

High Energy Physics Snowmass and P5 Processes

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BROOKHAVEN
NATIONAL LABORATORY

 U.S. DEPARTMENT OF
ENERGY

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Particle Physics Selection/Funding Model

- Increase in the cost and duration of the projects
 - What could have been studied/built “easily” already has been done
 - Only few accelerators working/experiments progressing
- Projects in most cases no longer “belong to a single Laboratory”
 - ATLAS/CMS experiments has many US national laboratories and Universities participating as well as from around the globe
- DOE/NSF formalized approval/construction process and controls the funding
 - From “get it done” to “follow formal rules”
 - Not just for particle physics
- Large number of interesting proposals available
 - With long time to construct and collect/analyze data
- Erosion of the science funding

How to Proceed in the New Environment?

- The field, all of us together, have to develop approach how to decide “what projects to do”
- Final decision belongs to funding agencies DOE and NSF in our case
 - They need input from us to decide where to spend money!
- Important points in providing recommendations
 - The science has to be excellent
 - The selection process has to be community wide
 - We all have to agree to the process and support the outcome
 - If many of us will complain about outcome, implementing recommendations will be hard
- The selected projects costs have to fit into “available envelope”

5 Steps Planning Process

- **Step 1**
 - Groups of scientists develop proposals for future projects/experiments
- **Step 2**
 - “Snowmass” community wide process discusses proposals, evaluates strong and weak points, physics reach and costs and summarizes outcome in a written form
 - Organized by Division of Particles and Fields (DPF) – professional organization, not Laboratories or funding agencies
- **Step 3**
 - P5 committee (Particle Physics Projects Prioritization Panel) is formed (by NSF and DOE) consisting of ~25 scientists representing all areas of particle physics
 - The committee, within about 6-12 months, have to recommend priorities based on available funding and on the expected cost of the projects
 - Recommendations covers ~10 years time span
- **Step 4**
 - HEPAP (High Energy Physics Advisory Panel) appointed by NSF/DOE reviews the proposal and recommends it to be considered by DOE
- **Step 5**
 - NSF/DOE fund recommended projects (assuming funds are available)

Why Planning Process is called “Snowmass”

- Since late 1980’s US community had summer meetings at the Snowmass village in Colorado
 - These ~3 weeks meetings brought the US (with many international partners) community together to discuss next steps for the field
 - While the format has changed since about ten years ago, the name for the “HEP planning process” remains



Most Recent Snowmass was in 2013



Snowmass on the Mississippi a.k.a CSS 2013

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Quick Links

▼ [TWiki registration](#)

▼ [Pre-meetings](#)

[Community Planning Meeting](#)
[All pre-Snowmass Meetings](#)

▼ [Colloquium questions](#)

▼ [Big Questions \(Quantum Universe\)](#)

Groups

[Energy Frontier](#)
[Intensity Frontier](#)
[Cosmic Frontier](#)
[Frontier Capabilities](#)
[Instrumentation](#)
[Frontier](#)
[Computing Frontier](#)
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[Theory Panel](#)

Google Search



snowmass2013.org
 WWW

Community Summer Study 2013

(Snowmass on the Mississippi) Minneapolis, 7/29 - 8/6 2013

The American Physical Society's Division of Particles and Fields is pursuing a long-term planning exercise for the high-energy physics community. Its goal is to develop the community's long-term physics aspirations. Its narrative will communicate the opportunities for discovery in high-energy physics to the broader scientific community and to the government.

Minnesota Information and Registration webpage [✉](#)

Follow [this link](#) [✉](#) to a preliminary agenda

Conveners, to request room for parallel sessions use [this link](#) [Request rooms](#)



COLLOQUIUM QUESTIONS

BIG QUESTIONS FOR OUR UNIVERSE.

LATEST NEWS

- July 24 update: list of questions for the colloquia at CSS2013 are posted
- May 7 Update: The [Snowmass Young Physicists Career and Science Aspirations Survey](#) [✉](#) is now online. Please encourage students and postdocs to respond. <http://tinyurl.com/snowmassyoung> [✉](#)

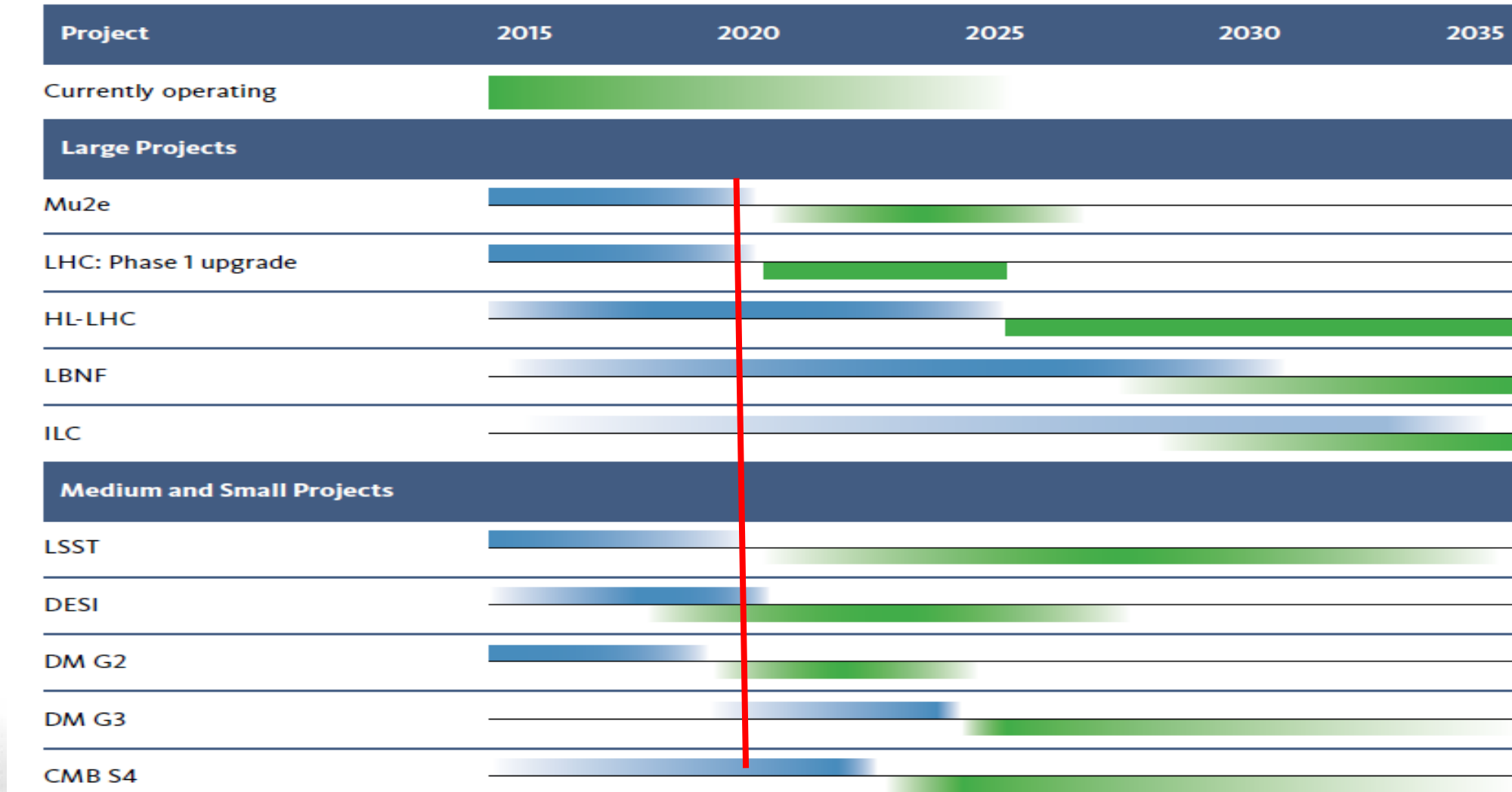
Main Challenge of the 2013 Snowmass/P5

Project	M\$
Near-term Projects (Mu2e, g-2, muon campus)	350
LBNE	900
Project-X through stage 3 (w/o expts)	1,700
Project-X stage 1 experiments	485
Project-X stage 2 and 3 experiments	500
NuSTORM	400
ORKA	80
LSST	175
Other Cosmic (G2-DM, CMB, DESI)	170
Near-term LHC detector upgrades	60
G3 Dark Matter	200
LHC Accelerator Upgrades	250
CMS+ATLAS Upgrades	600
ILC-250 GeV (US contribution)	1,700
ILC Detector (US contribution)	300
R&D for future Intensity Frontier accelerator	100
R&D for future colliders	300
Total	8,270

2013 Table

- Funding required to do “interesting science” was well above “available”
- Even more serious challenge is that some estimates of the funding appeared to be well below reality

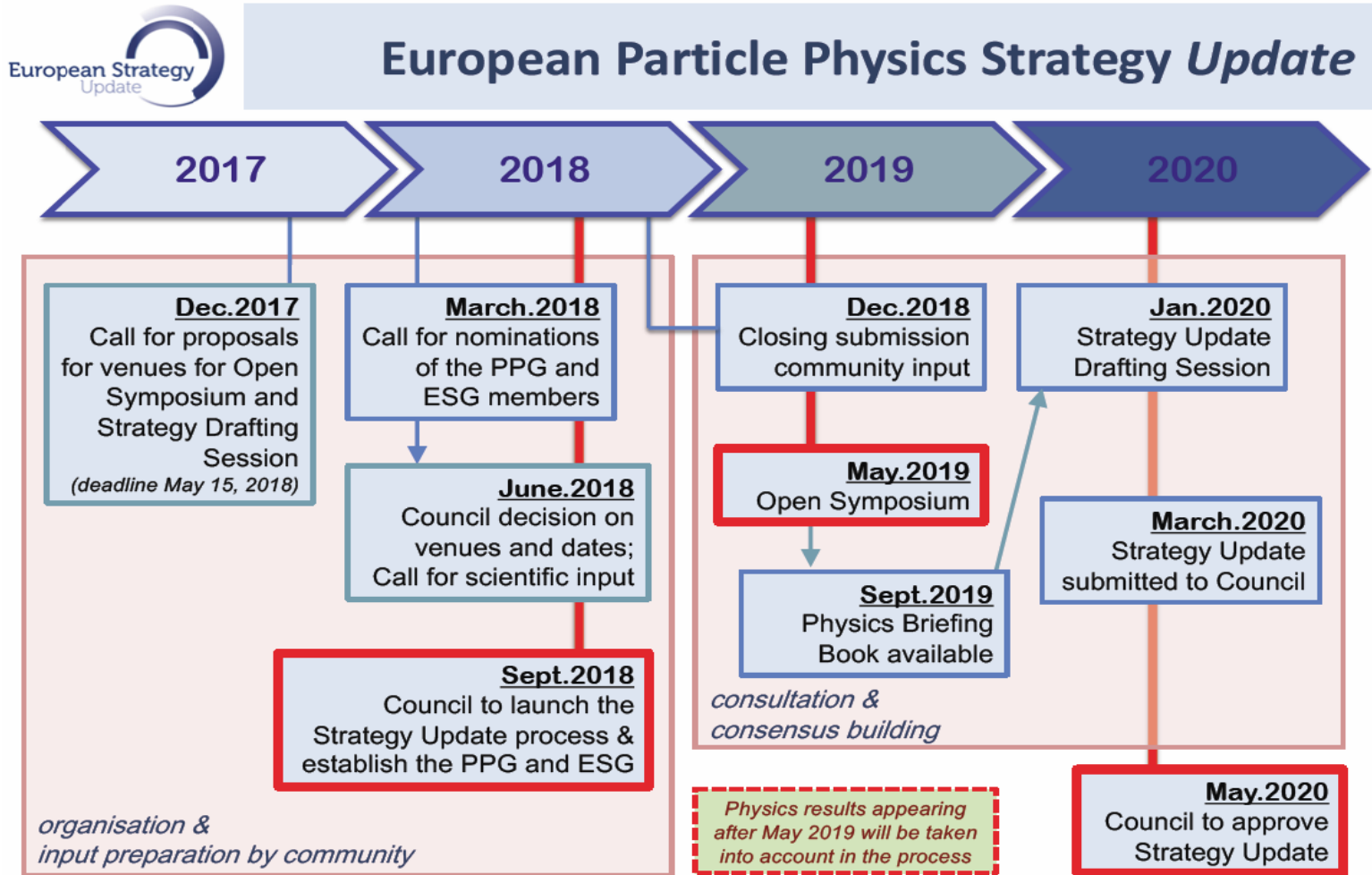
How 2013 Snowmass/P5 Plan Stands Today



Preparations for the Next Snowmass

- Why next Snowmass
 - New science and technological developments accumulated over past ~8 years
 - Beyond 2026 funding in HEP is expected to become available for “next large/medium projects”
- In the “new” Snowmass format
 - Proposals have to be developed in advance
- Good proposal includes
 - Excellent physics goals
 - Technical implementation description
 - Cost estimate and schedule
- To develop a proposal at least a year of concentrated efforts is usually required
- With Snowmass coming in 2020 preparations of the new proposals have to start soon
 - Projects already listed in previous P5 plan and under execution are not expected to be part of the discussion
 - While substantial upgrades, such as Mu2e-II or DUNE upgrades, are naturally to be discussed
- Examples
 - ATLAS/CMS upgrades beyond HL-LHC
 - Various cosmic and dark matter experiments
 - FCC, ILC and colliders in China
- It is not “BNL projects” planning, it is developing scientific proposals for US particle physics
 - Joint efforts between laboratories and universities and in close cooperation with international HEP community

HEP is Highly International



Europe, Japan, other countries/regions are developing plans which we have to monitor closely and in many cases be an active participants

Timeline for the Coming Snowmass/P5 Planning

- Will start at April 2020 APS meeting
- Developing proposals, workshops, interactions inside the community
 - Between April 2020 and July 2021
 - Organized by conveners of various study groups
- “Snowmass Meeting”
 - July 2021, location TBD
- Snowmass written summary
 - By late 2021
- P5 process
 - During 2022
- Snowmass/P5 outcome and guidance to the funding agencies
 - By early 2023

Concluding Remarks

- Next HEP planning process is about to start
 - It is important for us to participate to shape the future of our field!
- DPF with partner APS units is working on finalizing working groups
 - Call for conveners nominations was issued
- The process is guided by DPF – not funding agencies or laboratories
- All of us have to start getting engaged and working on future proposals

2013 Snowmass Aspirations - I

- **Probe the highest possible energies and smallest distance scales with the existing and upgraded Large Hadron Collider and reach for even higher precision with a lepton collider; study the properties of the Higgs boson in full detail**
- **Develop technologies for the long-term future to build multi-TeV lepton colliders and 100 TeV hadron colliders**
- **Execute a program with the U.S. as host that provides precision tests of the neutrino sector with an underground detector; search for new physics in quark and lepton decays in conjunction with precision measurements of electric dipole and anomalous magnetic moments**
- **Identify the particles that make up dark matter through complementary experiments deep underground, on the Earth's surface, and in space, and determine the properties of the dark sector**
- **Map the evolution of the universe to reveal the origin of cosmic inflation, unravel the mystery of dark energy, and determine the ultimate fate of the cosmos**

2013 Snowmass Aspirations - II

- Invest in the development of new, **enabling instrumentation and accelerator technologies**
- Invest in advanced **computing technology and programming expertise** essential to both experiment and theory
- Carry on **theoretical work** in support of these projects and to explore new unifying frameworks
- Invest in the **training of physicists** to develop the most creative minds to generate new ideas in theory and experiment that advance science and benefit the broader society
- Increase our efforts to **convey the excitement of our field to others**