



U.S. DEPARTMENT OF
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DOE Office of Science Long-Term Accelerator R&D Stewardship Program

*HEP Principal Investigator Meeting
June 16-17, 2014*

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Office of High Energy Physics
U. S. Department of Energy
Office of Science

Outline

- **What is the motivation for Accelerator Stewardship?**
- **What is it?**
- **How does it differ from General Accelerator R&D?**
- **Opportunities**
 - Accelerator Stewardship FOA / PA
 - Test facility programs



2011: Senate Requests 10-Year Plan for Accelerator R&D Stewardship



Accelerators for America's Future
Workshop: October 2009
Report: June 2010

<http://science.energy.gov/~media/hep/pdf/accelerators-rd-stewardship/Report.pdf>

“The [SEWD] Committee directs the Department to submit a ...

10-year strategic plan ... for accelerator technology research and development to advance accelerator applications in energy and the environment, medicine, industry, national security, and discovery science.

The strategic plan should be based on the results of the Department's 2010 workshop study, *Accelerators for America's Future*, ...”

Senate Report 112-075, p. 93. (Ordered to be printed September 7, 2011)

2012: Mission of Accelerator Stewardship



Strategic Plan for Accelerator R&D Stewardship

Report to Congress
September 2012

United States Department of Energy
Washington, DC 20585

▪ **Mission:**

- Support fundamental accelerator science and technology R&D
- Disseminate accelerator knowledge and training

▪ **Implementation:**

- **Facilitate access to** national laboratory accelerator **facilities** and infrastructure **for industrial and U.S. government agency users/developers** of accelerators and related technology
- **Develop innovative solutions to critical problems, to the benefit of both the broader user communities and the DOE discovery science community**
- Serve as a catalyst **to broaden and strengthen the community** that relies on accelerators and accelerator technology



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What is Stewardship and what is GARD?

GARD = General Accelerator R&D

- **Stated simply:**

GARD	predominantly impacts the HEP R&D mission
Accelerator Stewardship	predominantly impacts non-HEP applications

N.B.: Accelerator R&D very often impacts both realms. How you write the goals of your proposal is an important factor in determining whether it is GARD or Stewardship.

- **Who defines what the non-HEP applications are?**
 - The **Stewardship customers**, who are:
 - The Office of Science: principally SC/BES, SC/NP, and SC/FES
 - The broader DOE: principally DOE/EERE, DOE/AMO, and DOE/NNSA
 - The broader federal research enterprise: DoD, NIH, and DHS, among others
 - Industry

Formulating a National Accelerator Stewardship Program

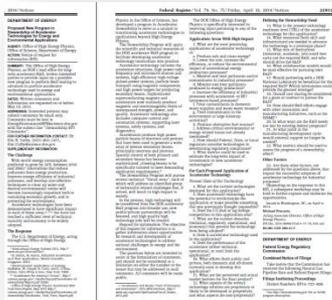
Task Force on Accelerator R&D established by the Director,
Assistant Director High Energy Physics, Office of Science

Office of High Energy Physics
Accelerator R&D Task Force
Report



Reports & RFI responses available at:

<http://science.energy.gov/~media/hep/pdf/accelerator-rd-stewardship>



2012 Accelerator R&D Task Force

- Identified initial stewardship opportunities and potential impediments

2013 Ion Beam Therapy Workshop (with NIH)

- Identified the role of accelerator technology and facilities in further cancer therapy

2013 Laser Technology for Accelerators Workshop

- Identified high average power “ultrafast” lasers as key enabling technology for discovery and applied sciences

2014 Congress authorizes Accelerator Stewardship for first time

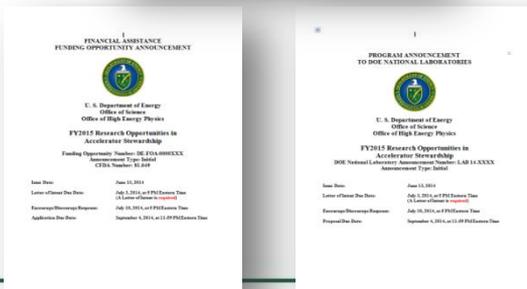
2014 RFI and Energy & Environment Workshop

- RFI has identified key accelerator R&D needed to advance energy and environmental applications of accelerators; workshop in planning stages

FY2015 Funding Opportunity Announcement

2014 Facilities Pilot Program Meeting

- Planning meeting of accelerator SC labs to discuss the potential user community needs and how to make the facilities more accessible



Accelerator R&D Stewardship Program Elements

- **Funding Opportunity Announcements / Program Announcements**

- **Accelerator R&D Stewardship FOA and PA**

- Funding Opportunity Announcement is
- National Laboratory Program Announcement is

Issued!

DE-FOA-0001142

LAB-14-1142

- **SBIR/STTR FOA** (coming fall 2014)

- **SC Accelerator Test Facilities**

- **Brookhaven Accelerator Test Facility** (open now!)
- **Facility Pilot Program**: Accelerator R&D Infrastructure (coming in 2015)

- **Future**

- Additional Energy & Environment topic(s) (formulated based on recent RFI)
- Additional topics (depending on good ideas and available resources)



Funding Opportunity and Laboratory Announcements

- **Topics**

- **Track 1 : Applied Accelerator Research.**

- This category is for focused R&D efforts aimed at solving a specific accelerator application problem in a specific area.
 - Eligibility: U.S. academia, labs, industry.
 - Teaming and cost-sharing are *expected*.
 - Proposal format: Technology development plan.

- **Track 2 : Basic Accelerator Research.**

- This category is for long-term generic accelerator R&D.
 - Eligibility: U.S. academia *only*.
 - Teaming and cost-sharing: encouraged, but not expected.
 - Proposal format: Research proposal.

- Proposals may apply to **one Track only**.

- Track 1 proposals may encompass **one topic only**.

- Within some Track 1 topics, a proposal may address multiple areas.

Applied Research (Track 1) Topics

Topic 1: Particle Therapy Beam Delivery Improvements

Technical Contact: Michael Zisman, (301)-903-2718, Michael.Zisman@science.doe.gov

Targeted R&D leading to one of:

- Less massive and more compact beam delivery systems capable of delivering ion beams from protons up to carbon that are suitable for patient therapy,
- Technology that can provide for rapid (seconds) scanning of the beam over a tumor volume in three dimensions, that is both transversely and longitudinally,
- Beam diagnostic technologies for ion beam therapy, with emphasis on increased readout speed and accuracy of position and dose.

Proposals to design an accelerator or accelerator complex are outside the scope of this call, and such proposals will be declined without review

Stewardship customer: NIH/NCI.

References: DOE/NIH Workshop on Ion Beam Therapy

<http://science.energy.gov/hep/research/accelerator-rd-stewardship/workshop-reports/>

Related calls: NIH PAR-13-096, PAR-13-371 (both now closed).

Applied Research (Track 1) Topics

Topic 2: Ultrafast Laser Technology Program

Technical Contact: Eric Colby, 301-903-5475, Eric.Colby@science.doe.gov

Targeted R&D in one or more of the following areas:

- Ultrafast gain materials capable of very high average power,
- Increased robustness and reduction in size of optical components,
- Innovations in laser architectures, cryogenics, other advanced thermal management techniques,
- Wavelength extension further into the infrared,
- Improvements in laser quality.

Proposals to develop full-scale demonstration laser systems are out of the scope of this FOA, and will be declined without review.

Stewardship customers: SC/BES, SC/NP, SC/FES, DoD, and DHS. SC/HEP also benefits.

References: Workshop on Laser Technology for Accelerators

<http://science.energy.gov/hep/research/accelerator-rd-stewardship/workshop-reports/>

Related calls: CRNBAA14-002, BAA-N00173-02, BAA-AFOSR-2014-0001, BAA-RQKM-2013-0005.

Applied Research (Track 1) Topics

Topic 3: Energy Efficiency Improvements Compatible with Office of Science Accelerators

Technical Contact: Eric Colby, (301)-903-5475, Eric.Colby@Science.doe.gov

R&D leading to new concepts in very high efficiency power conversion systems in two categories:

- **Plug-Compatible Concepts** -- targeted at upgrading existing power supplies, modulators and/or klystrons that are currently in service. Designs must be as close to plug-compatible as possible.
- **Revolutionary Concepts** -- Developments in this area must offer revolutionary gains in efficiency. While plug-compatibility is not required, a cost/benefit analysis must be included in the application to support the claim that the differential cost of developing, deploying, and operating the new power system components will generate a positive return on investment over a 10-year time period.

Stewardship customers: SC/BES, SC/NP, and Industry. SC/HEP also benefits.

References: E.O. 13514, and DOE's 2010 Strategic Sustainability Performance Plan

http://www.energy.gov/sites/prod/files/edg/media/DOE_Sustainability_Plan_2010.PDF

Related calls: none.

Basic Research (Track 2)

Long-Term Generic Accelerator R&D

Technical Contact: Michael Zisman, (301)-903-2718, Michael.Zisman@science.doe.gov

Basic research aimed at improving the theory, computational tools, and fundamental physical and technical understanding of accelerator science.

Topic areas include: beam physics, advanced computational methods for accelerator design and analysis, beam diagnostics and feedback control, new superconducting materials, new materials and coatings for accelerator components, novel power sources for accelerators, new particle sources, novel magnet designs, novel lattice designs, and novel technologies for secondary beam production.

Significant increases in performance (flux, brightness, polarization, coherence, stability, reliability, flexibility) and **decreases in cost** (construction cost, operating cost, physical size, complexity) are sought.

Stewardship customer: varies by topic area.

References: Advisory committee reports, workshop reports, NAS reports, industry technology roadmaps, etc.

Related calls: NSF PD-13-7243.

Merit Criteria for Accelerator Stewardship Proposals

(in addition to the usual 10CFR605 criteria)

QUALITY OF THE ACCELERATOR R&D STEWARDSHIP OPPORTUNITY

In the questions that follow, the term “**Stewardship customer**” is used broadly to refer to the entity (other than HEP) whose mission or research objectives encompass the proposed work. The Stewardship customer can be another Office of Science (e.g., BES, NP, FES), another DOE program office (e.g., NNSA, EERE, ARPA-E) another federal agency (e.g., NIH, DoD), or industries that use accelerator technology.

1. Does the proposed work require significant scientific or technical **advances in accelerators or accelerator-related technology**? (Accelerator-related technology includes such things as: superconducting magnets and RF cavities, RF and magnet power systems, specialized laser systems, specialized diagnostics and controls, and so on.)
2. Will the proposed work result in substantial **impact on the Stewardship customer’s needs** and result in some **synergy with the HEP mission**? (synergies might include: developing additional expertise or facilities relevant to present or future HEP-supported work).
3. For the primary participating institution(s), is the activity reasonably **consistent with the institution’s primary mission**? (e.g., if a National Laboratory is involved, is the activity consistent with that Laboratory’s primary mission?)
4. Is the PI/collaboration arguably **the best performer/provider for the Stewardship activity**? Are other entities capable of providing a substantially similar (or superior) capability?
5. What evidence is there that the **Stewardship customer endorses the goal**? Does this proposal address issues that have been identified in writing (e.g., advisory committee reports, workshop reports, white papers, roadmaps) by the Stewardship customer? Does the Stewardship customer participate substantially and materially in this effort (e.g., by co-funding, cost-sharing, in-kind donation or equipment, donation of effort)?

Funding Opportunity and Program Announcements

- **Deadlines**

- FOA/PA Issue date: June 13, 2014
- LOI due date: **July 3, 2014 at 5 PM EDT**
- Encourage/discourage response: July 10, 2014
 - *Note: precedes the HEP CR LOI due date*
- Application Due Date: September 4, 2014 at 11:59PM EDT

- **Requirements**

- A Letter of Intent (“LOI”) is **required**
 - NOTE: The LOI format is a 2-page **summary proposal**.
- An encourage response from DOE is **required**.
- The application narrative is **limited to 16 pages**, regardless of the personnel count, and has a format that depends on whether it is an Applied or Basic R&D proposal.

Accelerator Test Facility Stewardship Programs

- **Brookhaven ATF is now a dedicated Accelerator Stewardship facility**
 - ATF currently supporting 19 experiments
 - 13 support long-term R&D of interest to BES, NP, DARPA, DNDO & others
 - Use criteria has broadened to enable Stewardship mission
- **Open Facilities Initiative will make SC accelerator infrastructure more easily available**
 - Will begin with a one year **Pilot Program**
 - Seed funding provided to SC accelerator labs to (1) publicize their test facility capabilities and (2) go out and engage non-programmatic users
 - Designed to test extent/type of demand; user logistics
 - Intended to increase visibility of, and access to facilities
 - May become a permanent part of Stewardship

Summary

- **Eligibility for Accelerator Stewardship program is broad**
 - It is *not* a Lab entitlement program
- **“Customer” must actively want (and ideally participate in) the activity**
 - Pure “technology push” is not sufficient
- **Activities should accrue some measureable intellectual benefit to HEP and/or other SC offices**
- **Stewardship R&D should address high-impact challenges that**
 - Applied R&D: solve specific problems on ~5-10 year timescale
 - Basic R&D: provide broadly useful accelerator science advances
- **Handling IP likely to remain a challenge**
 - WFO provides precedent
- **Near-term successes will be vital to the viability of Stewardship**
 - SC & Congress must hear *from the customers* (not us!) that this is working



Questions?



Authority & sense of the Congress

physics used similar funding scenarios and should serve as a model for assessing priorities for the fusion program.

High Energy Physics.—Within available funds, the agreement provides \$15,000,000 to support

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erations at the Homestake Mine in South Dakota.

Within the funds for High Energy Physics, the Committee also recommends \$20,000,000 for Accelerator Stewardship. The Committee recognizes the critical role accelerator technology can play in addressing many of the economic and societal issues confronting the country. The Committee supports the Office of Science's efforts to make unique test facilities available to U.S. industry to accelerate applications of accelerator technology. Testing accelerator technology, such as at beam facilities, is the only, unambiguous way to demonstrate the operational efficacy of a new technology and repre

*“The challenge you’ll be facing this afternoon is . . . to explain to this Subcommittee, populated as it is with non-scientists like myself, why investing in your programs is a good use of taxpayer dollars. Your program has, of course, generally received broad bipartisan support. However, as budgets continue to be constrained, **you and your colleagues will have to work even harder to find ways to illustrate the importance of your programs as they compete with others for funding.**”*

-- House Energy & Water Development Appropriations Subcommittee Chair Mike Simpson, addressing Pat Dehmer on March 25, 2014.



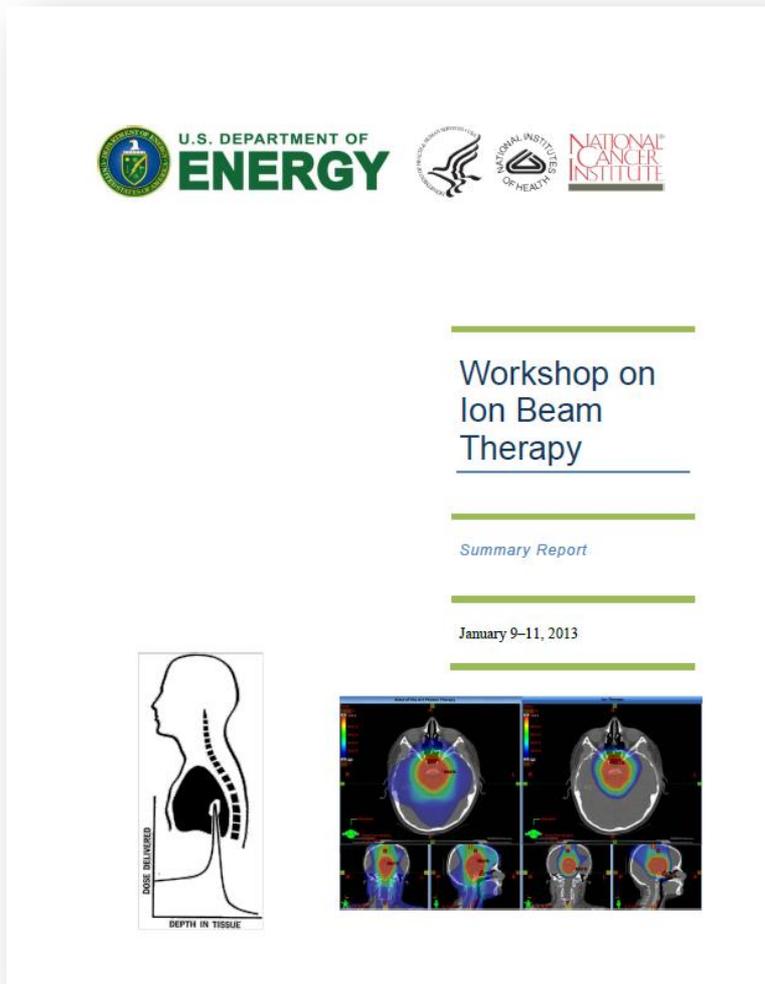
Accelerator Stewardship in FY 2014

- **In its initial year Accelerator Stewardship begins with redirected funding:**
 - Approximately **2/3** of the funding is in existing activities that were identified as having broad impacts beyond HEP:
 - 10 University grants pursuing broadly applicable fundamental physics and technology R&D (Beam physics, computation, SRF and SCM materials)
 - Operation of the Brookhaven Accelerator Test Facility (“ATF”)
 - Approximately **1/3** of the funding applies to initiatives starting in FY2014:
 - Prepare Brookhaven-ATF for increased utilization
 - Pilot program to open accelerator test facilities across the SC complex to “non-traditional” users (both OFAs and industry)
- **In FY2015 and beyond**
 - As the initial grants conclude, new grant applications will be sought along the Stewardship thrusts: Laser Technology, Ion Beam Technology for Medicine, and Energy & Environment applications. Stakeholder agencies (e.g., SC/BES, SC/NP, NIH, DoD, etc.) will be involved in formulating the calls, and evaluating the proposals.



DOE/NIH Ion Beam Therapy Workshop Report

January 9-11, 2013, Bethesda, MD



The Report highlighted 8 themes:

- Further studies of radiobiology and clinical efficacy are needed
- Machine R&D leading to
 - cost and size reduction
 - faster beam control and diagnostics
 - Faster 3D scanning
 - Smaller, less costly gantries
 - Real-time range and dose verification
- Future facilities will need multiple ion species
- International operational & clinical experience should be leveraged

http://science.energy.gov/~media/hep/pdf/accelerator-rd-stewardship/Workshop_on_Ion_Beam_Therapy_Report_Final_R1.pdf

DOE Workshop on Laser Technology for Accelerators

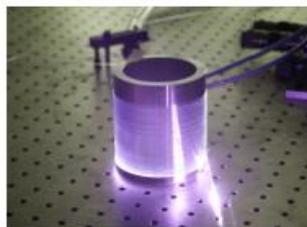
January 23-25, 2013 Napa, CA.



Workshop on
Laser
Technology for
Accelerators

Summary Report

January 23-25, 2013



- Charge:
 - Identify laser-based accelerator applications
 - Assess laser specifications for each
 - Identify technical gaps
 - Specify R&D activities needed to bridge gaps
 - Assess the proposed U.S. R&D activities against global laser R&D efforts
- Attended by ~50 participants; ~10 industry, ~5 international, including members of DOE-HEP, DOE-BES, DOD, NSF, CRS.
- Ultrafast lasers (<1 ps) operating at high average power (>1 kW), and highest power efficiency (>20%) as flexible, tunable, laboratory-based systems
- Challenges
 - No PW/kW gain materials; too low damage threshold optics
 - Costly, inefficient pumps
 - Little experience coherently combining ultrafast lasers
 - Pulse contrast and optical phase noise

<http://science.energy.gov/~media/hep/pdf/accelerator-rd-stewardship/Lasers for Accelerators Report Final.pdf>

Energy & Environmental Applications of Accelerators

- **Energy**

- Accelerator energy efficiency
 - EO13514 mandates 28% GHG reduction from FY08 to FY20; current DOE SC complex accelerator energy usage is ~1000 GW-h/yr
 - Initiative to increase accelerator efficiency will have broad impact across SC labs, and in industrial uses of accelerators
- Use of accelerators to deliver heat more precisely and controllably than conventional thermal processes

- **Environment**

- Pollution reduction NOX, SOX reduction by flue gas treatment
- Waste treatment; pollution remediation
- Pesticide and pharmaceutical reduction in domestic water supplies

- **Just completed a Request for Information**

- Digesting 250 pages of responses now!

Accelerator Stewardship Seen in a Broader Context

- For a majority of Accelerator R&D Stewardship activities, the intent is to carry the R&D forward to **first prototype** testing under relevant conditions. (i.e., to **TRL 5-6**)

Accelerator R&D Stewardship

National Network for Manufacturing Innovation

Work For Others

NATIONAL NETWORK FOR MANUFACTURING INNOVATION: A PRELIMINARY DESIGN

Table 1. Technology Readiness Levels and Manufacturing Readiness Levels, after [21]

TRL 1:	Basic principles observed and reported	MRL 1:	Manufacturing feasibility assessed
TRL 2:	Technology concept and/or application formulated	MRL 2:	Manufacturing concepts defined
TRL 3:	Analytical and experimental critical function and/or characteristic proof of concept	MRL 3:	Manufacturing concepts developed
TRL 4:	Component and/or breadboard validation in a laboratory environment	MRL 4:	Capability to produce the technology in a laboratory environment
TRL 5:	Component or breadboard validation in a relevant environment	MRL 5:	Capability to produce prototype components in a production relevant environment
TRL 6:	System/subsystem model or prototype demonstration in a relevant environment	MRL 6:	Capability to produce prototype system or subsystem in a production relevant environment
TRL 7:	System prototype demonstration in an operational environment	MRL 7:	Capability to produce systems, subsystems or components in a production relevant environment
TRL 8:	Actual system completed and qualified through test and demonstrated	MRL 8:	Pilot line capability demonstrated; Ready to begin Low Rate Initial Production
TRL 9:	Actual system proven through successful mission operations	MRL 9:	Low rate production demonstrated; Capability in place to begin Full Rate Production

