DOE HEP Accelerator R&D

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Office of Science, U.S. Department of Energy
The DOE/SC Accelerator R&D Program

• SC supports a wide range of accelerator science and technology R&D primarily aimed at enabling a broad spectrum of discovery science.

• Accelerator R&D in SC is generally characterized/organized by*
  – What is the application? Or, Who is the customer?
  – What is the likely timescale for this effort to reach its desired goal(s)?
  – What is the current readiness level of the technology (TRL)?

• Answers to these questions generally determine which SC subprogram “owns” the effort.
  – Within a subprogram there may be several distinct activities or thrusts focused on particular technologies or classes of problems.

• Generally speaking, in SC all near-to mid-term accelerator R&D is owned by the customer (BES, NP, HEP) and all mid- to long-term accelerator R&D is owned by the HEP program

*Since this is R&D, the development timescale is not always certain and the eventual application is not always known – so there is no shortage of grey areas.
Technology Readiness Level

- A method of estimating **technology maturity** developed by DOD, NASA and others
- Widely used for complex science and technology projects
- Applies to individual technology **elements**. A project or activity may have multiple elements at different TRL stages
- Range is TRL 1-9 with larger number meaning more mature
  - In HEP we have tried to tailor management of R&D efforts to the approx. TRL level
• HEP supports a wide range of accelerator science and technology R&D primarily aimed at enabling HEP discovery science.

• Near- to mid-term R&D is typically “owned” in Facility Operations
  – Incorporates generally known technologies (TRL 4+) that can be developed to the level of a full system prototype or full system test (TRL 7-8) in less than ~5 years
  – Priorities driven by customer/facility needs for science programs
  – Often takes the form of facility improvements that are installed and brought into operation over a few to several years
    • For example, PIP-I at Fermilab
  – Can also be incorporated into distinct Projects (e.g., LBNF, LCLS-II)
  – Individual components may be developed/provided by SBIR/STTR
  – Will not be discussed further here
Mid- to long-term R&D is “owned” in three separate HEP subprograms:
- General Accelerator R&D (GARD): **HEP-owned early-stage R&D**
- Accelerator Stewardship: **Non-HEP-owned early stage R&D**
- Directed Accelerator R&D: **HEP-owned mid-stage R&D**

Will focus on the first of these today (other 2 tomorrow AM).

**GARD: HEP-owned early-stage R&D**
- Focuses on basic accelerator science and related R&D.
- Accelerator science component (TRL 0-1): physics of beams
- R&D thrusts (TRL 1-3) can be developed to the level of proof-of-concept or component demonstration (TRL 3-5) in ~5-10 years
  - Technology “roadmaps” developed by the community. Will hear about several of these efforts today
- Priorities driven primarily by long-term goals of HEP program
- Too early to be incorporated into Projects (technology not ready)
- Individual components may be developed/provided by SBIR/STTR
• **Accelerator Stewardship:** *Non-HEP-owned early stage R&D*
  – Has many of the same general characteristics as GARD but is concerned with customers other than HEP
  – Priorities driven primarily by mid- or long-term goals of the customer, and the ability to make significant technical progress in 3-5 years
  – Multi-partner collaboration is important (labs, university, industry)

• **Directed Accelerator R&D:** *HEP-owned mid-stage R&D*
  – Selected R&D areas past the proof-of-concept level (TRL 3-4+) which are directed towards *specific future facilities* to demonstrate project readiness (TRL 6-7)
    • *E.g., HL-LHC (LARP), ILC*
  – Actual implementation may be 10+ years away
  – Priorities driven by HEP long-term goals
  – Individual components may be developed/provided by SBIR/STTR
Where these live on HEP Org Chart

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Computational HEP
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Commercialization & Tech Transfer

Facility Ops R&D

Directed R&D
LARP
Muong-2 (MAP)
LHC Operations
Abid Patwa
Simona Rolli

Other Operations [SLAC/Other Labs]
John Kogut

ACCEL
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Funding Trajectories of GARD, Stewardship, and SBIR

GARD = “General Accelerator R&D”