Refining ND Requirements using FD-Only Analyses

Elizabeth Worcester

ND/LBL Software Meeting

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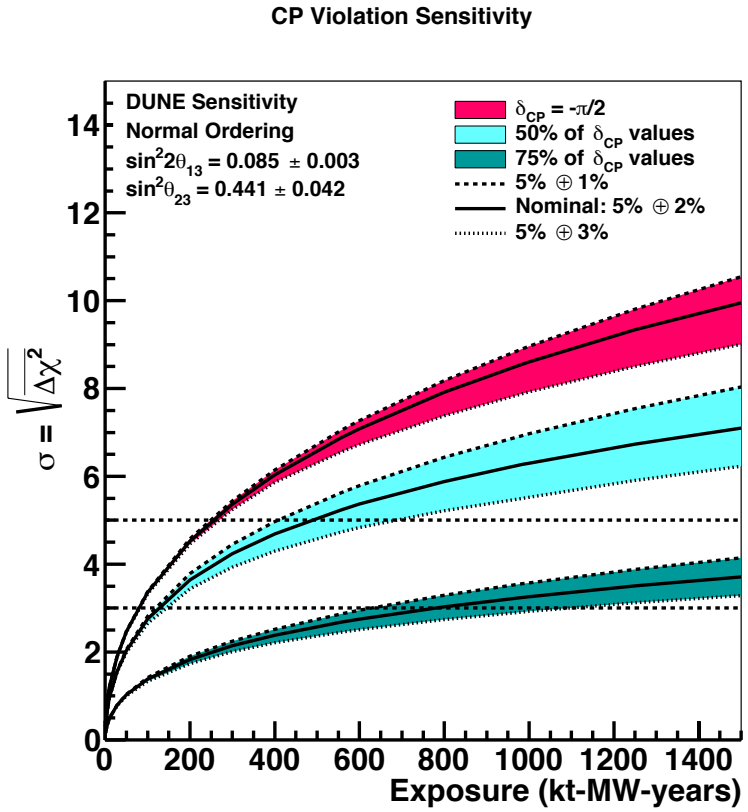
Systematics Requirements

- Primary systematics requirement (2% signal normalization uncertainty) comes from CDR-era GLoBES fits
- More refined requirements possible using same tools
  - What is norm. unc. requirement as a function of energy?
  - What is the relative importance of specific contributions to norm. unc. (ie: flux, xsec, detector) given expected sample-sample correlations
- What level of systematic cancellation can be expected among far detector samples?
  - Those uncertainties that **don't** cancel among FD samples must be a high priority for a ND
- At the risk of breaking Dan's no philosophy rule, I think there's significant potential for useful contributions to ND concept study from this direction.



GLoBES Studies

- "New" version of GLoBES allows more detailed systematics treatment
- Normalization uncertainties in energy bins very simple
  - I've started working on this…
- Systematics correlations/multiple detectors relatively simple
  - "LBNE" era GLoBES configs exist
  - Need to simplify and/or run on grid to make computing time sane
  - Could add ND with appropriate correlations fairly easily

- Second possibility: Energy dependent

example-sys-syntax.inc

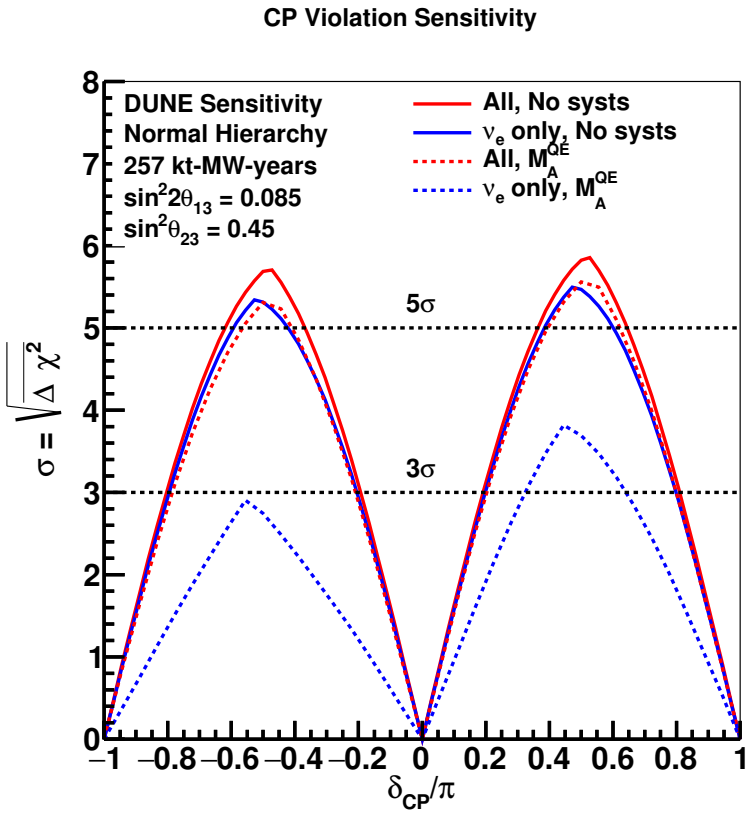
```
// Fiducial mass error
sys(#Sys1)<
  @error = 0.025
>
sys(#Sys2)<
  @error = 0.005
>

sys(#Sys3)<
    @energy_list = { 0.5, 1.0, 1.5 }
    @error_list  = { .1, .2, .1 }
>
```

Interpolation done in between, in reconstructed neutrino energy

```
rule(#nu_e_appearance)<
        @signal = 1.0@#nue_sig : 1.0@#anue_sig
        @sys_on_multiex_errors_sig = { #fid_mass, #xsec_corr, #xsec_e, #flux_corr, #ebias_corr, #ebias_e } :
                                     { #fid_mass, #xsec_corr, #xsec_anu, #xsec_e, #flux_corr, #flux_anu, #ebias_corr, #ebias_e }
        @background = 1.0@#numu_bkg : 1.0@#nue_bkg : 1.0@#anumu_bkg : 1.0@#anue_bkg : 1.0@#nut_bkg : 1.0@#anut_bkg : 1.0@#NC_bkg
        @sys_on_multiex_errors_bg =  { #fid_mass, #xsec_corr, #flux_corr, #ebias_corr, #ebias_mu } :
                                     { #fid_mass, #xsec_corr, #xsec_e, #flux_corr, #flux_beam, #ebias_corr, #ebias_e } :
                                     { #fid_mass, #xsec_corr, #xsec_anu, #flux_corr, #flux_anu, #ebias_corr, #ebias_mu } :
                                     { #fid_mass, #xsec_corr, #xsec_anu, #xsec_e, #flux_corr, #flux_anu, #flux_beam, #ebias_corr, #ebias_e } :
                                     { #fid_mass, #xsec_corr, #xsec_tau, #flux_corr, #ebias_corr, #ebias_tau, #ebias_e } :
                                     { #fid_mass, #xsec_corr, #xsec_anu, #xsec_tau, #flux_corr, #flux_anu, #ebias_corr, #ebias_tau, #ebias_e } :
                                     { #fid_mass, #xsec_corr, #xsec_nc, #flux_corr, #ebias_corr }
```

FastMC/mgt/LOAF



- Studies of sample-sample systematics cancellations using FastMC w/ reweights and a fitting tool (mgt/LOAF)
- Could be used to vary the "external" constraints (eg: M_A^{QE} constrained at 1% 5%, 10%, 20%...) to set requirements for ND
- Effort required?
  - Revive/update FastMC inputs
  - Running fits is not difficult – after a little tutorial, would be primarily keeping jobs running on grid, bookkeeping, bringing some physics instincts to tests to run and interpretation of results