

Heavy-ion fusion in the US

I was the director of the Office of Laser Fusion at the Energy Research and Development Administration (ERDA) in 1976, as mentioned by Robert Burke in his letter (PHYSICS TODAY, June 2010, page 59). The participants in the first workshop on what became known as heavy-ion fusion (HIF) were an exceptional group from the fusion and accelerator communities. Their conclusions warranted high confidence. Accordingly, I stated in my remarks at the close of the meeting that the heavy-ion approach to inertial fusion faced “no showstoppers.” From that time on, I have believed that HIF is the approach to take for fusion energy.

Support for HIF for energy production in ERDA and its successor, the Department of Energy (DOE), was excellent in fiscal years 1977–79 as the monies needed to demonstrate the concept and to define a heavy-ion demonstration experiment (HIDE) were small—only \$0.7 million in FY 1979. Costs were shared between the Office of Laser Fusion and the Office of High Energy and Nuclear Physics. John Deutch, then director of energy research, told me “to keep HIDE in the budget at any cost.”

The pressure to decrease HIF funding was great, for three reasons. First, laser fusion was viewed primarily as a military program, which made HIF, a non-weapons-lab program, a lower priority behind the mainline laser and light-ion programs. Second, the costs to achieve a scientific feasibility demonstration using the powerful lasers at Lawrence Livermore National Labora-

tory were large and rising. And third, Los Alamos and Sandia national laboratories, privately owned KMS Fusion (largely funded by the DOE laser fusion program), and the University of Rochester lobbied for ever greater funding for their inertial fusion programs. Members of the HIF community did not apply similar pressure.

I sought a \$7.0 million budget addition for HIF for FY 1979, but the House Appropriations Committee did not appropriate it, due to strong negative input from the House Armed Services Committee.

I was removed from my job as director in mid-FY 1979 for attempting to fund classified efforts in US industry, including Westinghouse’s attempt to develop automated pellet fabrication techniques. The Lawrence Livermore management interpreted my actions as a serious threat to the lab’s future. In parallel, budget pressures continued to increase, so money for constructing HIDE was scrubbed from the FY 1980 budget. As a result, the country has lost 30 years of progress that could have been made toward fusion energy. It is sad that magnetic fusion has gotten no further than it has, and yet we know that inertially confined fusion (ICF) is possible since we can create nuclear explosions.

In an interview with PHYSICS TODAY (September 2009, page 26), DOE undersecretary for science Steven Koonin expressed admiration for Glenn Seaborg’s approach during the Manhattan Project of “a shutting off of dead-ends . . . on the spot.” DOE would do well to restore that attitude. I wanted to cut the program that was developing a carbon dioxide laser, well known to be fundamentally hampered for driving pellet implosions by its long wavelength. Only years later was CO₂ laser development dropped.

The upcoming National Academy of Sciences (NAS) review of ICF for power production will be a key step forward if HIF receives due consideration. That may be somewhat difficult, for three reasons. First, DOE may already have established its preference for driver selection; Undersecretary Koonin said, “I

would keep an eye on NIF [the National Ignition Facility] as perhaps offering an alternative route to fusion energy.” Second, the experience I outline above shows the potential for interference from political and other nontechnical obstacles. And third, since virtually all inertial fusion funding for almost five decades has gone to laser and light-ion development, the NAS review will need to probe well below the surface to establish the advantages of HIF.

To be competitive, technologies, much like racehorses, need proper care and feeding. If the NAS review is to reach solid conclusions, serious options must be adequately funded beforehand in order to fully inform the NAS panel. Since leadership in the HIF technology has shifted to Europe and Russia, the NAS may need to tap the information available from those countries. The tremendous stakes involved should easily justify such an unusual step.

Finally, it is heartening that in the bill to reauthorize the America COMPETES Act, Congress has included language specifically calling on DOE to develop a plan to incorporate the NAS review’s recommendations.

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Amending the story of helium-3

In his Issues and Events story about the helium-3 supply (PHYSICS TODAY, June 2010, page 22), David Kramer did not mention a pending huge drain on the world’s tritium resource before it decays into ³He—namely, fuel for fusion research devices. The ITER fusion energy test facility alone will require an initial on-site inventory of 2 kg of tritium, about 10% of the expected worldwide nonweapons tritium inventory after 2020. Other tritium-consuming fusion devices—for example, Ignitor (PHYSICS TODAY, June 2010, page 27)—are in various approval stages.

Even if there is insignificant fusion burn of tritium in the ITER plasma, the facility will have an ongoing tritium

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