



Snowmass 2021

Instrumentation Frontier

IF07: Electronics/ASICs

Kickoff Meeting, June 11/2020

Gabriella Carini (BNL),
Mitch Newcomer (U Penn),
John Parsons (Columbia U)

Snowmass

— long-term planning exercise for the particle physics community

Its goal is to develop the community's long-term physics aspirations.

Its narrative will communicate
the opportunities for discovery in particle physics
to the broader scientific community and to the government.

U.S. Strategic Planning Process for Particle Physics

~year-long process

Snowmass Community-Wide “Science” Study

Organized by Division of Particles and Fields (DPF) of APS



~year-long process

P5 (Particle Physics Project **P**rioritization Panel)

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

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

Long-Range Plan for Nuclear Science (ν -less double beta decay)

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

HEPAP Accelerator R&D Subpanel Report

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Snowmass Topics led to P5 Science Drivers



Snowmass 2013 Report

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

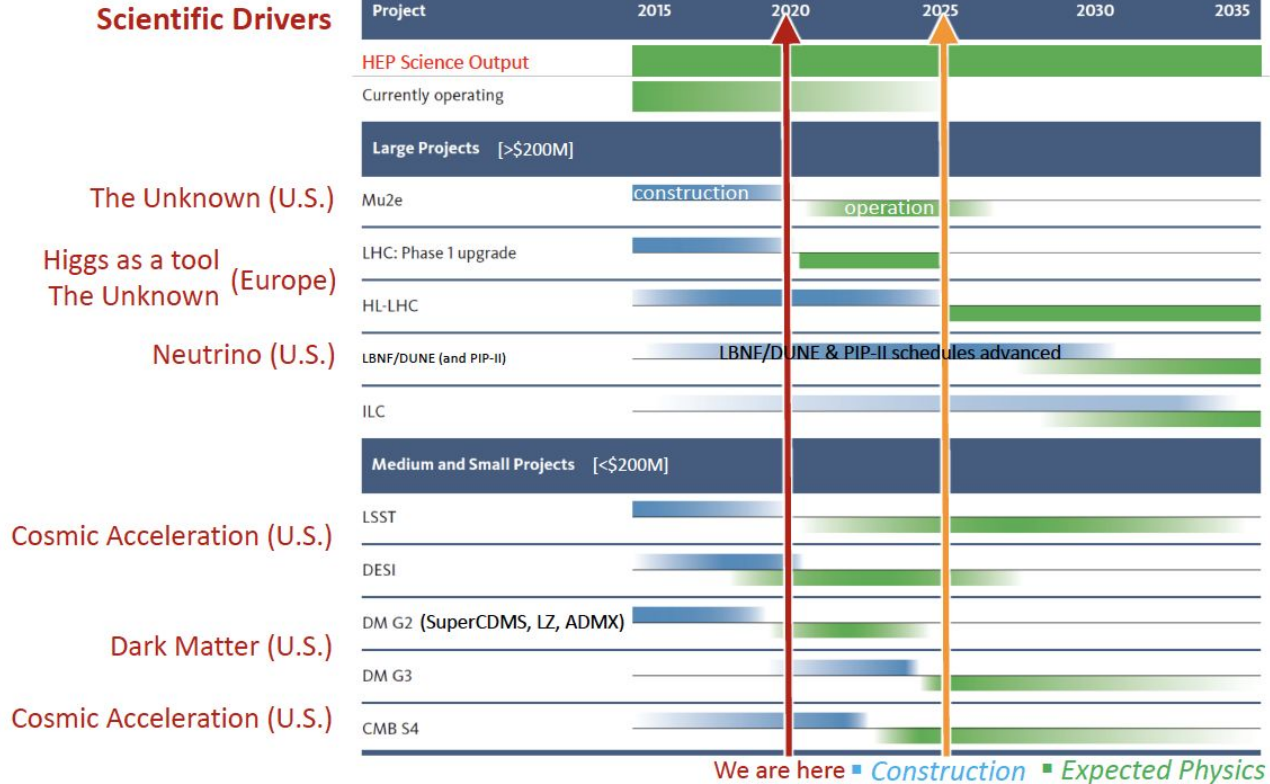
P5 2014 Report

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




P5 2014 has been very successful !!



Snowmass 2021

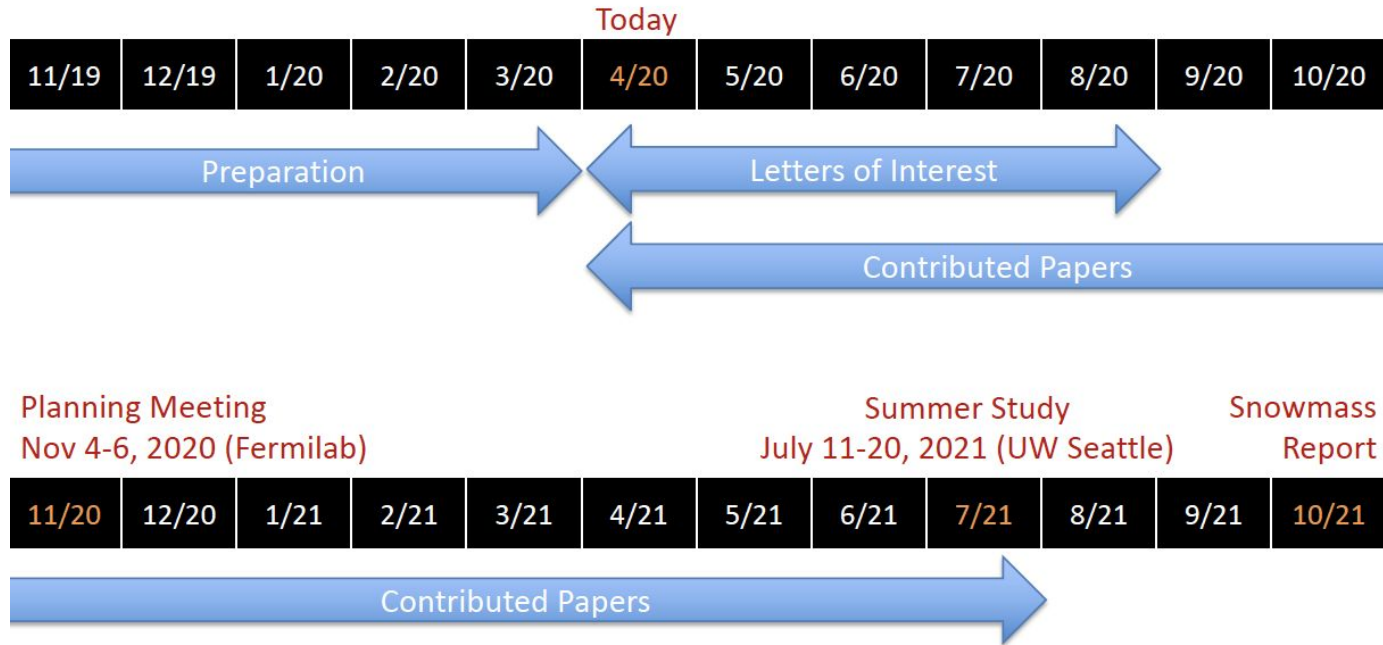
- 
- Successful Snowmass 2013 is our model!
 - Implement lessons learned from Snowmass 2013
 - Snowmass 2021: Ten Frontiers
 - Energy Frontier
 - Frontiers in Neutrino Physics
 - Frontiers in Rare Processes & Precision Measurements
 - Cosmic Frontier
 - Theory Frontier
 - Underground Facilities and Infrastructure Frontier
 - Accelerator Frontier
 - Instrumentation Frontier
 - Computational Frontier
 - Community Involvement
 - DPF Executive Committee + DPF Program Committee
 - Initial organization work
 - Scope of each Frontier + first draft of subgroups of each Frontier
 - Facilitate convener nominations

Community Contribution


- 
- **Letters of Interest (submission : April 1, 2020 – August 31, 2020)**
 - Allow conveners to see what proposals to expect and to encourage the community to begin studying them. Help conveners to prepare the Snowmass Planning Meeting (Nov. 4 - 6, 2020 at Fermilab).
 - Letters should give brief descriptions and cite the relevant papers to study.
 - Submission instructions: <https://snowmass21.org/loi>
 - Authors are encouraged to submit a full writeup as a contributed paper
 - **Contributed Papers (submission : April 1, 2020 – July 31, 2021)**
 - Part of the Snowmass proceedings.
 - White papers on specific scientific areas, technical articles presenting new results on relevant physics topics, and reasoned expressions of physics priorities, including those related to community involvement.
 - These papers and discussions throughout the Snowmass process will help shape the long-term strategy of particle physics in the U.S. Contributed papers will remain part of the permanent record of Snowmass 2021.
 - Submission instructions: <https://snowmass21.org/submissions/>.

Timeline

We are ahead of the curve compared to Snowmass 2013



Snowmass Young

- 
- The Snowmass 2021 process will develop a long-term strategic plan
 - Voices of early career members are critically important
 - Enrich and strengthen Snowmass-Young (SNOWMASS-YOUNG@LISTSERV.FNAL.GOV)
 - Forming a representative group for Snowmass Young
 - Soliciting nominations
 - Nominees: early career members (e.g. grad students, postdocs, etc.).
Nominees need not be APS members to participate in the process.
Nominations can include self-nominations and will be open until **May 11, 2020** through the google form: <https://forms.gle/Xpd4jW3Y6oxcXxmD7>
 - Coordinated by
 - Sara Simon, 2020 DPF Executive Committee Early Career Member
 - Fernanda Psihas, 2019 DPF Executive Committee Early Career Member

Snowmass Wiki (One-Stop Source)



SnowMass2021

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- ALL SNOWMASS CALENDAR
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 - SNOWMASS STEERING GROUP
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 - APS DPF SNOWMASS PAGE
- Snowmass Frontiers
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 - Logged in as: Young-Kee Kim (ddk)

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Welcome to Snowmass 2021

The Snowmass Process is organized by the Division of Particles and Fields (DPF) of the American Physical Society. Snowmass is an opportunity for the entire HEP community to come together to identify and document a vision for the future of particle physics in the U.S. and its international partners.

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) by emailing to 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)

[Edit](#)

DPF Community Planning Process

Various workshops will be organized by Frontier Conveners between the 2020 Snowmass Planning Meeting (Nov. 4 - 6, 2020 at Fermilab) and the 2021 Snowmass Summer Study (July 11 - 20, 2021 at UW Seattle). Workshop locations will be chosen to maximize "inclusiveness" based on accessibility and economic consideration. For all the meetings and workshops, we will make sure that we are inclusive to those who participate remotely and we will have a special session to discuss APS efforts for openness and the importance of open international collaboration.

[Edit](#)

News Highlight

see [Announcements](#) tab on the sidebar for a complete list

News Highlight: Upcoming meeting

- A virtual Town Hall meeting will take place at the original schedule (5:30 pm - 7:00 pm EDT on Saturday, April 18). We will provide a status report and receive your feedback. ZOOM connection by Web: <https://uchicagogroup.zoom.us/j/170161490> or by Phone: 877 853 5257, 888 475 4499, or your local number at <https://uchicagogroup.zoom.us/j/agjwAXAH5> (Meeting ID: 170 161 490)
- [Letters of Interest](https://snowmass21.org/loi) (April 1 - August 31, 2020) - <https://snowmass21.org/loi>
- [Contributed Papers](https://snowmass21.org/submissions/) (April 1 - July 31, 2021) - <https://snowmass21.org/submissions/>

<https://snowmass21.org/>
Sergei Chekanov (ANL)

Instrumentation Frontier



Phil Barbeau (Duke)



Petra Merkel (FNAL)



Jinlong Zhang (ANL)

Topical Group		Topical Group co-Conveners		
IF01	Quantum Sensors	Thomas Cecil (ANL), Kent Irwin (SLAC), Reina Maruyama (Yale), Matt Pyle (Berkeley)		
IF02	Photon Detectors	Juan Estrada (FNAL)	Mayly Sanchez (ISU)	Abigail Vieregge (Chicago)
IF03	Solid State Detectors&Tracking	Tony Affolder (UCSC)	Artur Apresyan (FNAL)	Lucie Linsen (CERN)
IF04	Trigger and DAQ	Darin Acosta (Florida)	Wes Ketchum (FNAL)	Stephanie Majewski (Oregon)
IF05	Micro Pattern Gas Detectors	Thomas Schwarz (Michigan)	Maxim Titov (SACLAY)	Sven Vahsen (Hawaii)
IF06	Calorimetry	Andy White (UTA)	Minfang Yeh (BNL)	Rachel Yohay (FSU)
IF07	Electronics/ASICS	Gabriella Carini (BNL)	Mitch Newcomer (UPenn)	John Parsons (Columbia)
IF08	Noble Elements	Eric Dahl (Northwestern)	Roxanne Guenette (Harvard)	Jen Raaf (FNAL)
IF09	Cross Cutting and System Integration	Jim Fast (PNNL)	Maurice Garcia-Sciveres (LBL)	Ian Shipsey (Oxford)

WELCOME PAGE

ANNOUNCEMENTS

SNOWMASS CALENDAR

ETHICS GUIDELINES

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SNOWMASS ADVISORY GROUP

SNOWMASS STEERING GROUP

FRONTIER CONVENERS

APS DPF SNOWMASS PAGE

SNOWMASS EARLY CAREER

- Snowmass Frontiers

ENERGY FRONTIER

NEUTRINO PHYSICS FRONTIER

RARE PROCESSES AND PRECISION

COSMIC FRONTIER

THEORY FRONTIER

ACCELERATOR FRONTIER

INSTRUMENTATION FRONTIER

COMPUTATIONAL FRONTIER

UNDERGROUND FACILITIES

COMMUNITY ENGAGEMENT FRONTIER

IF7: Electronics/ASICs

co-Conveners:

Name	Institution	email
Gabriella Carini	BNL	carini@bnl.gov
Mitch Newcomer	University of Pennsylvania	mitch@hep.upenn.edu
John Parsons	Columbia University	parsons@nevis.columbia.edu

Description

Most R&D will need to be compatible with an extreme environment - e.g. high radiation, cryogenic, space. Current and future custom integration allows higher density, enhanced circuit performance, lower power consumption, lower mass, much greater radiation tolerance or cryogenic temperature performance than is possible with commercial ICs or discrete components. Designs that in the past required significant area on a printed circuit board with many types of specialized chips can potentially be replaced by a single integrated circuit and in some cases, notably pixel detectors, both sensor and readout can be fabricated as part of the same ASIC saving significantly on cost, power per channel and material burden, while improving spatial resolution and potentially replacing highly inefficient data transfer off detector with abstracted parameters.

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IF07: Electronics and ASICs

- We should cover readout systems, including (but not limited to) their ASICs
- As starting point for background reading, there are some recent studies and reports, including:
 - CPAD Workshops
 - Annual workshops since 2015
 - Most recent (Dec. 2019): <https://wp.physics.wisc.edu/cpad2019/>
 - Report from CPAD 2018 available at <https://arxiv.org/abs/1908.00194>
 - DOE BRN Study Workshop on HEP Detector R&D, Dec. 2019
 - Report expected to be available soon
- Of course, while these are good starting points, new ideas and interests are very welcome as part of Snowmass 2021, which is a community-driven process



Techniques to Enable Continued Innovations in Instrumentation

- Identify Areas/Topics of Interest for Priority Support by funding agencies: Innovative & Mundane
 - *Some Examples in the following slides*
- Explore inter-agency support for development of ASIC blocks of common interest eg. NNSA & HEP
 - Need for commonly used blocks that must operate in extreme environments, that is not commercially interesting.
- Ensure State of the Art understanding/sharing of designs is broadly accessible within HEP/NP Instrumentation Groups to allow multi-institutional development as needed for complex SoC designs.
 - Encourage Continued use of common CAD tool platforms: eg. Cadence
 - Advocate for multi-institution IC technology NDA's modeled after CERN's *Frame Contracts*.
 - Encourage/Support workshops, seminars and Technical Development Short Courses to maintain and renew the design workforce.
 - Use common tools for Design Maintenance / Archiving/Revision among institutions eg. Clisoft or other...
 - Develop Reliable, Hierarchically compatible, Test bench techniques for all aspects of ASIC/System designs.



Topics: some examples

- Electronics/ASICs in extreme environments
 - Cryogenic temperature
 - Extreme radiation environments
- Fast timing
 - Picosecond timing resolution with size and power constraints
 - Precision clock and timing circuits
- Fine granularity, high precision instrumentation
 - Particle flow techniques
- New design and verification methodologies
 - Self assembly techniques



Topics: some examples

- Low power high speed I/O protocols
 - Power management blocks
- Fault tolerant communication
 - CMOS with integrated photonics
 - Silicon photonics and optical transmission
 - Wireless blocks
- Artificial Intelligence and Machine Learning techniques
 - Internet of Things technology
- Circuits for monolithic sensors with integrated readout
 - MAPS, SPADs, SiPM



Upcoming dates

- **Instrumentation Frontier Kickoff Meeting**
 - Friday June 19, 2020 (9 am to 6 pm US Central Time) (remote meeting)
 - <https://indico.fnal.gov/event/43730/>
- **Deadline for Lol submission**
 - August 31, 2020
- **Snowmass 2021 Planning Meeting**
 - November 4 - 6, 2020 at FNAL
- **Deadline for submission of Contributed Papers**
 - July 31, 2021
- **Snowmass 2021 Summer Study**
 - July 11-20, 2021 at UW Seattle
- **Snowmass 2021 Report Due**
 - October 2021



Next steps

- **Please attend the Instrumentation Frontier Kickoff Meeting**
 - Friday June 19, 2020 (9 am to 6 pm US Central Time) (remote meeting)
 - <https://indico.fnal.gov/event/43730/>
- **Prepare “flash talks” (few minutes) to present your interests**
 - We will organize a meeting in ~1 month to present these, and organize among the group a list of topics for further discussions and work in the coming months
- **Topical meetings**
 - A series of meetings, every 2-3 weeks, with each meeting focused on a particular topic
- **Joint meetings**
 - Some of the meetings can and will be held together with other IF subgroups (and there will also be discussions between IF and other frontiers)



Email lists

Join the Instrumentation Frontier email list: SNOWMASS-INSTRUMENTATIONFRONTIER@fnal.gov

- Topical Group e-mail list: SNOWMASS-IF-07-ELECTRONICS-ASICS@FNAL.GOV

Instruction for joining the mailing list:

- Send an e-mail message to listserv@fnal.gov
- Leave the subject line blank
- Type “SUBSCRIBE SNOWMASS FIRSTNAME LASTNAME” (without the quotation marks) in the body of your message. You'll get a Slack invitation when that subscription is approved.



SLACK channels

Slack channels for topics common to the Instrumentation Frontier: instrumentation

- Slack channel: if07-electronics_asics

Instruction for joining the SLACK channel

- Go to <https://snowmass2021.slack.com/> If your institution's domain is on the list, join in.
- If your institution is not on the list, send an email to any of the Frontier's conveners to get an invitation.