

Near Detector Neutrino Flux with Horn/Current Configurations

14th June 2018 / University of Warwick / DUNE BIWG Meeting

Motivation



Cross-section Calibration

- Accurate reconstruction of true neutrino energy is difficult due to uncertainties from missing p_t techniques and measurements of neutrals.
- Without a well-defined incoming neutrino beam energy, extrapolation to Far Detector without good calibration / well-known ν cross-sections is limited.
- Near Detector cross-section and flux measurements would benefit from some restriction of the wide-band neutrino beam to a more well-defined neutrino energy.

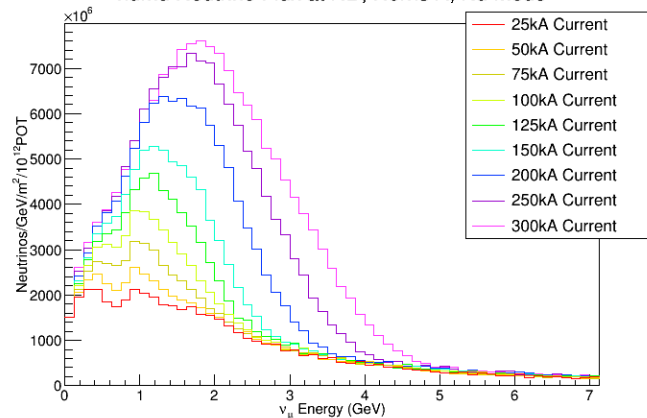
Concept



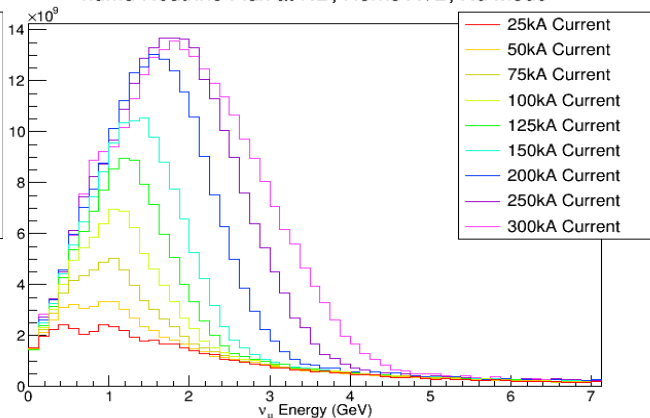
- Horn currents and configurations can be varied, with the caveat that all powered horns need operate on the same current value.
- We consider 5 options in configuration: A only, A+B, A+C, B+C, and A+B+C
- Tune-ability of neutrino flux over a range of current and configuration settings is shown in the following slides

NuMu Fluxes

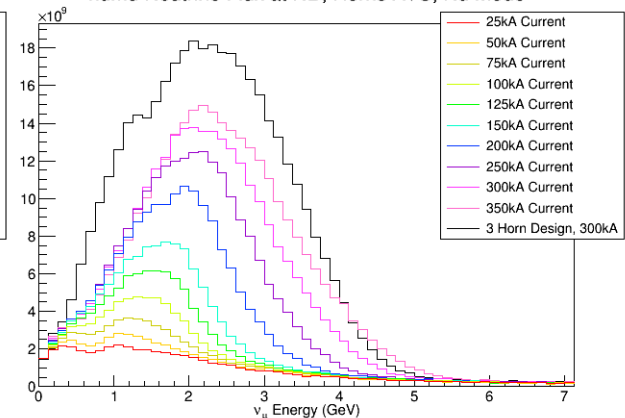
numu Neutrino Flux at ND, Horns A, Nu Mode



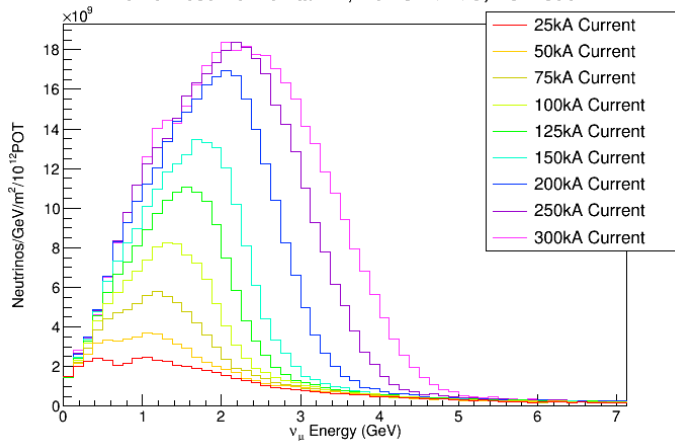
numu Neutrino Flux at ND, Horns A+B, Nu Mode



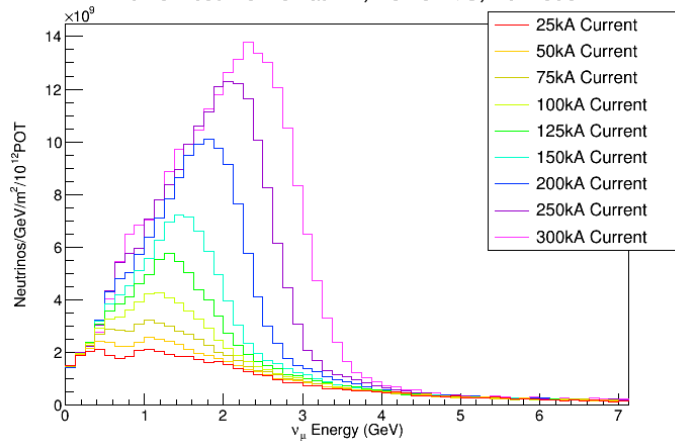
numu Neutrino Flux at ND, Horns A+C, Nu Mode



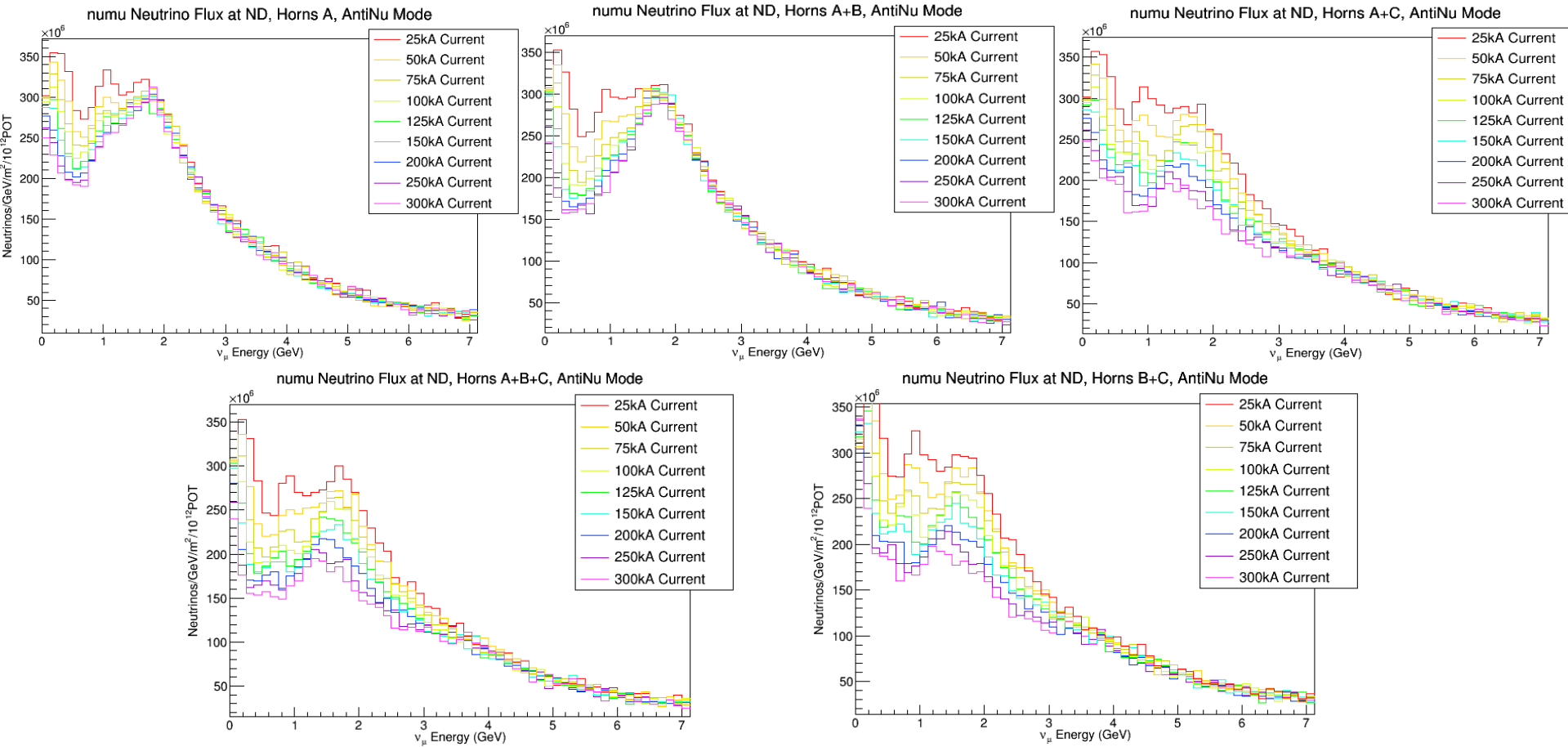
numu Neutrino Flux at ND, Horns A+B+C, Nu Mode



numu Neutrino Flux at ND, Horns B+C, Nu Mode



NuMu Fluxes



Linear Combination Fit



- Horn currents and configurations can be varied, with the caveat that all powered horns need operate on the same current value.
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- Tune-ability of neutrino flux over a range of current and configuration settings is shown in the following slides

Linear Combination Fit

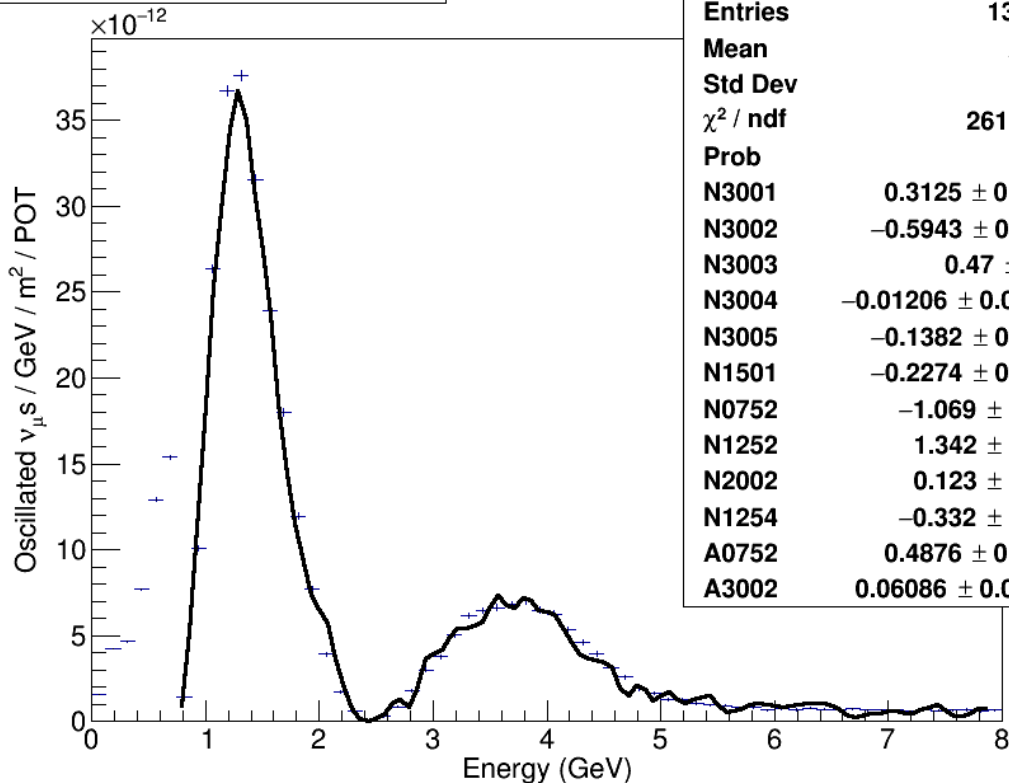
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Notation

- N/A - NuMode / AntiNuMode
- First 3 digits = current
- Last digit = Horn Config
- 1 - A
- 2 - A+B
- 3 - A+C
- 4 - A+B+C
- 5 - B+C

Range – 0.75 – 7.75GeV

numu_fluxosc_forplots



Linear Combination Fit

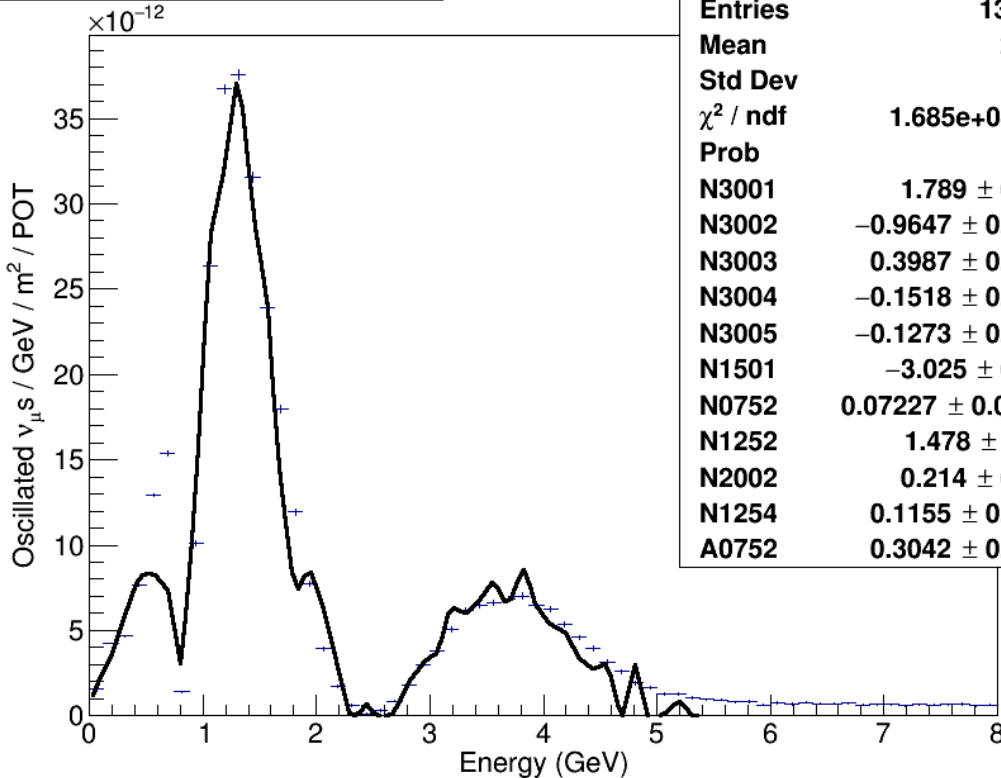
WARWICK

Notation

- N/A - NuMode / AntiNuMode
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Range – 0 – 5.5GeV

numu_fluxosc_forplots



numu_fluxosc_forplots

Entries	137152
Mean	2.092
Std Dev	1.54
χ^2 / ndf	1.685e+04 / 33
Prob	0
N3001	1.789 ± 0.025
N3002	-0.9647 ± 0.0090
N3003	0.3987 ± 0.0117
N3004	-0.1518 ± 0.0055
N3005	-0.1273 ± 0.0048
N1501	-3.025 ± 0.034
N0752	0.07227 ± 0.01045
N1252	1.478 ± 0.011
N2002	0.214 ± 0.007
N1254	0.1155 ± 0.0089
A0752	0.3042 ± 0.0053

Linear Combination Fit

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Notation

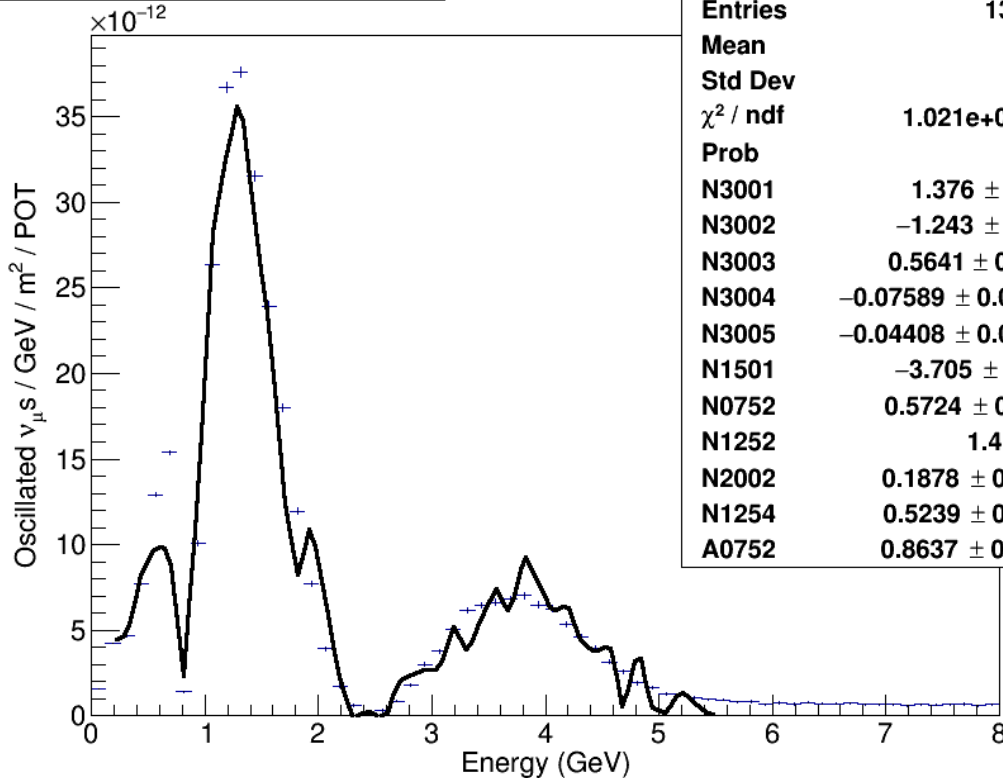
- N/A - NuMode / AntiNuMode
- First 3 digits = current
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- 1 - A
- 2 - A+B
- 3 - A+C
- 4 - A+B+C
- 5 - B+C

Range – 0.2 – 5.5GeV

numu_fluxosc_forplots

numu_fluxosc_forplots

Entries	137152
Mean	2.092
Std Dev	1.54
χ^2 / ndf	1.021e+04 / 31
Prob	0
N3001	1.376 ± 0.026
N3002	-1.243 ± 0.010
N3003	0.5641 ± 0.0121
N3004	-0.07589 ± 0.00560
N3005	-0.04408 ± 0.00497
N1501	-3.705 ± 0.037
N0752	0.5724 ± 0.0121
N1252	1.4 ± 0.0
N2002	0.1878 ± 0.0066
N1254	0.5239 ± 0.0103
A0752	0.8637 ± 0.0164



Linear Combination Fit

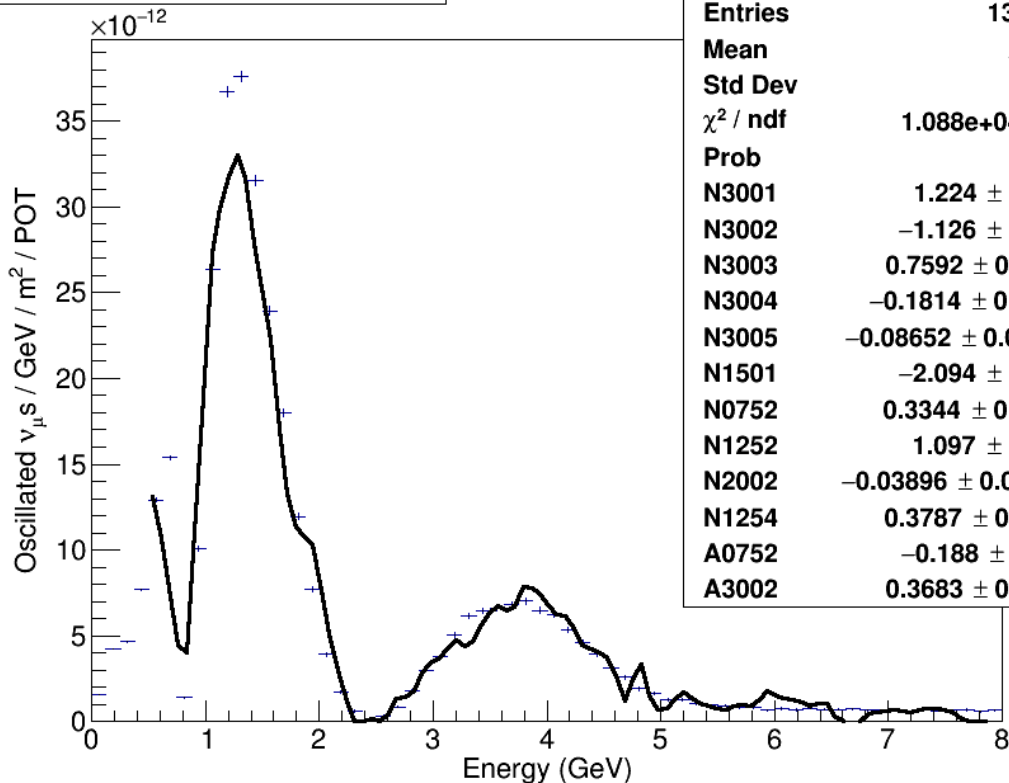
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Notation

- N/A - NuMode / AntiNuMode
- First 3 digits = current
- Last digit = Horn Config
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- 2 - A+B
- 3 - A+C
- 4 - A+B+C
- 5 - B+C

Range – 0.5 – 7.75GeV

numu_fluxosc_forplots



Linear Combination Fit



- Some reasonable agreement over certain ranges for NuMu flux
- Will also look at NuMu bar flux
- Can also include off-axis beams, both with and without different horn configurations