THE DOE-HEP ACCELERATOR R&D STEWARDSHIP PROGRAM*

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Abstract

Since the Accelerators for America's Future (AfAF) Symposium in 2009, the U.S. Dept. of Energy's Office of High Energy Physics (DOE-HEP) has worked toward broadening its accelerator R&D activities beyond its support of only discovery science to include medicine, energy and environment, defense and security, and industry. Accelerators play a key role in many aspects of everyday life, and improving their capabilities will enhance U.S. economic competitiveness and the scientific research that drives it. In 2011, a community task force was initiated by DOE-HEP to develop more fully the information from the original AfAF Symposium. Subsequently, a DOE-HEP concept (coordinated with the other cognizant Office of Science program offices) was developed for accelerator R&D stewardship. Here, we describe the evolution of the stewardship task starting from its origins in the ongoing DOE-HEP accelerator R&D program, the mission of the new program, and initial steps being taken to implement it. Several initiatives are currently being considered to launch the program, and these will be indicated. Involvement of the accelerator community in developing ideas for future stewardship activities will be crucial to the ultimate success of the program.

ORIGIN AND MOTIVATION

Although DOE-HEP has historically taken a broad view of its accelerator R&D program, an effort to examine stewardship needs more formally began in 2009 with the sponsoring of the Accelerators for America's Future Symposium [1]. The report from this symposium, published in 2010 [2], identified the importance of accelerator technologies to broad sectors of the U.S. economy, including discovery science, medicine, defense and security, energy and environment, and industry. It also called out the needs for improved interagency, inter-program, and industry-agency coordination, and highlighted the value of expanded training and education of accelerator scientists and engineers.

In 2011, the Senate requested [3] DOE to prepare a 10-year strategic plan for "accelerator technology research and development to advance applications in energy and the environment, medicine, industry, national security, and discovery science." In preparation for developing such a strategic plan, Dr. Jim Siegrist, Associate Director of Science for High Energy Physics, in consultation with other Office of Science (SC) Associate Directors, asked Norbert Holtkamp from SLAC to convene a community task force to review and expand upon the findings of the earlier AfAF report. This group met during the period November 2011–February 2012 and provided information to:

- identify research opportunities with potential for broad national benefits
- summarize the status of key research and technology areas identified
- identify possible impediments to successful accelerator R&D stewardship activities for the broad user base envisioned

The task force report [4] was very helpful in preparing the DOE-HEP strategic plan, which was sent to Congress in October 2012.

DESCRIPTION OF STEWARDSHIP

Relationship with Current Program

The ongoing HEP accelerator R&D program develops the basic science and technologies needed to design, build, and operate state-of-the-art accelerators. Such accelerators are essential for making discoveries in HEP. Moreover, as is clear from the studies in Refs. [2] and [4], accelerators are likewise essential for serving the broader communities of medicine, defense and security, energy and environment, and industry as well as the discovery science community.

As indicated schematically in Fig. 1, there is already a strong connection between current R&D thrusts and stewardship program needs. The center portion of the figure lists the 8 program thrusts of the current HEP accelerator R&D program. The columns on the left indicate the science goals that motivate the program, namely, the desires for higher particle or photon beam quality, for higher beam intensity, and for higher beam energy (or, equivalently, more compact accelerators) and how they overlap with the program thrusts. The columns to the right indicate the overlap between the broader accelerator community needs and the ongoing R&D program thrust areas. The complete overlap with the needs of discovery science is by design, as this community has, to date, been the only consumer of the R&D work. It is interesting, however, that there is also substantial overlap with the needs of the other accelerator communities. We conclude from this that the existing skill set is already well matched to the needs of the broader accelerator community.

Accelerator Stewardship Mission

The mission of the accelerator R&D stewardship program is to support fundamental accelerator science and technology development of relevance to many fields, and to disseminate accelerator knowledge and training to the broad community of accelerator users and providers.

Carrying out this new mission—in addition to carrying out the current HEP programmatic accelerator R&D effort—will be accomplished through:

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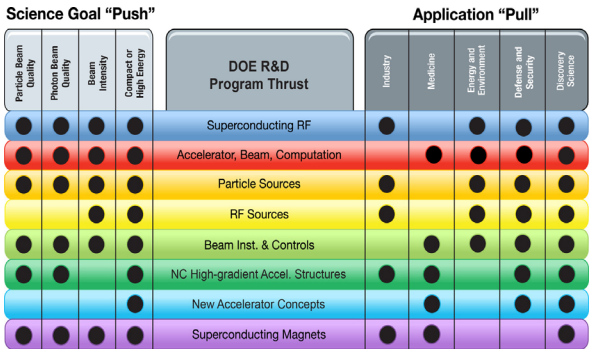

Figure 1: Connections between accelerator R&D thrust areas, science goals, and application needs (adapted from Ref. [4]).

- Facilitating access to national laboratory accelerator facilities and infrastructure for both industrial and other U.S. governmental agency users or developers of accelerators and related technology
- Working with accelerator user communities and industrial accelerator providers to develop innovative solutions to critical problems, to the benefit of both the broader user communities and the DOE discovery science community
- Serving as a catalyst to broaden and strengthen the community that relies on accelerators and accelerator technology

These elements are part of the accelerator R&D strategic plan.

STEWARDSHIP PROGRAM INITIATION

The steps envisioned to launch the stewardship program include:

1. Immediately augmenting existing programs to provide opportunities for industrial and federally funded users at DOE facilities by increasing support staff and funding for test facilities
2. In the mid-term (2–5 years), identifying a few topical areas with high impact for focused work; each area will have its own stakeholder board
3. In the longer term (5–10 years), select additional topical areas for focused work; new stakeholder boards will be created as topics are identified

In the steady state (depending, of course, on available resources), the HEP goal is to support at least three topical areas at any given time.

In preparation for item 1, an initial survey of available national laboratory infrastructure and capabilities was carried out in 2012. A follow-up meeting with the national laboratories to plan for stewardship activities at their test facilities is planned for early 2014.

Several potential topical areas have been identified for mid-term support (item 2). These include: improved particle beam delivery and control for cancer therapy facilities; laser development addressing the specific needs of the accelerator community, namely, high peak power, high average power, and high electrical efficiency; and energy and environmental applications of accelerators. One motivation for this last possibility is shown in Fig. 2, which gives the projected energy use of the SC accelerator laboratories compared with the anticipated mandated reductions. The SC accelerator complex energy usage is ~1000 GW-hr/yr, and is currently projected to increase about 50% by 2018. Without substantial improvements in efficiency, the challenge in meeting the mandated reductions is obvious.

For the longer term topics, we expect to solicit community input via workshops and discussions with other federal agencies.

Initial Topical Workshops

For the first two topics being considered under item 2 above, workshops were held to assess needs in these areas. The first, the Ion Beam Therapy Workshop, was organized jointly by DOE-HEP and the National Cancer Institute and took place in Bethesda, MD, from January 9–11, 2013. The second, the Laser Technology for Accelerators Workshop, was organized by LBNL and took place in Napa, CA from January 23–25, 2013. Both meetings were small and tightly focused, with attendance by invitation only. Representatives from the stakeholder agencies were also in attendance. Reports from the two workshops [5, 6] are available on the DOE-HEP website. A limited number of industrial observers were accommodated at each workshop, but did not participate in the preparation of the workshop reports.

Criteria for "Good" Accelerator R&D Stewardship Activities

In this section we provide some initial guidelines on choosing candidate activities for accelerator R&D stewardship. These should not be interpreted as hard and fast rules, but rather as an indication of the criteria that might be applied in the evaluation process.

1. The application must involve accelerators or accelerator-related technology having synergy with and benefitting the primary HEP mission.

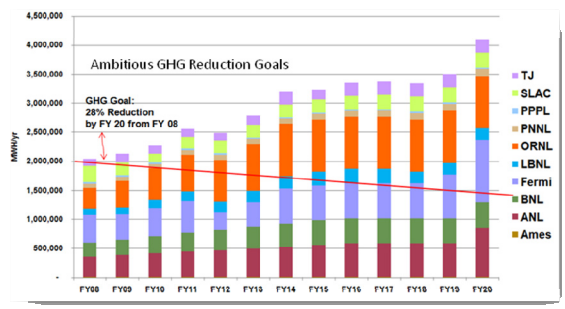

Figure 2: Projected energy usage of the SC accelerator complex through FY20 (bars). The red line indicates the decrease of 28% in green-house gasses (GHG) from FY08 to FY20 mandated by EO13514.

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2. There must be non-trivial intellectual involvement of the institution.
   Good: build an accelerator technology component (usually WFO*)
   Better: design an accelerator technology component (possibly WFO)
   Best: design, build, and test an accelerator technology component (stewardship)
3. The activity must be reasonably consistent with the mission of the institution and minimally impact its primary SC program(s).
   Good: activity maintains core skill or facility needed for the mission
   Better: activity expands core skill or facility needed for the mission
   Best: activity develops new core skill or facility needed for the mission
4. The institution must arguably be the best provider of the capability or service (and not compete with an existing business).
   Good: capability not unique, but institution is nearby to customer
   Better: capability is leading and institution is nearby to customer
   Best: capability is unique to provider
5. The customer benefitting from the stewardship activity must endorse the goals.
   Good: customer participates in task definition and writes letter of support
   Better: customer and institution partner; some cost sharing from customer (e.g., 1:10)
   Best: customer and institution partner; substantial cost sharing from customer (e.g., 1:1)

HOW YOU CAN ENGAGE

As we launch the accelerator R&D stewardship program, it is important that the accelerator community participate fully in its implementation. This can be done in a number of ways:

- Read the stewardship program description [7] and workshop reports found in Refs. [4–6].
- Respond to the Test Facilities Pilot Program call (national laboratories only) by identifying potential test facility customers and understanding their needs, and by responding to the meeting charge when it comes out.
- Prepare for topical area calls by starting to gather ideas and thinking about potential Collaborative Accelerator Research Teams (CARTs); be aware of related calls, e.g., the NIH P20 call for a National Center for Particle Beam Radiation Therapy Research [8] and the new DOE SBIR/STTR topical area for laser technology.
- Propose new, challenging topical areas; these should be "customer driven" and result in a potential solution that is broadly useful within a time frame of ≤ 10 years.

TAKE-HOME MESSAGES

Here we summarize the main points of the accelerator R&D stewardship program.

- Eligibility for the program will be broad; it is not a national-laboratory-only program.
- The "customer" must actively desire and participate in the activity; a pure technology push by potential providers is not sufficient.
- Activities should accrue some measureable intellectual benefit to HEP.
- Stewardship topical areas should address high-impact challenges on a roughly 5–10 year timescale; the intent is to solve problems and move on to other challenges.
- Handling intellectual property (IP) remains a challenge; existing WFO mechanisms provide a precedent, but IP will likely need to be handled case-by-case.

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* Work For Others activity.