

Beam simulations and target studies for the NOvA Experiment

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G. Brunetti, J. Cooper, M. Del Tutto

The question: a different target would give NOvA more neutrinos/POT?

The plan:

- Simulate different target configurations
 - Changing the fins length
 - Changing the number of fins
 - Inserting gaps in between the fins
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- See what happens at the signal and background for
 - ME and LE configuration
 - On- and Off-Axis
 - Near and Far detector
 - FHC and RHC
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- Do it by using g4numi and flugg → comparison

A preliminary work has been done using

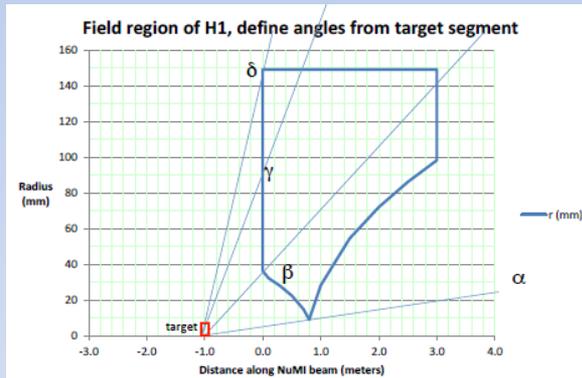
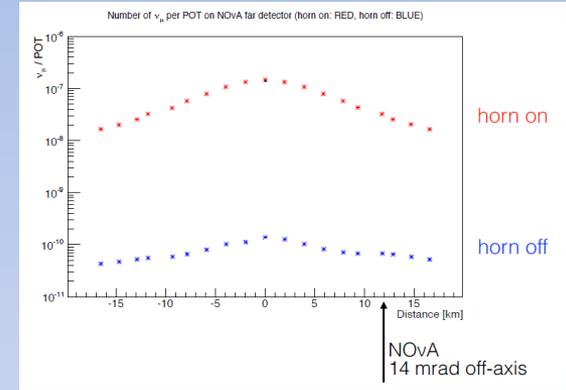
G4NuMI \rightarrow Dk2Nu \rightarrow FluxReader framework

Which can be considered as a starting point for next steps

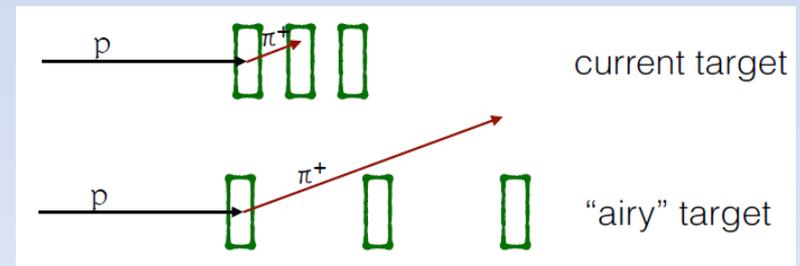
- Number of neutrinos VS FD position, with/without focusing
- Study on the trajectories of the secondaries

G4NuMI:

- Geant4: geant4-09-06-patch-01a;
- Physics list: FTFP_BERT;
- proto1-numix.

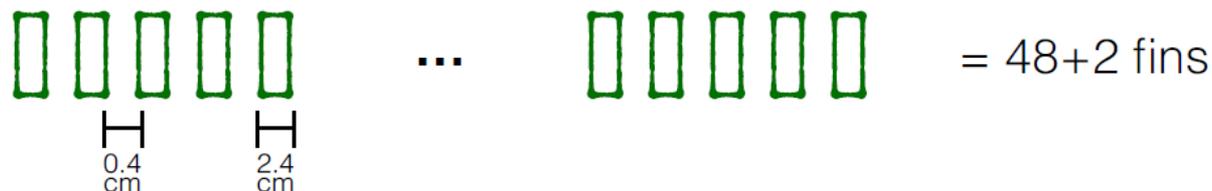


- Flux yield after removing fins from the target
- Signal & background fluxes inserting air gaps between the fins

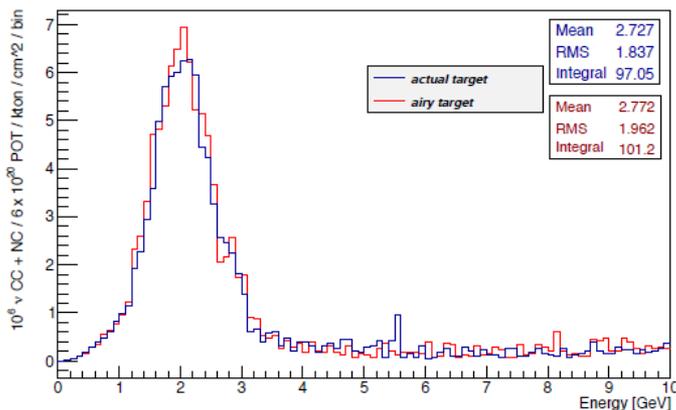


- A preliminary study was done with 10000 POT by inserting 1mm and 4mm gaps between the fins to estimate the ν_μ and ν_e fluxes at ND and at FD
- A VERY PRELIMINARY cross-check with flugg was done using 1,1.5,2 ... 4 mm gaps

Inserting gaps between the fins



ν_μ energy spectrum at near detector - CC+NC



Conclusions

- The variations observed in the fluxes with such tiny gaps are within the overall uncertainty
- At the moment we can not really compare directly the results obtained with G4NuMI and FLUGG

AND

- We need to simulated larger gaps and estimate the contribution of different parts of the target
- We need to see what happens moving the target upstream w.r.t. the focusing system
- We need to check more precisely the secondaries leaving the target

The plan is to continue this study in the next months (there are new NOvA students coming to Fermilab!) and cross-check G4NuMI vs Flugg