

Division of Particles & Fields

The US Snowmass Community Studies

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On behalf of the Snowmass Steering Group

CERN Council Meeting

December 16, 2021



In June 28 - July 16, 1982, the APS DPF organized an workshop, to “assess the future of elementary particle physics, to explore the limits of our technological capabilities, and to consider the nature of future major facilities for particle physics in the US.”

DPF Chair Charles Baltay:

“... 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.”

**This spearheaded the SSC exploration, and more.
The tradition continued.**

Global-scale projects require long-term strategic plans

With year-long,
wide community efforts,
Snowmass on the Mississippi
July 29 – August 6, 2013

(~700 participants)



Snowmass 2013 highly successful:

(Report by December 2013)

<https://www.slac.stanford.edu/econf/C1307292/>

The year-long process laid out a roadmap for great science opportunities, resulted in broad community buy-in.

essential inputs to P5



“Particle Physics Project Prioritization Panel”

- Projects prioritized according to funding scenarios
- Science research directions in HEP
- Funding profile for current and near-future projects in the decade

Building for Discovery

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

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.



The need for Snowmass 2021

Snowmass Goals: **Snowmass is a scientific study**

To define the most important questions for the field of particle physics

To identify promising opportunities to address them

- **Timing:** 2014 P5 recommendations are being favorably carried out: Significant increase in FY2018-21; Continued support in FY2022.

It is time to embark the next strategic plan: aiming at FY2024-25.

- **Related US domestic programs:**

- NAS Decadal survey on Astronomy & Astrophysics (2020)
- NAS Decadal survey on Elementary Particle Physics (2021)

- **Global programs:**

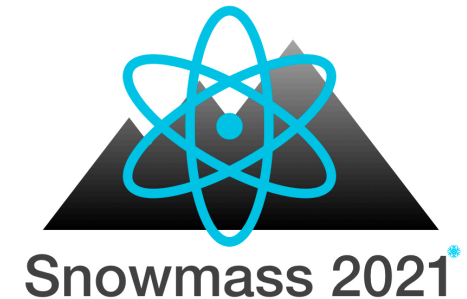
- 2017 JAHEP; KEK Roadmap: SuperKEKB; J-PARC; Hyper-K; ILC ...
- 2020 Update of European Strategy for Particle Physics
- 2021 Canadian Subatomic Physics Long-term Plan Report
- Latin America: Strategy Forum for Research Infrastructure
- China: Active discussions on CEPC/SPPC

Snowmass 2021 organization

Steering Group 2021

Chair: Tao Han
Chair-elect: Joel Butler
Vice Chair: Sekhar Chivukula
Past Chair: Young-Kee Kim
Ex Officio: Prisca Cushman

DPB: Sergei Nagaitsev
DNP: Yury Kolomensky
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Advisory Group 2021

- DPF Executive Committee
 - Secretary/Treasurer: Mirjam Cvetič
 - Councilor: Elizabeth Simmons
 - Member-at-Large: Natalia Toro
 - Member-at-Large: Andre de Gouvea
 - Member-at-Large: Mary Bishai
 - Member-at-Large: Lauren Tompkins
 - Member-at-Large: Mayly Sanchez
 - Member-at-Large: Gordon Watts
 - Early Career Member: Julia Gonski
- Editor and Communication
 - Editor – Michael Peskin
 - Communication – Bob Bernstein
- Representatives from the Int. Community
 - Africa / Middle East
 - Azwinndini Muronga, Nelson Mandela Metropolitan Univ, South Africa
 - Asia / Pacific
 - Atsuko Ichikawa, Kyoto University, Japan
 - Xinchou Lou, IHEP, China
 - Canada
 - Heather Logan, Carleton University
 - Europe / Russia
 - Val Gibson, Cavendish Laboratory, UK
 - Berrie Giebels, CNRS, France,
 - Michelangelo Mangano, CERN
 - Latin America
 - Claudio Dib, Universidad Tecnica Federico Santa Maria, Chile

Snowmass 2021 organization

10 Frontiers	80 Topical Groups
Energy Frontier	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
Frontiers in 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
Frontiers in Rare Processes & Precision Measurements	Weak Decays of b and c, Strange and Light Quarks, Fundamental Physics and Symmetry Tests, CP Violation and Lepton Number Violation, Charged Lepton Flavor Violation, Dark Sector at Low Energy
Cosmic Frontier	Dark Matter: Particle-like, Dark Matter: Wave-like, Dark Matter: Other, Cosmic Microwave Background, Cosmic Acceleration: The Modern Universe, Dark Energy & Cosmic Acceleration, Cosmic Acceleration: Energy & Cosmic Acceleration: Complementarity of Probes and Methods
Theory Frontier	String theory, quantum gravity, black holes, Quantum Chromodynamics, Quantum Field Theory, CFT and formal QFT, Scattering amplitudes, Lattice gauge theory, Nuclear Physics, Collider phenomenology, BSM model building, Astro-particle physics, Information science, Theory of Neutrino Physics
Accelerator Frontier	Beam Physics, Accelerators for Neutrinos, Accelerators for Electroweak and Higgs Physics, Accelerators for Physics Beyond Colliders & Rare Processes, Advanced Accelerator R&D: RF, Magnets, Targets/Sources
Instrumentation Frontier	Calorimeters, Detectors, Solid State Detectors & Tracking, Trigger and DAQ, Micro Pattern Gas Detectors, Cryogenics, Electronics/ASICS, Noble Elements, Cross Cutting and System Integration, Radio Detection
Computational Frontier	Experimental Algorithm Parallelization, Theoretical Calculations and Simulation, Machine Learning, Storage and processing resource access (Facility and Infrastructure R&D), End user analysis
Underground Facilities and Infrastructure Frontier	Underground Facilities for Neutrinos, Underground Facilities for Cosmic Frontier, Underground Detectors
Community Engagement Frontier	Applications & Industry, Career Pipeline & Development, Diversity & Inclusion, Physics Education, Public Education & Outreach, Public Policy & Government Engagement

30 Frontier conveners, ~250 Topical Group conveners, >40 Inter-Frontier Liaisons, ~25 Early Career Liaisons.

Snowmass Early Career

to represent early career members and promote their engagement in the Snowmass 2021 process; to build a long-term HEP early career community

Broad coverage/connection in science and global community!

Please find your role and contribute to the activity!

Snowmass Community Planning Meeting

5-8 October 2020

Virtual

US/Central timezone

The primary goal of the Community Planning Meeting is **to develop plans and steps to take (“Snowmass Planning”) between October 2020 and the Snowmass Community meeting in July 2021, leading to a final report in October 2021.**

- ~ 1,570 LOIs contributions
- 63 submissions to the “Voices from the Community”
- 25 Plenary speakers; 5 “Future Facilities” panelists
- 101 Breakout sessions’ organizers, chairs,
and all the participants
- ~ 3,000 participants

While the Snowmass activities were in the full swing, the COVID-19 pandemic hit hard and slowed down the process.

Snowmass Day

September 24, 2021

US/Central timezone

AF	Vladimir Shiltsev	11:00 - 11:10
CompF	Benjamin Nachman	11:10 - 11:20
CosmF	Aaron Chou	11:30 - 11:40
EF	Alessandro Tricoli	11:40 - 11:50

e.g. EF Summary

Get all the frontiers and participants back together on the same page and refocus our attention to the Snowmass activities

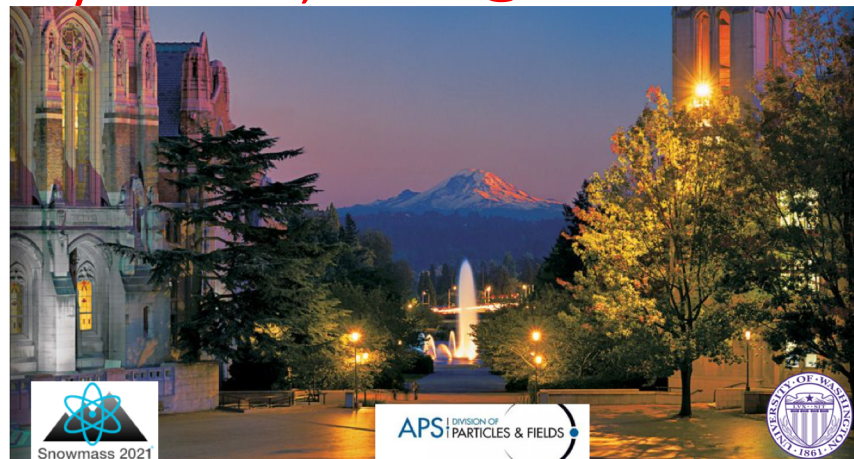
- **Ambitious Energy Frontier plans to pave the way towards addressing big questions**
- **Cross-fertilization across fields** (Theory, Cosmics, Accelerators, Instrumentation etc.)
 - Anomalies in related fields require dedicated and long-term effort in the EF to confirm new physics and unveil their origins
- **Energy Frontier activities have taken off in 2020, and have already restarted at full steam**
 - Great interest and response from national and international community (numerous LOIs, and ongoing contributions)
- **EF organization carries on from 2020 with few additions, Strategic plans have been laid out, Connection with other frontiers is established, Early Career representation is active, Monte Carlo sample production has started, Studies are on-going**
- **Plenty of time to join activities, propose new studies and address the many open questions**

SEC	Julia Gonski	12:40 - 12:50
Steering Group	Tao Han	

Snowmass activities in full swing

- Frontier's preparatory meetings
- Lecture series:
 - "Snowmass Agora on Future Colliders"
 - Physics at FNAL muon campus
 -
- **Contributed papers (white papers) by March 15**
They form the basis for the Snowmass write-ups and documents.
- **Community Summer Study (CSS, in person)**

July 17 – 26, 2022 @ UW – Seattle



Snowmass Timelines

