

Future Colliders in the P5 2023 Report

- The US collider community should be very encouraged and pleased with the 2023 P5 report and its recommendations!
- The presented P5 vision supports US Community's aspirations on Future Colliders: on Higgs Factories, 10 TeV pCM collider, and collider R&D
 - **Recommendation 2c** endorses an off-shore Higgs factory and urges the US to actively engage. (FCC-ee and ILC explicitly called out.)
 - **Recommendation 4a** supports vigorous R&D toward a cost-effective 10 TeV pCM collider R&D, with a goal of being ready to build major test and demonstrator facilities within the next 10 years.
 - **Recommendation 4g** asks to develop plans for improving the Fermilab accelerator complex that are consistent with the long-term vision of the report, including neutrinos, flavor, and a 10 TeV pCM collider.
 - **Recommendation 6** calls for a targeted panel (around 2026) to evaluate (a) the Higgs factory situation, (b) test/demonstrators and collider R&D, (c) a plan for the Fermilab evolution of the Accelerator complex, consistent with the long-term vision.

■ AREA RECOMMENDATIONS

- **Area Recommendation 6** calls for increase in generic detector R&D and supplemental funds for the collider R&D
- **Area Recommendation 8** calls for increase in GARD funding by \$10M/year to ensure US leadership in key areas.
- **Area Recommendation 9:**
“Support generic accelerator R&D with the construction of small scale test facilities. Initiate construction of larger test facilities based on project review, and informed by the collider R&D program.”
- **Area Recommendation 10** bolsters support for Collider R&D:
“To enable targeted R&D before specific collider projects are established in the US, an investment in collider detector R&D funding at the level of \$20M per year and collider accelerator R&D at the level of \$35M per year in 2023 dollars is warranted.”
- **Area Recommendation 12** calls for the formation of a dedicated task force led by Fermilab and charged with developing a strategic 20-year roadmap for Fermilab accelerator complex within the next five years.

Future Colliders: Status & Next Steps

- In anticipation of P5 guidance, the US HEP community has continued to be actively engaged with the international community in the ILC, FCC-ee and IMCC efforts.
- FCC: US-FCC detector/physics coordination panel; US-FCC workshop will be held at MIT, March 25-27, 2024; FCC week 2024 to be hosted in San Francisco, June 10-14, 2024
- ILC: U.S. engaged in efforts of the ILC-IDT on accelerator and detector design and R&D, organizational roles; ALCC
- IMCC: A few universities have MoC, many coordination roles in the organization; US Muon Collider coordination panel active; US/Americas collaboration forming.
- Fermilab Future Colliders initiative plans to hold “agora” style meetings in the new year to discuss next steps with the US community!

Extra Slides

Future Colliders Technology R&D

- The International Linear Collider:
 - U.S. scientists are engaged in efforts of the **ILC-IDT** on the accelerator design and R&D
 - SRF R&D for ILC main linacs, crab cavities, Sources: polarized e⁻ & e⁺, conventional e⁺, damping rings and kickers, beam delivery system and beam physics
 - (R&D for high gradient SRF (Standing wave and travelling wave structures) for ILC upgrade or for HELEN collider; Target gradient in the range of 55 – 90 MV/m)
- The Future Circular Collider:
 - Opportunities/interests for US efforts
 - High Q₀ SRF (400/800 MHz) R&D, NCRF (C³-type cavities), SC IR magnets R&D, MDI, polarization, Beam Instrumentation, beam physics, (FCC-hh magnets)
- Muon Collider R&D and Demonstrator
 - Fermilab is a possible site for the demonstrator; TDR planned for 2030
 - Modular approach, add as demo progresses
 - Component materials R&D to demonstrate radiation and shock resistance
 - High field magnet tests with muon production, cooling, acceleration
 - High gradient, NC RF cavities in cooling channel and SRF for acceleration
 - **Demonstrate a fully integrated module as an engineering prototype**

Exploiting Synergies in R&D

- The future collider R&D program can exploit synergies between various collider concepts and technologies
- Following critical areas have a lot of synergies across proposed colliders
 - RF System
 - High gradient, high efficiency SRF cavities
 - High gradient NCRF
 - High efficiency power sources
 - Magnets
 - Large bore solenoids
 - Low field magnets
 - High Field Magnets (~16T)
 - IR magnets
 - Fast ramping magnets
 - Accelerator/Collider Design
 - Parametric studies, beam dynamics, hardware specs, beam control and instrumentation
 - Synergy for e+e- Higgs factories: Injectors, Positron source, Beam polarization, Beam Delivery System (BDS), Interaction Region (IR), Machine Detector Interface

Colliders

ILC, HELEN, MuC, FCC-ee

CLIC, C3, MuC, FCC-ee

All

MuC

FCC-ee

MuC, FCC-hh (MDP)

All

MuC, FCC-ee