



PIP-II: Fermilab's New Accelerator

Lia Merminga Fermilab Community Advisory Board 26 July 2018

In partnership with: India/DAE Italy/INFN UK/STFC France/CEA/Irfu, CNRS/IN2P3

Why a new Accelerator?

3 Nobels in last 30 years:1988: discovery of muon neutrino1992: discovery of neutrino2002: cosmic neutrinos

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- Neutrinos are pretty cool:
 - Elementary particles with smallest mass of known particles
 - < one millionth that of the electron</p>
 - 'neutrino' electrically neutral and so small (mass)
 - typically pass through matter unimpeded & undetected
 - come in three flavors: electron, muon, tau
 - neutrinos oscillate between different flavors in flight
 - parameters of the oscillations still not completely understood
 - could unlock our understanding of the universe!
 - been a focus of physics at Fermilab since the beginning
 - Current focus on the oscillations: short baseline (detectors on site) and long baseline (detectors in Minnesota and South Dakota)

LBNF / DUNE / PIP-II



Long Baseline Neutrino Facility (LBNF) is the facility for the Deep Underground Neutrino Experiment (DUNE), a dual-site experiment for neutrino science and proton decay studies.

- Hosted at Fermilab (Batavia, IL) and SURF (Lead, SD)

The facility is an internationally designed, coordinated and funded program, a first of its kind for the US DOE.

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P5- Particle physics is global... and so is PIP-II

Recommendation 14: Upgrade the Fermilab proton accelerator complex to produce higher intensity beams. R&D for the Proton Improvement Plan II (PIP-II) should proceed immediately, followed by construction, to provide proton beams of >1 MW by the time of first operation of the new long-baseline neutrino facility.



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From 2014 P5 Report: "The PIP-II project at Fermilab is a necessary investment in physics capability, enabling the world's most intense neutrino beam, providing the wideband capability for LBNF, as well as high proton intensities for other opportunities, and it is also an investment in national accelerator laboratory infrastructure. **The project has already attracted interest from several potential international partners**."

The PIP-II Project

Mission

PIP-II will deliver the world's most intense beam of neutrinos to the international LBNF/DUNE project, and enable a broad physics research program, powering new discoveries for decades to come.



Goals

- Deliver 1.2 MW of proton beam power from the Main Injector over the energy range 60 – 120 GeV, at the start of LBNF ops —Establish a platform for future upgrades to multi-MW capability
- Provide a platform for extension of capability to high duty factor/higher beam power, multiple users and reliable operations
 —Support the ongoing 8 GeV program, including an upgrade path for Mu2e

Building the world's most powerful neutrino beam cost-effectively

PIP-II Site



PIP-II Scope





Proposed PIP-II Accelerator and LBNF Beamlines (delivering >2 MW in the future)



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PIP-II animation





PIP-II has a mature, validated technical design PIP2IT



PIP2IT is a complete systems-integration of the PIP-II Front End - coming to completion in FY21







PIP-II Injector Test Facility (PIP2IT)



PIP-II SRF Linac & Areas of International Interest



PIP-II is the first Accelerator Project in the U.S. with substantial International Contributions

SSR1 Cryomodule being assembled for the test





PIP-II leverages FNAL leadership in SRF technology – pushes state of the art in high gradient, high Qo, CW designs



Single Spoke Cavity Prototype



Elliptical Cavity β =0.90 Prototype at FNAL



Elliptical Cavity β =0.90 Prototype at FNAL



SSR1 Cryomodule Prototype

PIP-II driven SRF technology development has broad applications

PIP-II schedule



PIP-II is Building Momentum

Strong FY18 funding: Line item was created Construction start

 Enthusiasm and strong support from FNAL, OHEP, Office of Science, DOE, Congress

- ✓ Successfully completed DOE ICR and IPR reviews Dec 2017
- ✓ Launched CD-2/3a process: Goal is baseline end of 2018
- New organization and team members with focus on execution
- Major milestone achieved on July 23: DOE approved PIP-II to proceed with its design (CD-1)!















Thank you for your attention

