



Preparing for the Next Community HEP Planning Process

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The Future of U.S. Particle Physics

- **DOE HEP continues the implementation of the 2014 P5 global vision for particle physics**
 - Strong community support has been crucial to the successful implementation of the P5 strategy so far
 - Continued community support is necessary to maintain our momentum with the U.S. Administration and Congress
- **At an appropriate point, the strategy for U.S. particle physics will need to be reevaluated and updated**
 - Discoveries and results from upcoming experiments will impact the strategy for future investments
 - Next strategy should be informed by results from the 13-14 TeV run of the LHC, second generation dark matter experiments, precision muon experiments, and short- and long-baseline neutrino experiments
 - Further advance current R&D and planning activities conducted towards future projects (*e.g.*, high-field magnets, SRF cavities, CMB-Stage IV, and third generation dark matter)
 - Updated strategy for the future of particle physics should be available in time to guide next round of major investments
 - Guidance should be available as the current round of projects are being completed and the field seeks to make new investments
 - Updated strategy should incorporate results from current, ongoing studies of future collider initiatives by the international community



Considerations for Updating U.S. Strategy

- **P5 report is making a significant impact in budget formulation & appropriation**
 - Some large, high-priority projects have not yet reached important milestones in the DOE Critical Decision or appropriations process
 - Current plan saturates DOE HEP project funding until ~FY 2024
 - FY17 House (\$823M) and Senate (\$833M) marks above President's Request (\$818M)
 - P5 called out in House bill "DOE Research and Innovation Act" (Jan 24, 2017; *next slide...*)
- **NSF pre-project MREFC planning for the HL-LHC ATLAS and CMS detector upgrades now in process**
 - Anticipate that the National Science Board may make decision to proceed in 2018 at the earliest, with construction appropriations beginning in 2020 at the earliest
- **Global vision of current P5 report is central to ongoing discussion with international partners**
 - Core part of building upon new bilateral U.S.-CERN agreement
 - International partnerships are still growing for LBNF/DUNE
- **Transition to new administration adds uncertainty to timeline**
 - Must share P5 vision with new elements of management before plan can continue to move forward
 - Launching too early an update of the P5 strategy would confound decision makers
- **Beginning the next planning process too early would risk undermining ongoing efforts to implement the strategy of the P5 report**
 - Must avoid "decisional paralysis" until after the HL-LHC projects and LBNF/DUNE are baselined, resulting in strategy studies taking place in the 2020-2021 time frame

Timeline for Updating the U.S. Strategy

- The May 2014 P5 report was successful because it was well informed by the science community, including information from:
 - 2010 New Worlds, New Horizons in Astronomy and Astrophysics
 - 2012 Report of the Subcommittee on Future Projects of High Energy Physics (Japan)
 - 2013 European Strategy for Particle Physics Report
 - 2013 U.S. Particle Physics Community-driven “Snowmass” process
- From a DOE perspective, the appropriate timeline is:
 - 2018: Anticipated Japanese decision on ILC
 - 2018-20: New NAS Astronomy and Astrophysics Decadal Survey
 - 2019: Start of European Strategy for Particle Physics process
 - 2020: Release of updated European Strategy for Particle Physics
 - 2020: Begin process to update the 2013 “Snowmass” report
 - 2022: Release new P5 strategy report in time to inform FY 2024 budget
- U.S. community encouraged to work with international collaborators in developing other regional plans with a global vision for particle physics



- Fermilab had an All Scientists Retreat on May 4 to begin brainstorming
- Working Groups met beforehand to get warmed up
- Here are the introductory slides that I showed at the retreat

Goals of this retreat (mainly via the working groups)

- Get YOU to talk about YOUR views on the long-term plans for the laboratory's research program
- Collect input on interstitial/leveraged/symbiotic opportunities to enhance the Fermilab 10-year plan (pre-2026)
- Collect ideas on opportunities and challenges for the longer range outlook (post-2026)
- Facilitate communication between different groups at the lab related to long-term goals (e.g. for accelerator physicists to learn what HEP physicists are wanting to do and vice versa)

Boundary conditions on the exercise

- Fermilab remains the primary HEP and accelerator lab of the U.S.
 - But ok to assume that non-DOE-HEP percentage of our budget grows
 - OK to assume that the definition of the scientific boundaries of HEP will widen
 - Good to assume more leveraging+partnerships with other labs, industry, foundations
- OK to be optimistic about technology development; less ok to be optimistic about multiple budget doubling
- Science targets should be exciting!

Output of this retreat: beginnings

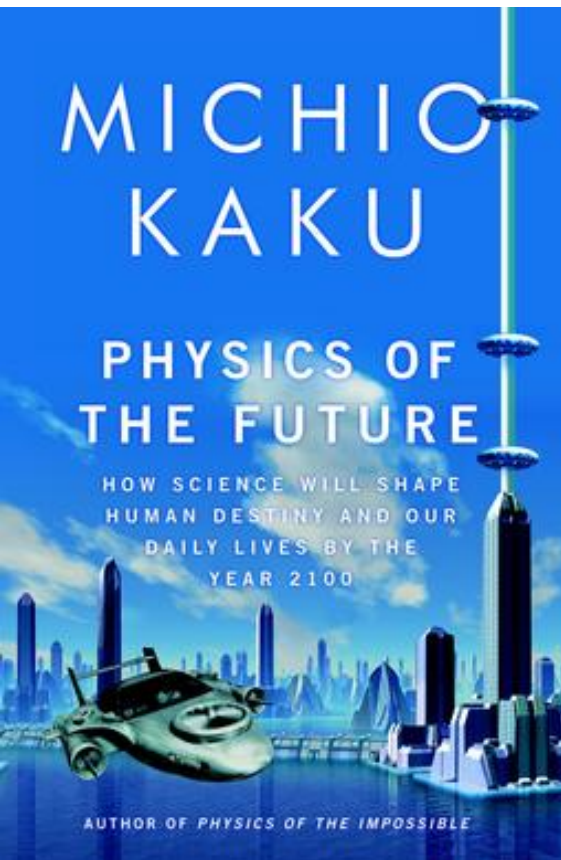
- Start of a schedule of events or work that needs to take place in order for Fermilab to give input to the next P5 process (~2021), including how to organize ourselves
- Start of a strategy for how to engage with the larger U.S. and international HEP community
- Start of a list of possible long-term lab goals
- Start of an estimate of what new work or input is needed to decide how to prioritize those goals (e.g. results from a currently running experiment, new R&D, etc)

We are here to brainstorm, **not** to make decisions, prioritize, or set limits

Post-retreat next steps

- Get feedback from Fermilab PAC
- Think about how to start engaging our user community for the next iteration – DPF meeting at Fermilab this August is a golden opportunity
- Make sure we align this strategic planning process with our LDRD program
- Get more organized on getting connected and informed about technology developments and science/mission overlaps in other communities

Let's try to get a jump on the future, instead of the future getting a jump on us



10 Predictions About the Future That Should Scare the Hell Out of You



George Dvorsky

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Notes from the All Scientist's Retreat [slide 1/5]

Expanding intellectual boundaries of HEP

- How broad should U.S. HEP neutrino program be?
- Should gravity waves become part of HEP?
- The Entanglement Frontier?
- Precision experiments that we didn't think we could do, enabled by technology advances
 - Dark sector [see next session this morning]
 - Table-top gravity experiments
 - Dark energy in the laboratory

Notes from the All Scientist's Retreat [slide 2/5]

Thinking big

- Is anybody (including the U.S.) ever going to build a post-LHC energy frontier collider?
- How should U.S. react to a positive ILC250 decision in Japan?
- How should U.S. react to a collider down-select (or partial down-select) in the next European Strategy update?
- What about the CEPC in China?
- Do we push to someday get a U.S. option on the table?
 - Some kind of wakefield based collider?
 - Get Elon Musk to build a 200 km tunnel for you?

Notes from the All Scientist's Retreat [slide 3/5]

Thinking big

- Another large neutrino detector at SURF in addition to DUNE?
- Post-LSST large spectroscopic survey?
- New experiments at FNAL enabled by PIP-II and/or other enhancements of the accelerator complex?
- G3 dark matter experiment? Going below the neutrino floor?

Notes from the All Scientist's Retreat [slide 4/5]

Responding to possible near-term discoveries

- HE-LHC in response to any LHC discovery beyond the Higgs
- Suite of new experiments to characterize dark matter after a direct detection discovery
- What if MicroBooNE confirms low energy anomaly or SBN sees steriles?
- What if the muon $g-2$ anomaly is confirmed?

Notes from the All Scientist's Retreat [slide 5/5]

Opportunities and impacts of new technologies

- New computing models
 - Exascale
 - AI
 - Quantum [see next session this morning]
- Accelerator science and technology
 - Are we being bold enough and broad enough?
 - Are we missing opportunities to leverage off accelerators that other communities need?
- Detectors
 - Quantum sensors [see next session this morning]
 - “Beyond Silicon” with graphene or other advanced materials
 - Fast timing
 - Etc.

How should Fermilab engage the HEP community?

“The committee is asked to review the steps the Laboratory is taking and on steps the Laboratory should take to ensure adequate preparation for this process, including engaging the Fermilab community and the greater HEP community, and establishing and communicating what has to happen and when.”