Report on Fermilab and Community Strategies

CERN Council Open Symposium on the Update of

European Strategy for Particle Physics

13-16 May 2019 - Granada, Spain

European Strategy Update

Interface of Fermilab with Snowmass

Fermilab

Fermilab PAC, July 20, 2019

Marcela Carena
Fermilab

European Particle Physics Strategy Update (EPPSU)

Every few years, the European particle physics community reviews the roadmap and priorities of the field, updating the European Strategy for Particle Physics Strategy to provide a clear prioritization of European ambitions in advancing the particle physics science.

More information is available here:
http://europeanstrategyupdate.web.cern.ch

See also Brigitte Vachon's talk, Fermilab PAC 01/2019

The next (third) update process was launched by the CERN Council in September 2017 with the establishment of the ESG Secretariat and is scheduled to be completed in May 2020.

The ESG Secretariat asked for input from the particle physics community across universities, laboratories and national institutes to submit written input by 18 December 2018 to prepare the discussions on the Strategy Update which is taking place in 2019.

Community proposals submitted are available at
https://indico.cern.ch/event/765096/contributions/

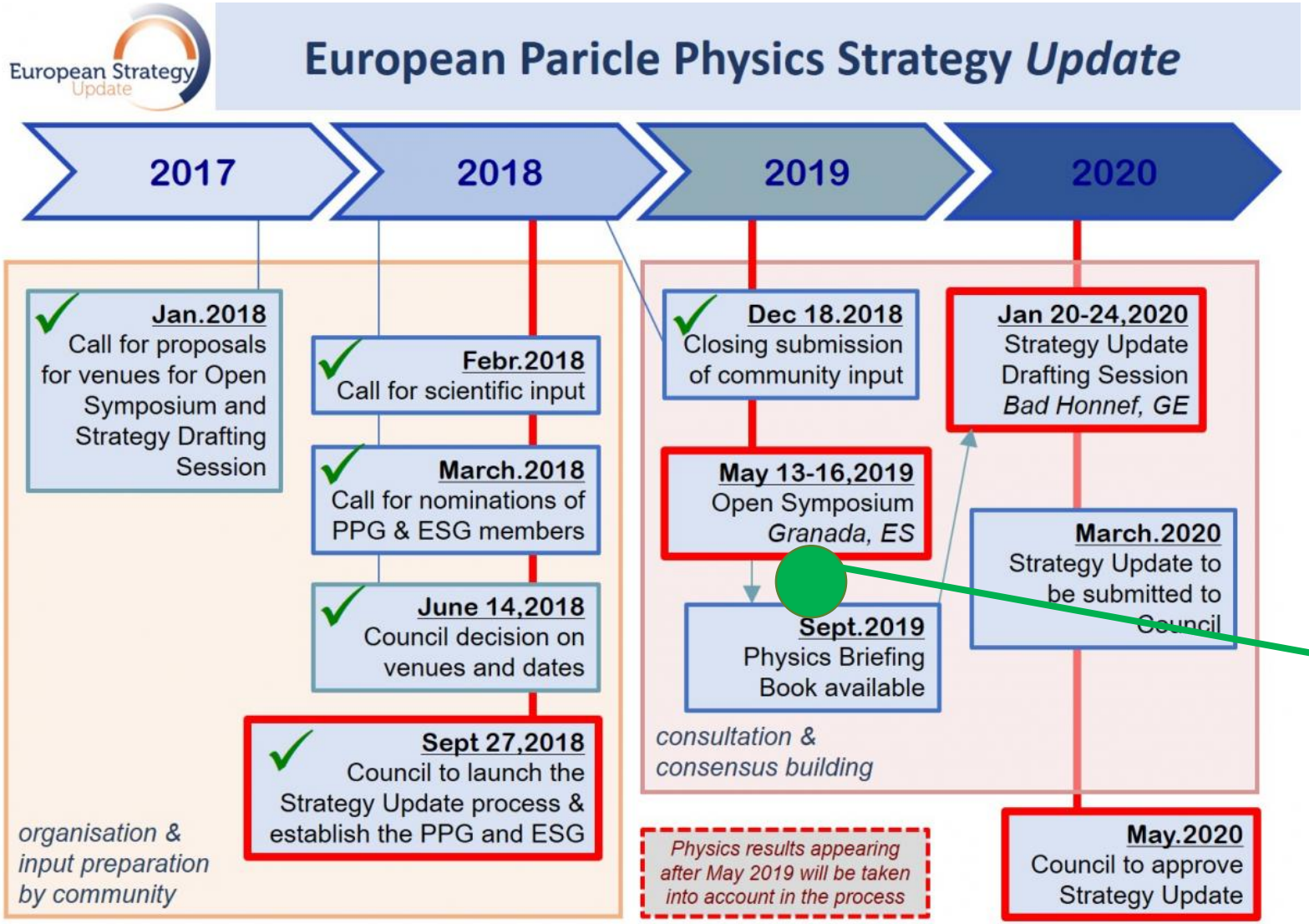
EPPSU Organization

- Strategy Secretariat:
  - Organizes EPPSU process.
  - 4 members (chaired by Halina Abramowicz + SPC, ECFA and EU lab. Directors" Mtg Chairs)

- European Strategy Group (ESG):
  - Drafts strategy update which it submits to CERN council for approval.
  - ESG is assisted by the Physics Preparatory Group.
  - ~ 36 members (+ 29 invitees).

- Physics Preparatory Group (PPG):
  - Prepares the scientific contribution to the work of the ESG (the "Briefing Book"), based on community input.
  - 17 members.

EPPSU 2020 Process



The Strategy update process includes two major events:

an "Open Symposium"

and

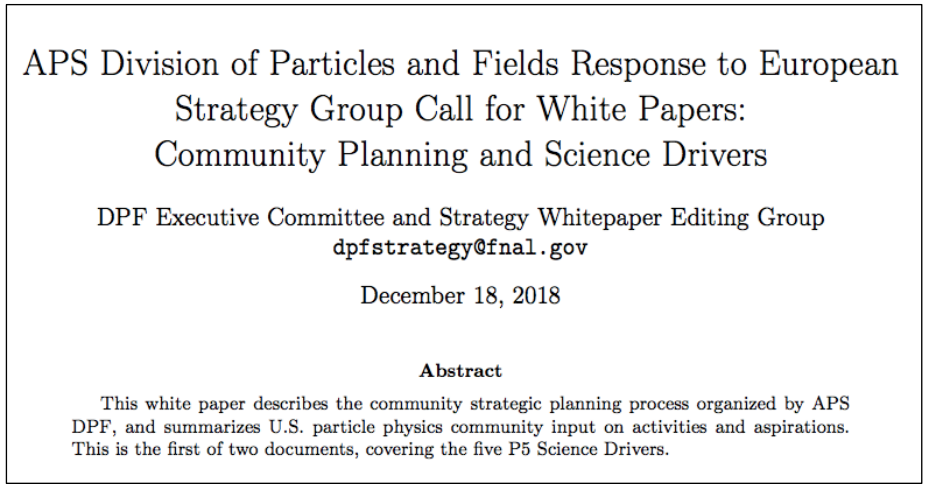
a "Strategy Drafting Session"

Writing the Briefing Book

Provide some narrative towards the Strategy Update by the ESG

US Community submissions to ESPP update

- US community submission organized by APS Division of Particle and Fields "DPF Whitepaper"
  -- Community Planning and Science Drivers: https://www.aps.org/units/dpf/upload/DPF-strategy.pdf
  -- Tools In Particle Physics: https://www.aps.org/units/dpf/upload/DPF-tools.pdf
  -- Addendum of White Papers https://www.aps.org/units/dpf/upload/Addendum-DPF-strategy.pdf



APS Division of Particles and Fields Response to European Strategy Group Call for White Papers: Community Planning and Science Drivers

DPF Executive Committee and Strategy Whitepaper Editing Group
dpfstrategy@fnal.gov

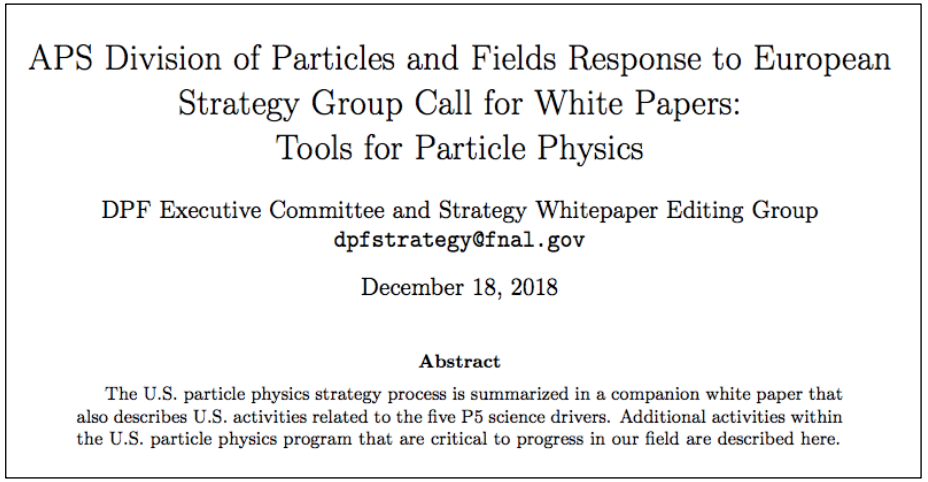
December 18, 2018

Abstract

This white paper describes the community strategic planning process organized by APS DPF, and summarizes U.S. particle physics community input on activities and aspirations. This is the first of two documents, covering the five P5 Science Drivers.

(149) Progress on P5;
Research interests beyond the P5 timescale

(150) Activities on theory, accelerator, computing, detector R&D



APS Division of Particles and Fields Response to European Strategy Group Call for White Papers: Tools for Particle Physics

DPF Executive Committee and Strategy Whitepaper Editing Group
dpfstrategy@fnal.gov

December 18, 2018

Abstract

The U.S. particle physics strategy process is summarized in a companion white paper that also describes U.S. activities related to the five P5 science drivers. Additional activities within the U.S. particle physics program that are critical to progress in our field are described here.

A DPF lead team of 21 editors **(5 From Fermilab)** took on the task to draft a first version of the Whitepaper which was circulated to the community for further comments and finalize in time for submission to the European Strategy in mid-December.

US Community submissions to ESPP update

Other submissions received from US community include

- Neutrinos
  - Deep Underground Neutrino Experiment, DUNE (123)
  - The Short-Baseline Neutrino Program at Fermilab (137)
  - Status of Fermilab's Neutrino Facilities (167)
- Dark Matter
  - MAGIS-1K: A 1000 m Atom Interferometer Device for Searches in Dark Matter and Gravity Waves (161)
- Flavor Physics
  - Charged LFV using Intense Muon Beams at Future Facilities (25)
- Electron-Ion Collider
  - Electron Ion Collider Accelerator Science and Technology - Designs, R&D and Synergies with European research in Accelerators (74)
  - Synergies between a U.S.-based Electron-Ion Collider and the European research in Particle Physics (99)

Also contributions to Future Collider international submissions

- ILC (66, 77, 107), CLIC (145, 146), CEPC (29, 51), FCCee,eh,hh (132, 133, 135, 136, 140), HE-LHC (160)

Open Symposium:

CERN Council Open Symposium on the Update of

European Strategy for Particle Physics

13-16 May 2019 - Granada, Spain

Physics Preparatory Group

Halina Abramowicz (Chair)
Shoji Asai
Stan Bentvelsen
Caterina Biscari
Marcela Carena
Jorgen D'Hondt
Keith Ellis
Belen Gavela
Gian Giudice
Beate Heinemann
Xinchou Lou
Krzysztof Redlich
Leonid Rivkin
Paris Sphicas
Brigitte Vachon
Marco Zito
Antonio Zoccoli

Local Organizing Committee

Francisco del Águila
Antonio Bueno (Chair)
Alberto Casas
Nicanor Colino
Javier Cuevas
Elvira Gámiz
María José García Borge
Igor García Irastorza
Eugeni Graugés
Juan José Hernández
Mario Martínez
Carlos Salgado
Benjamín Sánchez Gimeno
José Santiago

https://cafpe.ugr.es/eppsu2019/

eppsu2019@pcgr.org

Sponsored by:

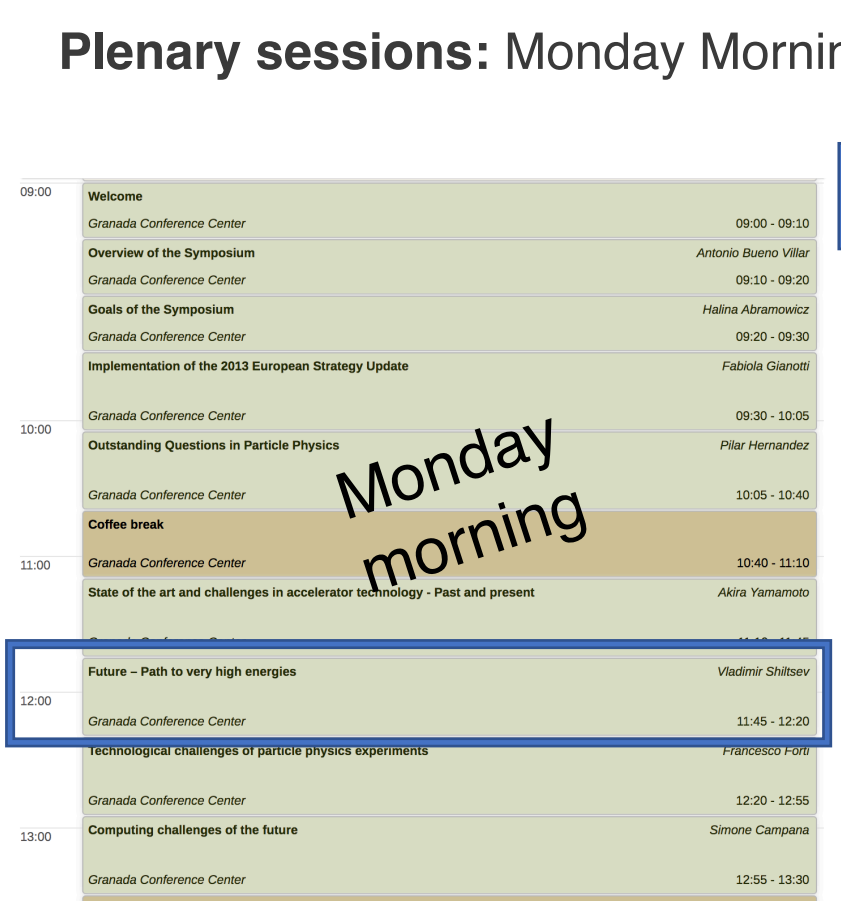
About 600 participants

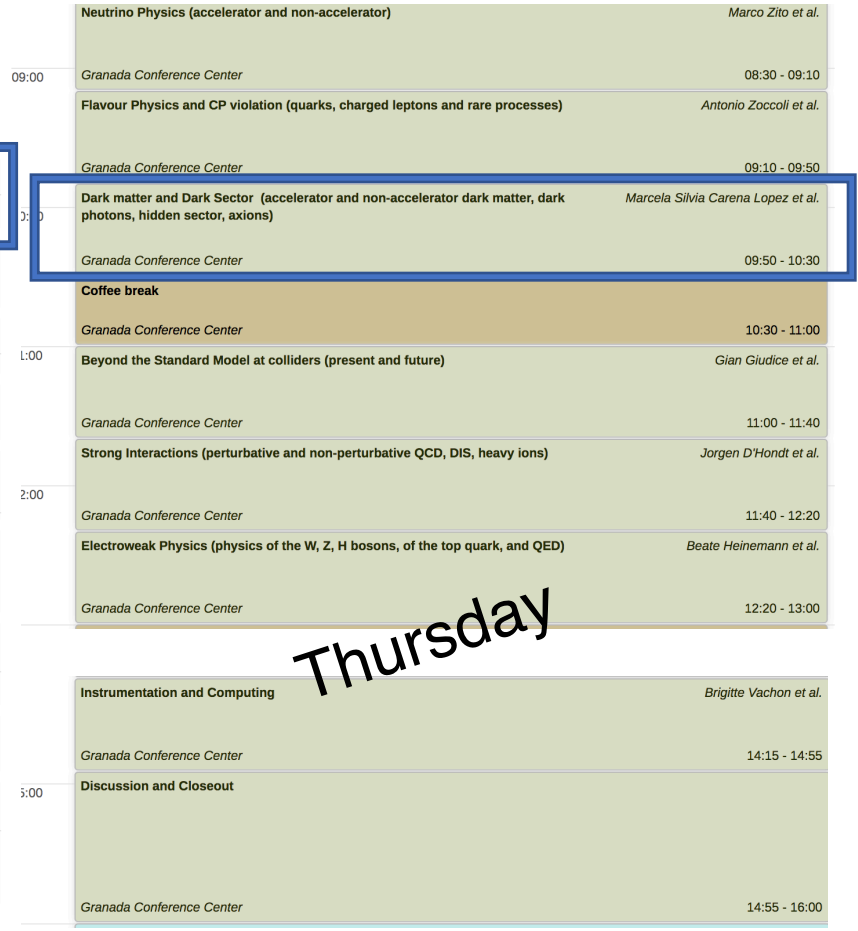
All talks available at: https://cafpe.ugr.es/eppsu2019/

Open Symposium: Granada, Spain, from May 13 to 16,. 2019

- The meeting consisted of plenary sessions as well as eight discussion sessions organized and convened by members of the Physics Preparatory Group (PPG).

Plenary sessions: Monday Morning, Wednesday Afternoon &Thursday.





Open Symposium: Granada, Spain, from May 13 to 16,. 2019

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-- Four discussion sessions run in parallel from Monday afternoon through Wednesday morning. ‘

Parallel sessions were organized around topics covered by the submission tracks:

Accelerator Science and Technology	Instrumentation and Computing	Electroweak Physics	Strong interactions
Caterina Biscari Lenny Rivkin	Xinchou Lou Brigitte Vachon	Keith Ellis Beate Heinemann	Jorgen D'Hondt Krzysztof Redlich

Each Parallel session findings and related submissions are being summarized in one chapter of the Briefing book

Scientific Secretaries assigned to different chapters are contributing to this effort.

Neutrino Physics	BSM at colliders	Dark Matter and Dark Sector	Flavour Physics and CP violation
Stan Bentvelsen Marco Zito	Gian Giudice Paris Sphicas	Shoji Asai Marcela Carena	Belen Gavela Antonio Zoccoli

Fermilab @ ESG Granada

Fermilab representation at ESG Granada:

- Alan Bross (Fermilab)
- Marcela Carena (Fermilab)
- Swapan Chattopadhyay (NIU/Fermilab)
- Gordan Krnjaic (Fermilab)
- Joseph Lykken (Fermilab)
- Regina Rameika (Fermilab)
- Elizabeth Sexton-Kennedy (Fermilab)
- Vladimir Shiltsev (Fermilab)

And some spokespeople:

- Edward Blucher (U Chicago)
- Bonnie Fleming (Yale)
- Stefan Söldner-Rembold (U. Manchester)

Some Highlights of the Discussions @ ESG Granada

European Strategy Update

But first, some observations from this meeting…

- If we are planning for decades into the future, we must get the opinions and involvement of the younger members of our community (Peter Jenni)
- Experts are telling us that high field magnets take decades to develop. "Are we going to spend the next 3 or 4 decades waiting for 16T magnets…" anon.
  - *100km tunnels may be the easy part of the next generation high energy frontier (with circular machines, at least)*
- For new physics 14TeV μ+μ- ☞ 100TeV pp (Vladimir SHILTSEV)
  - *need to pursue muon collider vigorously*
- When will plasma acceleration be central to planning?

CoEPP ARC Centre of Excellence for Particle Physics at the Terascale

Geoffrey Taylor "Perspective on the European Strategy from Asia", EPPSU2019, Granada 3

European Strategy Update

July 5th: Brief Summary paper on lower energy FCC-hh, based on NbTi magnet technology submitted to PPG

Physics potential @ https://cds.cern.ch/record/2681366

Strong Focus on Future Colliders

Asian (and personal) View

- Diversity is Critical to thrive in all environments, including HEP.
  - *Big and small facilities/experiments, at various stages of development and operation*
- Push for e+e- colliders, both Linear and Circular, as soon as possible.
  - *Linear Collider: ILC*
    - 1 Collision point
  - *Circular Collider: CepC*
    - 2 Collision points
- Push for FCC tunnel to be ready at completion of HL-LHC
  - *Stage the energy frontier with best option magnets available for early 2040's*
  - *?? Default: ~8T LHC magnets optimised for price*
    - Minimum energy: >50TeV
    - Magnet upgrade foreseen.
  - *ep and ion-ion options available*
  - *4 collision points*
  - *Upgrade path to higher energy after 20 years operation?*

See A. Yamamoto, L. Rossi, V. Shiltzev talks this

CoEPP ARC Centre of Excellence for Particle Physics at the Terascale

Geoffrey Taylor "Perspective on the European Strategy from Asia", EPPSU2019, Granada 43

Gearing up for the Next Snowmass

Snowmass 2013

Snowmass on the Mississippi (July 29 - August 6, 2013)

The planning process included more than a year of workshops. It presented a status of the field and exciting opportunities going forward. It did NOT prioritize

Charge: *The American Physical Society's Division of Particles and Fields is initiating a long-term planning exercise for the high-energy physics community. Its goal is to develop the community's long-term physics aspirations. Its narrative will communicate the opportunities for discovery in high-energy physics to the broader scientific community and to the government.*

The DPF is independent of funding agencies; free to define our science goals as a global community

The final reports were completed in about 6 months

P5 takes the scientific input from Snowmass and formulates a strategic plan to address the science within specified funding constraints

A successful Snowmass process results in community buy-in, even when hard budgetary decisions need to be made

Gearing up for the Next Snowmass

Project funding needs are projected to decrease in 2025

- Funding for HL-LHC projects complete in FY 2024/2025
- Funding for Line-Item Construction Projects LBNF/DUNE and PIP-II peak in FY 2025, and completes by FY 2027/2028
- Only CMB-S4 project remains in the list of P5 recommendations
  - Future Collider project has dependency on strategic planning in Europe and Asia
- Continuous new ideas and new input to budget formulation is critically important to continue the pursuit of funded Discovery Science (new Projects)
- Submit new Mission Needs (CD-0) at the rate of one/year from FY 2019 through FY 2035+

From Alan Stone, DPF EC meeting, April 2019

Working Backwards from FY 2025

- When the current P5 report was released in May 2014, the FY 2015 budget was already in Congress and the FY 2016 budget was being formulated
- **To provide timely input to the FY 2025 budget formulation, the "next P5" report will be required by March 2023**

Preparations for Snowmass 2021

Town Hall Meeting at APS (April 13, 2019)

- ❑ Presentation: US Strategic Planning Process
- ❑ Panel Presentation and Discussions with the Community

Panel: funding agencies, Snowmass 2013 representatives and DPF/DPB/DNP/DAP representatives

- ❑ Consensus on the Next Snowmass
  – Aim toward 2021 ➔ P5 can start in 2022, with a March 2023 report in time to inform the FY2025 budget
  -- Inclusive scope, same style.

Draft Timeline for Snowmass 2021

DPF Program committee is currently reviewing the old topics
https://www.aps.org/units/dpf/governance/committees/program.cfm

Aug 1@DPF: Plenary talk and Town Hall following with specific goals
1. Present the draft of new topics and solicit advice
   Continued topical refinement through google spreadsheet
2. Establish process by which conveners and working groups are formed
3. Discuss timescale and workshops

Fall 2019: Finalize topics and cross-cutting categories, Select conveners
Call for site selection for summer 2021

Spring 2020: Secure funding for workshops and overall plan
Choose 2021 site, date, and duration

Fall 2020 – Spring 2021: Conduct workshops, prepare initial white papers

Summer 2021: Snowmass Summer Study.

Report due by December 2021

Define Physics Groups and Cross cutting Groups

Our first task is to determine a complete set of physics and cross-cutting topics. We need to be broader than HEP Agency boundaries.

The charge for P5 may be narrower, but we need to understand the connections across boundaries. e.g. $0\nu\beta\beta$, gravitational waves, gamma ray astrophysics

Physics was organized according to Frontier
Intensity, Energy, Cosmic, Theory

Cross-cutting Groups
Accelerator Capabilities, Underground Capabilities, Instrumentation, Computing, Communication – Education - Outreach.

These topics defined the working groups and final summary papers (in ArXiv) as well as multiple white papers

Nail these down in the next few months ➔ Identify conveners and members.

Physics Groups and Cross-cutting Groups (2013)

Higgs Boson
Precision Study of Electroweak Interactions
Quantum Chromodynamics and the Strong Force
Fully Understanding the Top Quark
New Particles, Forces, and Dimensions
Flavor Mixing and CP Violation at High Energies

Neutrinos
Baryon Number Violation
Charged Leptons
Quark Flavor Physics
Nucleons, Nuclei, and Atoms
New Light Weakly Coupled Particles

WIMP Dark Matter Direct Detection
WIMP Dark Matter Indirect Detection
Non-WIMP Dark Matter
Dark Matter Complementarity
Dark Energy and CMB
Cosmic Probes of Fundamental Physics

Computing for the Cosmic Frontier
Computing for the Energy Frontier
Computing for the Intensity Frontier
Computing for Accelerator Science
Lattice Field Theory
Computing for Perturbative QCD
Distributed Computing and Facilities Infrastructure
Networking
Software Development, Personnel, and Training
Storage and Data Management

Communication with
the General Public
Policy Makers
the Science Community
Teachers and Students

Hadron Colliders
Lepton Colliders
High Intensity Secondary Beams from Protons
High Intensity Electron and Photon Beams
Electron-Ion Colliders
Accelerator Technology Development

Instrumentation for the Energy Frontier
Instrumentation for the Intensity Frontier
Sensors
Integrated Circuit Design in U.S. High Energy Physics

How can Fermilab Scientists best plug into Snowmass?

We just heard from Lauren:

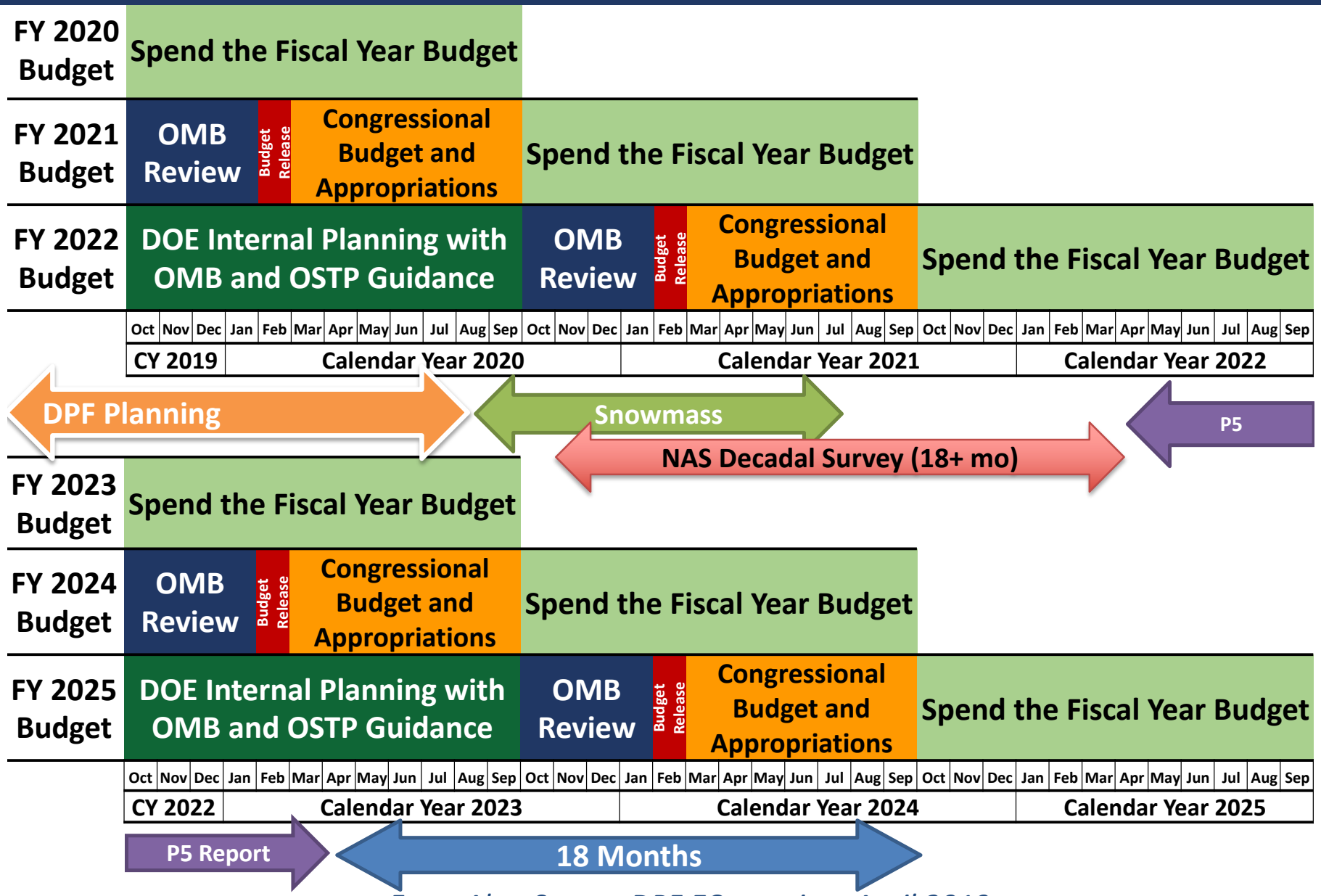
- SAC retreat exercise provides input for Snowmass process
- Continuous engagement with the broader community is one of the retreat goals
- Post-retreat activities for the working group leaders specifically include follow up with community planning efforts
- New SAC (starting 10/2019) will propose to organize a Snowmass pre-meeting at Fermilab in 2020

What else?

- Whitepapers/studies on capabilities of Fermilab facilities and possible future upgrades?
- LDRD to demonstrate feasibility of ideas to be advanced at Snowmass?
- Offer to host one of the main Snowmass workshops (which one?)
- Internal prioritization of possible future initiatives (get some options OFF the table)

Additional Material

Working Backwards from FY 2025



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