



P5

Particle Physics Project Prioritization Panel

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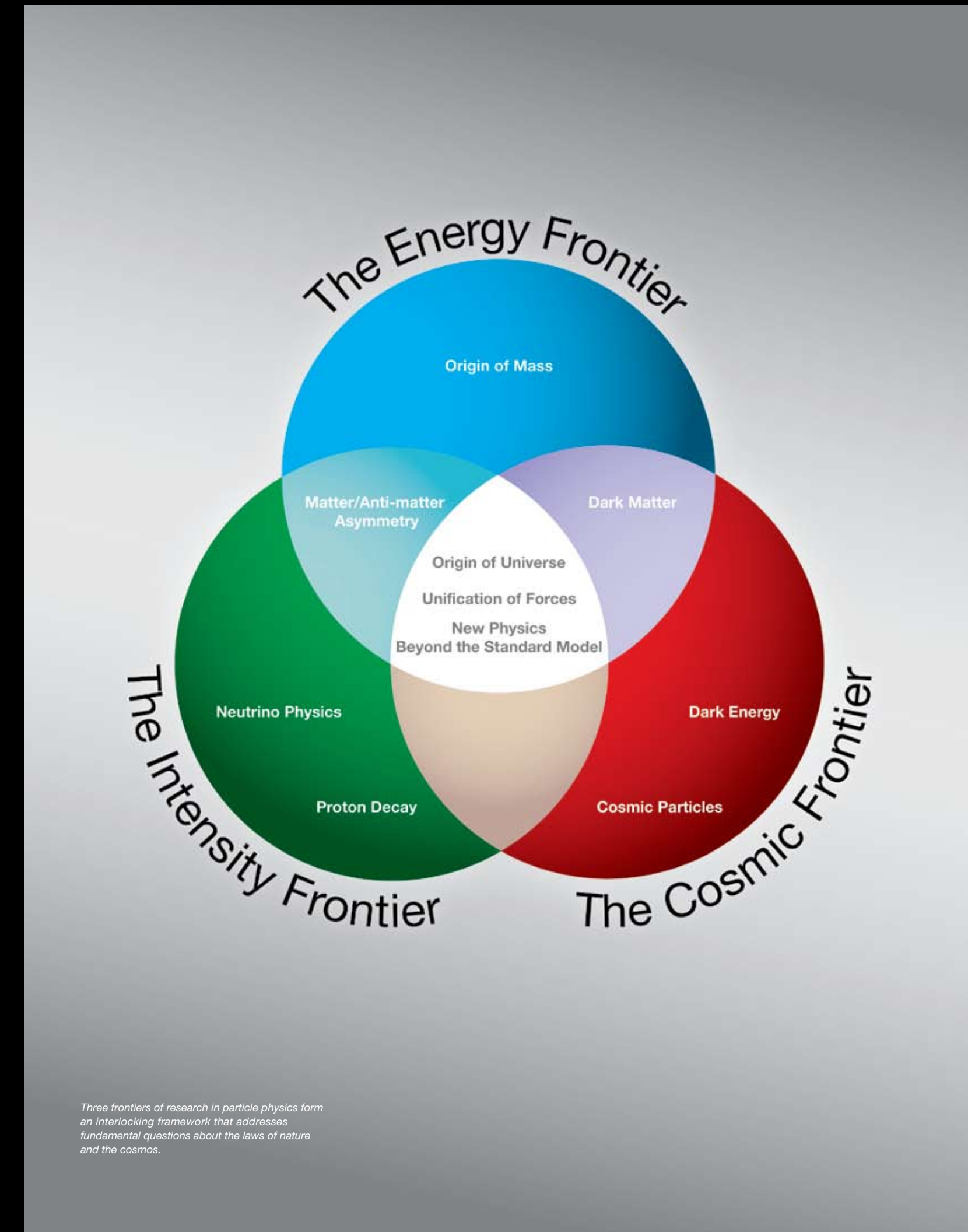
Virtual Town Hall, Austin, June 5, 2023

Background

- HEPAP (High-Energy Physics Advisory Panel) advises DOE OHEP and NSF PHY
 - Sunshine law requires such advisory panels are open
 - Impossible to discuss sensitive issues such as prioritization!
- But HEPAP can create a “subpanel” whose meetings can be closed
 - HEPAP subpanels existed for a long time, discussed “big things”
- Individual projects used to be purview of lab PACs
- Around that time, it was becoming increasingly clear that “projects” have become too big to be handled by lab PACs
- Natalie Roe: “national PAC” (Snowmass 2001)
 - A standing committee that handles decisions of mid-size and big projects in particle physics
- Bagger & Barish HEPAP subpanel recommended creation of P5 (2002)

2008 P5

- 2008 P5 (Charles Baltay)
 - First “modern” P5 with budget scenarios
 - Tevatron for one to two more years
 - **World-class neutrino program**
 - **Dark matter & dark energy, LSST**
- *US Particle Physics: Scientific Opportunities A Strategic Plan for the Next Ten Years*
- Followed by specific 2010 P5 on Tevatron that recommended additional 2-3 years



2014 P5

- 2014 P5 (Steve Ritz)
 - 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.
- Finally “got it right”
 - Well received in Washington
 - “*Made many hard choices*”
 - 3000 signatures from the community

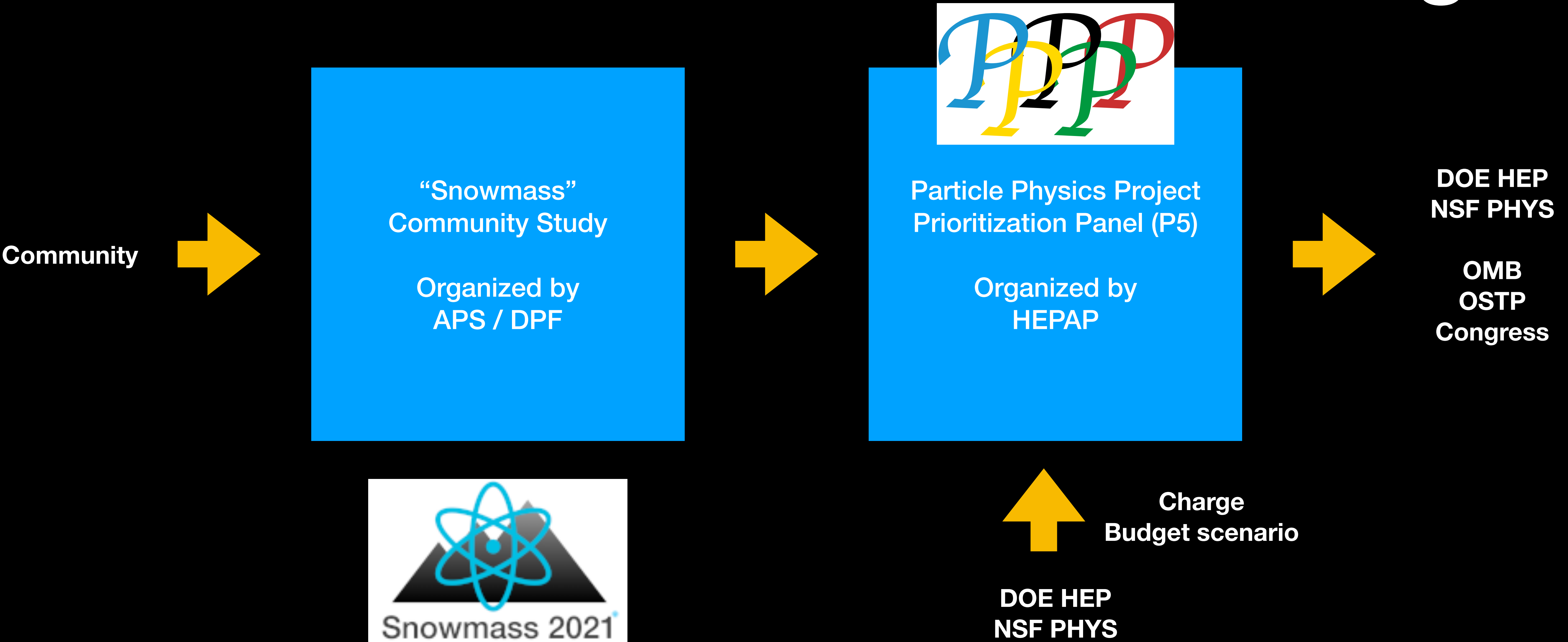
Buil
Strategic

Figure 1
Construction and Physics Timeline



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 [$<$ \$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.

US Process for Future Planning



Key Elements of a Successful P5

- Well informed by the science community
- Set a grand long-range vision for U.S. particle physics
- Faced budget constraints realistically
 - “Community made tough choices.”
- **Balanced portfolio**
 - Domestic and international
 - Small, mid-scale, and large projects
- **Community engagement critical to success**
 - “Bickering scientists get nothing.”



Harriet Kung, Snowmass in Seattle

Changing landscape

- **125 GeV Higgs does look like standard model**
 - Previous P5: “Higgs as a new tool for discovery”
- Recognition that **dark matter parameter space is big**
 - Growing in interest in low-energy weakly coupled sector
- **Λ CDM + inflation is the new Standard Model**
 - But H_0 , σ_8 tension
 - Inflation, cosmological constant vs swampland?
- **DUNE moving ahead**
 - Now Hyper-Kamiokande is also happening
- **Lattice vs g-2?**
- Interesting **anomalies in flavor** physics
- **Gravitational wave! High-energy neutrinos!**
- Now 10 frontiers (+costing frontier?)
- **National Initiatives**: Quantum, AI/ML, microelectronics
- Field is more global than ever, yet geopolitical challenges, climate change



My take away from Snowmass

- We have an exciting program lined up
 - Thanks to Steve Ritz, previous P5, agencies!
- We are broader than the current program energy, intensity, cosmic
 - Where is the boundary of our field?
- We are a forward-looking community
 - We need program beyond what the previous P5 outlined
 - We also need more freedom
 - better balance big, medium, small; projects vs research
- We deeply care about our community
 - Diversity, equity, inclusion, outreach, engagement
- Visited both DOE & NSF in early September
 - I'm still scared of the tasks ahead.
 - Reading Snowmass reports!



Decadal Overview of Future Large-Scale Projects		
Frontier/Decade	How do we develop enabling technology for long-term vision in a fashion executable in 20 years?	
Energy Frontier	U.S. Initiative for the Targeted Development of Future Colliders and their Detectors	
	US role?	Higgs Factory Scope? Technology? Complementarity?
Neutrino Frontier	LBNF/DUNE Phase I & PIP- II	DUNE Phase II (incl. proton injector)
Cosmic Frontier	Cosmic Microwave Background - S4	Next Gen. Grav. Wave Observatory*
	Spectroscopic Survey - S5* Scope?	Line Intensity Mapping* Do we embrace them?
	Big, small, new? Multi-Scale Dark Matter Program (incl. Gen-3 WIMP searches)	
Rare Process Frontier		Advanced Muon Facility Scope? Other science?

Table 1-1. An overview, binned by decade, of future large-scale projects or programs (total projected costs of \$500M or larger) endorsed by one or more of the Snowmass Frontiers to address the essential scientific goals of the next two decades. This table is not a timeline, rather large projects are listed by the decade in which the preponderance of their activity is projected to occur. Projects may start sooner than indicated or may take longer to complete, as described in the frontier reports. Projects were not prioritized, nor examined in the context of budgetary scenarios. In the observational Cosmic program, project funding may come from sources other than HEP, as denoted by an asterisk.

Balance

- Project vs research
- Large (>\$200M), medium (\$50-200M), small (<\$50M) (previous P5)
 - Collection of small may be medium
- Science vs R&D
 - Instrumentation, computing, theory
- National initiatives
 - AI/ML, microelectronics, QIS
 - How do we capitalize on it? How do we contribute to justify it?
- DEI
 - What can agencies do?
 - Mentoring statement in grant proposals (done!)

Costs/Risks/Schedule Committee

- One lesson from the previous P5 was some of the costs were off by a factor of $\sim\pi$
- Need to understand maturity of cost estimates better
- Jay Marx (Caltech), Chair
- Gil Gilchriese, Matthaeus Leitner (LBNL)
- Giorgio Apollinari, Doug Glenzinski (Fermilab)
- Norbert Holtkamp, Mark Reichanandter, Nadine Kurita (SLAC)
- Jon Kotcher, Srinu Rajagopalan (BNL)
- Allison Lung (JLab)
- Harry Weerts (Argonne)



Jay Marx

Charge to P5 cost committee (Draft - 3/1/2023)

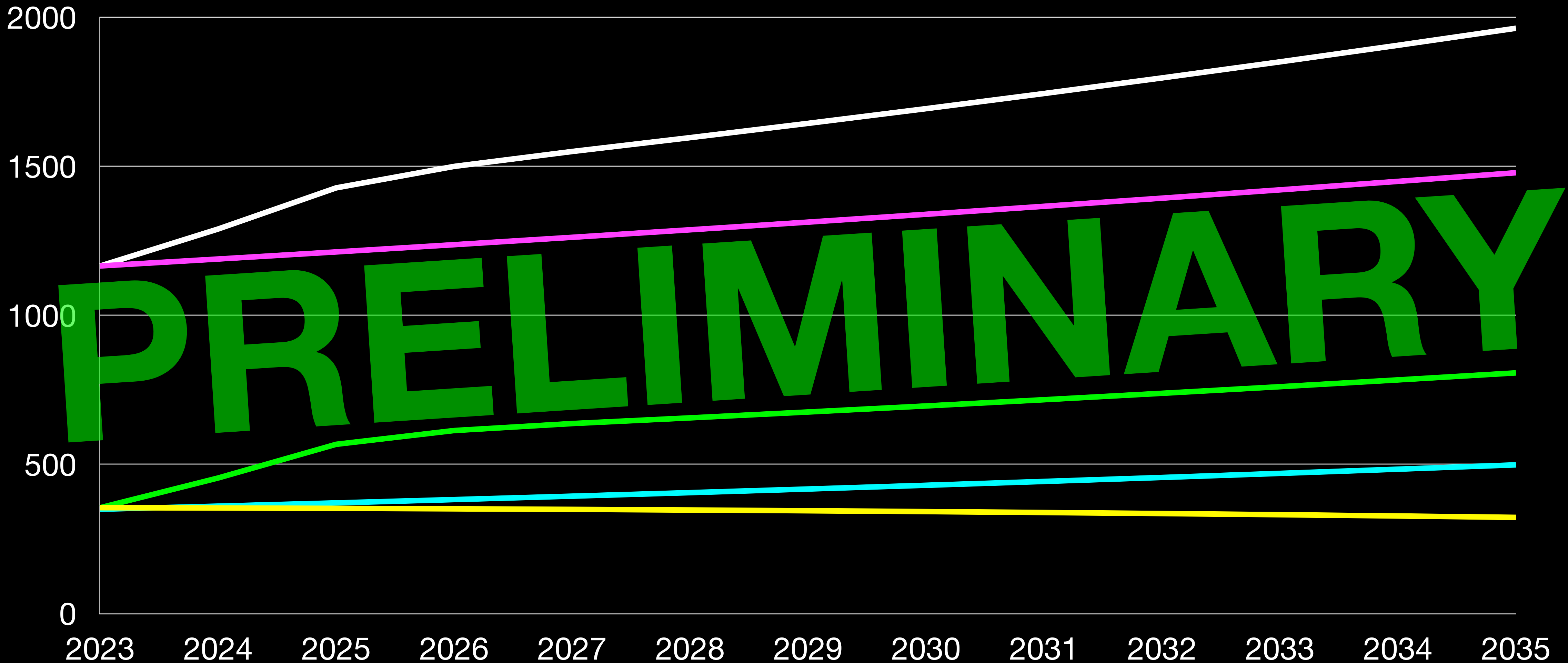
The cost/schedule/risk subcommittee to P5 is asked to obtain and clarify the cost/schedule/risk information from the proponents of high cost (>250M FY23\$) HEP projects funded or being considered for funding by the DOE and/or NSF. The subcommittee will not prepare its own estimates. The committee should assess this information at a high level, noting key assumptions, risks and cost and schedule uncertainties including the risk from non-DOE/NSF funding sources, international partners making in-kind contributions and collaborations and missing costly items, if any. The committee is also asked to comment on the operation costs for projects for during commissioning and when the resulting facilities are in steady-state operation. This committee will provide P5 with the expert opinions on the uncertainty ranges for the projects that P5 needs to develop a strategy for the field within assumed budgetary constraints. The subcommittee will submit their preliminary report to P5 in early summer.

Iterating with “big” projects

Will also ask for information from medium and small

Budget Scenarios

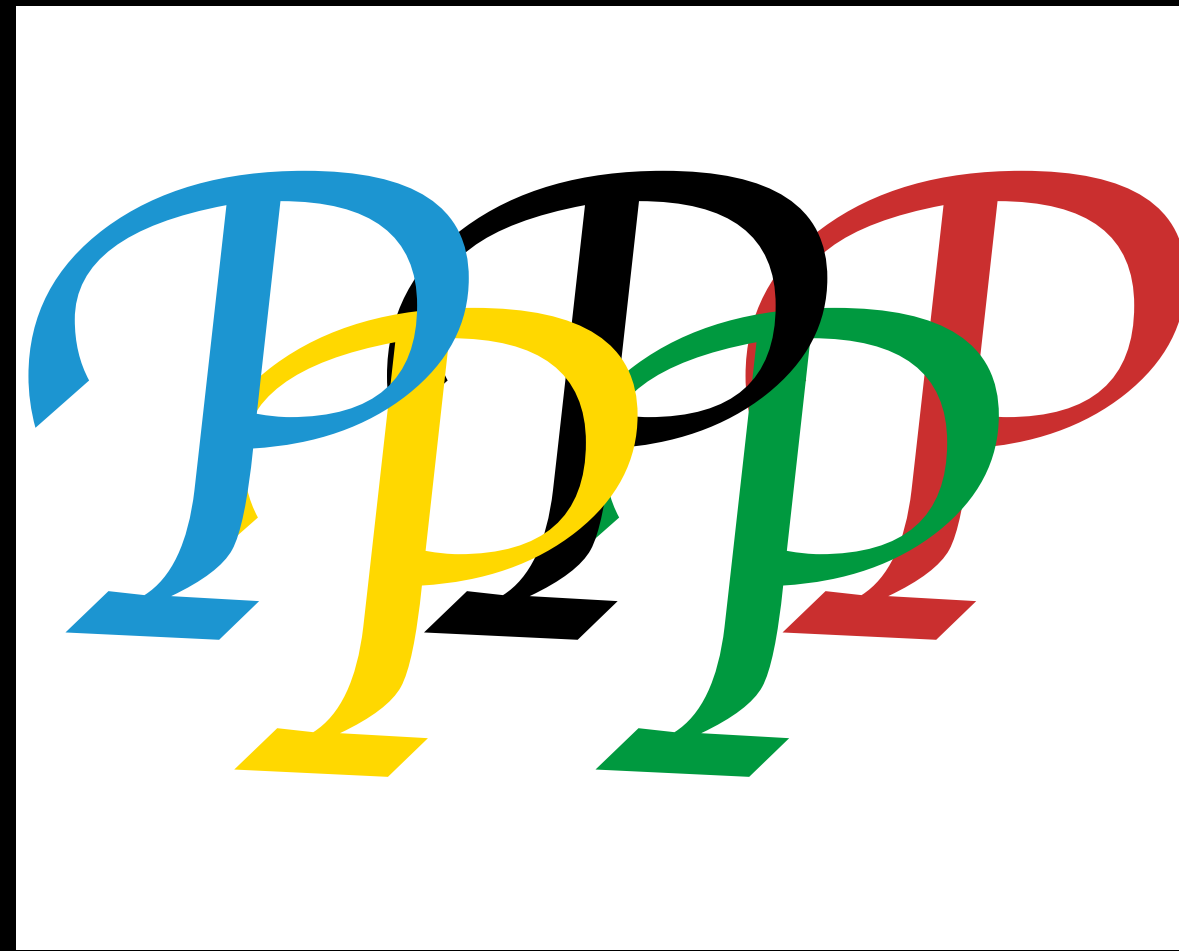
— A — B — Projects A — Projects B — constant level of effort



From the budget scenarios, research, facilities & ops are subtracted at the current level + 3% escalation to estimate project funds

Time Table

- Information Gathering mode
 - Open Town Halls (finished)
 - LBNL: Feb 22, 23. **513 participants**
 - Fermilab/Argonne: March 21, 22, 23. **797 participants**
 - Brookhaven: April 12, 13. **666 participants**
 - SLAC: May 3, 4. **512 participants**
 - All with short remarks (x3 oversubscription)
 - Virtual Town Halls: June 5 (UT Austin), June 27 (Virginia Tech)
 - DPF session on P5 (April 15), Early Career Network Workshop (June 8,9), ACE Science Workshop (June 14, 15)
- Deliberation Phase
 - Four closed meetings from May to July
 - Preliminary recommendations to agencies August
- Final report due October, subject to approval by HEPAP



Maximize science!