Flux and rates at the detectors

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nuSTORM Phone Meeting
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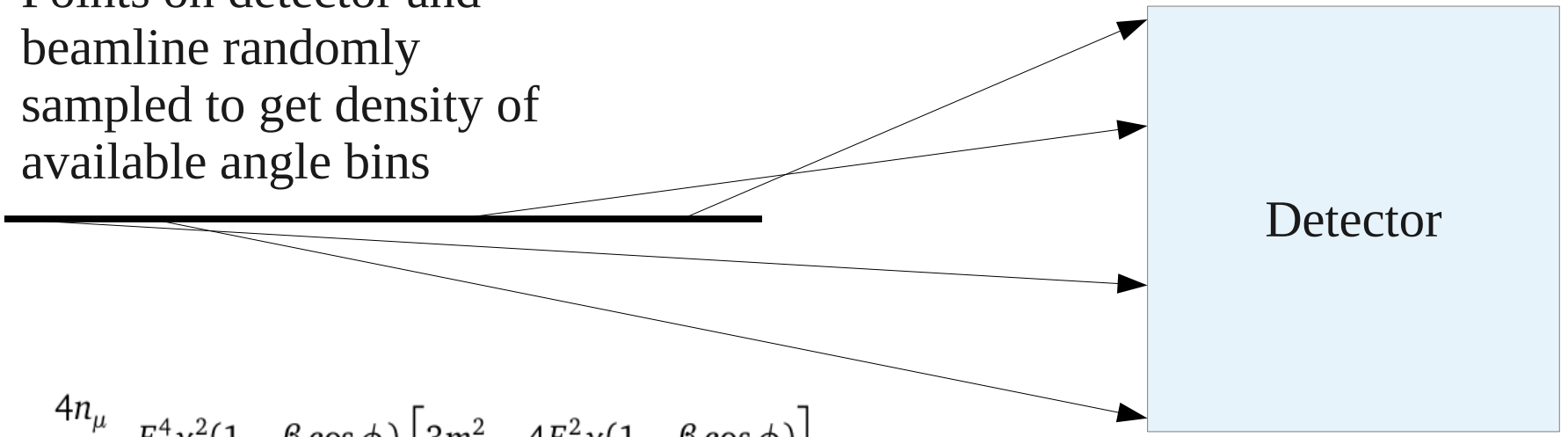
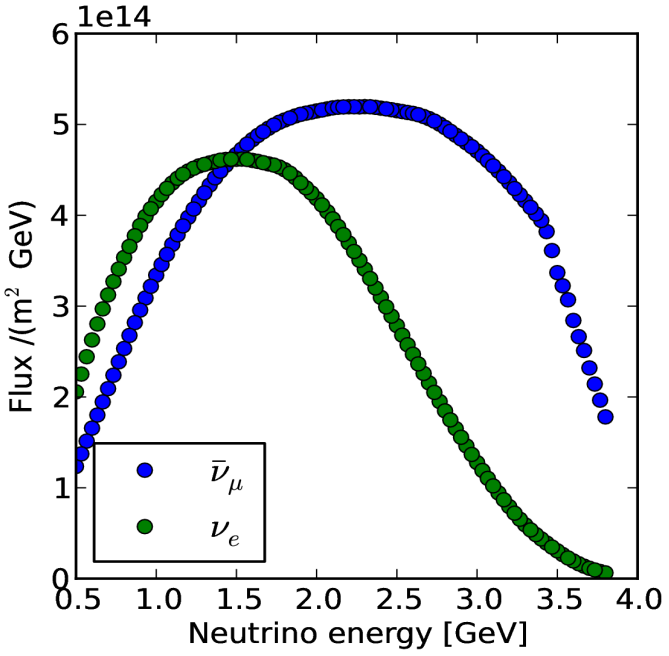
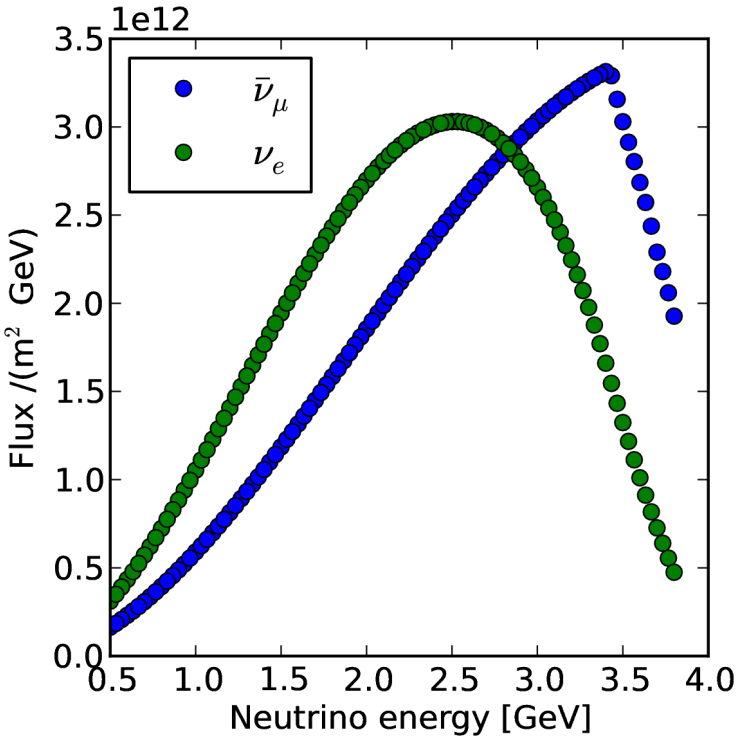
Points on detector and beamline randomly sampled to get density of available angle bins

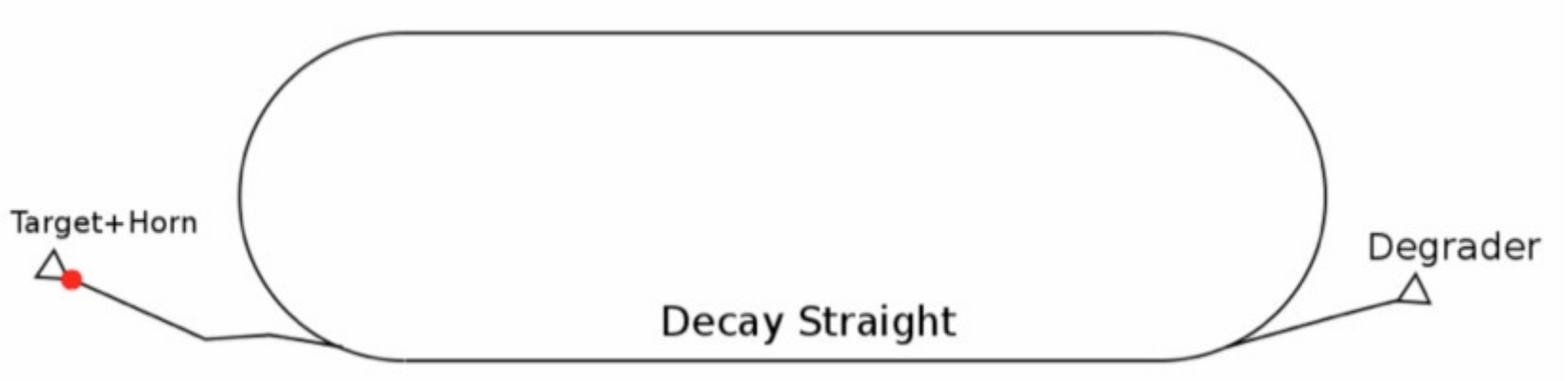


$$\frac{d^2N_\mu}{dy\,dA} = \frac{4n_\mu}{\pi L^2 m_\mu^6} E_\mu^4 y^2 (1-\beta\cos\phi)\left[3m_\mu^2 - 4E_\mu^2 y(1-\beta\cos\phi)\right],$$

$$\frac{d^2N_e}{dy\,dA} = \frac{24n_\mu}{\pi L^2 m_\mu^6} E_\mu^4 y^2 (1-\beta\cos\phi)\left[m_\mu^2 - 2E_\mu^2 y(1-\beta\cos\phi)\right],$$

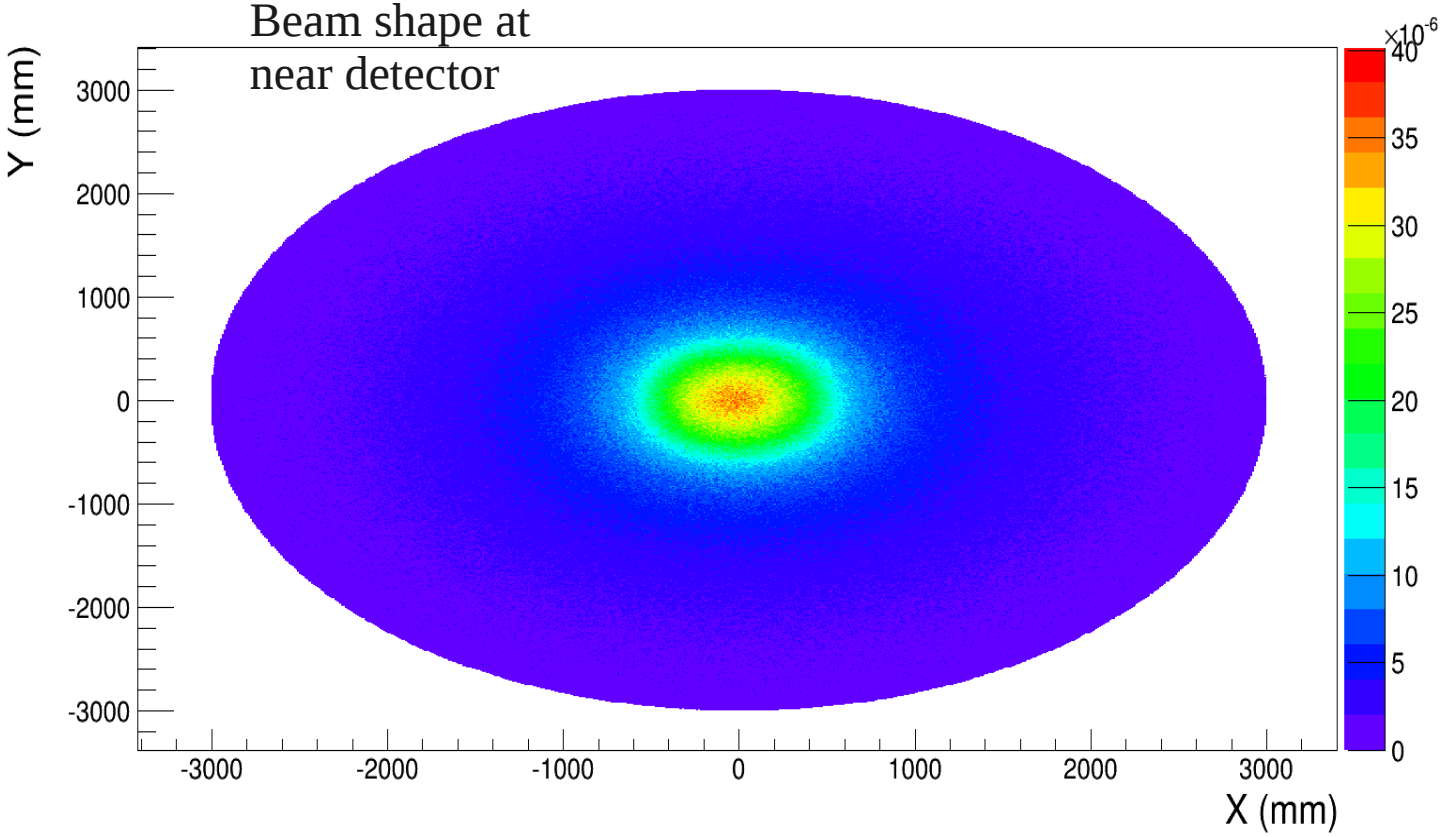


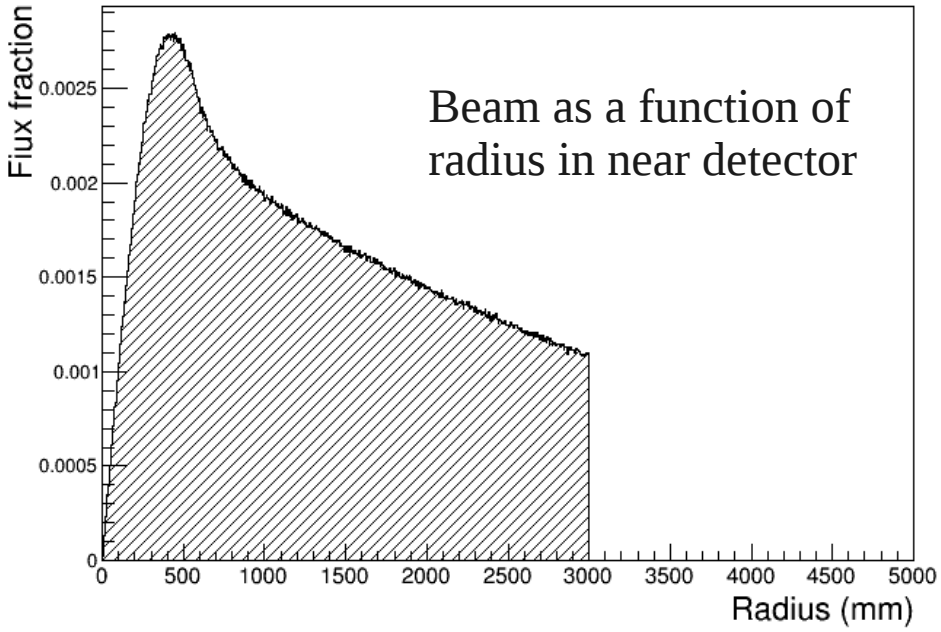




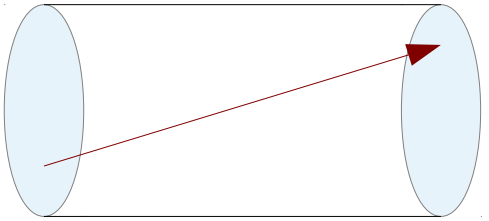
- Simulated 10^9 muons decaying along straight in G4Beamline with current optics
- Sampled neutrinos at detector plane 50m from end of decay straight with 6m radius
- Extrapolated to far detector

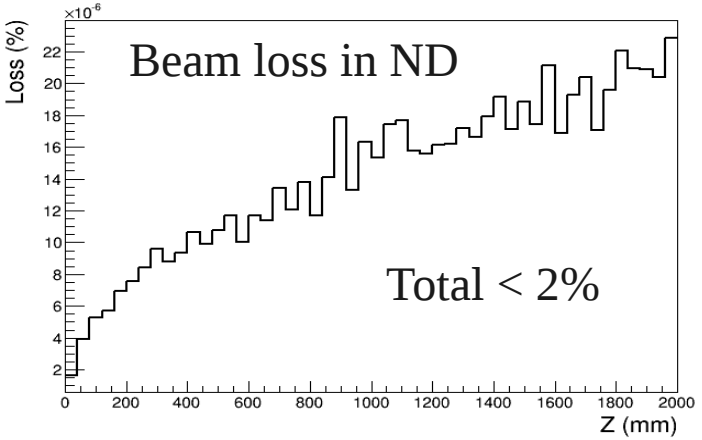
Distributions of beam at near detector

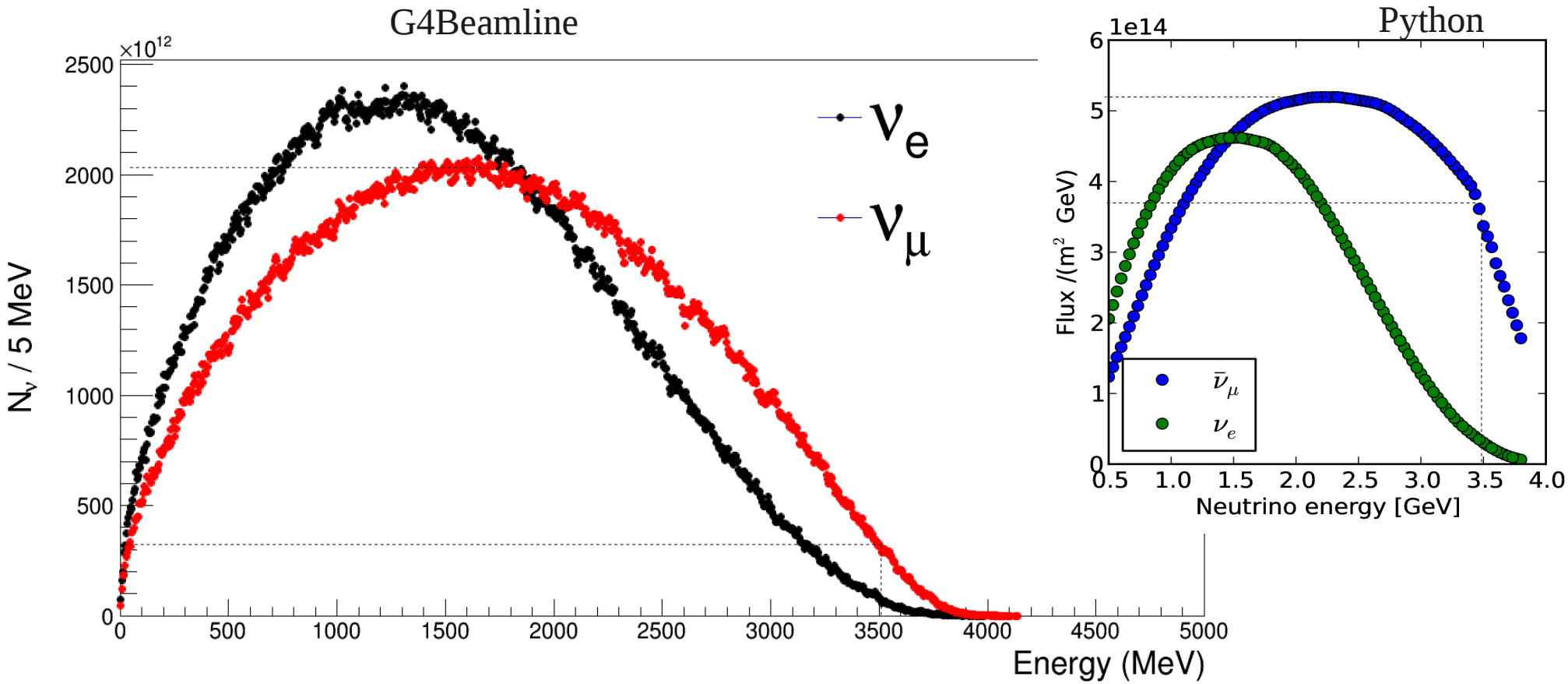




% of neutrinos that enter but leave ND



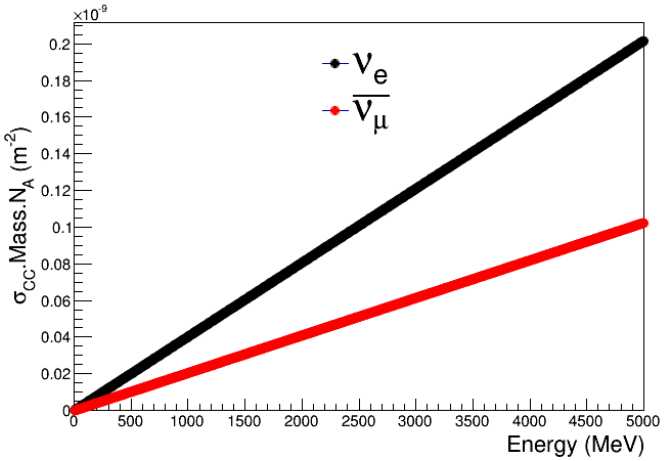


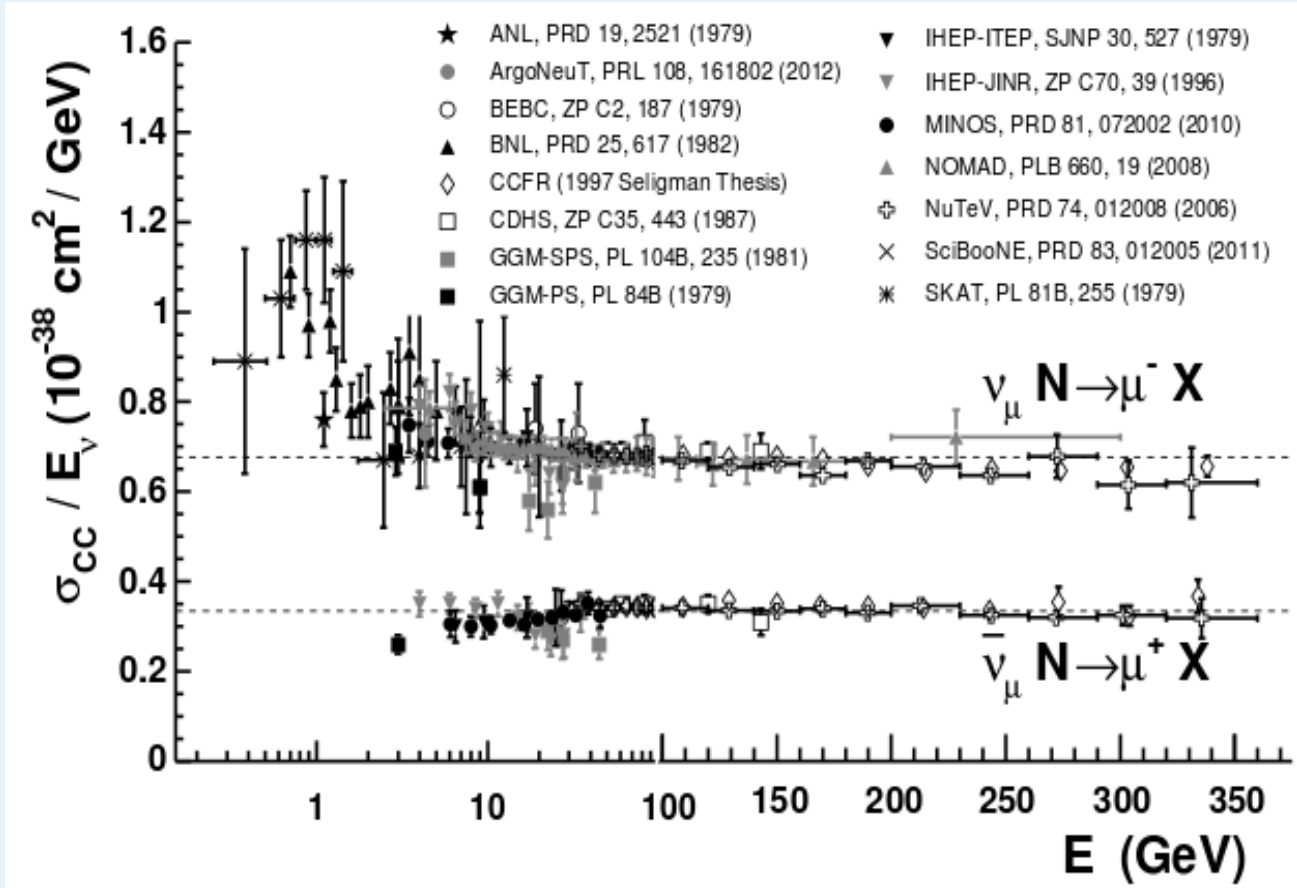


Bin all neutrinos in 3m radius at 50m with:
Weight = 1.8e18 * Fraction at detector / nSimNuAtDetector

Assuming CC cross sections linear with energy

All plots shown for CC





Anti-neutrino CC - 0.34 x 10^{-42} m^2 / GeV

Neutrino CC - 0.67 x 10^{-42} m^2 / GeV

$$N_{CC}(E) = N_\nu(E)/m^2 * \sigma(E) * Mass * N_A$$

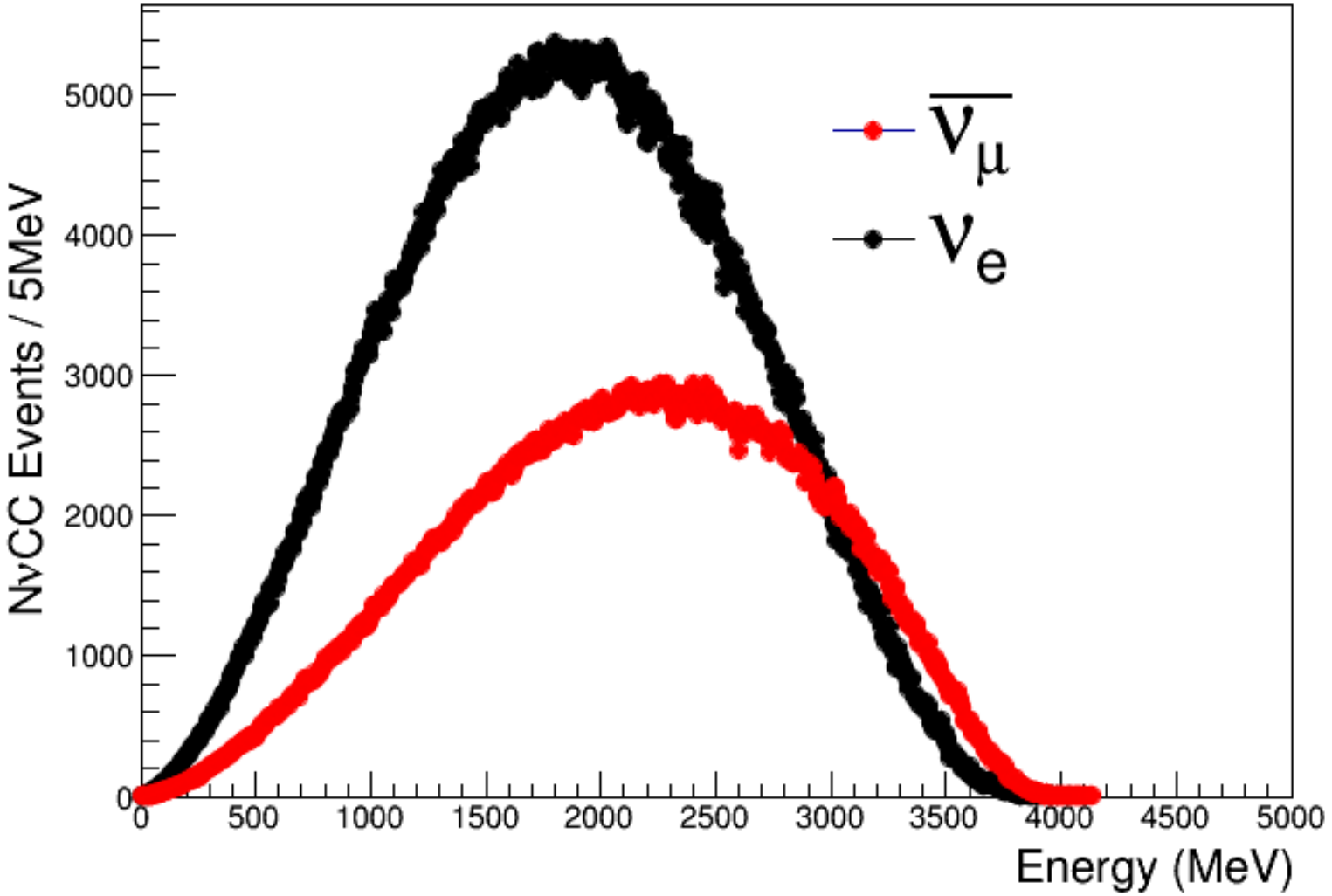
Flux at detector / area

Above cross sections in 5MeV bins

100T (converted to g)

Nucleons / g

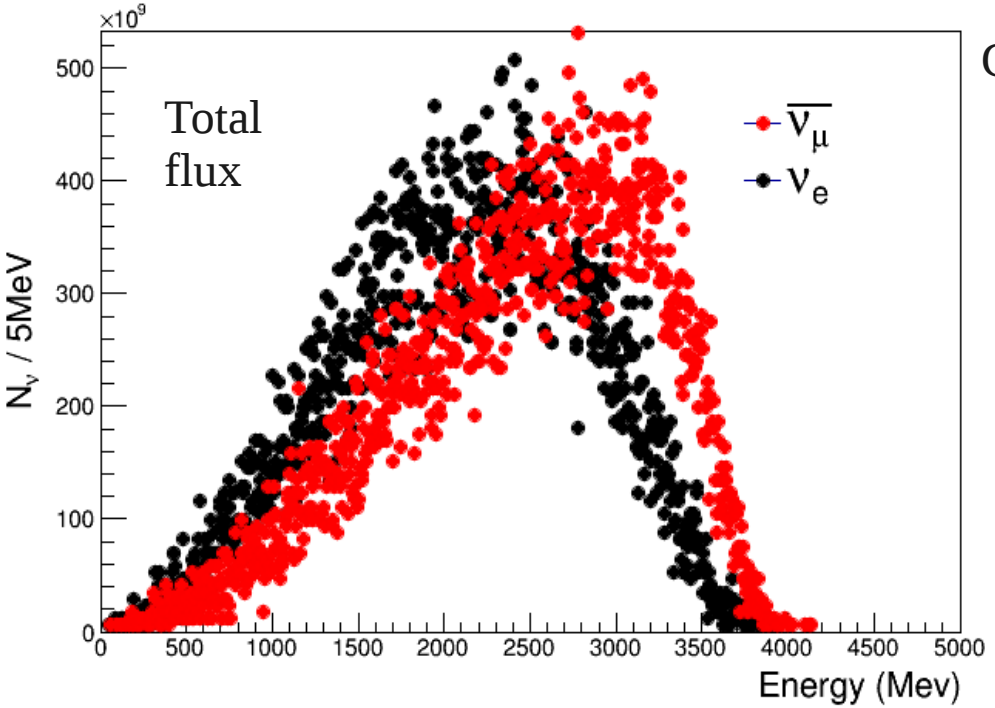
Interaction rates at near detector of 100T



2099166 ν_e

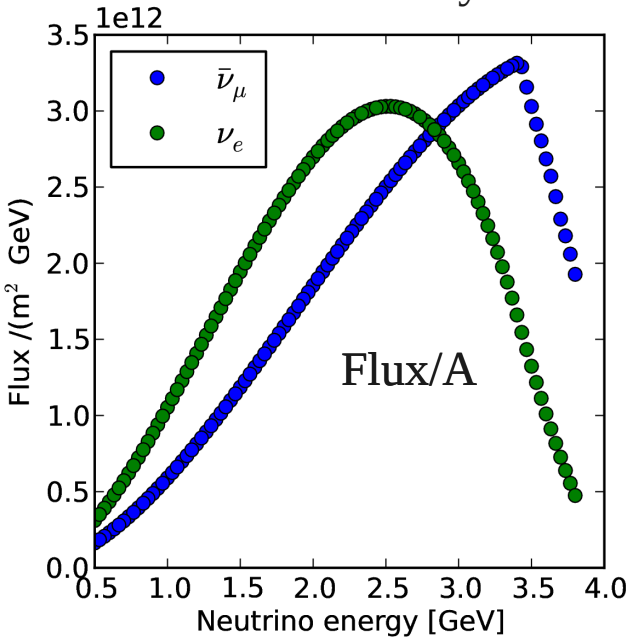
1242608 $\overline{\nu}_\mu$ per 100T

Flux + Interaction rates at far detector of 1.4kT @ 2km



G4Beamline

Python



179486 ν_e

105481 $\overline{\nu}_\mu$

Decaying particle	Channel		$N_{osc.}$	N_{null}	Diff.	$(N_{osc.} - N_{null})/\sqrt{N_{null}}$
μ^+	$\nu_e \to \nu_\mu$	CC	332	0	∞	∞
	$\bar{\nu}_\mu \to \bar{\nu}_\mu$	NC	47679	50073	–4.8%	–10.7
	$\nu_e \to \nu_e$	NC	73941	78805	–6.2%	–17.3
	$\bar{\nu}_\mu \to \bar{\nu}_\mu$	CC	122322	128433	–4.8%	–17.1
	$\nu_e \to \nu_e$	CC	216657	230766	–6.1%	–29.4
π^+	$\nu_\mu \to \nu_\mu$	CC	?	?	?	?
	$\nu_\mu \to \nu_e$	CC	?	?	?	?
μ^-	$\bar{\nu}_e \to \bar{\nu}_\mu$	CC	117	0	∞	∞
	$\bar{\nu}_e \to \bar{\nu}_e$	NC	30511	32481	–6.1%	–10.9
	$\nu_\mu \to \nu_\mu$	NC	66037	69420	–4.9%	–12.8
	$\bar{\nu}_e \to \bar{\nu}_e$	CC	77600	82589	–6.0%	–17.4
	$\nu_\mu \to \nu_\mu$	CC	197284	207274	–4.8%	–21.9
π^-	$\bar{\nu}_\mu \to \bar{\nu}_\mu$	CC	?	?	?	?
	$\bar{\nu}_\mu \to \bar{\nu}_e$	CC	?	?	?	?

Python + Globes