Snowmass 2021
US HEP Community Planning Exercise
Status Report

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Outline

- History of US HEP Community Planning Exercise and "P5"
- Organization of Snowmass 2021
- Impact of COVID on our plans
- Timeline for the report, a.k.a. the "Snowmass Book"
- Schedule of selected upcoming activities
- Summary and Outlook

Some Resources for Snowmass 2021:
Snowmass 2021 portal twiki: https://snowmass21.org/
Snowmass Early Career 2021: https://snowmass21.org/start/young
Historical overview: "How to Snowmass (article by C. Quigg)":
https://indico.fnal.gov/event/45207/attachments/133652/164937/How_to_Snowmass-final-links.pdf
Snowmass 2013 Book: https://tinyurl.com/ypfd679z
Link to material and report of P5, 2014: http://usparticlephysics.org/p5/

History: US HEP Community Planning Exercise, a.k.a. Snowmass

- **Snowmass, the DPF-hosted Community Planning Exercises, started in 1982**
  - The then DPF chair Charles Baltay said: "The 1982 DPF Summer Study was the first attempt in recent years to bring together physicists from the whole country to consider the future of our field from the point of view of the best overall national program. The DPF Executive Committee feels that this summer study was sufficiently useful in this last respect to hold similar summer studies at appropriate times in future years."
    - **The study lasted several months and culminated in a 3-week-long workshop in Snowmass Colorado**
- **Goal: To identify the most important questions in HEP and the tools and infrastructure required to address them**
  - **It was recognized that attention to sociology and demographics was a necessary part of the discussion**
- DPF-sponsored Community Studies were held in 1984, 1986,1988, 1990, 1996, and 2001, also concluding in a summer workshop in Snowmass
  - Similar smaller events were held from 2001-2010.
- In 2013, for reasons external to HEP, the meeting was held outside of Snowmass at the University of Minnesota and was shortened to ~10 days
  - **The shorter meeting required more work to be done in advance**

P5

- **In 2013, Snowmass provided input to the High Energy Physics Advisory Panel's (HEPAP) subpanel, the Particle Physics Project Prioritization Panel, a.k.a. P5**
  - Using Snowmass scientific input and budget scenarios provided by US DOE, P5 developed and presented to DOE a 10-year **execution plan, with priorities and recommendations,** for the field in the US, with an eye also towards the ten years following that
    - **P5 has a broad mandate but does tend to focus on large projects and facilities**

The "Snowmass Book" that we will produce and the many supporting Contributed Papers will provide critical input to P5

Goal of Snowmass 2021

- This Snowmass Community Planning exercise is again organized by the Division of Particles and Fields (DPF) of the American Physical Society as
  - **A ~ year-long "Science" study** in which the entire HEP community comes together to identify opportunities and, to the extent possible, document a vision for the future of particle physics in the U.S. and its international partners.
  - Its narrative will communicate the opportunities for discovery in particle physics to the broader scientific community and to the government.
  - **It will provide a validated set of inputs to the next P5**, which is expected to begin its work in the late fall of 2022 and produce a report in the spring of 2023.
- Young-Kee Kim, DPF Chair, 2020 said: "DPF aims for everyone's voice to be heard. Your contributions and participation are critical for the success of Snowmass and they will naturally occur as part of one or more working groups directed by the conveners of the now 10 Frontiers"
- For Snowmass 2021, the final meeting of Community Planning Exercise will take place at the **University of Washington in Seattle from July 17 to 26 in 2022**

Snowmass 2021

- **Why "Snowmass 2021"?**
  - The name Snowmass is retained since it implies **an outlook or state-of-mind** as to how we pursue our science in US HEP:
    - **Community driven and inclusive – all people and ideas are welcome**
    - **Global** - Open to all, including physicists from all over the world, and takes into account the plans in all other regions
    - **Interdisciplinary** – reaches out to related fields
  - **2021 because it takes place in same year as LP2021!**

Organization in Ten "Frontiers" -I

Snowmass 2021

Accelerator

Steve Gourlay
(LBNL)

Tor Raubenheimer
(SLAC)

Vladimir Shiltsev
(FNAL)

Cosmic

Aaron Chou
(Fermilab)

Marcelle Soares-Santos
(U.Michigan)

Tim Tait
(UC Irvine)

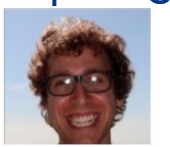
Community Engagement

Kétévi Assamagan
(BNL)

Breese Quinn
(Mississippi)

Computing

Steven Gottlieb
(Indiana U.)


Ben Nachman
(LBNL)

Daniel Elvira
(FNAL)

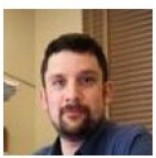
Energy

Meenakshi Narain
(Brown U)

Laura Reina
(FSU)

Alessandro Tricoli
(BNL)

Instrumentation


Phil Barbeau
(Duke)

Petra Merkel
(FNAL)

Jinlong Zhang
(ANL)

Organization in Ten "Frontiers" - II

Snowmass 2021

Neutrino

Patrick Huber
Virginia Tech

Kate Scholberg
Duke University

Elizabeth Worcester
BNL

Rare Processes & Precision Measurements

Marina Artuso
(Syracuse U.)

Alexey Petrov
(Wayne State U.)

Bob Bernstein
(FNAL)

Theory

Nathaniel Craig
(UCSB)

Csaba Csaki
(Cornell)

Aida El-Khadra
(UIUC)

Underground Facilities and Infrastructure

Laura Baudis (U. Zurich)

Jeter Hall (SNOLAB)

Kevin Lesko (LBNL)

John Orrell (PNNL)

All frontiers have topical subgroups (details on Twiki)

Accelerator:	7	Instrumentation:	10
Cosmic:	7	Neutrino:	10
Community Engagement:	7	Rare Processes:	7
Computing:	7	Theory:	11
Energy:	10	Underground:	6

More than 1500 people have signed up to participate in Snowmass!

Snowmass Early Career (SEC)

DPF Early Career representatives

Fernanda Psihas, 2019 (Fermilab)

Sara Simon, 2020 (Fermilab)

Reelected for 2022

Julia Gonski, 2021 (Columbia)

- Early Career physicists have been formally represented at Snowmass since at least 2001 and gained even more formal recognition in 2013 and now in 2021/22
- Key Initiatives:
  - **Snowmass Coordination:** Coordinate with the Snowmass frontiers and help get EC members involved in the process
  - **In-reach:** Professional development and building cohesion within the early career community
  - **Diversity, Equity, and Inclusion (DEI):** Initiatives to make HEP more representative, welcoming, inclusive, and equitable.
  - **Survey:** Collect data on the early career membership
  - **Long-Term Organization:** There is interest in extending this activity beyond Snowmass so define the long-term structure of the early career organization after Snowmass

DPF Oversight and Coordination: Snowmass Steering Group

DPF:

Joel Butler (chair, Fermilab)

Sekhar Chivukula (chair-elect, University of California, San Diego)

Andre de Gouvea (vice chair, Northwestern University)

Tao Han (past chair, University of Pittsburgh)

Young-Kee Kim (recent chair, University of Chicago)

Priscilla Cushman (recent chair, University of Minnesota)

APS Divisions with strong cross-disciplinary links:

Particle Beams: Sergei Nagaitsev (FNAL)

Nuclear Physics: Yury Kolomensky (University of California, Berkeley)

Astrophysics: Glennys Farrar (New York University)

Gravitational Physics: Nicolas Yunes ((University of Illinois, Urbana-Champaign)

The Steering Group Ensures a multi- and cross- disciplinary focus. Each frontier also has a liaisons to all other associated frontiers

DPF Oversight and Coordination: Snowmass Advisory Group

- **Chair (Joel Butler)**
- **The Snowmass Steering group**
- **Additional DPF Executive Committee members:**
  - Secretary/Treasurer: Tulika Bose, University of Wisconsin
  - Councilor: Bob Bernstein, FNAL
  - Member-at-Large: Kendall Mahn
  - Member-at-Large: Heather Gray
  - Member-at-Large: Mary Raafat Mikhail Bishai, BNL
  - Member-at-Large: Lauren Tompkins, Stanford University
  - Member-at-Large: Mayly Sanchez, Iowa State University
  - Member-at-Large: Gordon Watts, University of Washington - Seattle
  - Early Career Member-at-Large: Julia Gonski, Columbia University
- **Representatives of the International Community**
  - Claudio Dib, Universidad Tecnica Federico Santa Maria, Chile
  - Val Gibson, Cavendish Laboratory, UK
  - Berrie Giebels, CNRS, France
  - Atsuko Ichikawa, Kyoto University, Japan
  - Heather Logan, Carleton University, Canada
  - Xinchou Lou, IHEP, China
  - Michelangelo Mangano, CERN
  - Azwinndini Muronga, Nelson Mandela University, South Africa
- Editor
  - Michael Peskin, SLAC National Laboratory
- Communications Liaison
  - Robert Bernstein, Fermilab
- Technical Liaison
  - Sergei Chekanov, Argonne National Laboratory

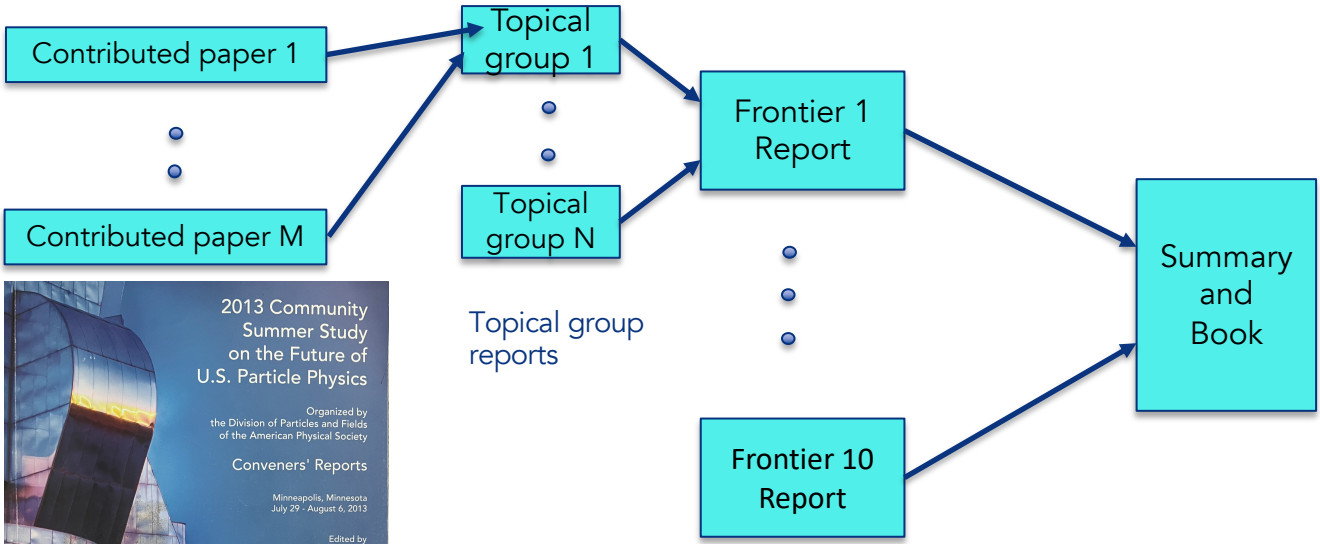
The Advisory Group ensures awareness of international plans and opportunities for collaboration

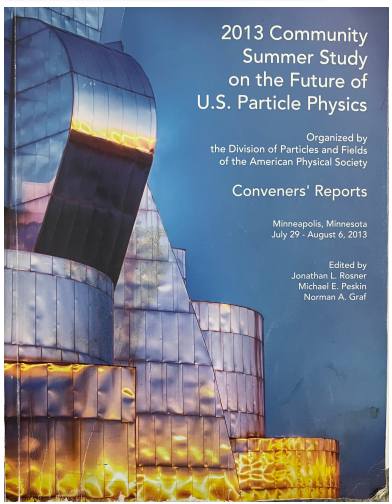
Impact of COVID

- This edition of Snowmass was planned to run from the summer of 2020 to a final get-together in July of 2021 at the University of Washington
- By early 2021, it became clear that COVID would have a major impact on our ability to carry out the necessary work because of
  - Lack of face-to-face meetings reduced efficiency
  - Heavy burdens fell on our young physicists, who do many of the studies
    - **Especially young physicists with children, who now had care for them all day and school them at home**
- In consultation with **DOE, which agreed to delay P5 by one year, to 2022/23**, we decided to take a ~7month pause/slowdown with the expectation that conditions would improve because of vaccines and other mitigation measures
  - **The meeting at University of Washington was delayed until July of 2022**
- The pause/slowdown began in January of 2021
- The startup dates varied among the frontiers, but by September everything was restarted and there was a **"Snowmass Day" on September 24, 2021**, to review the status and plans for completing the work in for the July 2022 meeting
- We hope that vaccination and mitigation will enable us to function well even in the face of the Omicron variant, which has surfaced since the restart

Our study will be sufficiently complete to provide the necessary inputs to P5 and we hope to avoid further postponements

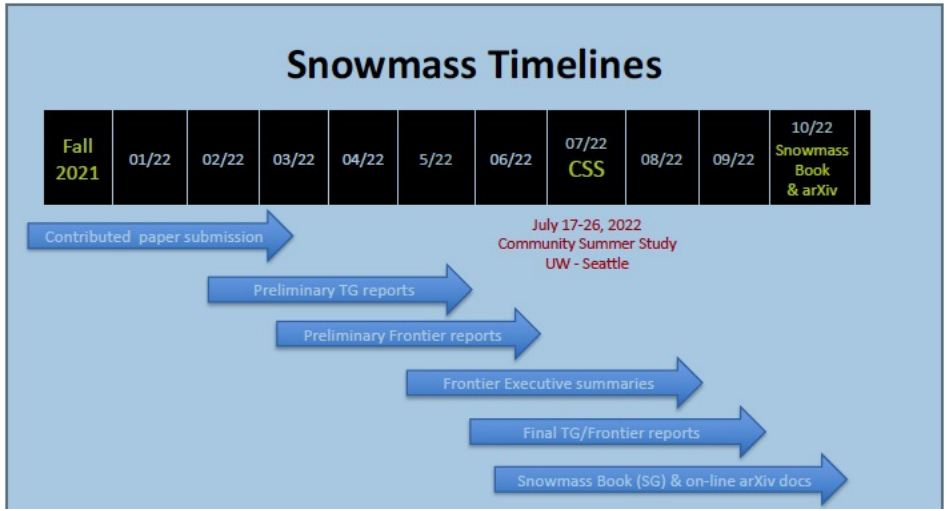
The Snowmass Book - 2021





- Report cover from Snowmass 2013, report is~ 350 pages
- The new report is expected to be ~500 pages
- Contributed papers will remain part of the permanent record of Snowmass

Timeline for Snowmass Book



- March 15: Contributed papers (a.k.a. White Papers)
- May 31: Preliminary Topical Group Reports
- June 30: Preliminary Frontier Reports
- July 17 – 26: Converge on reports for all the frontiers and produce executive summaries representing the views of their communities and providing the basic input needed for P5
- September: draft Executive Summary and Report Summary
- October- November: Snowmass Book finalized and ready for submission

Selected Upcoming Activities

- **Preparatory "All-frontier" meetings (which we hope will be HYBRID, i.e. will have both an in-person component and remote access) to complete and begin to synthesize the white papers:**
  - Instrumentation Frontier, Feb. 14-18, Stony Brook **(delayed, remote?)**
  - Theory Frontier, Feb. 23 – 25, KITP-UCSB: hybrid meeting
  - Neutrino Frontier, March 16 – 18, Oak Ridge National Lab, hybrid
  - Energy Frontier, week of March 27, Brown University, hybrid
  - Rare Decays and Precision Measurements: May 16 – 19, University of Cincinnati, hybrid
  - Community Engagement: May 24 - 26, Brookhaven National Lab, hybrid
- **Special Seminar series (all virtual) on topics that will shape US accelerator activities including construction projects and R&D**
  - Colliders (EF and AF)
  - Muon properties and decays (RPF and AF)
  - Neutrinos (NF and AF)
  - Accelerator Dark matter searches and other fixed target needs (RPF and AF)
- Ongoing Initiative of Snowmass Early Career
  - Colloquium series: "Big Questions in Particle Physics"

Summary and Outlook

- We hope that we will soon have gotten past, or at least mitigated, the impact of Omicron and can work efficiently for the next six months.
  - Some of our upcoming meetings may have to change from "hybrid" to "all-remote", but hopefully as the winter ends, we will be able to meet in person
- Despite all the challenges, an amazing amount of outstanding work is being done and, as we approach the July meeting, **discussions and debate are beginning to intensify, as they should**.
  - With our Snowmass and APS Codes of Conduct, I know we will proceed with mutual respect
- **We have a new generation that is emerging as leaders of our field in the US and who will contribute to shaping the new vision!**

Thank you for your attention!

Backup Slides

P5 Report, May 2014

Snowmass 2021

Building for Discovery

Strategic Plan for U.S. Particle Physics in the Global Context

Report of the Particle Physics Project Prioritization Panel (P5) May 2014

Distilled from the Snowmass 2013 inputs, five Science Drivers for the field:

- Use the Higgs boson as a new tool for discovery
- Pursue the physics associated with neutrino mass
- Identify the new physics of dark matter
- Understand cosmic acceleration: dark energy and inflation
- Explore the unknown: new particles, interactions, and physical principles.

- 29 recommendations
- Projects prioritized according to funding scenarios

As a result, highly impactful on the

- Directions/achievements in HEP
- Federal funding profile

for the current and near-future projects in the decade.

Timing of this Snowmass

- The 2014 P5 recommendations are now “launched”, based on significant budget increases in FY2018-2021
- It is time to start defining the next strategic plan, which could start to get its first, early funding in 2024/25
- Other US Domestic Programs are moving forward with their programs, e.g. NAS Decadal survey on Astronomy and Astrophysics
- Global programs are also moving forward, for example,
  - 2017 JAHEP/KEK Roadmap
  - 2020 Update of the European Strategy for Particle Physics
  - Latin America: Strategy Forum for Research Infrastructure
  - ….

10 Frontiers	80 Topical Groups
Energy	Higgs Boson properties and couplings, Higgs Boson as a portal to new physics, Heavy flavor and top quark physics, EW Precision Phys. & constraining new phys., Precision QCD, Hadronic structure and forward QCD, Heavy Ions, Model specific explorations, More general explorations, Dark Matter at colliders
Neutrino Physics	Neutrino Oscillations, Sterile Neutrinos, Beyond the SM, Neutrinos from Natural Sources, Neutrino Properties, Neutrino Cross Sections, Nuclear Safeguards and Other Applications, Theory of Neutrino Physics, Artificial Neutrino Sources, Neutrino Detectors
Rare Processes	Weak Decays of b and c, Strange and Light Quarks, Fundamental Physics and Small Experiments. Baryon and Lepton Number Violation, Charged Lepton Flavor Violation, Dark Sector at Low Energies, Hadron spectroscopy
Cosmic	Dark Matter: Particle-like, Dark Matter: Wave-like, Dark Matter: Cosmic Probes, Dark Energy & Cosmic Acceleration: The Modern Universe, Dark Energy & Cosmic Acceleration: Cosmic Dawn & Before, Dark Energy & Cosmic Acceleration: Complementarity of Probes and New Facilities
Theory	String theory, quantum gravity, black holes, Effective field theory techniques, CFT and formal QFT, Scattering amplitudes, Lattice gauge theory, Theory techniques for precision physics, Collider phenomenology, BSM model building, Astro-particle physics and cosmology, Quantum information science, Theory of Neutrino Physics
Accelerator	Beam Physics and Accelerator Education, Accelerators for Neutrinos, Accelerators for Electroweak and Higgs Physics, Multi-TeV Colliders, Accelerators for Physics Beyond Colliders & Rare Processes, Advanced Accelerator Concepts, Accelerator Technology R&D: RF, Magnets, Targets/Sources
Instrumentation	Quantum Sensors, Photon Detectors, Solid State Detectors & Tracking, Trigger and DAQ, Micro Pattern Gas Detectors, Calorimetry, Electronics/ASICS, Noble Elements, Cross Cutting and System Integration, Radio Detection
Computational	Experimental Algorithm Parallelization, Theoretical Calculations and Simulation, Machine Learning, Storage and processing resource access (Facility and Infrastructure R&D), End user analysis
Underground Facilities	Underground Facilities for Neutrinos, Underground Facilities for Cosmic Frontier, Underground Detectors
Community Engagement	Applications & Industry, Career Pipeline & Development, Diversity & Inclusion, Physics Education, Public Education & Outreach, Public Policy & Government Engagement
Snowmass Early Career	Snowmass Early Career to represent early career members and promote