High Energy Physics Advisory Panel
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Thank you for inviting me to speak this morning. I want to congratulate HEPAP for producing the two excellent reports on the "Quantum Universe." The recent report *"Discovering the Quantum Universe"* is as cleverly done as the earlier *"Quantum Universe"* and makes the case for continuing the quest for the fundamental constituents of nature in a very appealing way. I enjoyed it very much, and I am looking forward to hearing your impressions about how other audiences, especially non-physicists, have reacted to it.

Physical science received a boost when President Bush spoke of it in his State of the Union speech in January. Not one, but two science initiatives were featured, and the Department of Energy is a major beneficiary of both. I am going to talk more about the *American Competitiveness Initiative* (ACI), but the President has also launched an *Advanced Energy Initiative* (AEI) that focuses on alternative energy sources aimed at national energy independence. These initiatives appeared following a year of high visibility advocacy from a variety of groups, culminating in a report by a National Academy of Sciences panel chaired by former Lockheed-Martin chairman Norm Augustine. It is not correct to think of ACI as a response to the Augustine report, but the recommendations of the latter do significantly overlap the ACI and the AEI. Many other reports have appeared in recent years that make similar recommendations. They provide a policy context for understanding the significance of the Presidential initiatives.

The Competitiveness Initiative differs from the recommendations of the NAS report in a number of important respects. You may be aware of its components, but I will go over them here. Expanded federal funding for selected agencies with physical science missions; improved tax incentives for industrial investment in research; improved immigration policies favorable to high tech talent from other countries; and a cluster of education and training initiatives designed to enhance math and science education, particularly at the K-12 level. A brochure is available on the OSTP website that goes into more detail. I am only going to talk today about the physical science funding, and its implications for high energy physics.

The most expensive part of the ACI would be the permanent extension of the Research and Experimentation Tax Credit, which expired last December. Its cost would be $4.6 billion in the first year, accumulating to $86.4 billion over a ten year period. A total of $910 million is slated for the budgets of three designated "physical science" agencies. This is a 9.3% increase for the selected agencies, and the plan is to double their collective budgets over 10 years, a cumulative cost of $50 billion. The three agencies are DOE Office of Science, NSF, and what is called the NIST Core budget.

As this audience knows, federal physical science funding has been flat in constant dollars for more than a decade. The reasons for this are well understood, but involve multiple factors. Most dramatic was the abrupt change in Department of Defense research starting in 1991, the year historians cite as the end of the Cold War. The Department of Energy too began a re-examination of the roles of its laboratories in the post-Cold War period, of which a 1995 report by a committee chaired by Motorola's Bob Galvin was an early product. Recall that there was a recession during 1990-91, and Congress was looking for a "peace dividend" following the dissolution of the Soviet Union. Congress terminated the SSC project in 1992, and House Science Committee chairman George Brown exhorted scientists to re-think their case for continued funding, especially in physical science. Toward the end of the decade a new case did emerge in a document that ought to be better known. Congressman Vern Ehlers produced a report whose short title is *"Unlocking the Future"* that clearly stated the conclusion that the rationale for funding science was to ensure future economic competitiveness. While not emphasizing physical science, the report did stress that "It is important that the federal government fund basic research in a broad spectrum of scientific disciplines, including the physical, computational, life and social sciences, as well as mathematics and engineering, and resist overemphasis in a particular area or areas relative to others."

At the turn of the twentieth century, science policy makers began to worry about a growing imbalance between support for biological and physical science. Biomedical investigators were aware they depended on physical science instrumentation, and NIH leadership began to take steps to ensure access to it. Already in the late 90's NIH had transferred some of its funds to build beam lines at DOE's x-ray synchrotron facilities. In Fiscal Year 2002 expenditures for physical science by NIH actually exceeded those by NSF. Early in the new Bush Administration the President's Council of Advisors on Science and Technology (PCAST) released a report called *"Assessing the U.S. R&D Investment"* that said "All evidence points to a need to improve funding levels for physical sciences and engineering. " At the time, the country was still suffering the economic consequences of the burst dotcom bubble, and was realigning budget priorities in response to the terrorist attacks of September 2001. Completing the commitment to double the NIH budget was the highest science priority, next to establishing an entirely new science and technology initiative for homeland security. Nevertheless the Administration continued to expand funding for targeted areas of physical science, including the recently introduced National Nanotechnology Initiative, and maintained funding for the Networking and Information Technology R&D program. The NSF budget continued to increase at a rate above inflation. In the first term of the Bush Administration, combined federal R&D funding soared at a rate unmatched since the early years of the Apollo program, a jump of 45% in constant dollars over four years.

The ACI improves conditions for many if not all areas of physical science, but emphasizes fields likely to produce economically important technologies in the future. These are not difficult to identify, and all developed countries recognize their importance. Chief among them is the continued exploitation of our recent ability to image, analyze, and manipulate matter at the atomic scale. New technologies can be expected to spring from improved atomic-level understanding of materials and their functional properties in organic as well as inorganic systems. Physicists see exciting prospects for technologies based on quantum coherence. Chemists envision industry-transforming catalysts and new approaches to clean energy production. The convergence of nano-, info-, and bio-technology is already a familiar concept whose power has barely begun to reveal itself in applications.

Opportunities exist in particle physics and space science and exploration as well, but these are not emphasized in the Competitiveness Initiative. Not that the U.S. is withdrawing from these fields. Some of the increased budgets in NSF and DOE will increase their vigor. The overall NASA budget is sustained in the President's FY07 budget proposal at historically agreed upon levels, although space science is facing flat or diminished budgets for the next few years. In my view the U.S. is devoting a very healthy budget to space science, and with 56 space science missions currently flying it would be hard to argue that our international leadership in this area is in jeopardy. But ACI does signal an intention to fund the machinery of science in a way that ensures continued leadership in fields likely to have the greatest impact on future technology and innovation. In particular, although ACI will relieve some budget pressure on DOE high energy and nuclear physics, its priority thrust is toward the cluster of facilities and programs within Basic Energy Sciences (BES).

What does this mean for high energy physics? It means that the case for public funding for particle and nuclear physics is different from the case for lower energy physics. The particle physics community cannot rest in its pursuit of public support for its vision of exploring frontiers remote from socially important applications. In my view, the case made by HEPAP in the *"Quantum Universe"* reports sets the right tone for the campaign that must be pursued to achieve the necessary support for a new large accelerator. The International Linear Collider continues to be an important part of DOE's long term planning, but the ACI should not be interpreted as endorsing it as Administration policy. The American Competitiveness Initiative aims to strengthen fields more characteristic of Basic Energy Sciences, and is more or less neutral toward high energy or nuclear physics, which however will benefit from the initiative. BES is certainly under-funded relative to its importance to society, just as biomedical research was under-funded in the 1980's relative to its rapidly growing significance for health care. In an era of extraordinary demands on the U.S. domestic discretionary budget, course corrections in federal science funding entail the setting of priorities, the rationale for which must recognize national objectives of the utmost importance. ACI focuses on long term economic competitiveness, not long term dominance in particle and nuclear physics.

High energy physics labors at what is arguably the deepest frontier of science, and this fact is significant to its long term appeal to great nations. I expect it to continue to receive federal support in the context of a broadening trend of international collaboration.

Thank you again for inviting me, I will be glad to answer questions.