TDR DISCUSSION– 10/08

Mayly Sanchez
Iowa State University

TDR IMPORTANT DATES

- First deadline to submit drafts **November 1st, 2018.**
  - All text that does not need finalized studies needs to be **written in ~three weeks.**
  - Editors initial review complete by November 15, 2018.
- Second deadline to submit drafts December 1st, 2018.
  - Better interface with the rest of the document.
- Analyses frozen. Final plots and numbers assembled by Jan 2019 (collaboration meeting).
- Final drafts due March 1st, 2019.

  Remember text is aimed at your random HEP colleague reviewer.

  It must be concise and clear. Must not over document previous steps.

HOW TO WRITE/CONTRIBUTE?

- We will be using overleaf. A link for editing the overleaf document will be provided to you if you are responsible or a contributor for one of the sections.
- The link for viewing is here. Link for editing going out today!
- This is a draft overleaf site that follows the convention of the main Physics Volume as provided by Anne Heavey.
  - Use conventions for text (common/defs.tex). See bibliography for citations (common/tdr-citedb.bib). Let me know if you edit these.
- The document has been split in separate text files per section to avoid interference when simultaneously writing. As sections are ready, files will be transferred to main overleaf site.
- Each section starts with the names of the group assigned to as authors/ contributors. If you would like to contribute, let us know ASAP.

Authors have been requested to give an update on plans for each section today.

OUTLINE

Standard neutrino oscillation physics program

1.1 Beam neutrinos

1.1.1 Overview and Theoretical Context

Assigned to: **Mayly Sanchez**

No changes from CDR.

1.1.2 Expected Event Rate and Oscillation parameters

Assigned to: **Mayly Sanchez**

Oscillation parameter values and uncertainties input into the fitter. Integrated event rates expected in the FD. Section to be taken from CDR. For the expected event rate, ignore any description about sensitivity calculations as that will be in the next section. For the oscillation parameters, an update to current best parameters for DUNE needs to be done.

- CDR Table 3.1: Expected POT/yr at various beam power and proton momenta (Update to include engineered beam)
- CDR Table 3.2: Beam parameters CDR vs Engineered (Update to engineered beam only)
- CDR Figure 3.1: Appearance probabilities (nu and anu) for various dcp values. (No Update)
- CDR Table 3.4: central values and relative uncertainties (assuming Gaussian priors only) from NuFit20xx. Figures may need to be added if more sophisticated priors are used.

1.1.3 Sensitivity methods

Assigned to: **Elizabeth Worcester** with contributions from Chris Backhouse and Callum Wilkinson.

Method for calculation of sensitivity should be described. Describe previous work with Globes which might include validation of new software framework. Describe CafAna and any specifics of the DUNE fits.

- Sensitivity Calculation Methods - Text from CDR
- Statistical Methods - Text from CDR
- GLoBES - EW
- CAFAna Methods - CB
- Dune fit - CW

1.1.4 Flux Inputs and Uncertainties

Assigned to: **Laura Fields** with contributions from Zarko Pavlovic.

This section should discuss the flux relevant to the LBL physics and refer to the relevant parts of the description of the beam in the TDR.

Description of the flux. This section includes the description on how the beam has been optimized.

- Short summary of the beam section relevant to LBL physics
- Plots of the flux (reproduced)
- Discussion of optimization for LBL physics
- Uncertainties: sources, constraints, parameterization

1.1.4.1 Optimization of the LBNF Beam Designs

It is likely that this section no longer belongs here. Please comment it out.

- Figure 3.31 Sensitivity comparisons (CPV & MH) between CDR and Engineered beam designs

1.1.5 Neutrino Interactions and Uncertainties

Assigned to: **Kevin McFarland** with contributions from Kendall and the DuneReweight group.

This section has a description of event generator used, justify choices of model and a description of Dune Reweight and treatment of the uncertainties.

This will be organized by reaction type or effect, preferably with overarching categories as subsections.

- Interaction Model Choices and Uncertainties

1.1.6 Near Detector and Uncertainties

Assigned to: **Chris Marshall** with contributions from Mike Kordosky and Steven Manly.

This section describes assumptions in the Near Detector simulation and “reconstruction". Some thought has to go into the connection with the ND CDR and any other ND description in the TDR.

- Simulations
- “Reconstruction" and kinematic variables
- Event Selections
- Samples
- Detector Response Systematic Uncertainties
- Connection to Flux and Cross Section Systematic Uncertainty
- DUNE PRISM

1.1.7 Far Detector and Uncertainties

Assigned to: **Dan Cherdack** with contributions from Leigh Whitehead, Callum Wilkinson, Elizabeth Worcester and Tingjun Yang.

This section describes assumptions in the Near Detector simulation and reconstruction. Some thought has to go into the connection to the Far Detector chapter in the TDR.

- Simulations - TY
- Reconstruction and kinematic variables including energy reconstruction - TY
- Event selections (CVN) - LW
- Samples - EW, CW
- Detector response systematic uncertainties - DDC
- Connection to flux and cross section systematic uncertainties

1.1.8 Analysis Spectra and Samples

Assigned to: **Dan Cherdack and Chris Marshall**

The analysis spectra for the near and far detector that make it into the fitter. This might be merged into the previous or next section(s). Plots of samples that are necessary for the fit.

1.1.8.1 Near Detector Samples

- Event spectra broken down into exclusive channels

1.1.8.2 Far Detector Samples

- Event spectra broken down into exclusive channels (Update CafAna figure)

EFFECT AND PROPAGATION OF SYSTEMATIC UNCERTAINTIES

1.1.9 Effect and Propagation of Systematic Uncertainties

Assigned to: **Chris Marshall** with contributions by Luke Pickering and Callum Wilkinson.

Content will include:

- Overview of the systematic uncertainties
- Discussion of cancellations and constraints
- Discussion of what has the largest impacts on sensitivities
- Potential sources of bias

Potential figures and tables include:

- Error envelopes (vs energy) pre and post ND constraints (New plot)
- CafAna response functions examples
- CafAna chisq vs paramater constraint examples
- Table: Parameter constraints with pre/post fit 1σ uncertainties per systematic (New)
- Covariance matrix

SENSITIVITIES

1.1.10 Sensitivities

Assigned to: **Mayly Sanchez** with contributions from Elizabeth Worcester.

1.1.10.1 Mass Hierarchy

Update all figures using chosen framework(s) with/without osc and syst uncertainties using new plot format:

- CDR Figure 3.7: vs dcp
- CDR Figure 3.8: vs exposure
- CDR Figures 3.9-3.11: vs dcp w t23, t13, dm31 variations
- CDR Figure 3.12: Statistical fluctuations (vs dcp)

1.1.10.2 CP-Symmetry Violation

Update all figures using chosen framework(s) with/without osc and syst uncertainties using new plot format:

- CDR Figure 3.13: vs dcp
- CDR Table 3.7: Minimum exposure for CP violation at 3σ for 75% of dcp, and 5σ for 50% of dcp
- CDR Figure 3.14: vs exposure
- CDR Figures 3.15-3.17: vs dcp, w t23, t13, dm31 variations

1.1.10.3 Precision Oscillation Parameter Measurements

Update all figures using chosen framework(s) with/without osc and syst uncertainties using new plot format:

- CDR Figure 3.18: t23 octant sensitivity
- CDR Figures 3.19-3.22: t23, dcp, t13, dm31 resolutions vs exposure