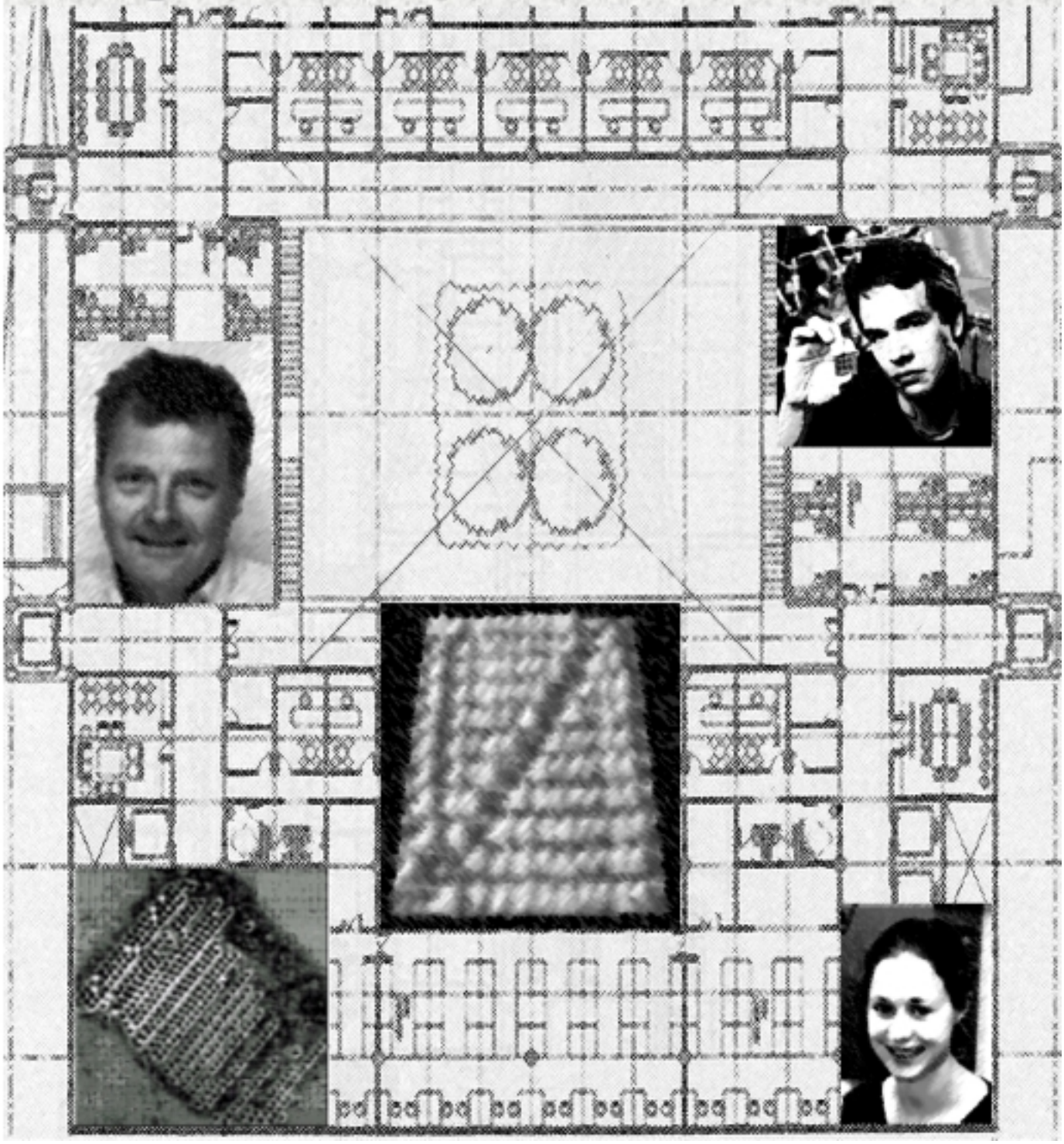
Progress Report: October, 2001



The California NanoSystems Institute: A Progress Report: October, 2001

Introduction We are nearing the one-year anniversary of Governor Davis' announcement that a California Institute for Science and Innovation would be founded at UCLA and UCSB in the form of the California NanoSystems Institute. The past year has been remarkable by any accounting. The terrorist acts of September 11, and the subsequent bio-terrorism events, have opened up a host of pressing societal, economic, and technological challenges that are critical to our nation's economy and security. The energy crisis that was recently experienced by the western United States has forced all of us reevaluate how the U.S. consumes and generates energy. The completion of the sequencing of the human genome has brought to the forefront a fantastic set of scientific opportunities as well as a number of strongly coupled bioethical issues. Finally, the slowdown of the nation's economy has introduced a new set of challenges related to the education of a technologically trained workforce as well as to the development of the next-generation technologies that will be brought to market by that workforce, and that will ensure our state's and nation's economic health for decades to come.

The California Institutes for Science and Innovation are poised to become the educational and technological leaders in this rapidly evolving world. As we take the CNSI from concept to reality, we are committed to both remaining adaptable to this changing world, as well as to holding to the steadfast course that is required for fundamental scientific discovery, taking that science to the next level in order to realize high-impact technology development, and attracting and nurturing the scientific talent that can make all of this happen. We are developing energy-efficient technologies for lighting, computation, and communications, and we are developing environmentally sustainable manufacturing approaches. We are developing new bio-medical and bio-molecular technologies for medical diagnostics, molecular therapeutics, and for sensing and responding to bio-toxins. We are recruiting some of the world's leading scientists in nanosystems research and we are recruiting and training a first-class pool of young student and postdoctoral scientists. We are developing the coursework, the research projects, and the facilities to make the CNSI the most exciting place in the world for carrying out nanosystems research. Finally, we are bringing these discoveries to the marketplace through the establishment of start-up companies and joint CNSI/industrial research agreements.

In this progress report, we focus on the people, the economic impact, the buildings, and the funding status of CNSI. While there is much more to be done, we believe that the CNSI is off to a spectacular start. We are grateful to Governor Davis and to the State of California for their continued support of CNSI and the other Institutes for Science and Innovation.

James Heath & Evelyn Hu, Scientific Directors, CNSI

"Life has a natural curve – you go up, plateau and go down. The only way to change this is to be continually starting new curves and remain in a state of becoming."

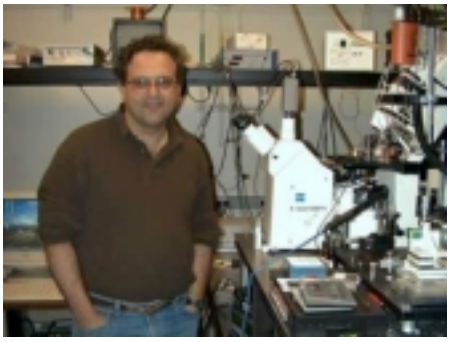
-- Norton Simon

II. New CNSI Faculty

In these pages we introduce new CNSI faculty members at UCSB or UCLA. These scientists came to the University of California to help realize and fulfill the potential and promise of CNSI. A brief introduction to these faculty is provided on these pages, and a more complete picture a few senior hires, including how their research program adds to CNSI is included in the Appendix to this report.. Several more faculty recruitments are currently underway at both campuses.

II.A. Senior Faculty

James K. Gimzewski (Senior Hire) Jim joined CNSI as a Professor in the UCLA Dept. of Chemistry and Biochemistry in January, 2001 after spending over 15 years at IBM's Zurich Research Laboratory. Jim brings tremendous expertise to the CNSI in the areas of molecular electronics, scanning tunneling microscopy, bio-NEMs devices, and ultra-sensitive nano-scale analytical instrumentation. Jim's scientific contributions have received international recognition, including the Duddell Medal (2001), Royal Academy of Engineering (2001), The Discover Award for Emerging Fields, (1997), and the Feyman Prize (1997).



Shimon Weiss (Senior Hire) Shimon joined CNSI as a jointly appointed Professor in the UCLA Department of Chemistry and Biochemistry, and the UCLA medical school's Department of Physiology. Shimon spent the last several years at Lawrence Berkeley Labs developing a host of bio-labeling and spectroscopic techniques for interrogating the form and function of biosystems at the single-protein or cellular level. Shimon's background in electrical engineering and quantum optics adds to the interesting mix of cross-disciplinary science in CNSI. Shimon's contributions have been internationally recognized through the Michael and Kate Barany 2001 Biophysical Society Award. He is a founder of Quantum Dot Corporation.

Carlo Montemagno (Senior Hire) Carlo joined CNSI as the Carol and Roy Doumani Professor in UCLA's Henry Samueli School of Engineering and Applied Science, and as the new co-chair of UCLA's bioengineering program. Carlo spent the last several years building a world class bio-NEMS and bio-engineering program at Cornell. Among his several contributions has been the development of bio-molecular motor-driven devices on chip-based platforms. This and related work has garnered him international recognition including major stories in the New York Times, Discover Magazine, and elsewhere.

George 'Bud' Homsy (Senior Hire) Having recently joined the Mechanical and Environmental Engineering Department from Stanford University, Bud Homsy's research interests are in the important areas that comprise microfluidics and interfacial flows. Using a combination of analytical theory, large scale

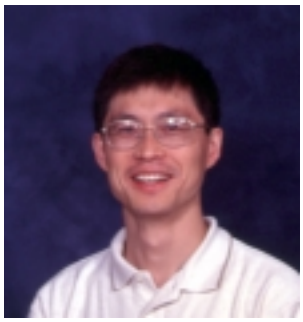
numerical simulation, and experimental studies Bud's work will have important bearing on microfluidics and MEMs and NEMs operation.

Tony Evans (Senior Hire) Tony will be joining CNSI and returning to UCSB. Coming from Princeton University, where he is currently directing the Princeton Materials Institute, Tony will nucleate programs in CNSI on micro- and nanomechanical properties of materials. Tony's research program has included the study of nanocomposite materials, their macroscopic structural properties, and the issues of stability, fatigue and degradation in these materials. A member of the National Academy, Tony has also been the recipient of numerous awards, including the Fulrath Award , Mathey Prize, Griffith Medal , Peterson Prize, and Ross Coffin Purdy Award.

Martin Moskovits (Senior Hire) Martin Moskovits joined the CNSI in the fall of 2000 as a Professor of Chemistry at UCSB, and as Dean of the Division of Mathematical and Physical Sciences, coming from the University of Toronto, where he has been a full professor since 1982. Martin was an early pioneer in the field of nano, doing seminal work over the past two decades on the physics and chemistry of small metal clusters, as well as on the controlled growth, physics, and transport properties of metallic nanowires His work has been internationally recognized in several ways. He is a Fellow of the Royal Society of Canada, and he won the Gerhard Herzberg award from the Spectroscopy Society of Canada in 1993, and, in 1999, he won the CSC EWR Steacie Award.

II.B. Junior Faculty

Jing Huang (Junior Hire) Jing joins the CNSI this Fall after completing a Howard Hughes Postdoctoral Fellowship in Professor S. Shreiber's lab at Harvard University. She comes as a junior faculty member in UCLA's Department of Molecular & Medical Pharmacology. Jing will add substantially to CNSI's program in Molecular Medicine. Her research interests involve the use of whole-genome expression profiling, chemical genetics, molecular biology, and biochemistry to study Tor (target of rapamycin)-dependent signal transduction networks and the molecular basis of human diseases/conditions involving this pathway, including cancer, diabetes, obesity, neurobiological disorders, and autoimmunity. By integrating the logic and tools of modern biological and chemical sciences, nanotechnology, and informatics, Jing will collaborate with other CNSI scientists to elucidate the functions and interactions of key proteins and other biomolecules in the cell, and use the insights to design small molecules that can serve as molecular probes of cells in basic research and ultimately as effective molecular diagnostics and therapeutics in medicine.



Jianghong Rao (Junior Hire) Jianghong joins the CNSI as an Assistant Professor in UCLA's Department of Molecular and Medical Pharmacology after completing a Damon Runyon-Walter Winchell Postdoctoral Fellowship in Professor George Whitesides' group at Harvard. Jiang interested in developing

of molecular probes that can be tools for monitoring specific biological active species or processes in vivo. He will work with other CNSI scientists to combine synthetic and physical organic chemistry and molecular biology with imaging techniques such as fluorescence microscopy and positron emission tomography (PET). For example, one goal is to build molecular probes that will act as optical indicators for neurotransmitters, and that will enable the direct monitoring of neuronal communication in real time.

Frank Brown (Junior Hire) Frank joins the CNSI as an Assistant Professor in UCSB's Chemistry Department, having served as an NSF Postdoctoral Fellow at UC San Diego and a Yen Fellow at U. of Chicago. With undergraduate degrees in both Chemistry and Mathematics, and a Ph.D. in Physical Chemistry, Frank's background well prepares him for the development of theoretical and computational tools from the physical sciences for use in studies of cellular biology. Frank will work with other CNSI researchers to understand critical issues related to cellular functioning: membrane dynamics, cytoskeletal assembly and the kinetics of enzymatic turnover.

Joan Emma Shea (Junior Hire) Joan Emma Shea has recently joined CNSI and the Chemistry Department at UCSB, having been an Assistant Professor at the University of Chicago. Prior to that, she pursued postdoctoral studies at the Scripps Research Institute. Her research focuses on developing and applying techniques of statistical and computational physics to the study of biological problems. Work with other CNSI researchers will include investigations of cellular processes such as in-vivo protein folding and protein aggregation.

III. The Economic Impact of the California NanoSystems Institute

These companies are nanotechnology and bio-nanotechnology based companies that were either started or have heavy involvement from CNSI faculty members. In most cases, the precise amount of start-up capital that is available to the companies is proprietary, and so estimates, given by company/CNSI members, are provided here. The LA Tech Center, which represents a unique and revolutionary environment for expediting the transfer of scientific discovery to the market place, was founded in August, 2001 in a 13,000 sq. ft. off–campus complex by CNSI faculty and is being explored as a model for how the CNSI will interface to the commercial world. Because its importance to CNSI, we present a slightly more in depth discussion of the LA Tech Center on the following page. The CNSI is beginning to work with local organizations, such as LARTA, who manage the state-supported California Technology Investment Partnership (CalTIP), and whose Venture Forums have jumpstarted over $400M in venture financing for technology development. LARTA worked with the CNSI earlier this year for a joint CNSI/Department of Commerce symposium that focused on the business opportunities and scientific and financial challenges of nanosystems.

III.A. CNSI-Related Start-up Companies

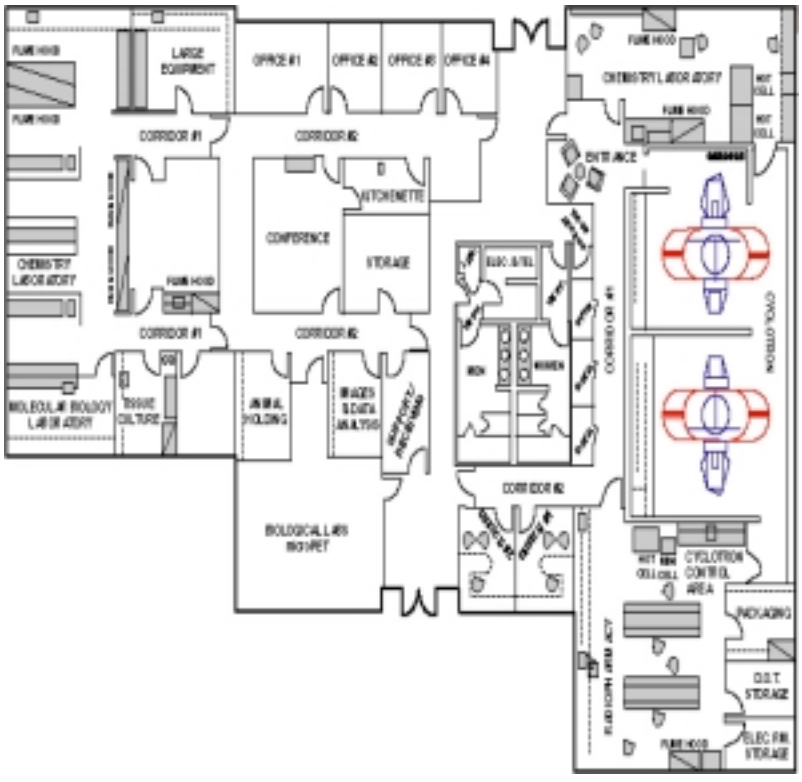
QUANTUM DOT ***Quantum Dot Corp.***	***Shimon Weiss, UCLA Department of Chemistry and Biochemistry and Department of Pharmacology; co-founder, Quantum Dot Corporation.***	***Semiconductor quantum dot biological labeling; advanced materials*** ***$60M VC capitol over 3 yrs (advanced to Stage II)***
Carbon Nanotechnologies Incorporated	***James Gimzewski, UCLA Department of Chemistry; board member, Carbon NanoTechnologies Incorporated***	***Large-scale production of single walled carbon nanotubes for materials applications*** ***$15-20M VC funding (Stage I)***
NanoSys	***Jim Heath, UCLA Department of Chemistry and Biochemistry and Department of Pharmacology and Scientific Director, CNSI; co-founder and Director of Scientific Advisory Board, NanoSys.***	***Nano and molecular electronics; $15-20M VC funding (Stage I)***
LA Tech Center	***Mike Phelps, Norton Simon Prof. & Chair of Pharmacology and CNSI Executive Board and founder, LA Tech Center***	***See §III.B.***
Agensys	***Owen Witte, UCLA Howard Hughes Investigator and Executive Board, CNSI and co-founder and director of Scientific Advisory Board,, Agensys***	***Biotech -- concentrating on defining tumor antigens and enzymes suitable for diagnostics and therapeutics. About $20 M in VC funds + other contracts***

Although ***Agensys*** and ***Quantum Dot Corporation*** both predate the CNSI, they continue to be outlets for CNSI-developed technologies. The other companies (and the ***LA Tech Center***) were formed within the past year. Several other start-up companies are currently in the works, and will be announced in subsequent progress reports.

III.B. The LA Tech Center

The LATech Center, opened in late summer of 2001, is a profit/non-profit partnership that reaches in one direction to a company, and in the other direction into UCLA and the CNSI. The company is PETNet Pharmaceuticals, which is wholly owned by CTI (Computer Technology & Imaging)). CTI owns a number of companies, and also partners with Siemens. Within the LA Tech Center there also exist agreements with various pharmaceutical companies that are not related to CTI. The goals of the LA Tech Center are two-fold. From a practical viewpoint, the goal is to utilize existing (including proprietary) and in-house developed drug and molecular libraries for pharmaceutical screening, biomedical diagnostics, and molecular medical therapeutics. From a philosophical standpoint, the LA Tech Center is being explored as a conceptual framework for building a road from the non-profit to the for-profit, and for building a scientific, technological, and business culture that can live and operate in that environment. Perhaps most critical to the CNSI is that the LA Tech Center is a new, existing entity in which this philosophy of rapidly transitioning fundamental discovery to the marketplace can be explored. A LA Tech Center II, which will achieve this same goal, but with a focus on bio-NEMS-types of devices for pharmaceutical testing and development, and for bio-toxin detection and response, is currently in the early planning stages.

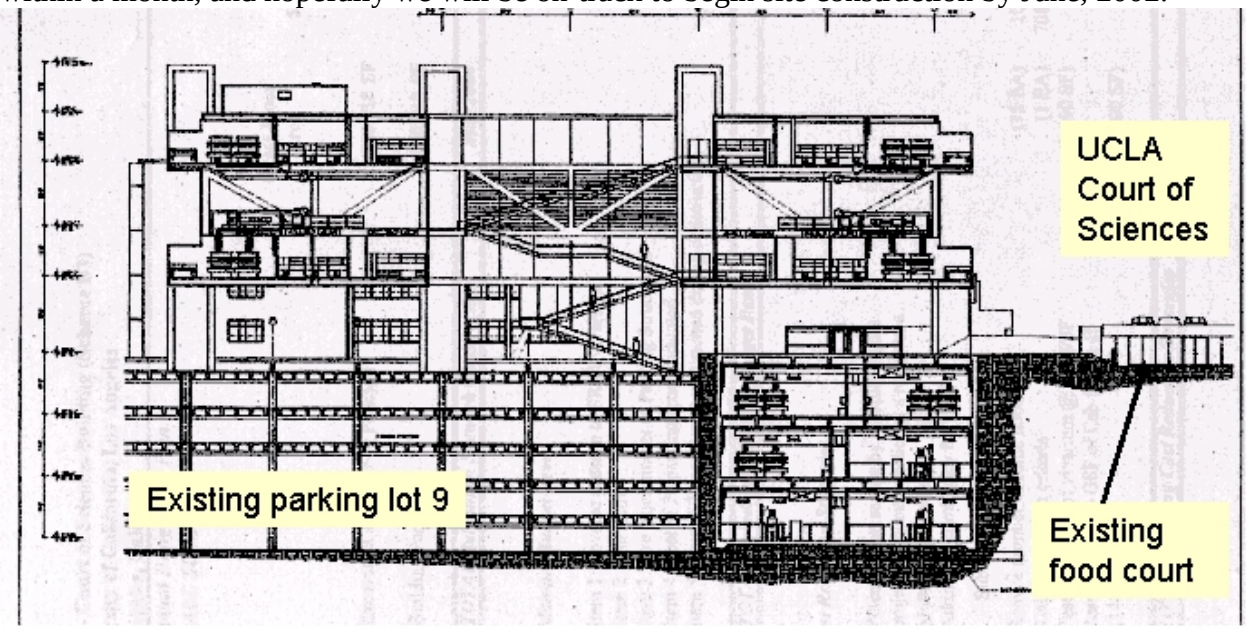
These pictures show exterior and interior views of the LA Tech Center. Below is a schematic of the actual building layout.



IV. The Buildings of the California NanoSystems Institute

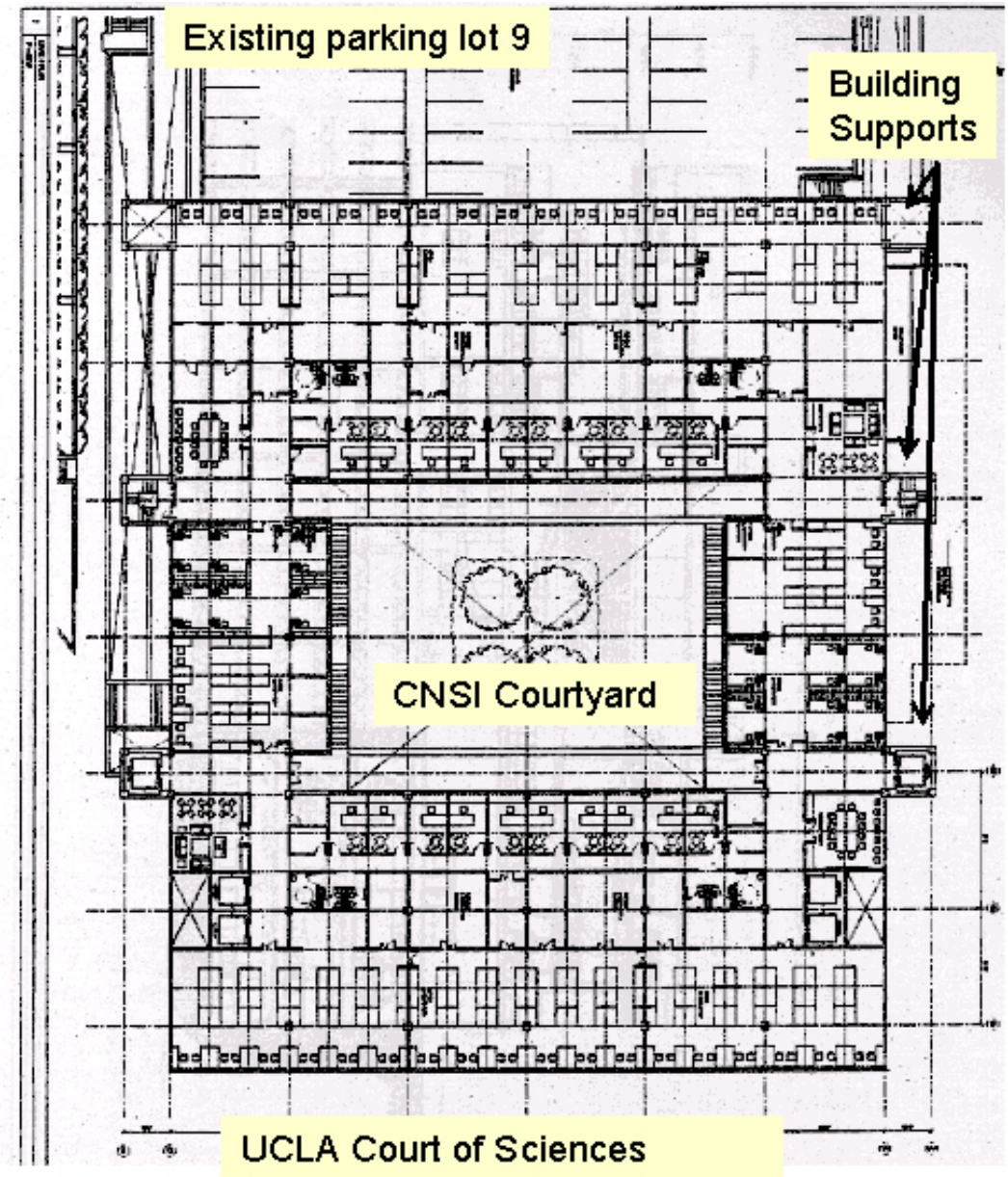
IV.A. University of California at Los Angeles CNSI

We have been working with Raphael Vinoly Associates (RVA) over the past 6 months to design the CNSI main building, and we are nearing a decision on exactly what it is we are going to build. Our initial plans were to build one building on the Court of Sciences (CoS) that would house the main UCLA effort of CNSI. A second component of CNSI would be housed as two floors within an Engineering I replacement building. This decision to split the institute was made for a number of reasons – one of which was the difficulty associated with putting a large building on the geographically-challenged CoS site. However RVA has come up with a remarkably clever solution to this problem, and so we are now proceeding with a program to house the CNSI at UCLA into a single building. This is obviously much better for CNSI as an entity, and is amplified by the actual design itself, which should give us a beautiful building for accomplishing our scientific mission. RVA has actually come up with two possible designs. Only one design will be presented here, but this is the design that we are working most strongly toward getting within budget. A final decision on which design will be built should be done within a month, and hopefully we will be on-track to begin site construction by June, 2002.



UCLA CNSI on the Court of Sciences, Side View

Above we show a side view of RVA's design for the UCLA CNSI building. This version, which is not final, but is a 3d revision of an initial concept, has three floors of basement laboratories that will be utilized for vibration-sensitive experimentation, such as electron microscopy, device fabrication, and low-noise physics-type experiments. RVA has then proposed that the top 3 floors (one is a floor designed to facilities support, with only a office, not lab, space) extend out over an existing parking structure (lot #9). The plan of those top floors is shown on the next page.



UCLA CNSI Building, Top View

This top view illustrates how the institutional concept is realized through a large floor plate that has inter-floor connectivity (a walkway connecting the two top floors) as well as direct visual access from any one lab into any other. This concept maintains the openness that is critical for an institute, but also has a remarkably high efficiency use of these top laboratory floors.

The design solves many problems: 1. It is consistent with long-range campus planning. 2. It solves the site problem of the large parking lot by rising above it. The parking lot structure stays, and the building site is simultaneously expanded to accommodate a larger building. 3. The design of the building is reflective of a true institute. This was a critical consideration, as the CNSI will house scientists from the biomedical, physical, and engineering disciplines, and an open environment that invites cross-disciplinary interactions is a must.

IV.B. Santa Barbara CNSI: UCSB has contracted with *Venturi, Scott-Brown* as the design architects, and *Altoon & Porter* as the executive architects. After extensive meetings during summer 2001, the programming phase of the building is nearly complete, and we expect to present the project to the Regents at the November meeting. Together with the Institute for Theoretical Physics (ITP), the CNSI Building will provide the first vista for those entering from the eastern side of the campus, and will also provide the entryway to the community of science and engineering buildings that will be clustered at that part of campus. The CNSI building will be adjacent to the Engineering Science buildings, the ITP, the Bren School for Environmental studies, the Materials Research Laboratory, and the Physics and Chemistry buildings. The critical mass of services and development of that side of campus will help to create a new, truly integrated community of learning and research.

As shown in the multilevel schematic above, the building will serve as the nucleation point for a community of researchers. Shared facilities will ensure widely available capabilities for nanostructure imaging and characterization. Digital media arts, visualization, and high performance computation will be distributed in the building. Flexible modular laboratories and extensive visitor offices will encourage broad participation between CNSI and the academic and industrial research community. A unique Integrated Molecular Systems Laboratory will bring together biological, chemical and semiconductor nanofabrication techniques in the creation of novel Nanosystems.

V. The Status of Federal Funding at CNSI

The CNSI is founded on developing the fundamental science and technologies of the nano-world, with applications to both information technologies and to molecular medicine. In § III we presented evidence of how we are beginning to take these emerging technologies to the market place. However, because of our long-term scientific goals, the CNSI is also heavily reliant on federal agency (NIH, NSF, DOE, DoD, etc.) support, and as of 10/20/01, we are well-ahead of our projected goals toward achieving and maintaining such support. Some of our major funding achievements are listed on these two pages. A number of smaller new grants in the nanosystems area have also been funded, and those add a few additional $M's to the numbers in these tables.

V.A. CNSI Large Federal Grants To-Date (UCLA)

Lead Faculty	Title	Agency	Start Date	End Date	Total Award
David Eisenberg	Structural Organization and Proteomics of TB	NIH	9/30/00	9/28/05	$4,915,530
Harvey Herschman & Mike Phelps	The UCLA Center for In Vivo Imaging in Cancer Biology	NIH/NCI	4/1/2000	3/31/2005	$9,225,900
Sam Gambhir & Mike Phelps	Mammalian Systems Biology	Ahmanson Fdtn.	10/2001		$2,000,000
Mike Phelps	Molecular Probes of Integrative Mammalian Biology	DOE	4/2001	3/2004	$6,000,000
Phoebe Stewart	Liq. He-cooled Cryo-Electron Microscopy	Ahmanson Fdtn.	10/2001		$500,000
Chih Ming Ho	Center for Chips with Heterogeneously Integrated Photonics	DARPA	10/1/2000	3/1/2003	$14,000,000
Stanley F. Nelson	Gene expression based classification of glial tumors	NIH/NCI	8/1/2000	1/31/2005	$3,240,000
James R. Heath	Defect Tolerant Molecular Electonics for Computing and Memory Applications	DARPA	7/1/2001	7/1/2005	$12,000,000
Eli Yablonovitch	Demonstration of a Spin-Coherent Photon Transmitter/Receiver System	U.S. Army	5/1/2000	11/30/2004	$5,000,000
Ken Lange	IGERT: Integrated Bioinformatics Training at UCLA	NSF	7/1/2000	6/30/2003	$2,700,000
Fred Wudl	IGERT: Materials Science	NSF	Fall/2001		$2,500,000
CNSI	Bio-NEMS Lab for Bio-signature Analysis	Intel	Fall 2001		$400,000

Total Awarded **$62,081,430**

Proposed (UCLA):

Lead Faculty	Title	Agency	Start Date	End Date	Total Award
Chih-Ming Ho	NASA Nano-Univ. Research Eng. & Tech. Institute	NASA	N/A	N/A	35,000,000
Ming Wu	MRSEC	NSF	N/A	N/A	30,000,000
Leena Peltonen	Genetic Center – Genomic Research	NIH	N/A	N/A	15,700,000

Total Proposed **$80,700,000**

V.B. CNSI Large Federal Grants To-Date (UCSB)

Lead Faculty	Title	Agency	Start Date	End Date	Total Award
David Awschalom	Optical manipulation of quantum information in semiconductor nanostructures	DARPA	4/26/2001	4/25/2006	$7,500,000
David Awschalom	Spin Interactions and Spin Dynamics in Electronic Nanostructures	ARO-MURI (Cornell)	5/1/2001	4/3/2006	$700,000
Noel MacDonald	Mechanical integration for networked telecommunications	DARPA	7/1/2001	6/30/2005	$2,670,000
Matthew Tirrell	Creating Nanoenvironments by control of self-assembly lipids	NSF	6/1/2001	5/31/2006	$1,600,000
Horia Metiu	Catalysis by Nanostructures: Methane, ethylene oxide, and propylene oxide synthesis on Ag, Cu, or Au Nanoclusters	AFOSR/ DURINT	6/1/2001	5/31/2006	4,293,452 +$400,000 (equipment)
Dan Blumenthal	Ultra-High-Capacity Optical Communications and Networking: NanoPhotonic Integration of Ultra-fast WDM Optical Communications Systems	NSF	10/1/2001	9/30/2004	$510,000

Total Awarded **$17,673,452**

Proposed (UCSB)

Lead Faculty	Title	Agency	Start Date	End Date	Total Award
Mark Rodwell	Institute for Nanometer Technologies for Electronic Computation & Measurement	NASA-URETI	4/19/2002	4/18/2007	$15,000,000
David Awschalom	Manipulation and Contrl of Nanoscale Magnetism for Multi-functional Information Processing	AFOSR	10/1/2001	9/30/2004	$450,000
Alison Butler	Enhancement of Bioengineering at UC Santa Barbara	Whitaker Foundation	1/1/2002	12/3120/04	$1,000,000
Evelyn Hu	REU Site Internships in Nanosystems Engineering and Technology (INSET)	NSF	1/1/2002	12/31/2004	$350,000
Mark Sherwin	Terahertz Modulation of Semiconductor Optical Amplifiers	NSF	1/1/2002	12/31/2004	$429,455
Dan Blumenthal	Tunable High-Q Optical Filtering for Advanced Optical Analog Signal Processing	DARPA	10/1/2001	9/30/2005	$3,467,299

Total Proposed **$20,696,754**

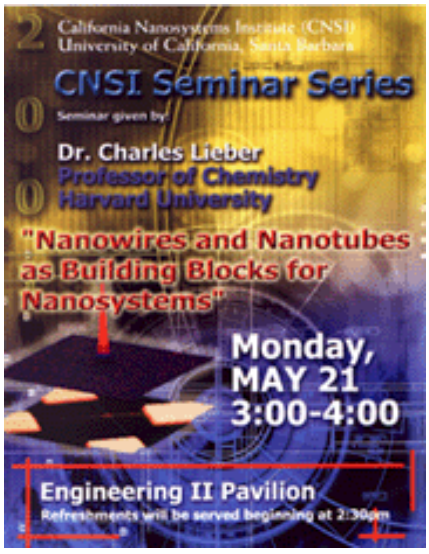
V.C. CNSI Corporate Connections While many of our discussions with our corporate partners have been slowed because of the current economic climate, several of our corporate contracts have advanced forward considerably. We have received an initial installment of $400,000 from Hewlett Packard, with $100,000 going toward a CNSI endowment, and $300,000 going toward directed projects. We are working with HP employees with respect to in-kind computational equipment. Intel has given $400,000 for a Bio-NEMS lab/teaching course, and has also given significant in-kind donations (worth a few $M) of fabrication equipment. We had a workshop with Digital Instruments / Veeco at UCSB, which will shortly be followed up by a second one at UCLA, and will culminate in the donation of at least $1M worth of scanning probe equipment for directed research projects. We have finalizing some agreements (Cree ($2.5M), Stanley Electric ($2.3M)) and we are working toward others (Applied Materials ($4M), GE ($2.5M)) and approximately 20 other companies, including some DuPont and IBM, both of whom are currently considering CNSI proposals totaling more than $1M. We are on-track to substantially exceed our initially stated goals of ~$31M corporate support, with more than 30% of that in hand already.

VI. Education and Outreach

The breadth of scope of disciplines that underlie nanoscience and nanotechnology perhaps surpasses any other field in recent times. Given such diversity, and the range of topics to be covered, crafting the appropriate educational curriculum provides a greater-than-usual challenge. CNSI has begun its education program this fall by offering a *Seminar on Software Systems for Nanotechnology*, taught by Professors Klaus Schauser and Peter Capello of the Computer Science department in UCSB. In the true spirit of the NanoSystems Institute, this seminar focuses on topics in the emerging software systems for Nanotechnology. Further details on the topics treated in the course may be found at www.cs.ucsb.edu/~schauser/sources/cs595i-f01. As we progress over the next year, we plan to build up to as many as 3 CNSI courses taught in any given quarter, and we are currently working toward having those courses simulcast at both campuses.

To be able to craft a Nanoscience curriculum that encompasses materials science, biology, physics chemistry, engineering and computer science, CNSI faculty must themselves broaden their scope of understanding and play the role of students. For that reason, we have instituted weekly Brown Bag seminars, informal talks of a tutorial nature, given by participating CNSI faculty, and we have done this at both campuses. The topics have covered protein folding, algorithms for bioinformatics, semiconductor quantum dots, and iron-loving bacteria, biomolecular motors, cryo-EM imaging of biosystems, and quantum computation. We expect that understanding gained through these faculty tutorials will set the foundation for the formulation of a truly cross-disciplinary curriculum in Nanoscience. We have also had a regular series of faculty/student/postdoc workshops. These have allowed us to get together and discuss strategies for obtaining center grants, IGERTs, and other cross-disciplinary proposals. It has also given the students and postdocs an opportunity to present their science to a scientifically trained audience that is not from their field.

CNSI is establishing a number of undergraduate internships in NanoSystems research areas, and has submitted a proposal to the National Science Foundation to establish a Research Experience for Undergraduates (REU) site in Nanosystems Science and Engineering. We have obtained an IGERT, which is a large ($2.5M) NSF grant that is exactly directed at training graduate students in the crossdisciplinary fields of nanosystems. We have also initiated discussions with the Parsons Foundation to establish a substantial number of graduate fellowships in Nanosystems Research. Within the next year, we hope to formally establish the CNSI graduate student recruiting program.



CNSI has established a partnership with the new Ventura County Discovery Center (VCDC), a new Science discovery center to be built in Thousand Oaks, strategically situated on the '101 Corridor' that connects the two campuses of CNSI. CNSI and VCDC sponsored a collaborative outreach to local industry, in an event held on July 18, 2001, hosted by Rockwell Science Center. This event represented the formal

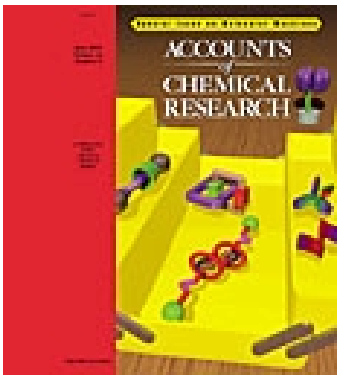
establishment of ties between CNSI and VCDC, and was attended by approximately 20 corporations that live on the 101 Corridor.

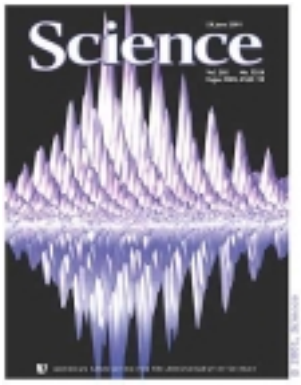
Finally, CNSI has also established an external seminar series, to complement our internal Brown Bag Seminars. Intended to bring in outstanding researchers in the nanosciences from all over the world, the CNSI seminar series has already hosted distinguished speakers such as Professor Harold Craighead and Charles Lieber.

VI. Education and Outreach

VII. CNSI in the News

CNSI researchers have won accolades and acclaim through their scholarly publications, recognition by their peers and reporting in the media. The same week that Governor Davis was awarding the Institute to the CNSI, Santa Barbara Professor *Alan Heeger* was in Stockholm receiving the *Nobel Prize in Chemistry* for his fundamental work on the discovery and properties of conducting polymers, and Professor *Herb Kroemer* was receiving the *Nobel Prize in Physics* for his seminal work in semiconductor microstructures. Earlier this year, Professors Heeger, *Art Gossard*, and *Bob Goldberg* (UCLA) were all inducted into the *National Academies of Sciences*. Professor Gossard was also the recipient of the 2001 *McGroddy Prize for New Materials*, given by the American Physical Society. *Shuji Nakamura* (pictured above left) won the *Honda Prize*, a recognition of a distinguished contribution to "eco-technology"-- the harmonizing of human activities and the natural environment. The Honda Foundation predicted that Professor Nakamura's energy-efficient lighting sources "will consume very little power, are environment friendly, and will be one of the most important energy saving devices." Professor Nakamura has also been named the *Cree Professor of Solid State Lighting*. *Atac Imamoglu*, noted for his recent work in optical approaches to Quantum Computation, was the recent recipient of the *Wolfgang Paul award*. *James Heath*, along with his HP collaborators, received the *2000 Feynman Prize* for his work in the area of molecular electronics, and this past spring he was the first chemist to receive the *Raymond and Beverly Sackler Prize in the Physical Sciences*. *Mike Phelps* received the *2001 Sloan Kettering Prize for Cancer Research* in recognition of his contributions to that field via his invention and development of PET molecular imaging technologies. *Jim Gimzewski* received the *2001 Duddell Medal*, and was inducted into the *Royal Academy of Engineering*, and his work in molecular nanotechnology was cited in both instances. *Shimon Weiss* received the *2001 Michael and Kate Barany Biophysical Society*

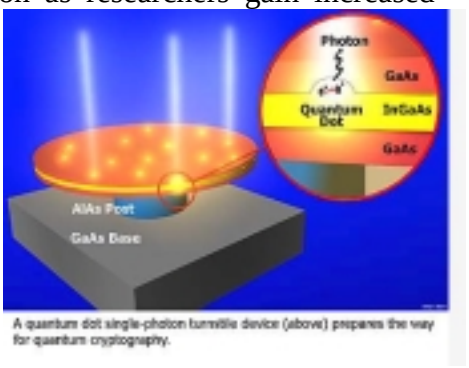




Art by Chester Gould, v
Two-way wristwatch radios li
Dick Tracy's may be closer to
thanks to 'spint
Science
says physicist

Award, and *Bill Gelbart* received the *2001 Hildebrand Award* from the American Chemical Society.

Research in *Spintronics* has gained increasing attention as researchers gain increased understanding and control over these natural 'nanomagnets'. Widespread reporting of CNSI results in this field includes publication in *Science* and *Nature*, as well as *USA Today* and the *N.Y. Times*. Light at the nanoscale shows remarkable properties, which can lead to an entire class of high-efficiency optical devices, and can achieve for *photonics* the integration and economy that miniaturization brought to electronics. CNSI researchers engineered a *single photon turnstile* by embedding quantum dots into a nanostructure.



A quantum dot single-photon turnstile device (above) prepares the way for quantum cryptography.

Molecular electronics was also in the news. In particular, a joint *UCLA/HP patent* on molecular memory was cited as one of the 5 patents that will transform business and technology by the *MIT Technology Review*.

UCLA's *Crump Institute*, which will move wholly into the CNSI and lead the molecular imaging component of CNSI, was featured heavily this past year as they reported the breakthrough of being able to image gene expression in living systems. *Sam Gambhir* (recently named as the Director of the Crump), *Harvey Herschman*, and *Mike Phelps* were all highlighted in a *Nature* news article in July, and the same group was discussed in *Newsweek* in June in the context of how molecular imaging is leading to new insights on Alzheimer's disease.

In other news, the CNSI was written about in the August 13 *LA Times* ("Science, State, Business Bond in a NanoSystem," by James Flanigan), among other places, and *Jim Heath* was named *Technologist of the Year 2001* by *the LA Business Journal.* *Jim Gimzewski's* letter on the preparation of single-crystals of single-walled carbon nanotubes received significant world-wide press, and has been nominated for the article of the year in *Science*.

Some of the figures on these pages are collected from just a few of the journal covers that were captured by CNSI scientists this past year, including *Phoebe Stewart's* beautiful work on understanding the form, structure, and function of adenoviruses and their receptors, *Fraser Stoddart's* molecular mechanical machinery, and *David Awschalom's* spintronics.

Appendix. Curriculum Vitae and Research Interests of Newly Hired Senior CNSI Faculty

We are particularly proud of our newly hired senior faculty members. Our ability to attract these world-class scientists is evidence of the excitement of CNSI, as well as the potential that CNSI has to transform technology and fuel California's economy. Here we present a more detailed picture of three of these scientists – each of whom are already playing a leading role within CNSI to help establish and push forward Governor Davis' and our joint vision for the Institute.

James Gimzewski

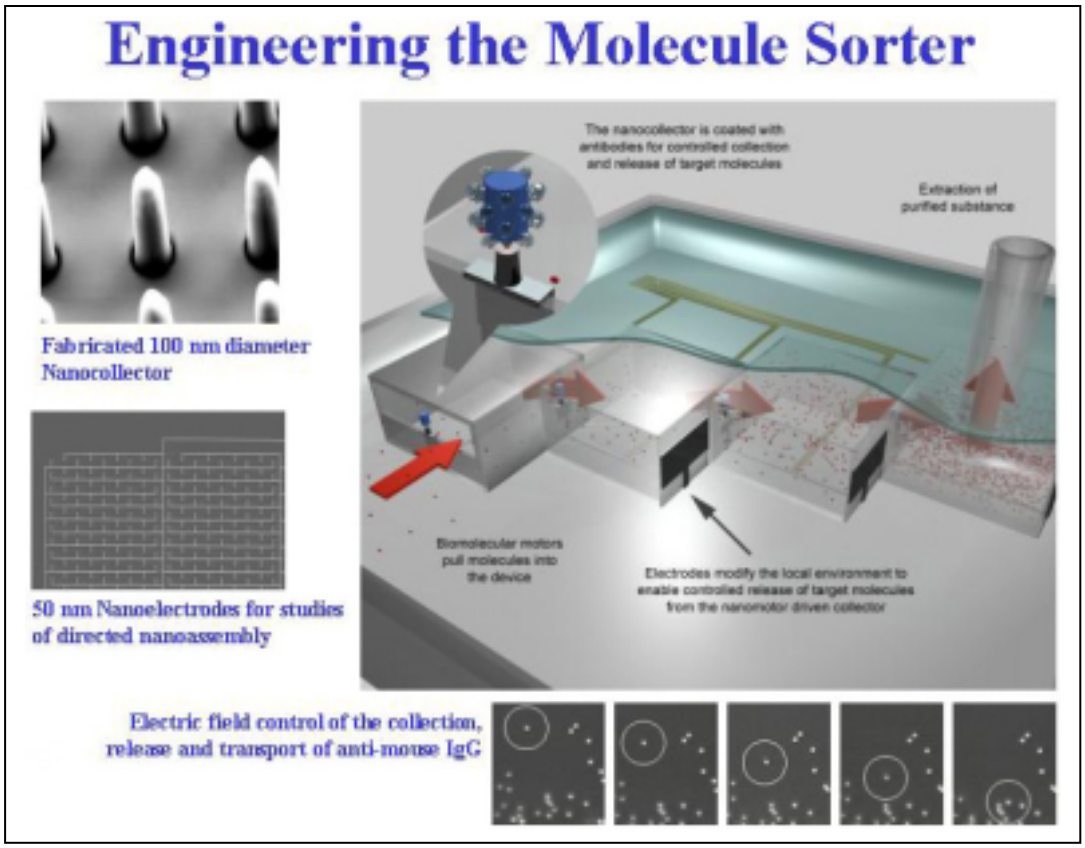
is a Professor in the Dept. of Chemistry and Biochemistry at UCLA. Until February 2001, he was a group leader at the IBM's Zurich Labs, where he was involved in Nanoscale science since 1983. He pioneered research on electrical contacts with single atoms and molecules, light emission and molecular imaging using STM. His accomplishments include the first STM-manipulation of molecules at room temperature, the realization of molecular abacus using bucky balls, the discovery of single molecule rotors and the development of new nanomechanical sensors based on nanotechnology, which explore the ultimate limits of sensitivity and measurement. Recently, he discovered a new method to make the world's most perfect carbon nanotube crystals. His current interests within CNSI are in the Nanoarchitectonics of molecular systems and molecular and biomolecular machines, in particular those with quantum mechanical possibilities for information processing.

Jim received the 1997 Feynman Prize in Nanotechnology, the 1997 The Discover Award for Emerging Fields, the 1998 'Wired 25' Award from Wired magazine and the Institute of Physics "Duddell" 2001 prize and medal for his work in Nanoscale science. He holds two IBM "Outstanding Innovation Awards", and is a Fellow of the Institute of Physics and a Chartered Physicist. Jim was elected to the Royal Academy of Engineering, and he has joined the scientific boards of Carbon Nanotechnologies, Inc. and Veeco-DI Instruments (A CNSI member company). With over 168 papers published, Professor Gimzewski's research continues to appear in journals, such as *Science*, *Chemical Engineering* and *Nature*. He also appeared in many popular magazines such as *Discover*, *The New York Times*, *Wall Street Journal* and *Scientific American*.

Jim received his Ph.D. in Physical Chemistry, University of Strathclyde, Glasgow, Scotland, UK.

Carlo Montemagno

Dr. Carlo Montemagno is currently the Carol and Roy Doumani Professor of Biomedical Engineering, the Chairman of Academic Affairs for UCLA's Biomedical Engineering IDP and a Professor of Mechanical and Aerospace Engineering. After receiving his B.S. degree from Cornell in biological engineering, Dr. Montemagno spent eight years in the U.S. Navy as a Civil Engineering Corp officer. During this time he earned a M.S. in Petroleum and Natural Gas Engineering at Pennsylvania State University, and became involved with the management of Naval Petroleum Reserves in California, ultimately rising to the post of Technical Assistant Director. In 1988, Dr. Montemagno joined Argonne National Laboratory, were he served as group leader for both the Advanced Environmental Studies and the Environmental Physics research groups. While at Argonne National Laboratory Dr. Montemagno earned his doctorate at the University of Notre Dame in Civil Engineering in 1995. He joined the Biological and Environmental Engineering faculty of Cornell University in 1995 where he stayed until joining UCLA in 2001. Dr. Montemagno's research is focused on the application of nanotechnology to biological systems. His current projects are directed at the development of biomolecular motor powered nanoelectromechanical devices, muscle powered MEMs devices, micro-robotics and the engineering of on-chip detectors for pathogens.



Shimon Weiss Shimon is a Professor in the Department of Chemistry and Biochemistry and in the Department of Physiology at the UCLA. He was previously a staff scientist at Lawrence Berkeley Labs, where he was involved in nanoscale science and single molecule spectroscopy since 1991. He pioneered research on coupling ultrafast spectroscopies with scanning probes microscopies. More recently he has led the newly established field of single molecule spectroscopy and its application to biology. He developed new microscopes to study single molecules at physiological conditions. His team was the first to detect fluorescence resonance energy transfer between a single donor and a single acceptor molecule, a technique that leads directly to the measurement of dynamic structure. Shimon's most recent invention, organo-luminescent semiconductor nanocrystal, or quantum-dots (QDs) used as biological probes, is revolutionizing the use of fluorescence in modern biotechnology and cellular imaging. His invention introduces a new technology that overcomes almost all of the fundamental drawbacks of conventional organic dye molecules affording multiplexing of many signals, and led to the founding of Quantum Dot Corp.

Shimon received the 1993 Outstanding Performance Director Award, Lawrence Berkeley National Laboratory, elected as a Fellow of the Optical Society of America (1999) and received the 2001 Michael and Kate Barany Biophysical Society Award.

With over 60 papers published, Shimon's research continues to appear in top journals, such as *Science*, *Nature and the Proceedings of the National Academy of Sciences* . He also appeared in and interviewed for popular newspapers such as *The New York Times* and the *San Francisco Chronicle*. He holds 7 patents in the areas of nano- and bio-technology.