Accelerator Subpanel Status Report

Don Hartill for the Subpanel

Subpanel Members

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Oliver Bruning	CERN	Andy Lankford	UC Irvine
Bruce Carlsten	Los Alamos	Lia Merminga	Triumf
Roger Dixon	Fermilab	Jamie Rosenzweig	UCLA
Steve Gourlay	LBNL	Mike Syphers	MSU
Don Hartill (Chair)	Cornell	Bob Tschirhart	Fermilab
Georg Hoffstaetter	Cornell	Rik Yoshida	Argonne
Zhirong Huang (BES)	SLAC		

Charge Summary

National Goals: Appropriate goals in broad terms for medium ($\leq$ 10 years) and long term ($\leq$ 20 years) U. S. Accelerator R&D for a world leading future program in accelerator based particle physics consistent with P5

Current Effort: Examine the scope of the current effort and evaluate how well these address the HEP mission as expressed by P5

Impediments: Describe any impediments that may exist in achieving these goals

Charge Summary

Training: Accelerator R&D efforts play a major role in training future accelerator scientists and technologists. How are we doing?

Balance: How do we maintain a healthy and appropriately balanced national program? Provide further guidance for a plan based on the science and technology case for increased investment in HEP Accelerator R&D called for in P5's Scenario C

Preliminary report by end of November with final report by March 2015

Information Gathering

Meetings were held at BNL, Fermilab, Argonne, SLAC and LBNL.

Subpanel Website:
http://www.usparticlephysics.org/p5/ards

Website has the agendas and the talks for the lab visits.

Town Hall meetings were held at each of the lab visits.

Meetings

First Meeting (Organizational) at SLAC July 7 & 8.

Road Trip to BNL, Fermilab & Argonne, and SLAC & LBNL week of August 25 to 30.

Two Day Meeting Newport Beach, CA Nov. 6 & 7

Final Two Day Meeting Chicago, IL Dec. 3 & 4

Road Trip

Energy frontier was the focus at BNL.

Intensity frontier was the topic at Fermilab.

Novel Particle Acceleration was the theme at SLAC/ LBNL.

Two hour executive session at LBNL followed by a two page report by each subpanel member on their impressions from the road trip.

Current GARD Program

In FY 14 the current General Accelerator Research and Development budget is 85.5 M$.

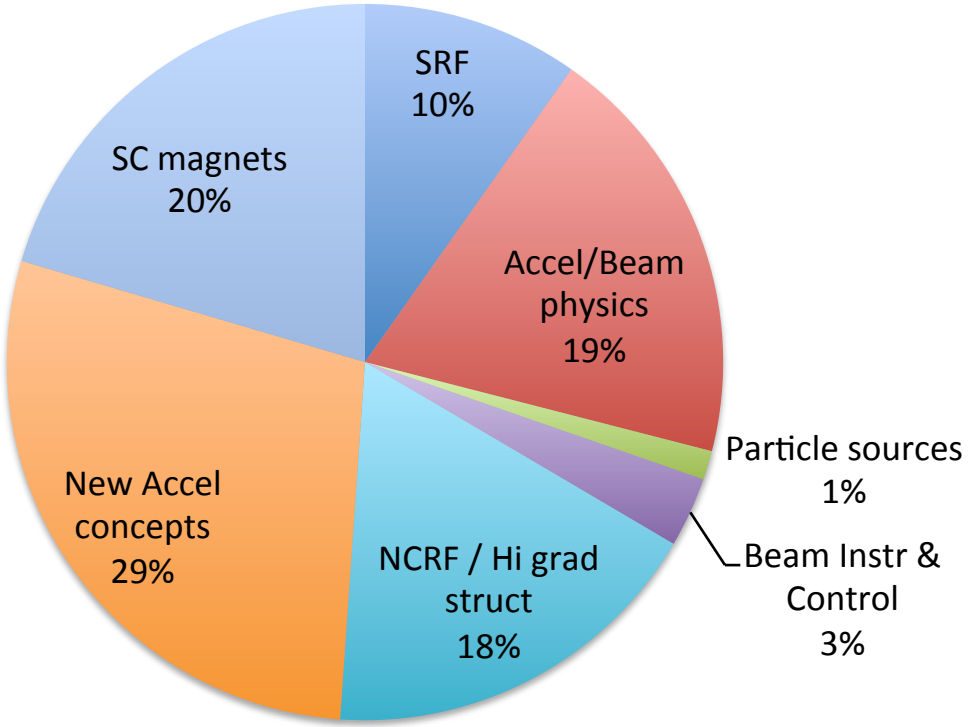
Since the P5 report, 26 M$ of SRF R&D at Fermilab has been redirected to the PIP II project and test facility operation support.

Also included in the GARD program is 12 M$ for wakefield acceleration operations and 5 M$ for superconducting magnet facility operating costs.

This leaves a net of 42.5 M$ for GARD base programs and is divided among the seven GARD thrusts and is illustrated by the following chart:

Current GARD Program

FY 2014 GARD budget - $26M(SRF: now redirected)
- $17M (12M wakefield ops + 5M magnet test ops)



NSF Program in Accelerator Science

In addition to the DOE GARD program, NSF has started their new program in Accelerator Science with a total funding level of 9.8 M$ this year.

Fourteen awards have been made covering a broad range of topics in Accelerator Science.

It is a very welcome addition to the NSF portfolio.

LHC Upgrades

The LARP program to construct the high field quadrupoles and dipoles based on Nb_3Sn has been moved from GARD to LHC Hi-Lumi directed R&D. Crab SRF cavities are also part of this program and are being developed by BNL and Old Dominion University.

The schedule for these upgrades is to begin installation in 2023 with a 2.5 year duration and then run until 2035 integrating ~ 3000 fb^{-1}. 1.2 km of the LHC will be replaced in the upgrade. Total cost ~ 800 MCHF for the LHC.

Pileup will be the principal experimental challenge with the potential of up to several hundred interactions per bunch crossing.

Future Collider Options

An ILC in Japan is under study.

Muon colliders were not endorsed by P5.

Andy and I were at the Future Circular Collider collaboration meeting three weeks ago at CERN. The URL for all the talks is https://indico.cern.ch/event/333236/other-view?view=standard

FCC R&D is now part of the CERN medium term plan and they have applied for H2020 funding to support some of the R&D. More than 25 institutions have signed MOU's to carry out different parts of the needed R&D. The FCC could be initially an ~ 200 GeV e+e- collider or an ~ 100 TeV pp collider.

Future Collider Options

The high energy physics community in China is pressing forward with a proposal for a 50 to 80 km ring. It would first be a ~ 200 GeV e+e- collider with a proposed construction start in early 2020's followed by a pp collider in the mid 2030's.

In addition, there is a 150 MEuro EU initiative spread over ten years in laser plasma acceleration with a focus on developing compact synchrotron radiation sources including FELs.

US GARD Opportunities

For the Intensity Frontier, the measure is MW•Ktons•beamtime /yr so accommodating higher beam power has significant leverage. Beam stability at synchrotron injection energies combined with higher power targets could have large benefits.

Future high energy colliders are expensive. Optimization studies will be key in lowering the cost and maximizing operating efficiency. Optimized superconducting magnet design both in field and manufacturablity will require R&D. For e+e-, more efficient RF would lower operating costs.

Advanced acceleration technology potentially has the promise of dramatically increasing the accelerating gradient and thereby significantly reducing the cost of a very high energy accelerator or collider.

Subpanel Challenges

The Accelerator R&D Subpanel is not a project review panel. Our task is to recommend a balanced program in accelerator R&D to OHEP to provide the US with a world leading program in accelerator based particle physics. And, parenthetically developing an exciting program that will attract additional funding to the program.

We were briefed on several initiatives each with a price tag of ~ 25 M$ per year including capital investment, operations, and experiments. One on-going program will stop at the end of FY16 unless a significant investment is made to reconfigure a portion of the SLAC linac because of the LCLS II construction project.

Subpanel Challenges

To make a contribution to future high energy colliders, the superconducting magnet program will need increased investment both in going to higher magnetic fields and in developing manufacturing techniques that significantly reduce the magnet assembly labor costs.

For the LCLS II cryomodules, the cost of Nb for the cavities is only 10% of the cost so improved manufacturing techniques have the potential of significantly reducing the cost of the completed cryomodules for a high energy SRF based collider.

Process

After the Road Trip we have set up the following six accelerator R&D areas to study in more detail:

Accelerator physics computation and simulation:

Advanced acceleration:

- Normal conducting RF structures and sources
- Wakefield accelerators
- Beam driven plasma wakefield acceleration
- Laser driven plasma wakefield acceleration
- Dielectric laser acceleration
- Fundamental aspects of muon acceleration

Process

Beam dynamics, instrumentation and controls:

- Space charge dominated beams
- Timing systems, beam controls, beam loss monitoring, etc.
- Similar activities at universities

Particle Sources and Targets:

- High power beams, horns, targets, and collimators
- Beam dumps

Superconducting Magnets and Materials:

Superconducting RF:

Process

The R&D needs for future very high energy colliders will be covered in the six areas mentioned previously rather than setting up a separate area.

High field superconducting magnets, beam dynamics and instrumentation, along with efficient RF acceleration are the key areas.

To make sure everything is included, a separate list of needed R&D will be maintained for these very high energy colliders.

Process

Each area has at least two subpanel members assessing the information provided to the subpanel and developing appropriate guidance and recommendations.

Good progress is being made by each of these subgroups and preliminary draft reports are being written by each subgroup. One subgroup has already has already produced a first draft.

Discussion between the subgroups takes place during our weekly telecons. These will be key in preparation for our meeting on Nov. 6 and 7. At that meeting, we may invite a few speakers who were not able to present their views during the road trip.

In addition, we plan to hold a virtual town hall meeting like P5 did on October 10 at 11 EDT. Details will be communicated via DPB and DPF.

Process

Written comments will be accepted on the subpanel website until October 17.

At the Nov. 6 and 7 meeting, the draft reports from each subgroup will be discussed and assembled into a very preliminary draft report.

During November the preliminary draft report will be refined using basecamp for document changes and discussions during telecons.

Process

The goal of the meeting on December 3 and 4 is to develop the final set of recommendations and comments that will form the draft report. It will be presented at the December HEPAP meeting. Final editing of the draft report will be done during December and January for early presentation of our final report to HEPAP.

Conclusions

A healthy program in accelerator R&D is key to insuring that the US accelerator based high energy particle physics program is world leading.

Training of the next generation of accelerator scientists and technologists is a very important element of this R&D program. See the HEPAP Subpanel report on personnel needs published this past spring.

Our hope is that our report will provide useful guidance to DOE OHEP in charting the future of accelerator R&D in the US.