Summary of Neutrino Interaction Rates for VLBNO Experiments

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Abstract

Summary of Monte Carlo estimates of neutrino interaction rates for various NuMI off-axis energy and beam configurations and FNAL-DUSEL Wide-Band Low-Energy (WBLE) beams.

TABLE I: Signal and background interaction rates for various NuMI beam configurations, baselines and off-axis distances. Rates are given per 10^{20} POT per kT. The rates are integrated over the range 0-120 GeV. For $\nu_\mu \to \nu_e$ oscillations a value of $\sin^2 2\theta_{13} = 0.04$ and $\Delta m^2_{31} = 2.5 \times 10^{-3}$ eV^2 is used. No detector model is used.

Distance off-axis	ν_μ CC	ν_μ CC osc	ν_e CC beam	ν_e QE beam	NC-1π^0	$\nu_\mu \to \nu_e$ CC	$\nu_\mu \to \nu_e$ QE
NuMI LE tune at 700 km							
0 km	92.6	68.2	1.104	0.074	3.67	0.672	0.167
40 km	1.002	0.547	0.038	0.013	0.078	0.015	0.010
NuMI LE tune at 810 km							
0 km	68.8	47.0	0.838	0.056	2.733	0.606	0.142
6 km	43.3	25.5	0.614	0.053	2.101	0.492	0.131
12 km	17.6	7.44	0.326	0.042	1.195	0.273	0.096
30 km	2.333	1.695	0.071	0.018	0.220	0.022	0.012
40 km	1.104	0.593	0.039	0.012	0.093	0.018	0.012
NuMI pME tune at 810 km							
0 km	143.9	115.5	1.053	0.064	4.236	0.764	0.124
6 km	60.0	40.7	0.740	0.057	2.399	0.538	0.115
12 km	16.2	7.51	0.355	0.039	0.984	0.237	0.079
30 km	1.850	1.277	0.064	0.014	0.144	0.018	0.009
40 km	0.888	0.501	0.034	0.009	0.066	0.013	0.007
NuMI ME tune at 810 km							
0 km	276.5	236.2	1.80	0.0914	6.96	1.40	0.188
6 km	79.4	53.2	1.068	0.0770	3.194	0.879	0.171
12 km	18.9	8.06	0.443	0.0485	1.168	0.305	0.099
30 km	1.84	1.20	0.0730	0.0152	0.135	0.0216	0.0108
40 km	0.861	0.506	0.0378	0.0097	0.0605	0.0121	0.0057

TABLE II: Signal and background interaction rates at 1300 Km (Fermilab-HOMESTAKE) using different WBLE beam energies and of axis angles. The rates integrated over the neutrino energy range of 0 - 120 GeV. Rates are given per 10^{20} POT per kT. For $\nu_\mu \to \nu_e$ oscillations a value of $\sin^2 2\theta_{13} = 0.04$ and $\Delta m^2_{31} = 2.5 \times 10^{-3}$ eV^2 is used. No detector model is used.

Degrees off-axis	ν_μ CC	ν_μ CC osc	ν_e CC beam	ν_e QE beam	NC-1π^0	$\nu_\mu \to \nu_e$ CC	$\nu_\mu \to \nu_e$ QE
WBLE 120 GeV at 1300 km with decay pipe 2m radius 380 m length							
0°	44.3	26.0	0.427	0.030	1.624	0.566	0.105
0.5°	20.4	9.5	0.216	0.025	1.004	0.317	0.078
1.0°	7.66	4.11	0.114	0.019	0.525	0.092	0.034
2.5°	1.10	0.487	0.023	0.008	0.093	0.020	0.013
WBLE 60 GeV at 1300 km with decay pipe 2m radius 380 m length							
0°	16.0	7.4	0.099	0.012	0.722	0.250	0.052
0.5°	8.39	3.07	0.072	0.011	0.490	0.149	0.040
1.0°	3.71	1.86	0.045	0.009	0.281	0.047	0.018
2.5°	0.61	0.265	0.012	0.004	0.053	0.011	0.008
WBLE 40 GeV at 1300 km with decay pipe 2m radius 380 m length							
0°	7.72	3.02	0.042	0.007	0.403	0.134	0.031
WBLE 28 GeV at 1300 km with decay pipe 2m radius 180 m length							
0°	2.41	0.896	0.012	0.003	0.170	0.048	0.014

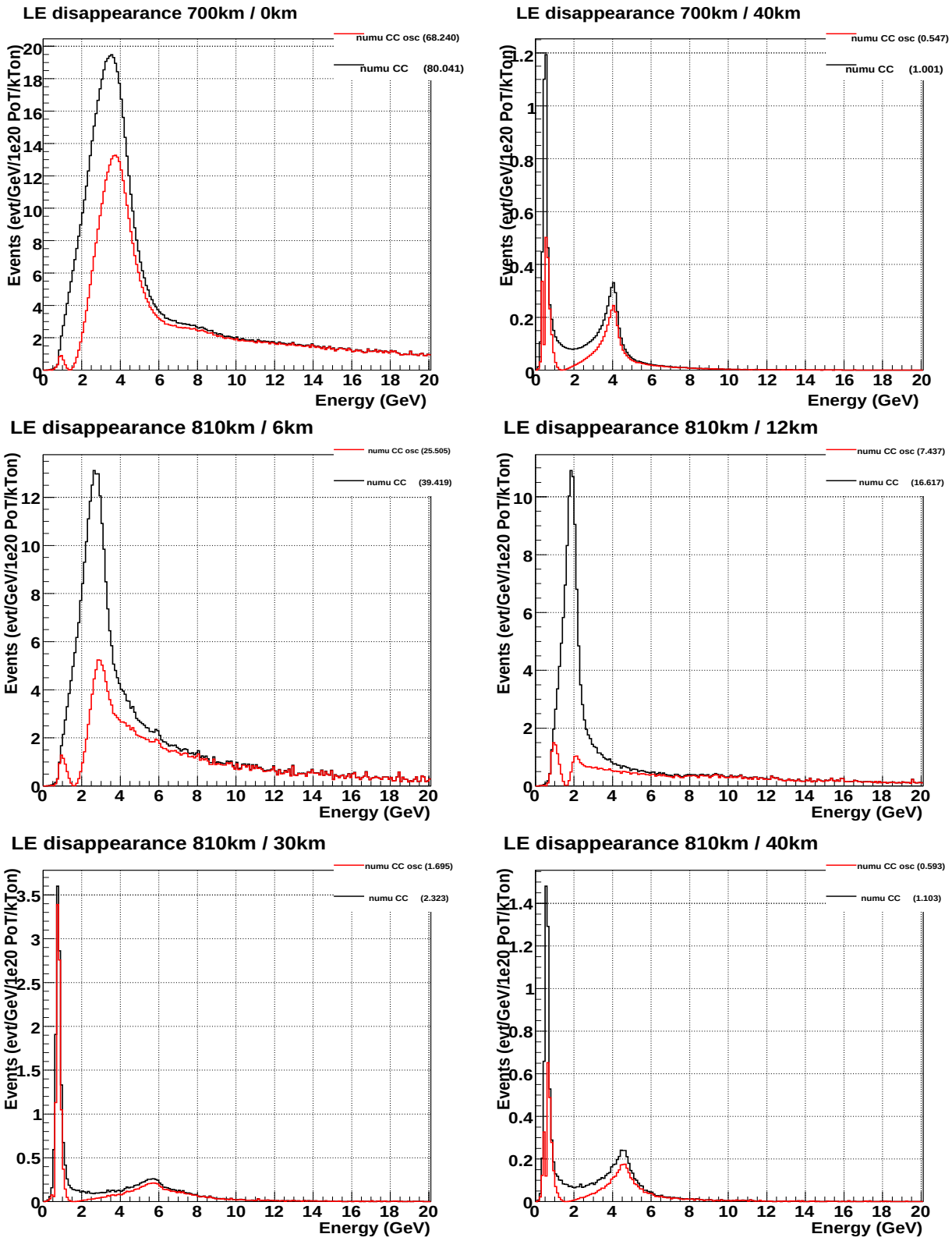

FIG. 1: $\nu_\mu \to \nu_\mu$ total CC interaction rates for NuMI LE tune and various off-axis options.

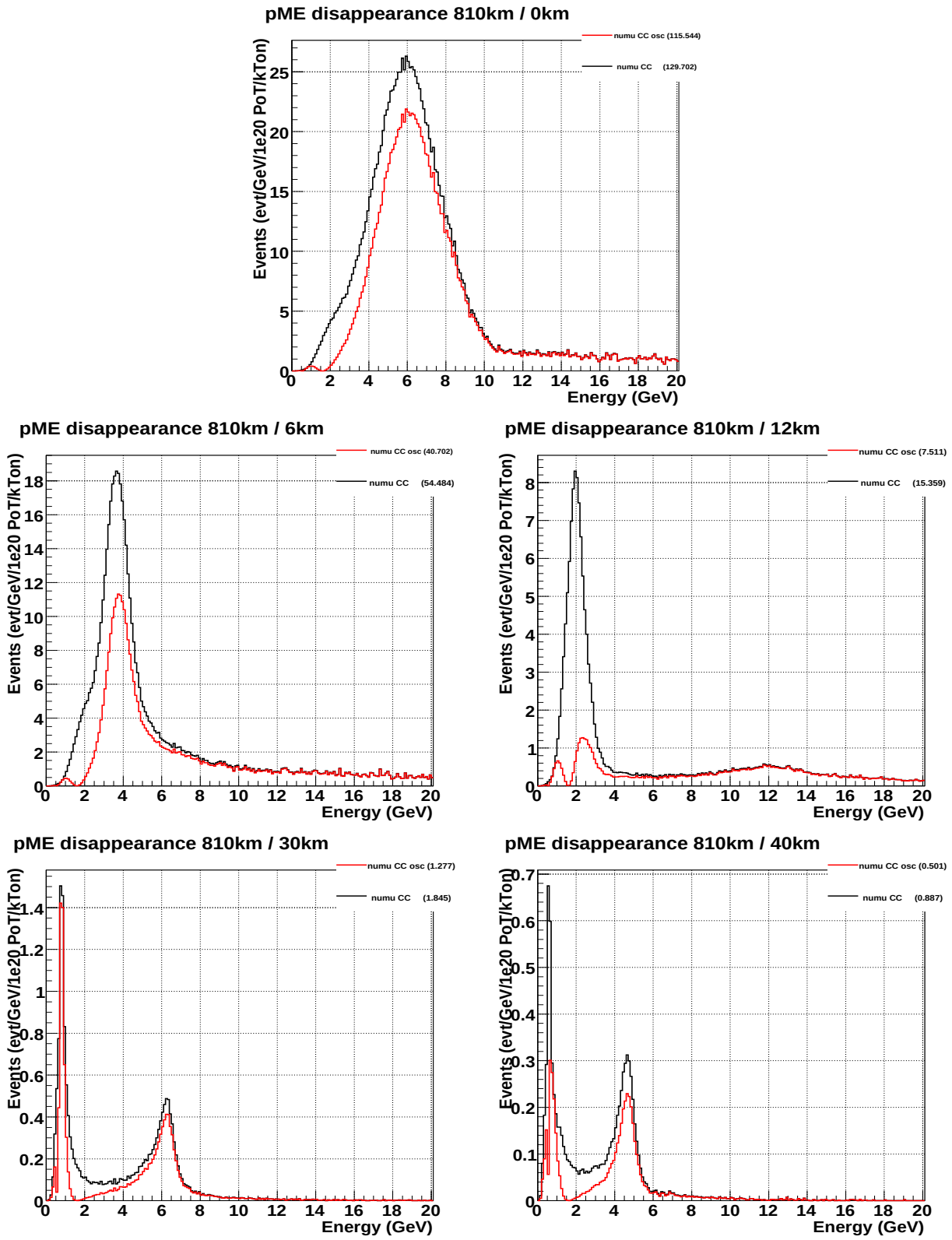

FIG. 2: $\nu_\mu \to \nu_\mu$ total CC interaction rates for NuMI pME tune and various off-axis options.

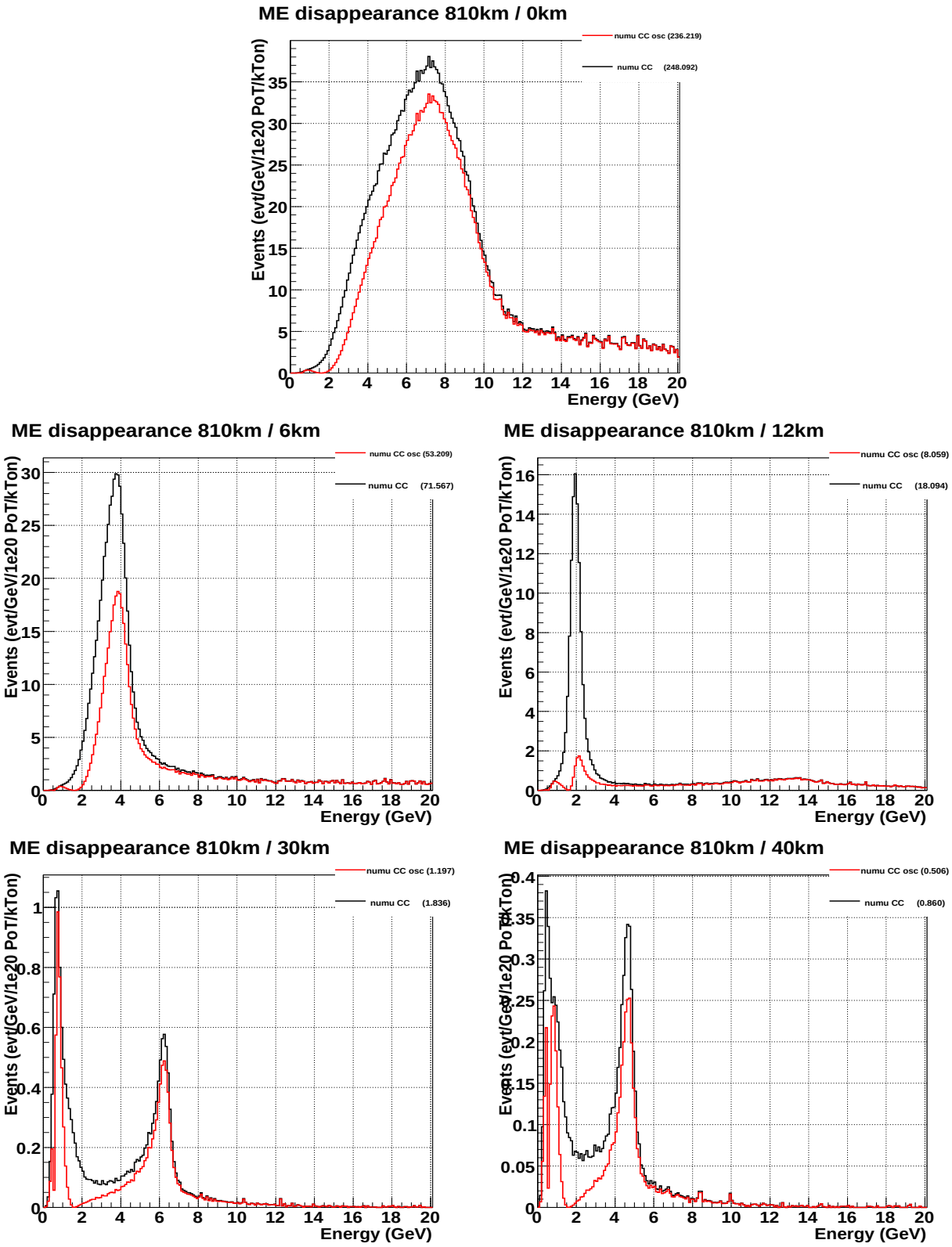

FIG. 3: $\nu_\mu \to \nu_\mu$ total CC interaction rates for NuMI ME tune and various off-axis options.

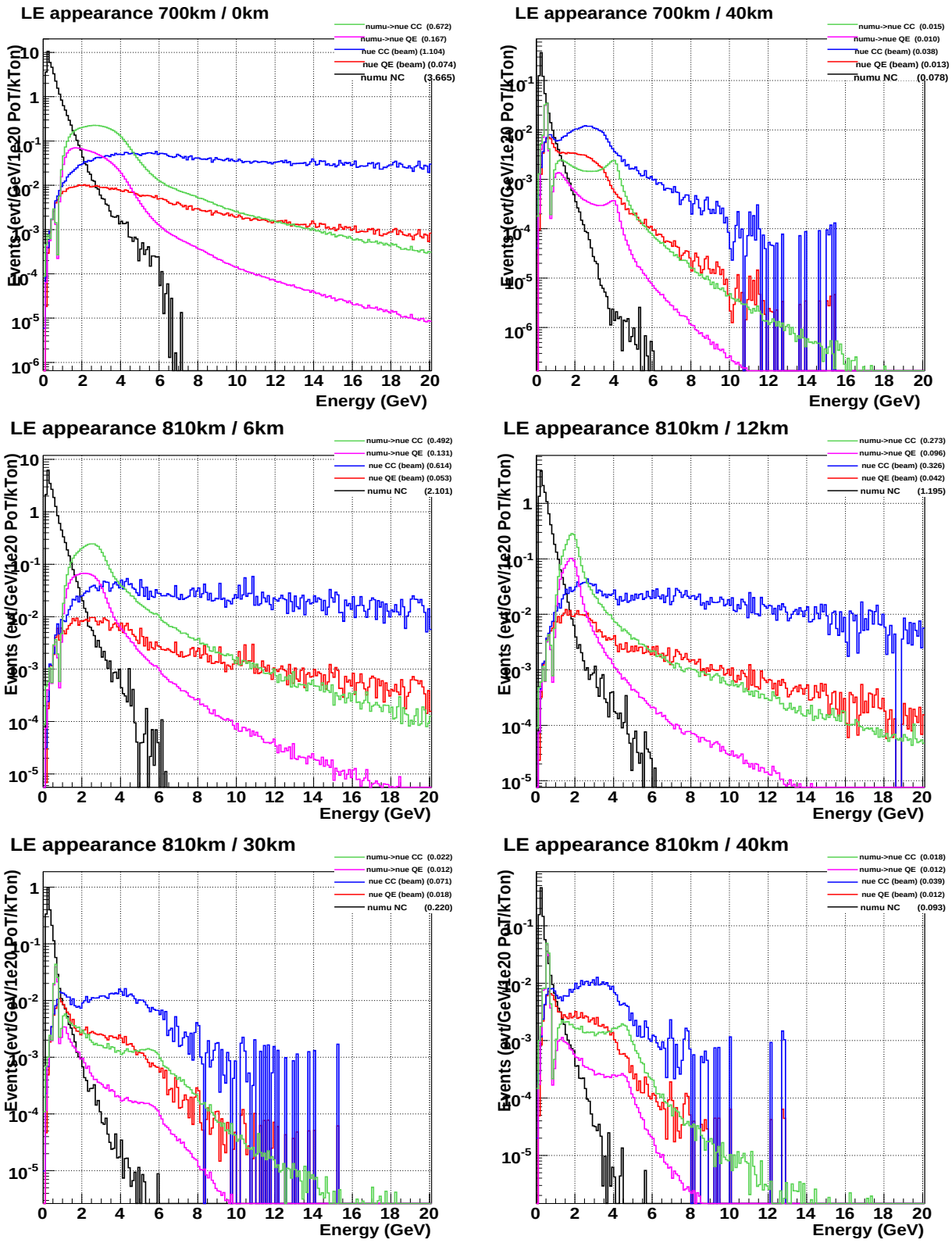

FIG. 4: $\nu_\mu \rightarrow \nu_e$ CC interaction rates for NuMI LE tune and various off-axis options.

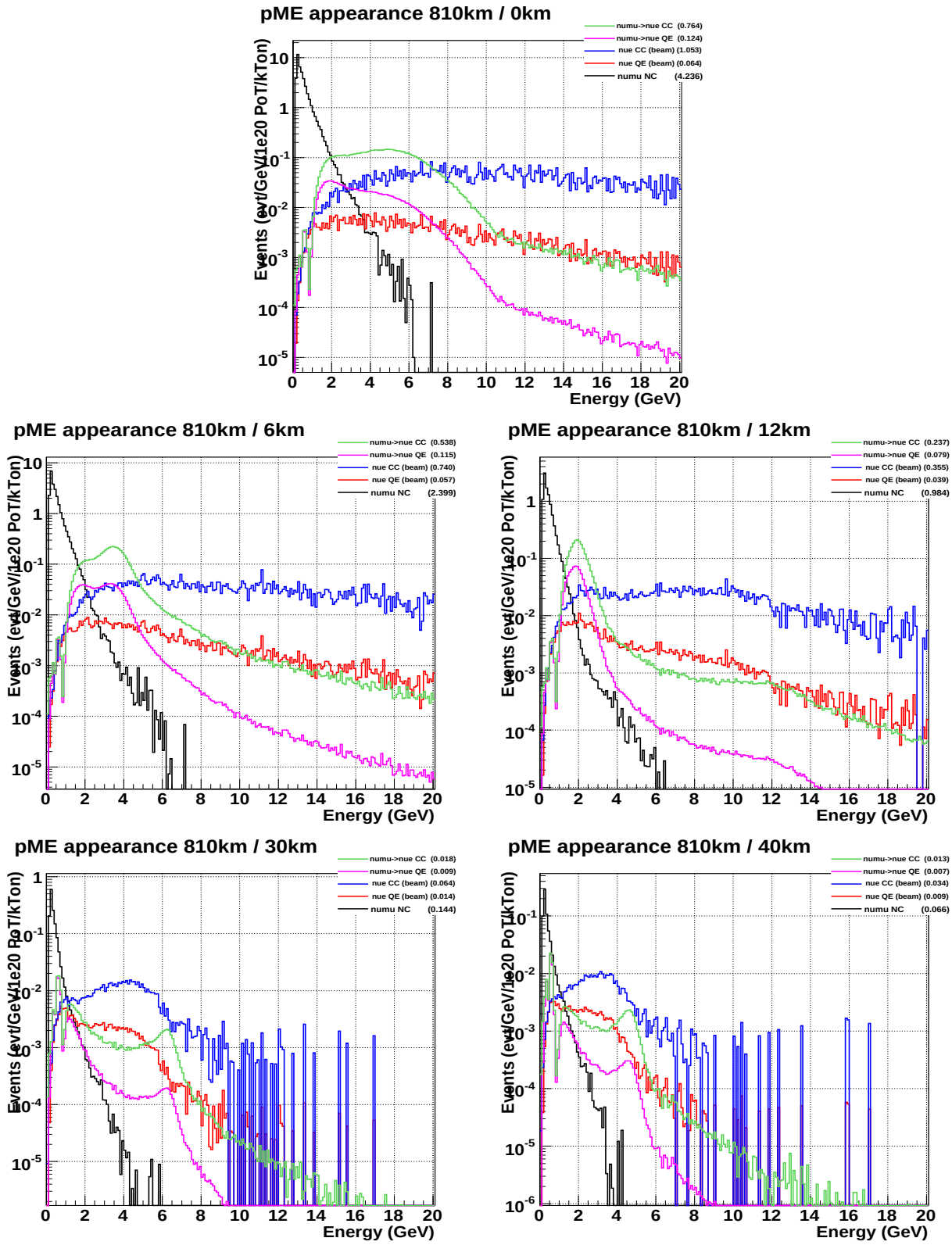

FIG. 5: $\nu_\mu \to \nu_e$ CC interaction rates for NuMI pME tune and various off-axis options.

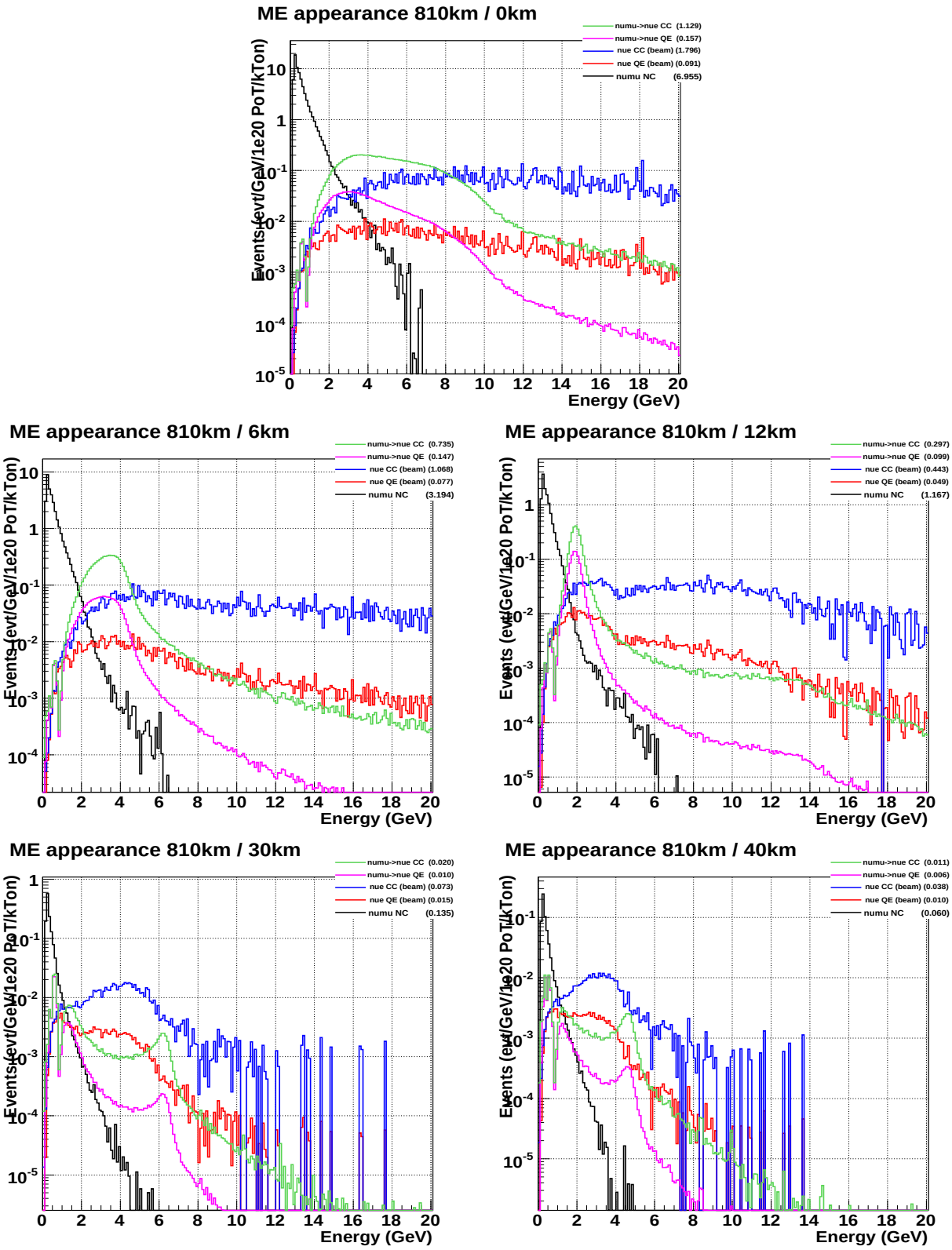

FIG. 6: $\nu_\mu \to \nu_e$ total CC interaction rates for NuMI ME tune and various off-axis options.

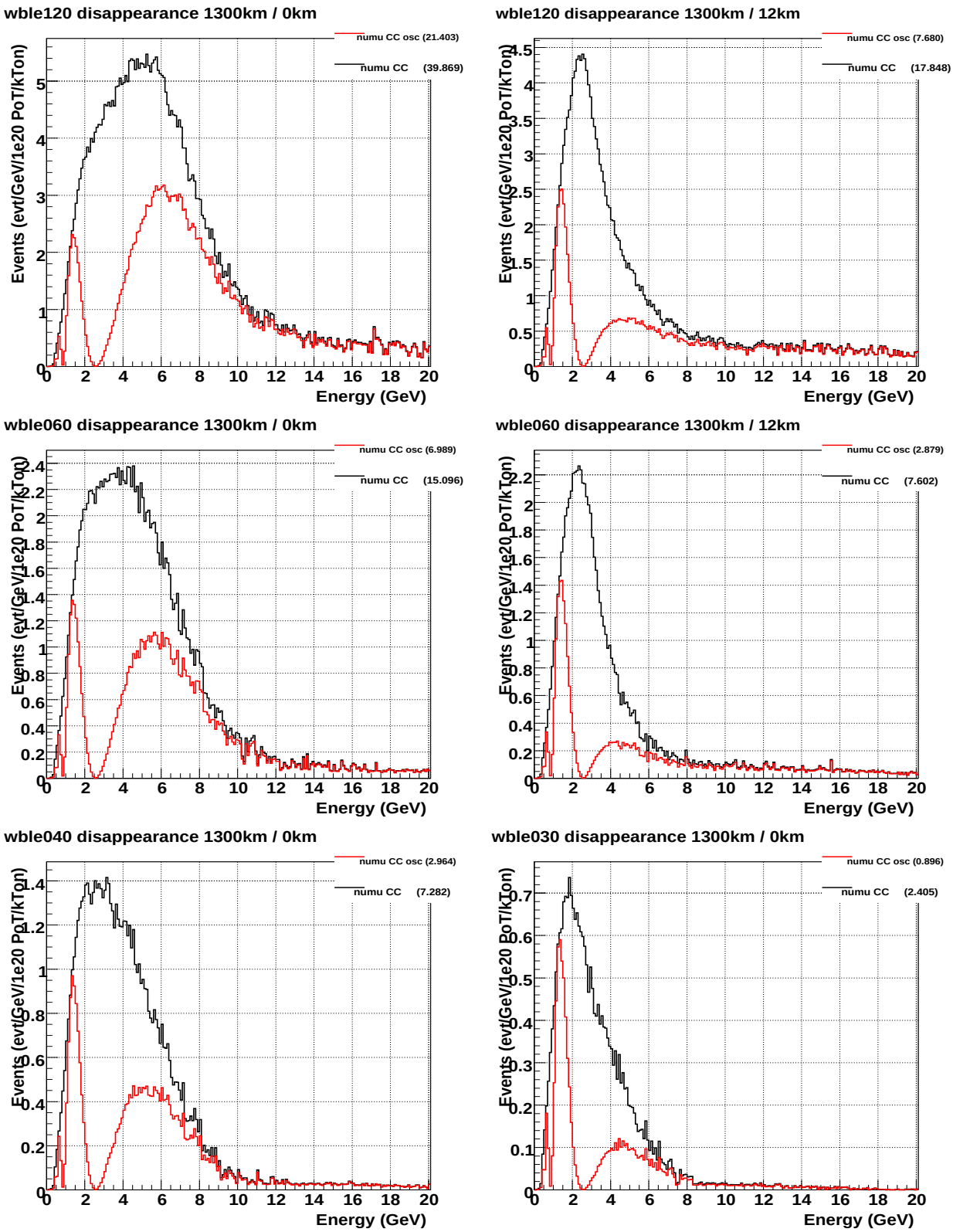

FIG. 7: $\nu_\mu \to \nu_\mu$ total CC interaction rates for WBLE beams with various off-axis options.

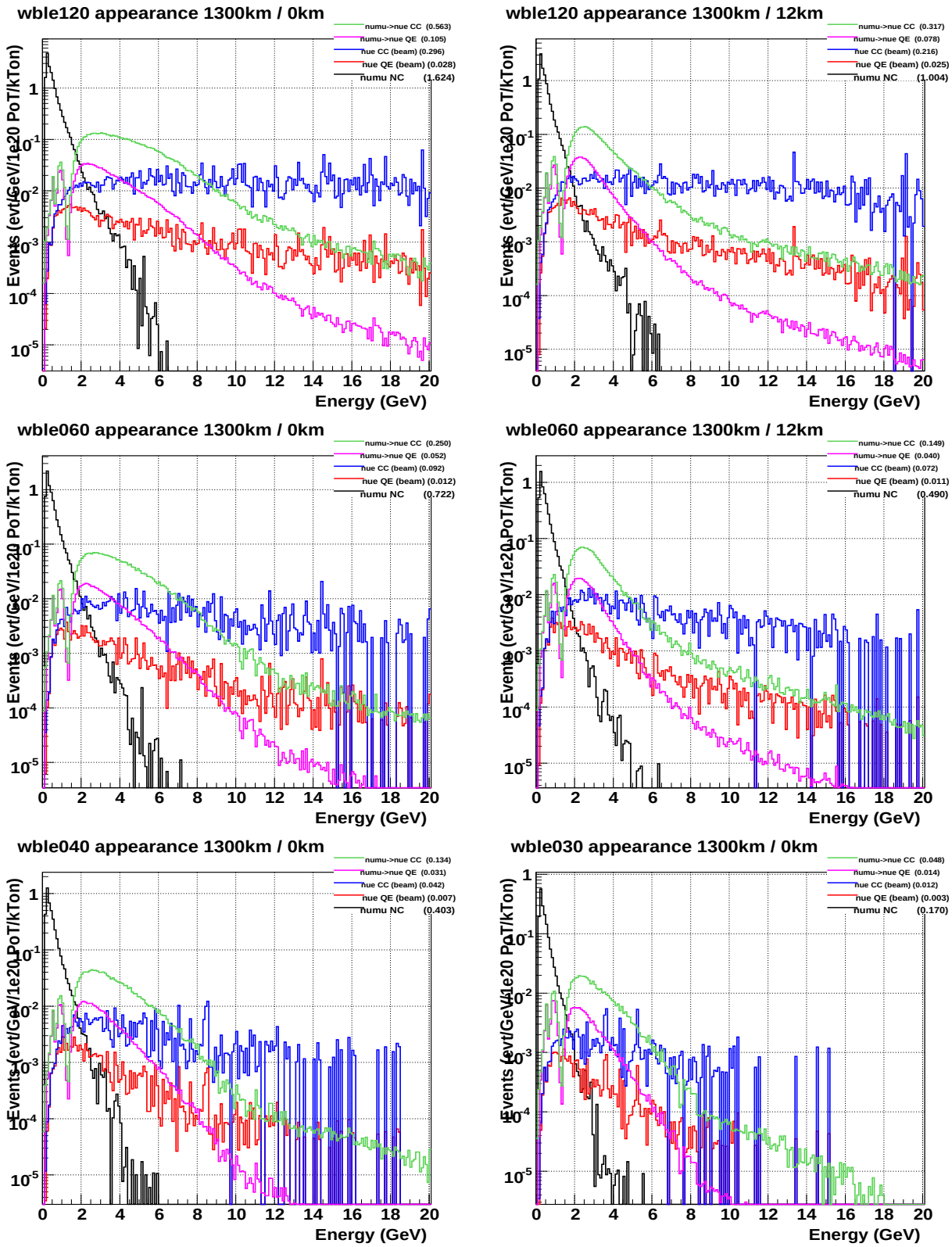

FIG. 8: $\nu_\mu \to \nu_e$ CC interaction rates for WBLE beams with various off-axis options.