

The “Opinion Splitter”: How the Superconducting Super Collider Divided American Physicists

Hannah Pell*

“Indeed, the funding of the SSC is quite analogous to building a \$5 billion spacecraft, putting a few Weinbergs and Glashows and Hawkings aboard, and sending them off toward some extragalactic fount of transcendental knowledge, with the understanding from the outset that *we on Earth would never hear from them again.*” - Daniel M. Smith. [10]

On 26 April 1988, members of the National Academy of Sciences convened in Washington, D.C. to celebrate its 125th anniversary. Frank Press – geophysicist and then-President of the Academy – took the stage to offer his address to elected members and guests. He boasted that they were in the midst of a “Golden Age,” noting a time of “unprecedented progress in scientific discovery.” [15] He described an international scientific community with a “high level of financial support by governments and industries.” New fields were emerging, such as “molecular biology, materials science, photochemistry, and microelectronics.” Additionally, scientists were submitting “record numbers of proposals of the highest quality.” There was certainly much to celebrate.

But all that was golden did not necessarily glitter. Scientists were also facing budgetary constraints due to an overwhelming federal deficit, despite President Reagan’s general enthusiasm for “megabuck” science initiatives. [6] Dialogue between scientists and government officials was breaking down. Mutual trust was strained. Press described these political challenges as well:

“The issues are funding levels and priorities. Our political leadership has no way of gauging the amount of resources necessary to maintain the strength of American science and technology. What it does see is that the inevitable competition for funds leads to conflicting advice from within the scientific community. *It learns of caustic debates among scientists in our journals and in the press. . . . Arguments over funding priorities spill over into intellectual attacks on worthiness of one field of research by practitioners of another. . . .* At a time when we should revel in dazzling progress in almost every field of science, this sniping and carping among scientists is disturbing and destructive.” [15] [emphasis mine]

The next day, a headline in the *Washington Post* read: “Academy Chief to Scientists: ‘Stop Carping’.” [17]

Why all the arguing in a “Golden Age” for science? For physicists, their ‘caustic debate’ was centered around a massive plan in the works: the Superconducting Super Collider (SSC). The SSC would have been the world’s largest and most energetic proton-proton collider at nearly 87 kilometers in circumference and 40 TeV center-of-mass energy. It was initially predicted to cost roughly \$3 billion, although this estimate nearly doubled over time. The SSC was pitched as a bold, revolutionary machine that would restore American scientific leadership on the international stage and serve as “the doorway to that new world of quantum change,” according to President Reagan. [1] Why would some physicists not be on board?

This essay examines how the SSC divided American physicists in three different yet interdependent ways – funding, priorities, and prestige – according to Letters to the Editor printed in *Physics Today* from 1985 to 1995. On the surface, these opinions may read as overly personal, political, or even downright petty. But at their core, they offer unique insights about the role of physics in a modern society. Embedded within the ‘sniping and carping’ are the diverse motivations and guiding principles that informed how these physicists answered the question: *what is the*

*hannahelaine Pell@gmail.com

purpose of your science? These debates illuminate the fact that funding decisions are fundamentally intertwined with scientific priority-setting and reflect what scientific causes are deemed more worthy than others. In turn, what is deemed more worthy vis-à-vis budget allocation can lead to a perceived prestigious few — particle physicists, in this case — whose work could be understood as *inherently* more deserving of such financial support.

In the March 1985 issue of *Physics Today*, theoretical particle physicists and Nobel laureates Sheldon L. Glashow and Leon M. Lederman published a co-authored essay arguing the necessity of the SSC. [5] They claimed the machine’s \$3 billion cost was one well worth paying because of the challenge it presented, potential technological spinoffs, and a sense of national pride and duty. Their essay brought the SSC conversation directly to the pages of *Physics Today* and essentially set the tone of the debate stage.

Glashow and Lederman presented a compelling case. The Standard Model was incomplete. Particle physicists still needed to find evidence of the Higgs Boson, the missing mass generation mechanism crucial to validating the descriptive power of the Standard Model. The SSC would enable American particle physicists to fulfill their “sacred duty to know [the universe’s] deepest secrets.” “It is simply *the need to know* that compels us to build a bigger and better accelerator,” they wrote.

Additionally, if the SSC would fail, there was simply no other viable option. “[There is] no alternative that preserves the scientific vitality, no, the *validity* of the activity. It is our opinion that high-energy physics must go in this direction or terminate the 3000-year-old quest for a comprehension of the architecture of the subnuclear world.” It was a now-or-never moment. The future of particle physics was at stake, and it demanded American leadership. “It remains for history to record whether, on the threshold of a major synthesis, we chose to turn our backs or to thrust onward. The choice is still upon us with the still-hypothetical SSC.”

It’s important to note that before the SSC, non-particle physicists “might grumble quietly among themselves about ‘those greedy high energy physicists,’ but few had come out in the open and published letters or articles voicing their discontent,” according to historian of science Michael Riordan. [16] In this case, however, the reaction was swift and public, and critics took aim first and foremost at the notion that the SSC’s costliness was in fact justifiable.

“Days of Reckoning”

In the midst of across-the-board budget cuts and federal financial instability, was a multi-billion dollar particle collider really a top priority? “The high-energy-physics community must be commended for its courage. Proposing the construction of a \$6-billion piece of scientific equipment at a time of \$200-billion government deficits and budget slashing left and right by Congress and the President certainly takes guts,” wrote theoretical physicist Robert J. Yaes. [4] The “days of reckoning” were coming for science budgets, according to former *Physics Today* contributing writer Irwin Goodwin. [7] Yet particle physicists insisted the construction of the SSC would more than pay for itself.

Yaes also pointed out that if the \$6 billion SSC budget were divided equally among the 4000 members of the American Physical Society Division of Particles and Fields at the time, it would amount to \$1.5 million spent per particle physicist. “It is interesting to contemplate what results might be achieved in other fields, such as condensed matter physics, or for that matter molecular biology or AIDs research, if capital expenditure of \$1.5 million per researcher were made.” [19]

Additionally, there was heightened concern among non-particle physicists that funding for the

SSC would deplete resources previously allocated to their work. Although Glashow, Lederman, and other SSC advocates attempted to alleviate these concerns by arguing that science was not a zero-sum game [5], it did little to quell their worries. John F. Waymouth, a former R&D director, chimed in:

“The advocates of the Superconducting Super Collider vehemently protest that it is not in competition with other branches of physics – that they are asking for ‘new money.’ I believe that this view of the situation is unrealistic in the present climate of massive budget deficits and the necessity to economize at every level of government. Any money provided for this project will be diverted away from government support of other science. At the very least, it will siphon off funds that could be used to provide desperately needed increased funding for eV physics.” [19]

Regardless if the SSC had been affordable at its peak \$5-6 billion estimate, not everyone agreed that this was the best use of the money. “I suggest that SSC promoters remember what such a price tag looks like through the eyes of opponents to SSC: 5000 \$1 million research contracts, 50,000 graduate fellowships, much sought-after funding for projects at existing high-energy facilities,” another physicist wrote. [18] The federal budgetary crisis loomed over the SSC, and the increased competition for financial support as a consequence of sweeping cuts was evident in physicists’ disagreements about its prioritization.

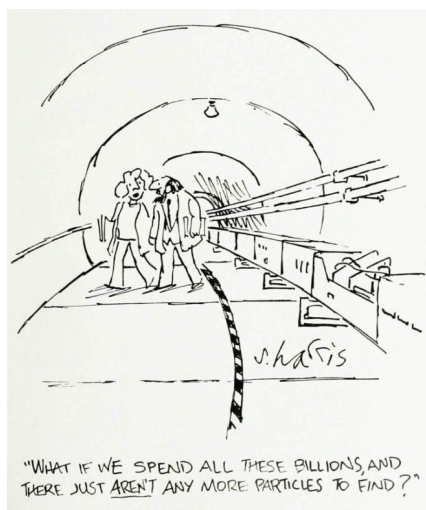


Figure 1: Cartoon published in the October 1988 issue of *Physics Today* [10]

Budgets Reflect Priorities

As Frank Press had pointed out, funding conversations can easily become “attacks on worthiness.” [15] The fiscal arguments regarding the SSC represented a deeper – and perhaps more divisive – conversation about what support different sub-disciplines in physics *deserved* relative to one another.

One framing of the priorities debate asked whether scientific motivations should point to research and knowledge for its own sake or for more practical (and potentially profitable) benefits. “Some

of the tools of high-energy experimental physics and astrophysics are very expensive, so priorities have to be set and sacrifices made,” wrote particle physicist Michael J. Glaubman. [10] But not everyone was convinced. Waymouth responded:

“The main point of [Glaubman’s] letter can be summarized as follows: We in the high-energy physics community have set our priorities; we recognize that sacrifices must be made to provide the necessary resources, but we are sure that the rest of you will gladly make them in order for us to proceed with this grand adventure of the human spirit. Good luck with your future efforts to obtain funding for your own, less important work.” [10]

Another framing of scientific worthiness was to consider who would benefit from the new knowledge. Some SSC critics expressed utilitarian sentiments, arguing that the most worthy science is that which offers the most tangible, direct, and immediate benefit to the most people:

“What turns me downright off is that SSC fans seem so preoccupied with their own perceived excellence that they seem unable to understand that 99% of voters probably don’t know what an accelerator is or give a hoot about whether QCD is the correct description for anything. Simply too few people benefit to warrant this expenditure of everybody’s tax money.” [14]

It is clear that physicists sensed imbalances in the field. The fiscal support promised to the SSC seemed to reflect a particular prioritization that only particle physicists enjoyed. Fundamental questions related to subatomic particles were superseding research that was perhaps more applicable to daily life. Particle physics was also described as elegant and esoteric, an “art for art’s sake, though far more costly to pursue.” [5] It was precisely this characterization that contributed to its perceived elevated status within the field and as a measure of national scientific prowess.

National Pride and the Ivory Tower

Funding is intertwined with priority-setting, and priority-setting can shape perceptions of importance. The SSC required financial backing from other countries, so its success would have demanded international diplomacy and cooperation. Yet motivations for the SSC were firmly rooted in efforts to reestablish American scientific power and prestige. “Particle physicists and the Reagan administration are convinced it is also one of the most conspicuous ways to reassert American scientific supremacy,” noted Goodwin. [6]

There were concerns that European particle physics would surpass progress in America. Glashow and Lederman — who cited “national pride and duty” as two of their core motivators for the SSC — wrote: “More and more, American accomplishments either recede in to the past perfect or dangle in the future conditional while the Europeans pursue the present indicative.” [5] Yet this was not sufficiently convincing for some. “While quite anxious myself to have Higgs either disclosed or discarded, I will not be dismayed in the slightest if this is done at CERN or at Serpukhov rather than in the US,” another physicist wrote in. [12] Was finding the Higgs *in the United States* more important than finding it at all?

Additionally, there were perceptions of imbalanced prestige *within* the American physics community. Historian of science Joseph Martin has argued that a *prestige asymmetry* — the notion that “otherwise similar activities garner unequal attention and approbation” — has divided condensed matter and particle physics in American science. [11] The SSC debate highlights this phenomenon, as condensed matter physicists in particular voiced their frustrations about particle physicists’ own “perceived excellence.” [14] Particle physicists were isolated “in an ivory tower bastion surrounded

by a world of people beset with overwhelming problems.” [18] “The nobility in their grand palaces, contemplating the ‘transcendent beauty and philosophical depth’ of their works of art, have heard the cries of the peasants and have told them to eat virtual funding,” another wrote. [18] It’s clear that financial support for the SSC fueled internal divisions within American physics along axes of perceived worthiness as well as international scientific influence.

Conclusions at the Horizon

The SSC was cancelled by Congress in 1993; it amounted to a \$2 billion hole in the ground in Texas. After its cancellation, Lederman published another *Physics Today* essay addressed to SSC critics beginning with: “Please believe that, as much as I am saddened by the demise of the [project], I hold no bitterness and I further do not believe that you are dancing on the SSC’s grave.” [9] Regardless of this outcome, the SSC was polarizing¹, and the debate it stirred shed light on internal issues of funding, scientific priorities, and prestige within the American physics community. It was always about much more than a particle collider.

Recently there have been headlines announcing “bold steps” toward the future of particle physics at CERN, which invariably necessitates funneling billions into newer, bigger, more energetic machines. [3] These headlines circulate in contexts of widespread financial instabilities, social inequities, and a global pandemic. Again, some physicists are openly arguing against it. [8] It is true that the potential positive spinoffs of collider science are difficult to price, and seeking answers to fundamental questions about our physical universe is awe-inspiring. It is also true, however, that when the nature of your work demands operations at the edge of the horizon² limitations can easily become an afterthought.

Each are very legitimate questions: “What lies beyond?” and “Is it worth it to see?”

¹One physicist took it upon himself to conduct a mail-in survey of the members of the American Physical Society about their opinions on the SSC. He found an even split on the issue. [13]

²“So far, as accelerator energies have increased, so has the number of problems, without many apparent spinoffs to benefit society. As one colleague told me, ‘When you get to the horizon, there is always another horizon.’” [2]

Supplementary Material - References List

The “Opinion Splitter”: How the Superconducting Super Collider
Divided American Physicists

Hannah Pell

References

- [1] President Reagan’s Remarks on the Superconducting Super Collider Program on March 30, 1988. *Courtesy of Ronald Reagan Presidential Library* (Mar. 1988).
- [2] BARTLETT, J. H. Physics and Society’s Needs. *Physics Today* 39, 11 (1986), 133–134.
- [3] CASTELVECCHI, D., AND GIBNEY, E. CERN makes bold push to build €21-billion supercollider. *Nature*, News (June 2020).
- [4] GALL, C. A., GLASHOW, S. L., YAES, R. J., AND VAN HEERDEN, P. Super Collider. *Physics Today* 39, 2 (1986), 11–13.
- [5] GLASHOW, S. L., AND LEDERMAN, L. M. The SSC: A Machine for the Nineties. *Physics Today* 38, 3 (1985), 28–37.
- [6] GOODWIN, I. Amazing Race: The SSC Generates Disorder and Discord. *Physics Today* 41, 5 (1988), 69–74.
- [7] GOODWIN, I. Days of Reckoning: Deficit Woes Weigh Heavily on Science Budgets. *Physics Today* 42, 11 (1989), 49–50.
- [8] HOSSENFELDER, S. The World Doesn’t Need a New Gigantic Particle Collider. *Scientific American, Policy & Ethics* (June 2020).
- [9] LEDERMAN, L. M. An Open Letter to Colleagues Who Publicly Oppose the SSC. *Physics Today* 47, 3 (1994), 9–11.
- [10] MARSHAK, R. E., LARSON, L. L., GLAUBMAN, M. J., SMITH, D. M., WEINBERG, S., AND WAYMOUTH, J. F. SSC: Essential Science or Unnecessary Expense? *Physics Today* 41, 10 (1988), 13–15, 114–120.
- [11] MARTIN, J. D. Prestige Asymmetry in American Physics: Aspirations, Applications, and the Purloined Letter Effect. *Science In Context* 30, 4 (2017), 475–506.
- [12] MOELLERING, W., GOLDWASSER, E. L., KANE, G. L., AND EINHORN, M. B. SSC Might Not Be Money in the Bank. *Physics Today* 41, 11 (1988), 149–152.
- [13] MORAVCSIK, M. J. SSC: Opinion Splitter. *Physics Today* 41, 5 (1988), 134.
- [14] PIEDMONTE, R. S., AND ALBRECHT, G. F. Of SSCs, Shuttles and Taxes. *Physics Today* 40, 10 (1987), 13–15, 152.
- [15] PRESS, F. The Dilemma of the Golden Age. *Science, Technology, and Human Values* 13, 3/4 (1988), 224–231.
- [16] RIORDAN, M., HODDESON, L., AND KOLB, A. W. Selling the Super Collider, 1983–88. In *Tunnel Visions: The Rise and Fall of the Superconducting Super Collider*. The University of Chicago Press, Chicago, IL, 2015, pp. 77–120.
- [17] SAWYER, K. Academy Chief to Scientists: Stop ‘Carping’. *The Washington Post* (Apr. 1988).
- [18] SCOTT, J. F., ROY, R., STOFFEL(S), J., LOMAX, J. F., MOELLERING, W., CHAYKA, P., JOHNSON, D. L., BARTH, N. H., AND LEDERMAN, L. M. Funding Big Science. *Physics Today* 39, 4 (1986), 11–15, 81–88.
- [19] WAYMOUTH, J. F., AND YAES, R. J. What Price Funding the Super Collider? *Physics Today* 41, 7 (1988), 9–13.