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From the Chairman

The "V" Word

"Vision" is a term that is often used as an attribute for people who need to do any sort of planning. Most professional scientists are called on to "show vision" as a part of their work, but what does that really mean? "Vision" is the ability to plan beyond the most immediate and obvious set of circumstances in order to enable a research program, company, or department to take advantage of opportunities.

We try to plan (show vision) when we predict what we will find in our research in a proposal to the National Science Foundation or other agency. However, basic research programs often change course during the period of a grant. Fortunately, most of our colleagues who are also familiar with the varying course of research are pretty forgiving about changes in plans. In fact, the typical research program provides what is perhaps the most important lesson about planning and vision: New and changing circumstances require planning to become an ongoing process.

These days, physics and astronomy departments are facing quite serious challenges which, without adequate planning and vision, could easily undermine an otherwise strong program. Such challenges include the permanent reduction of Defense industry following the end of the Cold War, a reduction in Federal spending for science research, and the shift of attention from physics and astronomy to gene splicing. Some reasonably serious scientists now consider the next century to be much more centered on biology, and it would be hard to argue in light of the recent spectacular announcements about cloning and the construction of chromosomes.

So what are we doing about it? Where is the vision? The future of physics and astronomy lies in the ability of the scientists to re-invent and expand their fields. For example, twenty years ago, solids were 3-dimensional. Then thin film technology allowed us to study 2-dimensional and eventually 1-dimensional materials. By logical extension zero-dimensional systems are of much current interest.

Recent meetings on condensed matter physics are full of talks on mesoscopic physics, quantum dots, and nano-technology. A single breakthrough

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Nicholas P. Warner

Nicholas P. Warner Wins Raubenheimer Award

Congratulations to Professor Nicholas Warner, winner of the prestigious Raubenheimer Award, the highest honor of the college. Established in 1980, this honor is presented annually by the College of Letters, Arts and Sciences to exceptional faculty members within each of the College's three disciplines (humanities, natural sciences, and social sciences) who have excelled in the areas of teaching, research, and service to the University. In addition to this recognition, Dr. Warner will receive a prize of $3,000 applied toward his research.

Professor Warner received a bachelor's degree in Theoretical Physics, Experimental Physics, Pure Mathematics and Applied Mathematics from the Australian National University in 1978. He received his Ph.D. in 1982 from the University of Cambridge under the supervision of Dr. Stephen W. Hawking. Since Dr. Warner joined our faculty in 1990, he has made an enormous contribution to the mission of our department and the University as a whole.

Nick Warner is an exceptional researcher. His work spans elementary particle physics and the mathematics of supersymmetry. Dr. Warner is able to extend the application of his work to a broad range of other topics outside traditional particle physics, including condensed matter physics. His colleagues characterize his work as being highly original and in some cases he has permanently changed the course of existing fields. In addition, Nick has played a large role in bringing two international conferences to USC.

Professor Warner is frequently published and his works are consistently cited as leading works in the field. He has been invited to serve on many important committees, including the General Education Task Force where his contribution led to the success of the committee and the ultimate acceptance of the College's general education plan. Dr. Nick Warner has received constant support for his work from the National Science Foundation and the Department of Energy with his proposals being consistently rated as excellent.

PERSPECTIVES ON TEACHING:
WARNER AND KNOL'S NEW "OBS-SESSIONS"

Initiated by Provost Lloyd Armstrong's three year project, USC is undergoing a change in their general education requirements. Under the new requirements, the amount of general education units has been lowered and the curriculum has been redesigned to suit a multidisciplinary and practical agenda. These newly designed courses are scheduled to begin officially in the Fall of 1997, yet the USC Department of Physics and Astronomy has already successfully test run its redesigned Astronomy 100 class.

Over the past several years Astronomy 100 has been a very popular general education course with enrollments approaching five hundred students each semester, accounting for nearly one-third of the students enrolled in the department. It was decided that this would be a good course to get an early start refurbishing to satisfy the new requirements. Professor Nicholas Warner and Robert Knol, Manager of Physics and Astronomy General Education Lab, set up a pilot program in the Fall '96 semester. Concentrating on one class section of about one hundred fifty students, Dr. Nick Warner worked to give Astronomy 100 a fresh approach emphasizing practical experience, while Robert developed and implemented the totally new "Laboratory Experience and Field Trip Component" required by the G. E. redesign.

This laboratory experience component is a major new requirement for all science G.E. courses. Dr. Warner is very enthusiastic about this requirement. While serving on the General Education Task Force, he actually penned the words, "practical or field experience is mandatory" for the new USC general education statement of purpose. However when asked about implementation in the department, Dr. Warner readily admits, "Robert is certainly the driving force behind this getting off the ground."

The purpose of the practical experiences is to draw upon the principles

Robert Knol holding a Celestron Telescope.

"We hope from a general point of view that students will get some sense of what science means; what it is that you do with science, how it applies to your environment."

brought out in lecture. Robert explains, "For instance when the Astronomy lecture deals with the rather dry subject matter of the moon and planets, and later on, stars and galaxies, we now take the students out for observation sessions and actually have them observe these phenomena through a decent telescope. This way we make a connection between lecture material and 'real life' or 'the real thing.'"

Dr. Warner feels that not only does this experience illuminate the lecture but it connects the students with the "aesthetic experience" of astronomy. Warner goes on to explain that enabling the student to "gain confidence in dealing with scientific equipment" and the "aesthetic experience of messing around with a halfway decent telescope" puts the student in touch with what Warner describes as an "active hobby," an experience that most students might not have had until this point. Many children today are more enthusiastic about playing video games or watching T.V. In other words, they are busy engaging in "passive hobbies." Dr. Warner laments that "it has become rare for kids to build things, or take things apart to find out how they work, or simply blow things up." It is Warner's assertion that these activities are essential to the development of an academic mind.

For the Fall '96 pilot test, Warner's Astronomy 100 students engaged in four of these practical experiences. First the class built a working sun dial which requires a good understanding of the Earth-Sun interaction and mechanics. The remaining three practical experiences were observation sessions, dubbed "Obs-sessions."

The first of these "obs-sessions" was a lunar eclipse observation giving students a chance to get acquainted with the telescopes. During this viewing they learned how to take measurements which they later used to calculate the size of the moon.

During the second observation, students were taught how to set up the telescopes for themselves. The stars and the rings of Saturn were observed and their positions were plotted. Students were able to locate celestial objects on their own, based on coordinates that were provided to them. One of the highlights of this observation was viewing the moons of Jupiter. Robert elaborates, "Over the course of an evening, the students can actually observe the movement of two of the moons of Jupiter."

The last "obs-session" was a dark sky observation at Pyramid Lake just north on the I5 freeway. A little over half of the students attending the viewing had never seen a dark sky making this a totally new experience.

Robert illustrates, "They were looking at the Milky Way and one of the students

actually said after half an hour, 'When is that cloud going to go away?'"

I said, 'What cloud?'"

He said, 'That white stuff up there.'"

I said, 'Now that's the Milky Way. That's what you're here for.'"

For a lot of them that was a revelation, to actually see that those are stars."

Students were very enthusiastic about working with the telescopes and some were even able to locate Uranus which is quite difficult. They also observed the Andromeda Galaxy and planetary nebulae. According to Knol,"These are things that people only see on T.V., science-fiction movies, or in picture books."

It is the introduction of these practical experiences that constitute the greatest change in the Astronomy 100 curriculum, and that means that the burden falls on Robert. Robert Knol is in charge of lab instruction for all new general education lab sections that will be created as a result of this new G.E. program.

Physics 100 will go through the same renovating process also to be rolled out in the Fall of '97. Robert has already begun the process of writing new labs for this course. He would like to create a lab section that really brings home the practical aspects of basic physics. He explains, "I hope that in that fashion the theoretical considerations that come out in the Physics lecture in the first few weeks make a whole lot more sense and are more approachable to them."

Robert, an experimental Physicist, also holds a bachelor's degree in Astronomy. When this job came along, he saw it as a great opportunity to instill a better appreciation and understanding for Astronomy as a science and a hobby. He is gratified to be a part of putting together such a good program that effectively addresses the challenge of providing a practical component for a group of five hundred students including field trips.

Dr. Warner also finds the effort rewarding, and being as enthusiastic about teaching as he is about his research, he is committed to the challenge of introducing science to the uninitiated. Teaching challenges him to find the "hook to engage [the students'] minds." That is to say that he must take these difficult concepts and present them in such a way that is easily understood by someone who is "intelligent, but not mathematically oriented."

Being a professor who believes his classroom should be an open forum for the exchange of ideas, Nick Warner enjoys a lot of vocal class interaction asserting this to be the key for a true understanding of a subject. Very pleased, he says, "In this last class, I think it was the most vocally interactive and most rewarding class I ever taught." It is Warner's belief that teaching and interaction with the students keeps ideas alive.

What do Robert Knol and Professor Warner hope to achieve from the experience of rejuvenating Astronomy 100?

"At the same time as one will teach [students] science . . ., you also engage them in what a basic science is and why you do that. And to some extent, a small amount of it is the aesthetic experience. And therefore, I believe the observational part absolutely enhances the aesthetic experience."

Robert: "We hope from a general point of view that students will get some sense of what science means; what it is that you do with science, how it applies to your environment." He would like to introduce the students to scientific thinking and the scientific method by presenting new ways of thinking that these students may have never experienced. Practical experiences in the labs are key to this process of intellectual transformation.

For Dr. Warner, this course is "the last chance by which we are going to engage the students in basic science and help them understand what basic science is."

Continuing, he says, "Astronomy is the archetype for basic science. It is quite literally useless. You can't make any money from astronomy. You can make it from astrology, but you can't make it from astronomy. It is one of the foundations of our culture. It is the yardstick by which we measure ancient cultures. It is a fundamentally important part of our culture. Occasionally it has very indirect practical applications, but rarely."

People say, 'So why do you do it?'"

And I usually respond with something like, 'Why do we engage in any cultural activity?'"

That usually creates in the petitioner lots and lots and lots of silence."

So at the same time as one will teach them science . . ., you also engage them in what a basic science is and why you do that. And to some extent, a small amount of it is the aesthetic experience. And therefore, I believe the observational part absolutely enhances the aesthetic experience."

The Fall semester's Astronomy 100 students were eager to participate in this pilot program. Robert points out that approximately 85% of the students were "very satisfied with the introduction of these practical experiences as part of the lecture" according to a survey that was designed specifically for this pilot class.

Professor Warner concurs that many of the students found the practical experiences to be rewarding and a definite enhancement, saying, "It made them less afraid of science." Some students even told Dr. Warner that if they had taken this class earlier they would have changed their major, emphasizing to him the significant impact of practical experience.

Laying the groundwork for the Fall 1997 semester, Robert Knol and Professor Warner's hard work will be implemented in three class sections of the new, improved Astronomy 100 allowing USC students the invaluable opportunity to acquire a new outlook on science through the lens of a telescope

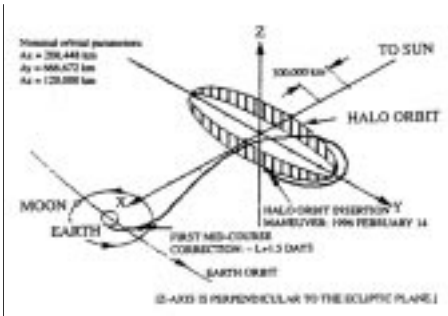
A MILLION MILES TO EARTH: USC INSTRUMENTS FIND A PLACE IN THE SUN

BY ERIC MANKIN, COURTESY OF USC NEWS SERVICE

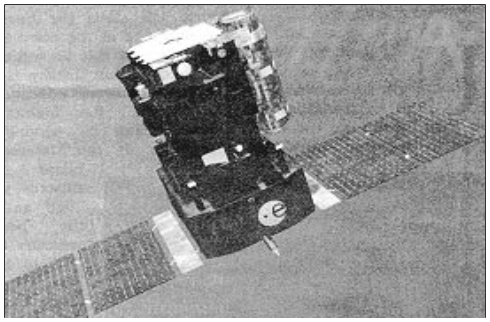
A USC-designed and -built instrument installed in a solar observatory space vehicle is giving scientists long-sought, accurate values for a key component in the Earth's energy diet. The Solar and Heliospheric Observatory (SOHO), launched Dec. 2, 1995, contains a sophisticated package designed to measure the flux of extreme ultraviolet light (EUV) and X-rays produced by the sun, as well as energetic particles.

SOHO's unique, stable observation position--1 million miles from Earth-sun line at a "Lagrange point" where the pulls of the Earth and sun balance--allows uninterrupted solar observations. "We have observed a 27-day modulation of the solar flux associated with the rotation period of the sun," said solar astronomer Darrell L. Judge, under whose direction one of the key solar EUV-monitoring instruments on the spacecraft, the CELIAS/SEM, was built. "Such variability is only observable through continuous monitoring of the sun, such as SOHO provides." The instruments's name is an acronym for Charge, Element and Isotope Analysis System/ Solar Extreme-ultraviolet Monitor.

The EUV spectrum is blocked by the Earth's atmosphere, making ground-based measurements impossible. Scientists have previously measured the flux of this radiation either by suborbital rockets rising briefly above the atmosphere, or by satellites that pass behind the Earth and thus out of view of the sun for part of their orbits. "SOHO permits the accumulation of an around-the-clock database over an extended period of time," impossible with the earlier platforms, Judge noted.



A schematic of SOHO's "halo orbit."



SOHO as it would look to an astronaut visiting it in its "halo orbit" above the Earth, with its flat solar panels deployed. The orbit is designed to allow SOHO to observe the sun continuously, without ever passing into the Earth's shadow.

The CELIAS/SEM, first turned on Dec. 16, was briefly turned off for operational reasons Dec. 20, and has operated continuously since then, providing extremely high-quality data. The observations taken from Dec. 16, 1995, to now have all been obtained during solar minimum, the time when the sun is at its lowest level of activity, and have found larger-than-expected variations in the amount of ultraviolet light produced by the sun.

During this period the CELIAS/SEM observed a flare episode in which the soft X-ray flux increased by a factor of 100. "We look forward to observations of the sun during a more active period." Judge said. The solar EUV data is important in planetary science studies because earlier studies have shown that EUV absorption in the upper atmosphere "produces heating, ionization, and excitation of atomic and molecular species, thus leading to complex chemical and transport processes in the affected atmospheric regions," according to a report on the experiment presented in June, 1996, at a solar workshop. A complete paper on the results will appear soon in the *Journal of Solar Physics*.

Scientists have attempted to model both planetary and solar atmosphere processes, but definitive tests of the models depend on more accurate measurements of the EUV flux than have so far been available. The SOHO project is being carried out by the European Space Agency (ESA) and the U.S. National Aeronautics and Space Administration (NASA) as a cooperative effort.

Other institutions involved in the CELIAS/SEM observations on board the SOHO spacecraft include the Max Planck Institute for Extraterrestrial Physics, Max Planck Institute for Aeronomy, the Braunschweig Technical University and the Physikalish-Technishe Bundesanstalt, all of Germany; the University of Bern, Switzerland; University of New Hampshire; University of Maryland; University of Arizona; JPL; the Institute for Space Physics in Moscow; and the Physics Laboratory of the National Institute of Standards and Technology in Maryland.

Judge's primary USC collaborators are co-investigator Howard S. Ogawa and project manager Donald R. McMullin

Alumnus Kostas Sfetsos Awarded European Union Fellowship and CERN Fellowship

Alumni Dr. Konstadinos A. Sfetsos, Ph.D. Physics '93, has been awarded simultaneously two prestigious fellowships in 1996: the European Union Fellowship, and the CERN Fellowship. Professor Itzhak Bars writes, "These are extremely competitive and clearly show that Sfetsos has been doing outstanding work."

The European Union fellowship is awarded to young scientists from the fifteen european member countries who are willing to work for two years in a scientific institute in another member country except their own which in Kostas' case is Greece.

The Center for European Nuclear Research or CERN fellowship, centered in Geneva, Switzerland, is for young scientists from CERN member countries. Both fellowships are awarded by an anonymous committee of senior leading scientists and are based on the accomplishments and potential of the candidate. Due to mandatory army service in Greece, Dr. Sfetsos will not be making use of this fellowship until July 1, 1997. Dr. Bars is on sabbatical at CERN until August 1997. Kostas' time there will not overlap long enough to have much time with him, but he hopes to start a collaboration.

Kostas Sfetsos transferred from the Virginia Poly Institute to the USC Department of Physics and Astronomy in 1988 as a graduate student where he worked closely with Professor Itzhak Bars. Kostas says, "Professor Bars was one of my main reasons for transferring. He has an outstanding reputation among the senior theoretical high energy physicists in the world. He is always involved in interesting problems and knows how to make unique contributions." During Kostas' USC residency, he and Dr. Bars collaborated on seven publications.

After graduating in August 1993, Konstadinos moved to the Netherlands where he held a post doctoral position in the Institute for Theoretical Physics at the Utrecht University. Here, he gained valuable experience working with top scientists, including Prof. G.'t Hooft, Prof. B. de Wit and Prof. E. Verlinde. While at Utrecht, Kostas was joined by his wife, Maria Stavridi (Ph.D. Biomedical Engineering, USC) who also held a post-doctoral position at the university in the Biophysics Institute. On March 22, 1996, Maria and Kostas had a son. During this past year, Kostas has focused his research on the interplay between duality symmetries and supersymmetry in string theory

Alumni News

Dr. G. Roger Gathers, B.S. Physics '60, retired recently from Lawrence Livermore National Laboratory where he has worked since receiving his Ph.D. in Physics at UC Berkeley in 1967. During his career, he has worked on nuclear testing, liquid metal physics, and shock wave physics and is the author of "Selected Topics in Shock Wave Physics and Equation of State Modeling." In addition, Gathers is a ham operator expert with an extra class license (N6GRF) and gives antenna design lectures at Ham Radio conferences.

Dr. Jien-Ping Jiang, Ph.D. Physics '90, is now at Optical Sciences Center, University of Arizona, as a research associate working on organic charge transport agents and organic light emitting diode (LED) as well as solid state laser and frequency conversion techniques.

Dr. Katri Leila Paivikki Huitu, Ph.D. Physics '92, has been placed in Helsinki, first in the Research Institute for High Energy Physics and starting last December, in the Helsinki Institute of Physics as the project leader of the high energy phenomenology project. After graduating from USC, her Physics interests have shifted somewhat to a more phenomenological direction, but Huitu still considers her education at USC on conformal field theory and string theory extremely valuable in order to be able to follow some recent developments in theoretical physics.

Dr. Inseob Hahn, Ph.D. Physics '93, has been doing a low temperature experiment using Helium 3 at JPL where he has spent two years as a postdoc, and is now a permanent employee. Hahn became interested in ultralow temperature physics when he completed his dissertation on this field at USC.

Dr. Ziad Maassarani, M.A. Physics '90; Ph.D. Physics '94, has been doing research in theoretical high-energy physics and statistical mechanics since graduation. After USC, he spent two years at the CEA in France (the French Atomic Energy Commission) in a post-doctoral research position. Maassarani is currently in Canada at the Laval University in Quebec City doing further research in a post-doctoral position.

Dr. Fei Ye, M.S. CENG '93; Ph.D. Physics '95, joined Teradyne Inc. in 1994 after completing his experimental work, and while finishing his dissertation. Ye was doing system software development in Teradyne's semiconductor testing division, and was the first USC physics graduate they hired. In 1995, he

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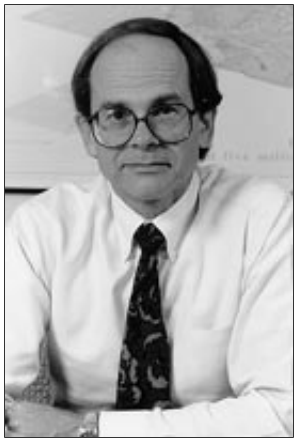

HANS BOZLER

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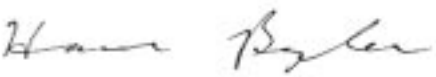
experiment in electron tunneling in the early 80's sparked a revolution in the imaging and manipulation of atoms. Now, physicists may even contemplate stitching together a "custom" strand of DNA.

Physics will *not* be left out of the biological revolution. Most new opportunities will come from newly invented fields or subfields of physics and astronomy. In addition, new opportunities for education are beginning to appear as technology oriented companies recognize an impending shortage of physical scientists. We need to expand our graduate and undergraduate degree opportunities to include combinations of physics training with professional and business training to develop students with highly marketable skills.

This summer Professor Tu-nan Chang will take over as our Department Chair. During the next few years he will face a continued period of transition as our Department reshapes its future. With vision, we will be able to take advantage of opportunities, enabling our science research and education programs to meet the challenges of the next decade



Hans Bozler

RESEARCH UPDATE:
KRESIN'S CLUSTER BEAM APPARATUS IS ALIVE

In January '97, Professor Vitaly Kresin's experimental cluster beam apparatus finally came to life after two years of assembling and upgrading. He and his new graduate students, Vitaly Kasperovich and George Tikhonov, were able to obtain the first real signal. Kresin's apparatus was born in the lab at UC Berkeley where he did his graduate work. Even then it was one of the bigger and more flexible cluster machines in the field; since then Dr. Kresin has further modernized and improved it.

Using this apparatus, Professor Kresin carries out experimental and theoretical research on microclusters - agglomerates of a finite number of atoms (from a few to thousands) which are bigger than a molecule but smaller than a piece of bulk matter. In the experimental apparatus, a beam of cluster particles is generated and flies through a series of vacuum chambers. While in flight, the clusters are subjected to various probes. Finally they pass through a mass spectrometer, which can be set to focus on a particular particle mass or to scan through a range of masses. In this way the intrinsic properties of a free cluster, the size of which (i.e., the number of atoms in it) is known precisely, can be studied.

Work in this field allows for considerable interaction with solid-state, atomic, chemical, and even nuclear physics, and has practical implications for surface science, nanoelectronics, catalysis, environmental studies, as well as many other fields.

At present, together with the graduate students and with the help from two undergraduates, Kyler Kuehn and Frank Lu, Kresin's group is pushing on to whip the cluster beam apparatus into shape and to analyze new data. This current program includes experiments on the scattering of atoms, molecules, and electrons off clusters, as well as measurements of the cluster response to external electric fields

Left to right: George Tikhonov, Vitaly Kasperovich, and Dr. Vitaly Kresin with cluster beam apparatus.

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accepted an offer from Sun microsystems and started his current career in microprocessor design. In the past one and half years, he has contributed to several projects, including Ultra-sparc's 200mhz, 330mhz and 400mhz processors, and is currently focusing on megacells circuit design and SRAM design.

MR. MICHAEL JOHN BANKS, B.A. EAST ASIAN LANGUAGES & CULTURE '95; B.S. PHYSICS '95, is attending graduate school at the University of Rochester in the Department of Physics and Astronomy where, in the Spring of '96, he was awarded an NSF Graduate Research Fellowship. He is researching quantum optics, specifically with a focus on experiments with cooled and trapped atoms. Banks recently passed his Preliminary Exam, which is the formal comprehensive physics test that begins official qualification for work toward the Ph.D. degree. He has also contributed to a couple of papers published for SRI International over the last two years

STAMP

MS. DANIELLE SWEARENGIN
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ASTRONOMY IN THE NEWS

COURTESY OF USC NEWS SERVICE

News that the sun's surface is covered with huge bumps or corrugations ran in the San Francisco Chronicle, San Jose Mercury News, Christian Science Monitor and Los Angeles Times, among other venues Dec. 18, and astronomer Edward Rhodes, who specializes in the study of the sun's heliosphere, was quoted in many of these. "I don't think this is at all impossible. I think it's potentially very exciting," he told the Associated Press

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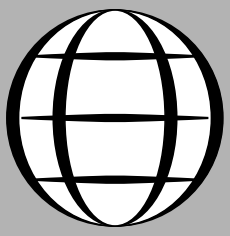
EDITOR: **DANIELLE SWEARENGIN**

USC PHYSICS AND ASTRONOMY ON THE INTERNET



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