

# USA Physics Strategies

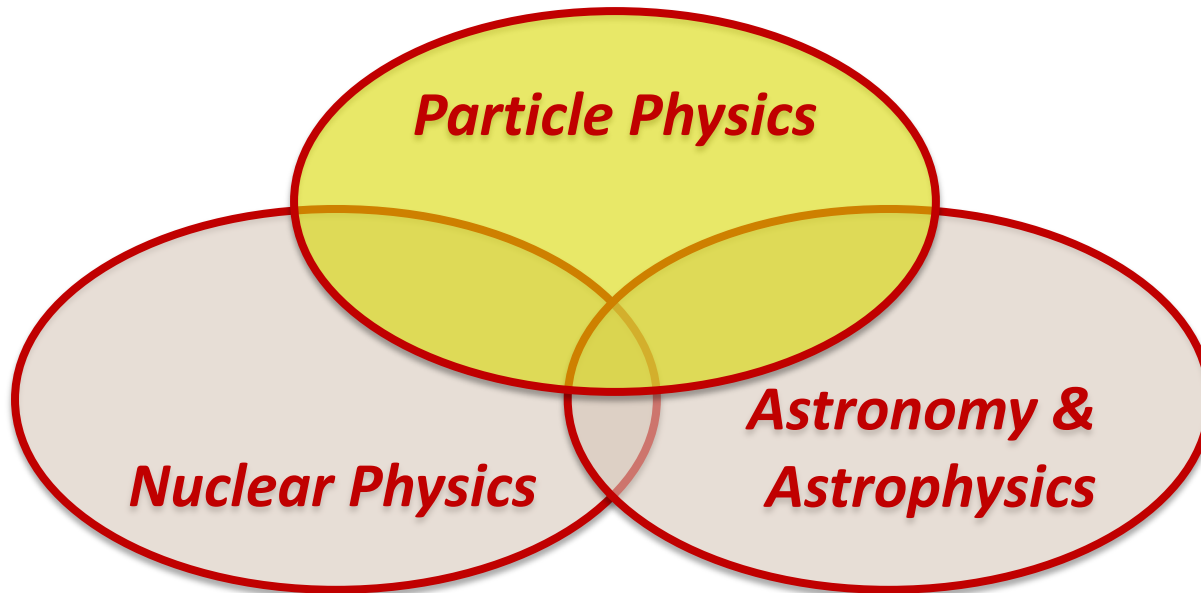
July 12, 2021

African Strategy for Fundamental and Applied Physics: Community Town Hall

Young-Kee Kim

University of Chicago

# Long-Range Strategic Plans



**Quantum Information Science**

# National Quantum Initiative Act

To explore and promote Quantum Information Science  
Signed into law on December 21, 2018 to ensure the continued leadership of the U.S.  
in quantum information science and its technology applications.  
It provides for a coordinated Federal program to accelerate quantum research and development  
for the economic and national security of the U.S.

A yearlong study by a coalition of academic researchers and technology firms helped trigger this.

*Funding Agencies:*

*Department of Energy (DOE)*

*National Institute of Standards and Technology (NIST)*

*National Science Foundation (NSF)*

***DOE Centers launched in 2020*** (\$575M total: \$115M each over the next 5 years)

Q-NEXT · Next Generation Quantum Science and Engineering

C<sup>2</sup>QA · Co-design Center for Quantum Advantage

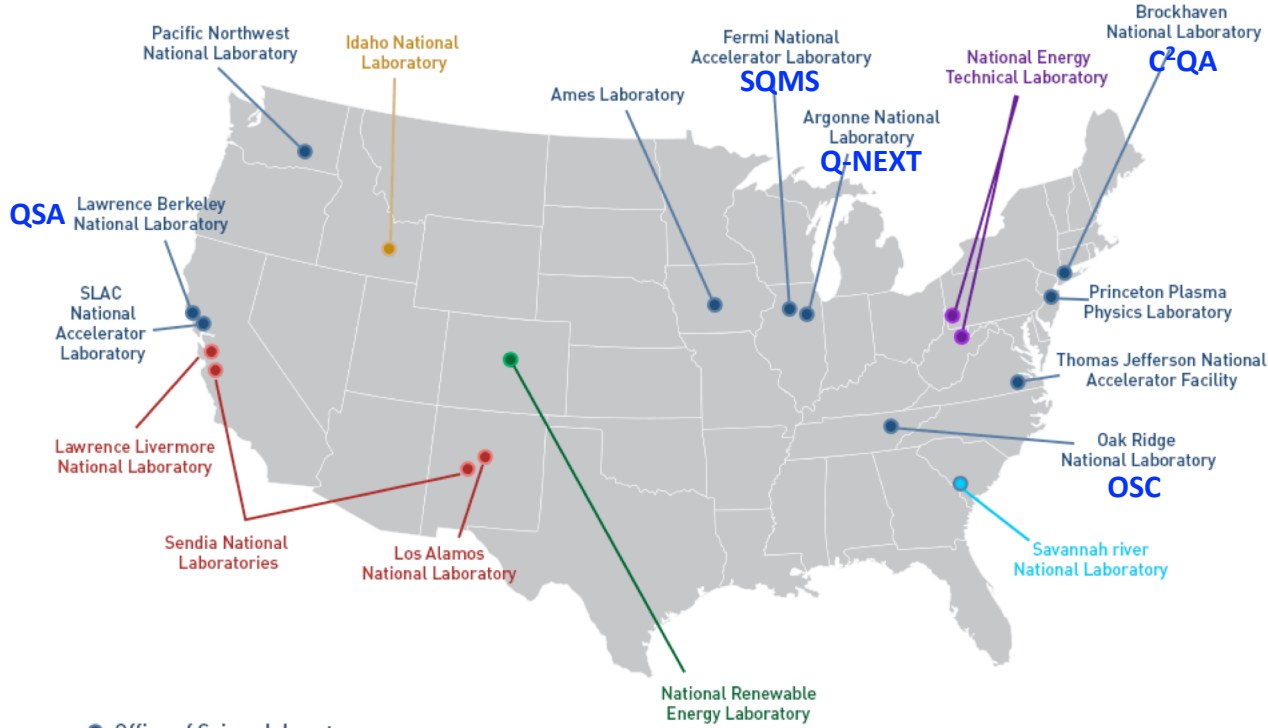
SQMS · Superconducting Quantum Materials and Systems Center

QSA · Quantum Systems Accelerator

QSC · The Quantum Science Center

# National Quantum Initiative: DOE Centers

## Department of Energy National Laboratories



- Office of Science laboratory
- National Nuclear Security Administration laboratory
- Office of Fossil Energy laboratory
- Office of Energy Efficiency and Renewable Energy laboratory
- Office of Nuclear Energy, Science and Technology laboratory
- Office of Environmental Management laboratory



# Astronomy & Astrophysics

## Decadal Surveys

Once every ten years, the astronomical communities gather panels of experts to set community-wide priorities for the coming decade. These surveys are facilitated by the National Academies and commissioned by the Federal agencies.

- Ground-Based Astronomy: A Ten-Year Program (1964)
- Astronomy and Astrophysics for the 1970s (1972)
- Astronomy and Astrophysics for the 1980s (1982)
- The Decade of Discovery in Astronomy and Astrophysics (1991)
- Astronomy and Astrophysics in the New Millennium (2001)
- New Worlds, New Horizons in Astronomy and Astrophysics (2010)



Astro 2010



Astro 2020

The Survey Report has been submitted for peer review

# Astronomy & Astrophysics: Astro 2010

- Scientific questions to be answered include:
  - Nature of dark energy
  - Structure, distribution, and evolution of exoplanetary systems
  - Detailed examination of extreme processes including supervovae and the merger of superdense objects
  - How galaxies and galaxy clusters formed from the early hot universe
- Examined technical readiness, scheduling, funding issues (major agencies, NASA, NSF, and DOE)
- The top priorities identified include:
  - WFIRST (Wide-Field Infrared Survey Telescope), a proposed space-based telescope to survey and catalogue exoplanets and help settle questions of the nature of dark energy
  - LSST (Large Synoptic Survey Telescope), a proposed wide field ground-based telescope to provide measurements of weak gravitational lensing and map and record transient or moving phenomena
  - New Worlds Technology Development Program to plan and lay the groundwork for future missions to study nearby Earth-like exoplanets
  - CCAT (Cerro Chajnantor Atacama Telescope), a proposed ground-based telescope sensitive in the millimeter and submillimeter range
  - LISA (Laser Interferometer Space Antenna) for measuring gravitational waves
  - International X-ray Observatory for investigating black holes and the evolution of large scale structure
  - Explorer program for small and medium-sized missions with rapid turnaround and high scientific return

# Nuclear Physics

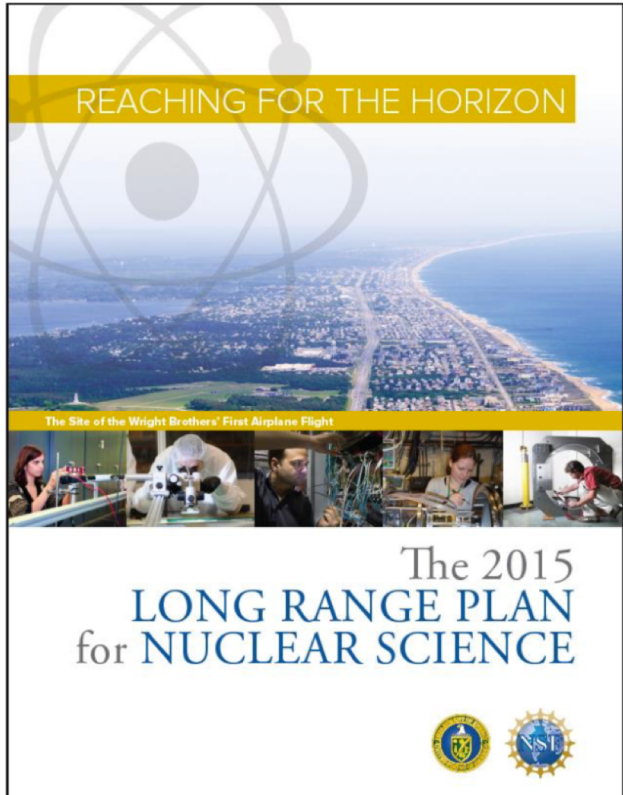
The Nuclear Science Advisory Committee (NSAC) provides advice to the Department of Energy (DOE) and the National Science Foundation (NSF) on the national program for basic nuclear science research.

Every 4~7 years NSAC is charged by DOE and NSF to make a long-range plan



# Nuclear Physics: LRP 2015

Most recent instance:

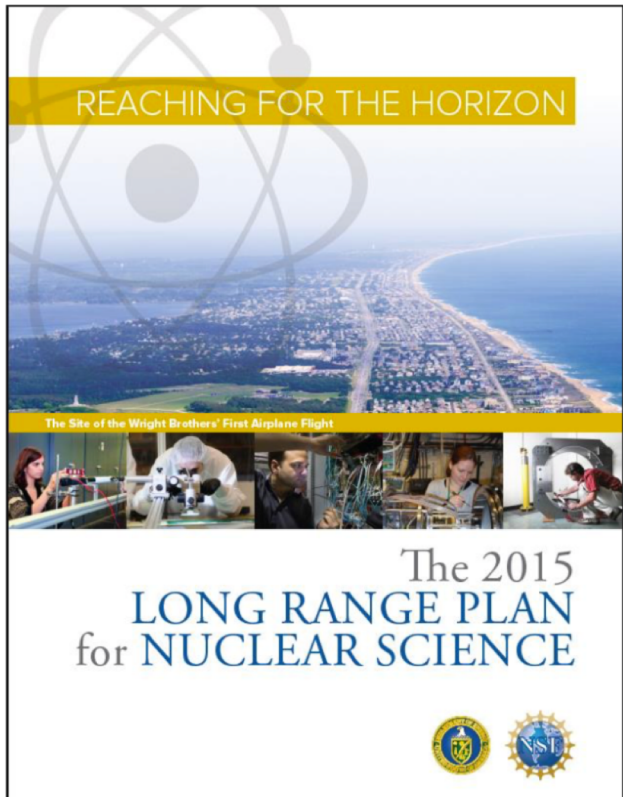


- Long Range Plan (LRP) working group
  - ~60 members from different sectors of the community + international observers from Europe and Asia
- Few months of community activities: DNP “Town Meetings” (summer 2014)
  - Education and Innovation
  - Nuclear Structure and Nuclear Astrophysics
  - Hadron and Heavy Ion QCD
  - Fundamental Symmetries, Neutrinos, Neutrons and Relevant Nuclear Astrophysics
- White papers submitted by community (Jan 2015)
- Resolution meeting of entire working group, to finalize recommendations (April 2015)
- Report finalized October 2015



# Nuclear Physics: LRP 2015

Most recent instance:



- Recommendations (LRP 2015)
  - Capitalize on investments made to maintain U.S. leadership in nuclear science.
  - Develop and deploy a U.S.-led ton-scale neutrino-less double beta decay experiment.
  - Construct a high-energy high-luminosity polarized electron-ion collider (EIC) as the highest priority for new construction following the completion of FRIB (Facility for Rare Isotope Beams)
  - Increase investment in small-scale and mid-scale projects and initiatives that enable forefront research at universities and laboratories.

# Particle Physics

Community-Driven **Science** Study, a.k.a. “**Snowmass**” (1.5 year-long process)

Define the most important questions for the field &

Identify promising opportunities to address them

Organized by Division of Particles and Fields (DPF) of American Physical Society

Particle Physics is global:

The Snowmass process involves communities and plans from other regions

Particle Physics is not isolated:

Snowmass process includes related communities

Long-Range Plan for Nuclear Science (neutrinos, fundamental symmetry, QCD, ...)

Decadal Survey on Astronomy and Astrophysics (dark energy, CMB, dark matter, ...)

Accelerator R&D Subpanel Report



Input to P5

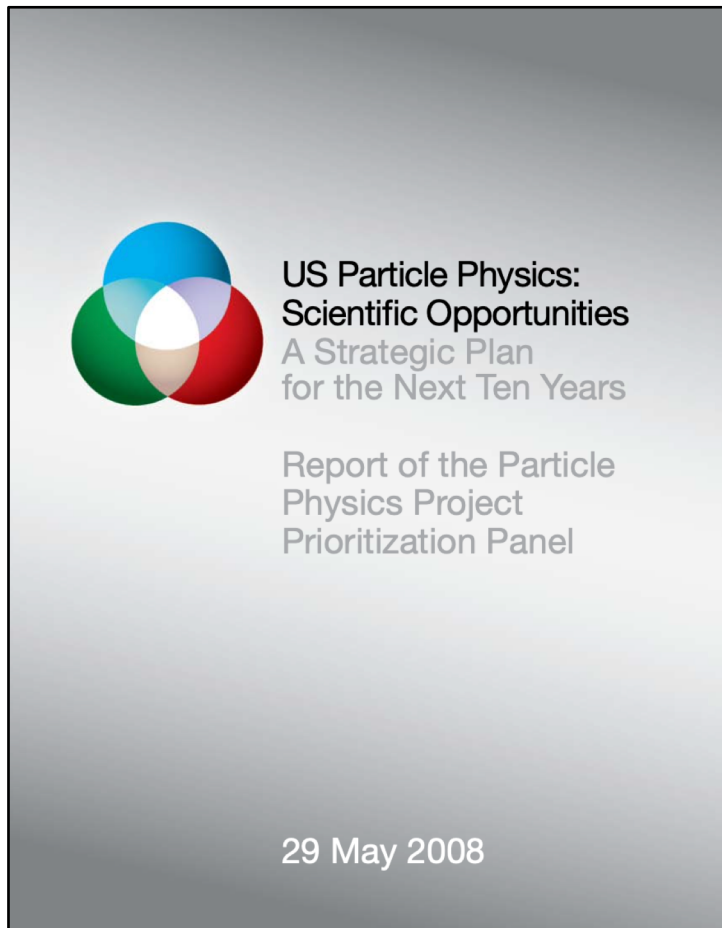
**P5**, Particle Physics Project Prioritization Panel (~year-long process)

formulate a 10-year execution plan (20 year vision) within funding constraints

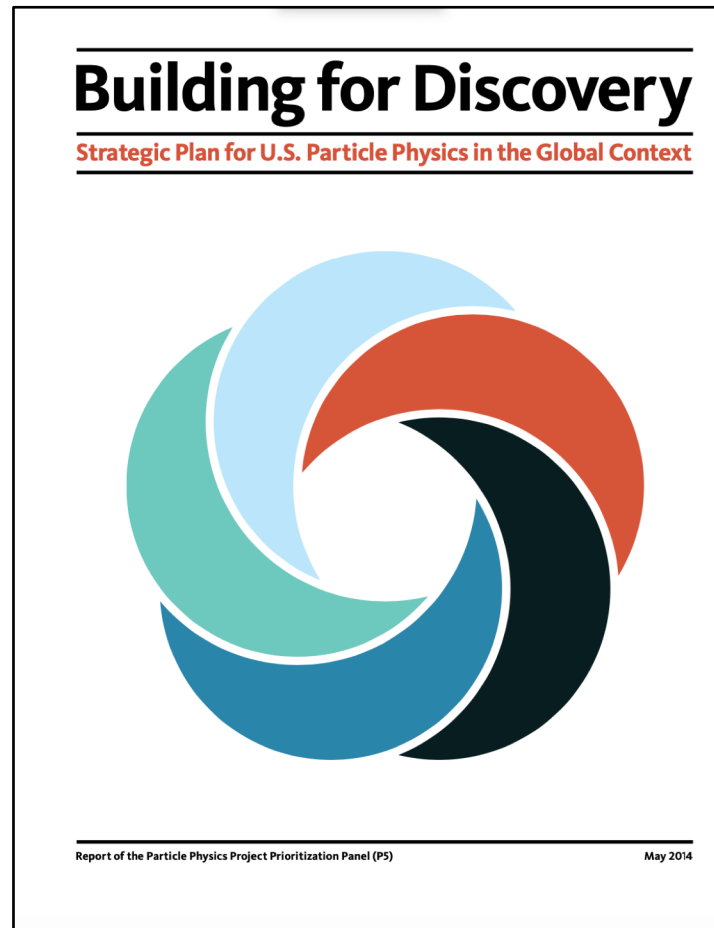
Subpanel of HEPAP, High Energy Physics Advisory Panel for DOE/NSF funding agencies

# Particle Physics

2008 P5 Report



2014 P5 Report



# Particle Physics: Snowmass (2013) + P5 (2014)

- Frontiers
  - Energy Frontier
  - Intensity Frontier
  - Cosmic Frontier
- Cross-Cutting
  - Facilities (Underground and Accelerator)
  - Instrumentation
  - Computing
  - Theory
  - Communication

**Five intertwined scientific Drivers** were distilled from the results of a yearlong community-wide study:

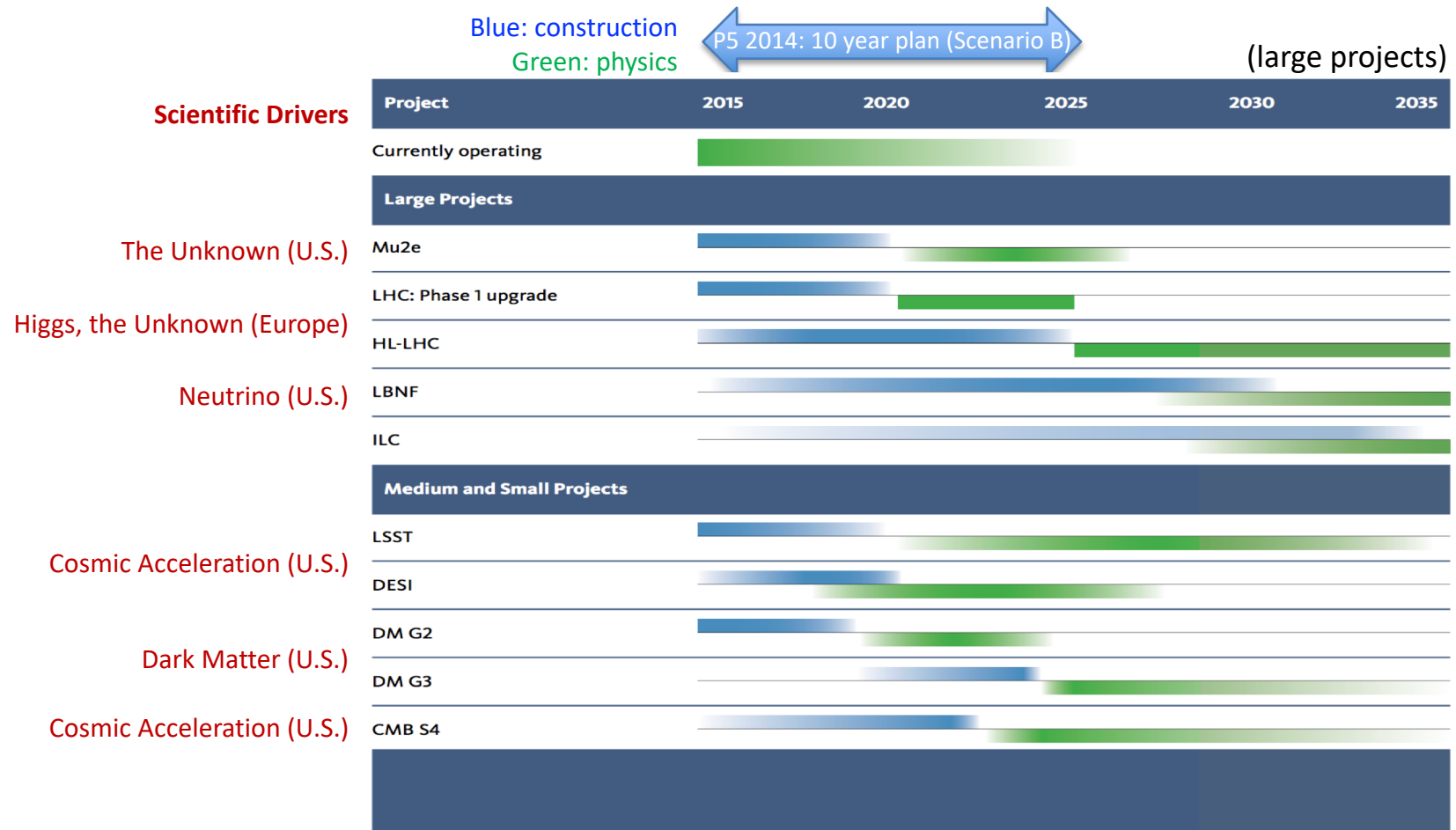
- Use the Higgs boson as a new tool for discovery
- Pursue the physics associated with neutrino mass
- Identify the new physics of dark matter
- Understand cosmic acceleration: dark energy and inflation
- Explore the unknown: new particles, interactions, and physical principles



# Particle Physics: Snowmass (2013) + P5 (2014)

## P5 2014 Report

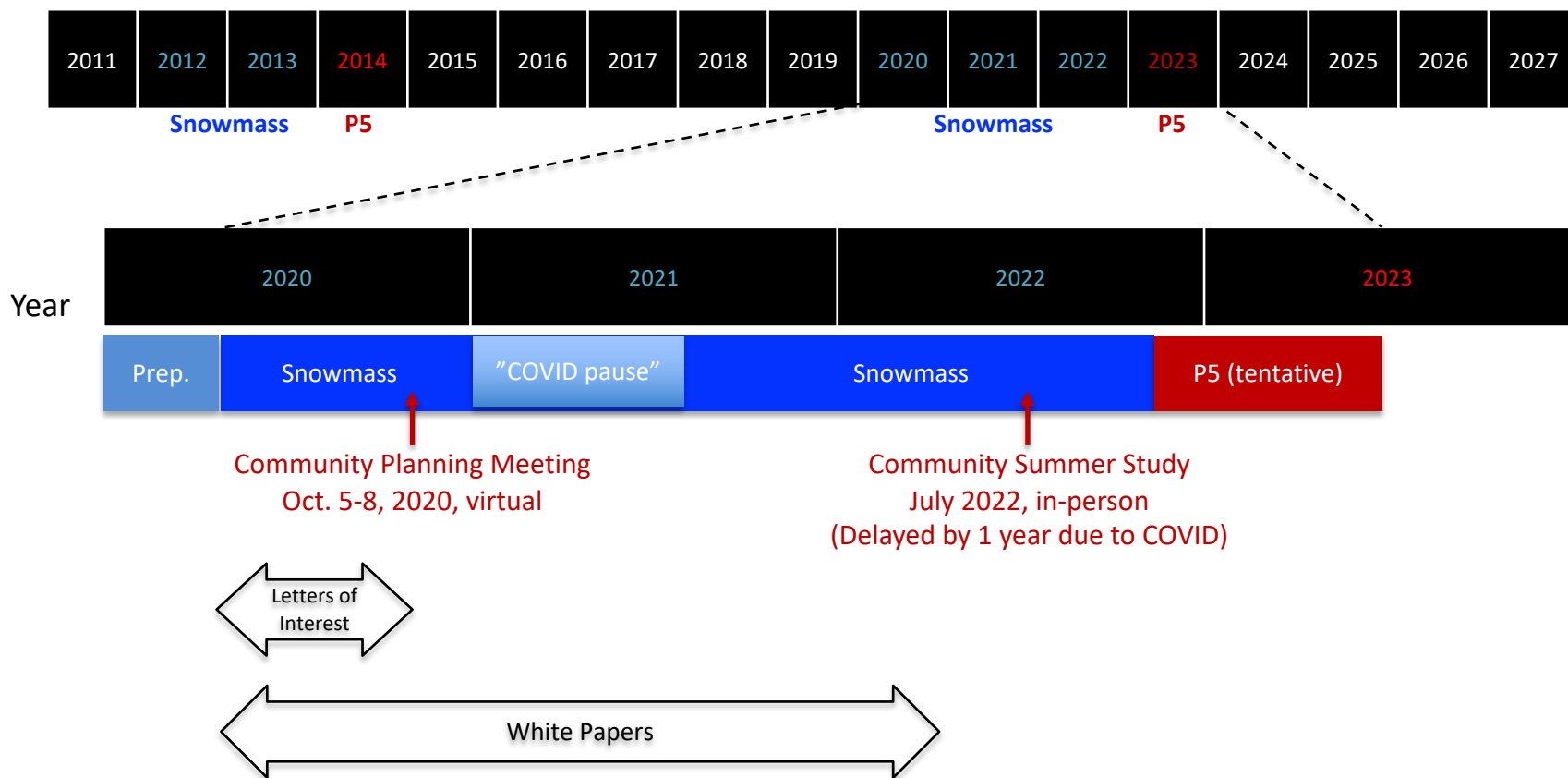
- Support a program of projects of all scales (large, medium, small), new ideas & developments
- Accelerator science / R&D, instrumentation R&D, computing / software; next gen. education and training



**FIGURE 1** Approximate construction (blue; above line) and expected physics (green; below line) profiles for the recommended major projects, grouped by size (Large [ $> \$200M$ ] in the upper section, Medium and Small [ $\leq \$200M$ ] in the lower section), shown for Scenario B. The LHC: Phase 1 upgrade is a Medium project, but shown next to the HL-LHC for context. The figure does not show the suite of small experiments that will be built and produce new results regularly.

# Particle Physics: Snowmass (2022) + P5 (2023)

## Snowmass: 2020 - 2022



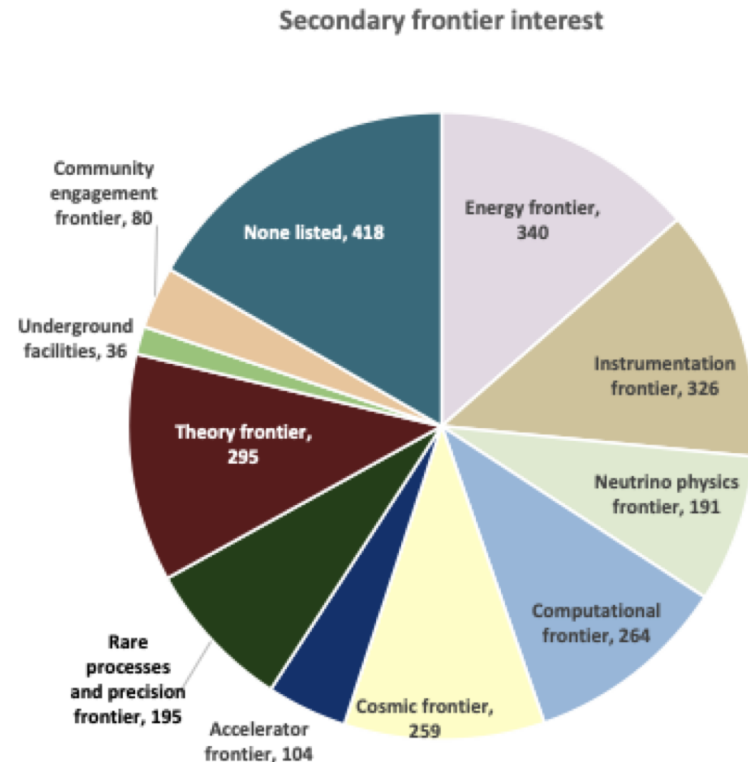
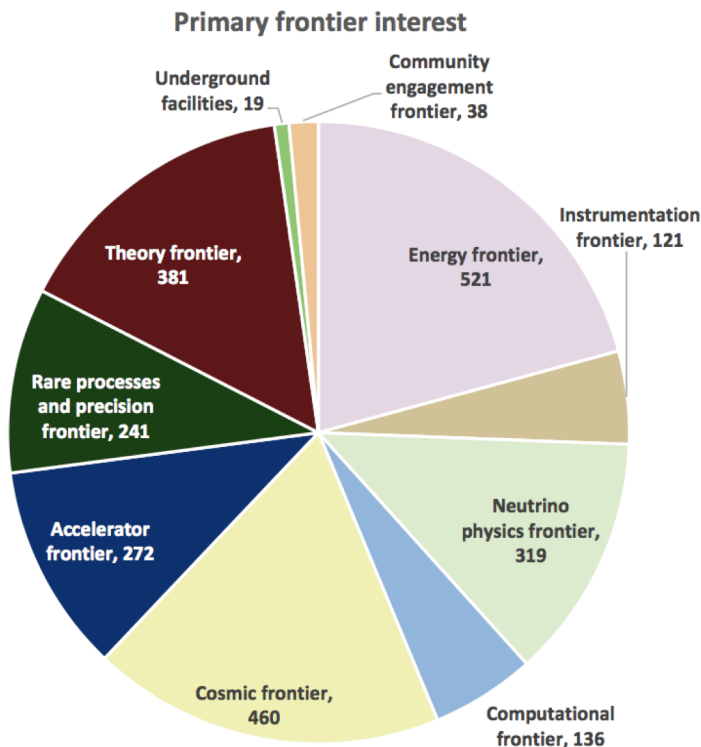
# Snowmass Community Planning Meeting

~3,000 participants (virtual)

~650 outside the North America Time Zone

(Note that 11am-4pm U.S. Central time was inconvenient – very inconvenient for many countries)

1,574 in total: submitted before August 31, 2020 (many LOIs – multiple frontiers)



# Snowmass Advisory Group

## DPF Executive Committee

(2020)

- Chair: Young-Kee Kim
- Chair-Elect: Tao Han
- Vice Chair: Joel Butler
- Past Chair: Prisca Cushman

(2021)

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

## Steering Group

- Secretary/Treasurer: Mirjam Cvetič
- Councilor: Elizabeth Simmons
- Member-at-Large: Rick Van Kooten (2020) → Mayly Sanches (2021)
- Member-at-Large: Elizabeth Worcester (2020) → Gordon Watts (2021)
- Member-at-Large: Natalia Toro
- Member-at-Large: Andre de Gouvea
- Member-at-Large: Mary Bishai
- Member-at-Large: Lauren Tompkins
- Early Career Member-at-Large: Sara Simon (2020) → Julia Gonski (2021)

## Editor and Communication Liaison

- Editor – Michael Peskin
- Communication – Bob Bernstein

## Representatives from Related Divisions

- DPB (accelerator physics): Sergei Nagaitsev
- DNP (nuclear physics): Yury Kolomoisky
- DAP (astro physics): Glennys Farrar
- DGRAV (grav. phys.): Gabriela Gonzales (2020)  
→ Nicolas Yunes (2021)

## 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, Canada
- Europe
  - Val Gibson, Cavendish Laboratory, UK
  - Berrie Giebels, CNRS, France
- Latin America
  - Claudio Dib, Universidad Tecnica Federico Santa Maria, Chile



# Transparent and Inclusive Process

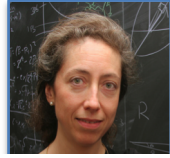
- DPF Executive Committee + DPF Program Committee + Representatives of Related Divisions (Astro, Nuclear, Grav. & Accelerator)
  - Initial organization work
  - Scope of each Frontier + first draft of topical groups of each Frontier
  - Facilitate convener nominations
- General call for frontier & topical convener nominations
  - Closed November 15, 2019
  - Self-nominated, by peer, or by a small group
- Frontier co-conveners (formed in January 2020)
  - Chosen by elected representatives (DPF EC + leaderships of Related Divisions)
  - Based on balance: senior/junior; theory/experiment; gender; region; labs/universities
  - ~3 co-conveners for each of the 10 Frontiers
- Topical groups and topical group conveners (formed in April 2020)
  - 6-10 topical groups for each frontier: ~80 topical groups in total
  - ~3 co-conveners for each topical group: topical group conveners from all the compiled nominations + others (e.g. international members), endorsed by the Steering Group
- Liaisons (formed Spring and Summer 2020)
  - Cross cutting areas

# Frontier Conveners

## Energy Frontier



Meenakshi Narain  
(Brown U.)



Laura Reina  
(FSU)



Alessandro Tricoli  
(BNL)

## Accelerator Frontier



Steve Gourlay  
(LBNL)



Tor Raubenheimer  
(SLAC)



Vladimir Shiltsev  
(FNAL)

## Frontiers in Neutrinos



Patrick Huber  
(Virginia Tech)

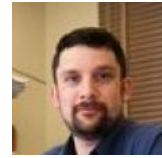


Kate Scholberg  
(Duke U.)



Elizabeth Worcester  
(BNL)

## Instrumentation Frontier



Phil Barbeau  
(Duke)



Petra Merkel  
(FNAL)



Jinlong Zhang  
(ANL)

## Frontiers in Rare & Precision



Marina Artuso  
(Syracuse U.)



Alexey Petrov  
(Wayne State U.)



Bob Bernstein  
(FNAL)

## Computational Frontier



Steven Gottlieb  
(Indiana U.)



Ben Nachman  
(LBNL)



Oliver Gutsche  
(FNAL)

## Cosmic Frontier



Aaron Chou  
(Fermilab)



Marcelle Soares-Santos  
(U.Michigan)



Tim Tait  
(UC Irvine)

## Underground Facilities and Infrastructure Frontier



Laura Baudis  
(U. Zurich)



Jeter Hall  
(SNOLAB)



Kevin Lesko  
(LBNL)



John Orrell  
(PNNL)

## Theory Frontier



Nathaniel Craig  
(UCSB)



Csaba Csaki  
(Cornell)



Aida El-Khadra  
(UIUC)

## Community Engagement Frontier



Kétévi Assamagan  
(BNL)



Breese Quinn  
(Mississippi)



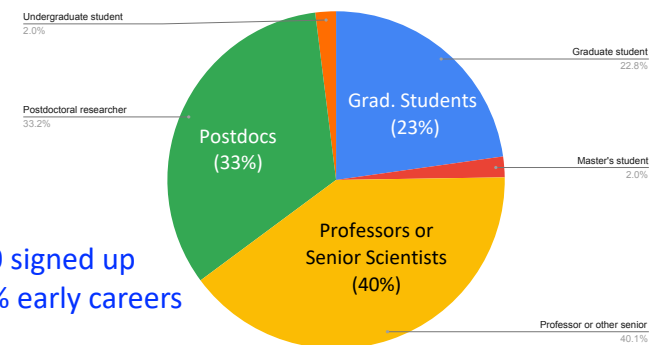
# Snowmass Early Careers

- The Snowmass 2021 process is towards a long-term strategic plan
  - Voices of early career members are critically important
  - Undergrad & grad students; postdocs, early-career faculty, engineers (<~10 years post-PhD)
- Representatives
  - Based on > 250 nominations!!
- Goals
  - Snowmass: Represent early careers and promote their engagement
    - Snowmass coordination: 2-3 Liaisons per Frontier
  - Build a long-term HEP early career community
    - Survey of the early career membership
    - In-reach: Professional development, ...
    - EDI (diversity, equity, and inclusion)
    - Long-term organization
- Snowmass Early Careers Wiki
  - <https://snowmass21.org/start/young>

## In-reach Initiatives (virtual events):

- Monthly big questions colloquium series
- “Coffee Collisions” to create new connections across career stages via for 1-on-1 meetings

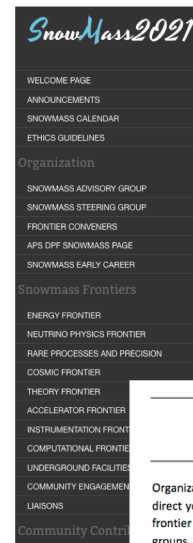
Career stages for participants in Coffee Collisions



~200 signed up  
~60% early careers

# Snowmass Communication

- Wiki (<https://snowmass21.org/>)
  - One-stop shop
    - Organization
    - Frontier/TG activities
    - Early Careers
    - Calendars (workshops, meetings, ..)
    - News and Announcements
    - Community Contributions
    - ....
- Monthly Snowmass Newsletter
- Slack channels (> 2,000 participants)
- Email
  - [snowmass@fnal.gov](mailto:snowmass@fnal.gov)
  - [snowmass-young@fnal.gov](mailto:snowmass-young@fnal.gov)
  - Frontier group mailing lists
  - Topical group mailing lists
  - ...



## Welcome to Snowmass 2021

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The Particle Physics Community Planning Exercise (a.k.a. "Snowmass") is organized by the Division of Particles and Fields (DPF) of the American Physical Society. Snowmass is a scientific study. It provides an opportunity for the entire particle physics community to come together to identify and document a scientific vision for the future of particle physics in the U.S. and its international partners. The P5 (Particle Physics Project Prioritization Panel) will take the scientific input from Snowmass and develop a strategic plan for U.S. particle physics that can be executed over a 10 year timescale, in the context of a 20-year global vision for the field.

We aim 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. There will be various Town Hall meetings for us to communicate with you and to receive your feedback. You are also welcome to provide input and suggestions on the Slack channel (<https://snowmass2021.slack.com/>). This Snowmass wiki provides news and announcements and has pages dedicated to each frontier. If you are an early career scientist, we encourage you to join the "Snowmass Young" mailing list ([snowmass-young@fnal.gov](mailto:snowmass-young@fnal.gov)) by emailing to [listserv@listserv.fnal.gov](mailto:listserv@listserv.fnal.gov) with the body of the message: "Subscribe snowmass-young YOUR NAME". Agendas and presentations of all Snowmass-related meetings are available via [this Snowmass Indico link](#).

Sincerely,

Young-Kee Kim (DPF Chair), Tao Han (DPF Chair-Elect), Joel Butler (DPF Vice-Chair), Priscilla Cushman (DPF Past Chair)

## Monthly Snowmass Newsletter

June 2020

Organization and activities of 5 direct you to various pages incl frontier pages with organization groups, and [core principles](#) encourage community members and to submit [Letters of Interest](#)

## Monthly Snowmass Newsletter

July 2020

### Energy Frontier

The Energy Frontier

A screenshot of a Slack channel conversation. The channel name is "#general". The conversation includes a message from "Young-Kee Kim" with a link to "https://snowmass21.org/". Another message from "nikahidreth" includes a "Google Docs" link for a survey on the impact of COVID-19 on the HEP community. The interface shows various Slack features like threads, drafts, and a list of channels and direct messages on the left sidebar.

# Snowmass Ethics

- Snowmass: dynamic exchange of ideas across a large swath of the community in a variety of formats including slack channels, meetings, and workshops.
- All community should feel safe and supported in engaging in all exchanges.
- DPF Ethics Task Force formed in April 2020
  - Drafted [DPF Core Principles and Community Guidelines](#)
  - CP&CG Response Team (names in bold) for responding to reports of violations
  - Task Force members
    - **Ketevi Assamagan**
    - Carla Bonifazi
    - Mu-Chun Chen
    - Prisca Cushman
    - **Andre de Gouvea**
    - Young-Kee Kim (ex-officio)
    - Samuel Meehan
    - **Sara Simon**
    - **Lauren Tompkins (chair)**
    - **Elizabeth Worcester**
- DPF Ethics Advisory Committee (standing committee) formed in Nov. 2020
  - Inaugural Committee members (Nov. 2020 – Oct. 2022)
    - Kétévi Assamagan
    - Bill Barletta
    - Melissa Franklin
    - Maria Elena Monzani
    - Pavel Fileviez Perez
    - Amber Roepe
    - Pekka Sinervo
    - Ruth Van de Water
    - Jeremy Wolcott