Deep Underground Neutrino Experiment (DUNE)

Addendum to Submission for the 2020 Update to the European Strategy for Particle Physics

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The DUNE Collaboration[1]

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2 Timeline

timeline

LBNF and DUNE are working toward three international project milestones:

- 2019 - Start main cavern excavation in South Dakota;
- 2022 - Start installation of first FD module;
- 2026 - Beam operation with two detector modules.

It is expected that these dates will be adjusted when the project baseline is defined. The key milestones to reach baseline status are:

- 2018/2019 - Collect data with both ProtoDUNE detectors.
- April 2019 - Submit TDR for far detector modules.
- July 2019 - Complete LBNC and NCG review of TDR.
- September 2019 - Present TDR to Resources Review Board (RRB).
- October 2019 - Conduct conceptual design (DOE CD-2/3b) review of LBNF and the USA scope of DUNE.

The TDR for the near detector is expected to follow the FD TDR by approximately one year. The schedule for the design and construction work for LBNF and DUNE has two critical parallel paths: one for the far site (South Dakota) another for the near site (Illinois). The schedule for the initial work is driven by the Conventional Facilities (CF) design and construction at each site. During the initial phase of the project, the far site CF is advanced first. The Ross Shaft rehabilitation work at SURF was halted in early 2018 at the 4850-ft level due to safety concerns, which have led to delays of several months. Early site preparation is timed to be completed in time to start excavation when the Ross Shaft rehabilitation work finishes. As each detector cavern is excavated and sufficient utilities are installed, the cryostat and cryogenics system work proceeds, followed by detector installation, filling and commissioning.

The first detector module is to be operational by 2024, with the second and third modules completed one and two years later, respectively. The DOE project management process requires approvals at critical decision (CD) milestones that allow the LBNF/DUNE project to move to the next step. In spring 2018 LBNF near site CF will seek CD-3b construction approval for Advanced Site Preparation to build the embankment. In 2020 LBNF and DUNE will seek to baseline the LBNF/DUNE scope of work, cost and schedule, as well as construction approval for the balance of the project scope of work. The project concludes with CD-4 approval to start operation.

3 Computing Requirements

The DUNE science program is expected to produce raw data volumes similar in scale to the data volumes that current LHC Run-2 experiments have already recorded. Baseline predictions for these data, are 30-60 PB of raw data per year for the combined near and far detectors.

DUNE data consists of simple but very large 2D and 3D data objects which share many characteristics with astrophysical images. Each "event" may be GB (beam interaction) or TB (full supernovae readout) in size. This presents opportunities to use current advances in machine learning and pattern recognition as a frontier user of High Performance Computing (HPC) facilities capable of massively parallel processing.

The DUNE collaboration has recently formed a formal Computing Consortium, with significant participation by European Institutions to work on common software and computing development and to formalize resource contributions. The consortium resource model benefits from existing Grid and WLCG infrastructure developed for the LHC. We expect this global computing consortium to grow and evolve as we move towards data from the full DUNE detectors in the middle of the next decade.

DUNE sees the way forward as further harmonisation of computing across HEP worldwide. This may be along the lines of those being suggested by WLCG i.e. formation of a common HEP Scientific computing Infrastructure coordination body (SCI) working with autonomous resource provision for different sectors such as the LHC, the Neutrino Experiments and other medium scale efforts.

DUNE also supports the aspirations of the High Energy Physics Software Foundation which seeks to harmonise software across HEPWe plan to utilize common computing layers for infrastructure access with common tools to ease integration of facilities with both the DUNE and LHC computing ecosystems. For example, we plan to utilize common data storage methodologies to establish large highly available data lakes to minimise storage requirements.

Finally, DUNE underlines the need to support software engineering effort to engineer and adapt codes and infrastructure to be fit for the next decade.