

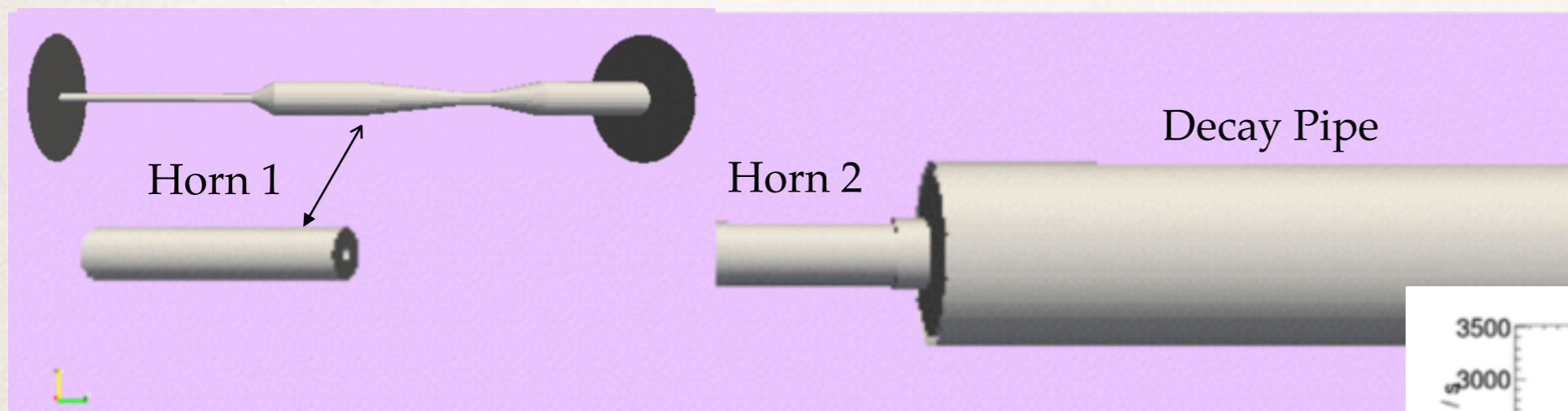
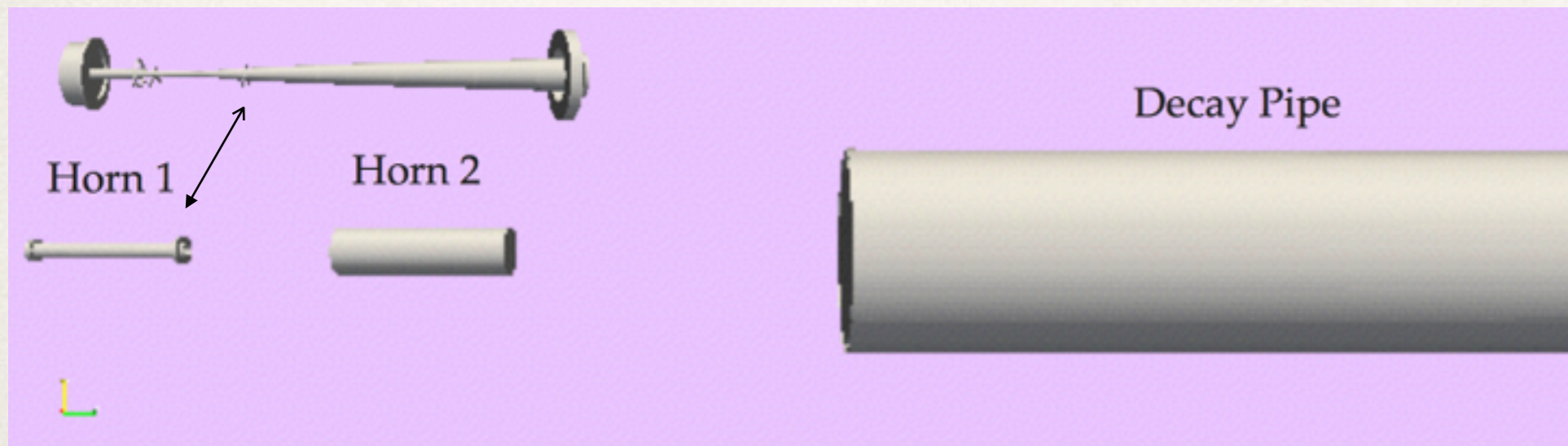
# Optimized Target Dimensions

Laura Fields

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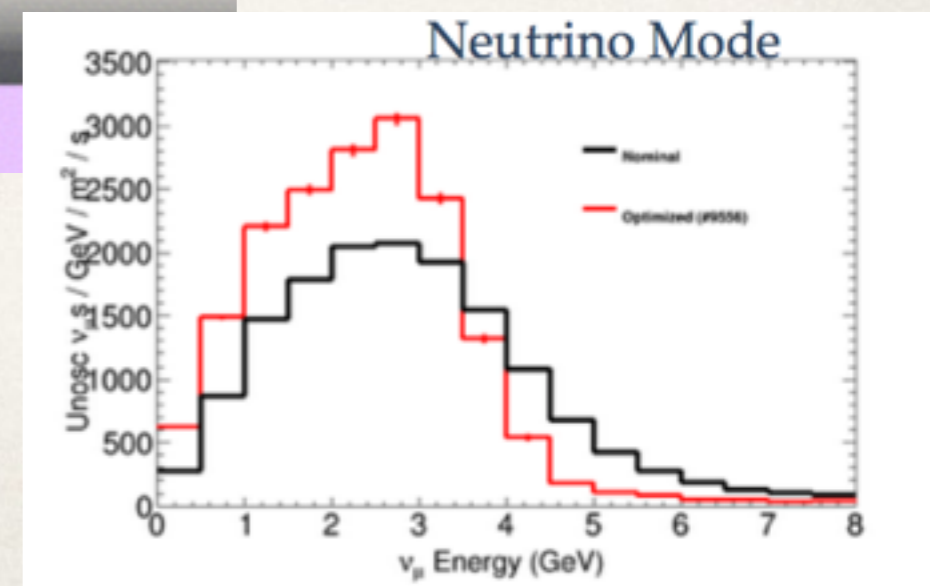
*24 September 2015*

# Introduction to Optimized Beam



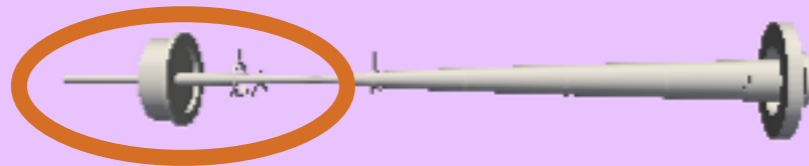
**Old news to everybody here: changes to the horn shapes/currents and target dimensions can give us more sensitivity to CP violation and the mass hierarchy**

**The various changes will be the subject of future meetings. Our focus today: the target**



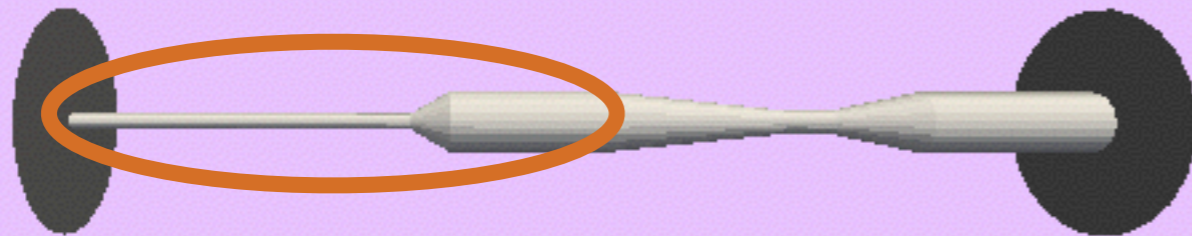
# Introduction to Optimized Beam

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**In the optimized design, the target starts at the upstream face of horn1**

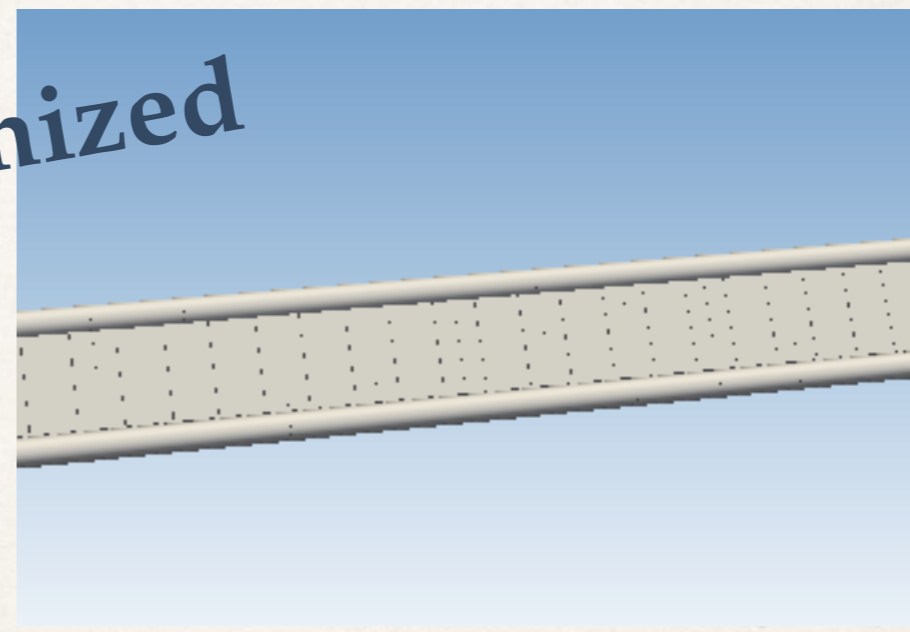
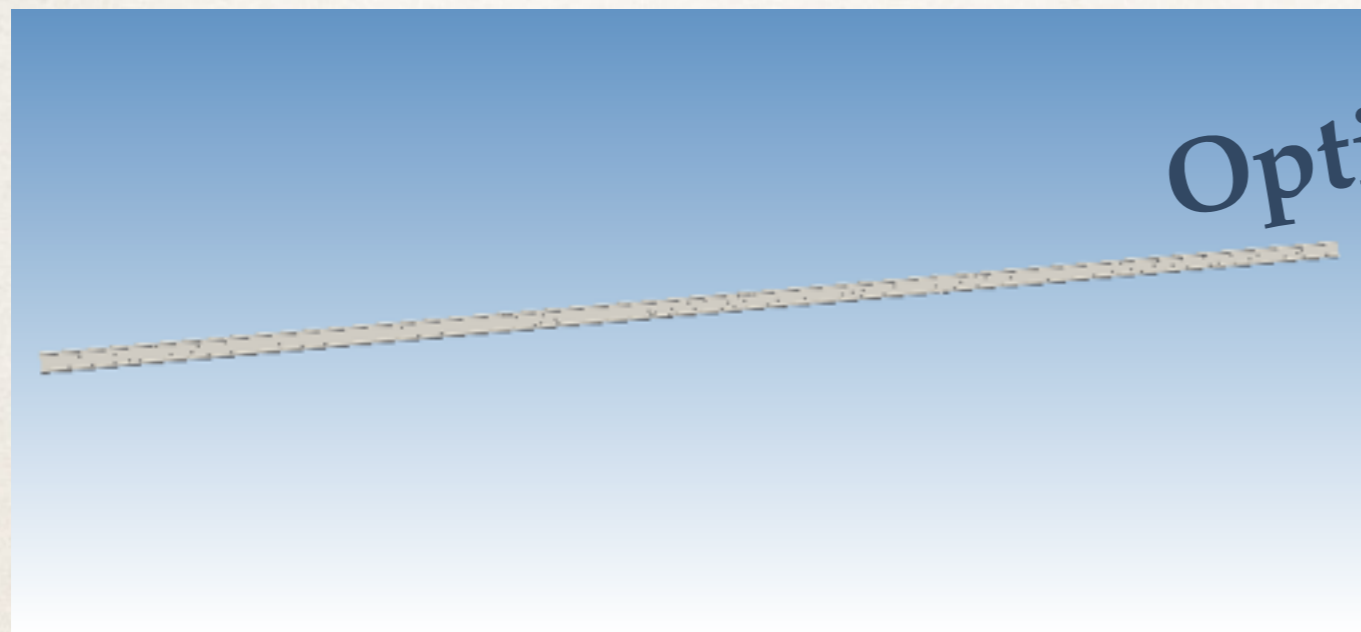
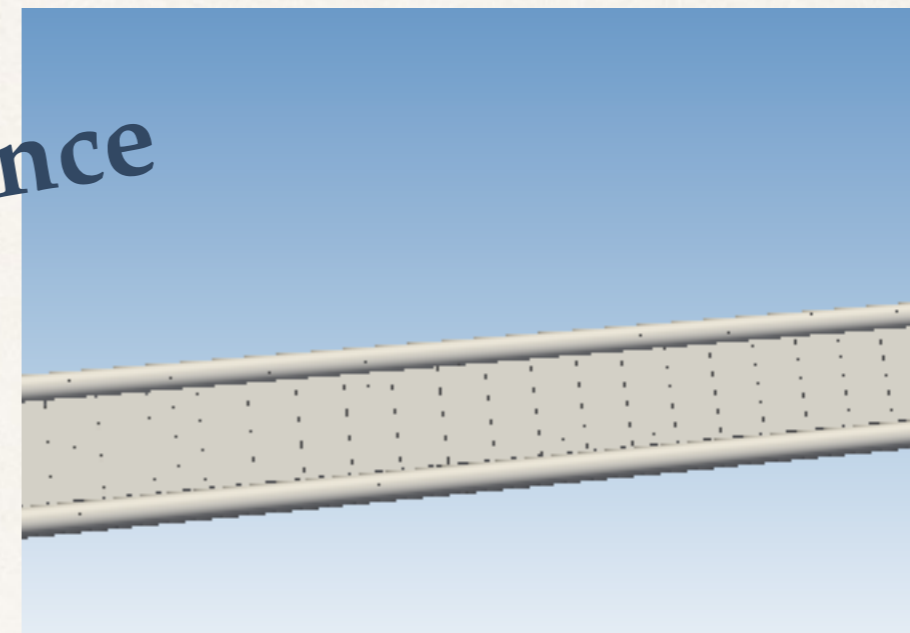
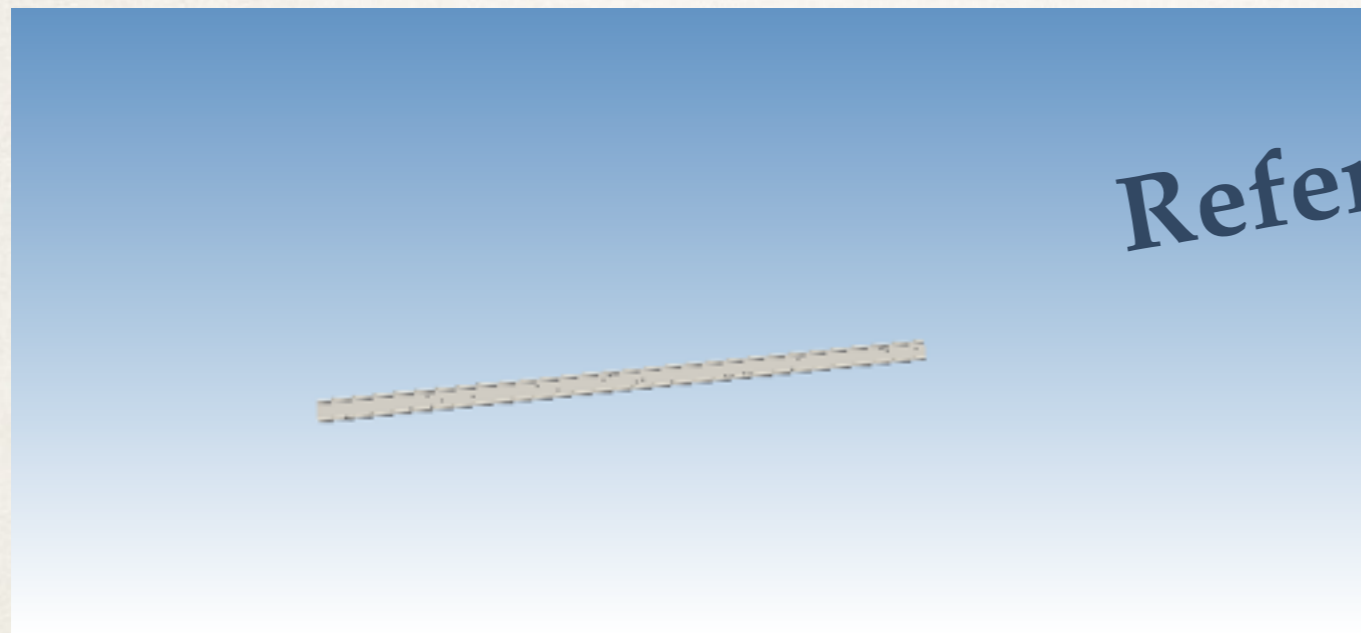
**This is distinct from the reference design, where the target begins 45 cm upstream of the same point**



Optimized target is also much longer (~2.5 m) than the reference design (~1m) and extends past the upstream cylindrical horn segment (which is 1.9 m long)

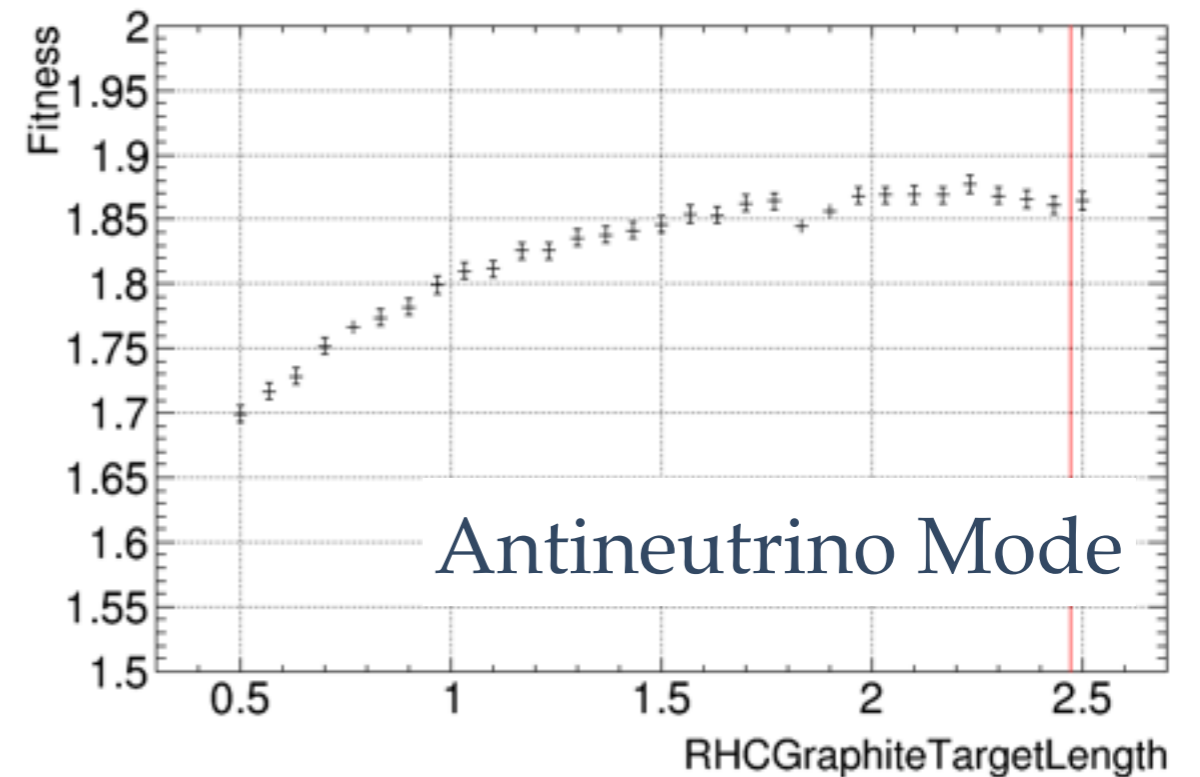
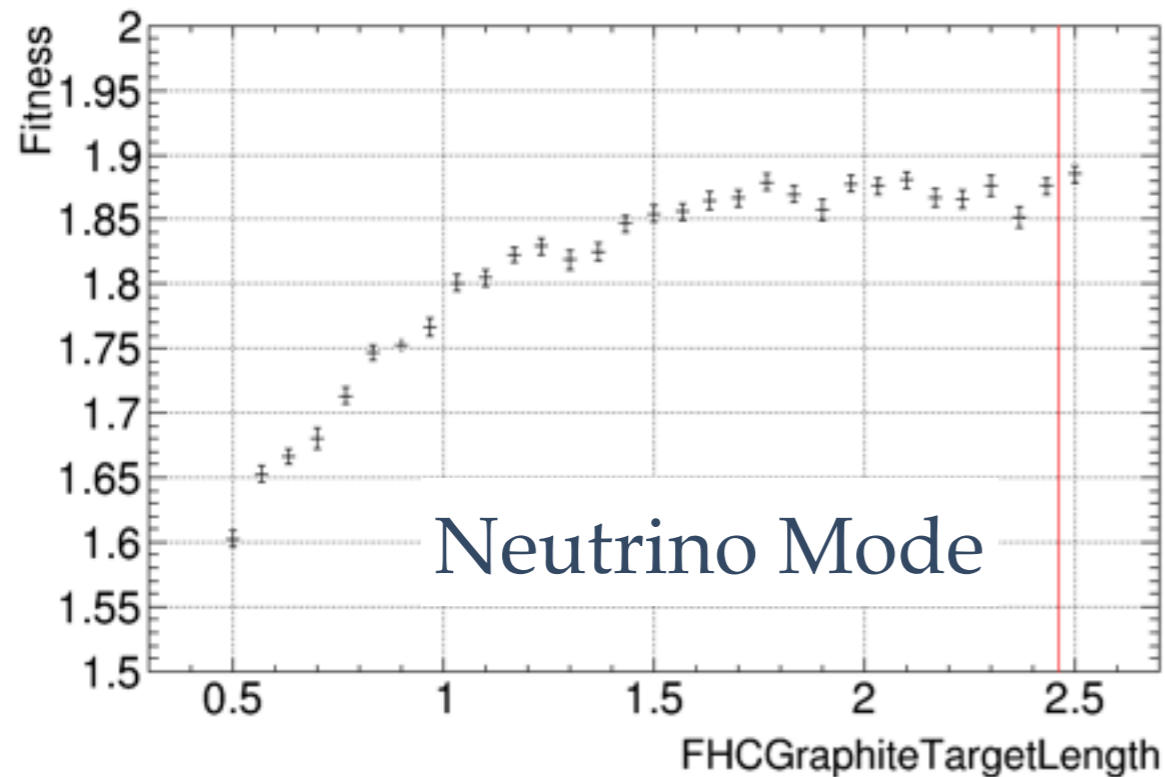
# Introduction to Optimized Beam

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Aside from the length, the targets are essentially identical  
Fin width was also varied in the optimization, but chosen value was  
~10 mm. Fin height was not varied

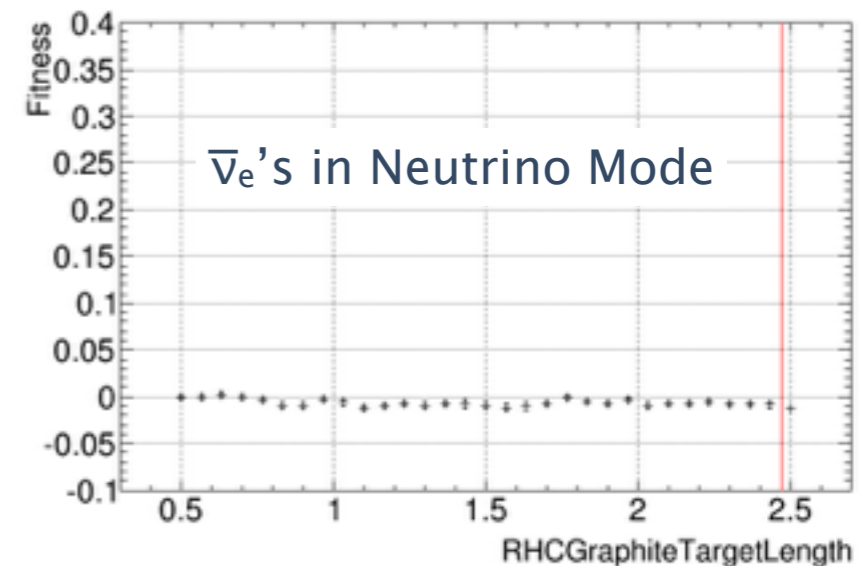
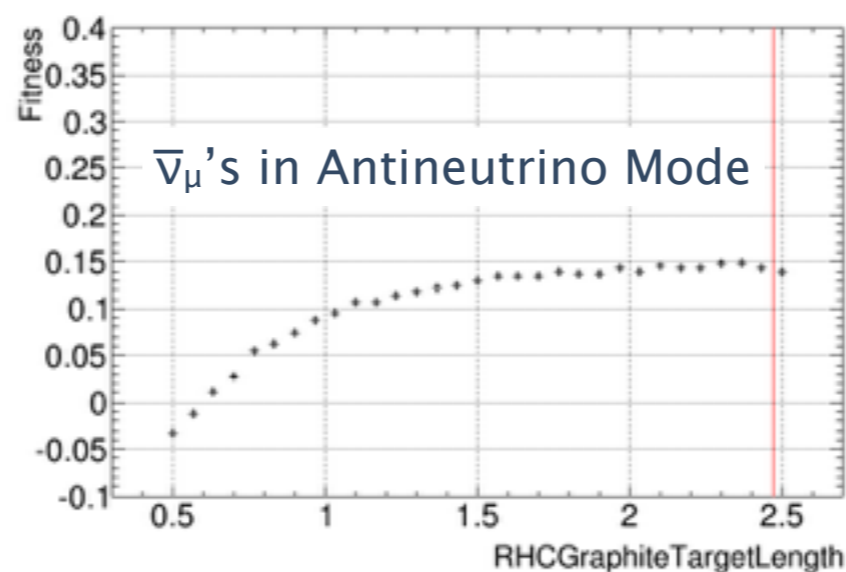
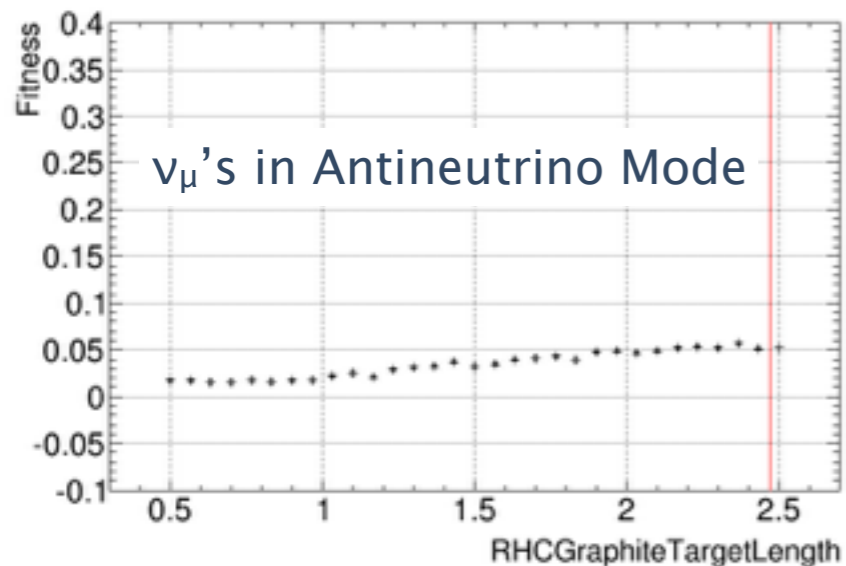
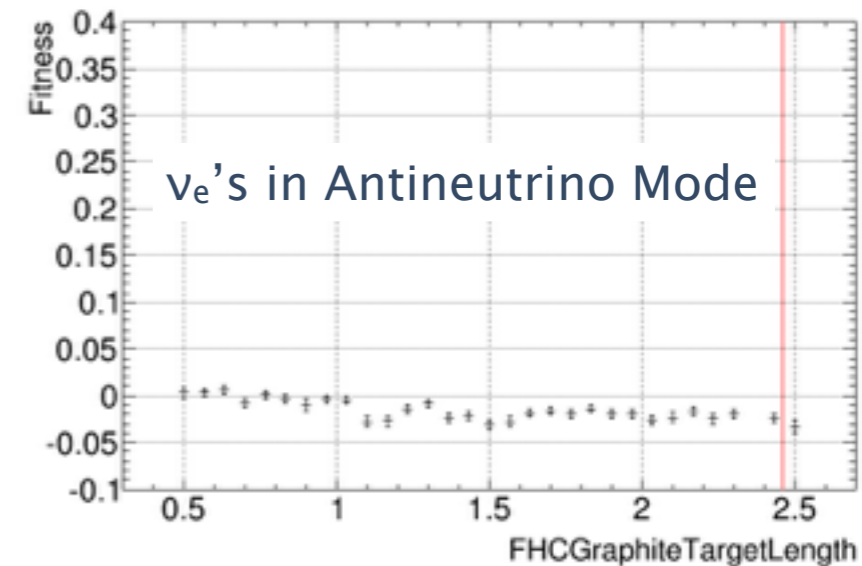
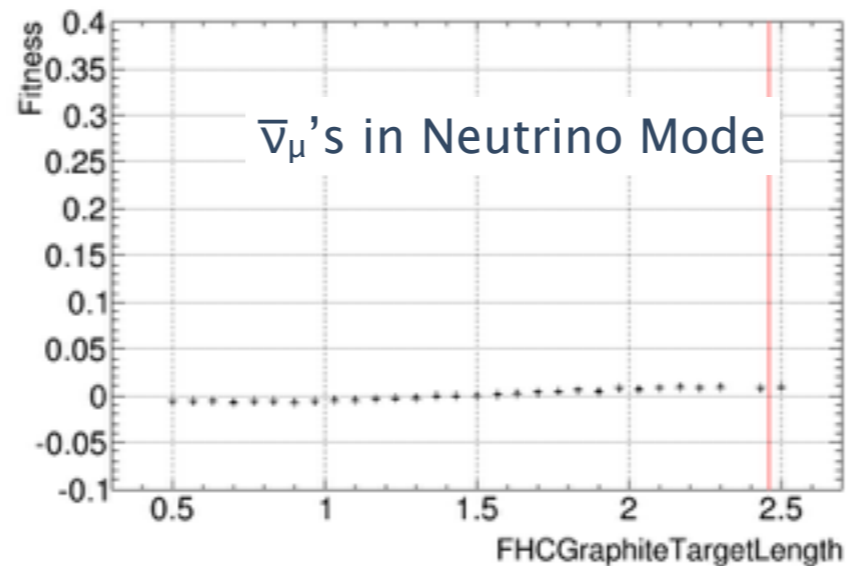
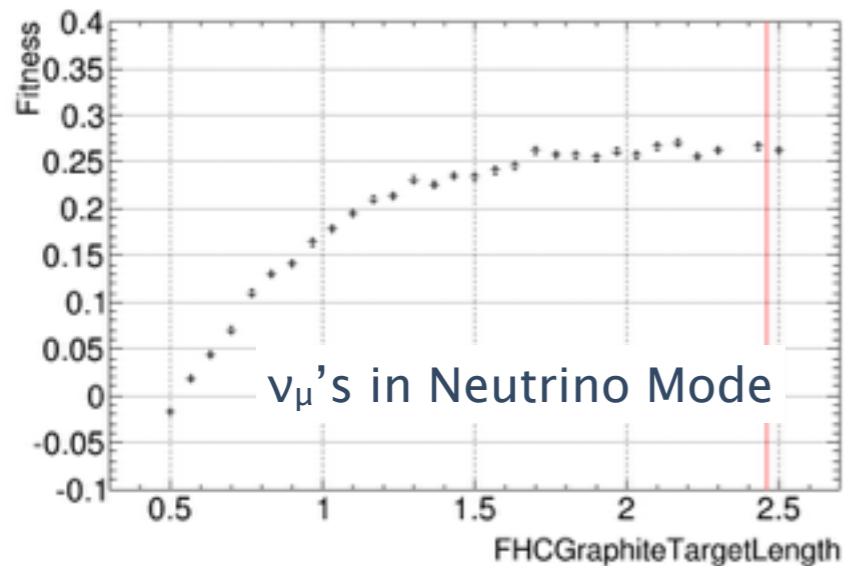
# How Much Does a Long Target Matter?



Effect on CP sensitivity varying target length  
using default hadron production model (QGSP\_BERT)

To get the total difference in CP sensitivity between two target lengths  
(assuming the same target length in neutrino and antineutrino mode),  
sum the difference observed in the left and right plots

# Which Neutrinos Matter?



Contribution to fitness from each flavor of neutrino. Bottom line: increasing signal neutrinos is driving target length. Decreasing wrong sign contamination modestly contributes. Electron neutrinos are modestly decreasing CP sensitivity.

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The End

# Optimized Parameters

Table 2: Parameters of focusing system optimization

Parameter	Allowed Range	Preferred Value FHC	Preferred Value RHC
Horn 1 $r_1$	20 - 50	40 mm	25 mm
Horn 1 $r_2$	35 - 200	166 mm	125 mm
Horn 1 $r_3$	20 - 75	65 mm	22 mm
Horn 1 $r_4$	20 - 200	167 mm	148 mm
Horn 1 $r_{OC}$	200 - 800	632 mm	660 mm
Horn 1 $l_1$	800 - 2500	1906 mm	1252 mm
Horn 1 $l_2$	50 - 1000	218 mm	713 mm
Horn 1 $l_3$	50 - 1000	911 mm	834 mm
Horn 1 $l_4$	50 - 1000	969 mm	466 mm
Horn 1 $l_5$	50 - 1000	281 mm	150 mm
Horn 1 $l_6$	50 - 1000	487 mm	890 mm
Horn 1 $l_7$	50 - 1000	979 mm	990 mm
Horn 2 Longitudinal Scale	0.5 - 2	1.39	1.84
Horn 2 Radial Scale	0.5 - 2	1.63	1.64
Horn 2 Radial Offset	-78 - 100	54.6 mm	46 mm
Horn 2 Longitudinal Position	3000 - 15000	14503 mm	13181 mm
Target Length	500 - 2500	2463 mm	2473 mm
Target Width	9 - 15	10.5 mm	10.0 mm
Proton Energy	40 - 130	109 GeV	116
Horn Current	150 - 300	297 kA	297 kA