SUPPLEMENTAL MATERIAL

This supplemental material contains additional tables that are referenced in the Letter, and then contains results from three extensions to the analysis which may be more easily compared to theory than the single pion analysis outlined in the Letter. The first extension is simply the differential cross sections extracted with an explicit cut on $\theta_\mu < 20^\circ$ to reduce the systematic uncertainties due to the modelling of the cross section in regions where the acceptance is low. The second extension is to loosen the W cut to 1.8 GeV to include multipion events, and the third extension is to report the multipion cross sections with the same muon angular cut.

Neutrino Beam Flux

E_ν in Bin	$1.5-2$	$2-2.5$	$2.5-3$	$3-3.5$	$3.5-4$	$4-4.5$	$4.5-5$	$5-5.5$	
ν_μ Flux (neutrinos/cm^2/POT ($\times 10^{-8}$))	0.291	0.387	0.476	0.502	0.402	0.242	0.131	0.077	
E_ν in Bin	$5.5-6$	$6-6.5$	$6.5-7$	$7-7.5$	$7.5-8$	$8-8.5$	$8.5-9$	$9-9.5$	$9.5-10$
ν_μ Flux (neutrinos/cm^2/POT ($\times 10^{-8}$))	0.053	0.041	0.035	0.030	0.026	0.023	0.021	0.019	0.017

TABLE I: The calculated muon neutrino flux per proton on target (POT) for the data included in this analysis.

Single Pion Analysis

The single pion analysis presented in the Letter measures $\nu_\mu + N \rightarrow \mu^- + \pi^\pm + X$, where N is a nucleus in the central tracking volume and the remaining hadron and nuclear recoil X may not contain additional charged pions. Charged current coherent pion interactions are included in this process; for such interactions, $X = N$ and the charged pion is a π^+. The neutrino energy is restricted to $1.5 \leq E_\nu \leq 10\,\text{GeV}$, and the hadronic system mass W is required to be less than 1.4 GeV.

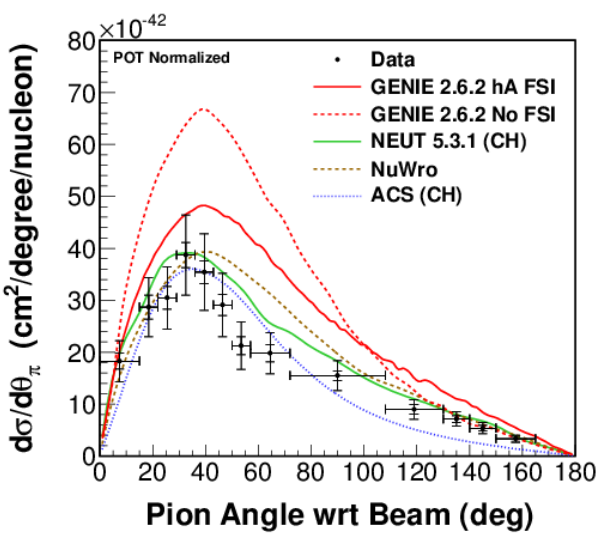

FIG. 1: The single pion analysis measurement of $d\sigma/d\theta_\pi$.

θ_π (degree) Bins	0 - 15	15 - 22	22 - 29	29 - 36	36 - 43	43 - 50	50 - 57
Cross section in bin	1.83	2.87	3.05	3.87	3.54	2.91	2.13
10^{-41}cm^2/degree/nucleon	±0.40 (0.23)	±0.57 (0.26)	±0.60 (0.25)	±0.77 (0.29)	±0.74 (0.26)	±0.61 (0.23)	±0.45 (0.20)
θ_π (degree) Bins	57 - 72	72 - 108	108 - 130	130 - 140	140 - 150	150 - 165	
Cross section in bin	1.98	1.55	0.90	0.71	0.54	0.33	
10^{-41}cm^2/degree/nucleon	±0.40 (0.19)	±0.29 (0.10)	±0.19 (0.11)	±0.14 (0.08)	±0.11 (0.06)	±0.07 (0.05)	

TABLE II: Measured $d\sigma/d\theta_\pi$ and total uncertainties for the single pion analysis. The absolute uncertainties are followed by shape uncertainties in parentheses.

Bins (degree)	0 - 15	15 - 22	22 - 29	29 - 36	36 - 43	43 - 50	50 - 57	57 - 72	72 - 108	108 - 130	130 - 140	140 - 150	150 - 165
0 - 15	1	0.78	0.71	0.71	0.73	0.71	0.66	0.65	0.78	0.73	0.72	0.69	0.60
15 - 22		1	0.82	0.82	0.83	0.82	0.78	0.76	0.84	0.74	0.74	0.73	0.64
22 - 29			1	0.87	0.86	0.86	0.83	0.81	0.85	0.72	0.73	0.73	0.65
29 - 36				1	0.89	0.88	0.85	0.83	0.85	0.73	0.75	0.74	0.66
36 - 43					1	0.90	0.86	0.83	0.87	0.75	0.76	0.76	0.67
43 - 50						1	0.86	0.83	0.86	0.74	0.75	0.75	0.67
50 - 57							1	0.82	0.84	0.72	0.73	0.73	0.66
57 - 72								1	0.82	0.72	0.73	0.72	0.65
72 - 108									1	0.80	0.80	0.79	0.71
108 - 130										1	0.75	0.73	0.66
130 - 140											1	0.76	0.67
140 - 150												1	0.66
150 - 165													1
0 - 15	1	0.19	-0.16	-0.24	-0.20	-0.23	-0.31	-0.26	0.02	0.13	0.08	0.04	-0.03
15 - 22		1	0.03	-0.02	-0.04	-0.07	-0.13	-0.13	-0.03	-0.02	-0.04	-0.04	-0.06
22 - 29			1	0.16	0.06	0.07	0.08	0.07	-0.06	-0.16	-0.13	-0.11	-0.07
29 - 36				1	0.19	0.18	0.13	0.09	-0.12	-0.21	-0.14	-0.12	-0.11
36 - 43					1	0.24	0.16	0.02	-0.10	-0.14	-0.16	-0.12	-0.11
43 - 50						1	0.17	0.07	-0.09	-0.14	-0.14	-0.11	-0.09
50 - 57							1	0.13	-0.03	-0.11	-0.11	-0.07	-0.02
57 - 72								1	-0.04	-0.05	-0.01	-0.02	0.02
72 - 108									1	0.07	0.04	0.05	0.06
108 - 130										1	0.17	0.13	0.11
130 - 140											1	0.23	0.16
140 - 150												1	0.17
150 - 165													1

TABLE III: Top: Full correlation matrix for the $d\sigma/d\theta_\pi$ uncertainties, single pion analysis. Bottom: Corresponding shape correlation matrix.

θ_π (degree)	I	II	III	IV	V	Total
0 - 15	11 (2.2)	7.5 (6.7)	11 (5.8)	8.8 (0.6)	4.9 (1.4)	20 (9.3)
15 - 22	9.9 (2.3)	9.2 (1.7)	7.1 (2.3)	9.2 (0.7)	3.5 (0.4)	18 (3.8)
22 - 29	10 (2.0)	11 (1.8)	4.4 (2.3)	9.3 (0.5)	3.3 (1.5)	18 (3.9)
29 - 36	10 (1.9)	12 (2.8)	4.9 (2.2)	9.1 (0.4)	3.2 (1.6)	19 (4.4)
36 - 43	11 (1.8)	12 (3.1)	5.6 (1.6)	9.0 (0.2)	3.3 (0.7)	20 (4.0)
43 - 50	12 (2.0)	12 (3.0)	4.7 (1.5)	9.4 (0.6)	3.1 (0.8)	20 (4.0)
50 - 57	12 (2.8)	12 (3.1)	3.9 (2.3)	8.7 (0.6)	4.7 (1.6)	20 (5.1)
57 - 72	11 (1.5)	10 (1.7)	2.8 (4.3)	8.6 (0.6)	3.8 (0.6)	18 (4.9)
72 - 108	11 (0.7)	7.8 (1.8)	6.1 (1.4)	8.9 (0.2)	4.4 (0.9)	18 (2.5)
108 - 130	11 (2.3)	6.4 (2.9)	8.3 (4.1)	9.2 (0.3)	4.4 (0.6)	19 (5.6)
130 - 140	9.7 (2.4)	6.8 (2.6)	7.7 (4.1)	9.1 (0.2)	4.3 (1.2)	17 (5.5)
140 - 150	9.2 (2.9)	7.3 (2.2)	7.4 (3.9)	9.0 (0.4)	4.3 (0.6)	17 (5.4)
150 - 165	9.7 (3.0)	6.1 (3.2)	5.6 (3.9)	9.2 (0.5)	5.4 (1.9)	17 (6.2)

TABLE IV: Fractional systematic uncertainties (in per cent) on the single pion $d\sigma/d\theta_\pi$ associated with detector response (I), neutrino cross section model (II), nuclear effects including FSI (III), flux (IV) and other sources (V). The absolute uncertainties are followed by shape uncertainties in parentheses.

T_π (MeV) Bins	35 - 55	55 - 75	75 - 100	100 - 125	125 - 150	150 - 200	200 - 350
Cross section in bin	1.13	1.16	1.07	0.85	0.76	0.66	0.38
10^{-41}cm^2/MeV/nucleon	±0.30 (0.20)	±0.25 (0.12)	±0.20 (0.09)	±0.15 (0.06)	±0.14 (0.05)	±0.11 (0.05)	±0.08 (0.04)

TABLE V: Measured $d\sigma/dT_\pi$ and total uncertainties for the single pion analysis. The absolute uncertainties are followed by shape uncertainties in parentheses.

Bins (MeV)	35 - 55	55 - 75	75 - 100	100 - 125	125 - 150	150 - 200	200 - 350
35 - 55	1	0.74	0.72	0.68	0.68	0.59	0.56
55 - 75		1	0.87	0.82	0.81	0.72	0.70
75 - 100			1	0.85	0.84	0.76	0.71
100 - 125				1	0.88	0.83	0.79
125 - 150					1	0.84	0.81
150 - 200						1	0.89
200 - 350							1
35 - 55	1	0.29	0.20	0.01	-0.02	-0.30	-0.36
55 - 75		1	0.39	0.09	0.02	-0.40	-0.47
75 - 100			1	0.21	0.13	-0.22	-0.53
100 - 125				1	0.25	0.01	-0.31
125 - 150					1	0.05	-0.21
150 - 200						1	0.27
200 - 350							1

TABLE VI: Top: Full correlation matrix for the $d\sigma/dT_\pi$ uncertainties, single pion analysis. Bottom: Corresponding shape correlation matrix.

Single Pion Analysis, Limited θ_μ Range

θ_π (degree) Bins	0 - 15	15 - 22	22 - 29	29 - 36	36 - 43	43 - 50	50 - 57
Cross section in bin	1.15	1.66	1.76	2.26	2.16	1.87	1.44
10^{-41}cm^2/degree/nucleon	±0.25 (0.17)	±0.29 (0.16)	±0.29 (0.15)	±0.37 (0.17)	±0.38 (0.16)	±0.34 (0.15)	±0.27 (0.14)
θ_π (degree) Bins	57 - 72	72 - 108	108 - 130	130 - 140	140 - 150	150 - 165	
Cross section in bin	1.41	1.18	0.69	0.55	0.414	0.256	
10^{-41}cm^2/degree/nucleon	±0.26 (0.14)	±0.21 (0.08)	±0.15 (0.08)	±0.11 (0.06)	±0.081 (0.047)	±0.054 (0.037)	

TABLE VII: Measured $d\sigma/d\theta_\pi$ and total uncertainties for the single pion analysis with $\theta_\mu < 20°$. The absolute uncertainties are followed by shape uncertainties in parentheses.

Bins (degree)	0 - 15	15 - 22	22 - 29	29 - 36	36 - 43	43 - 50	50 - 57	57 - 72	72 - 108	108 - 130	130 - 140	140 - 150	150 - 165
0 - 15	1	0.77	0.65	0.61	0.61	0.58	0.51	0.53	0.68	0.67	0.65	0.62	0.54
15 - 22		1	0.74	0.73	0.72	0.70	0.65	0.65	0.76	0.71	0.70	0.67	0.61
22 - 29			1	0.80	0.79	0.78	0.75	0.75	0.79	0.70	0.69	0.67	0.63
29 - 36				1	0.84	0.83	0.80	0.79	0.82	0.72	0.73	0.71	0.65
36 - 43					1	0.86	0.82	0.79	0.84	0.74	0.74	0.73	0.66
43 - 50						1	0.82	0.79	0.83	0.72	0.72	0.70	0.64
50 - 57							1	0.78	0.80	0.68	0.68	0.67	0.62
57 - 72								1	0.77	0.67	0.67	0.65	0.59
72 - 108									1	0.78	0.77	0.75	0.67
108 - 130										1	0.75	0.73	0.65
130 - 140											1	0.76	0.67
140 - 150												1	0.66
150 - 165													1
0 - 15	1	0.36	-0.04	-0.24	-0.30	-0.32	-0.39	-0.30	-0.10	0.11	0.06	0.01	-0.03
15 - 22		1	0.09	-0.07	-0.16	-0.19	-0.24	-0.17	-0.11	0.01	0.001	-0.01	0.001
22 - 29			1	0.14	-0.01	0.01	0.03	0.09	-0.10	-0.14	-0.11	-0.10	-0.02
29 - 36				1	0.14	0.15	0.13	0.17	-0.09	-0.16	-0.07	-0.06	-0.03
36 - 43					1	0.25	0.19	0.13	-0.02	-0.07	-0.07	-0.04	-0.01
43 - 50						1	0.22	0.16	0.01	-0.12	-0.11	-0.08	-0.05
50 - 57							1	0.20	0.05	-0.12	-0.11	-0.07	-0.01
57 - 72								1	-0.04	-0.14	-0.11	-0.11	-0.05
72 - 108									1	0.02	-0.04	-0.01	-0.04
108 - 130										1	0.18	0.15	0.10
130 - 140											1	0.25	0.14
140 - 150												1	0.16
150 - 165													1

TABLE VIII: Top: Full correlation matrix for the $d\sigma/d\theta_\pi$ uncertainties, single pion analysis with $\theta_\mu < 20°$. Bottom: Corresponding shape correlation matrix.

T_π (MeV) Bins	35 - 55	55 - 75	75 - 100	100 - 125	125 - 150	150 - 200	200 - 350
Cross section in bin	0.85	0.90	0.84	0.66	0.59	0.496	0.257
10^{-41}cm^2/MeV/nucleon	±0.21 (0.15)	±0.18 (0.09)	±0.15 (0.07)	±0.11 (0.05)	±0.10 (0.04)	±0.079 (0.036)	±0.053 (0.024)

TABLE IX: Measured $d\sigma/dT_\pi$ and total uncertainties for the single pion analysis with $\theta_\mu < 20°$. The absolute uncertainties are followed by shape uncertainties in parentheses.

Bins (MeV)	35 - 55	55 - 75	75 - 100	100 - 125	125 - 150	150 - 200	200 - 350
35 - 55	1	0.71	0.69	0.65	0.65	0.56	0.52
55 - 75		1	0.86	0.81	0.80	0.70	0.67
75 - 100			1	0.84	0.83	0.74	0.68
100 - 125				1	0.87	0.81	0.77
125 - 150					1	0.83	0.79
150 - 200						1	0.88
200 - 350							1
35 - 55	1	0.26	0.17	-0.02	-0.05	-0.29	-0.34
55 - 75		1	0.36	0.05	-0.01	-0.39	-0.44
75 - 100			1	0.18	0.10	-0.22	-0.52
100 - 125				1	0.22	0.01	-0.27
125 - 150					1	0.04	-0.17
150 - 200						1	0.29
200 - 350							1

TABLE X: Top: Full correlation matrix for the $d\sigma/dT_\pi$ uncertainties, single pion analysis with $\theta_\mu < 20°$. Bottom: Corresponding shape correlation matrix.

Multipion Analysis

The multipion analysis differs from the single pion analysis in three ways. First, X is allowed to include additional charged pions. Second, the limit on W is relaxed to be less than 1.8 GeV. Finally, due to the possibility of multiple pions per event, the multipion analysis does not measure differential cross sections. Instead, $(t\Phi)^{-1}dn_\pi/dT_\pi$ and $(t\Phi)^{-1}dn_\pi/d\theta_\pi$ are reported, where $t\Phi$ is the product of the number of fiducial nucleons and integrated flux, and n_π is the number of charged pions.

θ_π (degree) Bins	0 - 15	15 - 22	22 - 29	29 - 36	36 - 43	43 - 50	50 - 57
Measurement in bin	5.5	9.8	9.5	10.3	8.9	6.6	5.80
10^{-41}cm^2/degree/nucleon	±1.0 (0.5)	±1.7 (0.7)	±1.6 (0.6)	±1.7 (0.6)	±1.4 (0.6)	±1.1 (0.5)	±0.94 (0.44)
θ_π (degree) Bins	57 - 72	72 - 108	108 - 130	130 - 140	140 - 150	150 - 165	
Measurement in bin	4.90	3.08	1.61	1.32	1.05	0.68	
10^{-41}cm^2/degree/nucleon	±0.77 (0.46)	±0.43 (0.21)	±0.25 (0.17)	±0.20 (0.13)	±0.16 (0.11)	±0.11 (0.09)	

TABLE XI: Measured $(t\Phi)^{-1}dn_\pi/d\theta_\pi$ and total uncertainties for the multipion analysis. The absolute uncertainties are followed by shape uncertainties in parentheses.

Bins (degree)	0 - 15	15 - 22	22 - 29	29 - 36	36 - 43	43 - 50	50 - 57	57 - 72	72 - 108	108 - 130	130 - 140	140 - 150	150 - 165
0 - 15	1	0.85	0.85	0.84	0.78	0.75	0.69	0.56	0.69	0.59	0.60	0.58	0.52
15 - 22		1	0.86	0.85	0.82	0.79	0.75	0.64	0.75	0.65	0.65	0.63	0.57
22 - 29			1	0.88	0.86	0.84	0.79	0.68	0.78	0.65	0.66	0.65	0.59
29 - 36				1	0.87	0.85	0.81	0.70	0.79	0.65	0.68	0.66	0.59
36 - 43					1	0.88	0.84	0.71	0.77	0.63	0.65	0.63	0.58
43 - 50						1	0.84	0.74	0.79	0.64	0.66	0.64	0.59
50 - 57							1	0.78	0.79	0.67	0.67	0.65	0.59
57 - 72								1	0.78	0.69	0.71	0.68	0.61
72 - 108									1	0.74	0.75	0.74	0.67
108 - 130										1	0.68	0.66	0.60
130 - 140											1	0.71	0.63
140 - 150												1	0.63
150 - 165													1
0 - 15	1	0.37	0.30	0.20	-0.01	-0.13	-0.29	-0.45	-0.33	-0.22	-0.24	-0.23	-0.20
15 - 22		1	0.20	0.13	-0.01	-0.09	-0.22	-0.33	-0.23	-0.13	-0.18	-0.17	-0.15
22 - 29			1	0.19	0.10	0.03	-0.14	-0.32	-0.26	-0.22	-0.26	-0.23	-0.19
29 - 36				1	0.16	0.07	-0.05	-0.23	-0.24	-0.24	-0.20	-0.18	-0.19
36 - 43					1	0.30	0.16	-0.11	-0.21	-0.26	-0.25	-0.23	-0.16
43 - 50						1	0.21	0.01	-0.10	-0.18	-0.19	-0.17	-0.11
50 - 57							1	0.24	0.06	-0.01	-0.02	-0.03	-0.02
57 - 72								1	0.27	0.25	0.28	0.23	0.19
72 - 108									1	0.28	0.29	0.29	0.25
108 - 130										1	0.29	0.26	0.22
130 - 140											1	0.37	0.28
140 - 150												1	0.29
150 - 165													1

TABLE XII: Top: Full correlation matrix for the $(t\Phi)^{-1}dn_\pi/d\theta_\pi$ uncertainties, multipion analysis. Bottom: Corresponding shape correlation matrix.

T_π (MeV) Bins	35 - 55	55 - 75	75 - 100	100 - 125	125 - 150	150 - 200	200 - 350
Measurement in bin	2.16	2.11	1.92	1.80	1.59	1.25	0.83
10^{-41}cm^2/MeV/nucleon	±0.53 (0.39)	±0.39 (0.22)	±0.30 (0.14)	±0.24 (0.12)	±0.21 (0.11)	±0.17 (0.07)	±0.13 (0.06)

TABLE XIII: Measured $(t\Phi)^{-1}dn_\pi/dT_\pi$ and total uncertainties for the multipion analysis. The absolute uncertainties are followed by shape uncertainties in parentheses.

Bins (MeV)	35 - 55	55 - 75	75 - 100	100 - 125	125 - 150	150 - 200	200 - 350
35 - 55	1	0.74	0.69	0.59	0.52	0.51	0.46
55 - 75		1	0.84	0.72	0.66	0.64	0.61
75 - 100			1	0.80	0.76	0.74	0.70
100 - 125				1	0.85	0.81	0.73
125 - 150					1	0.84	0.78
150 - 200						1	0.89
200 - 350							1
35 - 55	1	0.44	0.25	-0.12	-0.28	-0.42	-0.46
55 - 75		1	0.41	-0.11	-0.28	-0.49	-0.51
75 - 100			1	0.08	-0.09	-0.36	-0.45
100 - 125				1	0.42	0.15	-0.23
125 - 150					1	0.32	-0.01
150 - 200						1	0.40
200 - 350							1

TABLE XIV: Top: Full correlation matrix for the $(t\Phi)^{-1}dn_\pi/dT_\pi$ uncertainties, multipion analysis. Bottom: Corresponding shape correlation matrix.

Multipion Analysis, Limited θ_μ Range

θ_π (degree) Bins	0 - 15	15 - 22	22 - 29	29 - 36	36 - 43	43 - 50	50 - 57
Measurement in bin	2.30	4.23	4.42	5.18	4.61	3.79	3.48
10^{-41}cm^2/degree/nucleon	±0.41 (0.22)	±0.68 (0.31)	±0.72 (0.30)	±0.80 (0.32)	±0.74 (0.32)	±0.61 (0.27)	±0.53 (0.25)
θ_π (degree) Bins	57 - 72	72 - 108	108 - 130	130 - 140	140 - 150	150 - 165	
Measurement in bin	3.12	2.06	1.08	0.88	0.70	0.452	
10^{-41}cm^2/degree/nucleon	±0.45 (0.27)	±0.28 (0.13)	±0.17 (0.11)	±0.13 (0.08)	±0.10 (0.07)	±0.073 (0.053)	

TABLE XV: Measured $(t\Phi)^{-1}dn_\pi/d\theta_\pi$ and total uncertainties for the multipion analysis with $\theta_\mu < 20°$. The absolute uncertainties are followed by shape uncertainties in parentheses.

Bins (degree)	0 - 15	15 - 22	22 - 29	29 - 36	36 - 43	43 - 50	50 - 57	57 - 72	72 - 108	108 - 130	130 - 140	140 - 150	150 - 165
0 - 15	1	0.84	0.83	0.83	0.78	0.76	0.71	0.59	0.72	0.61	0.62	0.60	0.57
15 - 22		1	0.85	0.84	0.82	0.80	0.77	0.66	0.76	0.66	0.66	0.64	0.60
22 - 29			1	0.87	0.86	0.84	0.80	0.69	0.78	0.66	0.67	0.66	0.62
29 - 36				1	0.87	0.85	0.81	0.71	0.78	0.65	0.69	0.67	0.62
36 - 43					1	0.87	0.83	0.70	0.75	0.62	0.65	0.63	0.60
43 - 50						1	0.83	0.72	0.76	0.63	0.66	0.64	0.61
50 - 57							1	0.75	0.77	0.66	0.68	0.66	0.61
57 - 72								1	0.74	0.66	0.69	0.66	0.60
72 - 108									1	0.73	0.73	0.72	0.65
108 - 130										1	0.66	0.64	0.58
130 - 140											1	0.69	0.60
140 - 150												1	0.60
150 - 165													1
0 - 15	1	0.32	0.26	0.20	0.06	-0.02	-0.18	-0.37	-0.21	-0.16	-0.19	-0.19	-0.13
15 - 22		1	0.17	0.13	0.06	0.01	-0.12	-0.24	-0.15	-0.10	-0.16	-0.16	-0.11
22 - 29			1	0.21	0.18	0.13	-0.06	-0.26	-0.21	-0.19	-0.22	-0.20	-0.14
29 - 36				1	0.23	0.14	-0.002	-0.20	-0.24	-0.22	-0.17	-0.15	-0.14
36 - 43					1	0.33	0.15	-0.15	-0.29	-0.27	-0.25	-0.22	-0.13
43 - 50						1	0.16	-0.08	-0.20	-0.21	-0.21	-0.18	-0.10
50 - 57							1	0.12	-0.07	-0.05	-0.05	-0.06	-0.03
57 - 72								1	0.12	0.15	0.20	0.15	0.12
72 - 108									1	0.22	0.20	0.20	0.13
108 - 130										1	0.21	0.19	0.12
130 - 140											1	0.28	0.16
140 - 150												1	0.19
150 - 165													1

TABLE XVI: Top: Full correlation matrix for the $(t\Phi)^{-1}dn_\pi/d\theta_\pi$ uncertainties, multipion analysis with $\theta_\mu < 20°$. Bottom: Corresponding shape correlation matrix.

T_π (MeV) Bins	35 - 55	55 - 75	75 - 100	100 - 125	125 - 150	150 - 200	200 - 350
Measurement in bin	1.42	1.42	1.29	1.21	1.06	0.82	0.501
10^{-41}cm^2/MeV/nucleon	±0.34 (0.25)	±0.26 (0.14)	±0.20 (0.09)	±0.15 (0.08)	±0.14 (0.07)	±0.11 (0.05)	±0.076 (0.036)

TABLE XVII: Measured $(t\Phi)^{-1}dn_\pi/dT_\pi$ and total uncertainties for the multipion analysis with $\theta_\mu < 20°$. The absolute uncertainties are followed by shape uncertainties in parentheses.

Bins (MeV)	35 - 55	55 - 75	75 - 100	100 - 125	125 - 150	150 - 200	200 - 350
35 - 55	1	0.73	0.68	0.58	0.52	0.51	0.46
55 - 75		1	0.84	0.72	0.66	0.65	0.62
75 - 100			1	0.80	0.75	0.73	0.69
100 - 125				1	0.84	0.80	0.72
125 - 150					1	0.83	0.77
150 - 200						1	0.88
200 - 350							1
35 - 55	1	0.41	0.22	-0.13	-0.28	-0.41	-0.44
55 - 75		1	0.38	-0.13	-0.29	-0.48	-0.48
75 - 100			1	0.07	-0.10	-0.35	-0.42
100 - 125				1	0.41	0.14	-0.21
125 - 150					1	0.31	0.01
150 - 200						1	0.41
200 - 350							1

TABLE XVIII: Top: Full correlation matrix for the $(t\Phi)^{-1}dn_\pi/dT_\pi$ uncertainties, multipion analysis with $\theta_\mu < 20°$. Bottom: Corresponding shape correlation matrix.