TESTIMONY

ON

THE DEPARTMENT OF ENERGY
OFFICE OF SCIENCE

BEFORE

THE SENATE ENERGY AND NATURAL RESOURCES SUBCOMMITTEE ON ENERGY

JULY 29, 2003

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Mr. Chairman, Members of the Committee, thank you for the opportunity to testify today. I've been asked to testify about the impact of the DOE science programs. I know them first hand, since my research has been supported by DOE and its predecessors, ERDA and the AEC, for more than four decades. I also directed one of DOE's science laboratories, the Stanford Linear Accelerator Center, for fifteen years.

According to statistics from the National Science Foundation's Science and Engineering Indicators, the Department of Energy is the largest supporter of long-term research in the physical sciences in the federal government (table attached). It is also the largest in mathematics and computing, and is number three in engineering. DOE's large-scale research facilities are essential to the work of more than 18,000 scientists in many disciplines from universities, industry and national laboratories. Most of the DOE's science activities are carried out through its Office of Science (SC).

These budgets are truly impressive. However, it is easy to spend money, but harder to spend it well. A close look will find that DOE's science funding has been well-spent indeed. One can look at any of the branches of Office of Science and see its leading role in advancing the nation's science and technology agenda.

- In Computing, SC operates the largest computer facility available for scientific work outside the nation's weapons laboratories, in the NERSC facility at the Lawrence Berkeley National Laboratory. Huge programs in physics simulation, combustion modeling, and climate change are being run. The computer is overloaded, its speed is less than what is required, and a new and larger facility is badly needed.

- In Nuclear and High-energy Physics, DOE builds and operates some of the world's leading accelerator facilities. The scientific output is prodigious as can be seen by counting papers, Nobel Prizes, or the number of foreign scientists that come to use these facilities.

- The Fusion Program has been at the forefront of the scientific advances that have led the nations of the world to international discussions on collectively building the world's first burning plasma facility. This $5 billion facility is a necessary prelude to the development of fusion as an energy source.

- The Basic Energy Sciences Program has led to great advances in condensed matter physics, materials and chemistry. Its synchrotron light sources, with their x-ray beams millions of times the intensity of conventional x-ray tubes, have had a revolutionary impact. Among those impacts is the development of the field of structural biology, and 35% of DOE's synchrotron light users are funded by the National Institutes of Health to untangle the structure of biologically important molecules.

- The Biological and Environmental Research Program was the engine for the start of the Human Genome Project at a time when the National Institutes of Health was hesitant to start what seemed to be a large, costly and long-term program. BER today has a broad portfolio and plays a major role in the U.S. Climate Change Research Program.

I said earlier that the DOE was the largest supporter of long-term research in the physical sciences in the federal government. In a time of large budget deficits, it may be imprudent to ask if this support is enough, but the question needs to be asked The President's Council of Advisors on Science and Technology (PCAST) thinks not and says so in its report of last fall, "Assessing the US R&D Investment". Industry also thinks not. Industry relies on government-funded research for the work that will be behind the "next big thing." As time goes on, the "last big thing" (telecommunications equipment, laptop computers, cell phones, for example) becomes a commodity, and its production (and the jobs that go with it) moves off shore to lower-cost locations.

The U.S. economy needs this next big thing. DOE's programs in such areas as nano-technology, quantum computing, or perhaps something that has not yet emerged clearly, may supply it. For the record, I have attached a copy of a letter to the President on this matter signed by a collection of Nobel Laureates and senior industrial personnel.

Mr. Chairman, Congress needs to take a hard look at the situation of the physical sciences in the federal budget. Over the last ten years the budget of the DOE Office of Science has declined, the budget of the National Science Foundation has increased by about 50%, and the budget of the National Institutes of Health has doubled (analysis attached). The increase in funding for the NIH and NSF has been a good thing. A recent bill, passed by Congress and signed by the President, authorizes a further doubling of the National Science Foundation's budget, also a good thing. However, because of the broad portfolio of the National Science Foundation, doubling its

budget alone would increase the funding of the Physical Sciences by only about 15%. Thus, the DOE's Office of Science needs attention.

The present situation is bad for the nation's science, is bad for the nation's economy and bad for the nation's security. Action is needed and I hope that the lead is taken by the Administration and Congress together.

----------Letter to President Bush, April 14, 2003----------

April 14, 2003

The President The White House Washington, DC 20500

Dear Mr. President:

This letter is prompted by the beginning of preparations for the FY 2005 budget, and the release, on October 16, 2002, of the report by your Council of Advisers on Science and Technology, "Assessing the U.S. R&D Investment." That report noted serious problems in the physical sciences, environmental sciences, mathematics, computer science and engineering that, unless remedied, will affect our scientific and technological leadership, thereby affecting our economy and national security. You began addressing these challenges in your FY 2004 budget submission, and more will need to be done to reverse the decline of the 1990s. From our perspectives in industry, academia and national laboratories, the PCAST report accurately stated,

"[T]he lack of funding in these…disciplines is cause for concern for a number of reasons: Both full-time graduate and Ph.D. students in most physical sciences, math and engineering are decreasing….Facilities and infrastructure in general for the physical sciences are becoming less than adequate for the needs of today's research problems. It is widely understood and acknowledged that the interdependence of the various disciplines requires that all advance together" (p. 5).

We note, further, that the growth in expert personnel abroad, combined with the diminishing numbers of Americans entering the physical sciences, mathematics and engineering – an unhealthy trend – is leading corporations to locate more of their R&D activities outside the United States.

We applaud your support for research as demonstrated by your administration's recently completed doubling of the NIH bio-medical research budget, and your signing of the bill authorizing major increases in the NSF budget. However, it is not widely recognized that NSF supports only a small portion of long-term research in the physical sciences, mathematics and engineering. A Presidential initiative for FY 2005, following on from your budget of FY 2004, and focusing on the long-term research portfolios of DOE, NASA, and the Department of Commerce, in addition to

NSF and NIH, would turn around a decade-long decline that endangers the future of our nation.

Dr. Marburger and Mr. Kvamme put it succinctly in their letter accompanying the PCAST report: "the report suggests targeting the physical sciences and certain engineering fields ... for budgetary reallocation given their importance to our nation's economic well-being and competitiveness in order to better balance the available budget dollars." We concur, and hope that even in these times of budgetary stress you can, through a Presidential initiative in the FY 2005 budget, expand on what you have begun to increase the nation's investment in future strength

Respectfully,

Burton Richter Physics Nobel Laureate Director Emeritus Stanford Linear Accelerator Center

Craig Barett Chief Executive Officer Intel Corporation

Phillip Anderson Physics Nobel Laureate Professor of Physics Princeton University

Ned Barnholt President and Chief Executive Officer Agilent Technologies

Nicholaas Bloembergen Physics Nobel Laureate Gerhard Gade University Professor, Emeritus Harvard University and Optical Sciences Center University of Arizona Linden Blue Vice Chairman General Atomics

John F. Cassidy Senior Vice President for Science and Technology United Technologies Corp

Steven Chu Physics Nobel Laureate Theodore and Francis Geballe Professor in the Humanities and Sciences Stanford University

Stuart D. Doyle Senior Vice President EDS General Motors

Jerome I. Friedman Physics Nobel Laureate Institute Professor Massachusetts Institute of Technology

Jerome J. Gaspar Senior Vice President Engineering & Technology Rockwell Collins

Ivar Giaever Physics Nobel Laureate Institute Professor Schools of Science and Engineering Rensselaer Polytechnic Institute

Sheldon Lee Glashow Physics Nobel Laureate University Professor & Metcalf Professor of Physics Boston University

Raymond G. Hemann President and Chief Executive Officer Advanced Systems Research, Inc.

William D. Hill Vice-President Engineering and Technology, Corporate Officer The Stanley Works

Russell A. Hulse Physics Nobel Laureate Principal Research Physicist Princeton Plasma Physics Laboratory

Dick Lampman Director Hewlett-Packard Laboratories

Joseph J. Miller, Jr. Executive Vice President and Chief Technology Officer Corning Incorporated

Craig J. Mundie Senior Vice President & Chief Technical Officer Microsoft Corporation

Richard Pearson President National Center for Manufacturing Sciences

Martin L. Perl Physics Nobel Laureate Professor of Physics Stanford Linear Accelerator Center

Robert Richardson Physics Nobel Laureate Vice-Provost for Research Cornell University

Robert N. Schmidt President, Cleveland Medical Devices Inc.

William T. Siegle Senior Vice President, Technology Operations and Chief Scientist Advanced Micro Devices

Russ Shade Chief Executive Officer High Voltage Engineering Corporation

Horst Stormer Physics Nobel Laureate Professor of Physics and Applied Physics Columbia University

Richard Taylor Physics Nobel Laureate Professor Stanford Linear Accelerator Center

Charles H. Townes Physics Nobel Laureate Professor of Physics University of California at Berkeley

John J. Tracy Vice President Boeing Phantom Works

Daniel C. Tsui Physics Nobel Laureate Professor of Electrical Engineering Princeton University

Kenneth Wilson Physics Nobel Laureate Professor of Physics The Ohio State University

Robert W. Wilson Physics Nobel Laureate Senior Scientist Harvard-Smithsonian Center for Astrophysics

CURRICULUM VITAE

Burton Richter – Paul Pigott Professor in the Physical Sciences, Stanford University Director Emeritus, Stanford Linear Accelerator Center Education

B.S. – Massachusetts Institute of Technology – June 1952 Ph.D. – Massachusetts Institute of Technology – September 1956

Employment Research Associate, High Energy Physics Laboratory, Stanford University, 1956-1960 Assistant Professor, Physics Department, Stanford University, 1960-1963 Associate Professor, Stanford Linear Accelerator Center, Stanford University, 1963-1967 Professor, Stanford Linear Accelerator Center, Stanford University, 1967 - Technical Director, Stanford Linear Accelerator Center, Stanford University, 1982-1984 Director, Stanford Linear Accelerator Center, Stanford University, 1984 -1999

Honors and Awards Loeb Lecturer, Harvard University, 1974 DeShalit Lecturer, Weizmann Institute, 1975 E. O. Lawrence Medal (U.S. Department of Energy), 1976 Nobel Prize in Physics, 1976 National Academy of Sciences, 1977 American Academy of Arts and Sciences (Fellow), 1989 Astor Visiting Lecturer, Oxford University, 2000 Laurea Honoris Causa in Fisica, Universita di Pisa, 2001 American Philosophical Society, 2003

Professional Societies American Physical Society (Fellow; President, 1994) American Association for the Advancement of Science (Fellow) European Physical Society

Committees, Consultantships and Directorships Member of the JASON Group — Mitre Corporation Member of the Board of Directors — Varian Medical Systems 1989-2002 Member of the Board of Directors — Litel Instruments, Inc. 1990- Member of the Board of Directors -- AREVA Enterprises, Inc. 2003- Honorary Member of the Board of Regents — The Mercersburg Academy Member of the Secretary of Energy Advisory Board (SEAB) President of the International Union of Pure and Applied Physics (IUPAP) 1999-2002 Member of Le Haut-Commissaire à l'Energie Atomique Visiting Committee (CEA) Chair, Committee on the Accelerator Transmutation of Nuclear Waste — DOE PCAST Review Panel; National Climate Change Assessment Member of the Executive Board — International Council for Science (ICSU) SEAB Review Committee on the National Ignition Facility Member of

the Board on Physics and Astronomy (Chair, 2003-) — National Research Council/National Academies of Science (NRC/NAS)

Open Publications Over 300 publications in high-energy physics, accelerators, and colliding beam systems.

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