2016 APS President — Homer Neal

By Emily Conover

Homer Neal, a particle physicist from the University of Michigan and a member of the ATLAS experiment, took over as 2016 APS President on January 1. In 2015 he served as pres-

ident-elect and as vice president in 2014. At the University of Michigan, Neal has served as interim presi-

dent and vice president for research, and as chair of the physics depart-

ment. He has also served as vice president for academic affairs and provost at Stony Brook University, and dean for research and graduate development at Indiana University. Neal was a member of the board of directors of Ford Motor Com-

pany for 18 years, and has served on numerous advisory committees for national labs and other scientific institutions. He received his Ph.D. in physics in 1966 from the University of Michigan.

During a recent visit to APS headquarters in College Park, Md., Neal received a childhood photo of his small town of Franklin, Kentucky, a place he described as "highly segregated," with separate schools and separate waiting rooms in the doctor’s office for white and black patients. Neal’s childhood hobby was ham radio, and he became close friends with another ham operator in his town, who was white. But, as Neal is African-American, leaders in the town disapproved of their relationship.

Neal was both astounded, and agreed to stop our communica-
tions," Neal said. "But it did teach me that basically when individuals are working on a scientific project together, the color of one’s skin doesn’t matter. It mattered to oth-
er’s, but it didn’t matter to us.”

By Emily Conover

New DOE Science Director Sets Sights on “Pasteur’s Quadrant”

By David Voss

Attend the APS Division of Fluid Dynamics (DFD) meeting and you’ll be served a fairly con-
tentious menu of plenary talks and technical sessions. Off the beaten path, however, you might find a feast for the eyes.

Each year the meeting hosts the division’s Gallery of Fluid Motion (GFM), which showcases the win-

ners in the annual contest for the best short videos and colorful poster presentations. These highlight how modern visualization methods and computer power can convey the complexity of fluid behavior (GFM is at gfm.aps.org).

And it’s not just science—also included is the aesthetic plea-
sure of motion, color, sound, and light. GFM coordinator Ken Kiger remembers his first encounter with the gallery: “As a first year grad student, I went to the DFD with my advisor,” Kiger recalls, “and they had this gallery up. I was capti-
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Kiger is a physics professor at the University of Maryland and has been running the gallery since 2010. “I’ve always felt there was an aesthetic quality to the fluid motion.”

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Art and Science in the Gallery of Fluid Motion

By David Voss

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The inspiration for the gallery came in the 1980s when physicist Milton van Dyke compiled a photo album to help teach fluid mechanics. “He solicited images from the com-
munity, and got over a thousand,” says Kiger. “Then, in 1983 (fluid dynamictist) Helen Reed organized the first Gallery of Fluid Motion at the division meeting. Apparently there was pent-up demand because they got 70 entries.” That number is even more significant when you consider that three decades ago the meeting had only 400 attendees, compared to over 3000 now.

Back then, the gallery entries were poster presentations. “Video entries came a decade later,” Kiger explains, but even then it was cum-
bersome. “They had to be sent in on VHS tape, local organizers had to dub a master tape, then put it in a VCR and have it loop. It was tedious.”

This year’s gallery featured videos and posters ranging from colorful simulations of hum-

mingbird flight to gruesome but effective models of blood loss and hemorrhaging produced by a pro-
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March 2016

This Month in Physics History

February 1811: Amadeo Avogadro Enumerated the Molecular World

By Richard Williams

Amadeo Avogadro, (1776-1856), lived in a time of flux in both Paris and in the govern- ment of his community. In physics, the very nature of the elements was debated by the leading scientists: Were they atoms or diatomic molecules? In gov- ernance, Turin, and the Piedmont Region where he lived were ruled successively by the Dukes of Savoy, the King of Sardina, and Napoleon Bonaparte, and then by the army of the Austro-Hungarian Empire.

Finally Turin was returned to the house of Savoy, all of this during Avogadro’s lifetime, while he lived and worked at the University of Turin. He resolved the confusion in physics, and, to the detriment of his career, gave his support to a political cause during the aftermath of Napoleon’s legislation. His discovery of the fundamental numerical property of gases underlies our understand- ing of the molecular world. His political activities cost him his professorship at the University of Turin, but he was reinstated in the new electoral cycle that would follow.

His full name was Lorenzo Romano Amedeo Carlo Avogadro, from a long line of nobility, achieved with his historical students in the legal profession. Their name derives from avogato, Italian for lawyer. He followed the family passion for science for some years, then, self-taught, began to work in phys- ics. He became professor of physics at the Academy at Vercelli, and later at the University of Turin.

Much of physics, at the time, was focused on the nature of gases. The French physicist, Joseph Louis Gay-Lussac observed, in reactions of gases, the relative volumes of reactants and products appeared to be in the ratio of small whole numbers. Avogadro went on from there [1].

He concluded that the only way to explain Gay-Lussac’s observation was that, under identi- cal conditions of temperature and pressure, for all ideal gases, any given volume must contain the same number of molecules, Avogadro’s number, \( N_A \). This is the number of molecules in the volume occupied by a gram molecular weight of an ideal gas. The magnitude of \( N_A \) was determined in many later experiments, converging on the now-accepted value: \( N_A = 6.023 \times 10^{23} \) particles per mole. The equal- number-per-unit-volume concept is now known as Avogadro’s law [2].

The other major question at the time was whether the elemental gases, hydrogen and oxygen, were atoms or diatomic molecules. Avogadro nearly resolved this question as well. He noted that if the gases were atoms, the reaction:

\[ 2H + O \rightarrow H_2O \]

would give a volume of \( H_2O \) twice that of the oxygen. The experiments clearly confirmed that the latter equation was the correct one. This resolved the question once and for all. Avogadro was the first to understand that hydrogen and oxygen were diatomic molecules. To appreciate the prescience of this achievement, note that, curiously, a century later, some influential scientists in the phys- ics community still questioned the very existence of individual molecules. Illustrating this remaining difference in views, the citation [2] for Jean Baptiste Perrin’s 1926 Nobel Prize in Physics reads, “for his work on the discontinuous structure of matter, and especially for his discovery of sedimentation equilibrium.” At the time, referring to Perrin’s work, one scientist noted, “This put an end to the long struggle regarding the physical reality of molecules.”

When he first published his work, the scientific community took little note of Avogadro’s dis- covery. In part, this was because he made no effort to visit scientists in France at the time. Eventually, in 1860, the Italian chemist and minister of education, Stasiniaco Cannizzaro, defended Avogadro’s work before the leading European scientists at an Inter- national Chemical Congress in Karlsruhe. But, the validity of Avogadro’s law was finally recognized.

Unfortunately, Avogadro had died several years earlier.

Today, 200 years after he proposed it, Avogadro’s law is taking on a new life in physics. In an article, “A More Fundamental International System of Units” [4], David Newell explains how the system of units will now be based entirely on physical constants. Physical objects, such as the long-used standard meter, with two marks on a platinum bar, and the standard kilogram, a perfect sphere, both in- ternalized under controlled conditions in Paris, were long among the reference standards for physical units. Nowadays, the units are defined by seven physical constants, one of which is Avogadro’s number.

The others are: the velocity of light in vacuum, Planck’s constant, and...
The Dichotomy Between Obama’s Mind and Skills

By Michael S. Lubell, APS Director of Public Affairs

As I watched President Obama deliver his State of the Union Address a few weeks ago, it struck me: Here is a man who has the most secretive of all American presidents, a history of brinkmanship with every policy decision. His intellectual skills are clearly in the political realm. In contrast, as far as I can tell, he lacks the skills of a statesman.

He admitted as much when he said, “It’s one of the few regrets of my presidency that the rancor and suspicion between the parties has gotten worse instead of better…”, but also noted, “I believe a president with the gifts of Lincoln or Roosevelt might have bridged the divide and I guarantee I’ll keep trying to be as good a dresser as I hold this office.”

The self-deprecation came late in the speech. Earlier he took a not-so-subtle swipe at his Republican critics when he remarked, “After all, it’s not much of a stretch to say that some of the only people in America who are certain that we’re doing the same job, in the same place, with a health and retirement package, for 30 years, are sitting in this chamber.”

Of course, when it comes to partisan rancor, there plenty of blame to go around. Republicans, who have controlled the House of Represenatives since 2011, called a vote to repeal Obamacare so many times that Democrats have vowed to come to the floor each time that either Democrats in the Senate would kill the repeal legislation or the president would veto it, just to score political points. Washington is where the blame game is playing out, but it’s state capitol politics and the statehouse hyper-partisanship were sown. State legislators and governors competed to gerrymander districts that created safe seats for single-party domination, removing all incentives for cooperation across the aisle in Washington. Following the 2010 election, Republicans took control of 21 state governments (house, senate, and governorship), relegating Democrats to just 10. In most states, legislatures and governors control the redistricting which occurs following each decennial census. And in 2011, Republicans controlled the Senate with numbers associated to indicate their location in the PACS Hierarchy. In Phsy, terms are generally simpler, and each term is designated appropriately. In other words, the states represented are research areas and physical systems. New Physics Classification Scheme Unveiled

Watch out physicists: There’s a new taxonomy in town. At the beginning of 2016, the American Institute of Physics (AIP) unveiled the Physics Subject Headings (PhySH) classification system, which will replace the Physics and Astronomy Classification System (PACS) previously used to organize APS journals into subject areas, and be used as a tool for readers of the APS journals—allowing for easier navigation through papers and topics of interest. It also helps APS assign papers to editors.

The American Institute of Physics (AIP) is a not-for-profit society of scientific member societies, of which APS is one—that created PACS in the 1970s. However, in 2010, AIP decided to stop maintaining it. A statement on AIP Publishing’s website says, “The continuing evolution of indexing, search, and technology has made it more challenging to honor the inherent limitations of PACS as a result, AIP decided that PACS 2010 would be the final version.”

This left a void, with no up-to-date classification system available for APS journals. “Of course new concepts weren’t disappearing all at the same time, so it started to be problematic for new fields of physics,” says APS Chief Information Officer Mark Doyle. Topological insulators, for example, are not included in PACS. As a result, Doyle says, “We decided we were going to build our own.” The system has been under development since 2012.

PACS categorizes papers according to concepts, which are tags that indicate the subject matter of the paper and the discipline it belongs to. During submission, authors select these from a list of about 3000. These concepts belong to “facets” or categories that indicate the nature of the concept. The facets currently include research areas, physical systems, as well as a number of theoretical, computational, and international topics. For example, spontaneous symmetry breaking is associated with the related concepts of symmetries and Higgs bosons.

The system includes a facet hierarchy system that should make it easier to browse papers and understand the connections between related papers and topics, Doyle says, as compared to PACS, which has a more rigid system. An additional challenge with PACS, Doyle says, is that it was not designed for the modern web environment in which it was designed to support “linked data,” which would allow computers to read and analyze data about the papers.

Physics is also designed to be simpler for users to understand. “The huge plus is that it’s word-based; there are actual English words rather than cryptic alphanumeric codes,” says Abhishek Agarwal, associate editor for Physical Review Letters, who helped coordinate the development of the system. “It’s much more intuitive, it’s transparent.”

Currently, APS is still collect- ing PACS with submitted articles because integrated systems and connections depend on them, but authors are now able to add PhsySH terms voluntarily. (For the newest version of the Physical Review Fluxid, authors are required to select PhsySH terms.) In the coming months, APS journals will phase out of PACS.

Agarwal emphasizes that PhsySH should not yet be consid- ered a finished project, but says he is pleased with the feedback so far: “extremely encouraging.”

The information that’s coming in from the authors is extremely valuable. “It is very early days, but authors are using it and they are using it the way we intended it to be used,” Agarwal says. APS editors plan to continue refining the system with input from the physics community. “It’s still very early days,” says Doyle. “We’re looking for feedback on it. We’re looking to iterate.”

More information about PhsySH is available at phys.org

2016 Budget Boosts Funding for Science in U.S.

By Emily Conover

In mid-December, U.S. lawmakers finally ironed out the details of the 2016 budget, and science “fareed better than well,” says APS Deputy Director of Public Affairs Michael Lubell. The $1.1-trillion omnibus spending bill lays out the funding landscape for government agencies through September 2016. Thanks to the budget deal Congress hashed out, the funding for scientific research was capped at $115 million, and the bill requests a report from the Secretary of Energy on the future of the project. NASA was a big winner, with 7.1 percent increase overall and a 6.9 percent increase due to its science programs. Planetary science received the largest increase of NASA’s science programs, at 13.4 percent. And the National Institute of Health received a hefty increase of nearly $2 billion. The National Science Foundation received a relatively small increase of 1.6 percent, but avoided large cuts that had been proposed for geosciences and social sciences, although social sciences funding is still at historically low levels. The Department of Defense’s science and technology programs received a significant 8.2 percent increase, which would bring the overall increase to 1.4 percent. The National Institutes of Standards and Technology received an 1.6 percent bump, and the National Aeronautics and Space Administration received a 5.8 percent increase.

Nervous about what’s now in the works. As APS News went to press, President Obama’s 2017 budget request to Congress was scheduled for release on February 9. Thanks to the October budget deal, the 2017 budget will be “essentially a cost of living increase,” says Lubell, and “the expectation will be that both the president and Congress are likely not to do too much tinkering.”

A comparison between PACS and PhsySH shows the differences between the two classification schemes for a single paper. As seen below, PACS offers categories with numbers associated to indicate their location in the PACS Hierarchy. In Phsy, terms are generally simpler, and each term is designated appropriately. In other words, the states represented are research areas and physical systems.
In the November 2015 issue of APS News, Michael Lubell wrote an article questioning whether science bears any responsibility for today’s political discontent. Although his article emphasized the need for increased productivity without corresponding gains in living standard, I believe that there is another important example in the climate change debate. The statements on both sides are getting meaner and more extreme. Members of Congress who believe in man-made climate change are threatening RICO (Racketeer Influenced and Corrupt Organizations) prosecutions of scientists who are skeptics, and congressmen on the other side are threatening to look into the government funding of the scientists who are believers in humans-induced climate change. Perhaps we can expect no better of our politicians, but when prestigious scientists sink to the same level, they do real harm to the credibility of the entire scientific enterprise. I hope that in the scientific world, scientists on both sides of the issue treat opposition with more respect and avoid statements like “The science is settled”; it almost certainly is not. Earth’s atmosphere is extremely complicated and we do not understand it that well.

Walker Manheim Allendale, New Jersey

BURKIN continued from page 2
the executive committee leaders that I come in contact with have been really great. I think at the end of the day you have to remember that they’re just trying to do their job, and they’re extremely intel- ligent people.

There’s a rumor that you have an_n. Do you want to share it?
Sure. So at four years old I started competitive baton twirling. I’ve been twirling since I was four so that’s twenty-one years. Once I got to college I found there’s a totally different level of competition, one of the world’s best teams. So, a lot like Olympic gymnasts will do — they’ll move to Texas to train with the best gymnastics coaches — I moved to Maryland to train with the best twirling coaches. And since 2010, I have won 12 world gold medals. We’ve been all over the place for the world championships. We were in Belgium, Switzerland, England, and just this past April I was in Italy. And we’ve been successful at each one, which was good. Probably the better talking point is I was a semifinalist on America’s Got Talent in 2008.

What do you like about baton twirling?
I have no idea. I don’t know. People say, “Why baton?” I couldn’t tell you. I have no idea. It’s like this weird addiction. We call it a sickness. This interview has been edited and condensed.

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By Emily Conover

A non-traditional style of scientific publishing is gaining ground, with new journals popping up in recent years. These “overlay” journals sit on top of arXiv or other scientific repositories and apply peer review. A link to the accepted paper on the journal’s website leads to the paper on the repository.

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“Not everyone is convinced. Questions remain about the scalability of overlay journals, and whether the journals can be sustainable.”

The newest such journal is the Open Journal of Astrophysics, which launched in February. Its first issue came out on December 22. Editor in Chief Peter Coles of the University of Sussex notes that he has been thinking for years about a model “in which the article is available from the arXiv.” By adding a front page, he says, “it’s an idea whose time has come.”

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Gowers is known for having an axe to grind with traditional publishers, particularly Elsevier; in 2012 he sparked a boycott of the company, protesting the high cost of subscriptions to its journals, and the idea that others will do the same.”

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The high expenses in these things are never really taken into account when they operate on a small scale,” Gowers says. “There’s either personal or institutional subsidies going into it, the salary, internet connection, and all of the rest.”

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applied energy technologies. An experimental condensed matter physicist, Murray has held a variety of prominent leadership positions within the scientific community, including the presidency of APS in 2009. She served as dean of Harvard University’s Paulson School of Engineering and Applied Sciences between 2009 and 2014. Prior to that, she was the principal associate director for science and technology at Lawrence Livermore National Laboratory (LLNL). After receiving her B.S. and Ph.D. in physics from Harvard, Murray began her career at Bell Labs in 1978, where she stayed until 2004, eventually moving into management roles during her time there.

Murray, whose appointment was confirmed by the Senate on December 10, 2015, took over from Patricia Dehmer, the deputy director for science programs in the Office of Science, who served as acting director after the previous director, William Brinkman, left in 2013. With just a few weeks at the helm already, Murray spoke with her, Murray says she is happy to be there. After she stepped down as dean of the Paulson School, she says she received a phone call from Secretary of Energy Ernest Moniz, who asked her to take on the job. “I decided, ‘Why not? I haven’t been in government before. Been in industry, been in a national lab, been in academia.’”

Murray highlights the Office of Science’s user facilities as another of her priorities. “We provide, I’d say, the lion’s share of the scientific user facilities that are world class,” she says. Such facilities include the ten national laboratories stewarded by the Office of Science. (DOE has 17 national labs in total; seven are associated with other parts of DOE.) Murray’s previous experience with national labs will come in handy for this job, she says.

At LLNL, a DOE lab under the Nuclear Security Administration, Murray learned about the complexity of the DOE system and the absolutely essential nature for national security. “In LLNL, she says, serve as “emergency expertise” for the country — citing, for example, the technical assistance the labs provided for the negotiations leading up to the agreement reached with Iran last year to dismantle parts of its nuclear program.

Murray also served on the Commission to Review the Effectiveness of the DOE’s Fusion Energy Projects, which released a report in fall 2015, outlining suggested improvements to DOE’s national labs. (See APS News January 2016.) Following up on the recommendations made by that commission, Murray says she hopes to merge the review process the Office of Science uses for its labs with other parts of DOE, to create a “review process that doesn’t just review the science programs, but the science programs and the applied energy programs” together. She adds, “These labs are an incredible national resource, and the programs don’t all necessarily know how the capabilities that these labs have because they only fund their particular program.” Within the Office of Science labs, Murray says, “Some of them have 50% of their portfolio outside the Office of Science and we need to steward that whole responsibility.”

“Within the Office of Science, the labs serve as “emergency expertise” for the country — citing, for example, the technical assistance the labs provided for the negotiations leading up to the agreement reached with Iran last year to dismantle parts of its nuclear program.

Impact of open access

With the increasing prevalence of open access, Murray says, the Office of Science may need to adjust its business model if publishing income declines. “Right now a good fraction of what supports other activities comes from publishing, and if we lose some fraction of the publishing income, we have to find other sources,” she said. “We should be prepared for that.”

Interactions with industry

Interaction with industry, Murray says, has worked to boost its contact with industry.

Neal would like to continue to strengthen these efforts. Citing his experience as a member of the board of directors of Ford Motor Company, Neal said, “I believe that I can do a lot of good and be there. After she stepped down as dean of the Paulson School, she says she received a phone call from Secretary of Energy Ernest Moniz, who asked her to take on the job. “I decided, ‘Why not? I haven’t been in government before. Been in industry, been in a national lab, been in academia.’”

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College Park, known for his work on string theory, supersymmetry, and supergravity. He is a member of the National Academy of Sciences, a recipient of the National Medal of Science, and he serves on the President’s Council of Advisors on Science and Technology. He has previously written about diversity in science for The Scientist and other publications.

“I was thunderstruck by the question,” Gates said, referring to Justice Roberts’ question about the importance of diversity in physics classes. “He asked specifically about physics, which for me was stunning. I wondered if he had come across some of Einstein’s writings on his perspective on race in America. Einstein actually said that from his perspective racism is a disease.”

Gates says the question is a valid one. “I take the Chief Justice’s question as a serious question asked by someone whose mind is looking to work things out and is looking for answers. So I think it’s a question that especially the physics community really ought to respond to.”

Diversity, Gates argues, is necessary to do the best possible science. “If you want to get the most active, the most innovative, the most rapid-moving science, I believe...diversity drives higher levels of innovation.”

For links to the statements mentioned in this article, visit the online version of APS News at aps.org.

Now Accepting Student Applications

The APS Bridge Program aims to increase the number of underrepresented minorities who earn a Ph.D. in physics by helping students gain admission to graduate programs. African-American, Hispanic-American, and Native American students interested in pursuing a Ph.D. in physics are encouraged to apply. Application deadline is March 21, 2016.

Eligibility Requirements

Underrepresented minorities who will complete or have already completed a bachelor’s degree in physics or a closely related field and plan to pursue a physics doctoral degree are encouraged to apply.

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Today, Sharp has chosen to go with the heart of FYFD in with the people, some of them in the fluid dynamics community, she says. “They really appreciate a lot of different features of the website, like seeing explanations of phenomena they don’t see anywhere else, or seeing the visuals and how they relate to everyday life.”

Asked about the website name, she admits that it poses a few problems. “I’ll hand my business card and get a lot of comments. “I get a lot of comments from people, some of them in the fluid dynamics community,” she says. “They really appreciate a lot of different features of the website, like seeing explanations of phenomena they don’t see anywhere else, or seeing the visuals and how they relate to everyday life.”

The artistic side of fluid motion also fascinates Nicole Sharp, originator of the provocatively named website F*ck Yeah Fluid Dynamics (Editor’s note: Fill in the void yourself). Sharp, a recent Ph.D. graduate in mechanical engineering, serves on the DFD Committee on Media and Science Relations.

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Fluids cineplex, red/green glasses are handed out for 3D videos. Awards are given for the best entries and the criteria vary from meeting to meeting. “For the most part [the judges] are told it’s an aesthetic gallery,” Kiger says. “There should be some technical relevance, but we have a lot of [other] venues for technical presentations. [The entries] should be primarily visually representative of a phenomenon in an eye-catching or artistic way.”

The director of the computational science center at Stanford contacted me because they have a large building they display art in,” says Kiger. “They thought it would be great if we could print and frame some of our best entries and display them.”

Kiger thinks some kind of traveling exhibition they display art in,“explains Sharp. “It’s gotten enormously popular in the past few years — everybody wants to have a video in the gallery and everyone wants to have a shot at winning. I love the website because it provides a lot of material for me.”

Both Kiger and Sharp hope to do more public outreach in the future. “The director of the computational science center at Stanford contacted me because they have a large building they display art in,” says Kiger. “They thought it would be great if we could print and frame some of our best entries and display them.”

Kiger thinks some kind of traveling exhibition would be a way to inform the public about the field.

Now that Sharp is full time at FYFD, she plans to get more involved in science communication. “It’s been my source of passion and interest, but I’d like to expand the site to content creation,” she says. “The nice thing about making my own videos or working with researchers to make videos is that I can really put the explanation that’s the heart of FYFD in with the visuals — have everything together in a single product.”

Erosion patterns modeled with water flowing over caramel. (Poster P0051 at gfm.aps.org, winner of a Gallery of Fluid Motion award.)

Surface waves created by small droplets bouncing on an oil bath. (Video V0064 at gfm.aps.org, winner of a Gallery of Fluid Motion award.)
Tunnel Visions: A Brief Comparison of the SSC and LHC Projects

By Michael Riordan, Lillian Hoddeson, and Adrienne W. Kolb

Prologue: In late 1993 the U.S. Congress cancelled the Superconducting Super Collider (SSC), an enormous proton accelerator designed to attain a collision energy of 40 TeV. The resulting loss cost over $1.8 billion, increasing from an estimated 2.8 billion Swiss francs in 1996 to more than 4.3 billion Swiss francs in 2009, it managed to survive and eventually discover the Higgs boson — using only about half its original design parameters. When lab costs and in-kind contributions from participating nations are included, the total approach $10 billion, a figure often cited in the press. This achievement in the face of problems similar to what the SSC project experienced, if not as severe, raises the obvious question: why did CERN and its partner nations succeed where the United States had failed?

From its early days, many thought the SSC should have been sited at or near Fermilab, taking advantage of the existing infrastructure there, both physical and human. CERN had done so for decades, building one machine after another as extensions of its existing facilities and reserving new sites only for major new projects such as extensions of its existing facilities and reserving new sites only for major new projects such as the SSC. Had the SSC been sole-sourced to Fermilab, it might have been easier to imagine a project requiring about a decade to complete and costing billions of dollars, euro, or Swiss francs — or, relevantly for today, a trillion yen. This climate of uncertainty argues for erring on the side of fiscal conservatism and for trying to reduce risks by building a new facility with strong international cooperation, thus recycling its infrastructure, both physical and human. Such a gradual, incremental approach has been followed successfully at CERN for decades now, and to a lesser extent at other high-energy physics labs. But U.S. physicists elected to stray from this well-worn path in the case of the Superconducting Super Collider. It took a giant leap of faith to imagine that they could construct the world’s largest particle accelerator: a 54-mile (87-km) tunnel ring, and a trillion-dollar superconducting magnet built from a never-before-seen material. It is important to note that any machine that they had previously built, at a green-field site where everything had to be assembled anew from scratch — including its management team — and defend the project before Congress in times of fiscal austerity. A more modest project sited instead at Fermilab (or Brookhaven) would likely have weathered less opposition and still be producing good physics results today. As one leading high-energy physicist acknowledged in hindsight, the SSC was probably “a bridge too far” for this once-powerful scientific community.

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