Self Assembly

Mentor: Adrian Ponce, *Visiting Associate in Chemistry; Senior Member of the Technical Staff, JPL*

BENJAMIN CHU
NASA USRP
Sophomore, APh; Columbia University

Analysis and Interpretation of Atmospheric OH Abundances Over Table Mountain Facilities

Mentor: Richard P. Cageao, *Member of the Technical Staff, JPL*

ZHIKANG CHUA
Caltech-Cambridge Exchange
Sophomore, Ec; University of Cambridge

Do People Save Enough for Future Expenses? An Exploration Into Whether People Are Economically Competent in Managing Their Finances for Expenses in the Future

Mentor: Colin F. Camerer, *Rea A. and Lela G. Axline Professor of Business Economics*

KEVIN A. CHURCHEL
Sophomore, Ph

Multisensor Assessment of Arctic Polynya Variability

Mentor: Benjamin Holt, *Member of the Technical Staff, JPL*

LORIAN V. CHURCHILL
Howard Hughes Medical Institute SURF Fellow
Freshman, Bi

Identification of Genes Affected by the *Supermom* and *Ihat2* Mutations in *Arabidopsis thaliana*

Mentors: Elliot M. Meyerowitz, *Professor of Biology*, and Elizabeth Haswell, *Postdoctoral Scholar in Biology*

LAWRENCE W. COLAGIOVANNI
Sophomore, CS; Massachusetts Institute of Technology

Adaptive Interplanetary Navigation

Mentor: Todd A. Ely, *Senior Engineer, Navigation and Mission Design Section, JPL*

MORGAN B. CORUM
Junior, Illustration; Art Center College of Design

MEMS Online

Mentor: Thomas George, *Supervisor, MEMS Technology Group, JPL*

KEVIN P. COSTELLO
Richter Scholar
Junior, Ma

Questions Motivated by the Size of Blocking Sets in Projective Planes

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

PAUL D. COUCHMAN
Caltech-Cambridge Exchange
Junior, Eng; University of Cambridge

An Analysis of the Signatures of Complex Systems With Particular Reference to the *E. coli* Bacteria

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

WILLIAM K. COULTER
Applied Materials SURF Fellow
Freshman, EE

Microconcentrator Photovoltaics

Mentor: Harry A. Atwater, *Howard Hughes Professor and Professor of Applied Physics and Materials Science*

CRAIG E. COUNTRYMAN
Beckman Scholar
Junior, Ch

New Strategies for the Synthesis of Pharmaceuticals: The First Enantioselective Total Synthesis of Ketorolac

Mentor: David W.C. MacMillan, *Associate Professor of Chemistry*

PATRICIA L. CRUZ
The James Irvine Foundation MURF Fellow
Junior, AMa; University of California, Berkeley

Use of Multiple Polarizations in Imaging Applications

Mentors: Oscar P. Bruno, *Professor of Applied and Computational Mathematics*, and Mario J. Chaubell, *Graduate Student in Applied and Computational Mathematics*

MARCO CURRELI
NSF Center for the Science and Engineering of Materials MURF Fellow
Junior, Ch; California State University, Los Angeles

Synthesis and Characterization of Silicon Nanocrystals Within the Cages of Zeolites FAU and EMT

Mentors: Mark E. Davis, *Warren and Katharine Schlinger Professor of Chemical Engineering*, and Yong Ba, *Professor, Department of Chemistry and Biochemistry, California State University, Los Angeles*

MIAN DAI
Junior, EAS

Internet Congestion Control

Mentor: Steven H. Low, *Associate Professor of Computer Science and Electrical Engineering*

LUSINE DANAKIAN
Thomas Hunt Morgan SURF Fellow
Junior, Bi/Ch

Effects of Anti-Huntingtin Antibodies on Mouse Models of Huntington's Disease

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

WEI LIEN S. DANG
Freshman, EAS (MS)

Carbon Nanotube Field Emission and High-Frequency Power Generation in a Nanoklystron

Mentor: Peter Siegel, *Group Supervisor, JPL*

MICHAEL E. DAVENPORT
Sophomore, Ph

Entanglement in N Qubits

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

NATALIA I. DELIGNE
Carolyn Merkel SURF Fellow
Sophomore, Geobi

Equilibrium Water Content of Olivine

Mentor: Paul D. Asimow, *Assistant Professor of Geology and Geochemistry*

DANN O. DEMPSEY
General Motors SURF Fellow
Senior, EAS

Arsenic Cycling in Natural Sediments: Effects of Aging

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

PETER J. DENNEDY-FRANK
Richter Scholar
Junior, PlSc

A Fault Model for Heating on Io

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

ANDREW P. DERVAN
Howard Hughes Medical Institute SURF Fellow
Sophomore, Bi; Yale University

Optimization of Sample Preparation and Liquid Chromatography Mass Spectrometry of Proteolyzed Nicotinic Acetylcholine Receptor as a Means of Enhancing Sensitivity for Proteomics Studies

Mentor: Henry A. Lester, *Bren Professor of Biology*

ERIN N. DIMAGGIO
NASA USRP
Sophomore, Ge; University of Michigan

Characterization of Martian Rock Shape: Implications for MER Airbag Drop Tests

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

SERINA M. DINIEGA
Hannah Bradley SURF Fellow
Junior, Ma

Martian Polar Wind Patterns: A Study Through Visual Surveys of Aeolian Features and Atmospheric Models

Mentor: Mark I. Richardson, *Assistant Professor of Planetary Science*

RAGHUVEER DODDA
Junior, CS; Southeastern Louisiana University

Noise Characterization in the LIGO Livingston 4-km Interferometer

Mentor: Mark Coles, *Member of the Professional Staff in Physics*

TIMOTHY E. DOLCH
Junior, Ph

Galaxy Clusters From the First Half of the Universe

Mentor: Peter Eisenhardt, *Research Scientist, JPL*

TIMOTHY DONG
Axline SURF Fellow
Pre-Freshman

The Role of Spatial Attention on the Scintillating Grid Illusion

Mentors: Christof Koch, *Lois and Victor Troendle Professor of Cognitive and Behavioral Biology and Professor of Computation and Neural Systems*, and Rufin Van Rullen, *Postdoctoral Scholar in Biology*

TYLER G. DRAKE
The Aerospace Corporation SURF Fellow
Sophomore, Ph

Nanowire Resonators

Mentor: Michael L. Roukes, *Professor of Physics*

KEVIN E. DUNCKLEE
Toshi Kubota Aeronautics SURF Fellow
Freshman, EE

Obelisk Project

Mentor: Morteza Gharib, *Professor of Aeronautics and Bioengineering*

LINDA Y. DUNN
Richter Scholar
Sophomore, EE

Pedestrian Traffic Signal Recognition

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

CHRISTINA A. DWYER
Erika C. Vote SURF Fellow
Freshman, Ay

CCD Observations of Comets and Asteroids

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

ZACHARY T. DYDEK
Honeywell SURF Fellow
Sophomore, ME

Studying the Phenomenon of "Booming Sand" in the Laboratory

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

KATHRYN A. DYL
Toni and Bob Perpall SURF Fellow
Sophomore, Geoch

Rotational and Vibrational Spectroscopy of Dihydroxyacetone

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

RICHARD D. EAGER
Freshman, Ph

Optimal Quantum Codes for the Symmetric Depolarizing Channel

Mentor: Hideo Mabuchi, *Associate Professor of Physics and Control and Dynamical Systems*

ERICA N. EBER
Junior, Ph

Offset Cancelled Phase Locking for LISA

Mentor: Thomas A. Prince, *Professor of Physics*

TAMBREA T. ELLISON
Amgen, Inc. MURF Fellow
Junior, Bi; Valdosta State University

Or83b Expression in *Drosophila melanogaster*

Mentors: Kai G. Zinn, *Professor of Biology*, and Anna M. Salazar, *Graduate Student in Biology*

BRIAN EMMERSON
Junior, Ph; University of Cambridge

Analysis of Rapidly Cooled Refractory Metal Using X-Ray Diffraction

Mentor: Riccardo DeSalvo, *Member of the Professional Staff in Physics*

ADRIENNE ERICKCEK
Junior, Ph; Princeton University

Late-Time Decay of Scalar Fields in Black Hole Spacetimes

Mentor: Mark Scheel, *Postdoctoral Scholar in Physics*

AARON P. ESSER-KAHN
William N. Lacey SURF Fellow
Sophomore, Ch

In vivo Incorporation of Tryptophan Analogues Into Proteins

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

ANDREI FARAON
Richter Scholar
Sophomore, Ph

The Analysis of Neutron Events in KamLAND Data

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

TYESHA L. FARMER
Amgen, Inc. MURF Fellow
Junior, Bi; Alabama A&M University

Coexpression of a Family of G Protein-Coupled Receptors Within Nociceptive Sensory Neurons of Trigeminal and Dorsal Root Ganglia

Mentors: David J. Anderson, *Professor of Biology; Investigator, Howard Hughes Medical Institute*, and Mark J. Zylka, *Postdoctoral Scholar in Biology*

WILL M. FARR
Edward C. Stone SURF Fellow
Junior, Ph

Numerical Solutions to Two-Dimensional Self-Similar Ultra-Relativistic Fluid-Flow Equations

Mentor: Re'em Sari, *Sherman Fairchild Senior Research Fellow in Astrophysics*

JENNY A. FISHER
Freshman, PISc

A Global Assessment of Dust Devil Activity on Mars

Mentor: Mark I. Richardson, *Assistant Professor of Planetary Science*

SUVI F. FLAGAN
Mr. Robert M. Abbey SURF Fellow
Sophomore, EAS

Acyl-Homoserine Lactone and Homoserine Lactone Degradation by Defined Microbial Mono- and Tri-Cultures

Mentor: Jared R. Leadbetter, *Assistant Professor of Environmental Microbiology*

REBECCA A. FLINT
Sophomore, Ph

Rover Localization Using Genetic Programming

Mentor: Patrick C. Leger, *Member of the Technical Staff, JPL*

RAYMOND C. FONG
Senior, Eng; Harvey Mudd College

Simulation Chamber for Test Instruments Aboard AFRL's TechSat21

Mentor: Lee K. Johnson, *Research Scientist, JPL*

WILLIAM T. FONG
Sophomore, ACM

Disk-Averaged Synthetic Spectra of Terrestrial Planets: Implementation of Methods in Numerical Analysis

Mentor: Victoria Meadows, *Research Scientist, JPL*

KNATOKIE FORD
Howard Hughes Medical Institute MURF Fellow
Sophomore, Ch; Clark Atlanta University

Ferric Iron Reduction and Growth in *Shewanella oneidensis* and *Pseudomonas chlororaphis*

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

EMILY B. FOX
NASA USRP
Sophomore, EE; Massachusetts Institute of Technology

Biomorphic Robot Arm Feedback Systems

Mentor: Mitra Hartmann, *Postdoctoral Scholar, JPL*

ORI D. FOX
NASA USRP
Junior, Astroph; Boston University

Jupiter's Polar Vortex Phenomenon: Comparing the Stratosphere and Troposphere

Mentor: Glenn S. Orton, *Senior Research Scientist, JPL*

CHRISTOPHER B. FRANCO
Howard Hughes Medical Institute SURF Fellow
Freshman, Bi

Functional Analysis of *SpFoxB* in the Development of *Strongylocentrotus purpuratus*

Mentors: Eric H. Davidson, *Norman Chandler Professor of Cell Biology*, and Veronica Hinman, *Postdoctoral Scholar in Biology*

LISA FUKUI
Freshman

Dumbbell-Shaped Fused Silica Fibers

Mentor: Phil Willems, *Staff Member in Physics*

NATHAN L. FUNG
Richter Scholar
Junior, EAS

Characterizing Six Major Aftershocks of the Northridge Earthquake Sequence

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

ILYA FUSHMAN
Richter Scholar
Junior, Ph

Imaging Single Molecules in Microfluidic Devices for DNA Sequencing Applications

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

JARED M. GABOR
Freshman, Ph

Analysis of High-Resolution Spectra of Young Stars

Mentor: Lynne Hillenbrand, *Sherman Fairchild Distinguished Postdoctoral Scholar in Astronomy*

MELANIE A. GAINEY
NASA USRP
Sophomore, Bi; Boston University

Proposal for an *in situ* and Remote Coastal Ocean Observatory

Mentor: Paul DiGiacomo, *Scientist, JPL*

STEVEN S. GAO
Axline SURF Fellow
Pre-Freshman

Granular Flows in Nature: Booming Sand Dunes

Mentors: Christopher E. Brennen, *Professor of Mechanical Engineering*, and Melany L. Hunt, *Professor of Mechanical Engineering*

MEGAN M. GARDNER
NASA USRP
Sophomore, CS; Brigham Young University

The Age of the Universe: The M92 Photometry Database

Mentor: Stephen D. Gillam, *Scientist, JPL*

JOHN D. GEISZLER
Sophomore, APh

Remote Sensing of Seasonal Phase Changes in Arctic Ocean Ice Cover

Mentor: Benjamin Holt, *Member of the Technical Staff, JPL*

LESLIE E. GIBSON
NASA USRP
Sophomore, Ch; Wellesley College

Fourier-Transform Infrared Spectroscopy for Future Use on Mars

Mentor: Soonsam Kim, *Principal Technical Staff, JPL*

PAOLA GIUSTI
Howard Hughes Medical Institute MURF Fellow
Junior, Bi; University of Puerto Rico, Rio Piedras

Designing a Metal Binding Site in the Mechanosensitive Channel of Large Conductance (MscL) of *Escherichia coli*

Mentors: Dennis A. Dougherty, *George Grant Hoag Professor of Chemistry*, and Don Elmore, *Graduate Student in Chemistry*

HILARY K. GLIDDEN
Sophomore, Neuro/Exp. Psy; University of Cambridge

Ontogeny of Trace Fear Conditioning in C57BL/6N Mice

Mentor: Christof Koch, *Lois and Victor Troendle Professor of Cognitive and Behavioral Biology and Professor of Computation and Neural Systems*

YIYANG GONG
Richter Scholar
Freshman, EE

Characterization and Design of Photonic Crystal Optical Waveguides

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

MELANIE A. GOODRICH
Sophomore, Ec

The Effect of Candidate Order on Election Results

Mentor: R. M. Alvarez, *Professor of Political Science*

DANIEL E. GOODS
Howard Hughes Medical Institute SURF Fellow
Senior, Graphic Design; Art Center College of Design

Running Into Spider Webs: Visual Cues for the Nonpictorial

Mentors: Russell E. Jacobs, *Member of the Beckman Institute*, and David Kremers, *Conceptual Artist in Biology*

BENJAMIN R. GRANETT
Hugh F. and Audy Lou Colvin International SURF Fellow
Sophomore, Ay

A New Algorithm for Hunting Low Surface Brightness Galaxies in DPOSS

Mentors: Roberto Scaramella, *Associate Astronomer, Rome Astronomical Observatory*, and S. G. Djorgovski, *Professor of Astronomy*

ERIK M. GRANSTEDT
Sophomore, EE

Proposal for an *in situ* and Remote Coastal Ocean Observatory

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

MEGAN A. GREENFIELD
Donald S. Clark SURF Fellow
Sophomore, ChE

Synthesis and Characterization of Photoresponsive Version of the Biocompatible Polymer Poly(ethylene glycol)

Mentor: Julia A. Kornfield, *Professor of Chemical Engineering*

JANE C. GREENHAM
Richter Scholar
Junior, PlSc

Characterization of Creep-Related Landforms in the Northeastern Hellas Region of Mars

Mentors: Alfred S. McEwen, *Associate Professor of Planetary Geology and Image Processing, University of Arizona*, and Mark I. Richardson, *Assistant Professor of Planetary Science*

NATHAN J. GREENWOOD
NASA USRP
Junior, Ph; California State Polytechnic University, San Luis Obispo

Growth of High Quality Nitride Photodiodes via Molecular Beam Epitaxy for Implementation in Ultraviolet Detector Arrays

Mentor: Robert A. Beach, *Member of the Technical Staff, JPL*

JULIA J. GREISSL
Junior, Ph

Towards the Initial Mass Function of the Star Forming Region MonR2: A Spectroscopic Investigation

Mentor: Lynne Hillenbrand, *Sherman Fairchild Distinguished Postdoctoral Scholar in Astronomy*

DAVID R. GRISWOLD
Freshman, EAS (CS)

Analysis of UV Images From the Cassini Mission

Mentor: Robert A. West, *Research Scientist, JPL*

ALEXA HALFORD
Junior, Ma/Ph; Augsburg College

Spectrophotometry of the Uranian Satellites

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

KOUN HAN
Arthur A. Noyes SURF Fellow
Sophomore, Bi

Interaction of Potent Photoreducing Platinum Complexes With DNA

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

JAMES M. HANSEN
Junior, Ph/Ma

Effective Field Theory of 3-Branes and the Cosmological Constant

Mentor: Mark B. Wise, *John A. McCone Professor of High Energy Physics*

RIZAL F. HARIADI
Senior, Ph/Bi; Washington State University

Molecular Mechanism of Self-Assembly of Two-Dimensional DNA Crystals

Mentor: Erik Winfree, *Assistant Professor of Computer Science and Computation and Neural Systems*

NZINGA HARRIS
Howard Hughes Medical Institute MURF Fellow
Sophomore, Bi; Mount St. Mary's College

Sequence Dependence on DNA-Protein Crosslinking

Mentor: Eric D. Stemp, *Visiting Associate in Chemistry*

JAMES W. HEGEMAN
Shirley and Carl Larson SURF Fellow
Sophomore, Ma

Progress Toward the Total Synthesis of Norzoanthamine

Mentor: Brian M. Stoltz, *Assistant Professor of Chemistry*

SARAH E. HENDRICKSON
Sophomore, EAS (Ae)

Conceptual Design of Interplanetary Sample Return Missions Using PowerSail and Solar Electric Propulsion Technology

Mentor: Joel C. Sercel, *Lecturer in Aeronautics*

MORGAN HENDRY
Freshman, Aeronautics and Astronautics; University of Southern California

Proposal for an *in situ* and Remote Coastal Ocean Observatory

Mentors: Lloyd C. French, *Systems Architect, JPL*, and Paul DiGiacomo, *Scientist, JPL*

PAUL HENSHALL
Junior, Ph; University of Leicester

Conceptual Design of Interplanetary Sample Return Missions Using PowerSail and Solar Electric Propulsion Technology

Mentor: Joel C. Sercel, *Lecturer in Aeronautics*

ISAAC A. HILBURN
Joanne Gimbel SURF Fellow
Sophomore, Geoph

Neoproterozoic Cap Carbonates: A Paleomagnetic Estimation of Formation Time and Study of Tepee and Crystal Fan Structures Within the Ravensthroat Dolostone and Hayhook Limestone in the MacKenzie Mountains, British Columbia, Canada

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

JAMES H. HILL
The James Irvine Foundation MURF Fellow
Sophomore, CS; Morehouse College

Backend Bytes

Mentor: Jason J. Hickey, *Assistant Professor of Computer Science*

DANIEL HOBOHM
Junior, Bioch; University of Cambridge

Investigations Into the Role of a Pharbin-Like Inositol Polyphosphate 5-phosphatase and p190 RhoGAP in the Neuromuscular Junction Development of *Drosophila melanogaster*

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

JACLYN M. HOMNICK
Freshman, Ph

Density Measurements at the Tricritical Point of Liquid Helium

Mentor: Melora Larson, *Senior Member of the Technical Staff, JPL*

SUE ANN HONG
Howard Hughes Medical Institute SURF Fellow
Freshman, EAS (CS)

The Timing of Conscious Perception

Mentor: Shinsuke Shimojo, *Professor of Biology*

SARAH M. HÖRST
Richter Scholar
Sophomore, PlSc

Search for Magnesium on Europa's Surface

Mentor: Michael E. Brown, *Associate Professor of Planetary Astronomy*

HAOMIAO HUANG
Richter Scholar
Freshman, EE

Surname Distributions as a Reflection of Marriage Patterns in Rural China

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

HERMES C. HUANG
Howard Hughes Medical Institute SURF Fellow
Sophomore, APh

First Principles Dislocations Properties in MgO From Molecular Dynamics

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

LINDSAY HUFTON
Junior, Bioch; University of Cambridge

***Flavivirus Capsid* Protein in RNA Replication and Encapsidation: Is the Capsid Protein Only Required for RNA Replication?**

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

PATRICK A. HUMMEL
Axline SURF Fellow
Pre-Freshman

On Consecutive Quadratic Non-Residues: A Conjecture of Issai Schur

Mentor: Dinakar Ramakrishnan, *Professor of Mathematics*

GEOFFREY O. IRVING
Richter Scholar
Junior, Ma

Robust Collision and Contact Handling for Curved, Deformable Surfaces

Mentor: Alan H. Barr, *Professor of Computer Science*

REHANA ISMAIL
NSF Center for the Science and Engineering of Materials MURF Fellow
Senior, Bioch; California State University, Los Angeles

Theoretical Calculation for the Functionalization of Methane by Mercuric Dichloride

Mentors: William A. Goddard III, *Charles and Mary Ferkel Professor of Chemistry, Materials Science, and Applied Physics*, and Matthias Selke, *Professor, Department of Chemistry and Biochemistry, California State University, Los Angeles*

RACHITA JAIN
NASA USRP
Junior, CS and Eng; University of California, Irvine

1988 Mars Radar Data Retrieval and Analysis

Mentor: Albert Haldemann, *Deputy Project Scientist, JPL*

DAVIT JANVELYAN
JPLUS SURF Fellow
Junior, CS; University of California, Los Angeles

Functional Role of Sleep in Learning and Memory

Mentor: Shinsuke Shimojo, *Professor of Biology*

JOSEPH S. JEWELL
Honeywell SURF Fellow
Sophomore, EAS (Ae)

Self-Actuating Valve for Pulse Detonation Engine

Mentor: Joseph E. Shepherd, *Professor of Aeronautics*

SUNEIL K. JHAMB
Freshman

Plasmon Excitation and Light Emission in Single Crystal Ag Nanowire Junction From Inelastic Electron Tunneling

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

LIANG JIANG
Richter Scholar
Sophomore, Ph

Observation of the Atom-Cavity: Understanding the Transition From Quantum to Classical Limit

Mentor: Hideo Mabuchi, *Associate Professor of Physics and Control and Dynamical Systems*

CRISTIAN S. JITIANU
Rita A. and Øistein Skjellum SURF Fellow
Sophomore, Bi

Optimization of the H-Pin Linker Length

Mentor: Peter B. Dervan, *Bren Professor of Chemistry*

EMILY G. JOHNSEN
Richter Scholar
Junior, SES

The Graffiti in the Caltech Steam Tunnels

Mentors: Judith R. Goodstein, *University Archivist; Faculty Associate in History; Registrar*, and William F. Deverell, *Associate Professor of History*

MATTHEW R. JOHNSON
Sophomore, EE; Colorado State University

Investigations Into the Effects of Cryogenic Operation Leading to Hot Carrier Injection in Power MOSFETs

Mentor: Michael A. Newell, *Senior Member of the Technical Staff, JPL*

NICHOLAS J. JOHNSON
Junior, ME; California State Polytechnic University, San Luis Obispo

Characterization of the Natural Resonance Properties of Rat Vibrissae Using High Speed Videography

Mentor: Mitra Hartmann, *Postdoctoral Scholar, JPL*

PORTIA L. JONES
NSF Center for Neuromorphic Systems Engineering MURF Fellow
Junior, Computer Eng; Xavier University of Louisiana

Designing a Classifier for Medical Images

Mentors: Pietro Perona, *Professor of Electrical Engineering*, and Pierre Moreels, *Graduate Student in Electrical Engineering*

TIMOTHY F. JONES
Junior, Chemistry

A Light Source for *in situ* Detection of Atmospheric Br by Laser-Induced Fluorescence

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

AMY JORDAN
Junior, Astroph; University of California, Berkeley

Analyzing Spectra of Europa for Evidence of Salts

Mentor: Michael E. Brown, *Associate Professor of Planetary Astronomy*

TED E. JOU
J. Kent Clark SURF Fellow
Junior, Ph

A History of Undergraduate Self-Governance at Caltech

Mentor: Miriam Feldblum, *Faculty Associate in the Humanities; Lecturer in the Humanities*

JAIME J. JUÁREZ
Sophomore, Aeronautics and Astronautics; Stanford University

Conceptual Design of Interplanetary Sample Return Missions Using PowerSail and Solar Electric Propulsion Technology

Mentor: Joel C. Sercel, *Lecturer in Aeronautics*

AKASH KANSAGRA
Freshman, Ph/Ma; Massachusetts Institute of Technology

An Improved Template Matching Algorithm for LIGO

Mentors: Szabolcs Marka, *Postdoctoral Scholar in Physics*, and John G. Zweizig, *Staff Member in Physics*

ELLIOTT M. KARPILOVSKY
Sophomore, ECE

Photochemical Modeling and Analysis of Hydroxyl Column Abundances

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

FUMIKO KAWAZOE
Senior, Ph; Ochanomizu University

Detector Sensitivity Investigations at the Thermal Noise Interferometer

Mentor: Eric Black, *Lecturer in Physics*

KIMBERLY E. KELSEY
Richter Scholar
Junior, Ge

The Formation of Painite

Mentor: George R. Rossman, *Professor of Mineralogy*

CHAD C. KESSENS
Junior, EAS (ME)

Caster Contributions to Dual-Wheel Robotic Explorers

Mentor: Daniel Helmick, *Member of the Technical Staff, JPL*

BASIT A. KHAN
Samuel P. and Frances Krown SURF Fellow
Junior, EE/BEM

Applying Surface-Plasmon Resonances in Single Metallic Nanoparticles to Diffractive Optics

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

HANNAH K. KIM
Howard Hughes Medical Institute SURF Fellow
Junior, Bi

Analysis of Dauer Formation Mutations in *C. briggsae*

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

MIKHAIL N. KISLITSYN
Senior, Ch; Higher Chemical College

Use of Hydrothermal and Ion Exchange Methods to Produce Novel Acid Silicates and Germanates

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

LUCAS J. KOERNER
Junior, Integrated Science (Ph)/Ma; Northwestern University

Three Input Matching/Driving Systems for Electro-Optic Modulators

Mentor: Richard Gustafson, *Research Scientist, LIGO*

JOSEPH C. KOO
Richter Scholar
Junior, EE

Characterization and Simulation of a Multiple Antenna Wireless Communication System Utilizing Space-Time and Error-Correcting Codes

Mentor: Babak Hassibi, *Assistant Professor of Electrical Engineering*

ERIC KORT
Sophomore, Ph; Pomona College

X-Ray Micro-Densitometry of Amorphous MoRuB for LIGO Flex-Joint Mirror Suspensions

Mentor: Riccardo DeSalvo, *Member of the Professional Staff in Physics*

STEPHANIE A. KOVALCHIK
Howard Hughes Medical Institute SURF Fellow
Junior, Bi

Economic Decision Making and Aging

Mentor: John M. Allman, *Frank P. Hixon Professor of Neurobiology*

DAVID M. KURTZ
Thomas C. Hays SURF Fellow
Freshman, Ch

Arene Coupling and C-H Activation by Palladium Complexes

Mentor: John E. Bercaw, *Centennial Professor of Chemistry*

NATHAN KURZ
Sophomore, Ma/Ph; Pennsylvania State University

BEAM Centering on the LIGO Test Masses

Mentor: Michael Landry, *Postdoctoral Scholar in Physics*

JEFFREY KWONG
Senior, Aerospace Eng; University of California, Los Angeles

Bio-Material Detection Experiment Development for Deep Underwater Environments

Mentors: Gindi French, *Member of the Technical Staff, JPL*, and Arthur L. Lane, *Research Scientist, JPL*

CHARLES LA
Samuel P. and Frances Krown SURF Fellow
Sophomore, EAS

Plasma Energy Analyzer Development

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

CHRISTINA T. LAM
Richter Scholar
Junior, ECE

Reviving Master Pianists

Mentors: Steven E. Koonin, *Professor of Theoretical Physics*, and Wolfgang Fink, *Member of the Technical Staff, JPL*

TIN YIU LAM
Joseph B. Koepfli SURF Fellow
Junior, Ch

Progress Toward the Total Synthesis of Lemonomycin

Mentor: Brian M. Stoltz, *Assistant Professor of Chemistry*

CORINNE LAMB
Junior, Ph/Ay; State University of New York at Stony Brook

Fused Silica Suspension Research

Mentor: Phil Willems, *Staff Member in Physics*

STEPHAN T. LAVAVEJ
Sophomore, EAS

Implementing a Stream-Oriented Burrows-Wheeler Compressor

Mentor: André M. DeHon, *Assistant Professor of Computer Science*

NICHOLAS M. LAW
Junior, Natural Science; University of Cambridge

X-Ray Flash Detection in XMM-Newton Archival Data

Mentors: Shrinivas R. Kulkarni, *John D. and Catherine T. MacArthur Professor of Astronomy and Planetary Science*, and Robert E. Rutledge, *Postdoctoral Scholar in Physics*

JENNIFER H. LEE
Richter Scholar
Junior, APh

Modeling of Planar Photonic Crystal Optical Circuits

Mentor: Oskar J. Painter, *Assistant Professor of Applied Physics*

JONATHAN J. LEE
Caltech-NUS Exchange
Sophomore, ECE

Conference Management System

Mentor: Ai Poh Loh, *Professor of Electrical and Computer Engineering*

SHAUN P. LEE
Samuel P. and Frances Krown SURF Fellow
Freshman, ECE

Self-Assembly of DNA Crystals From a Two-Dimensional Boundary

Mentor: Erik Winfree, *Assistant Professor of Computer Science and Computation and Neural Systems*

TONY LEE
Richter Scholar
Freshman, Ph

Discovery Potential of the Higgs Boson Through Weak Boson Fusion and Diphoton Decay

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

JEREMY M. LEIBS
Axline SURF Fellow
Pre-Freshman

Stochastic Modeling of Error Correction in Kinase-Based Biochemical Circuits

Mentor: Erik Winfree, *Assistant Professor of Computer Science and Computation and Neural Systems*

ELIZABETH D. LESTER
Howard Hughes Medical Institute MURF Fellow
Junior, Bi/Premed; Baylor University

Online Monitoring of Aerosolized Bacterial Spores: An Anthrax "Smoke" Detector

Mentor: Adrian Ponce, *Visiting Associate in Chemistry; Senior Member of the Technical Staff, JPL*

HONGYI LI
General Motors SURF Fellow
Freshman, Ma

Estimation of the Number of Incommensurate Frequencies in a Nonlinear Dynamical System

Mentor: Michael C. Cross, *Professor of Theoretical Physics*

JENNIFER X. LI
Mrs. J. Stanley Johnson SURF Fellow
Freshman, Bi

Comparing the LIN-12 Mediated Pathways for Vulval Induction Between *C. elegans* and *C. briggsae*

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

ROBERT L. LI
Howard Hughes Medical Institute SURF Fellow
Sophomore, Bi

Automated Conversion of Biology Literature From PDF to ASCII

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

XIAOFENG LI
Richter Scholar
Junior, EE

The Implementation of a 20Gbit/sec Integrated Transmitter for Optic Fiber Communication Based on Interval Modulation Coding

Mentor: Seyed-Ali Hajimiri, *Assistant Professor of Electrical Engineering*

ERIC S. LIN
Richter Scholar
Sophomore, Ph

Electron Backscattering From Materials Used in the UCN Neutron Spin-Electron Angular Correlation Experiment in Beta Decay

Mentor: Bradley W. Filippone, *Professor of Physics*

JOSEPH H. LIN
Caltech-NUS Exchange
Sophomore, EE

GameCity

Mentor: Adrian D. Cheok, *Assistant Professor of Electrical and Computer Engineering, National University of Singapore*

MILO LIN
Axline SURF Fellow
Pre-Freshman

Selecting DNA Sequence for a Desired Secondary Structure

Mentors: Niles A. Pierce, *Assistant Professor of Applied and Computational Mathematics*, and Erik Winfree, *Assistant Professor of Computer Science and Computation and Neural Systems*

SAMUEL D. LINDSAY-LEVINE
Robert L. Blinkenberg SURF Fellow
Sophomore, Ph

The Supersaturation and Temperature Dependence of Ice Crystal Growth Rates in Vacuum

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

BINGHAI LING
Samuel P. and Frances Krown SURF Fellow
Freshman, Ch

Synthesis of Chondroitin Sulfate Glycosaminoglycans

Mentor: Linda C. Hsieh-Wilson, *Assistant Professor of Chemistry*

JANESSA M. LINK
Samuel P. and Frances Krown SURF Fellow
Junior, Ge

Fathers of Modern Geology: The Scientific, Social, and Historical Relationship of William Smith and His Contemporaries

Mentor: William F. Deverell, *Associate Professor of History*

ZHIHAO LIU
Axline SURF Fellow
Pre-Freshman

The *k*-Nearest-Neighbor Representation

Mentor: Yaser S. Abu-Mostafa, *Professor of Electrical Engineering and Computer Science*

ETHELMAE V. LOEWER
Dr. Terry Cole SURF Fellow
Freshman, ChE

Progress Towards the Total Synthesis of Phlorglucinol Natural Products

Mentor: Brian M. Stoltz, *Assistant Professor of Chemistry*

PO-SHEN LOH
Øistein and Rita A. Skjellum SURF Fellow
Sophomore, Ma

Image Reconstruction With Ridgelets

Mentor: Emmanuel Candes, *Assistant Professor of Applied and Computational Mathematics*

DAGNY L. LOOPER
Sophomore, Ay

Extrasolar Planets: Predicting and Observing Times of Transit Using Photometric Dimming

Mentor: David Charbonneau, *R.A. Millikan Postdoctoral Scholar in Astronomy*

GALEN R. LORAM
Peter A. Lindstrom, Jr., SURF Fellow
Freshman, Ec

Palladium (II)-Catalyzed Oxidative Kinetic Resolution: An Approach to the Enantioselective Synthesis of the Hypoglycemic Diterpneoid Saudin

Mentor: Brian M. Stoltz, *Assistant Professor of Chemistry*

EVAN R.P. LOWE
NSF Center for Neuromorphic Systems Engineering MURF Fellow
Sophomore, Eng; University of Michigan

Automatic Tracking of Electric Fish

Mentor: Malcolm A. MacIver, *Postdoctoral Scholar in Mechanical Engineering*

MICHAEL LUBARSKY
Junior, Applied Bi; Georgia Institute of Technology

Microbial Characterization of an Indian Ocean Deep-Sea Hydrothermal Vent System

Mentor: Kasthuri J. Venkateswaran, *Member of the Technical Staff, JPL*

BERTRAND H. LUI
Richter Scholar
Freshman, EAS

Conceptual Design of Interplanetary Sample Return Missions Using PowerSail and Solar Electric Propulsion Technology

Mentor: Joel C. Sercel, *Lecturer in Aeronautics*

SARAH A. LUXENBERG
Northern California Associates SURF Fellow
Sophomore, Ch

Synthesis of a Fully Protected α-Hydroxy Tyrosine Molecule

Mentor: Dennis A. Dougherty, *George Grant Hoag Professor of Chemistry*

TAMMY Y. MA
Freshman, EAS (Ae)

Use of *SplB* as a Genetic Marker for the Presence and Enumeration of Spore-Forming Organisms

Mentor: Kasthuri J. Venkateswaran, *Member of the Technical Staff, JPL*

YUSSANNE P. MA
General Motors SURF Fellow
Sophomore, ACM

Sources of Stratospheric Sulfate Aerosol: Modeling Sulfur in the Atmosphere

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

KATHERINE J. MACK
Junior, Ph

Foregrounds for Future 21cm Observations of the High Redshift Universe

Mentor: E. S. Phinney, *Professor of Theoretical Astrophysics*

DAVIN B. MADDOX
Richter Scholar
Freshman, Ma

Rational Triangles and Elliptic Curves

Mentor: Edray H. Goins, *Irvine Foundation Instructor of Mathematics*

SIDDARTH MADHAV
Junior, Ph/EE

90° Geometry Optical Filters Using Volume Holograms

Mentor: Demetri Psaltis, *Thomas G. Myers Professor of Electrical Engineering*

THELMA F. MADZIMA
Howard Hughes Medical Institute MURF Fellow
Sophomore, Plant Biotechnology; Fort Valley State University

Establishment of Transgenic Lines for Chromatin Immunoprecipitation Analysis in *Arabidopsis thaliana*

Mentors: Elliot M. Meyerowitz, *Professor of Biology*, and Toshiro Ito, *Postdoctoral Scholar in Biology*

MICHAEL R. MAIRE
Arthur R. Adams SURF Fellow
Junior, Ma

Recognizing Deformable Objects Using Local Scale-Invariant Features

Mentor: Pietro Perona, *Professor of Electrical Engineering*

ARPIT MALAVIYA
JPLUS SURF Fellow
Sophomore, EE; Moorpark College

A Study of the Effects of Electrode Composition on the Performance of Solid Acid Fuel Cells

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

KAISEY S. MANDEL
Junior, Ay

Construction of the Cluster Potential and Cosmological Constraints From Strong Lensing in Abell 2218

Mentors: Marc P. Kamionkowski, *Professor of Theoretical Physics and Astrophysics*, and Eric Agol, *Chandra Postdoctoral Fellow in Physics*

MADDALENA MANTOVANI
Senior, Ph; University of Pisa

Characterization of $(Mo_{0.6}Ru_{0.4})_{1-x}B_x$ Alloy for Use in Developing Suspensions for Gravitational Wave Detectors

Mentor: Riccardo DeSalvo, *Member of the Professional Staff in Physics*

VANESSA MARQUEZ
NASA USRP
Junior, Aeronautical Eng; Massachusetts Institute of Technology

Defining and Creating a Solar System Homework Helper Website for K-12 Students

Mentor: Phillips W. Davis, *Staff Member, JPL*

DANIEL MASON
Sophomore, ME; Rensselaer Polytechnic Institute

Advanced LIGO Suspension Research

Mentors: Calum I. Torrie, *Staff Member in Physics*, and Janeen H. Romie, *Staff Member in Physics*

CHRISTOPHER L. MCCLENDON
Mr. and Mrs. Donald M. Alstadt SURF Fellow
Freshman, Bi

Fidelity of Seryl-tRNA Synthetase to Binding of Natural Amino Acids

Mentors: William A. Goddard III, *Charles and Mary Ferkel Professor of Chemistry, Materials Science, and Applied Physics*, and Vaidehi Nagarajan, *Director, Biomacromolecular Simulations, Materials Simulation Center*

CEARA J. MCNALLY
Junior, Eng/Ph; University of Maine, Orono

The Great Observatories Origins Deep Survey: Studying Galaxy Formation Throughout Cosmic History

Mentor: Daniel Stern, *Scientist, JPL*

TYREL M. MCQUEEN
Howard Hughes Medical Institute SURF Fellow
Sophomore, Ch; Harvey Mudd College

High Speed O_2 Monitoring via Fluorescent Quenching

Mentor: John A. Moss, *Visiting Associate in Environmental Science and Engineering*

RACHEL A. MEDWOOD
Dr. and Mrs. J. Howard Marshall SURF Fellow
Sophomore, EAS

The Specific Effects of Sleep Deprivation on Different Forms of Memory

Mentor: Shinsuke Shimojo, *Professor of Biology*

SHARON MEIDT
Junior, Ph; Davidson College

Non-Gaussian Noise in the Thermal Noise Interferometer

Mentor: Eric Black, *Lecturer in Physics*

RICHARD P. MEYER
Sophomore, Ph; California State Polytechnic University, San Luis Obispo

High Redshift Emission-Line Galaxies

Mentor: B. T. Soifer, *Professor of Physics*

FLORIN MINGIREANU
Freshman, Ph; University of Bucharest

How Changing Isotopic Compositions Can Resemble a Changing Fine-Structure Constant

Mentor: Marc P. Kamionkowski, *Professor of Theoretical Physics and Astrophysics*

VIKRAM MITTAL
Dr. Chandler C. Ross SURF Fellow
Junior, EAS (Ae)

Conceptual Design of Interplanetary Sample Return Missions Using PowerSail and Solar Electric Propulsion Technology

Mentor: Joel C. Sercel, *Lecturer in Aeronautics*

TAMARA S. MITTMAN
Sophomore, ESE; Harvard University

In situ Measurements of Nitric Acid in the Polluted Boundary Layer by Chemical Ionization Mass Spectrometry

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

TOMONARI S. MIYASHITA
Freshman, Ph

A Radiotelescope for Observations of Astrophysical Polarized Radiation

Mentor: Andrew E. Lange, *Marvin L. Goldberger Professor of Physics*

SWATI MOHAN
Sophomore, ME; Cornell University

Conceptual Design of Interplanetary Sample Return Missions Using PowerSail and Solar Electric Propulsion Technology

Mentor: Joel C. Sercel, *Lecturer in Aeronautics*

NELSON F. MORALES
Howard Hughes Medical Institute MURF Fellow
Junior, Ch; University of Puerto Rico, Rio Piedras

Synthesis and Characterization of a Förster Probe for the Optical Detection of the Enzyme Myeloperoxidase

Mentors: John H. Richards, *Professor of Organic Chemistry and Biochemistry*, Harry B. Gray, *Arnold O. Beckman Professor of Chemistry*, and Stephen M. Contakes, *Postdoctoral Scholar in Chemistry*

CLARE E. MOYNIHAN
Richter Scholar
Freshman, Bi

Construction of a Lambda Probe

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

MICHAEL MUELLER
Howard Hughes Medical Institute SURF Fellow
Freshman, CS

Strand-Loop-Strand Motifs: Prediction of ß Hairpins and Diverging Turns in Proteins

Mentors: David Baker, *Associate Professor of Biochemistry, University of Washington; Assistant Investigator, Howard Hughes Medical Institute*, and Stephen L. Mayo, *Associate Professor of Biology and Chemistry; Associate Investigator, Howard Hughes Medical Institute*

NORA J. MULLANEY
Marcella Bonsall SURF Fellow
Junior, EAS

Creating a Graphical Multi-Species Analysis System for Finding and Displaying Conserved Regions of DNA

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

ALEJANDRO D. MUÑOZ
Bristol-Myers SURF Fellow
Sophomore, Ph

Deriving Global CO_2 Fluxes

Mentor: James T. Randerson, *Assistant Professor of Global Environmental Science*

GAUTHAM P. NAIR
Class of '36 SURF Fellow
Sophomore, Ch

Gas Phase IR-Cavity Ringdown Spectroscopy Studies of Pernitrous Acid

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

ARJUN V. NARAYANAN
Howard Hughes Medical Institute SURF Fellow
Junior, Bi

Computational Prediction of Amino Acid Recognition by Yeast Arginyl-tRNA Synthetase

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

OR NEEMAN
Howard Hughes Medical Institute SURF Fellow
Sophomore, Ma

Modeling Pheromonal Learning in Mice

Mentors: Charles H. Anderson, *Research Professor, Washington University School of Medicine*, and Steven R. Quartz, *Assistant Professor of Philosophy*

KEVIN NIELSON
NSF Center for the Science and Engineering of Materials MURF Fellow
Senior, Ch/Ph/Bi; California State University, Los Angeles

Potential Paths for Protein Property Permutation via Artificial Amino Acids

Mentors: David A. Tirrell, *Ross McCollum-William H. Corcoran Professor and Professor of Chemistry and Chemical Engineering*, and Wayne Tikkanen, *Professor, Department of Chemistry and Biochemistry, California State University, Los Angeles*

SHAKUNTALA NITTURKAR
Senior, EE; California State Polytechnic University, Pomona

Deep Ocean Vent Explorer (DOVE)

Mentor: Gindi French, *Member of the Technical Staff, JPL*

GEORGE NOID
Junior, Ph; University of Tennessee

Photothermal Deflection in a Synthetic Sapphire Crystal

Mentor: Joseph M. Kovalik, *Staff Member in Physics*

HUNG D. NONG
Richter Scholar
Sophomore, ACM

Computational Methods for Solutions of Neutron Scattering Problems Employing the Fermi Pseudopotential

Mentors: Oscar P. Bruno, *Professor of Applied and Computational Mathematics*, and Brent T. Fultz, *Professor of Materials Science*

MATTHEW O. NORMAN
Junior, APh

Simulation of Muon-Produced Neutron Radiation at KamLAND

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

GALEN C. O'NEIL
Sophomore, Engineering Ph; Santa Clara University

High Resolution Thermometer for Experiments at the Tricritical Point

Mentor: Melora Larson, *Senior Member of the Technical Staff, JPL*

KARIN I. ÖBERG
Howard Hughes Medical Institute SURF Fellow
Freshman, Ch

Development of a Fluorescence Based Detector for Measuring Enantiomeric Excesses of Optically Active Molecules

Mentor: Jesse L. Beauchamp, *Mary and Charles Ferkel Professor of Chemistry*

JONG C. OH
Howard Hughes Medical Institute SURF Fellow
Junior, Bi

Evaluation of Muscarinic Receptor Isoforms Function in Gastrointestinal Motility

Mentors: Michael G. Ross, *Professor of OB/GYN, Harbor-UCLA Medical Center*, and Helen McBride, *Postdoctoral Scholar in Biology*

RYAN E. OLF
Arthur R. Adams SURF Fellow
Freshman

Neural Correlates of Change Blindness Through a Computational Approach

Mentor: Christof Koch, *Lois and Victor Troendle Professor of Cognitive and Behavioral Biology and Professor of Computation and Neural Systems*

MELINDA T. OWENS
Beckman Scholar
Sophomore, Bi

Role of Dendritic Protein Synthesis in Long-Term Potentiation in Cultured Hippocampal Neurons

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

HEATHER PARTNER
Junior, Ph/Ma; Indiana University of Pennsylvania

An Improved Actuator for Earth-Tide Compensation

Mentors: Richard L. Savage, *Member of the Professional Staff in Physics*, and Paul Schwinberg, *Staff Member in Physics*

TEJAS J. PATEL
Freshman

Investigation of the Applicability of MISR Aerosol Measurements

Mentor: Robert A. West, *Research Scientist, JPL*

ROBERT E. PAYAWAL
Junior, Ph; California State Polytechnic University, San Luis Obispo

The Millimeter-Wave Properties of Superconducting Microstrip Lines

Mentor: Jonas Zmuidzinas, *Professor of Physics*

CHRISTINA M. PELZER
NASA USRP
Sophomore, Space Sciences; Florida Institute of Technology

Flexure Compensation

Mentor: Mitchell Troy, *Member of the Technical Staff, JPL*

KALOYAN M. PENEV
Richter Scholar
Junior, Ph

White Dwarf Normal Mode Excitation

Mentor: Roger D. Blandford, *Richard Chace Tolman Professor of Theoretical Astrophysics*

XIAO P. PENG
Freshman, Ch

Characterization of Yeast Dna2 Nuclease and ATPase Activity and Its Interactions With Other Proteins Involved in Okazaki Fragment Processing

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

IMAN E. PERRY
Howard Hughes Medical Institute MURF Fellow
Junior, Psy/Premed; Hampton University

Exploring the Restricted Repressor *Pmar1* Gene

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

DAVID S. PICKAVANCE
Caltech-Cambridge Exchange
Junior, Eng; University of Cambridge

Hydro-Elastic Pumping

Mentor: Morteza Gharib, *Professor of Aeronautics and Bioengineering*

NICHOLAS A. PIRO
Howard Hughes Medical Institute SURF Fellow
Sophomore, Ch

Coordination Chemistry and Catalytic Abilities of Palladium-Carbene Complexes Based on *N*-Substituted Pyridin-2-ylidenes and *N*-(2-pyridal)pyridin-2'-ylidenes

Mentor: John E. Bercaw, *Centennial Professor of Chemistry*

YAN QI
Howard Hughes Medical Institute SURF Fellow
Freshman, Ch

The Effect of pH on the Rotational Conformations of 3-Methylpentanedioic Acid

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

WILLIAM QUARLES
Senior, Ph/Technical and Scientific Communication; James Madison University

Noise Characterization in the LIGO Livingston 4-km Interferometer

Mentor: Mark Coles, *Member of the Professional Staff in Physics*

MICHAEL R. QUINN
Richter Scholar
Freshman, Ph

Shallow Water Simulations of the Stability of the Zonal Velocity Profile of Jupiter

Mentor: Andrew P. Ingersoll, *Professor of Planetary Science*

JOSE M. QUINTERO
The James Irvine Foundation MURF Fellow
Sophomore, AMa/Industrial Eng; Claflin University

Search for Accreting X-Ray Pulsars in the Galactic Center

Mentors: Shrinivas R. Kulkarni, *John D. and Catherine T. MacArthur Professor of Astronomy and Planetary Science,* and Robert E. Rutledge, *Postdoctoral Scholar in Physics*

SURJEET RAJENDRAN
Sophomore, Ph

Topics in Data Analysis From Gravitational Wave Interferometers Including a Cross Correlation Statistic to Identify Co-Incident Bursts in LIGO

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

MICHAEL D. RAUSCHER
Senior, Materials Eng; California State Polytechnic University, Pomona

Mechanical Properties of 304 Stainless Steel Reinforced $Zr_{57}Nb_5Al_{10}Cu_{15.4}Ni_{12.6}$ Metallic Glass Composites Cast in a Preheated Mold

Mentor: R. D. Conner, *Senior Postdoctoral Scholar in Materials Science*

JAMES M. REBESCO
Howard Hughes Medical Institute SURF Fellow
Sophomore, Ph

Figure-Ground Discrimination Using Adelson-Bergen Motion Energy

Mentor: Christof Koch, *Lois and Victor Troendle Professor of Cognitive and Behavioral Biology and Professor of Computation and Neural Systems*

TALMESHA A. RICHARDS
Howard Hughes Medical Institute MURF Fellow
Sophomore, ChE/Ma; University of Maryland-Baltimore County

Purification and Characterization of Artificial Extracellular Matrix Protein

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

EUNICE V. RIVAS
Howard Hughes Medical Institute MURF Fellow
Junior, Bi; Mount St. Mary's College

DNA-Charge Transfer in Subtelomeric Regions

Mentors: Jacqueline K. Barton, *Arthur and Marian Hanisch Memorial Professor and Professor of Chemistry,* and Sarah Delaney, *Graduate Student in Chemistry*

MICHAEL RIZK
Junior, ECE

The Biomorphic Arm as a Platform for Neural Net Learning

Mentor: Chris Assad, *Member of the Technical Staff, JPL*

AMY L. ROBERTS
Sophomore, Ph/Ma; State University of New York at Stony Brook

Characterization and Calibration of UCN A's Scintillation Detector

Mentor: Bradley W. Filippone, *Professor of Physics*

JUAN A. RODRIGUEZ
Junior, EAS (ME)

Instrumentation Mechanisms for Examining Ice Cores and Exploring Yellowstone's Hot Springs

Mentor: Gindi French, *Member of the Technical Staff, JPL*

NITZAN C. ROTH
Richter Scholar
Junior, ACM

Computational Modeling of the Bladeless Blood Pump

Mentor: Morteza Gharib, *Professor of Aeronautics and Bioengineering*

ARIEL T. RUFFIN
The James Irvine Foundation MURF Fellow
Sophomore, Ph; Tennessee State University

Evaluating Ferromagnetic Contacts to Carbon Nanotubes for Spin Injection

Mentor: Michael L. Roukes, *Professor of Physics*

COLIN W. RUNDEL
Howard Hughes Medical Institute SURF Fellow
Junior, Bi

Genetic Analysis of Oxygen Stress and Aging in *Drosophila melanogaster*

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

RICHARD U. RYMER
Howard Hughes Medical Institute SURF Fellow
Sophomore, Bioch; University of Colorado

Conformational Analysis by NMR Spectroscopy of *meso*-2,3-Dimethylsuccinic Acid (MDMSA)

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

JI-HOON RYU
Sophomore, ECE

3D Reconstruction of Specular Surfaces

Mentor: Pietro Perona, *Professor of Electrical Engineering*

JULIA E. SALAS
Robert K. and Alice L. Roney SURF Fellow
Junior, Ch

DNA Electron Transfer as a Means to Study Protein-DNA Interactions

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

TIMOTHY M. SANDERS
Senior, Aeronautics and Astronautics; Purdue University

Optimal Low-Thrust Interplanetary Spacecraft Trajectories via a Pareto Genetic Algorithm

Mentor: Jon A. Sims, *Technical Group Supervisor, JPL*

KIRAN K. SAVJANI
Caltech-Cambridge Exchange
Junior, ChE; University of Cambridge

The Collective Swimming of Microorganisms

Mentor: John F. Brady, *Chevron Professor of Chemical Engineering*

SUZANA E. SBURLAN
Richter Scholar
Sophomore, APh

Absorption Spectroscopy With Vertical Cavities on Microfluidic (PDMS) Flow Channels

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

JASON R. SCHADEWALD
Richter Scholar
Sophomore, Ma

An Analysis of the Harmonic Polynomial $p(z)-\bar{z}$

Mentor: Anatolii Grinshpan, *Bateman Research Instructor in Mathematics*

DAVID B. SCHARFE
Junior, ME; University of Southern California

Space Flight Propulsion Diagnostic Instrumentation Development

Mentor: Lee K. Johnson, *Research Scientist, JPL*

JOSEPH A. SCHREIER
NASA USRP
Senior; Rensselaer Polytechnic Institute

Confidence Contours for Functional Fits in Low Temperature Physics

Mentor: Martin Barmatz, *Principal Member of the Technical Staff, JPL*

RICK D. SCHROEDER
Junior, Ge/CS; California State University, Bakersfield

Mars Rock Shape Characterization

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

JENNIFER L. SCHURR
General Motors SURF Fellow
Junior, Ch

Chemical Speciation of Mercury Dry Deposition Using a Water Surface Sampler

Mentors: James J. Schauer, *Assistant Professor, University of Wisconsin, Madison*, and Michael R. Hoffmann, *James Irvine Professor of Environmental Science*

KATHERINE J. SCOTT
Ray Owen SURF Fellow
Junior, EAS (ME)

Characterization of Booming Sands

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

ISAAC SEE
Mrs. Edwin L. Cline SURF Fellow
Junior, Ma

Construction and Assay of a Functional Molecular Device

Mentor: Niles A. Pierce, *Assistant Professor of Applied and Computational Mathematics*

KATHRYN E. SEIFERT
Junior, Ch; Canisius College

Nitrogen-Doped TiO_2 Is an Efficient Visible-Light Photocatalyst

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

AYA SEKIDO
Junior, Physics; Waseda University

Measurement of the Laser Beam Profile for the 40 Meter Prototype Interferometer Gravitational Wave Detector

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

CANDACE S. SEU
Freshman, ChE

X-Ray Study of Dioxygen Complexes as Models of Oxyhemoproteins

Mentors: Charles Simmons, *Assistant Professor of Chemistry, University of Hawaii, Hilo*, and Richard E. Marsh, *Senior Research Associate, Emeritus*

KRISTIN R. SHANTZ
Richter Scholar
Sophomore, ECE

Microfluidic Single-Cell Gene Amplification for Termite Gut Bacterial Analysis

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

NATHAN A. SHEETZ
Sophomore, ECE

Advanced Methods for the Spectral Analysis of Climatic Time Series

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

MONA A. SHEIKH
Arthur Rock SURF Fellow
Junior, EE

Wavelet Decomposition of ECG Waveform During Ventricular Fibrillation

Mentor: P. P. Vaidyanathan, *Professor of Electrical Engineering*

SAKEN SHERKHANOV
Senior, Bi

Defining Domains of Splicing Factor Prp8

Mentors: Christine Guthrie, *Professor of Biochemistry, University of California, San Francisco*, and John N. Abelson, *George Beadle Professor of Biology*

CELIA E. SHIAU
Howard Hughes Medical Institute SURF Fellow
Junior, Bioengineering; University of California, Davis

Establishing Secreted Factors in Neural Tube-Ectoderm Interactions for Trigeminal Placode Induction

Mentor: Marianne Bronner-Fraser, *Albert Billings Ruddock Professor of Biology*

JASON J. SHIH
Thomas E. Everhart SURF Fellow
Junior, EAS

Capacitive Sensing in Microfluidics

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

ERIK G. SHIPTON
NASA USRP
Senior, Ph/AMa; University of California, Berkeley

Chemical Sensing With Spectroscopy

Mentor: Adrian Ponce, *Visiting Associate in Chemistry; Senior Member of the Technical Staff, JPL*

MARIE-CLAIRE E. SIDDALL
Junior, Ch; University of California, Irvine

Irvine: A Model for Effective Urban Conservation

Mentor: William F. Deverell, *Associate Professor of History*

BARBARA SIMONI
Senior, Ph; University of Pisa

Classification of Physical Characteristics of $(Mo_{0.6}Ru_{0.4})_{1-x}B_x$ in the Amorphous Regime

Mentor: Riccardo DeSalvo, *Member of the Professional Staff in Physics*

LAURA C. SINCLAIR
Richter Scholar
Sophomore, Ph

Effect of Interface Roughness on the Mobility of Electrons in Semiconductor Quantum Wells

Mentor: James P. Eisenstein, *Professor of Physics*

JORAN S.C. SIU
Sophomore, EE; Cornell University

Cooperative Control of Semi-Autonomous Vehicles

Mentor: Richard M. Murray, *Professor of Mechanical Engineering*

SHILOH N. SMALL
Howard Hughes Medical Institute MURF Fellow
Senior, Bi; University of Montana

Charactrerization of Chick Adenomatous Polyposis Coli (APC) in Neural Crest Development

Mentors: Marianne Bronner-Fraser, *Albert Billings Ruddock Professor of Biology*, and Lisa T. Ziemer, *Postdoctoral Scholar in Biology*

ANDREA J. SMITH
Sophomore, Ph

Characterization of LIGO LSC Electronics

Mentor: Matthew J. Evans, *Staff Scientist in Physics*

HEATHER L. SNIVELY
Senior, Bi; University of California, Santa Cruz

Model Atmospheres: Determining the Spectral Features That Indicate Life

Mentor: Victoria Meadows, *Research Scientist, JPL*

JONATHAN C. SO
Sidney R. and Nancy M. Petersen SURF Fellow
Freshman, EAS

Design of a High Throughput Assay for Pulp Bio-Bleaching

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

BENJAMIN SOLISH
Sophomore, Aeronautics and Astronautics; Massachusetts Institute of Technology

Proposal for an *in situ* and Remote Coastal Ocean Observatory

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

JAVIER Z. SOLIZ
General Motors Minority SURF Fellow
Freshman, APh

Near-Infrared Light Detection by Means of Metal-Ge-Si Heterostuctures

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

ANGELA M. SPENCE
Sophomore, Aerospace Eng; Mississippi State University

Wake Mode Transitions of a Cylinder With Low Mass Damping Oscillating Transverse to a Flow

Mentor: Morteza Gharib, *Professor of Aeronautics and Bioengineering*

ELIZABETH L. STAMESHKIN
Howard Hughes Medical Institute SURF Fellow
Junior, Bi

Is VEGF Involved in Neural Crest Development?

Mentor: Marianne Bronner-Fraser, *Albert Billings Ruddock Professor of Biology*

DANIEL J. STARK
Freshman, Ph/Ma; University of Oklahoma

The Synthesis of $CaZn_2Sb_2$ and Related Compounds and Their Thermoelectric Properties

Mentor: G. J. Snyder, *Member of the Technical Staff, JPL*

ROSALIA STELLACCI
Senior, Physics Methodologies; University of Pisa

Metal Creep Measurement in Gravitational Wave Detectors

Mentor: Riccardo DeSalvo, *Member of the Professional Staff in Physics*

SABRINA STIERWALT
NASA USRP
Junior, Ph/Astroph; University of California, Berkeley

Uranian Satellites

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

MELISSA J. STRAUSBERG
The Associates SURF Fellow
Sophomore, PlSc

A Study of Moist Convection in the Jovian Atmosphere

Mentor: Andrew P. Ingersoll, *Professor of Planetary Science*

LINDA E. STRUBBE
Flintridge Foundation SURF Fellow
Junior, Ay

How Would Present-Day Galaxies Look in the Very Early Universe?

Mentors: Nicholas Z. Scoville, *Francis L. Moseley Professor of Astronomy*, and Kartik Sheth, *Postdoctoral Scholar in Astronomy*

CHRISTINA M. STUJENSKE
Howard Hughes Medical Institute MURF Fellow
Senior, Ch/Bi; Barry University

Toward the Enantioselective Synthesis of Detrol: An Application of Iminium Catalysis Methodology

Mentors: David W.C. MacMillan, *Associate Professor of Chemistry*, and Nick A. Paras, *Graduate Student in Chemistry*

ANNE M. SULLIVAN
JPLUS SURF Fellow
Sophomore, Ma/Ay; Pasadena City College

Asteroid Astrometry

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

CHRISTOPHER T-K. SUNG
Sophomore, Bi/Ch

Global Rephosphorylation Changes to Serines 2 and 5 in the Immediate Heat Shock Response of *Drosophila*: A Study of the Relocalization of Transcription to the Heat Shock Family Loci, and the Roles of Various Proteins in This Change

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

FRANCY Y. SUNG
Mr. and Mrs. Fred M. Wells SURF Fellow
Sophomore, Bi

The Effects of Ethanol vs. Cranially Disrupted Retinoid Signaling on Chicken Embryos

Mentor: Marianne Bronner-Fraser, *Albert Billings Ruddock Professor of Biology*

LAUREN SWAN
Sophomore, Photography; Art Center College of Design

Emotions and Aesthetics: An Experimental Approach Toward an Aesthetic Experience of Art

Mentor: Steven R. Quartz, *Associate Professor of Philosophy*

KEVIN SYLVES
NASA USRP
Junior, Ae Eng/Double Bass Performance; University of Michigan

Performance Improvements of a Gas-Fed Pulsed Plasma Thruster

Mentor: John K. Ziemer, *Member of the Technical Staff, JPL*

JENNIFER C. TAGGART
William H. and Helen Lang SURF Fellow
Junior, Geoph

A Re-Examination of Spreading Rates for the South Atlantic

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

MAZHAREDDIN TAGHIVAND
Spira Manufacturing Corporation SURF Fellow
Sophomore, ECE

Correlation Between Shielding Effectiveness and Transfer Impedance of Shielded Cable

Mentors: George Kunkel, *President, Spira Manufacturing Corporation*, and David B. Rutledge, *Kiyo and Eiko Tomiyasu Professor of Electrical Engineering*

JAPECK TANG
Richter Scholar
Sophomore, ECE

Human Interaction With Semi-Autonomous Vehicles

Mentor: Richard M. Murray, *Professor of Mechanical Engineering*

SARAH L. TEEGARDEN
Howard Hughes Medical Institute SURF Fellow
Junior, Bi

Immunohistochemical Labeling of Dopamine Receptors in the Anterior Cingulate Cortex

Mentor: John M. Allman, *Frank P. Hixon Professor of Neurobiology*

CHRISTINA L. TELLES
Howard Hughes Medical Institute SURF Fellow
Junior, Bi

Lateralization of Cerebellar Processing During Olfaction

Mentors: Noam Sobel, *Assistant Professor of Psychology, University of California, Berkeley*, and Gilles J. Laurent, *Associate Professor of Biology and Computation and Neural Systems*

RACHEL N. THESSIN
Lester Lees Aeronautics SURF Fellow
Junior, APh

Bringing Phase to Quadrature Phase Interferometry

Mentor: Paul E. Dimotakis, *John K. Northrop Professor of Aeronautics and Professor of Applied Physics*

ANDREW R. THOMPSON
Junior, Ph/CS; Drake University

A Software Interface for the Deep Ocean Vent Explorer

Mentors: Gindi French, *Member of the Technical Staff, JPL*, and Arthur L. Lane, *Research Scientist, JPL*

ROBERT W. THOMPSON
Junior, Ae Eng; Georgia Institute of Technology

Proposal for an *in situ* and Remote Coastal Ocean Observatory

Mentors: Lloyd C. French, *Systems Architect, JPL*, and Paul DiGiacomo, *Scientist, JPL*

SAMUEL W. THOMSEN
Sophomore, Ph

Extended Results for the Minimum Capacity of a Gaussian Quantum Channel

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

STEFANO TIRELLI
Senior, Ph; University of Pisa

Investigating Stress/Strain Behavior of Amorphous Metallic Alloys Proposed for Suspensions in Gravitational Waves Detectors

Mentor: Riccardo DeSalvo, *Member of the Professional Staff in Physics*

DANIEL J. TIRRELL
Sophomore, History; Princeton University

Memorializing the Civil War: The Collection of Lieutenant Colonel John Page Nicholson

Mentor: William F. Deverell, *Associate Professor of History*

NEIL K. TIWARI
Freshman, Ch

Biomimetic Self-Assembly of Mesostructures in Microgravity: The Nature of the Capillary Bond

Mentor: Adrian Ponce, *Visiting Associate in Chemistry; Senior Member of the Technical Staff, JPL*

PHUONG N. TO
Junior, Bioch; Mount St. Mary's College

Detection of DNA-Protein Crosslinking via Inhibition of Cleavage by Endonucleases

Mentor: Eric D. Stemp, *Visiting Associate in Chemistry*

REGAN B. TOWAL
Junior, EE; Georgia Institute of Technology

Bilateral Coordination During Free Whisking Behaviour in the Rat

Mentor: Mitra Hartmann, *Postdoctoral Scholar, JPL*

CUONG C. TRIEU
Richter Scholar
Sophomore, ChE

New Stationary Phases for Use in Denuder Samplers Used for the Collection of Semi-Volatile Organic Chemicals of Environmental Concern

Mentor: Richard C. Flagan, *Irma and Ross McCollum Professor of Chemical Engineering*

VICTOR C. TSAI
Marcella Bonsall SURF Fellow
Sophomore, Geoph

The Morning Glory of Southern California

Mentor: Hiroo Kanamori, *John E. and Hazel S. Smits Professor of Geophysics*

KEVIN Y. TSE
Mr. and Mrs. Robert E. Anderson SURF Fellow
Junior, Bi

SCID.adh: A Novel Cell Line With Which to Examine Early T-Cell Commitment

Mentor: Ellen Rothenberg, *Professor of Biology*

NORA N. TU
Howard Hughes Medical Institute SURF Fellow
Junior, Bi

Developing a Mouse Model for Mental Illness Based on Prenatal Exposure to Influenza Virus

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

MICHAEL R. TUTTLE
Junior, Aerospace Eng; Virginia Polytechnic Institute and State University

Conceptual Design of Interplanetary Sample Return Missions Using PowerSail and Solar Electric Propulsion Technology

Mentor: Joel C. Sercel, *Lecturer in Aeronautics*

BRIAN S. UNDERWOOD
Samuel P. and Frances Krown SURF Fellow
Freshman, Ch

The Tandem [2,3] Dipolar/Oxyanion Acetal Claisen Rearrangement

Mentor: Brian M. Stoltz, *Assistant Professor of Chemistry*

TRISTAN S. URSELL
NASA USRP
Junior, Ph; Rensselaer Polytechnic Institute

Compatibility of Segmented Thermoelectric Generators

Mentor: G. J. Snyder, *Member of the Technical Staff, JPL*

YELIZ UTKU
Junior, Ch; Koc University

Reversible Hydrogels From Self-Assembling Proteins

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

DAVID A. VAN VALEN
The James Irvine Foundation MURF Fellow
Junior, Ma; Massachusetts Institute of Technology

Mechanics of DNA

Mentor: Robert B. Phillips, *Professor of Mechanical Engineering and Applied Physics*

ANDREA E. VASCONCELLOS
Bob and Carole Chapman Minority SURF Fellow
Freshman, Bi

Evidence for Neuronal Migration in Infant Human Anterior Cingulate Cortex

Mentors: Cynthia Shannon-Weickert, *Senior Staff Fellow, National Institute of Mental Health*, and John M. Allman, *Frank P. Hixon Professor of Neurobiology*

VIRGINIA P. VASSILEVSKA
Arthur R. Adams SURF Fellow
Junior, APh

Crossing Numbers of Bipartite Graphs

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

JOHN VEITCH
Junior, Ph; University of Glasgow

Advanced LIGO Suspension Research

Mentors: Calum I. Torrie, *Staff Member in Physics*, and Janeen H. Romie, *Staff Member in Physics*

ANAEL VERDUGO
Mr. and Mrs. Downie D. Muir III SURF Fellow
Junior, Ma

A Note on Almost Periodic Schrödinger Operators

Mentor: David Damanik, *Sherman Fairchild Postdoctoral Scholar in Mathematics*

VALERIE A. VILLAREAL
NSF Center for the Science and Engineering of Materials MURF Fellow
Senior, Ch; California State University, Los Angeles

Enzymatic Study on Glucose-6-Phosphate Dehydrogenase Immobilized With Fluoroalkylated Polyethylene Glycol Using Capillary Electrophoresis

Mentors: Julia A. Kornfield, *Professor of Chemical Engineering*, and Frank Gomez, *Professor, Department of Chemistry and Biochemistry, California State University, Los Angeles*

AARON VIRSHUP
Junior, Ph; Grinnell College

Characterization of Glitches in LHO Interferometers

Mentor: Michael Landry, *Postdoctoral Scholar in Physics*

PAULA E. VOINESCU
Senior, General Medicine; Craiova University of Medicine and Pharmacy

Expression of Densin-180 Splice Variants in Different Brain Areas and in Neurons of Different Ages

Mentor: Mary B. Kennedy, *Allen and Lenabelle Davis Professor of Biology*

RUSSEEN P. WALI
Sophomore, Ch

Optimizing the Conditions for the Degradation of Oxalite in an Aqueous Solution Using Ultrasound and Ozone

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

DON WALKER
NSF Center for Neuromorphic Systems Engineering MURF Fellow
Junior, Ch; Southern University

Solutions Studies of Regenerative Processes in Dye-Sensitized TiO_2 Photoelectrochemical Cells

Mentors: Nathan S. Lewis, *George L. Argyros Professor and Professor of Chemistry*, and Elizabeth I. Mayo, *Graduate Student in Chemistry*

RON WALKER
The James Irvine Foundation MURF Fellow
Junior, Ch; Southern University

Synthesis of a Regioregular Ethylene Vinyl Alcohol Co-Polymer (EVOH) via the Ring Opening Metathesis Polymerization (ROMP) of an Acetonide Protected Cyclooctene-cis-5,6-diol

Mentors: Robert H. Grubbs, *Victor and Elizabeth Atkins Professor of Chemistry*, and Christian Scheier, *Postdoctoral Scholar in Computation and Neural Systems*

NICHOLAS R. WALL
Howard Hughes Medical Institute SURF Fellow
Freshman, Bi

The Role of Local Protein Synthesis in Synaptic Transmission

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

CLAIRE L. WALTON
Edward W. Hughes SURF Fellow
Freshman, Ma

Detecting Distant Clusters of Galaxies in the Deep Lens Survey

Mentor: Judith G. Cohen, *Professor of Astronomy*

JIALAN WANG
Dr. Paraskeva N. Danailov SURF Fellow
Sophomore, Ma/Ph

Studying GAT1 Using mGAT1-XFP Knock-In Mice

Mentor: Henry A. Lester, *Bren Professor of Biology*

JIALING WANG
Freshman, Computer & Telecomunications; University of Pennsylvania

Mapping the MER1 Mutation in *Arabidopsis thaliana*

Mentors: Elliot M. Meyerowitz, *Professor of Biology*, and Marcus Heisler, *Postdoctoral Scholar in Biology*

LIZHOU WANG
Rossum Family SURF Fellow
Sophomore, Ph/EE

Magnetic Microtraps for Strong Coupling in Cavity QED

Mentor: Hideo Mabuchi, *Associate Professor of Physics and Control and Dynamical Systems*

OLIVER WANG
Junior, CS; Cornell University

Cooperative Control of Semi-Autonomous Vehicles

Mentor: Richard M. Murray, *Professor of Mechanical Engineering*

YINGBING WANG
Warren and Katharine Schlinger SURF Fellow
Junior, ChE

Expanding the Roadmap for Hitchhiking Through Sequence Space

Mentors: Frances H. Arnold, *Dick and Barbara Dickinson Professor of Chemical Engineering and Biochemistry*, and Jonathan J. Silberg, *Postdoctoral Scholar in Chemical Engineering*

CLARENCE WARREN
JPLUS SURF Fellow
Sophomore, ME; Santa Monica City College

Proposal for an *in situ* and Remote Coastal Ocean Observatory

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

MEGHA W. WATUGALA
Honeywell SURF Fellow
Junior, CS

Human Interaction With Semi-Autonomous Vehicles

Mentor: Richard M. Murray, *Professor of Mechanical Engineering*

ANDREW WEBER
Senior, Ph; University of Maryland, College Park

Angular and Frequency Response of Gravitational Wave Interferometers at Higher Frequencies

Mentor: Mark Coles, *Member of the Professional Staff in Physics*

KAREN M. WEBSTER
The James Irvine Foundation MURF Fellow
Sophomore, EE; Michigan Technological University

Belief Propagation Decoding of Reed-Solomon Codes

Mentor: Jon Hamkins, *Supervisor, Information Processing Group, JPL*

JACOB J. WEEL
Junior, Ph; University College Utrecht

Linear Thermoelastic Damping in a Fused Silica Suspension

LYNETTE WEHMER
Junior, Ph; Hope College

Alignment of NASA Lessons to National Science Standards

Mentor: Rebecca Knudsen, *Education Research Specialist, JPL*

KIRSTEN F. WELGE
Samuel P. and Frances Krown SURF Fellow
Sophomore, Bi/H

Mesodermal Specification in the Starfish *Asterina miniata*

Mentors: Eric H. Davidson, *Norman Chandler Professor of Cell Biology*, and Veronica Hinman, *Postdoctoral Scholar in Biology*

JACOB R. WEST
Junior, Ph

Is a Single Projective Measurement Universal for Quantum Computation?

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

SIMON D.C. WEST
Junior, Ma/Ph; University College London

Designing a Laser Cavity for Adaptive Homodyne Phase Measurement

Mentor: Hideo Mabuchi, *Associate Professor of Physics and Control and Dynamical Systems*

JUSTIN S. WHITE
Richter Scholar
Sophomore, Ph

Fabrication and Analysis of Pyramid Quantum Dot Nanostructures Embedded in Photonic Crystals

Mentor: Eli Kapon, *Professor of Physics, Swiss Federal Institute of Technology*

JACQUELYN S. WILBUR
Sophomore, EAS (ME)

Mechanical Structures to Aid in Precision Measurements in Field Investigations

Mentor: Gindi French, *Member of the Technical Staff, JPL*

SARAH M. WILHOIT
Freshman, ME

Longevity of Life, Using the Live Dead Assay to Date *Bacillus subtilus*

Mentor: Adrian Ponce, *Visiting Associate in Chemistry; Senior Member of the Technical Staff, JPL*

MELISSA K. WILLIAMS
NASA USRP
Senior, Ay/Ph; Valdosta State University

CCD Observations of Comets and Asteroids

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

RYAN WILLIAMS
Freshman, Ma/Philosophy; Louisiana State University

ALADDIN: A Computer Application for the Analysis of Data Received From the LIGO Observation Channels

Mentors: Szabolcs Marka, *Postdoctoral Scholar in Physics*, and John G. Zweizig, *Staff Member in Physics*

MICHAEL J. WILSON
Freshman, EAS (CS)

Analysis of Placement Methods for SCORE Computations

Mentor: André M. DeHon, *Assistant Professor of Computer Science*

PHILIP H. WONG
Barbara and John Gee SURF Fellow
Freshman, ME

Applying Micro-Fabrication Technology to Developing Silicon-Based Zinc-Air Micro-Batteries

Mentor: Erik K. Antonsson, *Professor of Mechanical Engineering*

DANIEL L. WU
Professor Fredrick H. Shair SURF Fellow
Sophomore, ChE

Shape-Selective Alcohol Oxidation by Perruthenate-Containing Zeolites

Mentor: Mark E. Davis, *Warren and Katharine Schlinger Professor of Chemical Engineering*

ZHIZHANG XIA
Axline SURF Fellow
Pre-Freshman

Inclusion of Temperature in Multivariable Analysis of Leakage Current in CMOS Technology

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XIAO XU
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Freshman, Engr; Pasadena City College

Band Diagonal Preconditioning in Fourier Space

Mentor: Oscar P. Bruno, *Professor of Applied and Computational Mathematics*

MILING YAN
Axline SURF Fellow
Pre-Freshman

Characterization of *Variovorax paradoxus* Motility

Mentors: Jared R. Leadbetter, *Assistant Professor of Environmental Microbiology*, and Frances H. Arnold, *Dick and Barbara Dickinson Professor of Chemical Engineering and Biochemistry*

ZICHAO YANG
Howard Hughes Medical Institute SURF Fellow
Sophomore, ChE; National University of Singapore

An NMR Spectroscopic Investigation of the Solvent Effects on the Conformational Equilibrium of 3-Mercaptopropionic Acid

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CHUCK-HOU YEE
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Freshman, EAS

Modeling Motion Detection for Bottom-Up Visual Attention

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SINA YEGANEH
Beckman Scholar
Sophomore, Ch

Synthesis and Characterization of a New Novel Dye Sensitizer for Nanocrystalline TiO_2-Based Solar Cells

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MEHMET B. YENMEZ
Richter Scholar
Freshman, Ma

Nilpotent and Lie Groups

Mentor: Igor Belegradek, *Taussky-Todd Instructor in Mathematics*

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Fabrication of Periodic Nanostructures

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

WILLIAM C. YOUNG
Freshman, Ma/Ph

Broadband Plasma Ion Energy Spectrometer

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

WEI ZHANG
Howard Hughes Medical Institute SURF Fellow
Sophomore, Ch

Tuning Separation Distance Between Individual Biomolecules Immobilized on Chemically Functionalized Surfaces

Mentor: Charles P. Collier, *Assistant Professor of Chemistry*

ZHIPENG ZHANG
Richter Scholar
Sophomore, Ph

The Correlation Between Multiple Nanoscale Cantilevers Coupling Through Fluid

Mentor: Michael C. Cross, *Professor of Theoretical Physics*

QI ZHOU
The Associates SURF Fellow
Sophomore, EE

Undergraduate Women Leading the Way

Mentor: **Miriam Feldblum, *Faculty Associate in the Humanities; Lecturer in the Humanities***

PHILIP ZIGORIS
Junior, CS; Cornell University

Cooperative Control of Semi-Autonomous Vehicles

Mentor: **Richard M. Murray, *Professor of Mechanical Engineering***

CECILIA I. ZURITA
NSF Center for the Science and Engineering of Materials MURF Fellow
Sophomore, Bioch; California State University, Los Angeles

The Release of Vancomycin From Synthesized Fluoroalkyl Modified Poly(ethylene glycol)

Mentors: **Julia A. Kornfield, *Professor of Chemical Engineering*, and Frank Gomez, *Professor, Department of Chemistry and Biochemistry, California State University, Los Angeles***

LEGEND

Ae	Aeronautics
ACM	Applied and Computational Mathematics
AMa	Applied Mathematics
APh	Applied Physics
Astroph	Astrophysics
Ay	Astronomy
BEM	Business Economics and Management
Bi	Biology
Bioch	Biochemistry
Ch	Chemistry
ChE	Chemical Engineering
CS	Computer Science
EAS	Engineering and Applied Science
Ec	Economics
ECE	Electrical and Computer Engineering
EE	Electrical Engineering
Eng	Engineering
ESE	Environmental Science and Engineering
Ge	Geology
Geobi	Geobiology
Geoch	Geochemistry
Geoph	Geophysics
H	History
Ma	Mathematics
ME	Mechanical Engineering
MS	Materials Science
Ph	Physics
PlSc	Planetary Science
Psy	Psychology
SES	Science, Ethics, and Society
SS	Social Science

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