

Neutrino and Muon Experiment Overview

Kevin Lynch HPT Roadmap Workshop 2023 April 11

We're here to discuss the High Power TARGETRY roadmap...

- ... but it's not just about TARGETS: *beam intercepting devices*
 - Targets
 - Beam Windows
 - Collimators
 - Beam Absorbers
 - Decay Volumes
 - Remote handling
 - Rad Hard Instrumentation
 -



Experiments: current and future (a selection of US HEP efforts at FNAL)

- Sources
 - LINAC
 - PIP-II
- Neutrinos
 - BNB
 - NuMI
 - LBNF
- Muons
 - g-2
 - Mu2e
 - Mu2e-II
 - AMF
 - Muon Collider
- All of these (will) use proton beams to produce their secondaries



Sources

- Warm LINAC
 - As old as Fermilab ... and it is showing
 - 400 MeV H-
 - Feeds Booster
 - Feeds MTA/ITA
 - Limits power to the rest of the complex
- PIP-II
 - Superconducting 800 MeV LINAC
 - Lots of discussion on upgrade paths (1-8 GeV add ons)
 - ~ 2030
 - 1.6 MW H-
 - In principle, capable of simultaneously supplying 1.6MW H+ (with upgrades)
 - Will initially feed an upgraded Booster
 - Potential future direct feeds to other facilities/experiments
 - Test facility? Irradiation facility? Low energy muons? Fusion physics?



- The Booster Neurino Beam is a facility for low energy neutrino production and feeds many experiments
 - SBND
 - *BooNE
 - ICARUS
 - ANNIE
 -
- One target, one horn
- Been running since 2002



BNB

- Beryllium target
 - Air cooled
- 8 GeV protons
- 4-5e12 POT per pulse @ ~5HZ
 - ~600W energy deposition
- Target lifetime is years
- Potentially runs "forever"



NuMI

- NuMI is another "facility"
 - MINOS
 - NovA
- One target, two horns
- Been running since 2005



NuMI

- Graphite fin target
 - Water cooled
- 60-120GeV proton beam
- 1MW capable components
 - Record around 900kW, currently running at 800kW
- NuMI ends with the long shutdown





LBNF

- The future of neutrino physics in the US
- One target, three horns
- Comes online in ~2030



LBNF

- Graphite target
 - Helium cooled
 - 1.5m
- 60-120 GeV protons
- 1.2MW → 2.4MW
 - ACE?
- Facility lifetime > 30yrs





Mu2e

- Search for $mu \rightarrow e$ conversion
 - 1e4 improvement
- 8GeV protons
- 8kW on target
- Radiation cooled tungsten
 - 700W radiated
 - Planned annual target replacement
- Facility lifetime: 10yrs?





Future muon facilities

- Mu2e-II
 - Same architecture as Mu2e
 - 800MeV protons
 - 100 kW on target
 - Conveyor target scheme under exploration
 - He cooled?
- AMF
 - Entirely new architecture
 - 800MeV 8GeV protons ?
 - Up to 1MW on target
 - No target concept close to realization
- Muon collider
 - Synergies with AMF
 - 2-4 MW on target

