
A Newsletter from the Kavli Institute for Theoretical Physics at UC Santa Barbara

KITP

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KITP Ranks First In Research Impact

HOW CAN THE PERFORMANCE of the Kavli Institute for Theoretical Physics be measured and assessed?

Anne Kinney in an article published in the Nov. 13, 2007, issue of the *Proceedings of the National Academy of Sciences* presents a new way of assessing "National Scientific Facilities and Their Science Impact on Nonbiomedical Research." Her approach enables comparison of the impact of research fostered in conjunction with a given facility. The KITP with a score of 6.56 registers the highest impact-index reported.

The KITP is not only the highest ranked National Science Foundation (NSF) facility, but the highest ranked of all research facilities, including (in order from second to fourth) the highest ranked department—Astronomy at Berkeley with an impact-index of 6.30; the highest ranked university—Harvard with an impact-index of 6.15; and the highest ranked national laboratory—Stanford Linear Accelerator (SLAC) with an impact-index of 5.65.

Kinney, who serves as director of the astrophysics division in NASA's science mission directorate, describes Berkeley's Astronomy Department (with an impact-index second only to KITP in her assessment) as "traditionally…one of the highest ranked scientific groups and so serves as a gold standard." Presumably that standard also applies to the facility with the highest impact-index.

Assessing the quality of KITP programming performance has proved challenging for the institute's directors because much of the measurable effect in terms of quality research is manifested in publications by visiting scientists whose primary institutional affiliation is elsewhere.

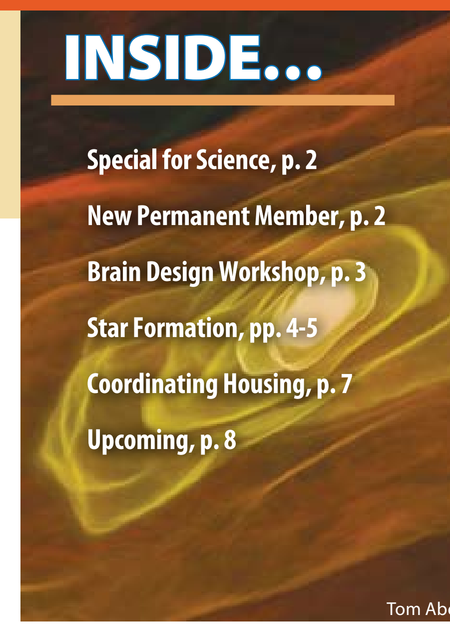
This way in which KITP differs from other institutions with which it is being comparatively evaluated is underscored in an explanatory footnote to the *PNAS* article: "KITP is a theoretical physics institute that regularly organizes conferences and long-term workshops in physical sciences. Many of the authors of papers with KITP affiliation are visitors, with other home institutions."

The key relevant question addressed in the *PNAS* article is how to compare research facilities whose size and nature differ appreciably from one another. The answer is a "normalized *h* index."

The number of citations to a published paper is usually a good assessment of the quality of the research reported in that paper because being cited in papers by other scientists demonstrates the impact of the cited work on the research of others. The higher the impact, the more significant is the research of the source.

The *h* index, pertaining to the body of a researcher's work, is a more definitive indicator of overall quality. The *h* index of a scientist is the largest number of his/her publications cited more than *h* times. The bigger an individual's *h* index, the more highly cited papers the individual has published. This *h* index is now widely used to measure the citation impact of an individual.

SEE **KITP RANKS FIRST** ON PAGE 2



INSIDE...

Tom Abel

Inside the Virtual World of the KITP:

'A Wonderland of Far-Seeing on the Web'

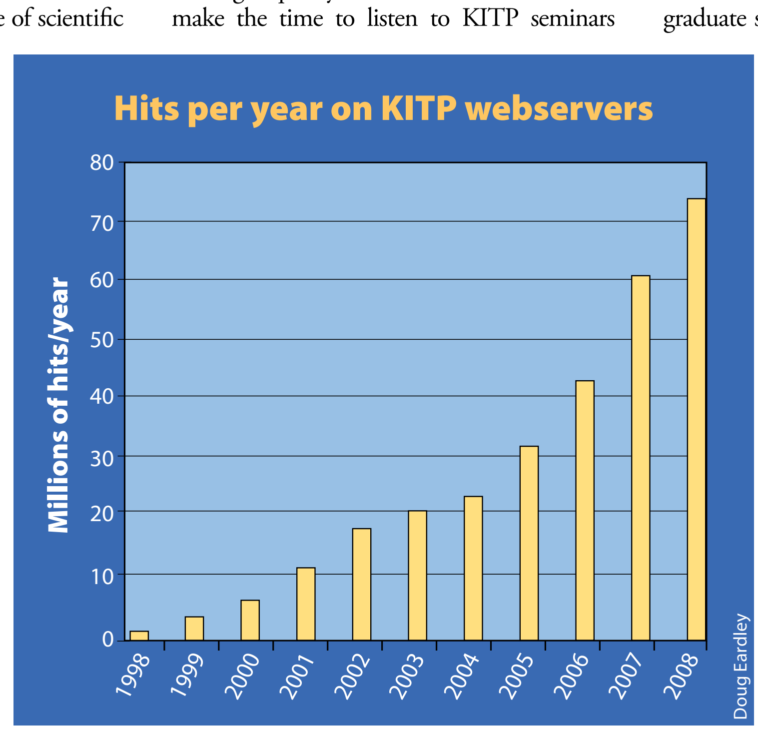
THE KITP WEB SITE is the opposite of "all-show/no-go." It may, upon first inspection of the homepage at www.kitp.ucsb.edu, look like a humdrum vehicle analogous to the base-model Ford pick-up circa 1997. But under that dated hood, so to speak, lies the visionary apparatus of the virtual KITP—a 10-year archive of scientific talks (now averaging 1,000 a year) ready for access worldwide in a number of formats variously combining audio and visual information for user reenactment.

Presiding over the virtual KITP is web wizard and UCSB physics professor Douglas Eardley. It is, literally, his creation as well as his province though he insists that he couldn't have done it without the able assistance of the KITP computing staff, especially its leader, Kevin Barron.

According to another visionary on-line archivist and physicist, Paul Ginsparg, "The KITP talk archive is both an extraordinarily useful resource and an extraordinary proof of concept." Ginsparg developed the "arXiv," which sounds like and is an "archive" for electronic preprints of scientific papers in physics, mathematics, computer science, and quantitative biology.

Observing that the KITP's "on-line talks provide a surprisingly effective source of information otherwise unavailable," Ginsparg noted, "It helps that the KITP seminars are uniformly of the highest quality, given by experts in every field, and the visual and sound quality is also more than adequate."

Ginsparg, professor of physics and computing and information science at Cornell, pointed out, "Now I am already at a relatively elite institution, not exactly lacking for high quality seminars, but nonetheless make the time to listen to KITP seminars (ordinarily from home while using wireless headphones and doing something else, *e.g.*, changing a diaper). I can only imagine how spectacularly useful and important it must be for students and researchers in other parts of the country, and rest of the world, who do not have comparable access to local resources. I wish every institution were set up to provide a similar resource, but at the moment the KITP talk archive remains unique. It fits naturally within the KITP mission; it's been implemented superbly."



Doug Eardley

A spontaneous email to KITP director David Gross from a Case Western Reserve graduate student in physics, Murad Mithani, attests to the usefulness of the talk archive to somebody formerly "without access to local resources."

Mithani wrote of the talk archive, "I just wanted to thank you and your team for the great contribution that it is making in the lives of so many people.

"To give you an example, I did my undergrad almost 12 years ago in Pakistan. From then on I couldn't afford to study anymore but always wished for a chance to study more of physics. Before coming to Case this year, during the last 5 years, the only physics professor accessible to me was the Kavli Institute. Every weekend, I would treat myself to a few lectures that would make me see and think about the world outside my world. And now even at age 33, so long after doing my bachelor's, I still am able to understand most of what is being discussed in physics graduate courses only because the Kavli Institute allowed me to stay tuned to the latest in the world of physics."

Gross credits the virtual KITP for enabling the brick-and-mortar KITP to remain "in the absolute vanguard of 21st-century theoretical physics innovation."

SEE **VIRTUAL KITP** ON PAGE 6

Rice Endows Fund to Make KITP More Family Friendly

FOR TWO DECADES physicists visiting the KITP have been treated to stunning views of the Santa Ynez Mountains from a rental house on La Coronilla Drive near Santa Barbara's Mesa district. The owners of that property, Ann and Myron ("Mike") Rice, enjoyed cordial interactions with their physicist tenants and with KITP housing coordinator Monica Curry. That mutually gratifying, long-term relationship prompted Ann late last summer to phone Curry to explore how the gift of the house might benefit the KITP.

The $1.4 million proceeds from the property's sale are being used to endow the "Drs. Ann and Myron Rice Family Fund for the Kavli Institute for Theoretical Physics." Because the endowment was established in the form of a charitable remainder trust, Ann has also generously added a cash gift of $30,000 to enable the Family Fund to become operational in the spring of 2008.

The Family Fund enables families–especially those in which the physicist is also the mother of young children–to participate in the weeks- and months-long collaborative research opportunities that are the hallmark of KITP programming.

KITP Director David Gross noted that the percentage of KITP participants who are women is roughly the same as the percentage of physicists who are women in the United States—*i.e.*, 13 to 15 percent. "We aim to raise that percentage," said Gross, "ultimately to 50 percent, and the Rice gift serves as an example nationally of the kind of effort required to make the profession more attractive to women."

The Family Fund was the brainchild of KITP development director Sarah Vaughan, who at the time of the Rice call to Curry, had already extensively explored with Curry the difficulties would-be program participants, most notably women, face when uprooting children from the carefully crafted child-care and schooling routines tailored to their home base.

Questionnaire after questionnaire returned by women physicists at the end of their participation in KITP programs noted how hard it had been to make from afar expensive arrangements for the housing, care, schooling, and transport of children that enable the physicist to immerse herself in the intense, collaborative, face-to-face research experience afforded to visitors.

Ann Rice, an expert on personal and familial finance, said, "I began by thinking that La Coronilla could serve as a permanent temporary address for physicists—as a rental property gifted to the KITP. But as soon as I learned of the prospect of a Family

SEE **FAMILY FUND** ON PAGE 7

Balents Becomes KITP Resident Expert In Hard Condensed Matter

Randall Lamb

Leon Balents (front) and his physics graduate students Miles Stoudenmire (l), Sungbin Lee, and Gang Chen

CONDENSED MATTER PHYSICIST Leon Balents has been appointed a permanent member of the KITP.

Sankar Das Sarma of the University of Maryland, who chairs the KITP advisory committee, served as chair of the search committee that chose Balents, who comes to the KITP from the UCSB Department of Physics.

Said Das Sarma, "We conducted an international search to fill the position. It certainly speaks well for the UCSB Physics Department that the best candidate we could find for the position was already on campus. We tried to identify a better candidate from the outside, but couldn't. Leon is a superb condensed matter theorist. We think he will be an extraordinary asset to the KITP. He is young and brilliant and creative—just the right characteristics for guiding programming in the area of physics that represents more physicists than all other areas of physics combined and that has the most profound impact on the direction of technological development and hence society."

After obtaining a 1989 BS degree in physics and mathematics from MIT, Balents completed a 1994 PhD in physics from Harvard. He was a postdoctoral fellow at the then Institute for Theoretical Physics (ITP) at Santa Barbara from 1994 to 1998. After a year as technical staff member at Bell Laboratories, he joined the UCSB Physics Department in 1999, was promoted to the tenured position of associate professor in 2001 and to professor in 2002.

Balents said that his ITP postdoctoral fellowship "was by far the most important experience in my career. Coming here from Harvard was such a change in atmosphere and level of activity that it took my breath away."

His experiences at the ITP converted Balents from soft- to hard-condensed-matter theory. "I got into soft condensed matter to start with," he said, "because it was very accessible. With advanced mathematics, you could get in and just attack research problems."

Condensed matter physics is largely concerned with the study of materials—*i.e.*, matter that is "condensed" or holds itself together, which largely means solids and liquids. A handy way of distinguishing soft- from hard-condensed-matter theory is that the former deals with problems in which quantum mechanics is not essential; whereas with problems in hard condensed matter, quantum mechanics is more the rule than the exception.

"Like most other things in physics," said Balents, "it comes down to energy scales and length scales. What makes a material hard are very strong forces holding the particles together, and the basic forces that hold atoms together are very strong. In soft materials the building blocks are bigger—not individual atoms but large molecules or polymers—and the residual forces between the molecules are weaker, and that makes them hold themselves together not as strongly, so that their behavior is more classical than quantum mechanical."

One great standing problem in hard-condensed-matter theory is to understand how certain cuprates (copper-oxide materials), discovered experimentally some 20 years ago, superconduct. What excites Balents now is the discovery of an entirely new class of superconductors that are iron-arsenide based. Chemists in Japan and China made the discovery two years ago, and condensed matter theorists took notice about six months ago. By comparing and contrasting the iron-arsenides with the cuprates, said Balents, "We could really learn a lot about this general phenomenon," and maybe even make the potential theoretical breakthrough that has been the goal for so many condensed matter theorists for two decades.

"Another pretty exciting development, which is different and actually pretty heavily driven by theory rather than experiment," he said, "is the realization that there can be physics similar to the quantum Hall effect in two- and three-dimensional materials in zero magnetic field as a result of spin orbit interactions. Spin orbit is a kind of relativistic effect that usually is not very important in solids, but is an integral part of the Dirac equation that you would use if you were doing high energy physics," explains Balents.

Though it would take a lot of effort to explain how, this development relates to a possible whole new technology that would use the spin of particles. All of modern technology (with a very few spin-based exceptions) makes use of the charge of particles.

Balents, who confesses, "I am a little backward in personal technology; I rarely use a cell phone," nonetheless is engaged in laying the intellectual infrastructure for transformative technologies. "Yes," he said, "I do get glimpses of technologies to come. Envisioning them is a big part of the motivation ultimately. I like to sit back and ask myself what would make, not an incremental improvement, but an order of magnitude change."

Of his KITP appointment, Balents said, "For years I've looked at the permanent members as scientific heroes. I am thrilled to be one. What a fantastic environment for doing science right in the middle of all these active programs and working with the top postdocs from around the world and with such wonderful colleagues."

Balents has served as an organizer of two KITP programs: "Exotic Order and Criticality in Quantum Systems" in 2004 and "Moments and Multiplets in Mott Materials" last fall.

The recipient of an NSF Career Award, he has also been awarded Sloan Foundation and Packard Foundation fellowships.

What Is Special About the KITP Mode For Doing Science?

THE KITP ENABLES scientists to interact in a way that differs significantly from the ways provided by the customary venues for interaction, as the following account shows.

The standard theory for star formation has assumed the presence of strong magnetic fields in the molecular-hyrodgen clouds where stars are formed. Paolo Padoan of UC San Diego has been arguing, on the basis of computer simulations, for weak fields or, more precisely, for a scatter—*i.e.*, in some places strong, in others weak. The test for the scatter model is whether it fits the observations, which are done by radio astronomers, such as Richard Crutcher at the University of Illinois.

But observers talk one language, so to speak; and computer simulators, another. So the problem of testing model against observation turns on communication between people.

Padoan served as an organizer for the four-month-long "Star Formation" program at KITP in fall 2007, and Crutcher visited for several weeks. The two had discussed their work in passing at various conferences. "Here," said, Padoan, "we talked and talked, and we are finally on the same page." That agreement, he said, "would not have happened if we went to a dozen more conferences," because the two scientists needed to be able to engage in sustained discussion.

The opportunity for sustained discussion is what the KITP affords visiting scientists.

Often, scientists, especially when they disagree about significant issues, said Padoan, "need much more time than at a conference or at a shorter workshop to really reach an agreement, to really nail certain problems down completely. If we don't spend enough time communicating on a single issue, we end up wasting time because we have to come back to the same problem. Here, we can talk today and talk again tomorrow and the next day until we completely understand each other and know we are speaking the same language."

People, even scientists, sometimes prefer not to hear objections because they have a vested interest in a certain result or theory. But at KITP, said Padoan, people have the opportunity to question, confront, and argue with each other. A discussion scheduled for 30 minutes can take 90 because content can override the exigencies of schedule, as content generally cannot in a conference setting.

"I have been grilled here on one of my papers for three hours," said Padoan. "They were after me like jackals, but it was fun; it was great! That is how science is done."

KITP RANKS FIRST

CONTINUED FROM PAGE 1

Ignoring big tails in the citation distribution, the *h* index stresses not the most influential papers, but the pattern of influential papers and therefore career productivity. For instance, the *h* index would not unduly weight a review article that is highly cited, but as such is the exception rather than the rule in a given scientist's pattern of citation.

The *PNAS* article uses this *h* index for individuals cumulatively to measure the research impact of science research facilities (including mathematics and the engineering fields, but excluding biomedical science) wherein these individuals function. Plotting *h* versus the size of an institution turned up a simple scaling law: for a large group, *h* scales as the number of papers to the 2/5 power. Thereby the *h* indices of institutions can be normalized to factor out differences such as size. In other words, a physics department with 50 faculty members can thereby be compared equitably to a physics department with 100 faculty, since one would expect the absolute number of published paper citations by the latter to outnumber the former simply because there are twice as many scientists publishing papers that can be cited.

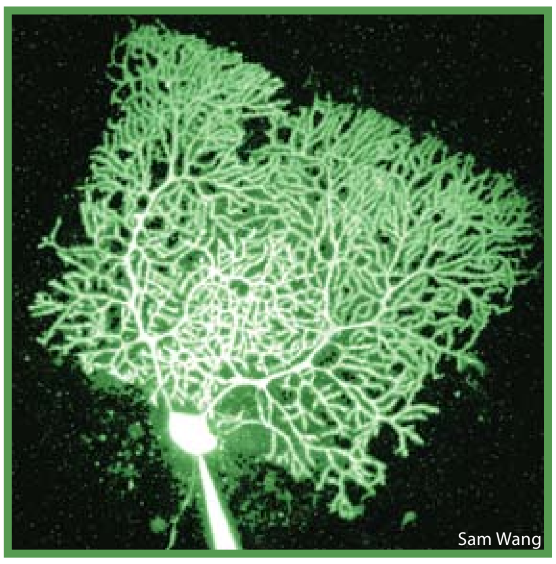
The normalized *h* index enables further comparisons of different types of research environments such as universities as a whole, individual departments within universities, national laboratories, and institutes. It provides, in effect, a way of comparing apples and oranges.

Visitors to the KITP are asked to acknowledge in their papers the work done at the KITP. Such acknowledgement is standard procedure pertaining to working visits in the academic community. In its first place assessment of the KITP, the *PNAS* article used "data from even years beginning with 1980 and ending with 1998." The reason given for the 1998 cutoff is the need to allow time for citations to accrue.

As the *h* index factors out the anomalously highly cited paper, whether Nobel Prize winner or review article, so the normalized *h* index factors out the presence of one stellar and oft cited scientist in the midst of a pedestrian group. So what is being assessed is the overall scientific efficacy of environments as producers of significant scientific research, and in the physical sciences, including mathematics, the KITP achieves the highest impact.

How well does KITP achieve its mission of creating an environment to enhance significant scientific research? The answer, according to the *PNAS* article, is better than any other nonbiomedical research facility in the United States and, therefore, probably the world.

How Brains Think About Themselves When They Come Together to Consider That Question Systematically


Sam Wang

Cerebellum neuron, filled with fluorescent dye through glass pipet (projecting from bottom) and visualized using two-photon microscopy.

- *Alcoholic drinks ingested don't kill brain cells.*
- *Crossword puzzles and Sudoku don't ward off senile dementia or Alzheimer's nearly as effectively as physical exercise can.*
- *Nicotine and caffeine are two of the most powerful enhancers of brain functioning yet discovered.*
- *The answer to the question, "How much of your brain are you likely using?" is "All."*
- *If you are left-handed, you are more likely either to score higher on the SATs or to have a severe intellectual deficit than if you are right-handed.*

PRINCETON NEUROSCIENTIST Sam Wang used the same title for his April 16 public lecture at the KITP as for his new book, *Welcome to the Brain*, and the same provocative subtitle, *Why You Lose Your Car Keys but Never Forget How to Drive and Other Puzzles of Everyday Life*. The lecture, at least, could have as fittingly been called, "Welcome to the Brain: What It Thinks It Knows About Itself but Doesn't.*"* As the above sample indicates, Wang has an uncanny knack for identifying misinformation about the brain.

Wang majored in physics as an undergraduate, and did his graduate work at Stanford in neuroscience. A recent article published in his undergraduate alumni magazine, *Caltech News*, reported on Wang's transition from physics to biology: "One of the greatest challenges was replacing some of the intuitive approaches he had come to rely on in physics with different modes of thought. Another was the large mass of knowledge that had to be acquired. 'The field was a zoo—literally,' he says. Researchers have 'accumulated a large body of information, but they're still trying to find out the organizing principles behind it.'"

Those are key remarks for contemplating the marriage of physics and biology being consummated in KITP workshops such as "Anatomy, Development, and Evolution of the Brain," from March 17 to April 25. Physics, as a mature science, is characterized as much (if not more) by a way of thinking that is profoundly quantitative, as it is by the content or accumulated knowledge of the field. In biology, details still matter a lot. Whether theory beyond Darwin and DNA will play a systematizing role analogous to its role in physics remains a great question.

In addition to his public lecture and attendant book signing, Wang served as one of five organizers of the KITP brain-design workshop. The other organizers were Ken Kosik of UCSB, Alexei Koulakov of Cold Spring Harbor, Greg Lemke of the Salk Institute, and Sara Solla of Northwestern University. Wang added, "Of course, we got lots of advice from [KITP permanent member] Boris Shraiman because he has lots of interest in the subject matter."

The brain workshop, said Wang, "aimed to bring together several different threads in brain design and, more broadly, evolutionary biology and also theoretical physics in a way that had not been done before."

How have brains been optimized over the course of evolution to be very good at what they do? How have evolutionary forces and natural selection shaped brain architecture? Those are the overriding questions variously considered by the 69 brain workshop participants.

One approach to those questions, which comes from the core of modern neuroscience, aims to understand mechanisms of how brains and their components—neurons and glia—have developed. The first part of the workshop, organized by Lemke, focused on development issues.

Neurobiologists discussed processes that occur when, for instance, axons extend and become operational. (Axons are long, slender nerve fibers that conduct electrical impulses.) Discussion focused on the rules neurons use to grow and to extend, both at the molecular level as well as at the systems level, *i.e.*, how circuits get hooked up in the developing brain.

> *"A very large fraction of the genes in the genome are expressed in the brain and not in other parts of the body."*

The second part of the workshop pondered how brains might be optimized—in the sense of using, so to speak, the least amount of wire or energy to do their job. "This is an area," said Wang, "which attracts physicists and the area with which physicists who have started to work on neuroscience problems are likely the most familiar." He describes a realm of research in which theorists look for minimization principles, and experimentalists design tools and techniques to reconstruct entire blocks of neuronal circuitry.

Neuroscientists call that block of neuronal circuitry a "neuropil," a "pile" of connections between axons and dendrites all packed together in a seemingly solid mass of tissue. (Nerves are made up of two fibers, axons and dendrites, which protrude from the central cell body. Axons transmit, or send out, and dendrites receive neurotransmitters at synapses.) Tracing connections through a neuropil is a really hard problem. It's like mapping electronic circuits on a chip, but in three- instead of two-dimensions.

The third part of the brain workshop focused on understanding the evolution of brains in the context of comparison with the brains of other species.

The three parts of the workshops—development, optimization/anatomy, and evolution—represent three approaches employed by three usually distinct sets of researchers to understanding the brain's architecture. Integrating those approaches was the key aim of the workshop. Wang said that such an integrated approach was novel.

Wang's expertise is in optical technologies for monitoring neuro-circuitry in the living animal. His laboratory specializes in a technique called "two-photon microscopy." His research interests also include quantitative comparisons among species, particularly as related to the question of how brain structures scale up. As he explained that research question, "When you compare different species with each other, as brains get larger, what are the laws that govern how they scale up?

"For me," said Wang, "a large part of this workshop was learning about areas of research different from my own."

One area is "the development of technologies for taking a block of tissue [the neuropil], cutting that tissue up section by section, and coming up with a detailed structure of that tissue." Giving talks on their efforts to develop these technologies were Winfried Denk of the Max Plank Institute for Biomedical Optics, Sebastian Seung of MIT, and Dmitri Chklovskii of the Howard Hughes Medical Institute.

One of the difficulties with sectioning brains in the past, said Wang, "was reassembling the slices." Winfried Denk has made a major innovation in this technique by taking pictures of a fixed block face of tissue as each slice is taken so that a series of pictures are created whose images are automatically in line with each other because the block doesn't move.

"This is a very simple idea," said Wang, "but technically difficult because of problems with exactly how you get an electron beam to generate a useful image under these conditions. There are little tricks that Winfried and his collaborators employ to get the technique to work."

These technologies for making images of the brain generate huge databases, which in turn present a challenge for analysis. Some workshop participants are experts in automated recovery of structures. Their work, said Wang, promises to turn up significant finds in the next few years.

Another particularly exciting area of research looks at how nervous systems might be optimized from the viewpoint of developmental biological mechanisms—*i.e.*, putting the viewpoints presented in parts one and two of the workshop together.

The human brain with 10^{11} connections and 10^{15} synapses runs on 12 watts of power. So, how does it accomplish all that it does in such a small space and with such a small energy budget? Answering that question is pivotal to understanding brain architectures.

Said Wang, "Developmental mechanisms are critical for understanding how one might have a system that makes itself optimal simply by the rules it uses at a cellular level to set up the whole system. The idea here would be that the genome determines cellular mechanisms, and these cellular mechanisms work to drive development, and those developmental mechanisms generate the organism.

"So, if you think that the organism is optimized in some way, then one logical step is to go back and understand the developmental mechanisms and look for those rules and see what those rules are that generated the system. These could be rules of how you generate a map and rules for how you minimize the amount of wire that is used and rules for how the system can teach itself things once it is born and comes into the world. These rules are ultimately driven by developmental mechanisms."

Said Wang, "There is a whole field of biology called evolutionary and developmental biology, known to its proponents as 'evo-devo,' which has been thinking in this way about other body systems."

The last week or so of the workshop brought an evolutionary perspective to brain development. Said Wang, "At the end, one thing that has been very interesting to me is doing analysis at the level of the sequence of proteins and genetic information to try to understand how genomes may have evolved or to try to understand how proteins may have evolved.

"A very large fraction of the genes in the genome," he said, "are expressed in the brain and not in other parts of the body." There seems to be a lot of genome that is dedicated to coding the brain. Apparently, a lot of evolutionary effort with respect to the genome has gone into setting up this optimized brain. That evolutionary effort, in turn, indicates why, said Wang, "It is really important to join up ideas of optimization with ideas of development."

For all the emphasis on "optimization" as a key concept for understanding brains, Wang likens the evolution of the brain "to building an airplane after the plane has taken off. What I mean is that every generation of every species in the history of the diversification of animals has had to be well adapted to its niche; and so, as a result, there is some brain plan that was laid out fairly early in the history of vertebrates that if you look hard enough and deeply enough into a human brain, you can find vestiges of that old design. On top of it other things got piled; and on top of them, other things."

The evolutionary perspective tends to look at the brain in terms of innovating on a series of preexisting platforms—from the bottom up, so to speak. Optimization, by contrast, invokes a top-down perspective observing how well the brain works and asking how and why.

These two viewpoints can inform each other, Wang said. "These fields—brain optimization and brain evolution—have previously not communicated much with one another. What the workshop aimed to do—and did do!—was to get the proponents of these views talking to each other."

Why do we forget where we put our car keys, but remember how to drive?

In English, at least, we have but one word for "memory"; but Wang told his KITP public lecture audience, "Your brain has a half-dozen different memory systems," and the system for driving is different from the short-term system for key recall. For a more detailed answer, see *Welcome to Your Brain*, co-authored with Sandra Aamodt, editor of *Nature Neuroscience*, and published March 2008.


S.A. Solla

Sam Wang

Chris McKee (l) and Tom Abel

Charmien Carrier

How Do Stars Form?
Differently, at Different Cosmic Times

SURPRISINGLY, "the formation of the first stars is in some respects the best defined star formation mode," according to the on-line prospectus for the program "Star Formation Through Cosmic Time," held Aug. 6 to Dec 7, 2007. What is surprising is the implication that a process that took place some 13 billion years ago (about 700 million years after the beginning Big Bang) should be better understood than the process in ensuing epochs of the universe, including our own right now. Why? Theorists think things were simpler back then.

What key scientific issues did the program address?

Said Chris McKee of Berkeley, one of four organizers, "What we wanted to try to do was to discuss all the aspects of star formation, starting with the very earliest stars and coming up to the present. There has been an enormous amount of progress recently in observing and understanding the formation and evolution of galaxies and the general structure of the universe. One of the parts of that whole picture which is most uncertain is actually how stars form. So we wanted to try to bring together experts from around the world to make some progress on that question."

Tom Abel of Stanford, another of the program's coordinators, specializes in the first stars. He creates computer simulations to model the process whereby the very first stars—shining as much as a million times brighter than our sun—were formed. He likens those primordial objects to "rock stars" (*e.g.*, Janis Joplin or Jim Morrison)—living fast, brilliantly flaming out, and dying young.

The more massive the star, the shorter its life, and the more likely it is to collapse in upon itself and expire in a supernova explosion. Since core collapse and supernova are the fate of stars eight times or more massive than the sun, those first stars—roughly 100 times more massive than the sun—were doomed to annihilate in titanic explosions that emitted the fused nuclei of elements (*i.e.*, heavier than the stars' initial constituent hydrogen), as well as enormous amounts of radiation.

Both the heavy elements and the radiation, in turn, altered the environment or medium and changed the process of star formation. For instance, seeding the medium with heavy elements enabled little stars to be formed. Their appearance represents something akin to a phase transition in the history of the universe. The smaller the star, the longer is its life; so some of the first small stars—those less than 0.8 solar mass—presumably still exist.

Since stars smaller than the sun are more numerous than stars more massive than the sun, how can observers tell the difference in age between two small stars?

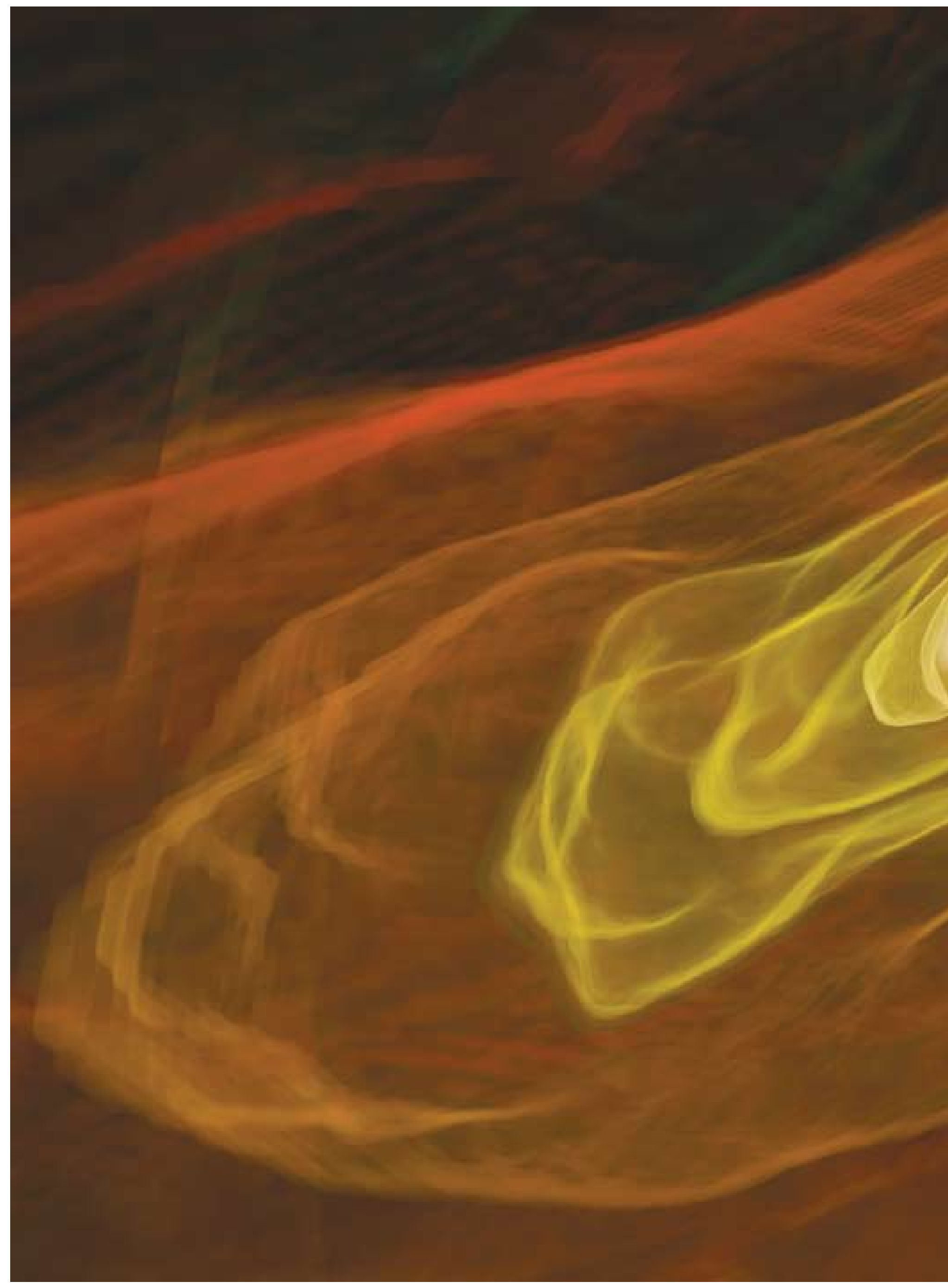
Not Heavy Metal

The presumption is that the oldest small stars would be made from an interstellar medium with a dearth of metals. Observers today are looking for stars that have very small amounts of metals. They have to look in our own Milky Way galaxy, which is the only place where such small stars with "low-metallicity" would be close enough to earth to be detectable.

Observers have found some stars that have an amount of iron in them that is only 1/100,000 as much as the sun's. Even though the amount of iron is dramatically low, the amount of the lighter element carbon is down only by a factor of 10; the relative amount of carbon is 10,000 times higher compared to the iron. So those stars provide interesting clues about the environment in early times after the first stars and therefore retrospectively about the processes within the first stars.

It may, in fact, be that low-metallicity stars reflect back not to the first, but to the second generation of stars forming in an ionized medium before the true advent of metals. The radiation emitted in the supernova death throes of the first stars would have ionized the medium, *i.e.,* turning hydrogen atoms into hydrogen ions or plain protons, and thereby giving rise to a process or chemistry for star formation different from the very first process.

Looking for those stars with low metallicity—living fossils, so to speak—is akin to doing stellar archaeology. They provide, according to McKee, "a very important observational window on star formation." What it would take to open that window wider is the proposed, very large 30-meter telescope. The partnership to build the estimated $750-million instrument includes the University of California, the California Institute of Technology, and Canada, and is being spearheaded by UCSB Chancellor Henry Yang.



Genesis simulated

The most common type of star is slightly smaller than the sun, which is itself half through its 10-billion-year lifespan.

Late in life, stars less than eight times as massive as the sun expand into "red giants" (larger [hence "giants"] but cooler [hence "red"]), and then the outer envelope puffs away leaving a little more than half the original mass. What is left is a white dwarf, and what is puffed out contains a dust of heavy elements that in turn also alters the environment for star formation.

So the processes, whereby stars form, change across cosmic time because the stuff out of which they form changes.

The Importance of Dust

For instance, dust is important because atoms stick to it. It has some sort of surface that neutral hydrogen atoms can move around on. Two hydrogen atoms moving on dust are more likely to find each other than if the dust grain weren't there. When the two neutral hydrogen atoms come together, they make a hydrogen molecule, and the binding energy of the molecule usually lifts them off the dust grain. Hence, dust particles are important contributors in turning gas clouds into the molecular form of hydrogen.

Stars form in clouds of molecular hydrogen. The clouds are cold and dark.

But the first stars formed before there was dust. So the first epoch of star formation differed significantly from star formation

Keith Kie

Alyssa Goodman

Observers of Star-Forming Confer With Its Simulators

WITHIN THE "STAR FORMATION" program, Alyssa Goodman of the Harvard/ Smithsonian Center for Astrophysics ran a workshop on large surveys of nearby star formation regions. Goodman, a program organizer, is an observer, who heads the COMPLETE Survey.

The workshop aimed to bring together survey leaders—astronomers who use mostly radio telescopes to collect data on molecular-hyrogden clouds and star formation in large swaths of the actual sky—with theorists, especially simulators who are modeling star formation via computer, to understand better the star-birthing process.

In an exercise worthy of the most arcane postmodernist fantasy, the observers and the simulators conferred in order to adjust the simulations, which operate (inside computers, so to speak) in a three-dimensional representational space evolving over millions of years, to look the way the simulations would in the two-dimensional representation plane of the "real" world that the observer now "sees" (though "see" is even more a misnomer with radio astronomy than with optical astronomy). To determine whether the simulations fit the observations, the "picture" produced by the simulations has to be modified to appear the way it would if an earth-bound observer were now surveying the simulated space via telescope.

Another goal of the workshop was for both observers and theorists "to understand the observational biases of the different kinds of surveys," according to Goodman. "There were questions about what the mass spectrum of gas is before it actually forms stars in conjunction with different models that were being discussed in the program," she said. "The theories make different predictions about that, and so people were very interested in what kinds of constraints are entailed in these large statistical surveys."

The workshop's benefits for theorists are clear, so what benefit is there for observers?

"First of all," said Goodman, "we get to talk to each other, which is very valuable. Second, we get to hear what the theorists are thinking about our observations.

"For observers like me, there are things that we can measure that we don't appreciate are so critically important.

"It turned out that the theorists were really obsessed with this idea that changes in the equation of state of the gas could cause very subtle differences in the density profile of particular blobs of gas that were forming stars. We can measure density profiles fairly accurately, but they didn't realize (and we didn't realize they didn't realize) that we can also measure the temperature profile pretty well, though it is very difficult to do and very uncertain. Back in my own group, we are now focusing on what we can do to better quantify the uncertainty in these temperature and density profiles because this little factoid is so important to the theorists.

"From reading the literature, we didn't appreciate that need," she said. "It is hard to tell from the literature the difference between a question and a super-important question."

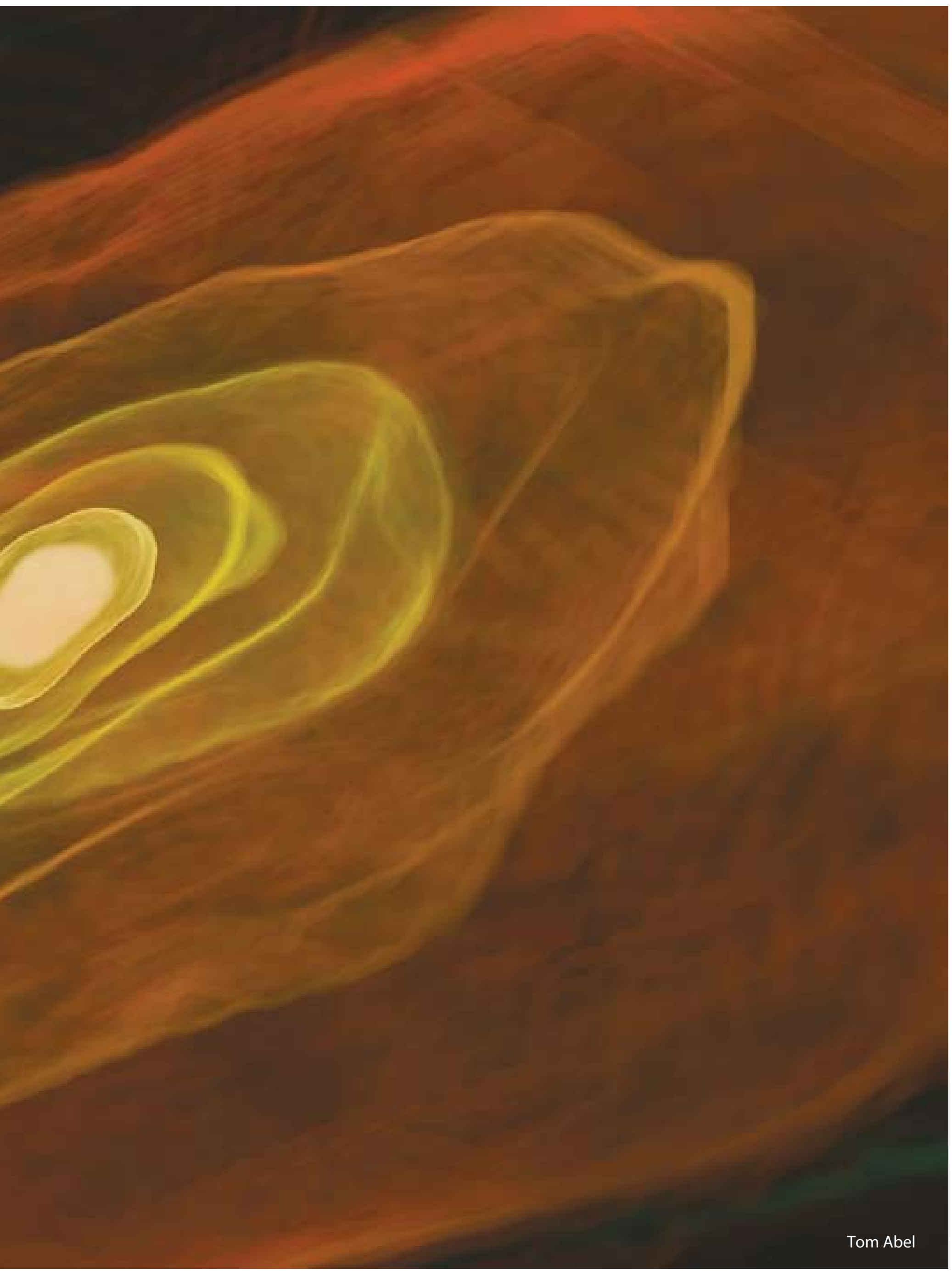
Talking face to face does have advantages for doing science, as Goodman's example shows.

in successive epochs. All the gases for star formation early on were warmer in part because no dust absorbed radiation, and the typical speeds for interactions were therefore faster, so massive stars of pure hydrogen grew fast. Since it takes lower temperatures to make low mass stars, there weren't any early on.

"If something is warm," said Abel, "it has more pressure; and so it will try to resist gravity much more than something cold unless, of course, the something that is warm is more massive, so that it experiences a gravitational force strong enough to counter the thermal pressure. That is why there could only have been larger stars early on.

"Our simulations predict only big ones early on. They can't make small ones. Those findings are consistent with observations." Conversely, it gets harder and harder to make big, big stars as the universe evolves.

Though Abel speaks with conviction about the first stars, there is a contrarian's view (as with most aspects of the various star formation scenarios across cosmic time). Understanding that view, even briefly, requires an introduction to the dark matter, which the standard view of early star formation sees as creating the "potential well" that enabled the first star formation.



Tom Abel

Down the Dark Matter Well

Dark matter is called "dark" because it does not radiate, but interacts with baryonic or ordinary matter (made up of protons and neutrons) gravitationally. What exactly dark matter is, no one knows, though the best guess is that it is comprised of the lightest supersymmetric particles whose existence is postulated by a particle-physics theory called "Supersymmetry." By far, most of the matter in the universe is dark.

As McKee explains, "The first stars formed in a well that was created by dark matter, and as the baryons accumulated eventually they acquired a high enough density that they would become self-gravitating, and they would collapse on their own. The difference between the baryons and the dark matter is that the baryons can lose energy [radiate]. When two baryons collide, they lose energy by radiation. As far as we know, dark matter colliding doesn't lose energy; so the baryons can condense to much higher densities than the dark matter."

What did change over time was the role of dark matter in star formation. "Though the very first stars formed in the gravitational potential well of this dark matter," said McKee, "right now when stars form, all the baryons are gathering together, and the dark matter has nothing to do with it." When the sun formed five billion years ago, the dark matter played no role.

McKee estimates that 99 percent of experts on star formation affirm that the first stars were massive.

A contrary but creative view (by Katherine Freese of the University of Michigan and her student Douglas Spolyar of the University of California at Santa Cruz and their collaborator Paolo Gondolo of the University of Utah) paints a picture of the lightest sypersymmetric particles and their anti-particles bashing into one another, annihilating, and turning into hugely energetic gamma rays and electrons and positrons. All that energy in turn would halt the fledgling first star's contraction. In place of the massive first star that Abel's simulations envision appears a curious object with a radius 10 times that of the sun (about the distance from earth to sun) though only a little more massive. The stuff of this star would be so diffuse that instead of running on normal, stellar nuclear reactions, it would be powered by dark matter annihilation.

Despite such an intriguing alternative hypothesis, there is consensus among most program participants about the construction of the first stars. But two big open questions that engendered lively debates among the 116 "Star Formation" program participants are:

(1) How rapidly do stars form?

(2) What explains the distribution of the mass of the stars that form?

McKee and one of his former students, Mark Krumholz of Princeton, have put forth one point of view on the rate of star formation. Another of the program organizers, Paolo Padoan of the University of California at San Diego, has done new simulations that could confirm that theoretical model, and perhaps extend it to include the effect of magnetic fields. McKee, who finds Padoan's results "interesting," said, "We would like to understand the rate of star formation quantitatively and not just qualitatively, which is the kind of understanding that people had before."

What is so intriguing about the mass distribution of stars is how fixed it appears to be across cosmic time despite the differences in star formation processes across time. (The sun is a little bit more massive than average.) "We are looking for general principles that predict this distribution and give probabilities," said McKee.

"If," he explained, "the spectrum of the stellar mass is dependent on the details of the physical condition, then you'd think you would find completely different distributions of mass in different places, but you don't. If you look at globular clusters [the most ancient stars found in globs spherically distributed in the Milky Way] these very, very old stars generally exhibit a peak in their mass spectrum that is similar to the peak inside the disk [the extended plane of the galaxy where gas and dust are densest and where star formation is ongoing]. The physical conditions when a globular cluster formed would probably have been very different than the physical conditions in star formation today, and yet somehow the typical mass is the same!" exclaims the usually quiet-spoken McKee.

Why? The answer likely has to do with the overriding and most important topic of the "Star Formation" program—turbulence or chaotic motion in the gas.

Is Turbulence the Key?

Said McKee, "The issue that has been a constant source of discussion is turbulence, both in the interstellar medium and in the molecular clouds. What is the source of this turbulence that is everywhere observed? We really don't have a very good understanding."

Turbulence may be the key to star formation. Most of the astrophysicists attending the program think so though some, such as Frank Shu of San Diego, disagree. Like the other much discussed phenomenon of magnetism, turbulence is thought both to inhibit and to enhance star formation.

Most importantly, turbulence, because it is universal, may provide a natural way of explaining a universal pattern such as the mass distribution of stars across cosmic time. Such an explanation would mean, of course, that regularities pertain with respect to chaotic motion.

"We decided," said Padoan, "to do idealized computer experiments with the single purpose of understanding the physics of supersonic turbulence, both with and without magnetic fields. And that's what we did for almost 10 years. In fact, we add gravity in the code, but kept it off. (It's been hard to resist the temptation of turning gravity on because when you turn on gravity, you form stars.)

"We discovered universal statistical properties of turbulence," he said. "The beauty of turbulence is that it's very complex, but it's got some kind of self-organization, or else there wouldn't be this mass spectrum of stars. There is a pattern, universal and scale-free. We think we have learned the probability distribution of the density field and the scaling of velocity in turbulence, and then we use those statistics to model analytically the mass distribution of stars. Soon we will have a theory of star formation, which is in a sense analytical, but whose ingredients—the fundamental results of supersonic turbulence—could not have been achieved without numerical simulations."

Looking ahead, Padoan said, "In order to convince the community, especially at this point, requires a world-record simulation. It's going to have to be a realistic simulation of a star-forming region, not just an idealized numerical experiment." Then comes the next step, "We—and others—have to try to disprove the theory, which is very important!" he said.

The Third Way

McKee calls computer simulations the third way of doing physics. The other two are theory/analytic technique and experiment.

Numerical simulations seem like a kind of telescope that brings cosmic events far, far away in time and space to focus in mind. Talking star formation with both simulators, Padoan and Abel, is quite an experience because they seem to be describing vast cosmic events that they are actually seeing occur in their minds' eye.

Padoan seems to peer deep inside dark molecular clouds of hydrogen to discern sheets, formed in rebound from shocks, in turn intersecting and forming filaments that then intersect and form the core where the proto-star gestates.

Abel conjures up the first stars turning on like fireworks going off in the darkness that "was upon the face of the deep" and gives new meaning to the old divine injunction, "Let there be light."

Charmien Carrier

Paolo Padoan (r) and his long-time collaborator Aake Nordlund

Virtual World

CONTINUED FROM PAGE 1

Noting the disconnect in having a work-a-day homepage as portal to "a wonderland of some of the most far-seeing intellectual content on the web," Gross said that he had recently asked Eardley to chair a committee (including Stuart Mabon and Simon Raab, successful businessmen and entrepreneurs, who are members of the KITP Director's Council) to oversee an overhaul of the KITP web site. The mission is to design and implement homepage and user interfaces that accord with the brilliance of the interior offerings.

Traffic Tallies

Whatever its homepage impressions, the KITP web site is extraordinarily popular. The total number of hits for the 12-month period ending March 31, 2008, comes to 76,208,536 or about 209,000 hits per day. That annual total is up from the previous year's total of 62,727,231 and the 2006 total of 44,877,855. The current annual tally of hits represents a roughly 75-fold increase in 10 years from the original annual total of 1,272,123 back in 1998. (See chart, page 1.)

Said Eardley, "We can estimate only crudely the proportion of usage by the public at large, in contrast to scientists. We believe this breakdown to be very roughly 50/50 at present based on ratios of hits from .com domains."

A really striking statistic is the sharp increase in downloads of audio-visual files for the 12-month period ending in March over the previous two years: 8,600,000 downloads in 2008; 2,800,000 downloads in 2007; and 620,000 downloads in 2006.

"The steep increase (quadrupling each year since 2005)," noted Eardley, "follows our introduction of several new kinds of videos and podcasts for each talk."

The speaker's visuals are available to a listener as a download separate from the audio. These visual files in PDF-format average 25 slides per file. The annual tallies ascended from 393,000 downloads in 2006 to 599,000 downloads in 2007 to 739,000 downloads in 2008.

According to Eardley, "We can measure total bandwidth going out of this place. And we can determine with more difficulty how increasing bandwidth usage pertains to increasing numbers of users. The total bandwidth has doubled every year," said Eardley.

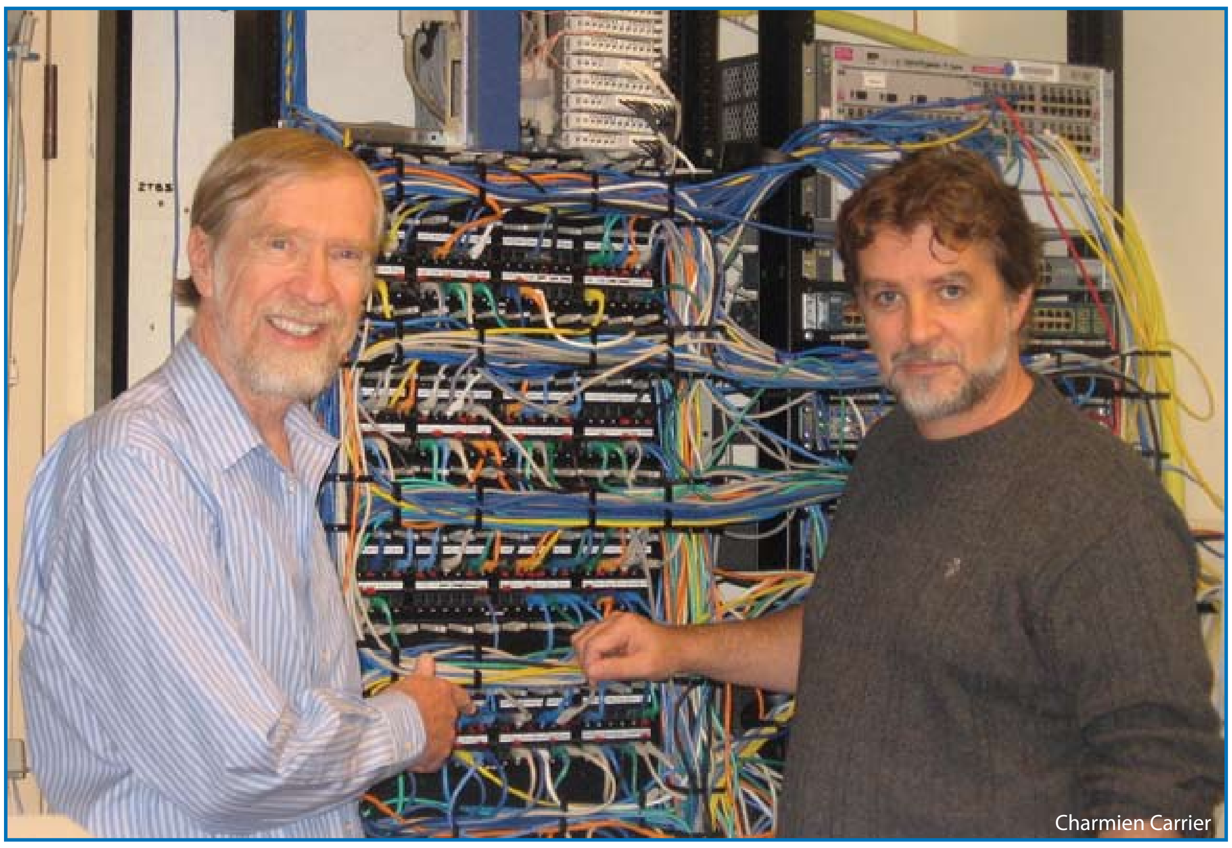
"The number of users is increasing more slowly by, we think, some 20 to 30 percent a year. Better computers," Eardley explained, "mean that more data can be downloaded at high quality video feed, so that the number of people downloading is not going up as fast as the actual bandwidth–the bits and bytes—being downloaded. But increasing the number of people who download per year by 20 to 30 percent still means that our growth cumulatively over the past decade has been enormous."

Transparencies to Start

The first experiment with putting KITP programming on line dates to 1997 with "Supernovae," held from Aug. 15 to Dec. 15. That program is memorable in retrospect because some participants were then engaged in analyzing the supernovae Type Ia data, which led to the earth-shaking conclusion that the expansion rate of the universe is now accelerating. Interestingly, that first effort at on-line programming pertained only to visual information. Eardley recalls, "One staff member collected all the transparencies (those were the days before widespread use of PowerPoint) and scanned them (it took a long time) and then put them onto the 'net."

For the second attempt, said Eardley, "We added audio recording to the transparencies so that the audience could hear the talk and see the slides. That program," Eardley said, "was on 'Jamming'—a topic pertaining to soft condensed matter systems, such as soap bubbles and grains of sand. If sand is dumped out of a bucket, the flow falters at first and then avalanches. There is a lot of scientific subtlety in that."

Though an astrophysicist, Eardley in his role of KITP web impresario has heard a lot of talks and snippets of very many more talks on all the other areas of physics, including those interfacing especially with mathematics and biology. Eardley hears so much because he edits every talk.



Charmien Carrier

Doug Eardley (l) and Kevin Barron

"What I have tried to do," he said, "is find out how to edit a one-hour talk with no more than five minutes of editing time. The main thing is to identify where a talk begins and ends. The end is usually signified by applause though there are usually questions that follow, which are often important to include in the on-line version. The other trick is to figure out when the talk begins, which is almost always obvious though most speakers like to warm up with either inconsequential comments or a joke. The joke always presents a problem of whether it is relevant to the talk or not."

The talks are recorded on two computers to guard against a technical failure in one. "We have had a chronic problem," said Eardley, "of speakers forgetting to turn on their microphone or of turning it off, so a computer staff member appears at the start of every talk and does a couple of things: makes sure the speaker's laptop is working and that the microphone to our two recording computers is turned on and operating when the talk begins."

Video above and beyond copies of transparencies and PowerPoint was instituted in the late '90s. The cameras were installed initially in the two seminar rooms in the original Kohn Hall building to accommodate video conferencing. Once the cameras were in place, it just seemed obvious that they should be used to record video of the speaker.

Most speakers, using computer-based presentation software to illustrate their words, write little on a blackboard though one of the two fixed cameras in the three seminar rooms is trained to zoom in on writing.

Blackboard Challenge

But the weekly "Blackboard Talks" present a special problem for video recording because speakers are encouraged to make more extensive use of the blackboard as a medium for communication. Intended to break the mold of the speaker's set-talk illustrated with computer-based visuals, these talks are meant to revert to the more traditional pedagogical mode of blackboard because the point of this series is for participants in one KITP program to explain their scientific concerns to participants in another completely different KITP program. To accommodate the special blackboard challenge, Eardley generally operates the cameras himself.

"In the almost new auditorium," said Eardley of the technically well-equipped facility in the 2004 addition where the "Blackboard Talks" generally occur, "each of two cameras looks at part of a blackboard. I have made a bunch of technical tools to try to automate editing together the separate views. I try to do this in five minutes. For a 'Blackboard Talk,' it may take 10 minutes. Occasionally, a mistake occurs, and then I have to go back and do a real-time job of editing."

Asked if he plans on marketing his editing software, Eardley said, "I try to give away the software, though it's hard to give away because then we're responsible for supporting it."

Terabyte Rule of Three

How does the KITP back up its terabytes of data representing 10 years of KITP talks? "We do the same thing Google does," said Eardley. "Google doesn't back anything up on tape. We have everything on three different hard drives."

One of the key editorial decisions that was made early on is that the KITP doesn't own the talk; the speaker does.

"Our original thought," said Eardley, "was that we wanted to post the talks so that scientists elsewhere could follow as a means of scientific communication, but we soon realized that the talks had huge educational value for the physics and allied science and mathematics communities, as well as for the intelligent lay public who want to learn about science.

"That realization about the identity of our users has helped guide our choice and use of technology. At first we thought we'd use the most advanced technology, but we got cries for help from places like India and Chile where there are sophisticated scientists and great scientific programs, but where the infrastructure is not as good as it is in the U.S. So we decided to provide a choice whereby people can get high bandwidth and low bandwidth versions. We try to provide the most advanced technology, but still have low bandwidth stuff easily available to everyone."

The virtual KITP benefits participants arriving mid-program. Access to earlier presentations enables latecomers to become current with program content. Also, because talks within programs address edge issues for researchers–*i.e.*, work in progress–the presentations tend to lack the structured clarity of published articles. The virtual KITP enables auditors to go back and hear again intellectually provocative utterances, either not fully comprehended initially or appreciated only in retrospect.

Eardley describes one noted Caltech string theorist reporting how listening to KITP talks via car radio eased the arduousness of the commutes (100-mile+, one-way) between Pasadena and Santa Barbara. (String theory is one of those physics fields where the material is so complex that any given talk by one string theorist is likely not understood by another string theorist [at least on first hearing].)

What enables talks to be heard over the car radio is their availability since 2005 via the KITP web site in Podcast format for downloading to computer-based iTunes or Windows Media Player and from there to an iPod or other MP3 player, whose output can in turn be played over a radio via wireless or wired transmission.

Despite the availability of new formats, a large number of users still download KITP talks in their original Real Audio format. The other popular format is Quick Time. Said Eardley, "I thought Real Audio was a 'sunset' niche product that would by now have sunk below the user horizon, but that just hasn't happened."

Early on in the history of the virtual KITP, Eardley contemplated the prospect of recording the talks in full video as does the Mathematical Sciences Research Institute (MSRI), an NSF-funded facility, akin to the KITP, located on the Berkeley campus. But he opted initially for the limited video of transparencies and PowerPoint. Anyone who has "watched" a KITP talk, since the cameras have been running in the seminar rooms, knows that the video coverage is intermittent. That approach makes smaller files that are amenable not only to fast download, but also for eventual transfer to an iPod-like portable player.

What does Eardley see as the next innovation?

"We have to do the YouTube format, Adobe Flash Technology."

Virtual KITP Top Ten

What talks number among the Virtual KITP Top Ten?

Two of the first three public lectures dating back to 1998 turn out to be the most popular: Edward Witten of the Institute for Advanced Study in Princeton on "Duality, Spacetime and Quantum Mechanics" and MIT's Wolfgang Ketterle on "A New Form of Matter: Bose-Einstein Condensation and the Atom Laser." Interest in the Ketterle public lecture surged when he won the 2001 Nobel Prize in Physics.

Of the staple fare for scientists, the 2001 program with the seemingly nondescript title "Statistical Physics and Biological Information" tops the KITP bestseller list. "Thousands of people are still listening to those talks after all these years," said Eardley, who notes that biologists especially "love the medium" of the virtual KITP.

Programs with large pedagogical content—giving physicists access to biology and biologists access to physics—have what Eardley calls "the longest legs." All of the biophysics programs have legs that are long, as do the mathematical programs with again that pedagogical component designed to bridge the disciplines of mathematics and physics.

Interestingly, the most popular of the KITP mainstay talks are also the most interdisciplinary.

Coordinating Housing Resembles 3-Dimensional Chess

Charmien Carrier

Sarah Vaughan (l) and Monica Curry

DIRECTOR DAVID GROSS is accustomed to explaining the logistics of KITP operations to audiences around the world who wish to emulate it as a retreat facility for scientific research. He said, "When I tell them that the KITP hosts 1,000 visitors a year and that we match 500 of them to a variety of local housing options and that we have one housing coordinator, they are amazed. Our housing coordinator, Monica Curry, is a treasure."

After eight years working as a real estate agent in the Santa Barbara area, Curry joined the KITP in 1993. "This job is perfect for me," said Curry, "because it is about relationships."

The self-described "people-person" recognized the same attribute in Ann and Mike Rice when she first visited them at the home that Ann would later give to the KITP in order to establish an endowment for its newly conceived Family Fund. The relationship between the Rices and Curry evolved over the years into a friendship.

Ironically, the house that turned into the Drs. Ann and Myron Rice Family Fund was itself unsuitable for housing families with young children. Said Curry, "It wasn't set up for families because of the extensive collection of Western art and figurines. I eyed those pieces and imagined what energetic young children might do to them, so I limited its availability to couples and families with older children."

Curry similarly assesses each housing unit under her purview (including the most unusual–a cement water tank converted to guest cottage on a ranch in the Foothills) to determine tenant suitability.

"The KITP housing process reminds me," she said, "of that three-dimensional chess game they used to play on the old Star Trek television series. Moving one piece affects many other pieces on multiple dimensions. I have to take into account the rental provider (when the property is available or not); who is most suitable for the house (kids or not); what transportation options pertain to a property; and, finally, there is the price range.

"Sometimes I have a house and a visitor that don't quite fit each other," she said, "but I know no better match is likely, so I have to sell the provider and/or the renter on each other. Then the worst case sometimes happens when that unlikely better arrangement does turn up, and I have to undo my own persuasive message in order to make a better all-around match by moving the first tenant elsewhere to put a more suitable tenant in the initial tenant's place."

Curry describes the non-physicist components of her version of three-dimensional chess as follows: "I have six university apartments and approximately 50 private apartments and condos (although only about 35 or so tend to be available at a given time). Of these, only the university apartments and about six or fewer of the private units are suitable for families; the rest are for couples or singles. I have a roster of about 60 'room in a home' rentals used for single visitors, of which about 40 are used regularly (the rest are a bit far away or are not always available)."

In addition, she said, "I increasingly use resources such as 'Craigslist' or online vacation rentals to expand rental inventory when I do not have something suitable for visitors." According to Curry, "a small handful" of visiting physicists use those same on-line resources to find their own housing accommodations. The rest of the visitors whom she doesn't house "stay mostly in hotels."

Asked about the pattern of family use, Curry said, "We previously did not have the ability to note family status in our database, but have recently added this criterion and will be tracking it henceforth."

Curry said that for the purposes of crafting a proposal for the Family Fund, she and KITP development director Sarah Vaughan worked up "guesstimates" of usage patterns. The number of families visiting three months during the summer has averaged eight to 10, and the number of families visiting five months during the academic year programs has averaged five to eight.

So Curry not only cultivated the relationship that led to the Drs. Ann and Myron Rice Family Fund, but also helped Vaughan envision it beforehand. "Monica is marvelous!" said Vaughan.

Family Fund

Ann Rice

CONTINUED FROM PAGE 1

Fund, I thought it would be a wonderfully appropriate memorial for Mike, who was so encouraging and supportive of my own career development. Both of us have had a life-long commitment to the value of higher education. With this gift we are enabling higher educators themselves to develop insight through collaboration. It pleases me that we have found a way to help that is deeply in keeping with our core values as a couple."

With a BA degree from the former Georgia State College for Women (GSCW), Ann Smith began teaching high school home economics when she was 19 years old. All the while teaching at the institutions she attended, she went on to complete a 1951 MS degree from the University of Georgia and a PhD from Florida State University in economics, sociology and personal finance.

The latter degree was conferred in 1964, the year that she joined the UCSB home economics faculty as a teacher of family finance and investment. The author of two college textbooks on family management and more than 50 articles and one book chapter related to teaching financial management, Rice also served on the board of the Consumers Union. Honored for her service on the advisory board of the U.S. Department of Agriculture, she was named Alumna of the Year by Georgia College and State University (formerly GSCW).

Born "Myron," but known as "Mike" thereafter, Rice, an Ohio native, attended Miami University, where he obtained bachelor and master degrees in business, and Cleveland College, where he earned a doctor of chiropractics. After enlisting in the U.S. Army Air Force in 1941 and serving in Europe during World War II, Mike met and married Ann. They were married for 52 years.

A skilled metal smith, Mike designed orthopedic footwear for children. In addition to his chiropractic practice, he owned and operated a trucking company. Awarded a Utah State University doctorate in business education in 1972, he served as professor at Santa Barbara City College for 20 years, where in addition to teaching he chaired the business department and supervised the work experience programs. He also helped to establish the graduate program at Brooks Institute, where he taught fledgling professional photographers how to make a business of their art.

UCSB Chancellor Henry Yang said, "I am so impressed with Ann and Mike Rice's evident commitment to what higher education can do to better people's lives. Thank you, Dr. Rice, for your generosity to UCSB and the KITP. UCSB is fortunate in our long relationship, beginning when you taught home economics in 1964 and extending to your graciously endowing this fund that will benefit physicists who are also parents visiting the KITP."

Gross said, "We are very grateful to have the means to level a little the playing field between men and women theoretical physicists who are parenting young children. Yes, we also expect that the fund will aid male physicists who are operating as single parents or whose visit to the KITP requires extra resources to support their family unit. But the main advantage of this wonderful gift is that it enables us better to welcome women physicists by offering to offset the added challenges of their leaving home with children in tow in order to do research at the KITP.

"I want to add how impressed I am, Dr. Rice, with your professional accomplishments, achieved in an era, not so long ago, when equal opportunity between the genders not only did not exist, but had yet to be conceived as a worthy goal. Thank you, Dr. Rice; you have made the KITP more family-friendly."

The Family Fund addresses the following needs: appropriate housing, childcare and schooling, and transportation.

Housing

According to Curry, whose job it is to match physicists to accommodations, families obviously require more, and therefore more expensive, space than the lone physicist or couple. Families generally can't be accommodated in a moderately priced rooming-house setting because children are likely to disrupt other inhabitants. And the requirement for more space often includes, in addition to room for children, room for an auxiliary childcare provider, whether nanny or relative.

Another housing hurdle is seasonal. Summer means school vacations, when physicists and their school-age children don't have classes. But summer also means higher prices for rentals in what is arguably one of America's most attractive vacation destinations. The Family Fund can be used to offset this seasonal cost differential.

Care and Education

Then there is the formidable challenge of finding and paying for reputable and reliable child-care and schooling away from home.

The Family Fund will address this need directly through subsidies, as well as indirectly through staff support to compile and maintain a password-protected alcove on the KITP home page. Parents can access this resource in conjunction with a "wiki," a forum (or blog) to promote on-line information exchanges among parent-physicists to enable assessment of local child-care and schooling options.

Perhaps the least obvious of the additional costs the Family Fund can address entails paying to preserve the daycare or schooling provision that parents have already secured at home. A parent might well feel compelled to choose preserving such a service (often hard-won) over risking its loss, through payment interruption, in order to advance a research career.

Transportation

Curry notes that another need women physicists, with or without children, have (in contrast to men) is for safe transportation. Frequently, men can comfortably bike at night between the KITP and their accommodations. But the same route may be questionable in terms of safety for biking women, thereby necessitating extra funds for a rental car or public transportation. Children also require transportation to day-care or school or summer camp. Finally, there is the cost of bringing children and possibly the nanny to Santa Barbara and back.

The Family Fund, in short, enables the KITP to adapt its mission as a retreat facility for the advancement of scientific research to the challenges of modern parenting and two-career families.

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Jean Carlson, Gregory Falkovich, John Harte, Brad Marston, Ray Pierrehumbert

Dynamo Theory
May 5 - July 18, 2008
Chris Jones, Daniel Lathrop, Steven Tobias, Ellen Zweibel

Boundary Layers in the Earth: A Multi-disciplinary View
June 22 - Aug. 8, 2008
Adam Dziewonski, Stan Hart, Louise Kellogg, Michael Manga, Barbara Romanowicz

Gauge Theory and Langlands Duality (Miniprogram)
July 21 - Aug. 8, 2008
Edward Frenkel, Sergei Gukov, David Morrison

The Theory and Practice of Fluctuation-Induced Interactions
Aug. 18 - Nov. 21, 2008
Thorsten Emig, Mehran Kardar, Adrian Parsegian, Roya Zandi

Building the Milky Way
Sept. 15 - Dec. 12, 2008
Andrew Benson, Juna Kollmeier, Matthias Steinmetz

Population Genetics and Genomics
Sept. 15 - Dec. 12, 2008
Martin Kreitman, Lluis Quintana-Murci, Massimo Vergassola

Fundamental Aspects of Superstring Theory
Jan. 5 - May 29, 2009
Melanie Becker, Nathan Berkovits, Joe Polchinski

Formation and Evolution of Globular Clusters
Jan. 12 - April 10, 2009
Fred Rasio, Alison Sills, Enrico Vesperini, Steve Zepf

Low Dimensional Electron Systems
Jan. 20 - June 12, 2009
Herb Fertig, Donna Sheng, Kun Yang

Quantum Control of Light and Matter
April 20 - July 17, 2009
Misha Ivanov, Navin Khaneja, David Tannor

CONFERENCES

Anticipating Physics at the LHC
June 2 - 6, 2008
Csaba Csaki, Tao Han, JoAnne Hewett, James Wells

Magnetic Field Generation in Experiments, Geophysics and Astrophysics
July 14 - 18, 2008
Chris Jones, Daniel Lathrop, Steven Tobias, Ellen Zweibel

Back to the Galaxy II
Sept. 29 - Oct. 3, 2008
Andrew Benson, Juna Kollmeier, Matthias Steinmetz

Population Genomics: Implications for Demography and Natural Selection
Oct. 16 - 17, 2008
Martin Kreitman, Lluis Quintana-Murci, Massimo Vergassola

Population Genomics of Human Disease
Dec. 3 - 5, 2008
Martin Kreitman, Lluis Quintana-Murci, Massimo Vergassola

Formation and Evolution of Globular Clusters
Jan. 12 - 16, 2009
Fred Rasio, Alison Sills, Enrico Vesperini, Steve Zepf

New Directions in Low-Dimensional Electron Systems
Feb. 23 - 27, 2009
Herb Fertig, Donna Sheng, Ziqiang Wang, Kun Yang

Concepts and Methods in Quantum Control: Theory and Experiment
May 18 - 22, 2009
Gustav Gerber, Misha Ivanov, Navin Khaneja

For details of programs go to our website: http://www.kitp.ucsb.edu/activities/

For Friends of KITP...

SEE WEB SITE:
www.kitp.ucsb.edu/community/friends_upcoming_events.php

Charmien Carrier

Full House. *Neuroscientist Sam Wang signs a copy of* Welcome to Your Brain *for Dilling Yang with Alan Heeger (l) and his wife Ruth next in line. UCSB physicist Heeger won the 2000 Nobel Prize in Chemistry. Dilling's husband, UCSB Chancellor Henry Yang, also attended the KITP public lecture Wang gave. (See article on KITP brain design workshop, p. 3.) At such overflow events, first preference for seating goes to Friends of KITP.*

For information about events and membership, contact Charmien Carrier at (805) 893-6349 or charmien@kitp.ucsb.edu. For other Friends queries, contact Sarah Vaughan, Director of Development and Community Relations, at (805) 893-7313.

KITP Director's Council

The Director's Council is made up of leaders in fields other than physics, but with an interest in physics, who meet several times a year to provide the KITP leadership with invaluable support and advice. Chaired by John Mackall, the Council also includes Joe Alibrandi, David L. Brown, Virginia Castagnola-Hunter, K.C. Cole, Michael Ditmore, Fred Gluck, Gus Gurley, James Knight, Stuart Mabon, Simon Raab, David Wenner, and Derek Westen.

For member profiles go to: http://www.kitp.ucsb.edu/community/director.html.