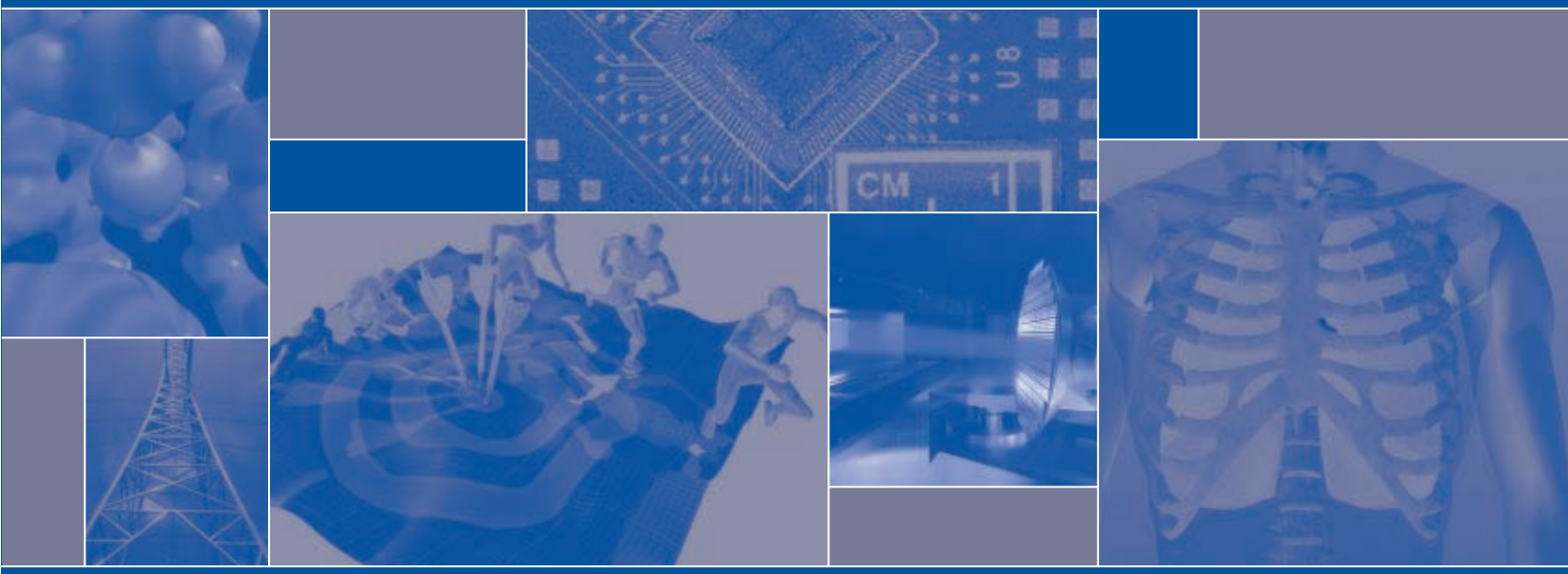
► Wyndham Baltimore Inner Harbor
101 West Fayette Street
Baltimore, Maryland 21201
410–752–1100

▼ ATP National Meeting June 3–5, 2001

ADVANCED TECHNOLOGY PROGRAM



► Technologies at the Crossroads: Frontiers of the Future

NIST
National Institute of Standards and Technology
Technology Administration, U.S. Department of Commerce
Gaithersburg, Maryland 20899-4701

NIST CENTENNIAL 1901-2001

2001 ATP National Meeting
June 3-5, 2001

Technologies at the Crossroads: Frontiers of the Future

At-a-Glance Meeting Guide

Note: Information was accurate at date of print. Visit our website for complete and updated information after the meeting.

Welcome to Our National Meeting

Advanced Technology Program

***Marc Stanley*,** Acting Director

Mr. Marc G. Stanley is currently the Acting Director of the Advanced Technology (ATP), at the National Institute of Standards and Technology (NIST). Mr. Stanley served as the Associate Director for the Program from 1993 to 2001.

Before coming to NIST, Mr. Stanley was the Associate Deputy Secretary of the U.S. Department of Commerce by Presidential appointment. He has served as a senior policy advisor to NIST Directors, as a consultant to the Department Commerce's Technology Administration, and as Assistant Secretary for Congressional and Intergovernmental Affairs at the Department of Commerce.

Mr. Stanley earned a B.A. from George Washington University and a Bachelor of Law degree from the University of Baltimore.

***Linda Beth Schilling*,** Acting Deputy Director

B.S., Chemical Engineering, University of California-Santa Barbara

Linda Beth Schilling is the Acting Deputy Director of the Advanced Technology Program (ATP).

Prior to becoming Acting Deputy Director, Ms. Schilling was Director, Chemistry and Life Sciences Office, ATP. Ms. Schilling is a chemical engineer, whose achievements as an ATP program manager included developing with industry an ATP Focused Program in Catalysis and Biocatalysis Technologies, which was launched in February 1995.

Prior to joining the ATP, Ms. Schilling was a Program Manager in the Office of Industrial Technologies (OIT) of the U.S. Department of Energy (DOE), Office of Energy Efficiency and Renewable Energy (EE). Ms. Schilling also worked for over eight years with Shell Offshore Inc. in New Orleans, LA as a Senior Reservoir Engineer.

Letter to our attendees . . .

June 3, 2001

Dear Meeting Attendee:

Welcome to the Advanced Technology Program's (ATP) National Meeting, "***Technologies at the Crossroads: Frontiers of the Future***." We're glad you're here.

ATP's role is unique in the federal government–it partners with industry on high-risk research to bridge the gap between the research lab and the marketplace. ATP provides a mechanism for industry to extend its technological reach and improve the quality of life for everyone. We also believe one of our key responsibilities is to act as a facilitator and encourage companies, universities, states, and research organizations to work jointly and creatively to produce new, synergistic technologies that will benefit the nation.

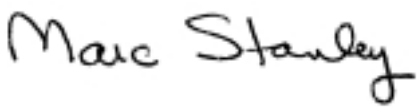
We believe our National Meeting's program reflects the forward thinking needed by industry and others for the U.S. to maintain its competitive edge bringing to the marketplace the technologies of the future. The "Frontier Sessions" are designed to stimulate and encourage you to proceed in research leading to path-breaking, innovative technologies that will make a difference in people's lives. We are very fortunate to have session leaders who are world experts in their various technology fields. Our program also includes keynote business and futuristic speakers that will provide insights into the "Frontiers of the Future."

The NIST Laboratories are also represented and our scientists will present, through the poster sessions, their new and fascinating research in the areas of measurement and standards. And, we are most fortunate to have many of our ATP awardees presenting in the showcase their technologies that will affect our lives in a positive way. We hope that you'll enjoy all of these special activities.

One last thought–we want to hear from you too. Many of our sessions are designed for interactive dialogue, and you'll also have an opportunity to network with ATP program managers, NIST scientists, as well as some of our guest speakers. We encourage you to participate.

Again, welcome to the National Meeting.

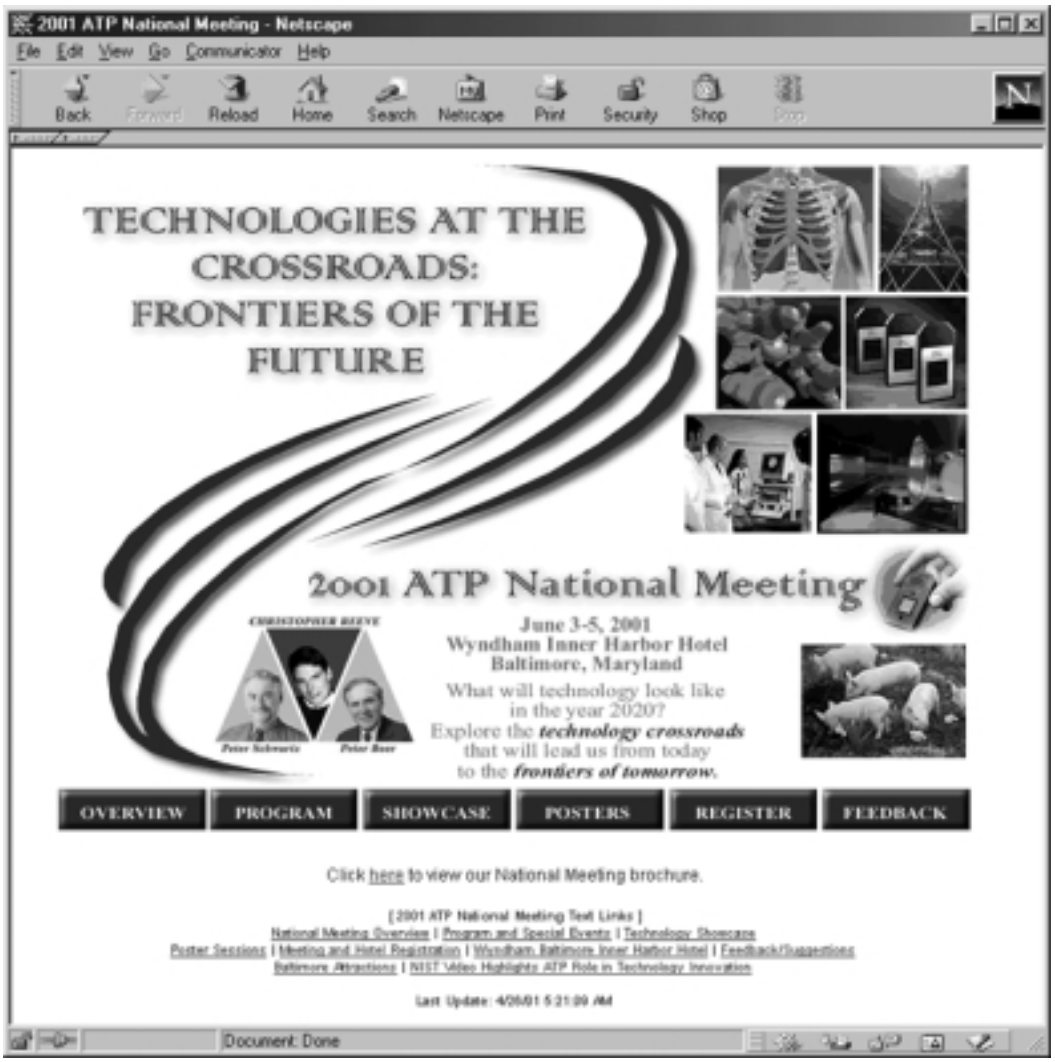
Sincerely,



Marc G. Stanley
Acting Director
Advanced Technology

National Meeting Website

For current and post meeting information, visit our website at:
www.atp.nist.gov/nationalmeeting



Program Guide

ATP National Meeting
June 3–5, 2001

Technologies at the Crossroads: Frontiers of the Future

Sunday, June 3

5:00pm–7:00pm	**On-Site Registration**	Promenade
	Hospitality Session	Apex Technology Arena
	Technology Showcase	Liberty Ballroom

Monday, June 4

8:00am	**Registration/Continental Breakfast**	Apex Technology Arena
9:00am	**Welcome/ Opening Remarks**	International A-E
9:30am	**"Ten Ideas that Have Already Decided The Future"** **Peter Schwartz–** Cofounder & Chairman Global Business Network	International A-E
10:15am	**Coffee Break**	Apex Technology Arena
11:00am	**Keynote Speaker**	International A-E
12:00 noon	**Christopher Reeve** Actor and Biomedical Research Advocate	International A-E
1:00pm	**Lunch**	Apex Technology Arena
2:00pm	**Frontier Forums # 1"Manufacturing With 2020 Intelligence"** **Roger W. Cope, Charles L. Bailey**	International D-E
	# 2 "Virtual Voyage Through Medicine" **Dr. Michael J. Ackerman, Dr. Richard M. Satava, Dr. Yulun Wang**	International A-C
3:30pm	**Coffee Break**	Apex Technology Arena
4:00pm	**Frontier Forums # 3 "The Pathway to Virtual Research Communities,"** **Dr. H. Mario Geysen, Dr. F. Raymond Salemme, Dr. Ian Maxwell**	International D-E
	# 4 "Replication of Nanodevices" **Dr. Ralph Merkle, Dr. George Skidmore, Dr. J. Storrs Hall**	International A-C
5:30pm	**Break**	
6:00pm	**Reception/Cash Bar**	Apex Technology Arena

Monday Special Activities

1:00pm– 6:00pm	**Technology Showcase**	Liberty Ballroom
1:00pm–7:00pm	**Poster Session**	Carroll, E. Poe, Mencken, Pratt-A, Pratt-B, Hopkins, Douglas and Peale rooms
1:00–5:00pm	**One on One Networking**	Carroll, E. Poe, Mencken, Pratt-A, Pratt-B, Hopkins, Douglas and Peale rooms
1:00–5:00pm	**Electronic Submission Exhibit**	Apex Technology Arena (Lower Lobby)

Tuesday, June 5

7:00am	**Continental Breakfast**	Apex Technology Arena
8:00am	**"Building Value Roadmaps for Frontier Technologies with Real Options"** **Dr. F. Peter Boer**	International A-E
8:45am	**Venture Capital Forum** **Presentation: Linda Powers** Managing Director, Toucan Capital **Panel:** Wei-wu He, William Snider, Michael Sheridan, Ginger Ehn Lew, Mike Joseph, Dr. Katya Flakshahi	International A-E
10:30am	**Coffee Break**	Apex Technology Arena
11:00am	**Frontier Forums # 5 "Connectelligence: The Convergence of People, Machines and Their Environment"** **Brock Hinzman, Dr. Charles Shanley**	International D-E
	# 6 "Diagnostic Imaging in the New Millennium" **Dan Silverman, MD, PhD., Dr. Nancy Allbritton**	International A-C
12:30pm	**Lunch**	Apex Technology Arena
1:30pm	**Frontier Forums # 7 "The Challenge of Molecular Electronics: Focusing Nanotechnology on the Future Computer"** **Christopher B. Murray, Dr. Paul Weiss**	International D-E
	# 8 "Regenerative Medicine as Alternative Therapy" **Dr. William A. Haseltine, Dr. Joseph Gold**	International A-C
3:00pm	**Meeting Adjournment**	

Tuesday Special Activities

9:00am–4:00pm	**Technology Showcase**	Liberty Ballroom
9:00am–4:00pm	**Poster Session**	Carroll, E. Poe, Mencken, Pratt-A, Pratt-B, Hopkins, Douglas and Pine rooms
9:00-4:00pm	**One on One Networking**	Carroll, E. Poe, Mencken, Pratt-A, Pratt-B, Hopkins, Douglas and Peale rooms
9:00–3:00pm	**Electronic Submission Exhibit**	Apex Technology Arena (Lower Lobby)

Keynote Speakers

KEYNOTE SPEAKERS

MONDAY, JUNE 4
9:00 A.M. Peter Schwartz, Futurist Speaker

Peter Schwartz
CEO of Global Business Network and
author of The Long Boom: The Coming Age of Prosperity

KEY TOPICS

- The Art of Scenario Planning
- Overcoming Resistance
- Ten Ideas That Have Already Decided the Future

Peter Schwartz is an internationally renowed futurist and business strategist. A specialist in scenario planning, he works with corporations and institutions to create alternative perspectives of the future and develop robust strategies for a changing and uncertain world. His current research and scenario work encompasses energy resources and the environment, technology, financial services, telecommunications, media and entertainment, aerospace, national security, and the Asia-Pacific region.

Peter is co-founder and chairman of Global Business Network, a unique membership organization and world-wide network of strategists, business executives, scientists, and artists based in Emeryville, California. Established in 1988, GBN specializes in corporate scenario planning and research on the future of the business environment.

From 1982 to 1986, Peter headed scenario planning for the Royal Dutch/Shell Group of Companies in London. His team conducted comprehensive analyses of the global business and political environment and worked with senior management to create successful strategies.

Before joining Royal Dutch/Shell, Peter directed the Strategic Environment Center at SRI International. The Center researched the business milieu, lifestyles, and consumer values, and conducted scenario planning for corporate and government clients.

Peter's two most recent books are ***The Long Boom*** (Basic Books, 1999), co-authored with Joel Hyatt and Peter Leyden, and ***When Good Companies Do Bad Things*** (John Wiley & Sons, 1999), co-authored with Blair Gibb. He is also the author of ***The Art of the Long View*** (Doubleday Currency, 1991; audio tape, 1995; paperback, 1996). This seminal publication on scenario planning has been translated into multiple languages and was selected as the number-one business book of 1992 by *Industry Week*. Peter also co-authored ***Seven Tomorrows: Toward a Voluntary History*** with James Ogilvy and Paul Hawken (Bantam Books, 1982), and ***The Emergent Paradigm: Changing Patterns of Thought and Belief*** with James Ogilvy (SRI, 1979). He has published and lectured widely and served as a script consultant on the films ***Deep Impact, Ware Gams, and Sneakers***.

Peter received a BS in aeronautical engineering and astronautics from Rensselaer Polytechnic Institute.

CREDENTIALS

- Chairman, Global Business Network
- Chief scenario planner for Royal Dutch/Shell Group, 1982-1986
- Director, Strategic Environment Center at Stanford Research Institute, 1977-1982
- Co-author, ***The Long Boom***: ***A Vision for the Coming Age of Prosperity*** (with Peter Leyden and Joel Hyatt)
- Author, ***The Art of the Long View*** (Doubleday Currency, 1991)

MONDAY, JUNE 4
12:00 P.M. CHRISTOPHER REEVE, Keynote Speaker

Christopher Reeve
Actor and Biomedical Research Advocate

Actor, director and activist are just some of the words used to describe Christopher Reeve. From his first appearance at the Williamstown Theatre Festival at the age of 15, Reeve established a reputation as one of the country's leading actors. However, since his injury in an equestrian competition in May 1995, Reeve has not only put a human face on spinal cord injury but he has motivated neuroscientists around the world to conquer the most complex diseases of the brain and central nervous system.

After graduating from Cornell University, Reeve pursued his dream of acting, studying at Juilliard under the legendary John Houseman. He made his Broadway debut opposite Katharine Hepburn in A Matter of Gravity and then went on to distinguish himself in a variety of stage, screen and television roles with a passion that continues today. Film credits include: "Superman" in 1978 and its subsequent sequels, "Deathtrap," "Somewhere in Time," "The Bostonians," "Street Smart," "Speechless," "Noises Off," "Above Suspicion" and the Oscar nominated "The Remains of the Day." Stage credits include: The Marriage of Figaro. Fifth of July, My Life, Summer and Smoke Love Letters and The Aspern Papers.

Reeve made his directorial debut with "In the Gloaming" on HBO in April 1997. The film was met with rave reviews, was nominated for 5 Emmys and won six Cable Ace Awards, including Best Dramatic Special and Best Director. Reeve's autobiography, Still Me was published by Random House in April 1998 and spent 11 weeks on the New York Times Bestseller List. His recording of Still Me earned Reeve a Grammy for Best Spoken Word in February 1999. In his first major role since becoming paralyzed, Reeve starred in an updated version of the classic Hitchcock thriller "Rear Window," for which he was nominated for a Golden Globe Award and won the Screen Actors Guild Award for Best Actor in a Television Movie or Miniseries. He also served as Executive Producer of the film.

Reeve has become a powerful advocate for the profound impact medical research can have on all of our lives. His sharp intelligence, wit and curiosity have enabled him to become a spokesperson for all who are affected by diseases of the brain and central nervous system.

Reeve joined the Board of Directors of the American Paralysis Association (APA) in late 1995, and in May of the following year he became its Chairman. In January 1996 Reeve and his wife Dana started the Christopher Reeve Foundation, a nonprofit organization dedicated to fighting paralysis caused by spinal cord injuries. On April 14, 1999, Reeve gave hope to the hundreds of thousands affected by spinal cord injury when he announced the merger of the APIA and the CRF into the Christopher Reeve Paralysis Foundation (CRPF). CRPF, a national, nonprofit organization, encourages and supports research to develop effective treatments and a cure for paralysis caused by spinal cord injury and other central nervous system disorders. CRPF also allocates a portion of its resources to grants that improve the quality of life for people with disabilities. Reeve serves as Chairman of the Board of CRPF. Other board appointments include Vice Chairman of the National Organization on Disability and World T.E.A.M. Sports.

In addition to his work on behalf of CRPF, Reeve's recent efforts include:

- Lobbying on behalf of the National Institutes of Health as part of a group called NIHx2 to double the NIH budget in five years. In part because of his work, the NIH was appropriated a 15% increase in funding for fiscal 1999, translating to more than $2 billion, the largest single increase ever;

- Testifying before the Senate Appropriations Subcommittee on Labor, Health and Human Services, Education and Related Agencies in favor of federally funded stem cell research;

- Providing instrumental and crucial support for the passage of the New York State Spinal Cord Injury Research Bill (7287C), landmark legislation that will make available up to $8.5 million annually in funds collected from violations of the state's vehicle and traffic laws to be appropriated among the leading research facilities in New York. Reeve was also involved in lobbying efforts for similar bills in New Jersey, Kentucky, Virginia and California;

- Testifying before the House Appropriations Subcommittee on Labor, Health and Human Services, Education and Related Agencies on behalf of the National Fund for Health Research Act;

- Working with Senators Jeffords and Rockefeller and Congresswoman Eshoo to raise lifetime caps on insurance policies from $1 million to $10 million;

- Serving as a member of the Executive Committee of *Funding First,* an initiative for medical research in honor of Mary Woodard Lasker, begun by former Senator Mark Hatfield;

- Joining with Senator Robert G. Torricelli to introduce legislation to create a national brain and spinal cord injury registry;

- Working with Senator Jeffords to help pass the 1999 Work Incentives Improvement Act (S-331) in the U.S. Senate, which allows people with disabilities to return to work and still receive disability benefits;

- Establishing a line of celebrity neckwear that is carried at over 1,000 JC Penney department stores across the United States. A portion of the proceeds benefits CRPF; and

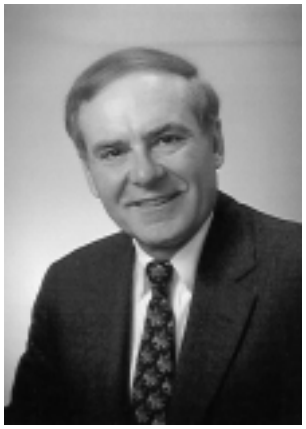
- Continuing to work tirelessly to obtain increased funding from both the public and private sectors to cure Parkinson's, Alzheimer's, MS, ALS, stroke, as well as to repair the damaged spinal cord.

While Reeve raises public awareness about the significance of medical research and the challenges facing those with disabilities, he is also educating families about the importance of having adequate health and disability coverage. In 1997, Reeve joined with HealthExtras, the first company to develop and price health and disability products for direct purchase via the Internet. Reeve serves as company spokesman.

Reeve's community and political involvement pre-dates his spinal cord injury. Over the course of many years, he has served as a national spokesman on behalf of the arts, campaign finance reform and the environment. He served as Co-President of The Creative Coalition from 1992-1994, and was also involved with Save the Children, Amnesty International, National Resources Defense Council, The Environmental Air Force and America's Watch. In 1987, he demonstrated in Santiago, Chile on behalf of 77 actors threatened with execution by the Pinochet regime. For this action, Reeve was given a special Obie Award in 1988 and the annual award from the Walter Briehl Human Rights Foundation.

In addition to these many roles, Reeve is the father of three children and husband to wife Dana. An inspiration to many, Reeve maintains a rigorous speaking schedule, traveling across the country giving motivational talks to numerous groups, organizations and corporations.

TUESDAY, JUNE 5
8:00 A.M. F. Peter Boer, Keynote Speaker



F. Peter Boer
President and CEO, Tiger Scientific, Inc.

Peter Boer is President and CEO of Tiger Scientific, Inc. and teaches Valuation of Technology in the School of Management at Yale University. Before founding Tiger Scientific, he served as Executive Vice President of W.R. Grace & Co. and as its Chief Technical Officer, with responsibilities for R&D, engineering, business development, environment, health, and safety. He also served with The Dow Chemical Company in a variety of R&D and P&L business management positions over a period of 13 years, and with the American Can Company as its Vice President and General Manager for Research & Development.

Dr. Boer is Past-President of the Industrial Research Institute, an organization of over 280 technically-based companies in North America, who perform approximately 85 percent of the industrial R&D in the United States.

He holds an A.B. degree in Physics from Princeton University, and a Ph.D. in Chemical Physics from Harvard University, where he did his research in borane chemistry that contributed to Professor W. N. Lipscomb's 1976 Nobel Prize in Chemistry. Dr. Boer is the author of approximately 80 scientific papers and patents. Dr. Boer is also a member of the National Academy of Engineering.

He serves on the Board of Directors of the NOVA Chemical Corporation of Alberta, ENSCO, Inc. and Rhodes Technologies. He also serves on advisory bodies for Harvard University, Princeton University, Texas A&M University, the National Research Council, and Los Alamos National Laboratory.

Building Value Roadmaps
for
Frontier Technologies
with
Real Options

Discounted cash flow (DCF) methods are the gold standard in financial valuation; unfortunately technologists have learned that DCF typically predicts that risky frontier technologies are not worth pursuing. Interest in Real Options is growing exponentially because it recognizes that management has flexibility in executing plans to which resources are yet to be committed, and value exists that cannot be captured by DCF alone. This value can be huge. R&D managers have sensed this point intuitively for years, but real options theory gives it quantitative standing.

A core insight is that plans--R&D plans or business plans--are really options. The total value of an enterprise is its economic value, which can be correctly valued by DCF, ***plus*** the strategic value of its plans, which can be valued by option theory. The consequences of this insight are radical, because options are valued by different algorithms than DCF. The idea is powerful because it affords a valuation method that applies equally to a traditional old economy company, and risky new startups. It will work whether the company is making money or not. And, it provides a new framework for the perplexing problem of how to value intellectual capital, such as patents, skilled R&D departments, joint ventures, and strategic partnerships. Yet, the method is entirely consistent with standard tools of corporate finance.

Frontier Forum 1
Manufacturing With 2020 Intelligence

FORUM 1: Manufacturing With 2020 Intelligence

International D-E

Chair: ***Richard "Chuck" Bartholomew***

Roger W. Cope, Vice President, Business Development
Lamb Technicon, Machining Systems

Charles L. Bailey, Vice President
Chemicals and Life Sciences Operations and Maintenance
Fluor Global Services

Manufacturing represents an opportunity to create significant national wealth and added value. How that will be done in the future, and how that will differ from the present is anyone's guess. This Frontier Forum will present the views and opinions on the future of manufacturing and processing in a variety of industrial sectors.

What will manufacturing facilities look like?
What new technologies will need to be developed?
What will the operating requirements be?
Where can greater intelligence and knowledge be built in?

These are just a few of the questions that will be addressed. The presentations will lay the foundation for future technology-based discussions on development needs and opportunities, leading to the beginning of long term planning for R&D collaborations and ventures.

Roger W. Cope, Vice President, Business Development
Lamb Technicon, Machining Systems

Roger Cope is responsible for marketing, international sales, strategic planning, research and development, and new product development. He joined Lamb Technicon Machining Systems in April 1996.

Prior to joining Lamb, Roger held positions as Corporate Group Vice President of Planning and Development at Dart Industries; Vice President, Corporate Development at Addressograph-Multigraph; and, for 15 years, a consultant specializing in start-up companies, turnarounds, and strategic planning. During this period, Roger served as President, Chief Financial Officer, and as an outside consultant to companies in many different industries. After serving as a consultant assisting in the development of a strategic plan for the Applied Technology Division of Litton Industries, Roger became a full-time employee, serving as Director of Strategic Planning and Air Force Marketing to assist in the assimilation of a major acquisition and in forging an aggressive growth program.

Roger has acquired a great deal of experience in the application of cutting tools, CNC machines, injection molding, blow molding, extrusions, and thermoforming operations in a variety of industries during his business career.

Roger holds a B.S. in Business Administration and an M.B.A in Finance, both from the University of Southern California.

Frontier Forum 2
Virtual Voyage Through Medicine

FORUM 2: Virtual Voyage Through Medicine

International A-C

Chairs: ***Bettijoyce Lide*** and ***Jayne Orthwein***

Dr. Michael J. Ackerman
Director, Office of High Performance Computing and Communications
National Library of Medicine

Dr. Richard M. Satava
Yale University School of Medicine

Dr. Yulun Wang, Founder/CTO
Computer Motion

Virtual Reality (VR) has found its place on the frontiers of medicine where it is transforming all aspects of healthcare. VR is revolutionizing healthcare delivery, training, research and education. It is breaking through the barriers of distance, enabling quality care in remote geographical areas. By providing new, effective methods for medical education and training, virtual reality will enable surgeons to practice a planned procedure before the patient enters the operating room. Once in the operating room, the surgeon can be guided using visualization technologies, with robots on hand to assist with some of the most difficult procedures. This Frontier Forum will present information from leading experts in virtual reality in medicine. Where is virtual reality pushing the frontiers of medicine? What is beyond this virtual voyage?

Dr. Michael J. Ackerman
Director, Office of High Performance Computing and Communications
National Library of Medicine

Visible Human Project: From Data to Knowledge

The Visible Human Project has its roots in a 1986 long-range planning effort of the National Library of Medicine (NLM). It foresaw a coming era where NLM's bibliographic and factual database services would be complemented by libraries of digital images, distributed over high speed computer networks and by high capacity physical media. Not surprisingly, it saw an increasing role for electronically represented images in clinical medicine and biomedical research. It encouraged the NLM to consider building and disseminating medical image libraries much the same way it acquires, indexes, and provides access to the biomedical literature. Early in 1989, under the direction of the Board of Regents, an ad hoc planning panel was convened and made the following recommendation: "NLM should undertake a first project building a digital image library of volumetric data representing a complete, normal adult male and female. This Visible Human Project will include digitized photographic images from cryosectioning, digital images derived from computerized tomography and digital magnetic resonance images of cadavers."

The initial aim of the Visible Human Project was to acquire transverse CT, MRI and cryosection images of a representative male and female cadaver at an average of one millimeter intervals. The corresponding transverse sections in each of the three modalities were to be registered with one another. A contract for acquisition of these pixel-based data was awarded in August 1991 to the University of Colorado at Denver, with Victor M. Spitzer, Ph.D. and David G. Whitlock, M.D., Ph.D. as the principal investigators.

The Visible Human Male data set consists of MRI, CT and anatomical images. Axial MRI images of the head and neck and longitudinal sections of the rest of the body were obtained at 4 mm intervals. The MRI images are 256 pixel by 256 pixel resolution. Each pixel has 12 bits of grey tone resolution. The CT data consists of axial CT scans of the entire body taken at 1 mm intervals at a resolution of 512 pixels by 512 pixels where each pixel is made up of 12 bits of grey tone. The axial anatomical images are 2048 pixels by 1216 pixels where each pixel is defined by 24 bits of color, about 7.5 megabytes. The anatomical cross-sections are at 1

mm intervals to coincide with the CT axial images. There are 1871 cross-sections for each mode, CT and anatomy. The complete male data set, 15 gigabytes in size, was made available in Novermber, 1994.

The Visible Human Female data set, released in November, 1995, has the same characteristics as the The Visible Human Male with one exception. The axial anatomical images were obtained at 0.33 mm intervals instead of 1.0 mm intervals. This resulted in 5,189 anatomical images, and a data set of about 40 gigabytes. Spacing in the "Z" direction was reduced to 0.33 mm in order to match the 0.33mm pixel spacing in the "XY" plane, thus enabling developers interested in three-dimensional reconstructions to work with cubic voxels.

In August 2000, higher resolution axial anatomical images from the male data set were made available. Seventy millimeter still pictures taken at the same time as the original digital pictures were digitized at a resolution of 4096 pixels by 2700 pixels. These images, in the range of 32 megabytes each, are available for all 1871 cross-sections.

The second phase of the project is well underway. Segmentation, classification and the building of a prototype database (AnatLine) of the thorax region of the Visible Male has been completed, with AnatLine currently in beta testing. A future web-based atlas of the head and neck region is under development, the intent of which is to be a model for a new wave of educational applications. It is to consist of six functional anatomy teaching modules. The Visible Human Project Imaging Processing Tools, has as its goal to create a self-sustaining development effort to support image analysis research in segmentation, classification and deformable registration of medical images. And, use of the Next Generation Internet (NGI) is being investigated by employing the Visible Human's large image data sets in real time 2D and 3D visualizations under haptic control.

The long-term goal of the Visible Human Project® is to produce a system of knowledge structures that will transparently link visual knowledge forms to symbolic knowledge formats such as the names of body parts.

For additional information on the Visible Human Project contact:

Visible Human Project
National Library of Medicine
8600 Rockville Pike
Bethesda, MD 20894
FAX: (301) 402-4080
email: vhp@nlm.nih.gov
internet: www.nlm.nih.gov/resear ch/visible/visible_human.html

Richard Satava, M.D.
Yale University School of Medicine

Dr. Richard Satava is a practicing general surgeon specializing in advanced medical research. He is also Professor of Surgery at Yale University School of Medicine. Dr. Satava is retired from the active duty Army Medical Corps and was previously the program manager at the Defense Advanced Research Projects Agency (DARPA). In addition to serving on the American College of Surgeons' Regents Committee on Informatics, Dr. Satava serves as a member of the College's Emerging Technologies and Residents Education Committees. He received his undergraduate degree at John Hopkins University, Baltimore, and he received his medical degree from Hahnemann University, Philadelphia. Dr. Satava served an internship at the Cleveland Clinic, his surgical residency at the Mayo Clinic, Rochester, MN and he completed a fellowship with a Masters of Surgical Research at the Mayo Clinic. He has been a member of the White House Office of Science and Technology Policy (OSTP), Committee on Health, Food and Safety. In addition, Dr. Satava is the past-president of the Society of American Gastrointestinal Endoscopic Surgeons (SAGES), he is a member of the board of governors of the Society of Minimally Invasive Therapy, the Society of Laparaendoscopic Surgeons (SLS) and he is active in numerous surgical and engineering societies. Dr. Satava serves on the editorial board of numerous surgical and scientific journals and he has written extensively about surgical education and surgical research.

Dr. Yulan Wang, Founder/CTO
ComputerMotion

Education
5/88, Ph.D. in Electrical Engineering, University of California, Santa Barbara. Dissertation: "RIPS: A Computer Architecture for Advanced Robot Control".
6/85, Scripps Institute of Oceanography, University of California, San Diego, Ph.D. 1-year study program in Applied Ocean Science Curriculum.
4/84, M.S. Degree in Electrical Engineering, University of California, Santa Barbara.
6/82, B.S. Degree in Electrical Engineering, University of California, Santa Barbara, graduated with honors.

Work Experience
Computer Motion, Inc., Goleta, CA
Dr. Wang founded CMI in 1989 to bring innovations in robotics and computer design to the marketplace. He secured capital from private investment as well as contracts from government agencies and commercial companies and was the principal investigator and award recipient for several small business innovation research grants from NSF and NASA. CMI is the leader in medical robotics and completed their IPO in 1997. In 1999, Deloitte and Touche named CMI one of the 50 fastest growing high tech companies in the Los Angeles area and a Technology Fast 500 winner for the U.S. Dr. Wang has been a Director of the company since it's inception and is currently the company's chief technical officer. He is the principal architect of the company's product strategy, and inventor of many of the technologies that are used to create the company's products. Dr. Wang has over 40 publications and holds over 50 patents and patents-pending. He frequently gives presentations at major medical meetings on the future of robotics and computers in the field of surgery.

Dr. Wang is the principle architect and inventor of the AESOP, HERMES and ZEUS medical robots. AESOP is the world's first FDA-cleared surgical robot. It is a voice-controlled robotic arm which positions and maneuvers the laparoscope used in minimally-invasive surgery. Ten patents have been issued on this technology. HERMES is the world's first voice controlled OR control center. ZEUS is the world's first robotic surgical system for enabling endoscopic heart bypass surgery. Seven patents have been issued on this technology.

University of California, Santa Barbara
Dr. Wang was a lecturer and researcher at UCSB for 2 years and was involved in several different robotic design projects. He was one of the first to receive his Ph.D. from the newly created UCSB Center for Robotics.

Presentations
Dr. Wang has given a number of presentations at major conferences around the world including: The International Congress on Computers and Robotics in Santa Barbara, CA; International Society for Gynecologic Endoscopy (ISGE) in Montreal; Japan Surgical Society (JSS) in Fukuoka; Association of Endoscopic Surgeons in Edinburgh, Scotland; Royal Australian College of Surgeons in Sydney; Association of Operating Room Nurses (AORN); International Gastro-Surgical Club (IGSC) in Strasbourg France; Utrecht MICABG Workshop in The Netherlands; Keio International Executive Program (KIEP) in Japan; World Congress on Minimally Invasive Cardiac Surgery (MICS) in Paris; Medicine 2001 International Conference in Montreal; International College of Surgeons (ICS) in Washington DC; Int'l Conference on Automation, Robotics & Artificial Intelligence (ICAR); American College of Surgeons (ACS).

Awards
Outstanding Contributions from the California Society of Professional Engineers, 1987; Cover story, NASA Tech Brief, 1994; Cover story, Transpacific Magazine, 1996; Feature story, "How'd They Do That?" Discovery Channel, 1997; 1997 Award for "Advancing World Health Care Through Robotics and Computers" from Power Conversion & Intelligent Motion Magazine; 1998 South Coast Business and Technology Entrepreneur of the Year; Guinness Book of Records 1999 & 2000.

Frontier Forum 3
The Pathway to
Virtual Research Communities

FORUM 3: The Pathway to Virtual Research Communities

International D-E

Chair: ***John D. Hewes***

H. Mario Geysen, Ph.D.
Glaxo-Smith Kline

F. Raymond Salemme, Ph.D.
3-Dimensional Pharmaceuticals, Inc.

Ian Maxwell, Ph.D.
Avantium Technologies B.V., Netherlands

The concept of Virtual Research Communities is one of geographically dispersed research centers utilizing intelligent research tools that are connected to each other via high-bandwidth networks. This Frontier Forum will describe potential paths forward for attaining the convergence of hardware and software technologies needed to develop the next generation technologies for the high throughput screening and discovery of tomorrow's advanced materials.

H. Mario Geysen, Ph.D.
Glaxo-Smith Kline

Dr. H. Mario Geysen was born in the Netherlands, 1944. Now an australian citizen, he is married with three children. He is presently employed by GlaxoSmithKline, at its RTP facility as Distinguished Research Scientist. He has won several awards for his work in Combinatorial Chemistry, and is a Kilby Laureate (2000). He has approximately 100 publications, and has various patents granted in six different fields of science.

Abstract: With the completion of the sequencing of the human genome, and our desire to find cures for an ever increasing range of ailments, the impetus to speed up the drug discovery process is acute and the focus of an intense effort by many pharmaceutical companies.

Drug discovery is a complex procedure, the output of which is a molecule in which many non-related attributes are independently satisfied in some form of screening process. It is further hampered by the geographic separation of the contributing centers, and the sequential way in which each hurdle along the path is addressed. An all to frequent outcome is to find that a molecule in which a substantial investment of time and effort has been made, fails to pass the next barrier necessitating a return to the beginning or at least an earlier candidate.

As each decision point is essentially the outcome of a screening process, advances in screening technology in terms of speed and numerical magnitude can have a significant impact on the overall success rate with which new drugs are developed. Screening technology now routinely utilizes a software screen of a virtual library of candidate molecules, followed by a hardware version of those members deemed to meet acceptable criteria in the virtual screen. Sharing an adequate description of the experimental outcome of each step of the process between the various contributing participants, is challenging our ability to improve on the success rate of past.

An overview of the current drug discovery process will be given with an emphasis on those hardware and software developments, which can be expected to impact the availability of tomorrows medicines. In addition, areas of the process in which developments are still required will be highlighted.

F. Raymond Salemme, Ph.D.

F. Raymond Salemme, Ph.D. founded 3-Dimensional Pharmaceuticals, inc. in 1993 and serves as President and Chief Scientific Officer. Prior to founding the company, he held research management positions in structure-based design, biophysics and computational chemistry at Sterling Winthrop Pharmaceuticals, duPont merck Pharmaceuticals, Inc. and the duPont central Research Department. In 1983, dr. Salemme founded the Genex Protein engineering Division, among the first industrial groups to use 3-dimensional structural tools as the basis for engineering proteins. From 1973 to 1983, he was Professor of Biochemistry at the University of Arizona. He holds a B.A. in Molecular Biophysics from Yale University and a Ph.D. in chemistry from the University of California-San Diego, specializing in protein X-ray crystallography. He is a member of numerous professional societies, has served on a number of national and international scientific review committees and journal editorial boards, and has authored over 75 scientific publications and patents in the areas of structural biology, biomaterials, computer modeling of proteins and structure-based drug design. Dr. Salemme is a co-inventor on 3DP's key technology patents in DirectedDiversity® Chemi-Informatics process control technology and ThermoFluor® assay technology.

Frontier Forum 4
Replication of Nanodevices

FORUM 4: Replication of Nanodevices

International A-C

Chair: ***Gradimir Georgevich***

Ralph Merkle, Ph.D.
Zyvex
Richardson, TX

George D. Skidmore, Ph.D.
Manager, Top-down Assembly Group
Zyvex

J. Storrs (Josh) Hall, Ph.D.
Research Fellow, Institute for Molecular Manufacturing

Many examples of biological replication exist in nature. The replication of biological structures usually requires an increasing array of tools and building blocks as the complexity of the structure increases. Manufacturing products with nanometer-scale features also requires elaborate tools to organize and manipulate atoms and molecules. At present, this process is painstakingly slow and not readily scaleable. However, some applications may be satisfied through biologically-inspired approaches where systems spontaneously self-assemble and replicate with nanometer-scale precision. This strategy may represent a truly low-cost manufacturing approach for nano-devices. This session will cover molecular replicating systems, including replications of more complex structures on the nanometer scale and exponential assembly into larger devices at the micron scale.

Ralph Merkle, Ph.D.
Zyvex

Dr. Merkle received his Ph.D. from Stanford University in 1979 where he co-invented public key cryptography. He joined Xerox PARC in 1988, where he pursued research in computational nanotechnology until 1999. He is now a Principal Fellow at Zyvex, where he continues to pursue research in nanotechnology. He chaired the Fourth and Fifth Foresight Conferences on Nanotechnology, is on the Executive Editorial Board of the journal Nanotechnology, was co-recipient of the 1998 Feynman Prize for Nanotechnology for theory, and was co-recipient of the ACM's Kanellakis Award for Theory and Practice, the 2000 RSA Award in Mathematics, and the IEEE Kobayashi Award. Dr. Merkle has published and spoken extensively and has eight patents.

George D. Skidmore, Ph.D.
Manager, Top-down Assembly Group, Zyvex

Dr. George D. Skidmore is the Manager of the Top-down Assembly Group at Zyvex.

Skidmore was awarded his two undergraduate degrees in 1993, a B.S. in Industrial Technology and a B.A. in Physics from Western Washington Univesity; and was awarded his Ph.D. in Physics in 1998 by the University of Minnesota.

While writing his thesis on high resolution magnetic force microscopy of nanofrabricated nickel particles, he developed skills in scanning probe microscopy, electron beam lithography, semiconductor and MEMS processing, and electronic microscopy.

He has co-authored nine scientific publications and one book chapter.

As an undergraduate, he worked an intership in manufacturing engineering constructing assembly lines and monitoring production manufacturing processes. Through these experiences he has gained a broad knowledge base in manufacturing, technology, and science.

Professional Experience

04/00 - Promoted to Zyvex Top-down Assembly Manager
08/89-03/90 Manufacturing Engineering Intern, Keytronic Corporation

Education

07/98 Awarded Ph.D. in Physics, University of Minnesota
06/93 Awarded B.A. in Physics and B.S. in Industrial Technology, Western Washington University
06/88 East Valley High School, Spokan, Washington

J. Storrs (Josh) Hall, Ph.D.
Research Fellow, Institute for Molecular Manufacturing

J. Storrs (Josh) Hall is a Research Fellow of the Institute for Molecular Manufacturing (IMM). His research interests involve most aspects of molecular manufacturing systems, but his particular area of specialization is systems-level analysis of self-extending, self-repairing, and self-replicating systems, including both mechanical and control software aspects.

Dr. Hall was co-inventor of adiabatic switching for reversible computing, an architectural necessity for energy-efficient computation at the molecular level. He is perhaps best known for this invention of *Utility Fog*, a proposed polymorphic material that can be programmed to simulate most actual materials ranging from solids to gasses. He was also the founder and moderator for the first decade of the Usenet's sci.nanotech discussion group.

Before coming to IMM, Dr. Hall was a researcher with the Laboratory for Computer Science Research at Rutgers University. He was a co-PI for the CAM Project, which designed massively parallel processors based on content-addressable memory principles. He also worked on design automation for microprocessors, and systems and languages for artificial intelligence.

At 46 years of age, Dr. Hall is married and lives in rural New Jersey. He is an avid tennis player, wine collector, and builds competition robots.

Frontier Forum 5
Connectelligence: The Convergence of People, Machines, and Their Environment

FORUM 5: Connectelligence: The Convergence of People, Machines and Their Environment

International D-E

Chair: ***Michael Schen***

Brock Hinzman, Technology Navigator
SRI Consulting Business Intelligence
Menlo Park, CA

Charles Shanley, Ph.D.
Vice President and Director
Technology and Special Government Programs
Motorola
Schaumburg, IL

How might healthcare, transportation, commerce, and even running a household be transformed, if at our fingertips, we could obtain and use information in real-time to exert control over our environment? Across our everyday lives, pervasive, ultra-low-cost and compact connected intelligence is increasingly integrating people, machines, and our environment into one. "Connectelligence" represents this convergence of smart electronic devices and materials, ultra-low cost electronics and photonics, embedded intelligence, ubiquitous computing, advanced networking, and knowledge-based system technologies. This Frontier Session will explore some of the opportunities likely to unfold as these technological enablers allow citizens to more effectively and enjoyably interface with the world around them.

Agenda

11:00 a.m.	***Welcoming Remarks*** Dr. Michael Schen, Program Manager Electronics and Photonics Technology Office, ATP
11:10 a.m.	***Creative Convergence*** Mr. Brock Hinzmann, Technology Navigator SRI Consulting, Business Intelligence
11:45 a.m.	***Connectelligence: What is it? How do we make it happen?*** Dr. Charles (Chip) Shanley, Vice President and Director Technology and Special Government Programs, Motorola
12:20 p.m.	***Open Discussion***
12:30 p.m.	Adjourn

Brock Hinzman, Technology Navigator
SRI Consulting Business Intelligence

Creative Convergence

Convergence implies that computing, miniaturization, the Internet, and wireless communications will merge together into one pervasive, seamless system. Many technology trends are pointing in that direction. This presentation will touch on mobility, portable intelligence, XML, Bluetooth, 3G, speech recognition, nanotechnology, and so forth. However, many of the promises are going unmet and lead times on new technologies are being stretched. It is also clear that not every consumer wants the same set of functional, social, or sensory benefits from being “always on.” Rather than a seamless network, it is probable we will end up with layers of networks and interfaces. Enormous opportunities will exist in creating solutions that match technologies with well-targeted needs and benefits.

Charles, W. Shanley, Ph.D.

Charles (Chip) Shanley received his B.S. in Physics from the University of Dayton in 1971. He received an M.S. in Materials Engineering from Dayton in 1973, working in the fields of crystallography and magnetic materials. He attended the University of Florida and in 1977 received a Ph.D. in Materials Science, specializing in the areas of modulation spectroscopy and corrosion. Chip joined the Applied Research organization of Motorola's Communications Sector in 1977 and held a variety of positions over the following fifteen years, culminating in the position of Director of Research. In 1989 he joined Corporate Research, and in 1998 was appointed Vice President and Director of Technology and Special Government Programs. He has seven issued patents in the field of radio systems and RF component design.

In his current position, Chip deals extensively with the evaluation, acquisition, transfer, and development of technology for Motorola. He has special responsibility for dealings with the U.S. Government and the US National Labs, including the sponsorship of cooperative R&D.

Chip is a member of the Motorola Science Advisory Board Associates and the vice-chairman of the Motorola Technology Action Council. He has previously served on the Critical Technologies Subcouncil of the U.S. Government's Competitiveness Policy Council and the Illinois Science and Technology Advisory Committee. Chip has been a member of the U.S. Government's Advanced Technology Panel since 1995, and has participated in a number of other reviews and technical advisory groups for the U.S. Government.

Frontier Forum 6
Diagnostic Imaging in the New Millennium

FORUM 6: Diagnostic Imaging in the New Millennium

International A-C

Chairs: ***Mrinal Dewanjee*** and ***Carlos Grinspon***

Daniel H. Silverman, M.D., Ph.D.
Associate Professor
Nuclear Medicine, Pharmacology and Structural Biology
University of California-Los Angeles

Nancy Allbritton, Ph.D.
Associate Professor, Department of Physiology and Biophysics
and Center for Biomedical Engineering
University of California-Irvine

In this Frontier Session, the presenters will discuss the areas of cutting-edge science and technology related to interactions of photons with tissues in diagnostic imaging. Dr. Silverman will describe the role of non-invasive imaging of neuro-degeneration using a specific and sensitive radioactive tracers and positron emission tomography (PET). While mutations can be diagnosed using the tools of DNA diagnostics, micro arrays and biopsied tissues or blood, the sites of disease in a patient should be located, so that diseased tissue can be ablated using laser technology or removed surgically at an early stage. With PET imaging, the effect of drugs and gene therapy on the diseased organs and tissues can be followed by sequential imaging techniques. By combining the latest advances in genomics, proteomics and functional imaging, diagnosis may become possible at a ultra early stage, thus leading to reductions in morbidity and mortality rates while improving the quality of life in a cost-effective manner.

Daniel H. Silverman, M.D., Ph.D.
Neuronuclear Imaging, Noninvasive Cancer Evaluation

The two major goals of our research program are 1) to explore in living human brain the interactions and neurologic bases of memory, mood, and pain perception — with respect to both normal and disordered function (as occurs in dementia, depression, and chronic pain syndromes), and 2) to develop noninvasive methodologies with which to optimize management of breast and colorectal cancers. These apparently disparate objectives are united through use of low-level radioactive biochemicals to characterize and map in the human body the distribution of processes having pressing relevance to patients seen in Nuclear and Internal Medicine. Both lines of research involve extensive application of positron emission tomography. With a focus ranging from molecular processes to human behaviors, our research activities correspondingly span the 'bench to bedside' spectrum from biochemical work *in vitro*, to monitoring and impacting upon progress of patients in the Ahmanson Biological Imaging Clinic.

Nancy Allbritton, Ph.D.
Profiling Signal Transduction Networks in Mammalian Cells

A central goal of genomics and proteomics is to catalog the biological molecules present in different organisms and cell types under various conditions. A greater challenge for accurate and comprehensive characterization, however, lies in determining the activities and functional relationships of the biological molecules, particularly the enzymes, as they occur within the complex cellular networks that comprise biological systems. To accomplish this task, new technologies must be developed to measure multiple chemical species within intact intracellular networks. We have demonstrated a new method for the simultaneous measurement of the activation of key regulatory enzymes in a single cell. This assay strategy should be broadly applicable to single-cell measurements of a broad range of enzymes, including kinases, phosphatases, proteases, and nucleases. New bioinformatic tools will need to be developed to describe and predict outputs from the signal transduction networks comprised of these enzymes. Multidisciplinary approaches will be required to unravel the complex signaling networks controlling cellular responses.

Daniel H. Silverman, M.D., Ph.D.
University of California, Los Angeles, School of Medicine
Department of Molecular and Medical Pharmacology
Division of Nuclear Medicine

Cornell University, Ithaca, New York
B.A. in dual majors of Biology and Chemistry, 1981

Harvard University, Cambridge, Massachusetts
Ph.D. in Biological Chemistry, 1987

Harvard Medical School, Boston, Massachusetts
Research Fellowship, 1987 - 1988

The Ohio State University, Columbus, Ohio
M.D., College of Medicine, 1992

University of California, Los Angeles
Internal Medicine Residency, 1992 - 1994

University of California, Los Angeles
Clinical Investigator in Internal Medicine, 1994 - 1996

University of California, Los Angeles
Nuclear Medicine Fellowship, 1994 - 1996

Professional Experience

Instructor, Harvard University. Designed and taught Biology Tutorial, *Biochemistry of the Brain Underlying Human Behaviors,* 1983-1985.

Postdoctoral Research Fellow, Biological Chemistry and Molecular Pharmacology, Harvard Medical School, Boston, MA. Developed hematologic experimental model for MHC-restricted neurologic disease, 1987- 1988.

Course Instructor, *Fundamentals of Clinical Medicine,* University of California, Los Angeles School of Medicine, 1996-1998.

Clinical Instructor in Nuclear Medicine and Internal Medicine, University of California, Los Angeles School of Medicine, 1996-1998.

Course Director, UCLA Extension. Designed and co-taught series on The Brain and Its Disorders, as well as a course on Brain Chemistry and Human Behaviors, 1999-2000.

Head, Neuronuclear Imaging Research Group, UCLA Medical Center, 1996-present.

Assistant Professor, UCLA School of Medicine, Dept. Molecular and Medical Pharmacology, Div. of Nuclear Medicine, 1998-present

Special Programs and Certifications

NIH Clinical Electives Program in Nuclear Medicine and Brain Positron Emission Tomography, 1991.
Diplomate of the American Board of Internal Medicine (1995 - 2005).
Diplomate of the American Board of Nuclear Medicine (1996 - 2006).

Nancy L. Allbritton
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Center for Biomedical Engineering
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Education:

1979	B.S., Physics, Louisiana State University, Baton Rouge, LA
1985	M.D., Medicine, Johns Hopkins University School of Medicine, Baltimore, MD
1987	Ph.D., Medical Physics/Medical Engineering, Massachusetts Institute of Technology, Dept. of Health Sciences and Technology, Program in Medical Engineering and Medical Physics, Cambridge, MA

Employment:

2/88 -5/88	Consultant for flow cytometry facility, Center for Cancer Research, Massachusetts Institute of Technology
1988	Postdoctoral Fellow with Dr. Herman Eisen, Dept. of Biology, Massachusetts Institute of Technology
1989 -1994	Postdoctoral Fellow with Dr. Lubert Stryer, Dept. of Cell Biology and Neurobiology, Stanford University
1994 -2000	Assistant Professor, Dept. of Physiology and Biophysics, University of California, Irvine, CA
7/1/00-	Associate Professor, Dept. of Physiology and Biophysics, University of California, Irvine, CA

Awards:

1979	Phi Beta Kappa
1982-1985	Massachusetts Institute of Technology, Health Sciences and Technology Fellowship
1995	Searle Scholar Award
1995	Beckman Young Investigator Award

Honors (Most Recent):

August 1999	Invited Speaker - Calcium Signaling, Gordon Conference, Henniker, NH
August 1999	nvited Speaker - Analytical Chemistry, Gordon Conference, Henniker, NH
October 1999	Invited Speaker - Frederick Conference on Capillary Electrophoresis, Frederick, MD
March 2000	Invited Speaker - American Chemical Society National Meeting, San Francisco
October 2000	Invited Speaker - Experimental and Theoretical Calcium Dynamics, Dresden, Germany
October 2000	Invited Speaker – Assay Development, San Diego, CA
February 2001	Invited Speaker - ARBF Annual Meeting, SanDiego, CA
March 2001	Invited Speaker - High Throughput Screening, San Diego, CA
October 2001	Invited Speaker - Federation of Analytic Chemists, Detroit, MI
June 2001	Invited Speaker - NIST Advanced Technology Program, Washington DC
March 2002	Invited Speaker- Protein Phosphorylation and Mechanisms of Cellular Regulation, Keystone Symposium, Taos, NM

Patents:

1. Kuhn, M., Meyer, T., and Allbritton, N.L. Bifunctional Chelating Polysaccharides. U.S. Patent No. 5,773,227.
2. Allbritton, N.L., Tromberg, B.J., Krasieva, T.B., Berns, M.W., Sims, C.E., Meredith, G.D. Fast Controllable Laser Lysis of Cells for Analysis. Patent No. 6,156,576.
3. Allbritton, N.L., Tromberg, B.J., Krasieva, T.B., Berns, M.W., Sims, C.E., Meredith, G.D. A Method and Apparatus of Using Reporter Molecules that Undergo a Change in Electrophoretic Mobility when Chemically Acted Upon. U.S. Patent Pending, #09/358,504.

Frontier Forum 7
The Challenge of Molecular Electronics: Focusing Nanotechnology on the Future Computer

FORUM 7: The Challenge of Molecular Electronics: Focusing Nanotechnology on the Future Computer

International D-E

Chairs: ***Thomas Lettieri*** and ***Clare Allocca***

Christopher B. Murray, Ph.D.
Manager, Nanoscale Materials and Devices
IBM, T.J. Watson Research Center
Yorktown Heights, NY

Dr. Paul Weiss, Professor of Chemistry
The Pennsylvania State University
University Park, PA

Recent advances in the field of molecular-scale electronics have raised expectations that this technology will one day usher in a world of circuits only a few atoms wide, providing the building blocks for ultra small, ultra dense, electronic computer logic. Such revolutionary advances would radically change the future of computing.

What breakthroughs and consequent spinoffs might we expect along the way? This Frontier session will explore recent notable achievements that show the promise of molecular scale electronics. Anticipating a stream of new advances, such as molecular wires, molecular switches and molecular sensors, particular attention will be placed on the enabling, spillover possibilities for this rapidly moving field.

Christopher B. Murray, Ph.D.
Manager, Nanoscale Materials and Devices
T.J. Watson Research Center, IBM

Dr. Murray is the manager of "Nanoscale materials and devices" at IBM's T.J. Watson Research center and contributes to the preparation and characterization of nanoscale materials. Dr. Murray joined IBM in 1995 after completing his Ph.D. studies in the department of chemistry at the Massachusetts Institute of Technology with Professor Moungi Bawendi. Dr. Murray's graduate thesis on the "Synthesis of and characterization of II-VI semiconductor quantum dots and quantum dot superlattices" was recognized by the American Chemical Society with the Noble Laureate signature award in graduate educatgion. While at IBM, Dr. Murray has lead an effort establish chemical route to nanocrystal-based magnetic and semiconducting materials and focused on the exploration of these systems for applications in future information technology. Dr. Murray has authored more than 35 articles and 6 patents in the area of semiconductor and magnetic nanocrystal materials.

Nanocrystals as Molecular-scale Electronic Building Blocks

Synthetic chemistry allow to production nanometer scale structures which are uniform size to +/- one lattice constant while controlling crystal shape, structure and surface passivation. We combine a high temperature solution phase synthesis with size selective processing techniques to produce organically passivated magnetic and semiconducting nanocrystals with size distributions less than 5%. These nanocrystals then form the basis for a combined structural and magnetic study of the evolution of magnetic properties with crystal size. These monodisperse nanocrystals self-organize during controlled evaporation to produce 2D and 3D superlattices (colloidal crystals, opals). The nanocrystals resemble "artificial atoms" sitting on regular close-packed superlattice sites, each separated by a selected organic spacer. The inter-particle spacing can be varied from intimate contact up to ~40Å separation. The superlattices retain and enhance many of the desirable mesoscopic properties of individual nanocrystals and permit the first systematic investigation of new collective phenomena. Our goal is to study the properties of both the dispersed nanocrystals and assemblies as all major structural parameters are varied (composition, size, and spacing). Procedures have been developed for Co and FePt magnetic nanocrystals as well as II-VI, and IV-VI semiconductor nanocrystals (quantum dots). Particular emphasis will be given to recent explorations of the transport phenomena in nanocrystal superlattices, which will be essential to the fabrication of devices incorporating these molecular-scale building blocks.

Dr. Paul Weiss, Professor Chemistry
Pennsylvania State University

Paul S. Weiss is an Associate Professor of Chemistry at The Pennsylvania State University, where he began his academic career as an assistant professor in 1989. He received his S.B. and S.M. degrees in chemistry from MIT in 1980 and his Ph.D. in chemistry from the University of California at Berkeley in 1986, working with Prof. Yuan T. Lee on crossed molecular beam reactions of excited atoms. He was a post-doctoral member of technical staff at Bell Laboratories from 1986-1988 and a Visiting Scientist at IBM Almaden Research Center from 1988-1989. He was a Visiting Professor at the University of Washington, Department of Molecular Biotechnology from 1996-1997 and at the Kyoto University, Electronic Science and Engineering Department and Venture Business Laboratory in 1998 and 2000.

Weiss investigates the chemical, physical, optical, and electronic properties of surfaces at the atomic scale using scanning tunneling microscopy and spectroscopy. He and his students have developed new techniques to expand the applicability and chemical specificity of scanning probe microscopies. They have applied these to the study of catalysis, self- and directed assembly, and molecular and nano-scale electronics. They work to advance nanofabrication down to ever smaller scales and greater chemical specificity in order to connect, operate, and test molecular devices. He and his group also use fluorescence microscopy, multi-beam optical tweezers, and micromanipulators to control and to probe the local composition in real and model biological membranes in order to mediate uptake, adhesion, infection, and immune response.
His interdisciplinary research group includes chemists, physicists, biologists, materials scientists, electrical and mechanical engineers, and computer scientists. He has published over 100 scientific publications and patents and has given over 200 invited and plenary lectures.

Since coming to Penn State, Weiss has been awarded a National Science Foundation Presidential Young Investigator Award (1991-1996), the Scanning Microscopy International Presidential Scholarship (1994), the B. F. Goodrich Collegiate Inventors Award (1994), an Alfred P. Sloan Foundation Fellowship (1995-1997), the American Chemical Society Nobel Laureate Signature Award for Graduate Education in Chemistry (1996), a John Simon Guggenheim Memorial Foundation Fellowship (1997), and a National Science Foundation Creativity Award (1997-1999). He was recently elected a Fellow of the American Association for the Advancement of Science (2000).

He is the founder and CEO of Atolytics, Inc., a start-up company developing nano-scale analytical equipment for the semiconductor and other industries.

<u>Measuring and Controlling Molecular-scale Properties for Molecular Electronics</u>
As the scales of devices shrink or change more disruptively, so must the resolution and capabilities of analytical tools. Tremendous opportunities exist in developing the sensitivity to probe chemical, physical, electronic, optical, mechanical, and other properties at the nanometer scale and below. I will show some of the capabilities that have been developed and how we have applied these in molecular electronics and in related areas. Our ability to make variations at the atomic scale, chemically and otherwise, gives us the capability to determine the sensitivity of properties to precise structures and thus to tailor these properties. Since measurements with scanning probe microscopes, the tools of choice, can (must) be made on a single nanostructure at a time, we are able to measure monodisperse samples and to guide the selection, synthesis, and assembly of optimized structures.

Frontier Forum 8
Regenerative Medicine as Alternative Therapy

FORUM 8: Regenerative Medicine as Alternative Therapy

International A-C

Chair: ***Mrunal Chapekar***

William A. Haseltine, Ph.D.
Chief Executive Officer
Human Genome Sciences, Inc.

Joseph Gold, Ph.D.
Genetic Engineering/Pluripotent Stem Cell Project
Geron Corporation

This Frontier Forum will feature two speakers and cover the following topics:

"***Tissue Regeneration***", will outline four developmental phases in the growth of regenerative medicine, a term Dr. Haseltine coined to describe new ways of using the body's own genes, proteins, antibodies, and cells to regenerate injured, worn, and damaged tissues and organs. Such innovations as replacement organs created in the laboratory using a patient's own cells are foreseeable in a matter of years. These and other developments are expected to significantly extend the human life span.

"***Human Embryonic Stem Cells: Applications for Drug Discovery and Regenerative Medicine***", will focus on the latest advances of genetic modification into Human Embryonic Stem Cells that facilitate their use for both *in vitro* studies and in clinical applications. Dr. Gold will also outline the usage of micro array technology to identify genes that may play important roles in the creation and maintenance of the pluripotent state. This information may be of use in devising a method to "reprogram" a somatic cell from a patient to form a stem cell whose differentiated progeny could be used to make fully compatible tissues for transplantation.

William A. Haseltine, Ph.D.
Chief Executive Officer
Human Genome Sciences, Inc.

William A. Haseltine is Chairman of the Board of Directors and Chief Executive Officer of Human Genome Sciences, Inc., (HGS), a company he founded in 1992. Human Genome Sciences mission is to develop products to prevent, treat and cure disease based on its leadership in the discovery and understanding of human genes.

William A. Haseltine holds a doctorate from Harvard University in Biophysics. Dr. Haseltine was a Professor at Dana-Farber Cancer Institute, Harvard Medical School and Harvard School of Public Health from 1976 to 1993. Dr. Haseltine became Chairman and CEO of HGS in 1993. He has a distinguished record of achievement in cancer and AIDS research and has received numerous awards for his scientific work. He is the founder and Editor of the journal *E-Biomed: The Journal of Regenerative Medicine.* Dr. Haseltine is the Chairman of the Board of Trustees of the National Health Museum, a member of the Brookings Institution Board of Trustees as well as a trustee for the Committee for Economic Development. Dr. Haseltine is also a member of the Trilateral Commission. He has over 250 publications in the scientific literature and has been awarded more than 50 patents for his discoveries.

Dr. Haseltine also has many years of experience with biotechnology companies. Since 1981 he has founded seven companies, each in a different area of medicine. As a scientific advisor to HealthCare Ventures, he helped to establish an additional 20 biotechnology companies. Dr. Haseltine has received many honors for his achievements in science, medicine and business.

Dr. Haseltine is married to entrepreneur Gale Hayman, co-founder of Giorgio Beverly Hills and founder of Gale Hayman Beverly Hills Cosmetics. They live in Washington, D.C. and New York city.

Regenerative Medicine: A New Medical Paradigm

Introduction: the Power of Genomics
The challenge now for genomics is not to discover human genes—most have already been isolated. Rather it is to **discover their natural function for scientific and medical purposes**.

A systematic program to discover the natural function of human genes has been under way for several years. This has already led to exciting medical discoveries. It represents the **initial successful effort to learn the biology of human genes on a very large scale.** This work is providing medically valuable products. It also illustrates a **roadmap for the biomedical science of the future—regenerative medicine**.

The problem we faced was learn enough about genes to discover drugs that repair and regenerate tissues damaged by disease, injured by trauma or worn by age. Our solution was to develop a series of **integrated, high-throughput tools** to analyze in detail the activity of the proteins that human genes give rise to.

Specifically, we sought human proteins that **modulate or change the behavior of cells** in ways that are therapeutically useful. New methods allow the **functions of thousands of human proteins to be explored simultaneously**. Automated systems permit the rapid collection of millions of data points. We have concentrated our efforts on **secreted proteins** because of their strong medical potential. We believe such molecules will pave the way to the use of human genes, proteins and cells to regenerate tissues and organs. A **custom-designed bioinformatics system** is needed to make the huge amount of data from our testing systems interpretable.

Description of screening technologies
The genes for signaling molecules were initially identified on the basis of computer analysis of their **gene sequences**.

They include hormone receptors, ion channels, transporters, antigens, and secreted proteins such as growth factors and hormones. These signaling molecules can instruct cells to **move or to stay put, to become more or less active, to specialize or to remain a generalist, to live or to die**. This is why they have unprecedented medical potential.

We put the human proteins encoded by these genes on **indicator cells**. Then we monitor the responses of the cells in great detail and record whatever changes our instruments detect.

When we see an interesting biological response in a particular type of cell, we check whether it is **selective**, because selectivity is crucial for medical applications.

Example: a new immune stimulator
One potentially important protein drug identified in this way, **BLyS**, stimulates antibody production. There are many reasons people need more antibodies: they might be older, be fighting an antibiotic-resistant infection, have AIDS, or be recovering from chemotherapy or an organ transplant.

When we put BLyS into animals we found it could **increase** the concentration of IgA and IgG by four-to-eight-fold over a 4-to-5 day period, even though it is a human protein and the test subjects were mice and rats (this result was published in 1999 in *Science*).

BLyS also stimulates **specific immunity** if co-administered with the antigen, suggesting a possible role in vaccines. We are now testing BLyS in patients with common variable immunodeficiency. Other diseases will follow.

There are many **other possible uses** of this molecule. We have just conjugated it with a radioisotope to make LymphoRad™. We hope to use the substance to kill B-cell tumors: the receptor for this molecule is found only on B-cells.

Antibodies are medically now coming to the fore, as it is possible to make **fully human monoclonal** antibodies in mice. Antibodies against BLyS have potential as therapies for autoimmune diseases, in which the patient appears to have too much BLyS.

The Evolution of Regenerative Medicine

BLyS exemplifies the **first phase of regenerative medicine**. We already know that some human proteins, such as insulin, growth hormone and erythropoietin, are good drugs. The impact of genomics as a source of pharmaceuticals has yet to be felt.

Regenerative medicine will move medicine beyond the now-dominant palliative modes of treatment. We see genomic research primarily as a means of developing drugs to accomplish this. By revealing the signaling systems that control cellular processes, it will **allow physicians to exploit the body's own systems to achieve therapeutic goals**.

The **second phase** of regenerative medicine will come when genes, proteins and cells are combined with biomaterials. This technology will allow us to rebuild irreparably damaged tissues and organs. Already, new blood vessels can be built outside of the body, for example, as can pieces of bladder and trachea. Programs are underway to regenerate liver and kidney tissues. Exploitation of these systems will be particularly powerful when combined with the use of **stem cells**.

People will be able not only to repair damaged organs and tissues, but ultimately to **replace them with younger ones**, because nuclear transfer technology (as demonstrated in the experiments that produced Dolly the cloned sheep) implies it is possible to reset the genetic clock in cells. This will constitute the **third phase** of regenerative medicine.

Eventually, we will learn how to fabricate neuro-electronic prostheses that will be engineered at the atomic level. Such devices will be able to integrate seamlessly with the body, including the central nervous system. This will constitute the **fourth wave** of regenerative medicine.

Joseph Gold, Ph.D.
Genetic Engineering/Pluripotent Stem Cell Project
Geron Corporation

Joseph Gold received his Ph.D. in Cell and Developmental Biology from Harvard University, investigating the molecular mechanisms by which retinoids affect gene expression. He was a postdoctoral fellow at University of California, San Francisco where he studied early mammalian development and genomic imprinting. He joined Geron Corporation in 1996 where he is the group leader in genetic engineering of the human emryonic stem cells and the team leader on the human Pluripotent Stem Cells project.

Human Pluripotent Embryonic Stem Cells

Human embryonic stem cells (hES cells) are karyotypically normal, immortal cells that are pluripotent (the capacity to differentiate into all somatic cell types). These cells hold great potential to provide purified differentiated cells for in vitro studies of cell function, target identification, drug toxicity and ultimately, for cell-based therapies. Because undifferentiated hES cells express telomerase they have the capacity for unlimited expansion in vitro and therefore can undergo multiple rounds of genetic modification. Scientists at Geron Corporation have developed methods for large-scale growth of undifferentiated hEs cells, as well as for the induction of differentiation to specific cell types. We have devised methods for the genetic modification of these cells, both to enhance the utility of the differentiated cells and to provide safeguards for transplantation. We are using microarray technology to analyze the genes expressed by differentiated cells to gain greater insight into potential mechanisms of regulation of cell fate, as well as to identify novel genes and potential targets for drug intervention. We are also analyzing the undifferentiated cells to identify the genetic program that produces and maintains the pluripotent state. These genes may provide a mechanism for reprogramming the normal somatic cells of a patient, producing immunologically matched stem cells for transplantation. This approach and others that would yield histocompatible cells for transplantation will be presented.

Venture Capital Forum

VENTURE CAPITAL FORUM

TUESDAY, JUNE 5 8:45 AM - 10:30 AM
International A-E
Chair: ***Omid Omidvar***

The goal of this Forum is to provide information on how Venture Capital firms choose the Frontier Technologies that they decide to fund out of an expanding universe of emerging technologies. This goal will be achieved by looking at some historical perspectives and the wisdom of recent selections in different areas of technology. For example, did the Venture Capital community foresee the rise of the Internet and the rocky road of the dot-coms? How do such events affect their future investments? These are important issues facing startup companies when developing and commercializing their path-breaking technologies.

Presentation:

Linda Powers, Managing Director
Toucan Capital

Ms. Powers, a Managing Director of Toucan Capital, will discuss some of the areas in which venture funding has been concentrated in the past several years–examples of the "herd mentality" at work. Ms. Powers will explore some of the lessons learned from the fallout in these areas, and changes in the way venture capitalists are now approaching investment decision making. She will describe some of the innovative approaches being tried by various funds, and some of the key criteria being used to choose among the many new technologies and inventions seeking funding (for example, evaluation of whether a technology is truly a platform, or is merely a product or feature set, and whether a technology not only ***creates or delivers*** substantial value, but can actually ***capture*** that value (in revenues)).

Panel:

Dr. Katya Flakshahi, Partner
New Enterprise Associates

Wei-wu He, Cofounder
General Partner
Emerging Technology Partners, LLC

Mike Joseph
Clairus Technologies, Inc.

Ginger Ehn Lew, CEO
Telecommunication Development Fund

Michael Sheridan, Managing Partner
Mohr, Davidow Ventures

William Snider, General Partner
Emerging Technology Partners, LLC

Venture Capitalist Biographies

***Katya Flakshahi**, Ph.D.*
Partner
New Enterprise Associates

Dr. Flakshahi joined NEA in January 2001 and focuses on information technology and communications investments. Prior to joining NEA, Katya was at Monarch Partners, where she was involved in wireless and broadband investments. Previously, she was at Velio Communications, a networking components company in San Jose, California, as a senior designer in their high-speed interconnects group. She was also a consultant to several technology-focused start-ups and assisted them in areas of fund-raising, marketing, and business development. She has been a consultant to Applied Materials, assisting their Vice President of strategic marketing with future product planning and positioning. Katya received a Bachelors degree in Electrical Engineering from Sharif University of Technology, Tehran, Iran where she ranked first in the nationwide entrance examination to all universities in Iran in 1989. She received a Masters and a Ph.D. in Electrical Engineering and a Masters in Engineering Management (with focus on high-tech marketing), all from Stanford University.

Wei-wu He
General Partner
Emerging Technology Partners, LLC

Wei-Wu He, Ph.D. is the General Partner and Co-founder of Emerging Technology Partners (ETP), LLC. Prior to co-founding ETP, he was the founder and president of OriGene Technologies, Inc., a successful genomic tool company. Dr. He was also one of the initial employees of Human Genome Sciences, Inc. Dr. He currently is a director for OriGene Technologies, Inc., InforMax, Inc., Aptus Genomics, Inc. and Clarus Technologies, Inc.

Dr. He has been awarded seven U.S. patents and has over 20 original research publications. He also serves on the board of many professional organizations.

Dr. He received his B.S. in Biochemistry from Nanjing University and his Ph.D. in Molecular Biology from Baylor College of Medicine. His previous research training experience includes research fellowships at the Mayo Clinic and the Massachusetts General Hospital and Harvard Medical School. He also holds an M.B.A from the Wharton School of Business.

Ginger Ehn Lew
Chief Executive Officer
Telecommunications Development Fund

Ginger Ehn Lew is Chief Executive Officer of the Telecommunications Development Fund. Prior to joining TDF, Ms. Lew was the Chief Operating Officer of the U.S. Small Business Administration (SBA), where she provided day-to-day management and oversight of the agency's $42 billion loan portfolio. Before joining SBA, Ms. Lew served as the General Counsel at the U.S. Department of Commerce. From 1991 to 1993, Ms. Lew was a member of a start-up technology firm based in San Francisco, California. Ms. Lew gained her management, planning and technology experience during her 6 years with Ernst & Young, advising technology companies on market expansion strategies for East Asia, Europe, and Africa. A native Californian from the San Francisco Bay area, Ms. Lew received her law degree from the University of California at Berkeley (Boalt Hall), and her Bachelor of Arts degree from UCLA. She is on the Board of Directors of the Czech Slovak American Enterprise Fund, and serves on the NASDAQ Listing and Review Council.

Michael Sheridan
Managing Partner
Mohr, Davidow Ventures

Michael Sheridan joined MDV to lead the opening of a new mid-Atlantic office. A resident of Northern Virginia, his charter is to identify and work with entrepreneurs to develop and grow Internet infrastructure and Internet services companies. He brings both operations and entrepreneurial expertise to MDV, and was recently on the board of MDV-funded Kendara, which was later acquired by @Home. He also consulted on MDV-funded Zip2.com, which was later acquired by Alta Vista. Currently, he serves on the board of directors of Panasas, Inc., an MDV portfolio company that delivers new capabilities to the multi-billion dollar network storage market.

Before MDV, Michael was the Vice President of Strategic Businesses at Novell where he was key in formulating the company's Internet infrastructure strategy and extending core products to the Internet in the form of "Net services." At the same time, he led the acquisition of key startups and architected Internet infrastructure deals with industry leaders such as AOL, CMGI and Lucent. He was also responsible for developing new directory and identity technologies that give users personal control of the "digital identity" that defines their relationship to the Internet.

Prior to Novell, Sheridan was a Senior Director at Sun Microsystems. Sheridan first joined Sun upon the company's acquisition of Folio, Inc., a business he founded that provided tools for the creation and use of advanced graphics. Sheridan later helped change the face of computing when he and a small team created the Java programming language. Sheridan then turned his attention to further iterations of Java strategy and business development in support of new networking technologies. He also led new product development on a class of hardware now commonly referred to as information or Internet appliances.

Sheridan graduated from The Claremont Colleges with a degree in Political Science and Russian Studies and did graduate work American University in Film and Video.

William Snider
General Partner
Emerging Technology Partners, LLC

Bill Snider, CFA is a general partner and co-founder of Emerging Technology Partners, LLC. Prior to ETP he was highly regarded mutual fund portfolio manager for T. Rowe Price in the $1.3 trillion municipal bond marketplace with 9 years of experience in the field, 7 of which as an investment manager. Mr. Snider joined T. Rowe Price's municipal bond department in 1991 after attending the Wharton School as an undergraduate. Shortly thereafter he became the youngest vice president and portfolio manager in the firm's 60+ year history. His responsibilities included managing $2 billion of mutual fund and institutional client portfolios as well as handling the commensurate marketing and client service responsibilities.

Mr. Snider currently is a director of Aptus Genomics and Clarus Technologies.

He holds the Chartered Financial Analysts accreditation and an MBA from the Wharton School.

Linda F. Powers
Managing Director
Toucan Capital

Ms. Powers has more than fifteen years of experience in the fields of corporate mergers and acquisitions (both hostile and friendly), restructurings, and highly leveraged, structured and specialty finance transactions. She is a co-founder and Managing Director of Toucan Capital Corp.

Prior to co-founding Toucan Capital, Ms. Powers was Senior Vice President, Global Finance, with Enron Corp. Enron is a leading developer and operator of energy infrastructure projects in over thirty countries worldwide, one of the largest market-makers in energy derivatives and other specialized financial instruments, and a rapidly growing telecommunications player. Prior to joining Enron, Ms. Powers served as Deputy Assistant Secretary of Commerce in the Bush Administration. In that capacity, she was responsible for a number of small business programs, mainly concerned with access to capital. She also assisted financial services, information services and related businesses in entering foreign markets, and was responsible for government-to-government negotiations to remove foreign market entry restrictions for U.S. firms. She was co-lead negotiator for the U.S. on the North American Free Trade Agreement, financial sector agreement, which opened banking, securities, insurance, pension fund and related opportunities in Canada and Mexico.

During the 1980's, Ms. Powers practiced law, specializing in corporate mergers, acquisitions and financings, and certain kinds of intellectual property transactions. While working for the headquarters of the European Union in Brussels, she was responsible for drafting the initial intellectual property rules which now govern know-how licensing in the European Union. Ms. Powers also taught International Business Transactions and European Business Law at Georgetown Law School for eight years, as an adjunct professor. She is a graduate, magna cum laude, of both Princeton University and Harvard Law School.

Technology Showcase

TECHNOLOGY SHOWCASE

The Liberty Ballroom
SUNDAY, JUNE 3, 5:00 PM - 7:00 PM
MONDAY, JUNE 4, 1:00 PM - 6:00 PM
TUESDAY, JUNE 5, 9:00 AM - 4:00 PM

A Showcase Directory will be available for all visitors in the Liberty Ballroom.

- **Learn About GE's Path-breaking Digital X-Ray Technology**
- **Visit PPL Therapeutics' Cloned Pig**
- **View the Digital Cinema of the Future by DemoGraFX**
- **Observe Avista Lab's 3kW Cartridge-Based Fuel Cel***

Through partnerships with the private sector, ATP's early stage investment is accelerating the development of innovative technologies that promise significant commercial payoffs and widespread benefits for the nation. A sampling of these technologies are on display at the ATP National Meeting Technology Showcase, providing attendees the opportunity to witness, first hand, these path-breaking technologies, and speak one-on-one to the innovators.

ATP invites all meeting attendees to tour the Showcase and investigate the many technical challenges that have been overcome, new innovations with the potential to provide widespread benefits to the nation. Discuss with representatives of the companies those technical and business issues that confronted them, and how these challenges were overcome. Find out how their private/public partnerships with ATP have accelerated the development of these innovative technologies and allowed industry to push the envelope from what could have otherwise been attempted. Ask these companies how sharing the relatively high development risks with ATP enabled them to provide advanced technical solutions to an array of industry and market needs, and in doing so, potentially made feasible a broad range of new commercial opportunities.

Although ATP makes no special allowance for small business, well over half of the 526 projects that ATP has selected for cost-sharing awards involve small businesses as single applicants or as leads in joint ventures. Talk to some of our showcase companies who received ATP awards as small, and often start-up companies, and find out how this funding has allowed them to develop their innovative technical ideas into new products, services or industrial processes that have stimulated the world's markets.

* ***Note***: view on Sunday evening, June 3, or from 1:00-2:00 P.M. on Monday, June 4.

Poster Session

POSTER SESSION

MONDAY, JUNE 4 1:00 PM - 7:00 PM
TUESDAY, JUNE 5 9:00 AM - 4:00 PM

New and fascinating NIST research areas will be the focus of a comprehensive **poster session**. Recent years have been witness to remarkable developments in the chemical, physical, and biological sciences that have impacted advances in all technologies.

Our goal is to provide a unique and educational experience to aid in the development of new infrastructures for future technologies and clinical therapies. We also hope to stimulate ideas that could be the basis for developing novel experimental models and critical design criteria for new "smart" materials and devices.

During this poster session, attendees will have the opportunity to meet with the scientists from the NIST Laboratories. The poster session will highlight different technologies.

NIST and ATP Poster Session

Poster Number	Room	Technology Focus	Poster Session Title
1	Carroll	**Optics**	Optical Coherence Tomography for Imaging of Tissue Scaffolds
2	"	"	Optical Tweezers and Optical Scalpels: Laser Tools for Micromanipulation
3	"	"	Biophysics at the Nanoscale
4	"	"	Cavity Ring-down Enhanced Chiral-Optical Spectroscopy for Biomaterial Interfaces and Solutions
5	E Poe	**IT**	Next Generation Digital Management
6	"	"	Interactive Digital TV Software Environment to Support Enhanced Entertainment, e-Commerce and e-Learning
7	"	"	Reflectance Calibration Standard for Optical Discs
8	"	"	Biometrics Technologies for Personal Authentication

NIST and ATP Poster Session (cont'd)

Poster Number	Room	Technology Focus	Poster Session Title
9	Pratt A	**DNA**	Biological Benchmark Standards for Tissue Engineering
10	"	"	Genetic Programming and Discovery
11	Mencken	**Condition-Based Maintenance**	Linear Motor Testbed and Accelerated Life Testing
12	"		Sensor Integration for Condition-based Maintenance
13	"	**Fire**	Combustion Gas Species Detection Using Communications Industry Diode Lasers
14	Pratt B	**BioTech**	Polymeric Templates for Combinatorial Assay of Cell Response
15	"	"	Designing Biomimetic Surfaces for Studying Cell-Surface Interactions
16	Hopkins	**Materials Science**	Process Metrology and Materials Data for Machining Simulation
17	"	"	Crystallographic Methods Development and Acid Site Characterization in Zeolites
18	"	"	High-Throughput Measurement of Molecular Transport Through Films, Membranes and Nanostructures
19	Peale	**Electronics**	Compound Semiconductor Composition Standards
20	"	"	Dielectric Metrology for High-Permittivity Polymer-Composite Films in the Microwave Range
21	"	"	Atomic Force Microscopy for Dimensional Metrology
22	"	"	Building Integrated Photovoltaics
23	Douglas & Lower	**Economic Assessment**	Time Path to Commercialization: Different Timelines for Different Technologies
24	Lobby	"	ATP Addresses the Funding Gap in the U.S. Innovation System

NIST and ATP Poster Session Information

1. ***Optical Coherence Tomography for Imaging of Tissue Scaffolds***
   Presenter: ***Amit Sehgal***
   Position: Post-doctoral Research Scientist
   Schooling/Degree(s): Ph.D., Polymers Science, with Prof. T.A.P.Seery, University of Connecticut, May 2000. B.Eng.(Honors), Chemical Engineering, University of Roorkee, India, May 1994.

   Previous Experience:
   Graduate Research Assistant, Polymer Program, UCONN.
   Structure and dynamics of polyelectrolyte solutions probed by static and dynamic light scattering. Influence of electrostatics and the ionic environment on polyions, ionomers, proteins and other macroionic systems in solution.
   Process Design Associate, Lubrizol Corp., OH
   Stage, DSM Research, Geleen, Netherlands

   Areas of Interest or Focus
   Functional Biomaterials, Cell-Surface Biophysics
   Polymer Thin Films
   Polyelectrolytes and Conducting Polymers
   Structure and Dynamics of Polymer Solutions
   Light Scattering and Fluorescence Photobleaching Recovery

2. ***Optical Tweezers and Optical Scalpels: Laser Tools for Micromanipulation***
   Time of presentation: Monday, June 4, 1:00-5:00 P.M.
   Presenter: ***Kristian Helmerson***, Physicist
   Schooling/Degree(s):
   B.S. in Physics, University of Washington, 1984
   Ph.D. in Physics, Massachusetts Institute of Technology, 1991

   Previous Experience
   NRC Post-Doctoral Fellow, NIST-Gaithersburg, 1991-1993.
   NIST staff scientist in the Laser Cooling and Trapping Group, 1993-present.

   Areas of Interest or Focus
   Optical manipulation of biological objects. Adhesion of biomolecules. Giant liposomes as synthetic cellular environments.

3. ***Biophysics at the Nanoscale***

Time of presentation: Monday, June 4, 1:00-4:00 P.M.
Presenter: ***Jeeseong Hwang***
Research Biophysicist
Schooling/Degree(s): The Johns Hopkins University / Postdoctoral Fellow, Biophysics
Michigan State University / Ph.D., Condensed Matter Physics
Seoul National University / B.S., Physics

Previous Experience:

Jeeseong Hwang has worked at the Johns Hopkins University and AT&T Bell Laboratories on developing advanced optical microscopies and adopting the use of the techniques in biology. He earned Ph.D. in physics studying surface diffusion of atoms using various scanning probe microscopies.

Areas of Interest or Focus

Our objective is to extend the measurements and standards infrastructure for the nanoscale optical characterization of thin films and interfaces. We are developing near-field scanning optical microscopy (NSOM) for quantitative evaluation of surfaces, with a particular emphasis on understanding organic multicomponent films. Current facilities include a metrological NSOM built on a linearized flexure stage, a wet-cell NSOM suitable for investigating biological or biomimetic films, and a near-field probe preparation and evaluation facility. Our program was recently extended to include the use of single molecules as a probe of their local environment.

4. ***Cavity Ring-Down Enhanced Chiral-Optical Spectroscopy for Biomaterial Interfaces and Solutions***

Time of presentation: Monday, June 4, 1:00-5:00 P.M.
Presenters: David Plusquellic and Teresa Petralli-Mallow
Presenter: ***Dr. David F. Plusquellic***
Research Physical Chemist / Spectroscopic Application Group / Optical Technology Division / Physics
Schooling/Degree(s): Ph.D. Physical Chemistry / University of Pittsburgh, PA on 9/1/92

Previous Experience:

My previous experience is in high resolution UV laser spectroscopy and in cavity ring down methods for enhancing absorption sensitivity. Other members of the team, Karen Phinney, Teresa Petralli-Mallow and Curtis Meuse have expertise in chiral stationary phases, circular dichroism at interfaces and in solution.

Areas of Interest or Focus

Tools for Engineered Surfaces
Tools for DNA Diagnostics
Advanced optical methods

A picture my be found at the web site: http://physics.nist.gov/Divisions/Div844/staff/Gp7/plusquellic.html.

5. ***Next Generation Digital Rights Management***
   Time of presentation: Monday, June 4, 1:00-5:00 P.M.
   Presenter: ***Gordon Lyon***

6. ***Interactive Digital TV Software Environment to Support Enhanced Entertainment, e-commerce and e-learning***
   Time of presentation: Monday, June 4, 1:00-5:00 P.M.
   Presenter: ***Alan Mink***

7. ***Reflectance Calibration Standard for Optical Discs***
   Time of presentation: Monday, June 4, 1:00-5:00 P.M.
   Presenter: ***Xiao Tang*** and ***Jian Zheng***

8. ***Biometrics Technologies for Personal Authentication***
   Time of presentation: Monday, June 4, 1:00-5:00 P.M.
   Presenter: ***Fernando Podio***

9. ***Biological Benchmark Standards for Tissue Engineering***
   Time of presentation: Tuesday, June 5, 1:00-3:00 P.M.
   Presenter: ***Peter Barker***
   Position: Project Leader, NIST-NCI Biomarkers Validation Project
   Schooling/Degree(s): AB Cornell; Ph.D. University of Texas

   Previous Experience:
   Post-doctoral: Yale (human genetics)
   Asstistant Professor (medical genetics & biochemistry)
   University of Alabama Birmingham
   Visiting Scientist-German Cancer Research Center, Heidelberg
   Staff Scientist-Cold Spring Harbor Laboratory

   Areas of Interest or Focus
   Human molecular genetics

10. ***Genetic Programming and Discovery***
Time of poster presentation: Monday, June 4, 1:00-4:00 P.M.
Presenters: ***John Hagedorn*** and ***Judith Devaney***

Presenter#1: ***John Hagedorn***
Position: Computer Specialist, Scientific Applications and Visualization Group, Math Division, NIST
Schooling/Degree(s):
M.S. Mathematics, Rutgers University 1980
B.A. Mathematics, University of Virginia,1975

Previous Experience:
Mr. Hagedorn has worked in scientific computing since 1981 on applications such as remote sensing, video animation, weather simulation, and fluid flow simulation.

Areas of Interest or Focus
High Performance Computing
Scientific Visualization and 3D Graphics
Machine learning

Presenter #2: ***Judith Devaney***
Position: Group Leader, Scientific Applications and Visualization Group, Math Division, NIST
Schooling/Degree(s):
B.S. Physics 1965; MS Computer Science 1988; Ph.D. Information Technology 1998

Previous Experience:
Dr. Devaney has worked extensively in the areas of parallel computing and machine learning including microcoding, algorithm design, and numerous applications.

Areas of Interest or Focus
Applications of Machine Learning Techniques to Scientific Datasets for insight and discovery
Parallel Computing
Scientific Visualization

11. ***Linear Motor Testbed and Accelerated Life Testing***
Author: ***Kari Harper***

12. ***Sensor Integration for Condition Based Maintenance***
Author: ***Kang Lee***

Kang Lee is currently the Leader of the Sensor Development and Application Group at the National Institute of Standards and Technology (NIST). Kang has over twenty-seven years of experience in the fields of electronic instrumentation design, sensor-based closed-loop machining and manufacturing, smart sensor networking, and Internet-based distributed measurement and control systems. He manages projects on sensor interfaces and sensor networking for metrology and manufacturing including activities in remote monitoring and control, condition-based maintenance, and control of sensor-based distributed manufacturing systems via the Internet at NIST.

13. ***Combustion Gas Species Detection Using Communications Industry Diode Lasers***
Time of presentation: Monday, June 4, 1:00-4:00 P.M.
Authors: ***Rodney Bryant***, ***William Pitts***, and ***Linda Blevins***
Presenter: ***Rodney Bryant***

Dr. Bryant joined NIST in 1998 as a National Research Council Postdoctoral Fellow where he conducted research that involved the demonstration of simultaneous planar measurements of fluid concentration and flow velocity in turbulent jets. He is presently a Mechanical Engineer in the Fire Metrology Group. His research interests include: laser-based measurement techniques, combustion species spectroscopy, fire-induced flows and turbulent mixing. He is currently involved in STRS funded projects on improving velocity measurement techniques in fire-induced doorway flows and improving fire diagnostics by characterizing the sources and magnitudes of uncertainties associated with heat flux gauge measurements. He is also working on a study of the effectiveness of thermal fire extinguishing agents as alternatives to halon 1301, sponsored by the Department of Defense's Next Generation Fire Suppression Technology Program (NGP). Dr. Bryant presently serves as principal investigator and co-investigator on projects, sponsored by the NIST Advanced Technology Program (ATP), that seek to develop tunable diode lasers as flame species detectors. Dr. Bryant has authored several conference and journal articles and is a member of The Combustion Institute, The American Institute of Aeronautics and Astronautics (AIAA), The American Society of Mechanical Engineers (ASME), and Sigma Gamma Tau (Aerospace Engineering National Honor Society).

14. ***Polymeric Templates for Combinatorial Assay of Cell Response***
Presenter: ***Amit Sehgal***
Post-doctoral Research Scientist
Schooling/Degree(s):
Ph.D., Polymers Science, with Professor T.A.P.Seery, University of Connecticut, May 2000
B.Eng.(Honors), Chemical Engineering, University of Roorkee, India, May 1994

Previous Experience:
Graduate Research Assistant, Polymer Program, UCONN.
Structure and dynamics of polyelectrolyte solutions probed by static and dynamic light scattering.
Influence of electrostatics and the ionic environment on polyions, ionomers, proteins and other macroionic systems in solution.
Process Design Associate, Lubrizol Corp., OH
Stage, DSM Research, Geleen, Netherlands

Areas of Interest or Focus
Functional Biomaterials, Cell-Surface Biophysics
Polymer Thin Films
Polyelectrolytes and Conducting Polymers
Structure and Dynamics of Polymer Solutions
Light Scattering and Fluorescence Photobleaching Recovery

15. ***Designing Biomimetic Surfaces for Studying Cell-Surface Interactions***
Presenters: ***John Elliot***, ***Alex Tona***, ***John Woodward***, and ***Anne Plant***
Contact: Anne L. Plant, Ph.D.
Biomolecular Materials Group
Biotechnology Division
NIST
100 Bureau Drive Mail Stop 8313
Gaithersburg MD 20899-8313
E-mail: *anne.plant@nist.gov*
Tel. 310 975-3124
Fax 301 975-8246 or 301 330-3447

16. ***Process Metrology and Materials Data for Machining Simulation***
Author: ***Matt David***

17. ***Crystallographic Methods Development and Acid Site Characterization in Zeolites***
Time of presentation: Tuesday, June 5, 11:00 A.M.-3:00 P.M.
Presenter: ***Brian Toby***
Research Chemist, Team leader for Crystallography at the NIST
Center for Neutron Research.
Schooling/Degree(s):
Ph.D. in Physical Chemistry, Caltech (1986)
B.A. in Chemistry, Rutgers (1980)

Previous Experience:
Former research scientist at Union Carbide and Air Products, also a researcher and instructor at the University of Pennsylvania. [User of a number of government labs as an industrial/academic researcher, including the NIST reactor, Argonne, Brookhaven and the ILL]

Areas of Interest or Focus
Crystallographic methods using neutron and synchrotron powder diffraction; zeolite characterization and modeling;electronic ceramic materials. [**I would be delighted to talk to anyone interested in performing proprietary or publishable research using the NIST neutron facilities.**]

18. ***High-Throughput Measurement of Molecular Transport through Films, Membranes and Nanostructures***
Time of presentation: Monday, June 4, 1:00-5:00 P.M.
Presenter: ***Dr. Chris Muzny***
Position: Research Physicist, Physical and Chemical Properties Division, NIST
MS 838.07, 325 Broadway, Boulder, CO 80305-3337
E-mail: muzny@boulder.nist.gov
Phone 303 497-5549

Other Contributors: Paul Scott, Barry Bauer, Alamgir Karim, and John Pellegrino
Schooling/Degree(s): Ph.D., University of Colorado at Boulder, 1994

Previous Experience: PREP post-doctoral at NIST 1996-1998; staff scientist at NIST 1999-present.

Areas of Interest or Focus
Membrane Science
Laser Light Scattering
Complex
Fluid Properties
Rheology

19. ***Compound Semiconductor Composition Standards***
Time of presentation: Monday, June 4, 1:00-3:00 P.M.
Tuesday, June 5, 11:00 A.M.-12:30 P.M. and 3:00-4:00 P.M.
Presenter: ***Tom Shaffner***

Dr. Shaffner holds degrees in physics from North Carolina State (B.S.) and Vanderbilt Universities (Ph.D.), and has been active in research involving semiconductor and polymeric materials in industrial and academic laboratories throughout his career. He served as manager of advanced lithography and materials characterization programs at Texas Instruments in Dallas for 21 years, prior to joining the Semiconductor Electronics Division at NIST as Group Leader of Materials Technology in 1998. Prior to this, he contributed to surface chemistry and microscopy programs at E.I. DuPont, and the University of Manchester (U.K.) during a sabbatical leave.

Position: Group Leader, Materials Technology, Semiconductor Electronics Division
Schooling/Degree(s):
Ph.D., Physics, Vanderbilt University
B.S., North Carolina State University

Previous Experience: Manager Materials Characterization, Corporate R&D
Texas Instruments Inc., Dallas, TX

Areas of Interest or Focus
Techniques of characterization relevant to semiconductor materials and devices

20. ***Dielectric Metrology for High-Permittivity Polymer-Composite Films in the Microwave Range***
Time of presentation: Monday, June 4, 1:00-5:00 P.M.
Presenter: ***Dr. C.K. Chiang***
Position: Physicist, Polymers Division, NIST.

Dr. Chiang received his Ph.D. in Solid State Physics from Michigan State University, East Lansing, Michigan. Before joining NIST, he worked as a postdoctoral researcher at the University of Pennsylvania, Philadelphia, PA, where he developed conducting polymers. His research interest is in electrical properties of materials. Current efforts concentrate on dielectric properties of polymer composite thin films. He is author and co-author of over one hundred papers and has received many US patents. His papers on polyacetylene are listed as suggested readings in Nobel Prize in Chemistry 2000.

21. ***Atomic Force Microscopy for Dimensional Metrology***
Time of presentation: Monday, June 4, 1:00-3:00 P.M.
Tuesday, June 5, 11:00 A.M.-1:30 P.M.

Presenter: ***Ronald Dixson***
Position: Physicist - Precision Engineering, NIST
Schooling: B.A. Physics, Ph.D. Physics

Previous Experience: Postdoctoral position at NIST working on AFM line width metrology.

Areas of Focus

Application of AFM to measurement problems in dimensional metrology.
Specific interest in pitch, height, and width measurements as frequently used in the semiconductor industry.

22. ***Building Integrated Photovoltaics***
Time of presentation: Monday, June 4, 1:00-4:00 P.M.
Tuesday, June 5, 11:00 A.M.-2:00 P.M.

Presenter: ***A. Hunter Fanney*** and ***Brian P. Dougherty***

23. ***Time Path to Commercialization: Different Timelines for Different Technologies***
Presenters: ***Jeanne Powell***, ***Kathy McTigue***, and ***Connie Chang***
Contact: Advanced Technology Program
NIST
100 Bureau Drive, Mail Stop 4720
Gaithersburg, MD 20899-4720
E-mail: *atp-eao@nist.gov*
Tel: 301-975-3189
Fax: 301-975-4776

The outcome to date of ATP's earliest completed projects have made us keenly aware that the time path from innovative R&D to commercialization and broad economic impact is long and highly variable across our project portfolio.

This past year, the ATP Economic Assessment Office began exploring the issue of different time paths to commercialization for different technologies using our portfolio of ATP projects. The results provide new insights into the innovation process across different technology areas and types of commercial applications that are useful in assessing the progress of funded projects.

Data collected from an early stage in ATP projects show companies' expectations about when their technologies will begin to generate revenues.

Results will be illustrated using a mix of case studies and statistical analysis.

24. ***ATP Addresses the Funding Gap in the U.S. Innovation System***

Presenter: ***Darin Boville***
Contact: Advanced Technology Program
NIST
100 Bureau Drive, Mail Stop 4720
Gaithersburg, MD 20899-4720
E-mail: *atp-eao@nist.gov*
Tel: 301-975-3189
Fax: 301-4776

The U.S. system of funding basic research functions well, is heavily studied and well understood. On the other end of the spectrum, our system of funding the development of a product functions well, is heavily studied, and is well understood. However, it does not seem that the middle ground, "post-basic research" to "pre-product development" is understood well, and may not be functioning as well as expected. This area is generally referred to as the "funding gap."

To help us understand the nature of the gap, we asked Professor Lewis Branscomb at Harvard University to undertake a major research project to bring together people who study issues relating to the funding gap– government officials who grapple with aspects of the funding gap, venture capitalists and others whose activities define the frontier of the gap, and entrepreneurs who have faced this gap as well. The poster will briefly discuss several key findings.

Electronic Submission System
Exhibit

Electronic Submission System Exhibit

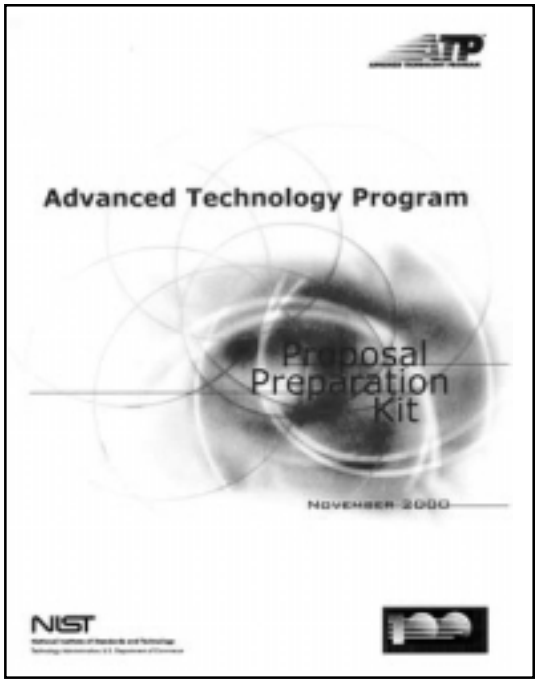
Special ATP Exhibit featuring *Electronic Submission System*
APEX Technology Arena (Lower Lobby)

This fall, ATP will begin piloting an ***Electronic Submission System*** (ESS) to allow proposers to submit ATP proposals securely over the Internet. Proposers will fill out forms and attach their proposal documents using a small application downloaded to their PC. Documents will be signed using ACES digital certificates and encrypted in transmission until they are safely behind ATP's firewall. Come to the ESS booth to see the Electronic Submission System under development and give your comments about its look and feel.

Contact: **Susannah Schiller**
NIST Mail Stop 4700
100 Bureau Drive
Gaithersburg, MD 20899-4700
E-mail: *susannah.schiller@nist.gov*
Tel: 301-975-2852 Fax: 301-926-9524

2001 ATP Competition

- $56.5 million available for new awards
- New streamlined competition process
- Proposal Preparation Kit (November 2000)
- Rolling submissions: ***Apply early!***



Networking Opportunities

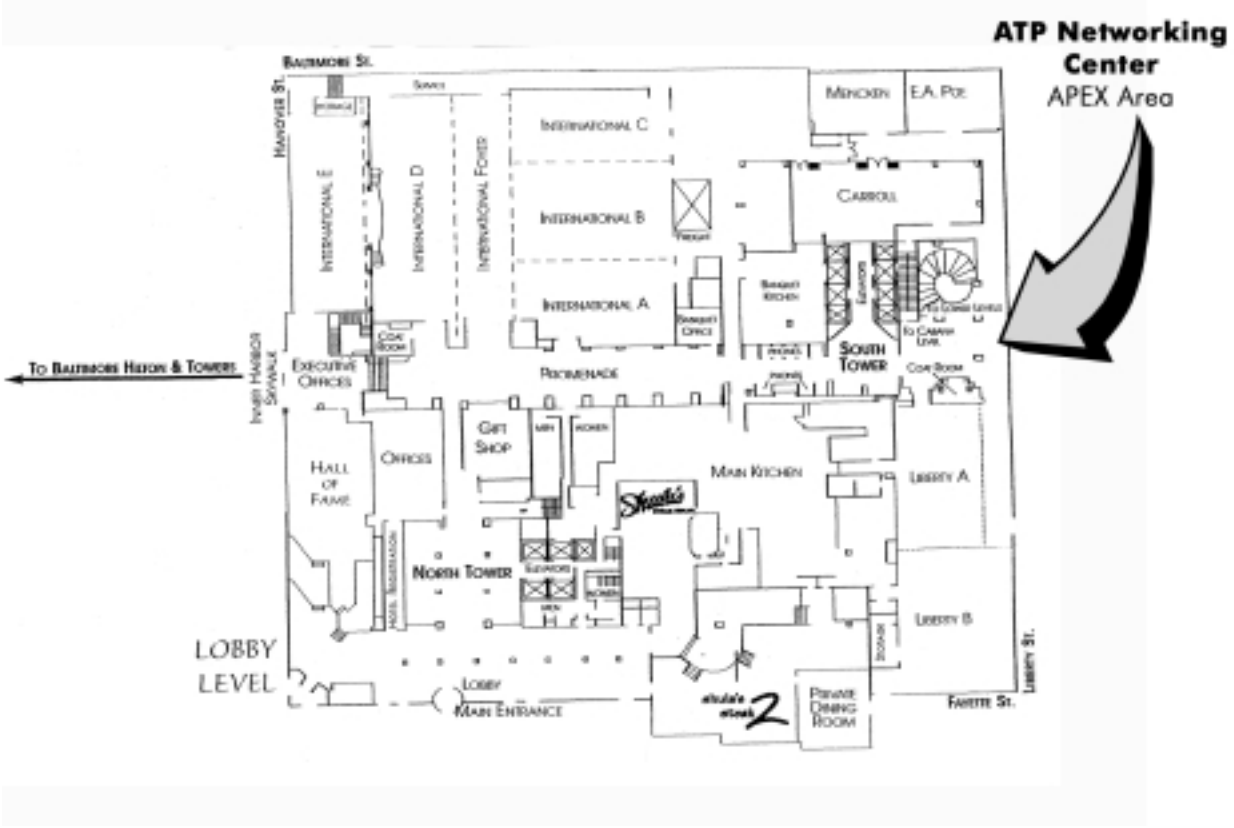
NETWORKING OPPORTUNITIES

An opportunity to interact with leaders in "cutting edge" technologies, ATP program managers and business experts.

For your convenience, we have an appointment book available for you to book one-on-one's with our technical and business experts. Mary Lou Norris and Ann Marie Kinnahan will schedule appointments for one-on-one's with ATP staff. Please visit our "Networking Center" located in the APEX Technology Arena.

Mary Lou Norris
Secretary to ATP Director

Ann Marie Kinnahan
Secretary to ATP Deputy Director



ATP Policy/Operations

Barbara Lambis
Senior Policy and Operations Advisor
B.A. in English, University of Maryland, College Park

Employed at the Department of Commerce (DoC) since 1969. Previously served as the Director, Office of Federal Assistance at DoC. Responsible for grants policy development and implementation, and senior consultant to top level staff in the Office of the Secretary and operating units in grants administration matters.

Areas of interest include policy formulation, development and implementation of procedures and regulations, and providing guidance to the public, DoC, and other Federal agencies.

Susannah Schiller
Group Leader, Information Resources

M.S., Statistics, University of Illinois
B.A., Mathematics and Computer Science, College of Wooster

Susannah Schiller is the Group Leader for ATP's Information Resources Group. Prior to her current position, Ms. Schiller served as special assistant to the Director of ATP in the development, execution and coordination of policy and communications for the program.

Ms. Schiller joined the ATP in January 1997, after spending eight years in the Statistical Engineering Division of NIST and one year in the NIST Program Office. In the Statistical Engineering Division, she focused on statistical consulting, particularly in the areas of designing and analyzing experiments for Standard Reference Material certification.

Chemistry and Life Sciences Office (CLSO)

Richard W. (Chuck) Bartholomew, Ph.D.
Program Manager, Chemistry & Materials Group

Ph.D., Mechanical Engineering, University of Michigan – Ann Arbor
M.S. and B.S., Nuclear Engineering, Rensselaer Polytechnic Institute

Experience includes 13 years as program manager and senior thermodynamicist providing project management, technical evaluations and assistance in commercialization of technologies for businesses of all sizes. Prior to this, taught / performed research in the thermal sciences at Michigan State University's Department of Mechanical Engineering.

Areas of interest include condition-based maintenance, industrial and manufacturing controls, intelligent maintenance/manufacturing, automotive, internal/external combustion engines, electric and hybrid electric vehicles, renewable energy, electric power generation/transmission, thermodynamics, vapor compression refrigeration, premium power / distributed power/power quality.

Robert Bloksberg-Fireovid, Ph.D.
Acting Group Leader, Chemistry and Materials Group
Program Manager, R&D Alliance Network

Ph.D., Chemical Engineering, Drexel University
M.B.A, Northwestern University
B.S., Biology, Penn State

Robert is a Program Manager and Acting Group Leader in the Chemistry and Life Sciences Office at ATP. He manages both the Catalysis and Biocatalysis and the Alliance Network programs. Prior to joining ATP, Robert sourced strategic raw materials for General Electric and Black & Decker, and worked in the corporate R&D divisisions of Wyeth Labs, Hercules, and CPC International.

Areas of interest include biocatalysis, metabolic engineering, catalysis, chemical processing, bioprocessing, polymer materials, and industrial R&D Alliances.

Mrunal S. Chapekar, Ph.D
Program Manager, Life Sciences Group

Ph.D., Biochemistry, University of Bombay, Bombay, India
M.Sc., in Biochemistry
B. Sc. in Chemistry, University of Bombay, Bombay, India

Seven years experience as an NIH researcher studying biology of cytokines and growth factors, and an FDA researcher in material biocompatibility. Nine year experience as an FDA reviewer in cell and gene therapy, tissue engineering, and cytokine and growth factors

Areas of interest include tissue engineering, aquaculture, animal genetics, cell and gene therapy, biomaterials, vaccines.

Mrinal K. Dewanjee, Ph.D.
Program Manager, Life Sciences

M.Sc. Chemistry, Dhaka University, Bangladesh
Ph.D. Nuclear and Radiochemistry, McGill University, Montreal, Canada

Twenty five years experience in Clinical Centers and Director of Radiopharmaceutical Laboratory and Experimental Nuclear Medicine; Professor, Radiology, Surgery and Bioengineering, University of Illinois at Urbana-Champaign, IL; University of Miami School of Medicine at Miami, FL, Mayo Clinic at Rochester, MN, and Tufts-NE Medical Center-Boston.

Areas of interest include tissue engineering, DNA diagnostics, non-invasive diagnostic imaging, human implants, bioengineering, biomaterials and clinical investigations.

Gradimir Georgevich, Ph.D.
Acting Group Leader, Life Sciences Group

Post-Doctoral, Institute of Molecular Biology, University of Oregon
Ph.D. Biological Sciences, University of Pittsburgh/Botany, University of Texas
B.S. Biological Sciences, University of Pittsburgh

Fifteen years experience in medical diagnostics and biotechnology R&D. Worked on the integration of reagents, methods and devices into functional assay systems.

Areas of interest include proteomics, nanotechnology, genomics, plant metabolism, sensors, MEMS, detection technologies, biotechnology, surface chemistry.

Rosemarie Hunziker, Ph.D.
Program Manager, Life Sciences Group

Ph.D. in reproductive immunology, University of Alberta, Edmonton, Alberta, Canada.
M.Sc. in Immunogenetics, Ohio State University
Undergraduate biology degree (chemistry minor), Philadelphia College of Pharmacy and Science

Post-Doctoral, Laboratory of Immunology, National Institute of Allergy and Infectious Disease, National Institutes of Health.

Areas of interest include tissue engineering and regenerative medicine; developing new opportunities for industry utilizing cutting edge technologies in genetics, immunology, cellular biology, molecular biology and medicine.

Andrew Klein, Project Manager/Business Specialist
Life Sciences Group

B.S., Economics, Wharton School, University of Pennsylvania
M.S., Finance, Johns Hopkins

Areas of interest include biotechnology, including tissue engineering, genomics, proteomics, nuclear transfer, and biomaterials.

Jean-Louis Staudenmann, Ph.D.
Project Manager, Life Sciences Group

Ph.D., Solid State Physics, University of Geneva

2000 to present: ATP; chemistry and materials group.
1993-2000 NIST; Physics Laboratory/Quantum Metrology Group
1987-1993: Howard Hughes Medical Institute at NSLS

Areas of interest include materials science and engineering (solid state, semiconductor, superconductivity, synthetic multilayers and super lattices); precision measurement, mechanical engineering, neutron diffraction, X-ray diffraction, instrumentation.

H. Felix Wu, Ph.D.
Program Manager, Chemistry and Materials Group

Ph.D., Mechanical Engineering, Cornell University, Ithaca, NY
M.S., Mechanical Engineering, Northwestern University, Evanston, IL
B.S., Mechanical Engineering, National Cheng-Kung University, Tainan, Taiwan

Sixteen years industrial R&D experience as Materials Engineer/Team Leader, four years project/program management experience in the Federal Government, and scientific professional in areas of fibers/polymers/composites.

Areas of interest include fibers, polymers, composites, materials interfaces and processing, composite manufacturing, civil infrastructure, durability/reliability, design, engineering mechanics, biomaterials/ bioengineering.

Steven Zullo, Ph.D.
Program Manager, Life Sciences Group

B.S., M.S., and Ph.D., Southern Illinois University at Carbondale

Areas of interest include benthic biology of acid stripmine lakes. Chironomidae as environmental indicators; drosophila genetics and speciation; mitochondrial genetics; mitochondrial function and dysfunction related to chronic hypoxia, oxidative stress and apoptosis; mitochondrial DNA gene therapy.

Electronics and Photonics Technology Office (EPTO)

Gerald Ceasar, Ph.D.
Program Manager

Ph.D, Columbia University, Physical Chemistry
B.S., Manhattan College, Chemistry
NATO and AFOSR Postdoctoral Fellow: Oxford University and Cal Tech

Joined ATP in 1994, after a 20-year career in industry at BP America and at Xerox in a variety of research management and technical positions.

Areas of interest include advanced energy and power technologies; large area electronics, thin film materials and devices; electronics and photonics technologies that look beyond today's CMOS silicon and focus on applications of quantum devices, nano and molecular assembly technologies.

Carlos Grinspon
Program Manager

MBA, The Ohio State University
BSEE, University of Massachusetts –Lowell

Ten years experience as Electronic Engineer working in industry in the areas of infrared preprocessor electronics, ASIC logical functions, and magnetic memory subsystems.

Areas of interest include infrared systems, displays and other imaging technologies, biomedical electronics, other microelectronics and photonics devices/systems.

Conway L. Lackman, Ph.D.
Economist

Ph.D, Economics, University of Cincinnati
MS, Business Administration, Arizona State University
B.A, Social Science, Ohio Wesleyan University

Ten years as high tech marketing consultant including four years with NIST/ATP and Business School professor. Twenty years as Fortune 500 marketing manager.

Areas of interest include wireless communications, radio frequency systems, telecommunications infrastructure, microelectronics.

Michael McDermott
Business Specialist

MBA, University of Pittsburgh
B.S. in Physics, John Carroll University

Twenty years experience in project management, manufacturing engineering, and operations; with emphasis in new product start-ups, product development, and quality improvement programs.

Areas of interest include electronics assembly, project management, new product research, ISO 9000 certification and training.

Purabi Mazumdar, Ph.D.
Project Manager

Ph.D., Physics, Polytechnic University, Brooklyn, NY
MBA, University of Maryland, College Park, MD

Experienced in project management, evaluation of proposals, research, development, manufacturing, quality control, and business planning in the semiconductor industry and at ATP.

Areas of interest include microelectronics, optoelectronics, semiconductor devices, semiconductor lithography, equipment for semiconductor manufacturing.

Michael Schen, Ph.D.
Program Manager

Ph.D., Polymer Science and Engineering, University of Massachusetts at Amherst, Amherst, MA
B.S., Chemistry, Rochester Institute of Technology, Rochester, NY
A.A.S., Chemistry, SUNY at Alfred, Alfred, NY

Prior to joining the ATP in 1997 as a Program Manager, Dr. Schen was the Program Manager for the NIST Laboratories' Electronic Packaging and Interconnection Program, a staff scientist at NIST in non-linear optical materials and electronic polymers, a Fulbright and French Government co-sponsored post-doctoral researcher at the Université de Montpellier, CNRS Laboratories, Montpellier, France in conducting polymers, and a research chemist at Eastman Kodak Co. in polymer science. Dr. Schen has 24 years of combined industrial, academic, and government experience in fundamental research, metrology, technology planning, program management and personnel supervision.

Areas of interest include organic and nano electronics, microelectronics and semiconductor manufacturing,connectelligence, packaging and interconnect technologies,electronic and photonic materials (especially organic/polymeric).

Elissa I. Sobolewski
Program Manager

B.S. in Mathematics, Duquesne University

Twenty-one years combined experience as a Project Manager in the field of electronics within the Department of Defense and the Department of Commerce

Areas of interest include microwave and millimeter wave technology, including materials, circuit design, processing and fabrication, packaging, testing and applications; wireless communications; fire research and advancing cost-effective technologies to support fire and emergency services personnel.

Information Technology and Applications Office (ITAO)

Bettijoyce B. Lide, Competitions Manager
Director's Office, ATP
Program Manager, Information Technology and Applications Office

M.S. in Technology Management, American University
B.S. in Chemistry, College of William and Mary

Twenty years experience in national and international efforts in the compilation and dissemination of evaluated physical and chemical reference data; Group Leader, Data Systems Development Group, Standard Reference Data, Technology Services

ATP experience includes the design, development, and implementation of competition structures; developed, with industry, the Information Infrastructure for Healthcare focused program. ATP competition structure and review process; healthcare informatics; biomedical; information technology; databases.

Harris L. Liebergot, Ph.D.
Program Manager

Ph.D. Information Science, Drexel University
M.S. Elect Eng, Drexel University
B.S. Physics, Drexel University

Twenty-four years hardware/software design, strategic planning, executive management in computer industry. Six years consultant in international information systems for U.S. Government and industry. Three years as a program manager in ATP.

Areas of interest include critical information infrastructure, dependable computing, learning systems, software engineering, general IT applications.

Omid Omidvar, Ph.D.
Program Manager

Ph.D., Electronics and Computers, University of Oklahoma
M.B.A. with concentration on securities, George Mason University

Consultant to NASA, DoD, DoT, and several Fortune 500 firms, scientist at NIST Information Technology Laboratory. Dr. Omidvar has published more than 100 technical papers, nine books in different areas such as robotics, control, vision, architecture, etc., with Ablex, Academic Press, Intellect Press, UK.

Areas of intrest include intelligent systems and pervasive computing, functional genomics and bioinformatics, biometrics and security, e-commerce, telepresences, and HDTV.

Economic Assessment Office

***Darin Boville*,** Economist

B.S. in Political Science/Public Policy Management, University of Akron. Masters in Public Policy, John F. Kennedy School of Government, Harvard University.

Five years experience in national technology policy issues in academia and government.

Areas of interest include technology policy, venture capital, and funding gap.

Connie Chang, Economist

Ph.D. coursework in science and technology policy and political economy. Massachusetts Institute of Technology
M.P.I.A. in international management, University of California, San Diego, School of International Relations and Pacific Studies
B.A. in economics, Wellesley College

Seven years with ATP; three years in investment banking.

Areas of interest include advanced materials and chemicals; manufacturing.

Jeanne Powell, Supervisory Economist
Economic Assessment Office

M.A. Economics, University of Maryland, M.A.T. Social Sciences, Northwestern University, C.P.A., B.A. History and Political Science, Cornell University

Four years performing economic modeling and analysis for Federal government, five years in public accounting (management consulting, auditing, and tax), and four years as professor of Economics and Business.

Areas of interest include survey and database design and analysis for program evaluation, program performance metrics, cost-benefit analysis.

Stephanie Shipp, Director, EAO

Ph.D., Economics, George Washington Univesity
B.A. Economics, Trinity College, Washington, D.C.

Assistant Division Chief, Housing and Household Economic Statistics Division, Census Bureau, 1997-2001. Branch Chief, Information and Analysis, Consumer Expenditure Survey Division, Bureau of Labor Statistics, 1983-1997.

Areas of interest include survey design and analysis of survey data for program evaluation; analysis of public finance issues; economic assessment studies and statistical analysis.

Contact Information for One-on-One Followup

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Omid Omidvar	301-975-4401	omid.omidvar@nist.gov

Economic Assessment Office

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Jeanne Powell	301-975-4196	jeanne.powell@nist.gov
Stephanie Shipp	301-975-8978	stephanie.shipp@nist.gov

General Information

NATIONAL MEETING INFORMATION

TECHNOLOGIES AT THE CROSSROADS: FRONTIERS OF THE FUTURE

LOCATION

The conference is at the Wyndham Baltimore Inner Harbor, 101 West Fayette Street, Baltimore, MD, phone: 410-752-1100.

COFFEE BREAKS AND LUNCH

Coffee and refreshments are provided during the morning, mid-morning, and mid-afternoon breaks. A set-menu lunch will also be provided each day.

SOCIAL EVENTS

In order to provide an opportunity for informal interaction, a hospitality reception will be held on Sunday, June 3, from 5:00 p.m. to 7:00 p.m. A cash bar reception will be held on Monday, June 4, at 6:00 p.m. Both events will take place in the "Apex Technology Arena".

TRANSPORTATION

Both Baltimore-Washington International Airport and Amtrak/MARC Penn train station are convenient to the meeting location.

Super-Shuttle, **1-800-258-3826** offers commercial van service from the hotel to Baltimore-Washington International, Dulles International, and Ronald Reagan National Airports. Call for reservations.

Taxis are available in front of the hotel.

Transportation to Inner Harbor area available. See the hotel concierge for information.

RESTAURANTS

In Wyndham Baltimore Harbor Hotel:

Shula's Steak House
Offering a formal dining experience, guests can enjoy the cuisine of one of America's top 10 steak houses.

Shula's Steak 2
For those in a more casual mood, Shula's Steak 2 offers selections ranging from steaks to sandwiches.

The Hall of Fame Lounge
Here, guests can unwind and enjoy the upscale cigar bar and appetizer menu.

Outside Wyndham Baltimore Inner Harbor Hotel:

Burkes Cafe
(Dining - Breakfast/Brunch)
36 Light St (at Comedy Factory), Baltimore 21202 • 410-752-4189

Maison Marconi
(Dining - Fine Dining)
106 West Saratoga St, Baltimore 21201 • 410-727-9522

Woman's Industrial Exchange
(Dining - Lunch)
333 N Charles St, Baltimore 21201 • 410-685-4388

Sotto Sopra
(Dining - Lunch)
405 N Charles St, Baltimore 21201 • 410-625-0534

Donna's at the Gallery
(Dining - Dessert & Coffee)
200 E Pratt St, Baltimore 21202 • 410-659-5315

Tio Pepe
(Dining - Fine Dining)
10 E Franklin St, Baltimore 21202 • 410-539-4675

Cheesecake Factory
(Dining - Dessert & Coffee)
201 E Pratt St Inner Harbor, Baltimore 21202 • 410-234-3990

NIST GENERAL INFORMATION

... working with industry to develop and apply technology, measurement and standards.

As part of the Commerce Department's Technology Administration, the National Institute of Standards and Technology (NIST) works to promote U.S. economic growth by collaborating with industry to develop and apply technology, measurements, and standards. NIST carries out its mission through a portfolio of four major programs:

Measurement and Standards Laboratories that provide technical leadership for vital components of the nation's technology infrastructure needed by U.S. industry to continually improve its products and services; the Advanced Technology Program, which accelerates the development of innovative technologies for broad national benefit through R&D partnerships with the private sector; grassroots Manufacturing Extension Partnership with a nationwide network of local centers offering technical and business assistance to smaller manufacturers; and highly visible quality outreach program associated with the Malcolm Baldridge National Quality Award that recognizes continuous improvements in quality management by U.S. manufacturers and service companies.

In fiscal year 2001, NIST is operating on a budget of about $720 million with nearly 3,200 staff members at its sites in Gaithersburg, Maryland and Boulder, Colorado. News and general information about NIST programs and services are available on the World Wide Web at http://www.nist.gov, or you can call general inquiries at: (301) 975-NIST (975-6478) or e-mail: inquiries@nist.gov.

NIST at 100: Foundations for Progress

For 100 years, the National Institute of Standards and Technology has helped to keep U.S. technology at the leading edge. Over the years, NIST has made solid contributions to image processing, DNA diagnostic "chips," smoke detectors, and automated error-correcting software for machine tools. NIST also has had major impact on atomicclocks, X-ray standards for mammography, scanning tunneling microscopy, pollution-control technology, and high-speed dental drills.

Founded on March 3, 1901, as the National Bureau of Standards, NIST was the federal government's first physical science research laboratory. NIST's major accomplishments of the past 100 years and their impact on industry, science and technology, the nation's economy, and the public—are described in **NIST at 100: Foundations for Progress**, an extensive, illustrated web site at ***www.100.nist.gov***.

ATP GENERAL INFORMATION

... accelerating the development of innovative technologies through partnerships with the private sector.

The Advanced Technology Program (ATP) bridges the gap between the research lab and the marketplace, stimulating prosperity through innovation. Through partnerships with the private sector, ATP's early stage investment is accelerating the development of innovative technologies that promise significant commercial payoffs and widespread benefits for the nation. As part of the highly regarded National Institute of Standards and Technology, the ATP is changing the way industry approaches R&D, providing a mechanism for industry to extend its technological reach and push out the envelope of what can be attempted.

Technology research in the private sector is driven by today's global, economic realities. The pace of technological change is faster than ever before, and victory goes to the swift. These realities force companies to make narrower, shorter-term investments in R&D that maximize returns to the company quickly.

The ATP views R&D projects from a broader perspective – *its bottom line is how the project can benefit the nation*. In sharing the relatively high development risks of technologies that potentially make feasible a broad range of new commercial opportunities, the ATP fosters projects with a high payoff for the nation as a whole – in addition to a direct return to the innovators. The ATP has several critical features that set it apart from other government R&D programs:

- ATP projects focus on the technology needs of American industry, not those of government. Research priorities for the ATP are set by industry, based on their understanding of the marketplace and research opportunities. For-profit companies conceive, propose, co-fund, and execute ATP projects and programs in partnerships with academia, independent research organizations and federal labs.

- The ATP has strict cost-sharing rules. Joint Ventures (two or more companies working together) must pay at least half of the project costs. Large, Fortune-500 companies participating as a single firm must pay at least 60 percent of total project costs. Small and medium-sized companies working on single firm ATP projects must pay a minimum of all indirect costs associated with the project.

- The ATP does not fund product development. Private industry bears the costs of product development, production, marketing, sales and distribution.

- The ATP awards are made strictly on the basis of rigorous peer-reviewed competitions. Selection is based on the innovation, the technical risk, potential economic benefits to the nation and the strength of the commercialization plan of the project.

- The ATP's support does not become a perpetual subsidy or entitlement – each project has goals, specific funding allocations, and completion dates established at the outset. Projects are monitored and can be terminated for cause before completion.

The ATP partners with companies of all sizes, universities and non-profits, encouraging them to take on greater technical challenges with potentially large benefits that extend well beyond the innovators – challenges they could not or would not do alone. For smaller, start-up firms, early support from the ATP can spell the difference between success and failure. To date, more than half of the ATP awards have gone to individual small businesses or to joint ventures led by a small business. Large firms can work with the ATP, especially in joint ventures, to develop critical, high-risk technologies that would be difficult for any one company to justify because, for example, the benefits spread across the industry as a whole.

Universities and non-profit independent research organizations play a significant role as participants in ATP projects. Out of the more than 526 projects selected by the ATP since its inception, well over half of the projects include one or more universities as either subcontractors or joint-venture members. All told, there are more than 153 individual universities participating in ATP projects.

ATP awards are selected through open, peer-reviewed competitions. All industries and all fields of science and technology are eligible. Proposals are evaluated by one of several technology-specific boards that are staffed with experts in fields, such as biotechnology, photonics, chemistry, manufacturing, information technology, or materials. All proposals are assured an appropriate, technically competent review even if they involve a broad, multi-disciplinary mix of technologies.

The ATP accepts proposals only in response to specific, published solicitations. Notices of ATP competitions are published in *Commerce Business Daily*. You may also request to be placed on a mailing list to receive notification of ATP competitions and other events by calling the ATP automated hotline (1-800-ATP-FUND) or by sending email to atp@nist.gov. The ATP Proposal Preparation Kit may be requested at any time. In addition to the necessary application forms, the kit includes a thorough discussion of the ATP goals and procedures as well as useful guidelines in the preparation of a proposal. Further information can also be found on the program's web site.

ATP Contact Information

Advanced Technology Program	
Hotline	1-800-ATP-FUND (1-800-287-3863)
Email	atp@nist.gov
Fax	(301) 926-9524
Homepage	www.atp.nist.gov
Electronics and Photonics Technology Office	(301) 975-4355
Email	atp-electronics@nist.gov
Information Technology and Applications Office	(301) 975-4643
Email	atp-infotech@nist.gov
Chemistry and Life Sciences Office	(301) 975-4714
Email	atp-chemistry@nist.gov
Email	atp-biotech@nist.gov
Economic Assessment Office	(301) 975-3189
Email	atp-eao@nist.gov

Small Business Participation in the Advanced Technology Program

Can small business compete effectively for funding under the Commerce Department's Advanced Technology Program? Although the ATP makes no special allowance for small business, the results of the first eleven years of the program show that small and mid-sized firms in fact are very successful in the rigorous, hard-fought ATP competitions.

Since 1990, the ATP has selected a total of 526 projects for cost-sharing awards to individual companies or industry-led joint ventures to develop high-risk, enabling technologies that would stimulate the U.S. economy by making possible important new products, services, or industrial processes for the world's markets. Well over half (58 percent) of these have gone to individual small businesses or to joint ventures led by a small business. Other small businesses also are involved in significant numbers in joint R&D ventures supported by the ATP, forming strategic partnerships with larger firms.

The small businesses that win ATP awards do so entirely on merit: no extra points are given for being a small business. Innovative technical ideas that have substantial potential impact on the economy are the key—and small companies have long been recognized as fertile ground for innovation.

ATP award winners have included quite a few start-up companies, small firms for whom the ATP can mean the difference between success and failure. ATP projects at small companies have already led to a radical new design for the next generation of high-current ion beam implanters (an important tool of the semiconductor industry); a revolutionary new organic-compound detection technique that provides a thousand-fold increase in sensitivity for the pharmaceutical and clinical chemistry industries; key technologies underlying the new "gene chips" that are having a dramatic impact in biotechnology; new superconductor technologies to improve cellular phone systems; innovative measurement technologies for the U.S. auto industry to improve the quality and lower the cost of new cars; a wholly new technology for inactivating dangerous viruses in human blood supply products; and many others.

Out of 526 ATP Awards:

Single applicants:	353	Small business:	250
Joint ventures:	173	Led by small business:	59

University Participation in the Advanced Technology Program

As part of the highly regarded National Institute of Standards and Technology, the Advanced Technology Program places special emphasis on working directly with industry, in contrast to other federal funding agencies that provide primary support for R&D at universities. By law, only for-profit companies and industry-led joint ventures are allowed to directly receive ATP awards. But universities, a traditional source of research excellence in the United States, play a significant role in many ATP projects, either as subcontractors or as members of industry-led joint ventures.

Out of the 526 projects selected by the ATP since its inception, 279 of the projects included plans to involve one or more universities as either subcontractors or joint-venture members. In many of these cases, more than one academic institution was involved. There are over 490 individual instances of university participation in ATP projects all told.

As some of the leading research institutions in the country, universities also are a valuable source of ideas. The ATP offers a vehicle to help move ground-breaking academic research with the potential for revolutionary change from the laboratory into the nation's industries.

Modes of participation

There are two ways that universities and non-profit independent research organizations can participate in ATP projects:

- A university or non-profit independent research organization (IRO) can be a subcontractor to a single company or to a joint venture of two or more for-profit companies.

- A university or IRO can participate in a joint venture that includes at least two for-profit companies, both of which are substantially involved in the R&D and both contributing toward the matching-fund requirement.

Any university or IRO can serve as the catalyst to organize a joint venture; however, only an IRO may submit the proposal and administer the project provided that the following conditions are met:

- The joint venture must include at least two for-profit companies, both of which are substantially involved in the R&D and both contributing toward the matching-fund requirement; and

- The industrial members of the joint venture must define the research agenda and the commercialization plans based on their needs and must have the leadership role in programmatically controlling the project. A university participating in a joint venture may not submit the proposal or administer the joint venture project.

ATP funding and cost-sharing

A university or IRO, if a subcontractor to a single applicant, can recover both direct and indirect costs from the ATP, since the cost of the subcontract is considered a direct cost to the ATP applicant, and direct costs of ATP single applicants are 100% reimbursable up to $2 million. A university or IRO acting as a member of an industry-led joint venture also can recover both direct and indirect costs from the ATP. A joint venture is required to pay the majority share of costs, both direct and indirect, on an ATP project. A university or IRO participating as a partner in a joint venture may particpate in this cost-sharing if it wishes, but it is not required to do so. The industry partners may cover the university or IRO's share of the costs.

Intellectual property

An important provision of the ATP legislation regarding intellectual property rights affects universities, federal labs and IROs—patents resulting from ATP awards must be vested in a company or companies incorporated in the United States. Thus, unless an organization participating in an ATP project is a for-profit company, it cannot retain title to patents resulting from ATP-sponsored R&D, although such an organization can receive mutually agreeable payments (either one-time, or continuing) from the company or companies holding title to the patent. In the past, ATP has agreed to submit changes in its authorization that would allow universities and companies to negotiate intellectual property agreements.

University participants

The following is a partial list of universities and other academic institutions participating in ATP projects, assembled from project proposals. (The ATP is not always informed of every incidence of university participation in projects as subcontractors or consultants.)

Arizona State University (Tempe, Ariz.)
Auburn University (Auburn, Ala.)
Baylor College of Medicine (Houston, Texas)
Boston University (Boston, Mass.)
Bradley University (Peoria, Ill.)
Brigham Young University (Provo, Utah)
Brown University (Providence, R.I.)
California Institute of Technology (Pasadena, Calif.)
Carleton University (Ottawa, Canada)
Carnegie Mellon University (Pittsburgh, Pa.)
Case Western Reserve University (Cleveland, Ohio)
Central State University (Wilberforce, Ohio)
Cincinnati Technical College (Cincinnati, Ohio)
City College of New York (New York, N.Y.)
Clark-Atlanta University (Atlanta, Ga.)
Clarkson University (Potsdam, N.Y.)
Clemson University (Clemson, S.C.)
College of William and Mary (Williamsburg, Va.)
Colorado School of Mines (Denver, Colo.)
Columbia University (New York, N.Y.)
Cornell University (Ithaca, N.Y.)
Drexel University (Philadelphia, Pa.)
Duke University (Durham, N.C.)
Emory University (Atlanta, Ga.)
Florida Atlantic University (Boca Raton, Fla.)
George Mason University (Fairfax, Va.)
George Washington University (Washington, D.C.)
Georgia Institute of Technology (Atlanta, Ga.)
Harvard University (Cambridge, Mass.)
Imperial College (London, England)
Iowa State University (Ames, Iowa)
Johns Hopkins University (Baltimore, Md.)
Kansas State University (Manhattan, Kan.)
Karolinska Institute (Stockholm, Sweden)
Kent State University (Kent, Ohio)
Lehigh University (Bethlehem, Pa.)
Louisiana State University (Baton Rouge, La.)
Marquette University (Milwaukee, Wis.)
Massachusetts Institute of Technology (Cambridge, Mass.)
Medical College of Pennsylvania (Philadelphia, Pa.)
Medical University of South Carolina (Charleston, S.C.)
Michigan State University (East Lansing, Mich.)
New Jersey Institute of Technology (Newark, N.J.)
New York Medical College (Elmsford N.Y.)
New York University (New York, N.Y.)
North Carolina State University (Raleigh, N.C.)
Northeastern University (Boston, Mass.)
Northwestern University (Evanston, Ill.)

Ohio State University
(Columbus, Ohio)
Ohio University (Athens, Ohio)
Oregon Health Sciences University
(Portland, Ore.)
Pennsylvania State College
(State College, Pa.)
Philadelphia College of Textiles and
Science (Philadelphia, Pa.)
Portland State (Portland, Ore.)
Princeton University
(Princeton, N.J.)
Purdue University
(West Lafayette, Ind.)
Rensselaer Polytechnic Institute
(Troy, N.Y.)
Rice University (Houston, Texas)
Rutgers University
(Piscataway, N.J.)
San Diego State University
(San Diego, Calif.)
San Jose State University
(San Jose, Calif.)
Stanford University (Palo Alto, Calif.)
State University of New York at
Albany (Albany, N.Y.)
State University of New York at
Brooklyn (Brooklyn, N.Y.)
State University of New York at
Buffalo (Buffalo, N.Y.)
State University of New York at Stony
Brook (Stony Brook, N.Y.)
Stevens Institute of Technology
(Hoboken, N.J.)
Swiss Federal Institute of Technology
(Lausanne, Switzerland)
Syracuse University
(Syracuse, N.Y.)
Texas A&M
(College Station, Texas)
Texas Tech University
(Lubbock, Texas)
Tufts University (Medford, Mass.)
University of Alabama at Birmingham
(Birmingham, Ala.)
University of Alabama at Huntsville
(Huntsville, Ala.)
University of Alabama at Tuscaloosa
(Tuscaloosa, Ala.)
University of Arizona (Tucson, Ariz.)
University of British Columbia
(Vancouver, Canada)
University of California at Berkeley
(Berkeley, Calif.)
University of California, Irvine
(Irvine, Calif.)
University of California at
San Diego (San Diego, Calif.)
University of California at San
Francisco (San Francisco, Calif.)
University of California at Santa
Barbara (Santa Barbara, Calif.)
University of Central England
(Birmingham, England)
University of Cincinnati
(Cincinnati, Ohio)
University of Colorado
(Boulder, Colo.)
University of Connecticut (Storrs, CT)
University of Dayton (Dayton, Ohio)
University of Delaware
(Newark, Del.)
University of Detroit, Mercy
(Detroit, Mich.)
University of Florida at Alachua
(Alachua, Fla.)
University of Florida at Gainesville
(Gainesville, Fla.)
University of Georgia (Athens, Ga.)
University of Houston
(Houston, Texas)
University of Idaho (Moscow, Idaho)
University of Illinois at Chicago
(Chicago, Ill.)
University of Illinois at Urbana
(Urbana, Ill.)
University of Kansas
(Lawrence, Kan.)
University of Kentucky
(Lexington, Ky.)
University of Liege
University of Maryland at Baltimore
(Baltimore, Md.)
University of Maryland at College
Park (College Park, Md.)
University of Massachusetts
(Amherst, Mass.)
University of Michigan
(Ann Arbor, Mich.)
University of Michigan
(Dearborn, Mich.)
University of Minnesota
(Minneapolis, Minn.)
University of Missouri at Rolla
(Rolla, Mo.)
University of Missouri at St. Louis
(St. Louis, Mo.)
University of Nebraska at Lincoln
(Lincoln, Neb.)
University of New Mexico
(Albuquerque, N.M.)

University of North Carolina at Chapel Hill (Chapel Hill, N.C.)
University of North Carolina at Charlotte (Charlotte, N.C.)
University of Oklahoma (Norman, Okla.)
University of Pennsylvania (Philadelphia, Pa.)
University of Pittsburgh (Pittsburgh, Pa.)
University of South Carolina (Columbia, S.C.)
University of Southern California (Los Angeles, Calif.)
University of Southern Mississippi (Hattiesburg, Miss.)
University of Tennessee (Knoxville, Tenn.)
University of Texas at Arlington (Arlington, Texas)
University of Texas at Austin (Austin, Texas)
University of Toronto (Toronto, Canada)
University of Tulsa (Tulsa, Okla.)
University of Utah (Salt Lake City, Utah)
University of Virginia (Charlottesville, Va.)
University of Washington (Seattle, Wash.)
University of Wisconsin at Madison (Madison, Wis.)
University of Wisconsin at Milwaukee (Milwaukee, Wis.)
University of Wyoming (Laramie, Wyoming)
Vanderbilt University (Nashville, Tenn.)
Virginia Polytechnic Institute (Blacksburg, Va.)
Washington State University (Pullman, Wash.)
Washington University (St. Louis, Mo.)