All-scientist retreat summary

Erica Snider
on behalf of the Scientist Advisory Council
PAC meeting, July 18, 2018

What I will talk about

- Introduction
- Overview of the first retreat
- Overview of the second retreat
- Working group summaries from the second retreat
- Summary and conclusions

Introduction: the Fermilab All-scientist retreats

By request of Directorate, Scientist Advisory Council organized two scientist retreats recently to discuss the future of the laboratory's science program

- "First" retreat: May 4, 2017
- "Second" retreat: April 26, 2018

Each was preceded by weeks of preparatory discussions and work within a set of pre-defined working groups

- Scientists invited to participate in working groups of interest

Working groups for each retreat were charged with specific set of goals

Overall goal is to ensure Fermilab is ready to contribute to community planning

The first retreat: May 4, 2017

Goals

- Gather scientific staff views on long-term plans for Fermilab research program
- Collect input on the Fermilab 10-year plan (pre-2026) and longer-range outlook (post-2026)
- Facilitate communication between different groups at the lab related to long-range goals
- Produce a report outlining a schedule of events needed to prepare Fermilab's input for the next community planning process (P5), and how best to organize for that

Emphasis was on thinking, not making decisions, setting priorities or limits

The first retreat: May 4, 2017

Desired output

- A starting draft of
  - a schedule of events / work needed to give input to next P5 process
  - a strategy for how to engage with larger US / International HEP community
  - a list of possible long-term lab goals
  - an estimate of what new work is needed
- A report from the retreat, coordinated by SAC
- A staff better organized, connected and informed about technology developments and science/mission overlaps in other communities

Organization for May 4, 2017 retreat

	Working group	Conveners
Physics	Cosmic science	Bradford Bensen, Andrew Sonnenschein
Physics	Energy frontier science	John Campbell, Anadi Canepa, Dmitri Denisov, Bogdan Dobrescu, Sergo Jindariani, Vladimir Shiltsev
Physics	Neutrino science	Mike Kirby, Alexander Himmel, Louise Suter
Physics	Precision science	Doug Glenzinski, Brendan Kiburg, Juliana Whitmore
Technology	Accelerator science	Sam Posen, Thomas Strauss, Alexander Valishev, Bob Zwaska
Technology	Computational science	Oliver Gutsche, Gabriel Perdue
Technology	Detectors for science	Juan Estrada, Petra Merkel, Vadim Rasu
Technology	Applied science	Jin Chang, Charles Thangaraj

Results from the first retreat

Working groups met for one month in advance of the retreat

Report submitted to Fermilab Director, distributed to scientists, noted:

- Fulfilled first two goals:
  - Gathering views on long-term plan + collecting input for pre and post-2026 outlook
  - Though little substance in the post-2026 long-range outlook
- Only partially fulfilled second two goals:
  - Facilitating communication, developing a schedule for P5 preparation, etc.

Recommended

- Seek “lessons learned” from previous Snowmass / P5 working group leaders
- Start to prepare for community-wide planning by summer 2018 by identifying group leaders, organizing additional retreats that fit in with HEP-wide schedule
- Organize next retreat in 2018 around three “core capabilities” working groups
  - Accelerator, computing, detectors

The second retreat: April 26, 2018

In planning / organizing the second retreat

- Specifically asked to address the lack of substance in the post-2026 outlook
  - Precluded working groups focus on technology areas alone
- Some changes to address cross-communication issues
  - Asked physics groups to address relevant applied sciences
    - Eliminated separate Applied Sciences working group
  - Started earlier to reduce conflicts in meeting times
    - Two months of meetings prior to retreat
- Added a group around new efforts on quantum computing and detectors
- The context specifically included the need to provide input to the European Strategy Group (ESG)
- Selected mostly new conveners, mix of experience and areas of work

The second retreat: April 26, 2018

Goals given a narrower focus

- Facilitate discussion and seek input in answering the questions
  - What are the interests of the Fermilab scientists for the decade following 2026?
  - How do we give our input to the US community planning and the European Strategy Group?
  - What is the post-retreat plan for working with US, European and other partners to give our input
- Considerations
  - Build on the previous report
  - Speak to needed facility construction/upgrades, R&D, new physics knowledge
  - Consider activities at Fermilab, and at other places Fermilab should be involved in
  - Consider how we should approach coordinating with area communities

Organization for April 26, 2018 retreat

	Working group	Conveners
Physics	Cosmic science	Bradford Bensen, Lauren Hsu, Albert Stebbins
Physics	Energy frontier science	Anadi Canepa, Dmitri Denisov, Paddy Fox, Sergei Nagaitsev
Physics	Neutrino science	Zarko Pavlovic, Louise Suter, Joseph Zennamo
Physics	Precision science	Doug Glenzinski, Mark Lancaster, Chris Polly
Technology	Accelerator science and technology	Jonathan Jarvis, Martina Martinello, Nikolay Solyak, Charles Thangaraj, Alexander Valishev
Technology	Computational science	Adam Lyon, Jim Kowalkowski
Technology	Detectors for science	Juan Estrada, Angela Fava, Petra Merkel, Vadim Rusu
Technology	Quantum science	James Amundson, Roni Harnik

Second retreat agenda

Thursday, 26 April 2018

11:30 - 12:00 Get box lunch + Intro talk
Convener: Dr. Joseph Lykken (Fermilab)
Material: slides

11:45 **Introduction talk** *15'*
Material: Slides

12:00 - 13:40 Group Reports I
Convener: Michelle Stancari (Fermilab)

12:00 **Cosmic Science Working Group** *25'*
Speakers: Dr. Bradford Benson (Fermilab), Dr. Lauren Hsu (Fermilab), Dr. A
Material: Slides

12:25 **Energy Frontier Science Working Group** *25'*
Speakers: Dr. Anadi Canepa (Fermilab), Dmitri Denisov (Fermilab), Dr. Patri Nagaitsev (FNAL)
Material: Slides

12:50 **Neutrino Science Working Group** *25'*
Speakers: Dr. Louise Suter (FNAL), Dr. Joseph Zennamo (Fermilab)
Material: Slides

13:15 **Precision Science Working Group** *25'*
Speakers: Dr. Douglas Glenzinski (Fermilab), Prof. Mark Lancaster (UCL), Dr
Material: Slides

13:40 - 14:00 BREAK

14:00 - 15:40 Group Reports II
Convener: Dr. Gabriel Perdue (Fermilab)

14:00 **Accelerator Science and Technology Working Group** *25'*
Speakers: Dr. Jonathan Jarvis (Fermilab), Dr. Martina Martinello (Fermilab), Dr. Nikolay Jayakar Thangaraj (Fermilab), Alexander Valishev (Fermilab)
Material: Slides

14:25 **Computational Science Working Group** *25'*
Speakers: Mr. Jim Kowalkowski (Fermilab), Dr. Adam Lyon (Fermilab)
Material: Slides

14:50 **Detectors for Science Working Group** *25'*
Speakers: Dr. Juan Estrada (FNAL), Angela Fava, Dr. Petra Merkel (Fermi National Accel Laboratory), Dr. Vadim Rusu (FNAL)
Material: Slides

15:15 **Quantum Science Working Group** *25'*
Speaker: Dr. James Amundson (Fermilab)
Material: Slides

15:40 - 16:00 BREAK

16:00 - 17:00 Group discussion
Convener: Roni Harnik (FNAL)

17:00 - 17:10 Adjourn

https://indico.fnal.gov/event/16914/

Fermilab

Second retreat results and follow-up

- Most working groups met two or more times prior to
  - Attendance, participation in most was robust
- Retreat proper attended by >160 scientists

- WG conveners presented summaries of working group discussions, conclusions, followed by an open discussion session
- Conveners asked to write a brief summary for a report with major outcomes, planned or suggested follow-up work
  - Some groups have continued to meet, work
  - Others have plans, but have not yet to initiated follow-up work

Working group summaries

Working group summaries

Cosmic science working group

- Discussed a broad program pursuing three of the five P5 science drivers
  - Dark matter, dark energy, inflation / neutrinos, the R&D that seeds this science
  - The retreat offered an opportunity to flesh out, refine and coalesce ideas, priorities
- Detailed internal discussions of opportunities and options for exploring each area in collaboration with other groups
  - Goals for 2018 -- 2026 building on existing strengths
  - Suggested goals for 2026+ in dark matter and cosmic surveys
    - 10-year plan for leadership in DM, DE, theory, CMB
- Moving forward
  - Already working within DOE community planning process for astro / P5, and with various existing or proposed collaborations
  - Continuing to meet, but do not anticipate input to ESG

Working group summaries

Energy frontier science working group

- Articulated a broad program of activities at the energy frontier
  - Technologies, accelerators, physics, detectors, community planning
  - Engaged wide community beyond the Fermilab staff
- Recommendations to
  - Increase LDRD proposals to address funding shortfalls, R&D gaps
  - Engage in development of US hosted energy frontier facilities option for Snowmass
  - Consider small-scale experiments needed to fully utilize LHC physics potential
- Moving forward
  - Holding monthly meetings to discuss status, plans, ideas
  - Participating in white paper preparation for all energy frontier proposals including accelerators, detectors and physics via respective international organizations
    - A number of white papers in various stages of progress.
    - Goal is submission to ESG by December 18, 2018
  - Actively participate in Snowmass preparations

Working group summaries

Neutrino science working group

- Examined where experimental, theoretical knowledge expected to be in 2026; neutrino beams beyond LBNF; precision tau neutrino experiments; vision for continued work and discussion
- Identified interest among staff in wide-range of non-overlapping topics, from precision neutrino oscillations to searches for neutrinoless double-beta decay and relic neutrinos
- Moving forward
  - Create targeted (yet to be formed) working groups
  - Focus on feasibility, key aspects of measurements where Fermilab can play a transformative role
  - Develop reports highlighting where Fermilab facility can support these measurements
  - Feed these into overall white paper focused on future of Fermilab neutrino science, which would serve as input to ESG, and future US community efforts

Working group summaries

Precision science working group

- Has been on-going planning effort since the first retreat
  - Worked to narrow the focus to a small number of experiments with impact, good alignment with Fermilab strengths, strong user community, feasible
  - Aiming to formulate a program for 2025+
- Engaged with the precision community from the outset
  - Working with collaborating partners on current & proposed experiments / concepts
  - **Jointly submitting white papers to ESG**: a coherent program of muon CLFV
  - Strategy:
    - **Identify next-generation opportunities** for Muon Campus experiments within context of other opportunities, **participate in European planning**, ensure **readiness for P5** exercise
- Moving forward
  - Mu2e-II will continue to host workshops. Advance highest priority R&D needed LDMX already plugged into community planning process
  - Meet to discuss whether to pursue EDM experiments, level of engagement with MUonE, requirements to advance LDMX-mu, how best to engage the CLFV community

Working group summaries

Accelerator science and technology working group

- Strategic goals
  - Leadership in beam physics, accelerator technology
  - Provide accelerator technologies for future accelerators
- Discussed the plan to achieve these goals
  - Maintain robust R&D program around IOTA/FAST facilities, broad collaborations, alignment with international strategy and context
  - Enable full exploitation of existing complex via cost effective upgrades, physics driven path to 2.4 MW
  - Push R&D in various related areas, e.g., high-power targetry & RF / beam cooling,...
  - Drive superconducting RF R&D with Nb, new materials, new collaborations
  - Advance superconducting magnet R&D looking in new directions, cost/performance optimization

Working group summaries

Computational science working group

- Already strongly engaged in community planning, R&D
  - Involved with HEP-CCE, HSF to identify, pursue cross-cutting R&D opportunities
  - Major contributor to community white paper to determine R&D roadmap for HL-LHC and DUNE
- Discussed on-going push to exploit current generation of computing architectures, new technologies and techniques
  - High performance computing, hybrid computing, machine learning, frameworks,...
  - Concrete plans for 2021-22 goals, a vision for 2025-26; noted that projecting beyond that is speculative for computing technologies.
- Moving forward:
  - Execute existing R&D projects, follow on with new proposals and projects
  - Continue to engage with ASCR program
  - Work with our partners (labs, universities, CCE, HSF) and plan the future

Working group summaries

Detectors for science working group

- Build upon synergies with other working groups.
  - Identified forward-looking R&D topics + broader areas where workstreams can be combined, resources optimized
  - Contribute to physics-driven white papers in cooperation with science groups, tailoring proposals for technological developments to the scientific scope
- Recommendations
  - Increase accessibility to resources and facilities for detector R&D
  - Reduce barriers between divisions
  - Monthly inter-division meetings to facilitate communication, sharing of goals, explorations of feasibility
- Suggestions for further engaging broader community
  - Launch collaborations on specific R&D projects, sharing of infrastructure
  - Award grants specific for staff exchange, collaborative networks
  - Participage in DPF CPAD workshops to foster exchange of research

Working group summaries

Quantum science working group

- A new area, but already with a broad range of R&D directions
  - HEP technology for quantum computing: e.g., high-Q SC cavities, cold instrumentation
  - Quantum technology for HEP experiments
  - Quantum networking
  - Quantum computing for Fermilab science
- An active group with connections across HEP, industry
- Have pursued a strategy of submitting proposals to funding calls
  - Highly successful so far, with several more in the pipeline
  - Fermilab is a recognized leader in this area
- Moving forward
  - Continue with leadership R&D aligned with Fermilab research program utilizing new funding sources
  - No plans at present to contribute to ESG

Summary and conclusions

- The two retreats succeeded in spurring discussion and exploring ideas related to long-range plans across the Fermilab science program
- Progress made in preparing input to ESG via these activities
  - Some groups already preparing or participating in community white papers
- Several groups continuing to meet and are developing / executing plans for moving forward, engaging the U.S. community planning process
  - Others have yet to move on plans
- SAC plans to monitor progress, assist with organizing input if needed

2018 -- 2019 SAC membership

Oct 1, 2016 -- Sept 30, 2018:

- John Campbell
- Harry Cheung
- Debbie Harris
- Sergo Jindariani
- Erica Snider
- Michelle Stancari
- Thomas Strauss

Oct 1, 2017 -- Sept 30, 2019:

- Phil Adamson
- Eliana Gianfelice-Wendt
- Nick Gnedin
- Roni Harnik
- Lauren Hsu
- Martina Martinello
- Gabe Perdue
- Anna Pla-Dalmau
- Charles Thangaraj

Link to the list of current and past members on the public SAC Fermipoint site