Fermilab Physics Advisory Committee mini Meeting dedicated to NuMI run plan in 2026/2027

Charge: We are requesting that the PAC reviews the current run plan for operating the NuMI beam (in terms of POTs and run mode) during calendar years 2026 and 2027, taking into consideration the goals of the experiments/projects, planned maintenance and repairs of the accelerator complex, as well as budgetary constraints

A subcommittee of the PAC was formed to address the charge. Its membership was determined based on relevant expertise and/or prior involvement in the Fermilab accelerator subcommittee.

The PAC NuMI Sub-Committee: Halina Abramowicz (Chair), Klaus Blaum, Allen Caldwell, Albert De Roeck, Atsuko Ichikawa, Mayly Sanchez

Scientific Secretary: Sergo Jindariani

Indico: https://indico.fnal.gov/event/70129/

Findings

On the accelerator complex side

- The electrical power infrastructure is at present limited due to malfunction of transformers in the two substations that deliver power in particular to the accelerator complex. At least two of the four transformers available in Kautz Road substation are required to operate the Main Injector (MI), though at reduced power. Only one is functional and therefore the MI cannot be operated. Moving one of the transformers from the main station to the Kautz Road station was discussed, but deemed too risky.
- A second transformer is expected to be repaired and operational by summer 2026. The MI can be operated in 2026 from September 1st to December 26, which may provide 16 to 18 weeks of running with reduced power.
- The MI could in principle be operated in 2027, even at full power, but that will interfere with plans for modernization of the accelerator complex to prepare for 1.2 MW for LBNF/DUNE.

On the experiments side

- There was no beam delivery for MI since 2024

- In 2026, MI could deliver 1.5-2.5x10^20 POTS. This is in contrast to the original PAC recommendation of 7x10^20 POTS.
- There is an inherent conflict of interest between the NOvA and DARPA projects. The former requests an anti-neutrino beam while the latter prefers a neutrino beam.
- The other affected experiments, DUNE 2x2 and ICARUS, require as much statistics as possible and therefore will be better satisfied by a neutrino beam running.

Comments

- The PAC heard input from all the four affected experiments which were asked to assess their physics impact of the reduced beam time.
- The tension between the CP/mass ordering results of NOvA and T2K may indicate new physics. The present statistical power of the NOvA data is not sufficient to resolve the issue. The published NOvA results are based on 26×10^20 POTS in neutrino mode and 12×10^20 POTS in antineutrino mode. An additional 2.84×10^20 POTS collected in antineutrino mode has not yet been analysed. The PAC was not convinced that an additional 10% of antineutrino mode data would make a significantly stronger impact than an addition of neutrino mode data.
- DARPA has only very preliminary estimates of expected rates and it was not possible for the PAC at this time to definitively establish whether any of the modes would be strongly favored.
- DUNE 2x2 and ICARUS require statistics which would favor the neutrino mode.

Recommendations

The PAC recommends to run the NuMI beam in 2026 in neutrino mode and to proceed with the accelerator modernization without any delays. The PAC suggests that the results of NOvA be reviewed after analyzing as soon as possible the 2.84×10^20 POTS already collected in antineutrino mode. Should these results have an impact on understanding the tension between the NOvA and T2K measurements, a compromise between the accelerator needs and the physics, including financial considerations, can be considered.