

Snowmass 2021

Accelerator Frontier

Accelerator Sci, Edu, Outreach

Kick-off/Info Meeting, May 21 2020

In conjunction with GARD ABP Workshops Summary Mtg

Vladimir Shiltsev (FNAL)

Zhirong Huang (SLAC)

et al.

The Snowmass process

Long-term planning exercise for the particle-physics community.

- “Develop community long-term physics aspirations.”
- “Communicate opportunities for discovery in particle-physics to broader community and to the (US) government.”

(Young-Kee Kim, DPF Chair, [Town-Hall Meeting, 2020 April APS meeting](#))

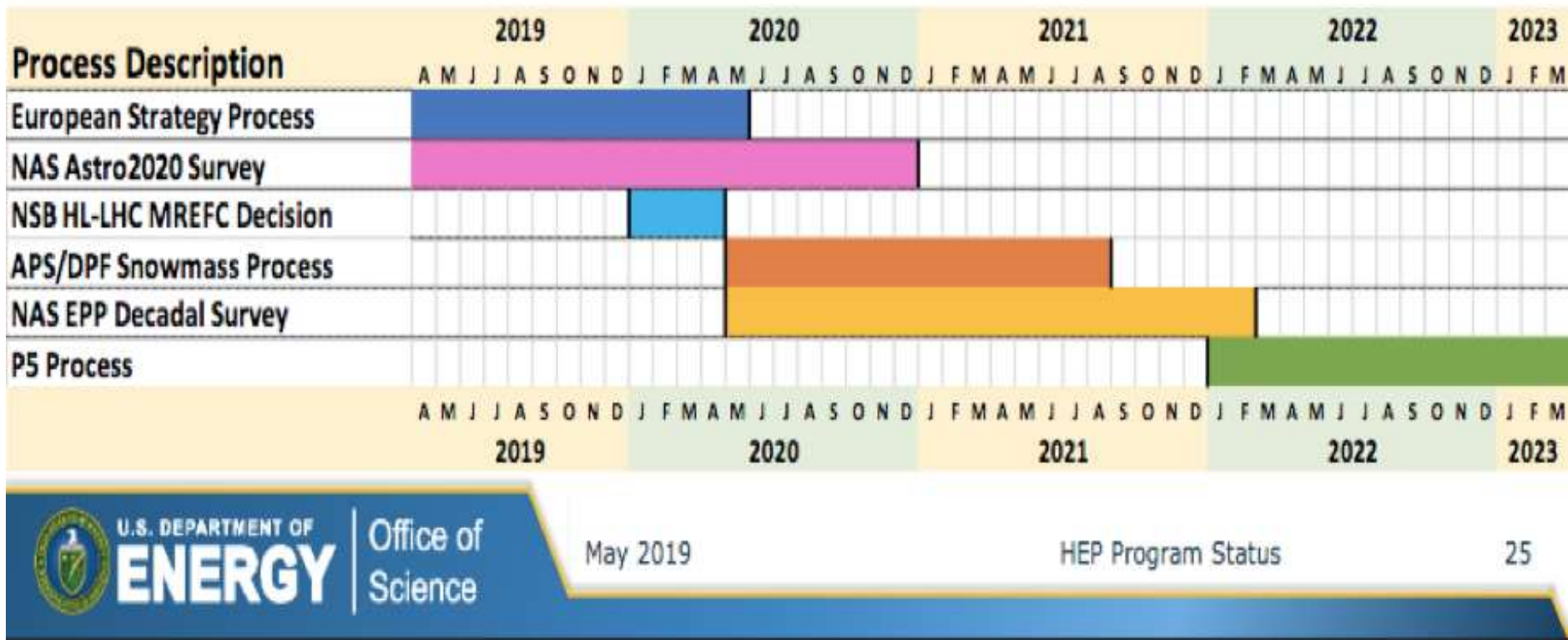
Physics-driven effort.

- Covers all areas of particle physics and facilitates cross-cutting.
- Develop overarching physics studies.

Global effort.

- Input from non-US community is essential.
- Input from recent international studies, for example HL-LHC, European Strategy Particle Physics Update (ESPPU), future colliders etc.

International Timeline



Office of
Science

May 2019

HEP Program Status

25

[Snowmass Final Report: Fall 2021](#)

NAS (National Academy of Sciences) Decadal Survey Report: end 2020 or very early 2022

Snowmass 2021 results will be used as input to the next P5 (2022)

Snowmass 2021 Timeline

We are ahead of the curve compared to Snowmass 2013

Today

4/20

Preparation

Letters of Interest

Contributed Papers

(Continued...)



Planning Meeting
Nov 4-6, 2020 (Fermilab)

Summer Study
July 11-20, 2021 (UW Seattle)

Snowmass
Report

11/20

7/21

10/21

Contributed Papers

Past Snowmass and P5

- **Snowmass 2013: new successful model**

- Energy Frontier
- Intensity Frontier
- Cosmic Frontier
- Cross-cutting groups: Facilities, Instrumentation, Computing, Theory, Communication.

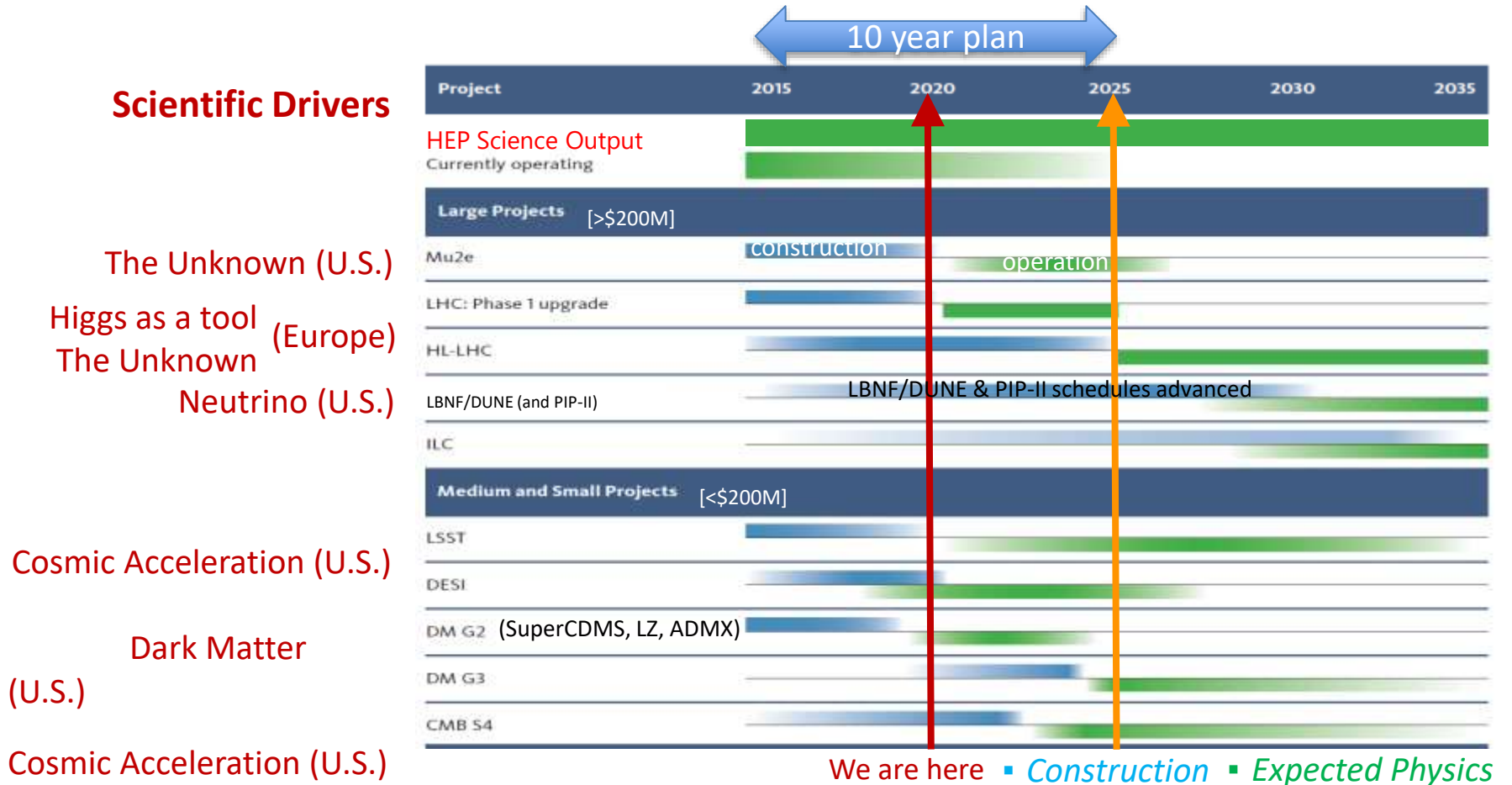
Report:

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

- **P5 (2014): identified five scientific drivers**

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

P5 2014 has been very successful !!



Snowmass 2021: leading to the next P5

Ten Frontiers (with Liaisons in between).

- **Energy Frontier**
- **Frontiers in Neutrino Physics**
- **Rare Processes & Precision Measurements**
- **Cosmic Frontier**
- **Theory Frontier**
- **Underground Facilities**
- **Accelerator Frontier**
- **Instrumentation Frontier**
- **Computational Frontier**
- **Community Engagement Frontier**

Wiki: <https://snowmass21.org/start>

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Snowmass2021

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Welcome to Snowmass 2021

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

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.

News Highlight

see *Announcements* tab on the sidebar for a complete list

News Highlight: Information and Upcoming Events

- Presentations and recording of the virtual Town Hall meeting that took place on Saturday, April 18 are available at <https://indico.fnal.gov/event/23601/>
- **Letters of Interest** (April 1 - August 31, 2020) - <https://snowmass21.org/loi>
- **Contributed Papers** (April 1 - July 31, 2021) - <https://snowmass21.org/submissions/>
- Agendas and presentations of all Snowmass-related meetings are available via this Snowmass Indico link.

Organization

The ten Frontiers are lead by Frontier Conveners who have been nominated by the community and selected by the DPF Executive Committee plus members of the chair lines of Division of Astrophysics (DAP), Division of Physics of Beams (DPB), Division of Nuclear Physics (DNP) and Division of Gravitational Physics (DGRAV). Each of the Frontier conveners are currently choosing topical group conveners, drawing heavily from the original nomination list. This process was developed in order to provide a diverse and representative leadership including junior and senior researchers, theorists and experimentalists, and balance regarding gender, geographical distribution, and background.

The Steering Group oversees the process and meets regularly with the Frontier Conveners. The Steering Group consists of the DPF Chair line and one representative each of the related units DAP, DPB, DNP, and DGRAV. An Inclusive Advisory Group is consulted on major decisions, and consists of the Steering Group plus the rest of the DPF Executive

Accelerator Frontier “Challenges”

- How can existing accelerator facilities be upgraded or extended to serve new particle physics experiments and a broader physics base?
- What are the next accelerators for particle and nuclear physics on a 10 to 20-year time scale?
- What are the most efficient Higgs and electroweak factories that can start operation by the end of the LHC program ~2040?
- What are the most efficient options for a beyond-LHC energy-frontier discovery collider facility by 2050/60?
- What are the 20-year goals and expectations for core accelerator technologies such as RF, magnets, particle sources and targets?
- Are there coherent long-term physics and infrastructure scenarios?
- Can ERLs, muon accelerators, wake-field and other advanced technologies deliver on a promise of sustainable and financially feasible next-generation particle physics facilities, i.e. by ~2040?
- What are the accelerator technology and accelerator science gaps needed to be overcome to realize such facilities?

Accelerator Frontier Conveners



Steve Gourlay (LBNL)



Tor Raubenheimer (SLAC)



Vladimir Shiltsev (FNAL)

Topical Group		Topical Group co-Conveners			
AF01	Beam Phys & Accel. Education	Z. Huang (Stanford)	M. Bei (GSI)	S. Lund (MSU)	
AF02	Accelerators for Neutrinos	J. Galambos (ORNL)	B. Zwaska (FNAL)	G. Arduini (CERN)	
AF03	Accelerators for EW/Higgs	M. Ross (SLAC)	Q. Qin (IHEP, Beijing)	Georg Hoffstaetter (Cornell)	
AF04	Multi-TeV Colliders	M. Palmer (BNL)	A. Valishev (FNAL)	N. Pastrone (INFN, Torino)	
AF05	Accelerators for PBC and Rare Processes	E. Prebys (UC Davis)	M. Lamont (CERN)	Richard Milner (MIT)	
AF06	Advanced Accelerator Concepts	C. Geddes (LBNL)	M. Hogan (SLAC)	P. Musumeci (UCLA)	R. Assmann (DESY)
AF07	Accelerator Technology R&D				
	Sub-group RF	E. Nanny (SLAC)	S. Posen (FNAL)	H. Weise (DESY)	
	Sub-Group Magnets	G. Sabbi (LBNL)	S. Zlobin (FNAL)	S. Izquierdo Bermudez (CERN)	
	Sub-Group Targets/Sources	C. Barbier (ORNL)	Y. Sun (ANL)	Frederique Pellemoine (FNAL)	

Topical Group Activities

All AF Topical Groups (TG) have:

- [wiki pages](#) and [Indico sites](#) for their meetings
- **mailing lists** (will have)

Everybody's contribution and participation are vital to the Snowmass process!

How to engage:

- **Contact the AF1-7 conveners** and **join the AF1-7 activities** (join meetings, discussion).
- Bring **existing studies** and/or **new ideas and projects to investigate**.
- Write a **Letter of Interest** (LOI): 2 pages, briefly what you want to work on (the AF conveners and the TG conveners will facilitate the process).
 - This can be done as individuals, user groups or collaborations
 - **We invite collaborations & initiatives to submit (one or multiple) LOIs with a set of open questions and how to get new users involved in the studies.**
- Various **user groups are providing documents** with contact informations, available studies, available tools, etc

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First AF Lol received ! (today)

Gamma Factory

LETTER OF INTEREST, SNOWMASS 2021



Abstract

This contribution discusses the possibility of creating novel research tools by producing and storing highly relativistic atomic beams in high-energy storage rings, and by exciting their atomic degrees of freedom by lasers to produce high-energy photon beams. Their intensity would be, by several orders of magnitude, higher than those of the presently operating light sources, in the particularly interesting gamma-ray energy domain reaching up to 400 MeV. In this energy domain, the high-intensity photon beams can be used to produce secondary beams of polarised electrons, polarised positrons, polarised muons, neutrinos, neutrons and radioactive ions. The atomic beams, the photon beams and the above secondary beams are the principal research tools of the proposed Gamma Factory. New research opportunities in a wide domain of fundamental and applied physics can be opened by the Gamma Factory scientific programme.

Gamma Factory Group

Contact person: M. W. Krasny

e-mail address: miczyslaw.witold.krasny@cern.ch

- <https://www.snowmass21.org/docs/files/su-mmaries/AF/SNOWMASS21-AF-TOPIC001.pdf>

Accelerator Frontier Update

- All Topical Group Convener slots filled
- Lol template distributed and solicitations are being sent out
- **1st received (GF)**, some **10 Lols** are in the works (that we know of), more to come...
- All Topical Groups have had at least **one meeting**.
- We think of AF own meetings and conferences as well as using various other opportunities: eg **these GARD-ABP Workshops !**, **Neutrino 2020 (June 22-July 2)**, **EF Workshop (July 9-10)**, **HB2020 (Oct 5-9)**, etc
- Liaisons – [*already in place with Theory, Energy, Instrumentation, Rare Processes*] – many discussions ...in process, eg @EF “kick off” meeting today
- **DPB announcement – early May**, also via **US PAS, EPS-AG** and **IEEE**
- **NOMINATE SNOWMASS YOUNG TODAY !!!** get your students and postdocs involved

Snowmass Young (I)

From: Sara Simon <smsimon@umich.edu>

Subject: Solicitation for Snowmass Young Representatives

Date: April 7, 2020 at 1:33:09 PM EDT

To: snowmass@fnal.gov, snowmass-young@fnal.gov, snowmasconveners@listserv.fnal.gov

Dear Colleagues,

As part of the Snowmass 2021 process, we are soliciting nominations for representatives for Snowmass Young. The Snowmass 2021 process will develop a long-term strategic plan, so the voices of early career members are critically important and we want them to be heard.

These representatives will have the opportunity to shape how early career members are included in the Snowmass process. This could include finding ways to get early career members engaged with the working groups, incorporating career development opportunities into events, surveying early career members as was done for Snowmass 2013, and integrating other items of interest to early career members into the events.

Nominations can be made by anyone, but nominees should be 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 22, 2020** through the google form below:

<https://forms.gle/Xpd4jW3Y6oxcXxmD7>

Nominees will be reviewed and selected to ensure that the group is representative of the field. More details about the responsibilities and Snowmass process are included below. Please circulate this broadly.

Sincerely, Sara M. Simon & Fernanda Psihas 2019 DPF Executive Committee Early Career Member

Snowmass Young (II)

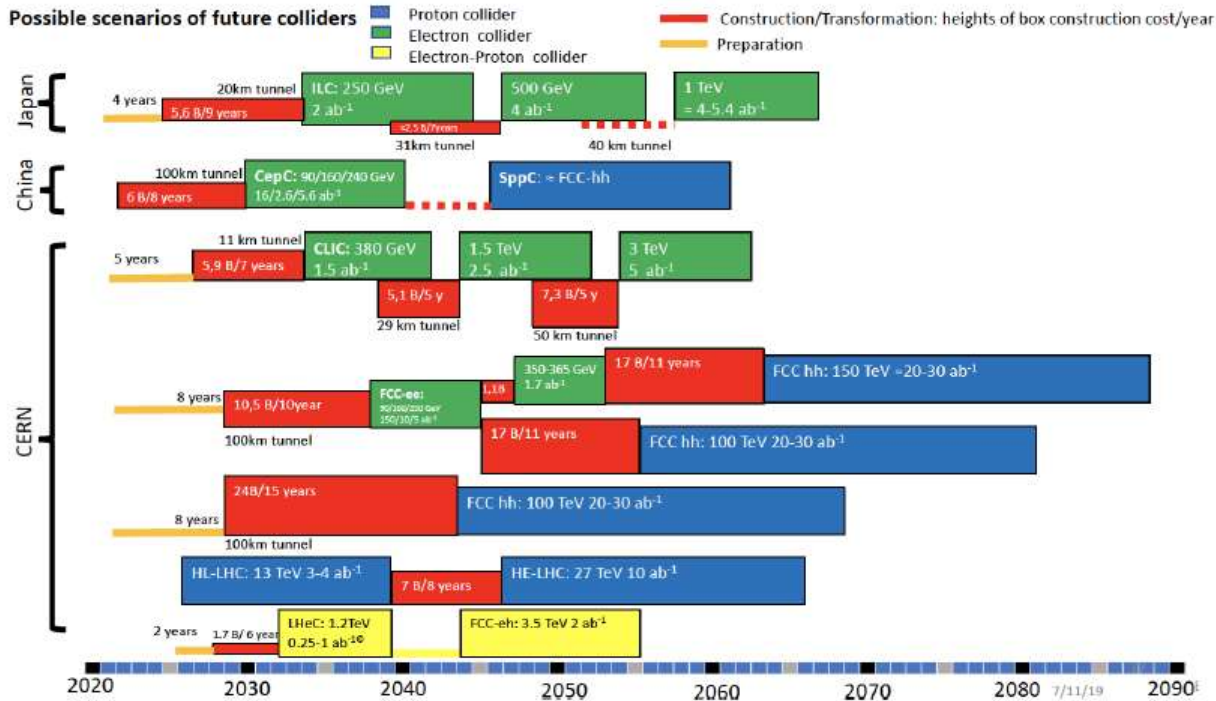
- (from Snowmass wiki) - If you are an early career scientist, we encourage you to join the “**Snowmass Young**” mailing list (snowmass-young@fnal.gov) by emailing to listserv@listserv.fnal.gov with the body of the message “**Subscribe snowmass-young YOUR NAME**”.
- **NOMINATE!**

https://docs.google.com/forms/d/e/1FAIpQLScA9zuSNeYTQsWbPtxJ2mdXME01MymoB5DJRzLAI3aM_bG9_w/vi/ewform

*We hope you will
join the work of the
Snowmass 2021
Accelerator Frontier!*

- Back up slides

Future Collider Scenarios & Timelines



Ursula Bassler @ Granada meeting

● 5/21/2020

Future Colliders Scenarios

- ESG studies, comparing various options, are detailed in the [briefing book](#)
- Snowmass21 will **expand on these studies** and **add other collider scenarios**, e.g. muon collider, Electron-Ion Collider, other c.o.m. (if needed)....
- **Our goal is to:**
 - Identify “**Focus Questions**” and the “**Scientific Merits**” of the various collider options.
 - Develop a global picture and a future roadmap.
 - Compile existing studies [start from ESG briefing book and confirm with Accelerator Frontier].
 - Add new studies and information.
 - For pp future colliders, HL-LHC will serve as a critical baseline. HL-LHC results may be revisited if deemed necessary.

AF: Engaging early career members of the community

The Snowmass process thrives on the participation of young people and offers an ideal environment for young people to get involved and promote their own initiatives.

We strongly encourage young members of the community to get involved!

To all senior members: [get your students and postdocs involved!](#)

Snowmass Young: [forum of early career members.](#)

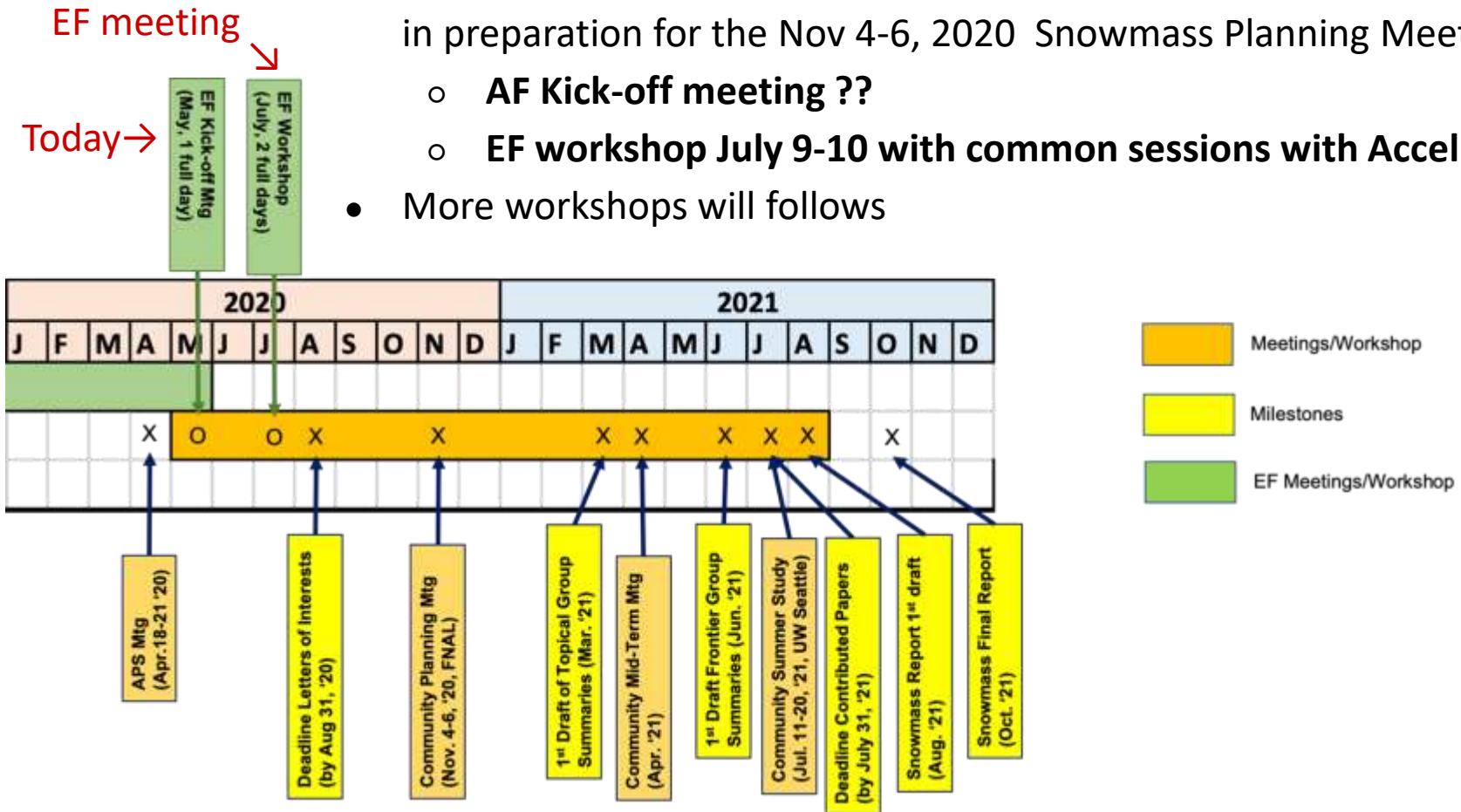
- Nominations for representatives solicited (closed on May 11).
- Nominees: early career members (e.g. graduate students, postdocs).
- Coordinated by:
 - Sara M. Simons (2020 DPF ECEarly Career Member)
 - Fernanda Psihas (2019 DPF EC Committee Early Career Member)

Liaisons among Frontiers *and Projects*

- They will provide high-level and bi-directional communication b/w Frontiers.
- They will be people with interests in both communities.
- **Official Liaisons:**
 - Neutrino Physics Frontier: TBD
 - Rare Processes and Precision: Robert Bersntein (FNAL)
 - Cosmic Frontier: n/a
 - Theory Frontier: Liantao Wang (Chicago)
 - Energy Frontier: Dmitri Denisov (BNL), Meenakshi Narain (Brown)
 - Computational Frontier: TBD
 - Instrumentation Frontier: Andy White (UTA)
- In addition to official Liaison we foresee **'Link People'**
 - Provide a more technical link between AF2-AF6 and established teams/projects
 - They will be people who are embedded in both communities based on their personal interests.

Accelerator Frontier Planning

- Two AF community meetings to be arranged before the Lol deadline and in preparation for the Nov 4-6, 2020 Snowmass Planning Meeting:
 - AF Kick-off meeting ??
 - EF workshop July 9-10 with common sessions with Accel Frontier
- More workshops will follows



EF Meeting and July Workshop

- **Kick-off Meeting:** Today [Thursday May 21, 2020](#) (full day).
 - **Review of existing studies, and plans to engage communities.**
 - *Goal is to lay out our plans, strategy, activities, discuss the organisation of the EF group and TGs, how to communicate within the community.*
 - *Summaries of studies that can be considered as stepping stones for TG activities (e.g. surveys of previous or international studies, e.g. ESG results, Yellow Reports etc.) as well as overviews of ideas for studies that can be carried out for Snowmass 2021.*
 - *Present plans for and use of letters of intents and contributed papers within the EF group, and the strategy for MC production.*
- **EF Workshop: July 9-10, 2020** (two full days)
 - **First opportunity for the community to present ideas, plans, and results if already available.**
 - **Plans to have dedicated joint sessions with other Frontiers, and common session between TGs.**

“Letters of Interest” and “Contributed Papers”

- **Letters of Interest (LOI)**

(submission period: April 1, 2020 – August 31, 2020)

“They allow Snowmass conveners to see what proposals to expect and to encourage the community to begin studying them. They will help conveners to prepare the Snowmass Planning Meeting that will take place on November 4 - 6, 2020 at Fermilab. Letters should give brief descriptions of the proposal and cite the relevant papers to study. Instructions for submitting letters are available at <https://snowmass21.org/loi>.

Authors of the letters are encouraged to submit a full write-up for their work as a contributed paper.”

- Very brief (two pages).
- Uploaded by Authors through Snowmass 2021 Wiki.
- Index of submitted LOI available on the Snowmass 2021 Wiki.
- Could represent existing work (cite) or new ideas.
- Will help the EF conveners plan the work of the Frontier (including liaisons with other Frontiers: avoid duplication/build synergy).
- If further developed in the context of the Snowmass 2021 exercise could lead to a Contributed Paper.

“Letters of Interest” and “Contributed Papers”

- **Contributed Papers**

(submission period: April 1, 2020 – July 31, 2021)

“Contributed papers will be part of the Snowmass proceedings. They may include 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. Instructions for submitting contributed papers are available at

<https://snowmass21.org/submissions/>”

- More extensive studies.
- May include white papers, scientific/technical articles, etc.
- Can but do not have to be related to a given LOI.
- Submitted by Authors following instructions given on Snowmass 2021 Wiki page (submit to arXiv, send email to M. Peskin with subject “Contribution to Snowmass 2021”, etc.)
- Will be part of the official Snowmass 2021 records..

Inputs from Collaborations

- **We need to start receiving inputs from International Collaborations**
 - Plans for analyses, MC samples, framework availability and how to share them with the Snowmass community, contact people etc.
 - Letters of Interests
- **Following slides show three contributions received by EF so far – as an example, more are expected from other collaborations**
- Those contributions will be made available to the whole Snowmass community soon

Inputs from Collaborations: **ILC**

Opportunities for joining ILC studies at Snowmass 2021

Jim Brau, Jenny List, Michael Peskin, Andrew White

for the LCC Physics and Detector Exec. Board

May 12, 2020

Inputs from Collaborations: ILC

<https://indico.cern.ch/event/896263/>

How to get involved with ILC

- **Associate Director for [Physics and Detectors](#) of the Linear Collider Collaboration (LCC):** Jim Brau jimbrau@uoregon.edu
- **LCC Physics WG: Phenomenology, global interpretations, general physics case, etc**
 - **Coordinators:** Michael Peskin mpeskin@slac.stanford.edu
Christophe Grojean Christophe.grojean@desy.de
Keisuke Fujii keisuke.fujii@kek.jp
- **ILD and SiD: Design and optimisation of detector concepts, individual physics analyses, access to large MC data sets**
 - **ILD:** Spokesperson: Ties Behnke ties.behnke@desy.de
Physics Coordination: Keisuke Fujii keisuke.fujii@kek.jp
Jenny List jenny.list@desy.de
Executive Team member from the US: Graham Wilson gwwilson@ku.edu
 - **SiD:** Spokespersons: Andy White awhite@uta.edu
Marcel Stanitzki marcel.stanitzki@desy.de
Physics Coordination: Tim Barklow timb@slac.stanford.edu
- **Detector R&D, across detector concepts and across collider projects:**
 - **CALICE:** Roman Poeschl poeschl@lal.in2p3.fr (spokesperson) - Highly granular EM and hadronic calorimetry
 - **FCal:** Wolfgang Lohmann wolfgang.lohmann@desy.de (spokesperson) - Forward and luminosity calorimetry
 - **LCTPC:** Allain Bellerive alainb@physics.carleton.ca (regional coordinator for the Americas) - Gaseous tracking
 - **Silicon tracking and EM calorimetry :** Marty Breidenbach mib@slac.stanford.edu
- **The LCC Physics and Detector group intends to make available signal and background event samples.**

Inputs from Collaborations: ILC

We envision 4 levels of participation:

Fast simulation: A fast-simulation framework and large samples of SM events at ECM = 250, 350, 500, and 1000 GeV. We are compiling a list of study questions covering all aspects of ILC physics.

Full simulation: Corresponding full simulation data in a high-level analysis format that can be used directly in root.

Detailed detector: For detailed detector design, one should learn the ILCSoft simulation framework. The SiD and ILD groups will offer no-cost guest memberships.

Detector R&D: A comprehensive list of current R&D projects is available; scan this list for potential collaborators. The R&D collaborations invite new members.

Inputs from Collaborations: ILC

We are preparing a list of questions for possible Snowmass analyses, with references to existing work. At the moment, we have about 50 questions, in a 20-page document. Some examples:

Higgs #4

4. Higgs decays to 2 jets. At lepton colliders, Higgs decays to all hadronic modes can be observed directly. Current studies of $h \rightarrow b\bar{b}, gg, c\bar{c}$ date from the era before deep learning, and before the understanding of q/g jet separation gained from LHC. What, now, is the optimum method for separating these three decay modes. What systematic errors can be achieved?

2-fermion #4

4. $e^+e^- \rightarrow \tau^+\tau^-$. The tau lepton has a unique role in studies of e^+e^- 2-fermion production because its polarization can be directly measured. How can we best use this additional handle to constrain or discover BSM models?

We expect to have these questions and simulation resources available in the next month or so, to help Snowmass participants begin hands-on study of ILC physics.

Inputs from Collaborations: FCC

MEMORANDUM

From: FCC Physics and Experiments Design Study; M. Benedikt, A. Blondel, P. Janot, M. Mangano

To: Snowmass conveners

Object: Participation to the 2020-2021 Snowmass Study

Contact persons

The contact persons from the FCC physics and experiments studies to the Snowmass study frontiers are as follows:

- Overall contact: [Markus Klute](#), plus [Alain Blondel](#), [Patrick Janot](#) and [Michelangelo Mangano](#)
- Energy Frontier: [Patrizia Azzi](#) and [Gregorio Bernardi](#) (FCC-ee), [Michele Selvaggi](#) (FCC-hh), [Christophe Grojean](#) (Phenomenology)
- Frontiers in Rare Processes and Precision Measurements: [Stéphane Monteil](#) (b and c physics) and [Mogens Dam](#) (τ physics)
- Theory Frontier: [Matthew McCullough](#)
- Instrumentation Frontier: [Mogens Dam](#) and [Franco Bedeschi](#)
- Computational Frontier: [Luc Poggioli](#)

Software support can be obtained from the FCC software group (see [C. Helsens](#) and [G. Ganis](#) in [14]) who will be happy to integrate software contributions.

Inputs from Collaborations: FCC-hh



CERN-FCC-PHYS-2020-0005
12 May 2020

A framework and goals for FCC-hh physics studies at Snowmass 2021

Clement Helsens^{1)*}, Michelangelo L. Mangano^{2)*}, Michele Selvaggi^{3)*}

^{*} European Organization for Nuclear Research (CERN), Geneva, Switzerland

Abstract

We summarize the key results obtained by physics studies carried out for the FCC-hh Conceptual Design Report, documenting the existing tools and software framework that were developed. Indications are provided for further work, on physics performance and simulation software development, which could be a target for Snowmass 2021 studies of a pp collider at 100 TeV. The primary goal of this note is to inform about, and document, the existing resources, to encourage coordination and collaboration building on the work already done.

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2 *The physics studies*

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Input from Collaborations: LHeC

CERN-ACC-NOTE-2018-0084
December 18, 2018



Exploring the Energy Frontier with Deep Inelastic Scattering at the LHC A Contribution to the Update of the European Strategy on Particle Physics

LHeC and PERLE Collaboration

Contacts: Oliver Brüning (CERN) and Max Klein (U Liverpool)
oliver.bruning@cern.ch, max.klein@liverpool.ac.uk

Executive Summary

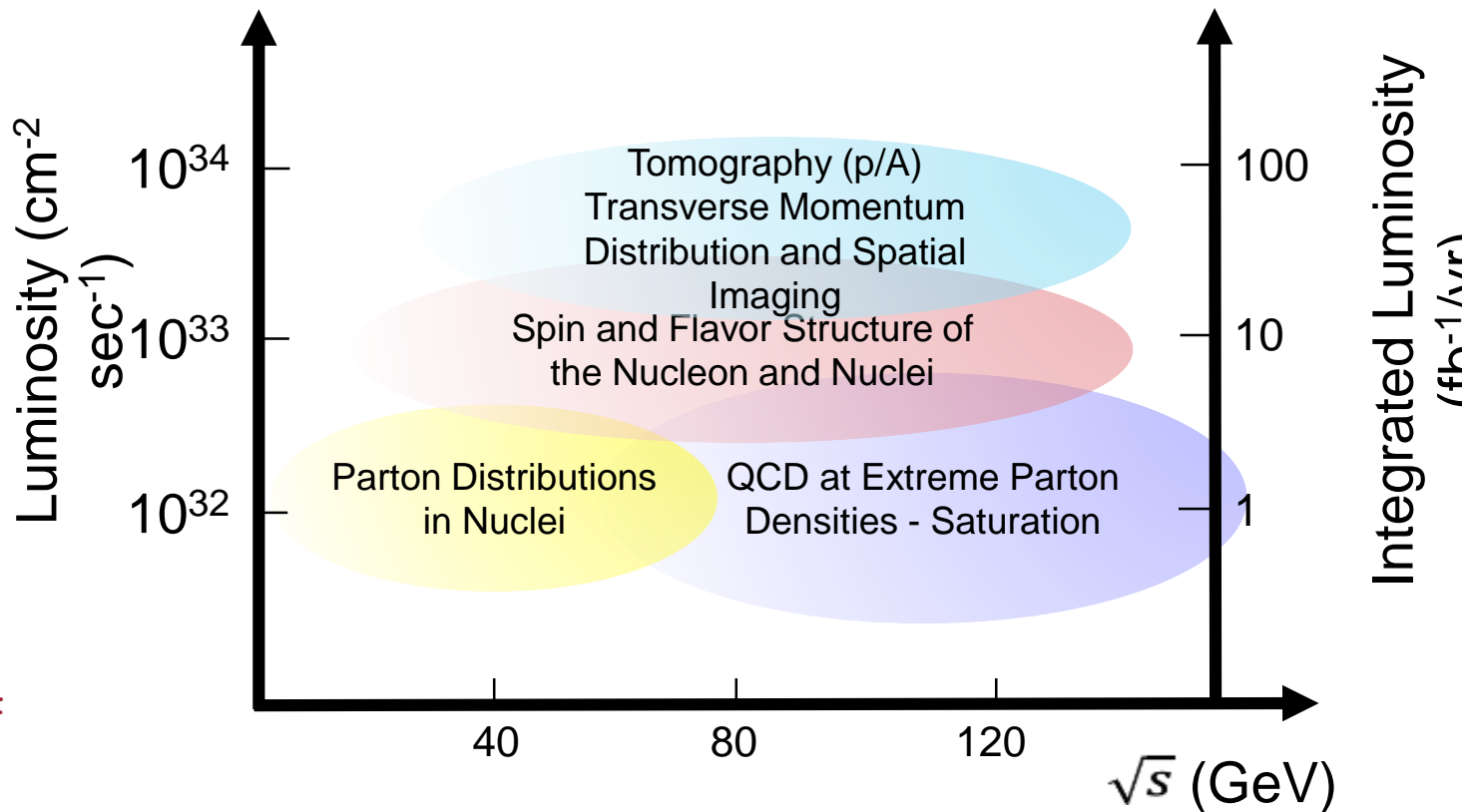
The Large Hadron Collider determines the energy frontier of experimental collider physics for the next two decades. Following the current luminosity upgrade, the LHC can be further upgraded with a high energy, intense electron beam such that it becomes a twin-collider facility, in which ep operates concurrently with pp. A joint ECFA, CERN and NuPECC initiative led to a detailed conceptual design report (CDR) [1] for the Large Hadron Electron Collider (LHeC) published in 2012. The LHeC uses a novel, energy recovery linear (ERL) electron accelerator which enables TeV energy electron-proton collisions at high luminosity, exceeding that of HERA by nearly three orders of magnitude. The discovery of the Higgs boson and the surprising absence of BSM physics at LHC demand to extend the experimental base of particle physics suitable to explore the energy frontier, beyond pp collisions at the LHC. Following a mandate of the CERN Directorates and guided by an International Advisory Committee, this motivated representatives of more than 100 institutes to proceed, as sketched here, with the development of the accelerator, physics and detector prospects for the LHeC with the intention to publish an update of the CDR in early 2019 [2].

The very high luminosity and the substantial extension of the kinematic range in deep inelastic scattering (DIS) compared to HERA, make the LHeC a uniquely powerful TeV energy collider, which rests on a maximal exploitation of the LHC infrastructure. Realising an "Electrons for LHC" [3] programme would create the cleanest, high resolution microscope accessible to the world, one may term a "CERN Hubble Telescope for the Micro-Universe". It is directed to unravel the substructure of matter encoded in the complex dynamics of the strong interaction, a necessary input for future hadron colliders, including HL-LHC. Being complementary to the LHC and a possible future e^+e^- machine, the LHeC would scrutinise the Standard Model (SM) deeper than ever before, and possibly discover new physics in the electroweak and chromodynamic sectors. Adding ep transforms the LHC into an outstanding, high precision Higgs facility. Through the extension of the kinematic range by about three orders of magnitude in lepton-nucleus (eA) scattering, the LHeC is the most powerful electron-ion research facility one can build in the next decades, for elucidating the chromodynamic origin of the Quark-Gluon-Plasma and clarifying the partonic substructure and dynamics inside nuclei for the first time.



Input from Collaborations: **EIC**

- EIC: Study structure and dynamics of matter at high luminosity, high energy with polarized beams and wide range of nuclei



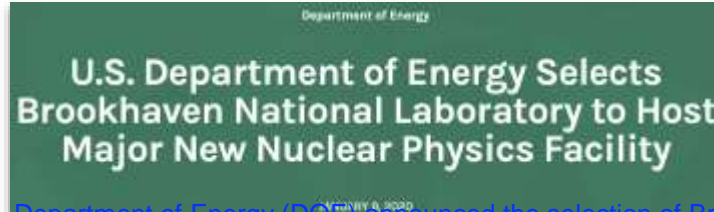


EIC CDO and Site Selection

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Announcement by the Department of Energy on January 9, 2020

<https://www.energy.gov/articles/us-department-energy-selects-brookhaven-national-laboratory-host-major-new-nuclear-physics>



WASHINGTON, D.C. – Today, the U.S. Department of Energy (DOE) announced the selection of Brookhaven National Laboratory in Upton, NY, as the site for a planned major new nuclear physics research facility. The Electron Ion Collider (EIC), to be designed and constructed over ten years at an estimated cost between \$1.6 and \$2.6 billion, will smash electrons into protons and heavier atomic nuclei in an effort to penetrate the mysteries of the “strong force” that binds the atomic nucleus together.

The EIC’s high luminosity and highly polarized beams will push the frontiers of particle accelerator science and technology and provide unprecedented insights into the building blocks and forces that hold atomic nuclei together. Design and construction of an EIC was recommended by the National Research Council of the National Academies of Science, noting that such a facility “would maintain U.S. leadership in nuclear physics” and “help to maintain scientific leadership more broadly.” Plans for an EIC were also endorsed by the federal Nuclear Science Advisory Committee.

Secretary Brouillette approved Critical Decision-0, “Approve Mission Need,” for the EIC on December 19, 2019. “The Department is excited to be moving forward with an Electron Ion Collider at Brookhaven National Laboratory,” stated **Office of Science Director Dr. Chris Fall**. “However, participation from many parts of the DOE laboratory complex will be essential if the EIC is to be a success.”

Thomas Jefferson National Accelerator Facility in Newport News, VA will be a major partner in realizing the EIC, and several other DOE laboratories are expected to contribute to EIC construction and to the groundbreaking nuclear physics research program that will be accomplished there.

Bernd Surrow

Snowmass Energy Frontier Kick-Off Workshop
Philadelphia, PA, May 21, 2020

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Engagement in SnowMass2021 process

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- EIC program provides excellent opportunities for HEP community such as QCD and electro-weak physics in addition to novel instrumentation applications.
- The EIC User group is committed through the EICUG Steering Committee to engage in the process of formulating Letters of Interest for various working groups including EF04, EF05, EG06 and EF07, besides Instrumentation Working Groups. Several informal discussions took place between the EICUG Steering Committee and several co-conveners.
- The EICUG Steering Committee is committed to help this process to ensure that EIC-related submissions are consistent with the overall EIC planning of a new collider facility in the US at Brookhaven National Laboratory in cooperation with the DOE Office of Nuclear Physics.