U.S. DEPARTMENT OF ENERGY | Office of Science

GARD Summary and Prospects

HEPAP Meeting
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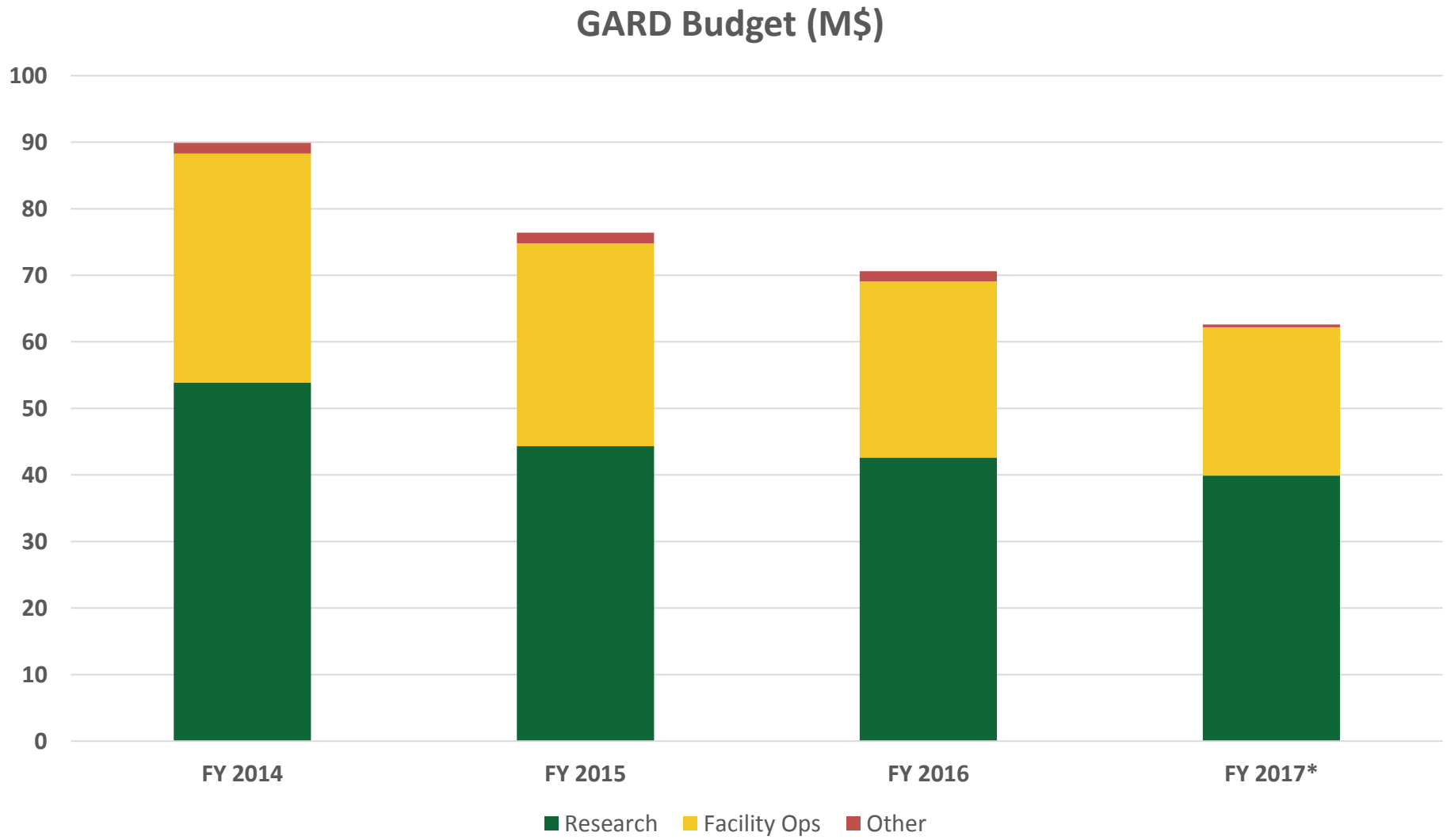
GARD Strategy

- Implement HEPAP Accelerator R&D Subpanel recommendations within budget and programmatic constraints.
- Develop Research Roadmaps for all 5 Thrusts:
  - Advanced Accelerator Concepts
    - Workshops held, reported published. http://science.energy.gov/hep/community-resources/reports/
  - Accelerator and Beam Physics
  - Particle Sources and Targets
    - Preparatory workshop held at FNAL May 31—June 1, 2017
  - RF Acceleration Technology (NC and SC RF)
    - Workshops held, report in final preparation stage.
  - Superconducting Magnets and Materials
    - Workshop held, report published. https://science.energy.gov/~/media/hep/pdf/Reports/MagnetDevelopmentProgramPlan.pdf

HEP Strategy

- **Multi-MW proton beam**
  - Priority is completion and commissioning of PIP and R&D for PIP-II
  - Progress has been slow due to overall funding constraints
- **Very high-energy *pp* collider**
  - Priority is basic technology R&D
  - Pursuing R&D in coordination with CERN study
  - Funding-limited
- **Mutli-TeV e^+e^- collider**
  - Plasma-wakefield technology, an element of the possible technology roadmap for a multi-TeV e^+e^- collider, has been identified as a priority by the DOE Office of Science due to broader science impacts
  - Moving forward with R&D
- **Far future R&D**
  - This effort is ongoing at approximately a constant level of funding
  - This was incorporated into, e.g., university comparative review

GARD Budget Trend



* As of May 2017

Potential Budget Impacts on GARD

- **Advanced Accelerator Concepts**
  - FACET-II delayed: more difficult to align schedule with LCLS-II; slow down progress in PWFA and other user research
  - BELLA 2nd beamline delayed: hold up 5GeV+5GeV staging
- **Accelerator and Beam Physics**
  - FAST/IOTA at FNAL delayed for both e- and p beam research
- **Particle Sources and Targets**
  - Unable to make needed additional critical investment in high power target development
- **RF Acceleration Technology**
  - Slow down progress in SRF and RF sources innovation
- **Superconducting Magnets and Materials**
  - Unable to carry out the U.S. MDP plan

Other GARD Challenges

Beam intensity needs and challenges at FNAL

- PIP-I and 700 kW goals achieved (2017)
- 900 kW -- PIP-I+ (~2022)
  - New target, improvements to existing Linac, Booster, Main Inj.
- 1.2 MW – PIP-II (Project)
  - Replace Linac, improvements to Booster, Main Inj.
- 2.4 MW – PIP-III (GARD)
  - Replace Booster (either a new RCS or an 8-GeV SRF linac)

- Accelerator science challenges: stripping injection, space charge, low losses, beam instabilities, SRF and NCRF systems, target systems

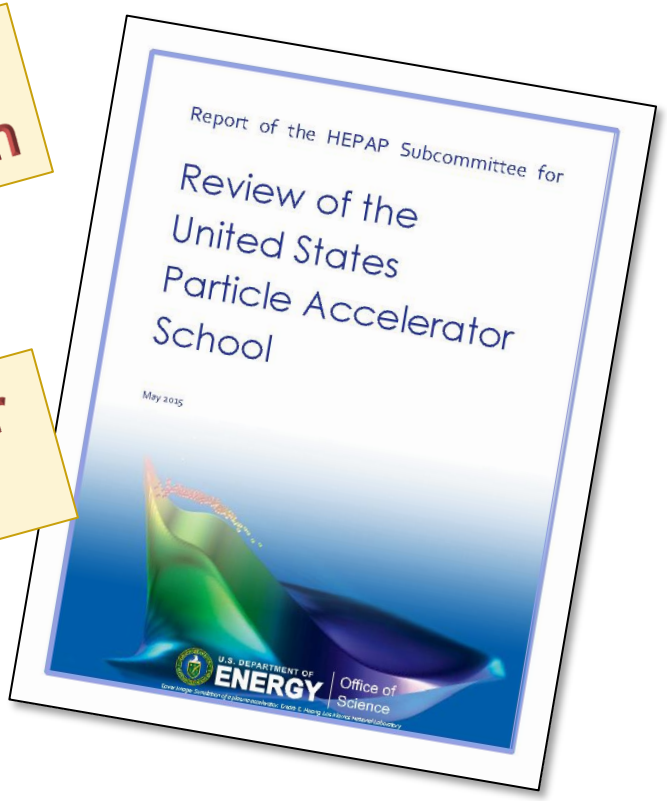
Other Challenges: Accelerator Science Training

From Crawford HEPAP presentation - 12/10/2015

- **Review of the United States Particle Accelerator School (USPAS)**
  - Report presents a clear case that "USPAS effe… and efficiently serves the critical need… workforce development and …
- **HEP charged FNAL t… for managem… …osal**
  - Reviews we… …e; iterating on managemer…
- **Request for Information on Strengthening U.S. Academic Programs in Accelerator Sci…**
  - Sought community input …
    - Increasing t… …ence
    - I… …aboratory roles
    - … …n academic acc. science
  - 21 r… …ived are available at:
    - http://science.energy.gov/hep/community-resources/reports/
  - Responses emphasized the central importance of USPAS to academic training in accelerator science

Done, but declining GARD budget may cause problem

Done. Information will guide our accelerator traineeship FOA.



- **It is clear that USPAS plays a central role in the training of accelerator scientists in the U.S., and we are investigating complementary ways to strengthen academic accelerator science**

GARD Measures

- Complete all the GARD thrust research roadmaps and use them to focus and guide the program
- Use data from Laboratory Optimization process (ongoing) to further prioritize GARD efforts
- Ensure GARD accelerator facilities are used to its fullest extent, maximizing their science output together with their users/collaborators.
- Strengthen coordination with the NSF Accelerator Science Program, DOE Accelerator Stewardship (Track 2) Program, BES, NP and FES
- Continue to make the best utilization of GARD resources, adjusting as necessary, to support the P5 strategic plan for HEP

Research Roadmap in Action

From: LPA collider studies (LBNL Institutional Review presentation, Schroeder)

Advanced Accelerator Concepts Research Roadmap Workshop Report • *February 2016*

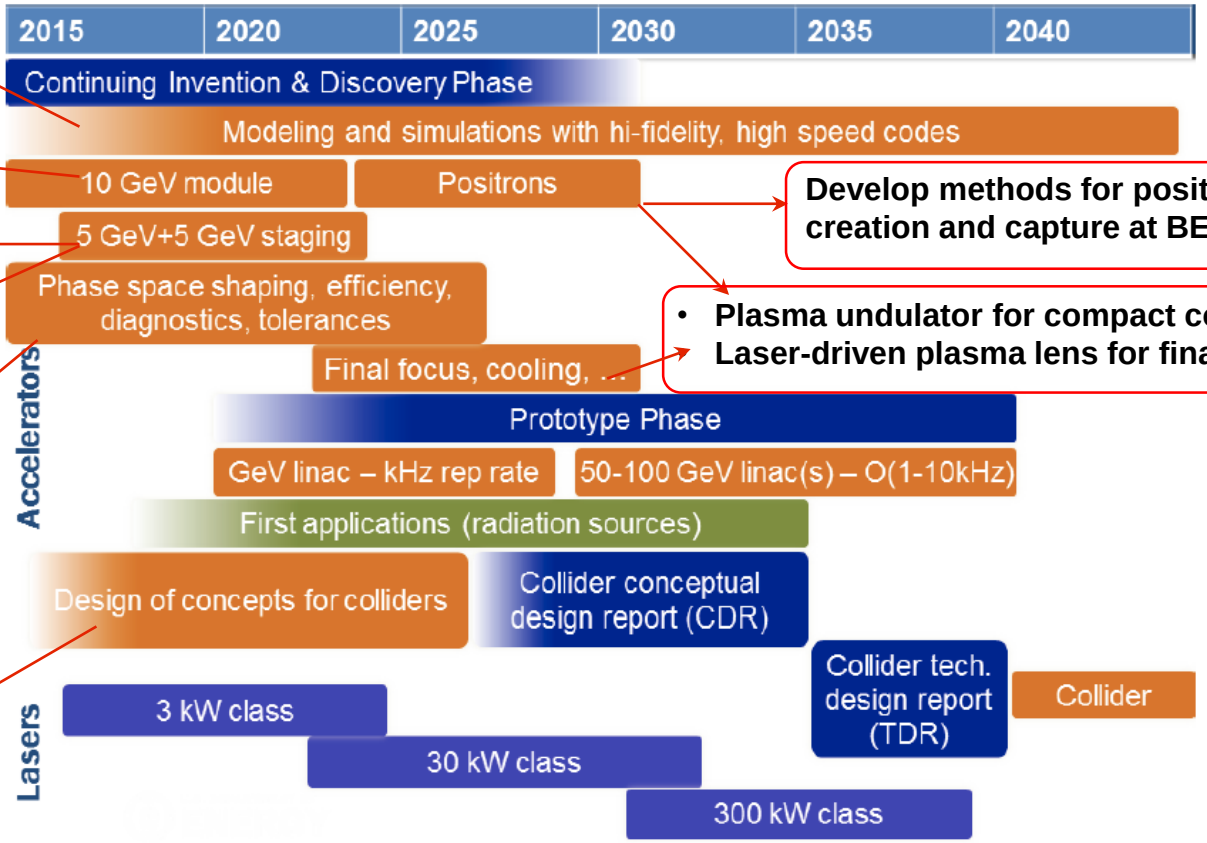
Improving speed & efficiency of computation (INF&RNO, WarpX, FBPIC, etc.)

- **Understanding laser propagation physics**
- **Modeling BELLA expts.**
- **3D MHD cap modeling**

Develop compact beam stage coupling

Explore novel injection methods (ionization injection, laser-triggered injection, density gradients, etc.)

- **Ion motion in bubble regime**
- **Hosing in quasi-linear regime**
- **Non-uniform LPA stages**



Develop methods for positron creation and capture at BELLA

- **Plasma undulator for compact cooling**
- **Laser-driven plasma lens for final focus**

Summary

- GARD is facing severe budgetary challenges
- Tools and Process are in place to guide the program to best support HEP mission
- Roadmaps developed for GARD research thrusts are already being used to align research efforts.