

DUSEL Beamline Simulations Update

DUSEL collaboration mtg 10/14/08

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DUSEL
Beamline
Simulations
Update

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Recap of
previous work

NuMI focusing
system studies
for DUSEL

Optimizing
decay pipe
length

Summary

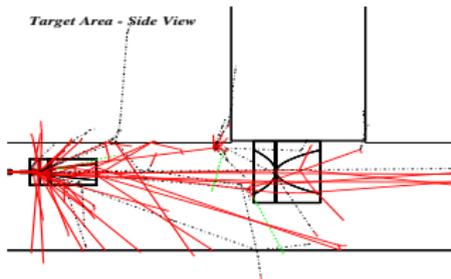
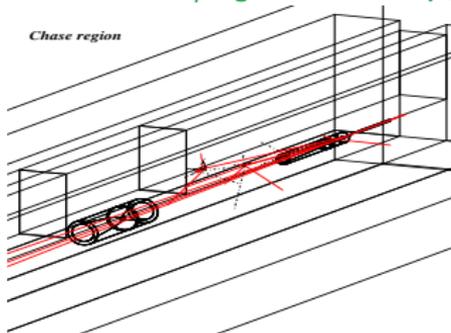
Future studies

- 1 Recap of previous work
- 2 NuMI focusing system studies for DUSEL
- 3 Optimizing decay pipe length
- 4 Summary
- 5 Future studies

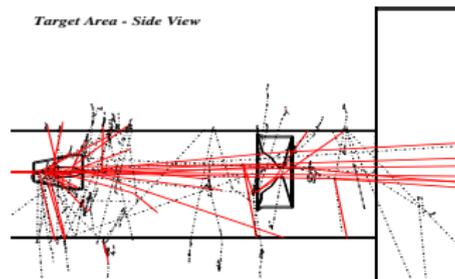
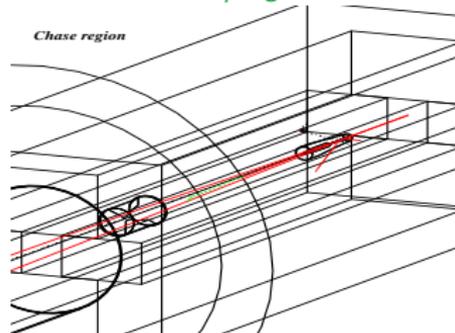
Previous beam simulations

Beam to DUSEL: carbon-composite target with a density of 2.1g/cm^3 for a MW class beam + 2 wide-band horns based on BNL-AGS E734/E889:

NuMI horns/target with 120 GeV p+



Wide-band horns/target with 120 GeV p+



GEANT 3.21 simulation of wide-band horns+decay pipe, with FLUKA '05 for target hadro-production.

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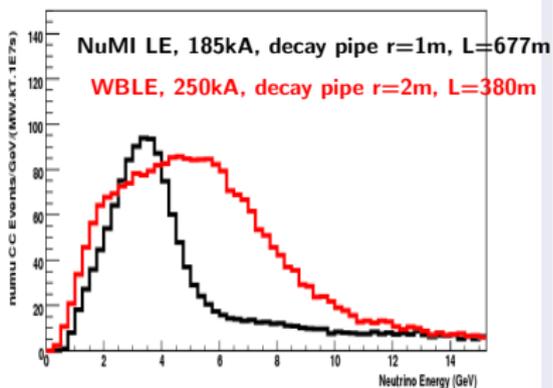
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Beam fluxes used in previous studies

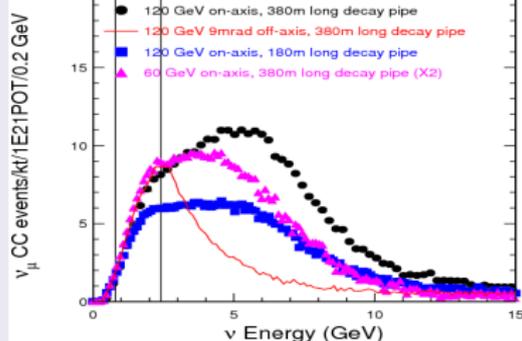
WBLE horns + shorter wider tunnel

NuMI and Wide-Band Beam Event Rates



Go off-axis to reduce HE lux

Homestake Beam with 4m Diameter Tunnel at 1300km

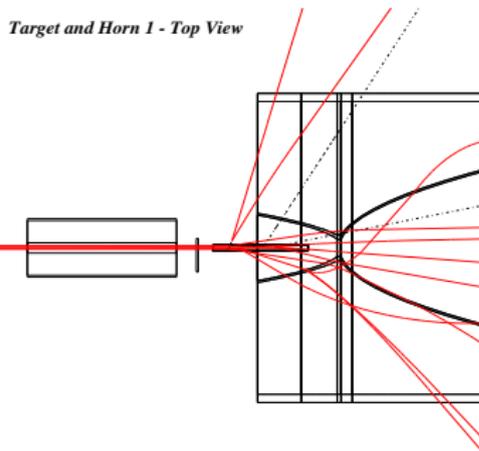


Physics sensitivity with $W\text{Ce}$, 3σ for all δ_{CP} (θ_{13} , hier)/50% δ_{CP} (CPV)

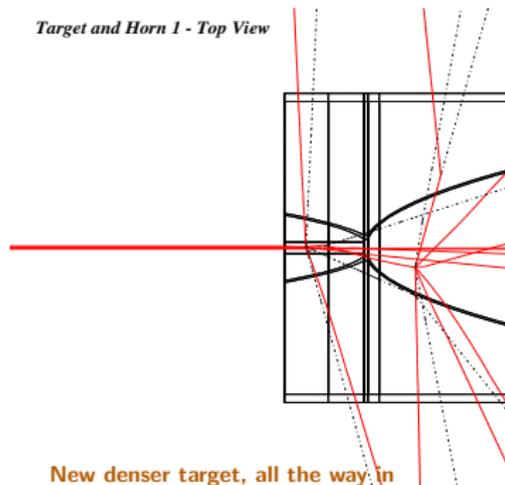
Beam	Det size (FIDUCIAL)	Exposure $\nu + \bar{\nu}$	bkgd uncert	$\sin^2 2\theta_{13}$	$\text{sign}(\Delta m_{31}^2)$	CPV
NuMI/HStake 120 GeV 9mrad off-axis	100kT	700kW 2.6+2.6yrs	5%	0.018	0.044	> 0.1
	100kT	1MW 3+3yrs	5%	0.014	0.031	> 0.1
	300kT	1MW 3+3yrs	5%	0.008	0.017	0.025
	300kT	1MW 3+3yrs	10%	0.009	0.018	0.036
	300kT	2MW 3+3yrs	5%	0.005	0.012	0.012
	300kT	2MW 3+3yrs	10%	0.006	0.013	0.015

GOAL: Optimize focusing and decay pipe size for 120 GeV beam

Insert CC target ($r=6\text{mm}, L=80\text{cm}, \rho = 2.1 \text{ g/cm}^3$) into NuMI Horn1, increase current to 250kA:

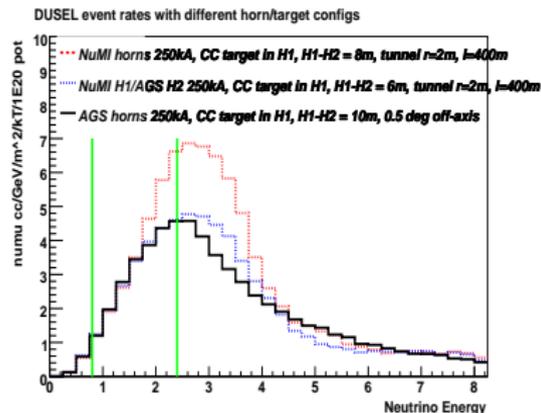
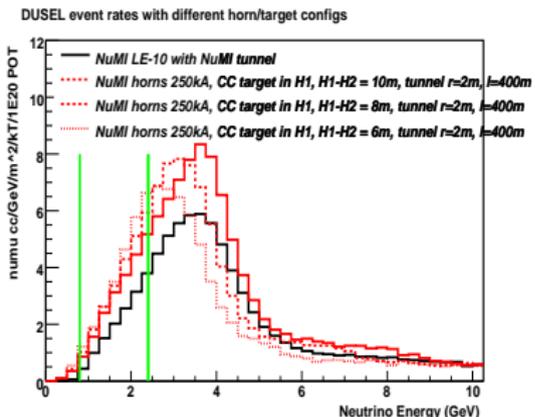


Default NuMI target/fin/baffle



New denser target, all the way in

- 1- Decrease separation between Horn1 and Horn2
- 2- Try different horn combinations of WBLE and NuMI horns



Using the NuMI horns with different target configuration and the wider decay pipe produces an on-axis flux compatible with a WCe DUSEL detector

Vary decay pipe length

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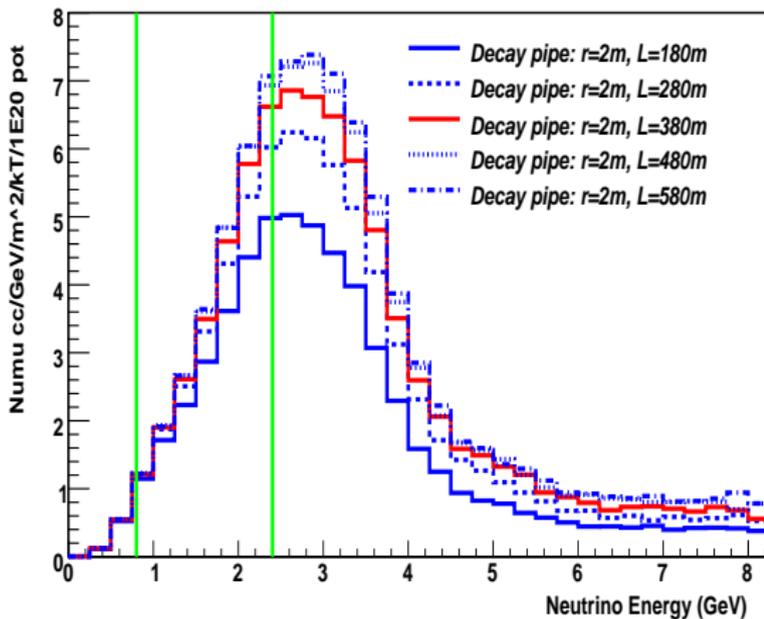
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DUSEL event rates with different decay pipe sizes



- Very preliminary studies in optimizing the focusing system for the DUSEL beamline using 120 GeV beam have demonstrated:
 - NuMI horns without modification + thicker denser target inside NuMI horn 1 can produce an **ON-AXIS** beam that will work with WCe
 - Still having trouble getting enough flux at 1GeV.
- Decay pipe lengths between 300-400m are sufficient with radius = 2m. Details of exact length will depend on civil construction costs.

- **There is still not enough flux at 1 GeV - suggestions? Change horn shape? 3 horns?**
- **Can we get rid of the HE tails with a beam plug? Probably needs reoptimization of focusing system.**
- **Study decay effect of pipe radius on flux - can we go up to 2.5m?**
- **Study different solid target sizes (preferably using FLUKA08), materials and locations in Horn 1 - this should be informed by the physical properties of the most promising materials for MW class solid targets from the R&D program (AIBuMet??).**
- **Optimize wide-band horn studies for operation at 60 GeV (Project X).**
- **Add He to decay pipe and reasses for anti-neutrino beam/low energy flux.**
- **WRITE IT ALL UP !**