**Outline of the electron neutrino charged-current inclusive cross section measurement**

*Leonidas Aliaga Soplin, Pengfei Ding, Andrew Norman*

*09/15/2016*

**General Overview**

Analysis is time sensitive. Detailed timeline in the analysis outline adds up to 4-month, till the end of January 2017. In case of unforeseen items not covered by the detailed timeline or any delays of the work, the overall timeline is aimed to complete core analysis on a 6-month time scale (March 2017). Contingency timeline stretches to 10 months (July 2017).

* Strategy is team based.
  + Want to avoid lone-wolf model
  + All results easily reproducible with cross checks
* Make the analysis primarily in Art
  + The analysis will be reproducible in CAFAna as a check of consistency.
* Construct the analysis methodology (and framework) as a template for future neutrino cross-section analysis;
  + Use standardized reconstruction and PID methods consistent with the core neutrino oscillation analyses
  + CVN based on the full event topology will be used
  + Prong-by-prong CVN is not currently considered
    - Extension to prong-by-prong would be considered at a later point in the timeline to extract additional information
  + Multiple unfolding techniques available in the framework
  + Making tools for various cross checks
* Develop the analysis with plans to extend to differential cross sections in relevant quantities (q2, opening angles, Pt)
* No plan to develop this analysis to a fully double-differential cross section;

**Analysis outline**

1. **Finalize Data and MC samples**
   1. Primary data set (Options)
      1. Fall 2015 to Shutdown 2016
      2. All data up to shutdown 2016
      3. 3rd analysis data (I.e. top off prior to March)
   2. Preference
      1. Use no post-shutdown data
      2. Limit data to golden run periods
   3. Ready to break data into run periods (epochs)
   4. Use existing or generate run matched MC (production group has already provided some).
2. **Initial Data and MC comparison (two weeks, Oct 7, 2016)**
   1. Define several group of cuts for event selection (loose, medium, tight);
   2. Perform data/MC comparison for all kinematic variables
   3. Perform data/MC comparison for other variables which might be used in event selection.
      1. Derived or correlated quantities (I.e. mva discriminates)
3. **Event Selection Cuts (two weeks, Oct 28, 2016)**
   1. Start with kinematics cuts in the event selection used in νe oscillation analysis;
   2. Use CVN based on whole event topology for further event selection;
   3. Study the event selection efficiency and acceptance; loot at different channels in MC;
   4. Study the systematic uncertainties of the event selection.
4. **Background Estimation (overlap with III, two weeks, Nov 11, 2016)**
   1. Relative ratios between different background channels are taken from MC;
   2. Estimate the normalization factor from sidebands to reduce the impact from the systematic uncertainties of flux and GENIE cross sections.
5. **Flux (overlap with others, Dec 2016)**
   1. Generate new MC samples with DK2Nu flux model;
   2. Alternatively, using energy dependent weights to reweight the current MC to match PPFX flux.
6. **Unfolding (two weeks, Nov. 25, 2016)**
   1. This analysis itself may not need to unfold the results;
   2. But the unfolding procedure still needs to be studied and its systematic uncertainty needs to be estimated;
   3. The primary unfolding technique used will be the simple bin-by-bin unfolding;
   4. But a second and/or third unfolding technique needs to be compared with.
7. **Systematic uncertainties (four weeks, Dec 30, 2016)**
   1. Event selection efficiency (stat. of MC ⊗ difference of data/MC efficiency);
   2. Background estimation (stat. of MC ⊗ sys. of normalization factor);
   3. Flux (provided by PPFX flux);
   4. Calibration (use calibration systematic sample);
   5. Unfolding;
   6. Cross section model (currently there are three, we want to choose the one which can be reweighted easily so that we do not to redo the analysis every time);
   7. Others.
8. **Cross checks (four weeks, Jan 27, 2017)**
   1. LID vs. CVN
   2. Look at MRE sample
   3. Different unfolding techniques