University of Tuzla
Faculty of Natural Sciences and Mathematics
Physics Department

Data binning for PWA of pion photoproduction

H. Osmanović, R. Omerović, M. Hadžimehmedović, J. Stahov

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Data sources - $\pi^0 p$

Experiment	Year	Author (Source)	E_{LAB} range [MeV]
Differential cross section σ_0			
CB-MAMI	2008	Prakhov PRL111-062004	147 - 795
CB-MAMI	2015	Prakhov 2015	218 - 1443
CB-MAMI	2015	Prakhov EPT	1428 - 1573
Beam asymmetry Σ			
TAPSA2	2001	Leukel	240 - 440
GRAAL	2005	Bartelini EPJA26-399	551 - 1475
CB-MAMI	2008	Prakhov PRL111-062004	147 - 317
Recoil asymmetry P			
DNPL	1972	Prentice NPB41-353	850 - 1250
KHARKOV	1976	Debrechinski JETP43-218	585 - 615
KHARKOV	1978	Zybalov SJNP28-218	650, 700
DNPL	1979	Bussey NPB154-492	1300
KHARKOV	1980	Bratashevski NPB166-525	480 - 1275
KHARKOV	1983	Belyaev NPB213-201	280 - 450
CB-MAMI	2014	Hartman PRL113-062001	684 - 917

Experiment	Year	Author (Source)	E_{LAB} range [MeV]
Target asymmetry T			
CB-ELSA	2014	Hartmann PRL113-062001	684 - 917
CB-MAMI	2014	Kashevarov	440 - 1430
Double - polarisation asymmetry F			
CB-MAMI	2014	Kashevarov	440 - 1430
Double - polarisation asymmetry G			
DAPHNE	2005	Ahrens EJPA26-135	340
CB-ELSA	2012	Thiel PRL109-102001	633 - 1300
Double - polarisation H			
CB-ELSA	2014	Hartmann PRL113-062001	684 - 917
Double - polarisation asymmetry E			
CB-ELSA	2014	Gotschall PRL112-012003	730 - 2100
CB-MAMI	2015	Linturi	225 - 1395
Observables sgT and sgF			
CB-MAMI	2014	Schumann - Otte	144 - 419
Observable sgE			
DAPHNE	2001	Preobrajenski	310 - 780

approx: $1075\ \text{MeV} < W_{cm} < 1970 MeV$

Data sources - $\pi^0 n$

Reaction	Year	Source - Authors	Energy Range W [MeV]
$\gamma n \to \pi^0 n$	Differential cross section σ_0		
	x	A.Ando et al., Physik Daten, Karlsruhe	1203-1517
	1972	C. Bacciet al., Phys. Lett. C 39, 559	1323-1535
	1973	Y. Hemmiet al., Nucl. Phys. B 55, 333	1318-1604
	1967	Klinesmith, Ph.D Thesis	1611-1869
	Σ		
	2009	R.Di Salvo et al., Eur. Phys. J. A 42, 151	1484-1912

Data sources - $\pi^+ n$

Reaction	Year	Source - Authors	Energy Range W [MeV]
$\gamma p \to \pi^+ n$		Differential cross section σ_0	
	1967-2001	S.D.Ecklund, R.L.Walker, Phys.Rev. 159, 1195 (1967)	1481-2201
		C.Betourne et al., Phys.Rev. 172, 1343 (1968)	
		B.Bouquet et al., Phys.Rev.Lett. 27, 1244 (1971)	
		T.Fujii et al., Phys.Rev.Lett. 26, 1672 (1971)	
		K.Ekstrand et al., Phys.Rev. D6, 1 (1972)	
		T.Fujii et al., Nucl.Phys. B120, 395 (1977)	
		I.Arai et al., J.Phys.Soc.Jap. 43, 363 (1977)	
		E.J.Durwen, Ph.D. Thesis (1980); BONN-IR-80-7	
		K.H.Althoff et al., Z.Phys. C18, 199 (1983)	
		W.Heise, Ph.D. Thesis (1988); BONN-IR-88-06	
		K.Buechler et al., Nucl.Phys. A570, 580 (1994)	
		H.W.Dannhausen et al. Eur.Phys.J. A11, 441 (2001)	
	2009	M.Dugger et al., Phys.Rev. C79, 065206	1497-2505
	2004	J.Ahrens et al., Eur.Phys.J. A21, 323	1178-1313
	2006	J.Ahrens et al., Phys.Rev. C74, 045204	1323-1533
		Σ	
	1960-2001	G.Blanpied et al., Phys.Rev. C64, 025203 (2001)	1201-2259
		R.E.Taylor, R.F.Mozley, Phys.Rev. 117, 835 (1960)	
		R.C.Smith, R.F.Mozley, Phys.Rev. 130, 2429 (1963)	
		J.Alspector et al., Phys.Rev.Lett. 28, 1403 (1972)	
		G.Knies et al., Phys.Rev. D10, 2778 (1974)	
		V.B.Ganenko et al., Yad.Fiz. 23, 100 (1976)	
		P.J.Bussey et al., Nucl.Phys. B154, 205 (1979)	
		V.A.Getman et al., Nucl.Phys. B188, 397 (1981)	
		P.Hampe, Ph.D.Thesis, 1980	
		R.Beck et al., Phys.Rev. C61, 035204 (2000)	
		J.Ajaka et al., Phys.Lett. B475, 372 (2000)	
		J.Bocquet et al., AIP Conf.Proc. 603, 499 (2001)	
	2014	M.Dugger et al. PRC 88, 065203 (2013), PRC 89, 029901	1724-2093

Year	Source-Authors	Energy Range W [MeV]
	P	
1979-1981	P.J.Bussey et al., Nucl.Phys. B154, 205 (1979)	1201-2259
	V.A.Getman et al., Nucl.Phys. B188, 397 (1981)	
	K.Egawa et al., Nucl.Phys. B188, 11 (1981)	
	T	
1972-1996	P.J.Bussey et al., Nucl.Phys. B154, 205 (1979)	1201-2360
	V.A.Getman et al., Nucl.Phys. B188, 397 (1981)	
	K.H.Althoff et al., Nucl.Phys. B53, 9 (1973)	
	S.Arai et al., Nucl.Phys. B48, 397 (1972)	
	P.Feller et al., Nucl.Phys. B102, 207 (1976)	
	K.H.Althoff et al., Phys.Lett. B59, 93 (1975)	
	H.Genzel et al., Nucl.Phys. B92, 196 (1975)	
	K.H.Althoff et al., Phys.Lett. B63, 107 (1976)	
	K.H.Althoff et al., Nucl.Phys. B131, 1 (1977)	
	M.Fukushima et al., Nucl.Phys. B130, 486 (1977)	
	V.A.Getman et al., Yad.Fiz. 32, 1008 (1980)	
	K.Fujii et al., Nucl.Phys. B197, 365 (1982)	
	H.Dutz et al., Nucl.Phys. A601, 319 (1996)	
	G	
1980-2005	J.Ahrens et al., Eur.Phys.J. A26, 135 (2005)	1217-2097
	P.J.Bussey et al., Nucl.Phys. B169, 403 (1980)	
	A.A.Belyaev et al., Yad.Fiz. 40, 133 (1984)	
	H	
1980-1986	P.J.Bussey et al., Nucl.Phys. B169, 403 (1980)	1217-2052
	A.A.Belyaev et al., Yad.Fiz. 43, 1469 (1986)	
	A.A.Belyaev et al., Yad.Fiz. 40, 133 (1984)	

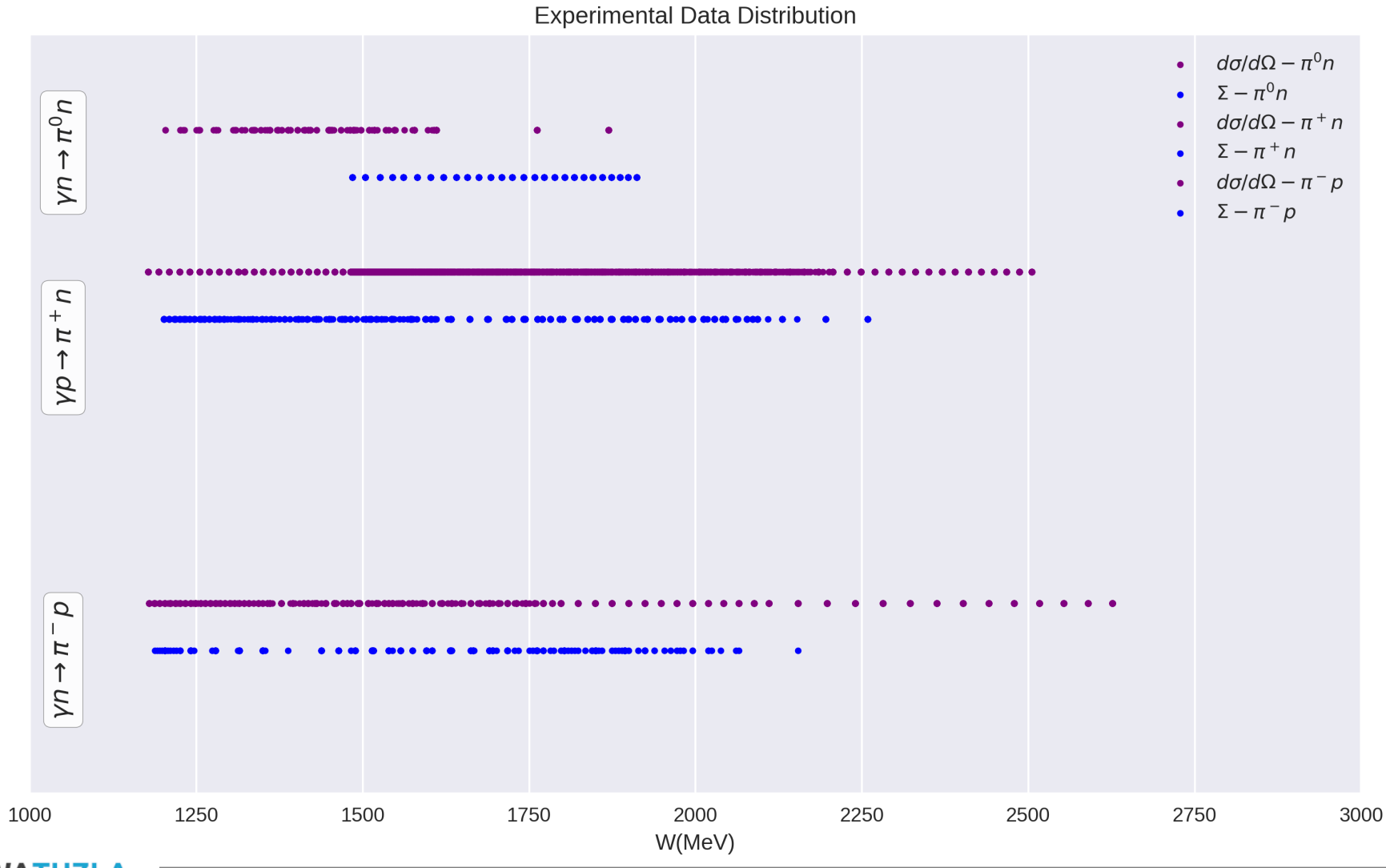
Data sources - $\pi^- p$

Reaction	Year	Source - Authors	Energy Range W [MeV]	Year	Source - Authors	Energy Range W [MeV]
$\gamma n \to \pi^- p$	Differential cross section σ_0			Σ		
	1978	P.E.Argan et al., Nucl. Phys. A 296, 373	1188-1312	1989	F.V.Adamian et al., J. Phys. G 15, 1797	1575-2061
	1974	M.Beneventano et al., Nuovo Cim. A 19, 529	1336-1587	1972	J.Alspector et al., Phys. Rev. Lett. 28, 1403	1483-2154
	1977	T.Fujii et al., Nucl. Phys. B 120, 395	1174-1761	1974	G.Knies et al., Phys. Rev. D 10, 2778	1438-1539
	1981	K.Fujii et al., Nucl. Phys. B 187, 53 (1981).		1974	K.Kondo et al., Phys. Rev. D 9, 529	1203-1388
	1974	G. von Holtey et al., Nucl. Phys. B 70, 379	1187-1279	2010	G.Mandaglio et al., Phys. Rev. C 82, 045209	1516-1894
	1960	G.Neugebauer et al., Phys. Rev. 119, 1726	1350-1662	1980	L.O.Abrahamian, Sov. J. Nucl. Phys. 32, 69	1604-1996
	1974	P.E.Scheffler, P.L.Walden, Nucl. Phys. B 75, 125	1418-1798	1976	V.B.Ganenko, Sov. J. Nucl. Phys. 23, 511	1203-1350
	2012	W.Chen et al., Phys. Rev. C 86, 015206	1690-2620	1964	F.F.Liu et al., Phys. Rev. B 136, 1183	1226-1315
	T			1995	A.M.Sandorfi, Proc. Conf., 05/30/95.	1188-1220
	1989	V.L.Agranovich et al., VANT 8, 5	1187-1279	P		
	1975	K.H.Althoff et al., Nucl. Phys. B 96, 497	1315-2154	1980	H.Takeda et al., Nucl. Phys. B 168, 17	1494-1764
	1976	K.H.Althoff et al., Nucl. Phys. B 116, 253		1963	J.P.Kenemuth, P.C.Stein, Phys. Rev. 129, 2259	1492
	1977	T.Fujii et al., Nucl. Phys. B 120, 395	1393-1604	1974	M.Beneventano et al., Nuovo Cim. A 19, 529	1360-1492
	1981	K.Fujii et al., Nucl. Phys. B 187, 53				

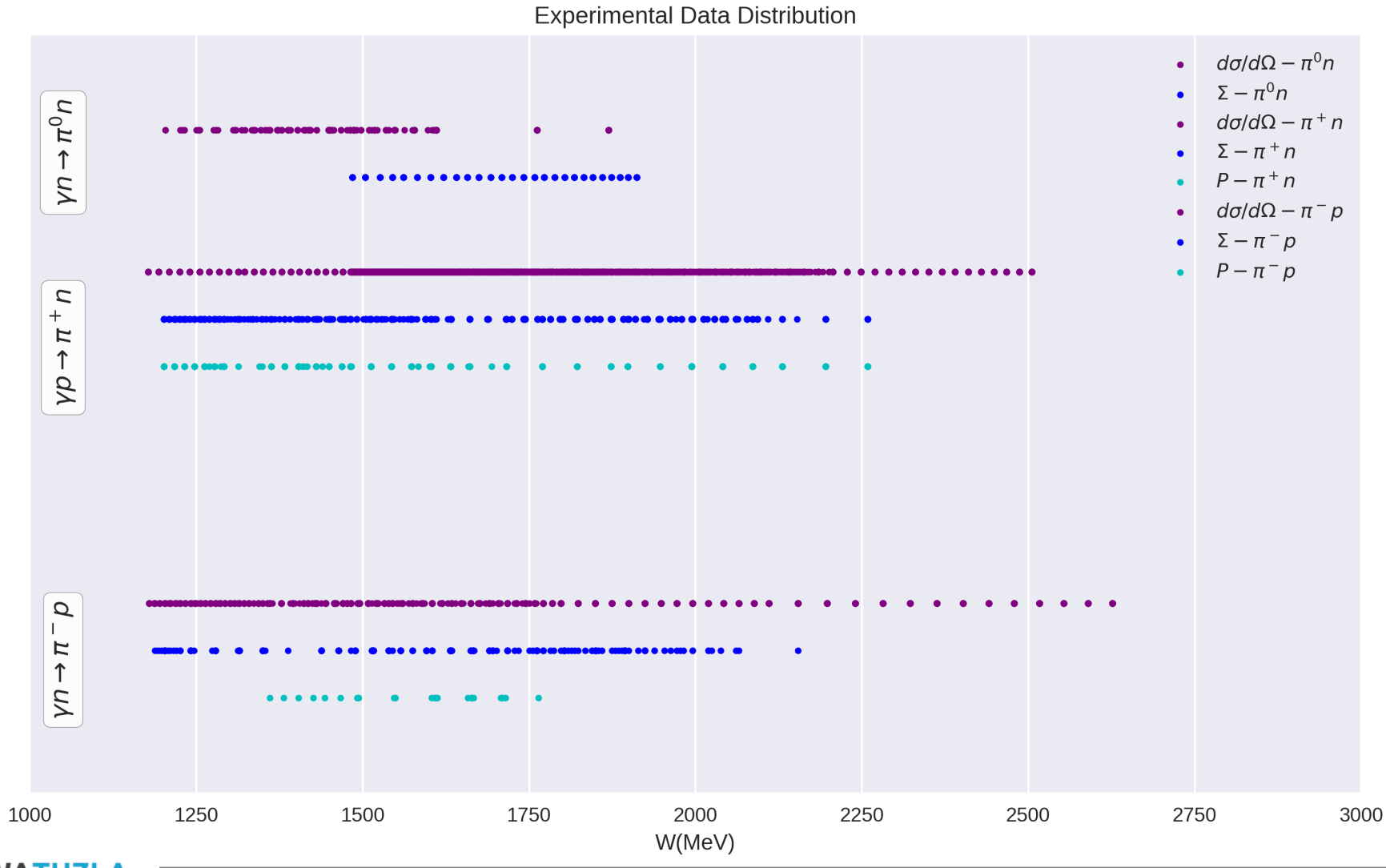
Energy distribution of experimental data for $\pi^0 p$

Energy distribution of experimental data for $\pi^0 n$, $\pi^+ n$, $\pi^- p$

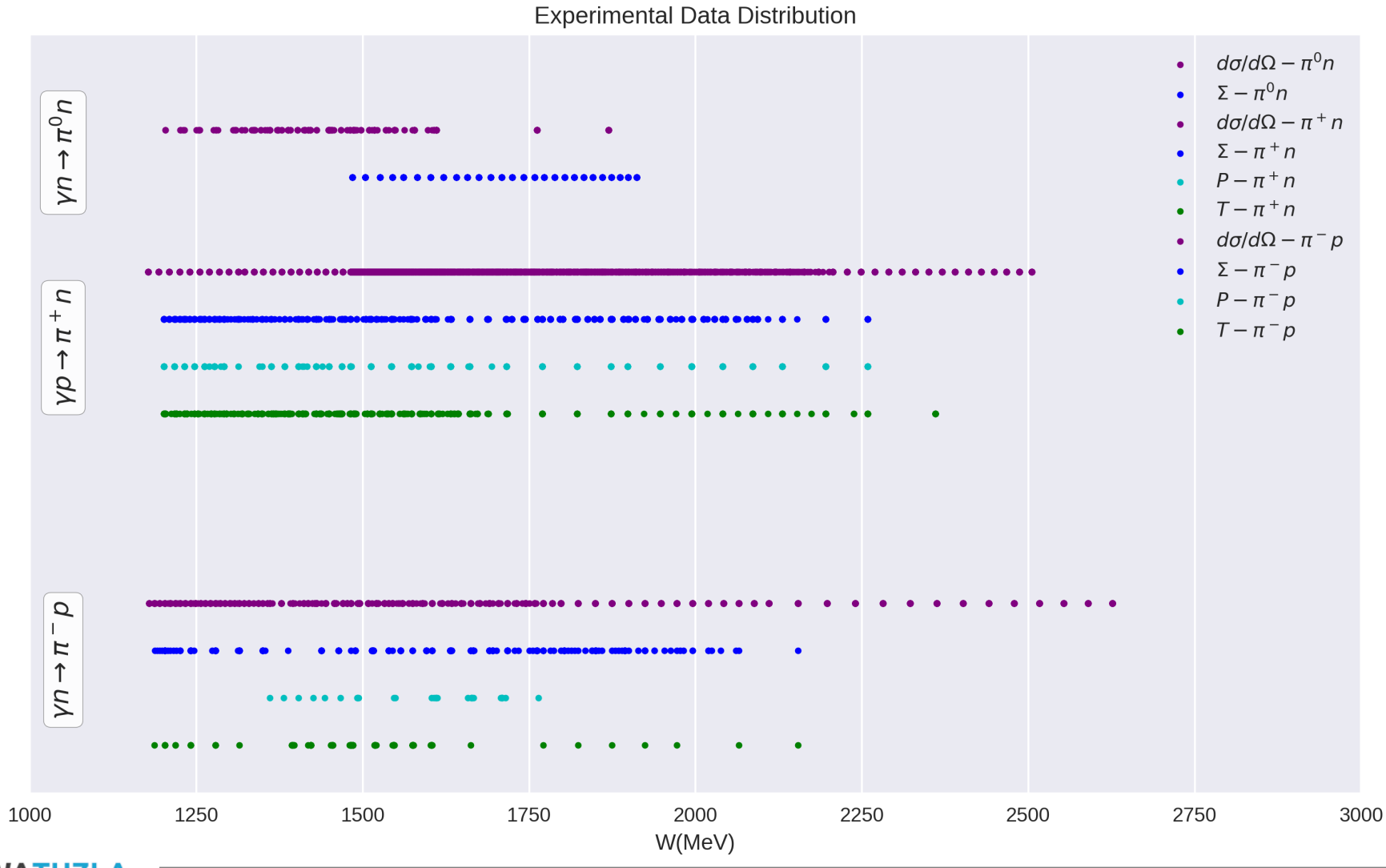
Energy distribution of experimental data for $\pi^0 n$, $\pi^+ n$, $\pi^- p$



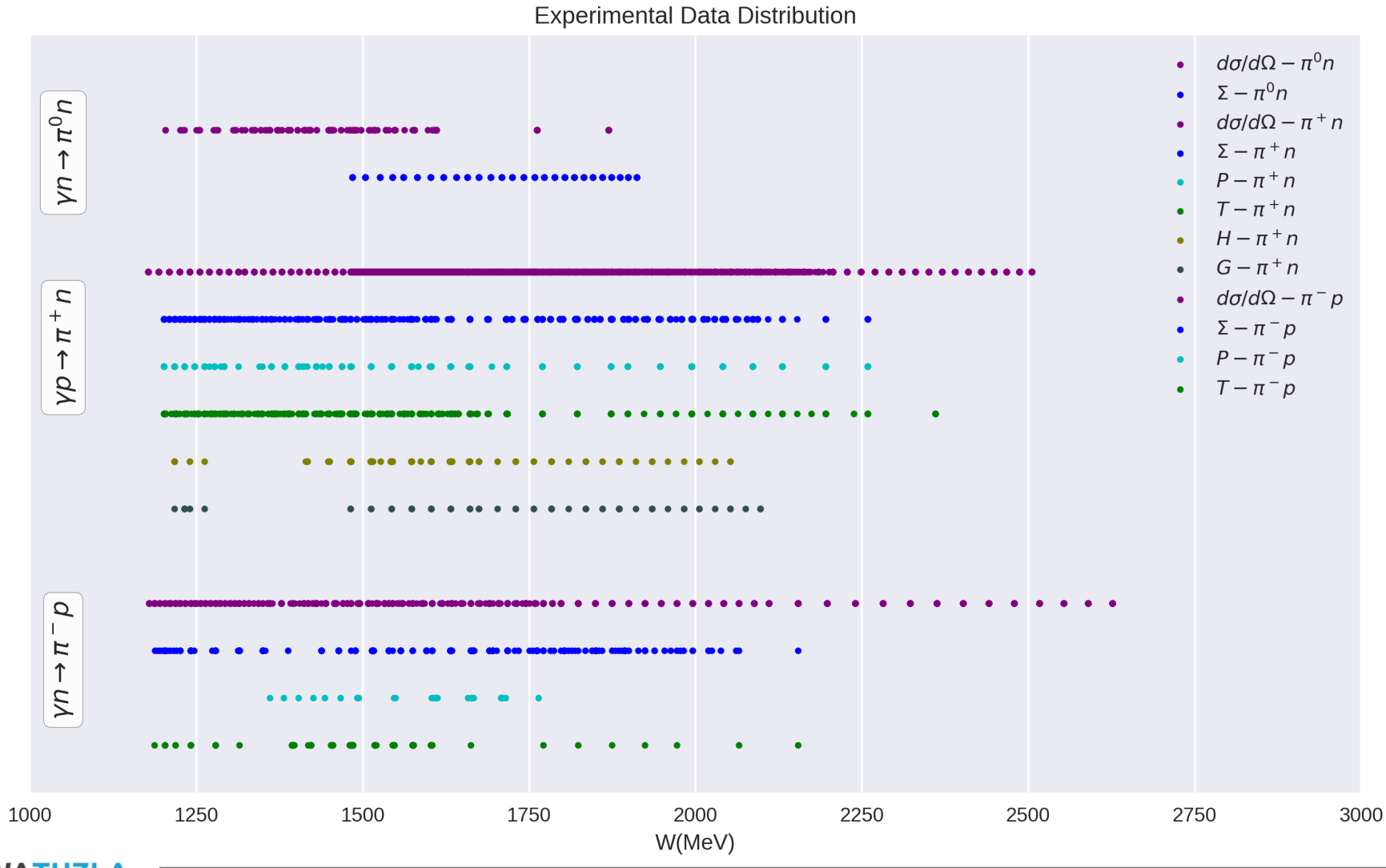
Energy distribution of experimental data for $\pi^0 n$, $\pi^+ n$, $\pi^- p$



Energy distribution of experimental data for $\pi^0 n$, $\pi^+ n$, $\pi^- p$



Energy distribution of experimental data for $\pi^0 n$, $\pi^+ n$, $\pi^- p$

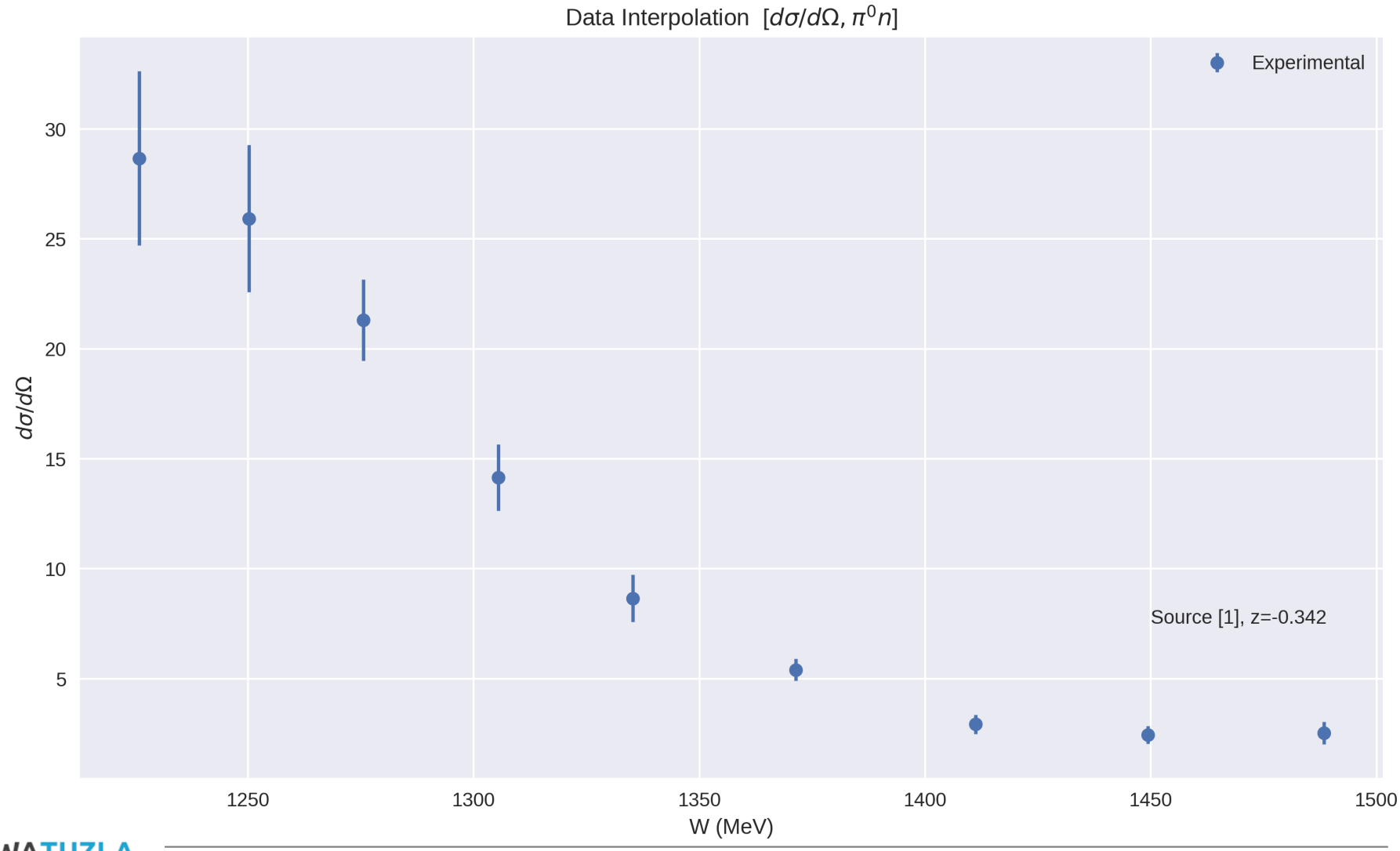


Energy distribution of experimental data for $\pi^0 p$, $\pi^0 n$, $\pi^+ n$, $\pi^- p$

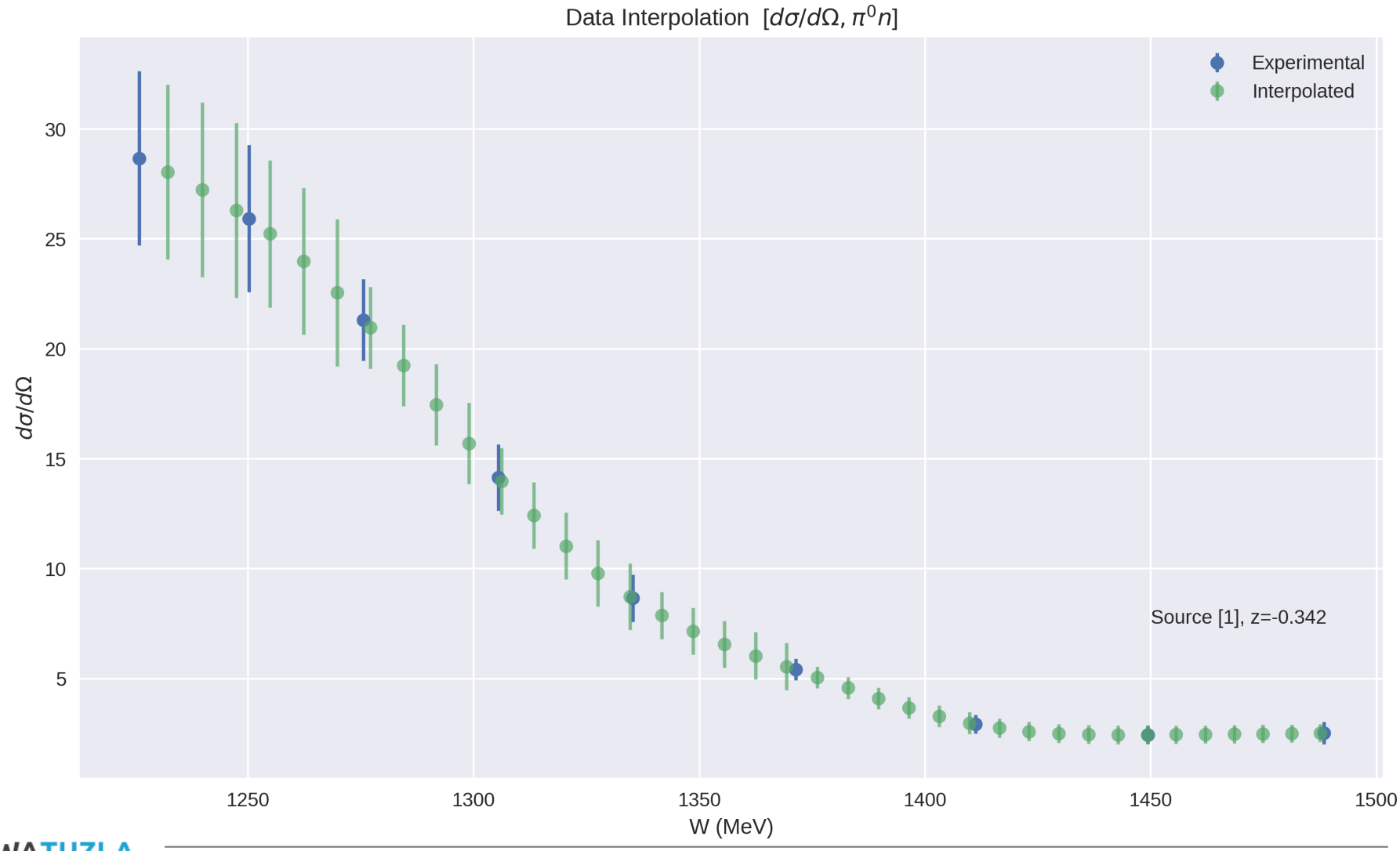
Energy distribution of experimental data

- Various datasets with different energy ranges and different energy binns
- No exact energy match for different observables or even for the same observable from different sources
- We predefined energy values for which SE analysis is to be done
- Interpolation was performed only for those energy values that were nearest to the experimental ones.

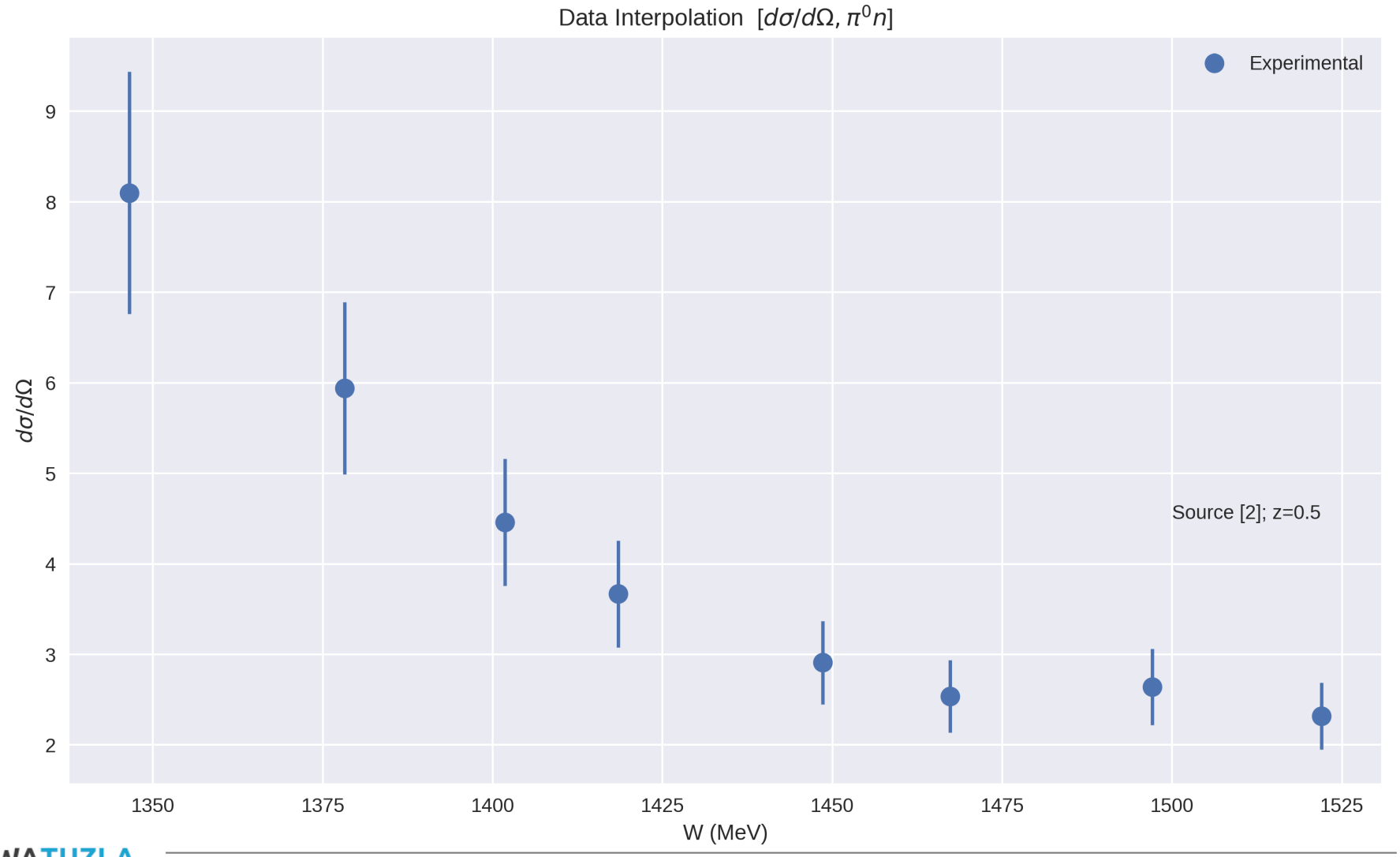
Data Interpolation: $\pi^0 n$ $d\sigma/d\Omega$ $z = -0.342$



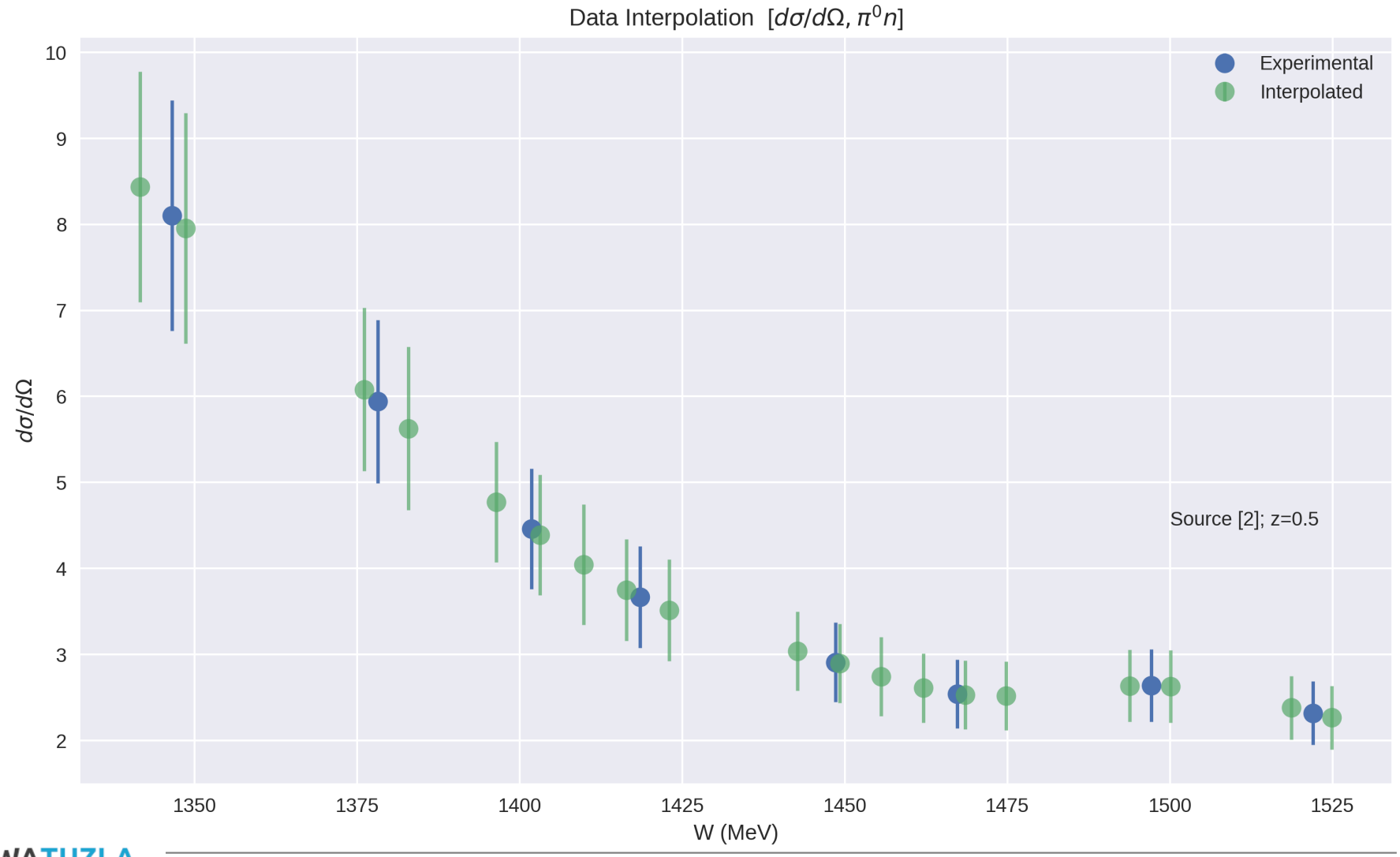
Data Interpolation: $\pi^0 n$ $d\sigma/d\Omega$ $z = -0.342$



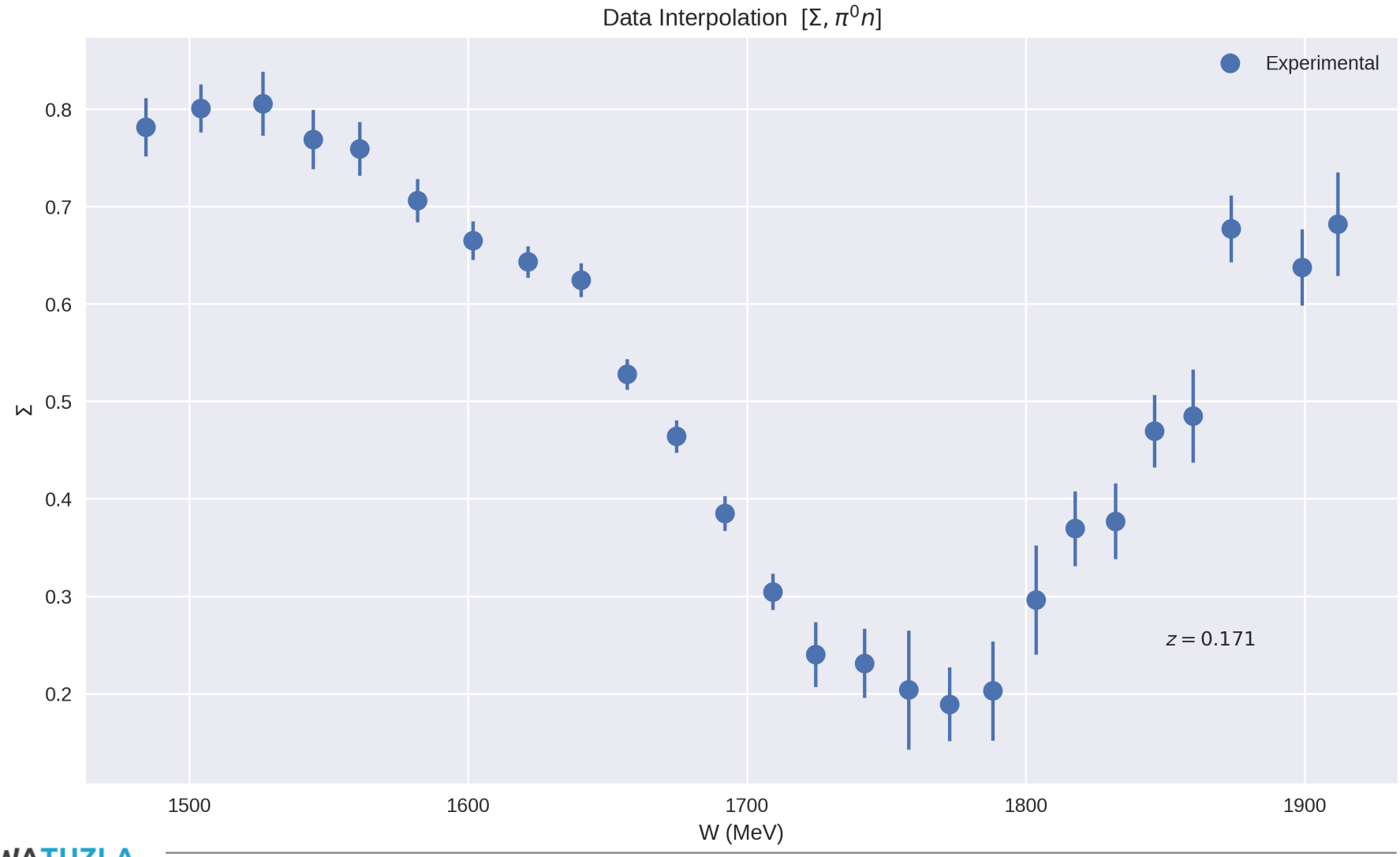
Data Interpolation: $\pi^0 n$ $d\sigma/d\Omega$ $z = 0.5$



Data Interpolation: $\pi^0 n$ $d\sigma/d\Omega$ $z = 0.5$

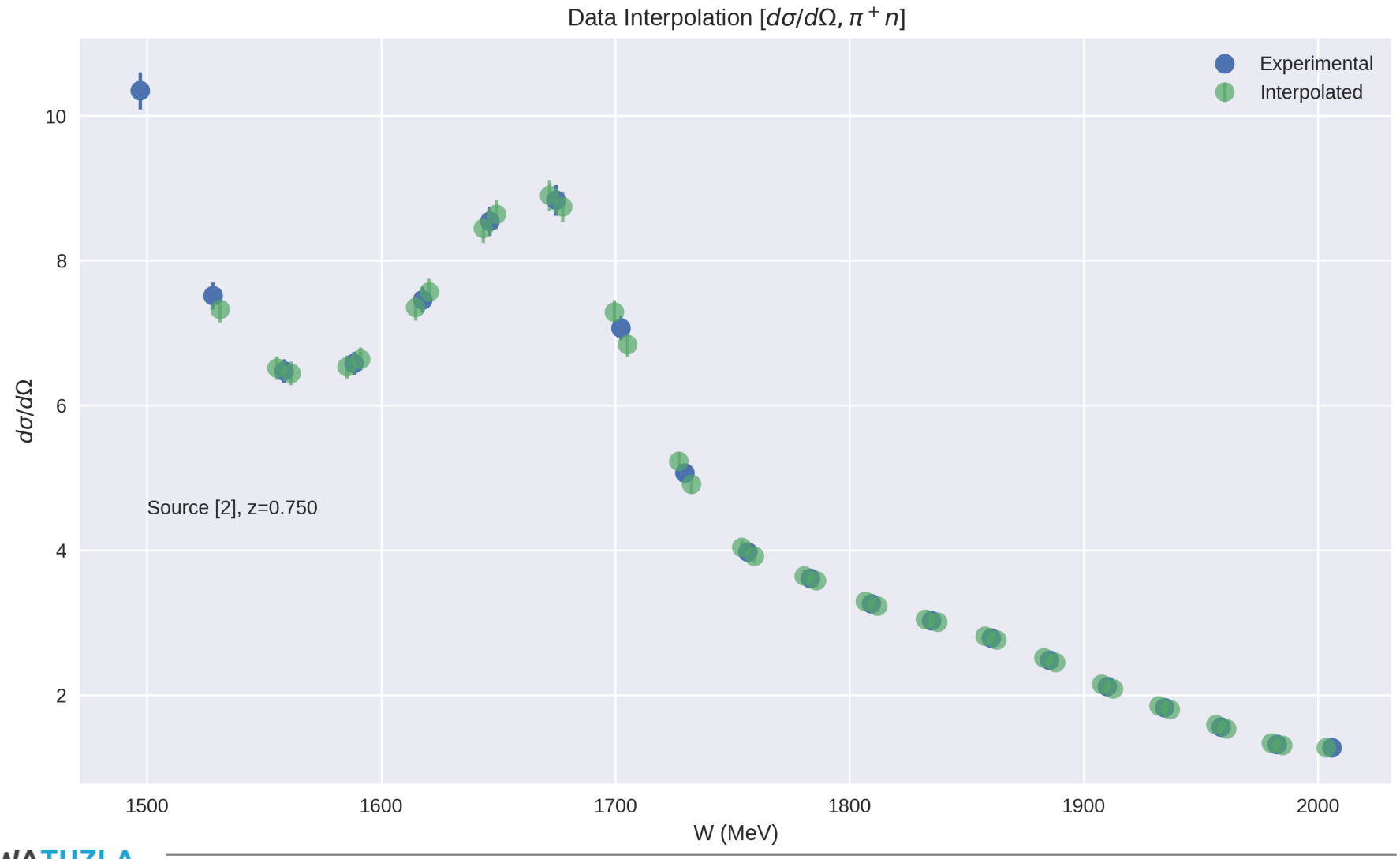


Data Interpolation: $\pi^0 n \quad \Sigma \quad z = 0.171$



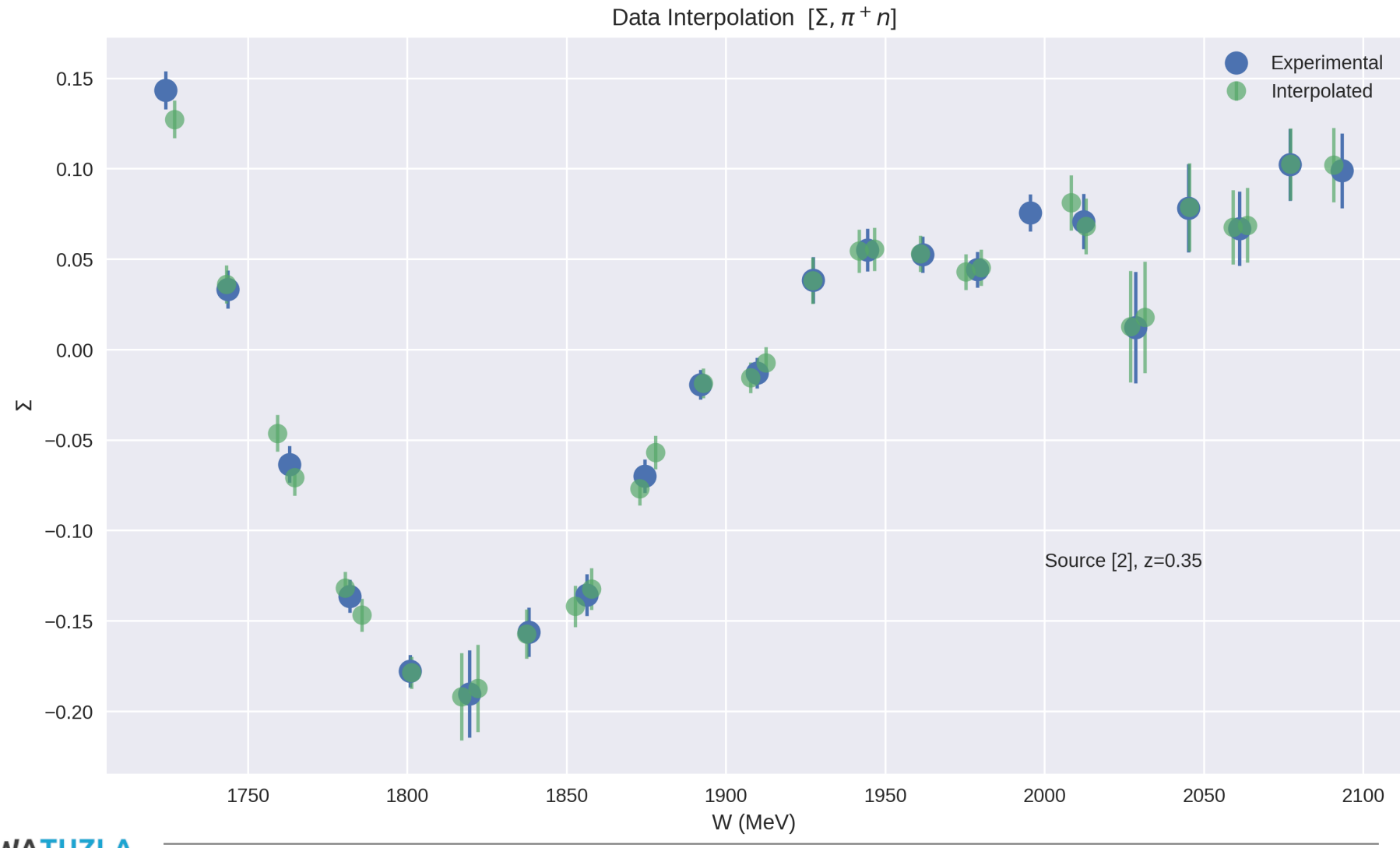
Data Interpolation: $\pi^0 n \quad \Sigma \quad z = 0.171$

Data Interpolation: $\pi^+ n \quad d\sigma/d\Omega \quad z = 0.75$

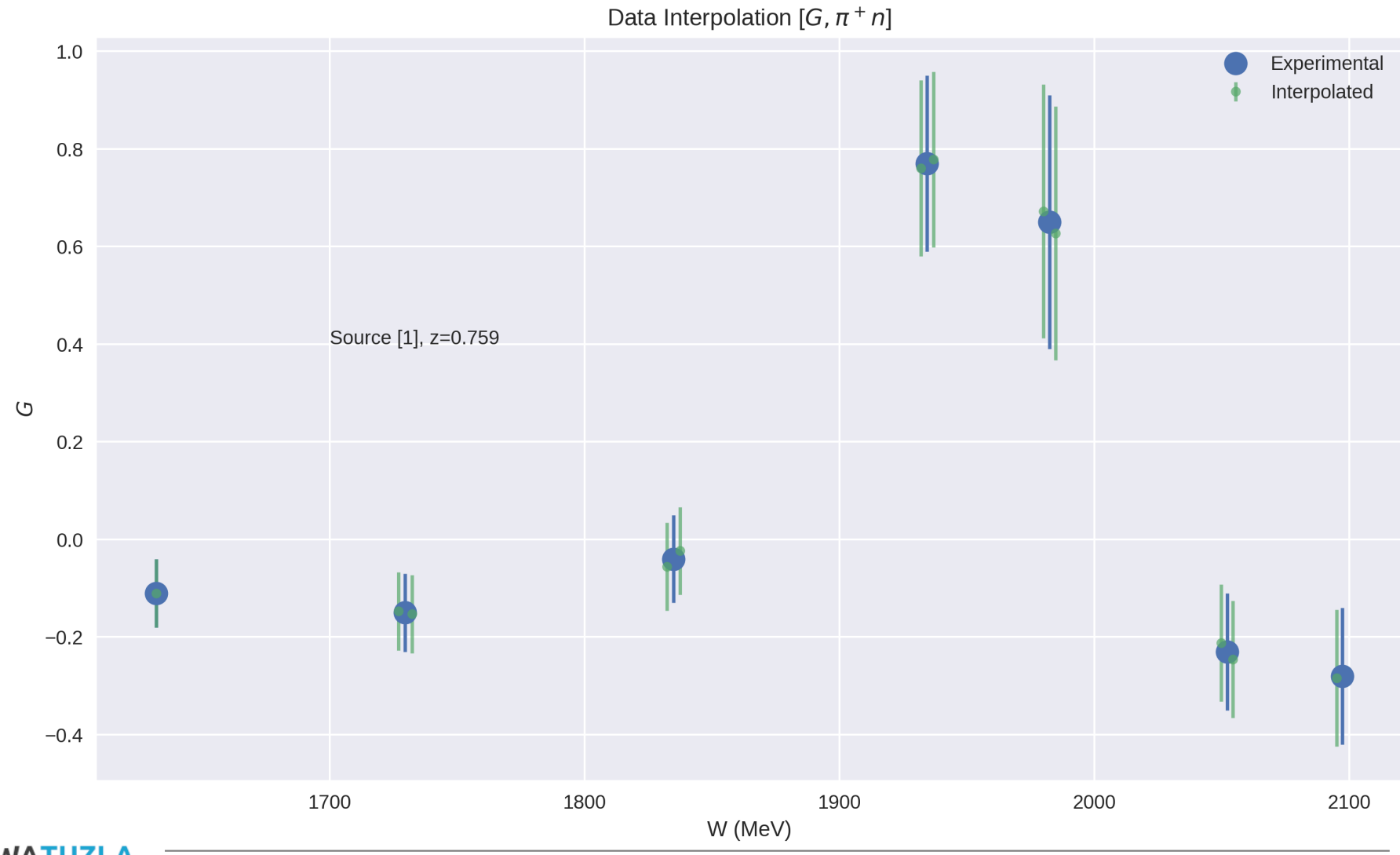


Data Interpolation: $\pi^+ n \quad \Sigma \quad z = -0.316$

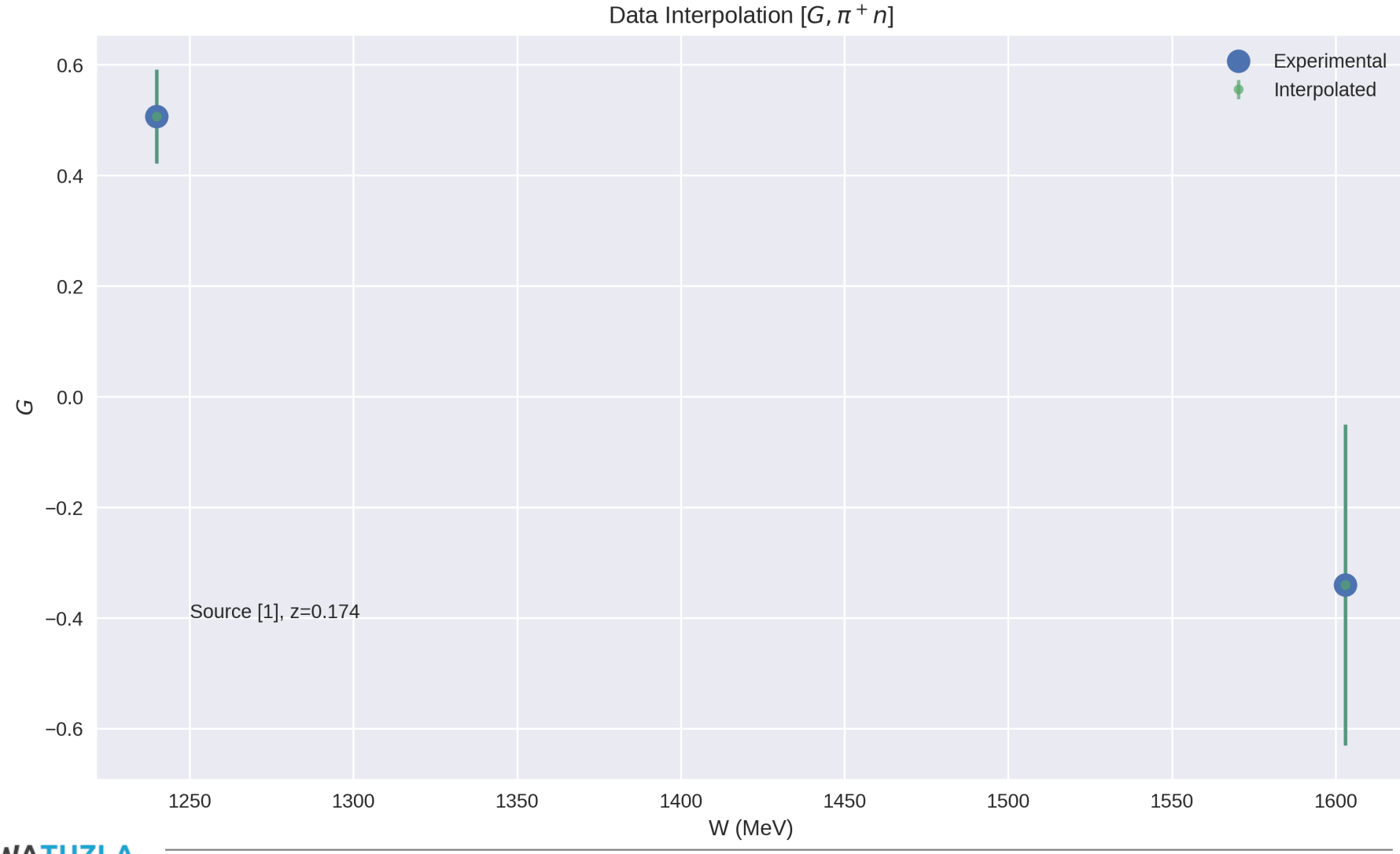
Data Interpolation: $\pi^+ n \quad \Sigma \quad z = 0.35$



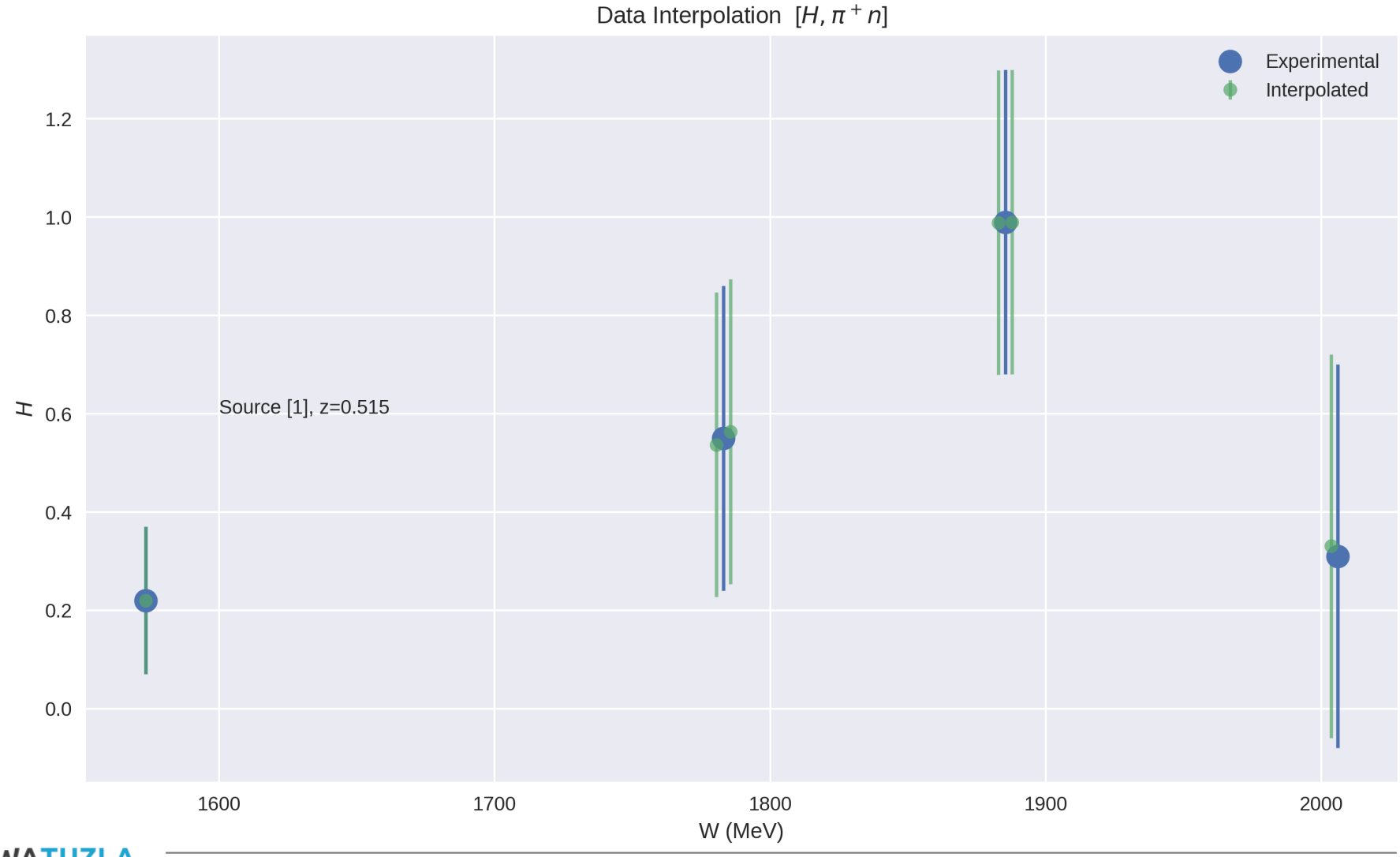
Data Interpolation: $\pi^+ n \quad G \quad z = 0.759$



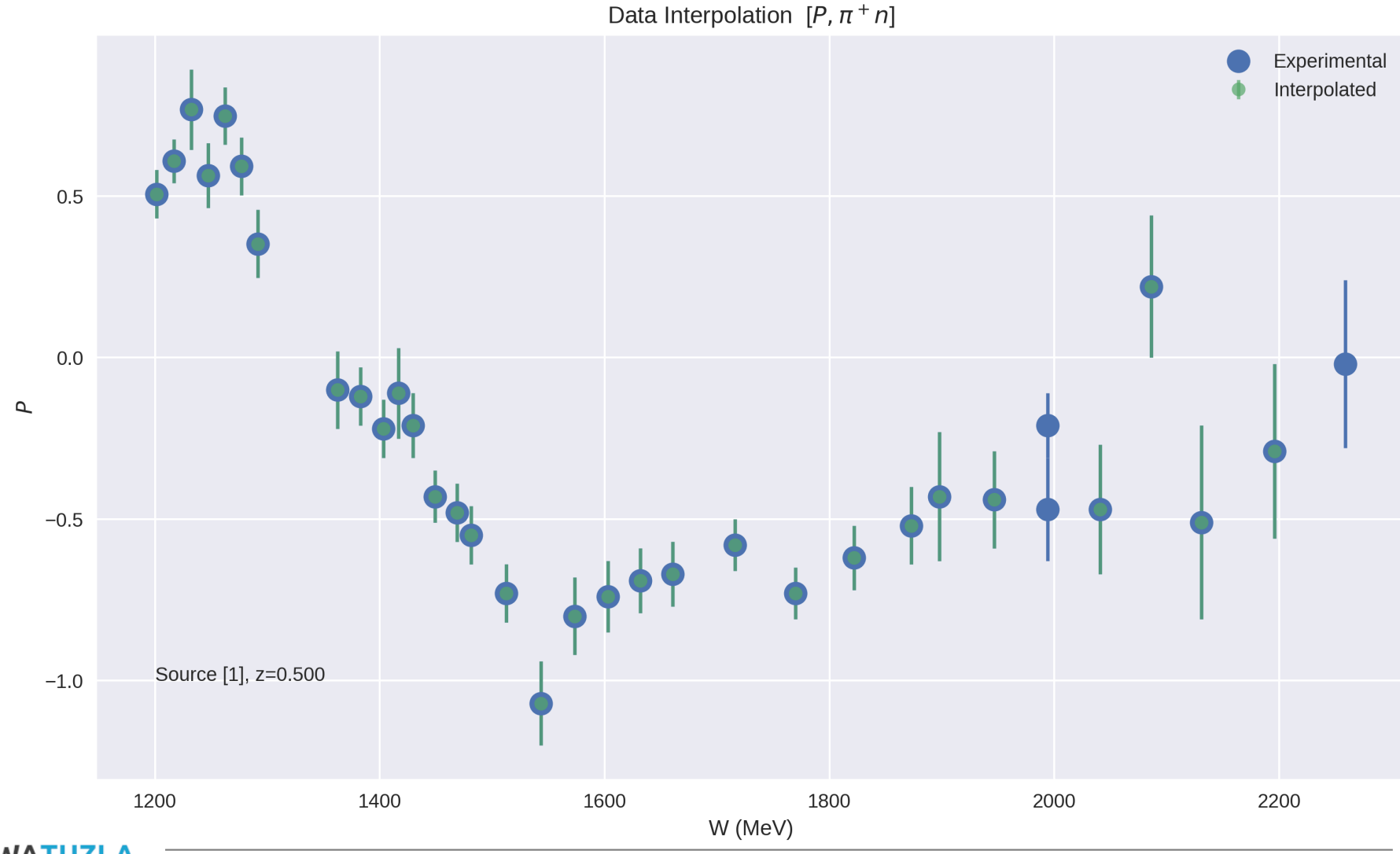
Data Interpolation: $\pi^+ n$ G $z = 0.174$



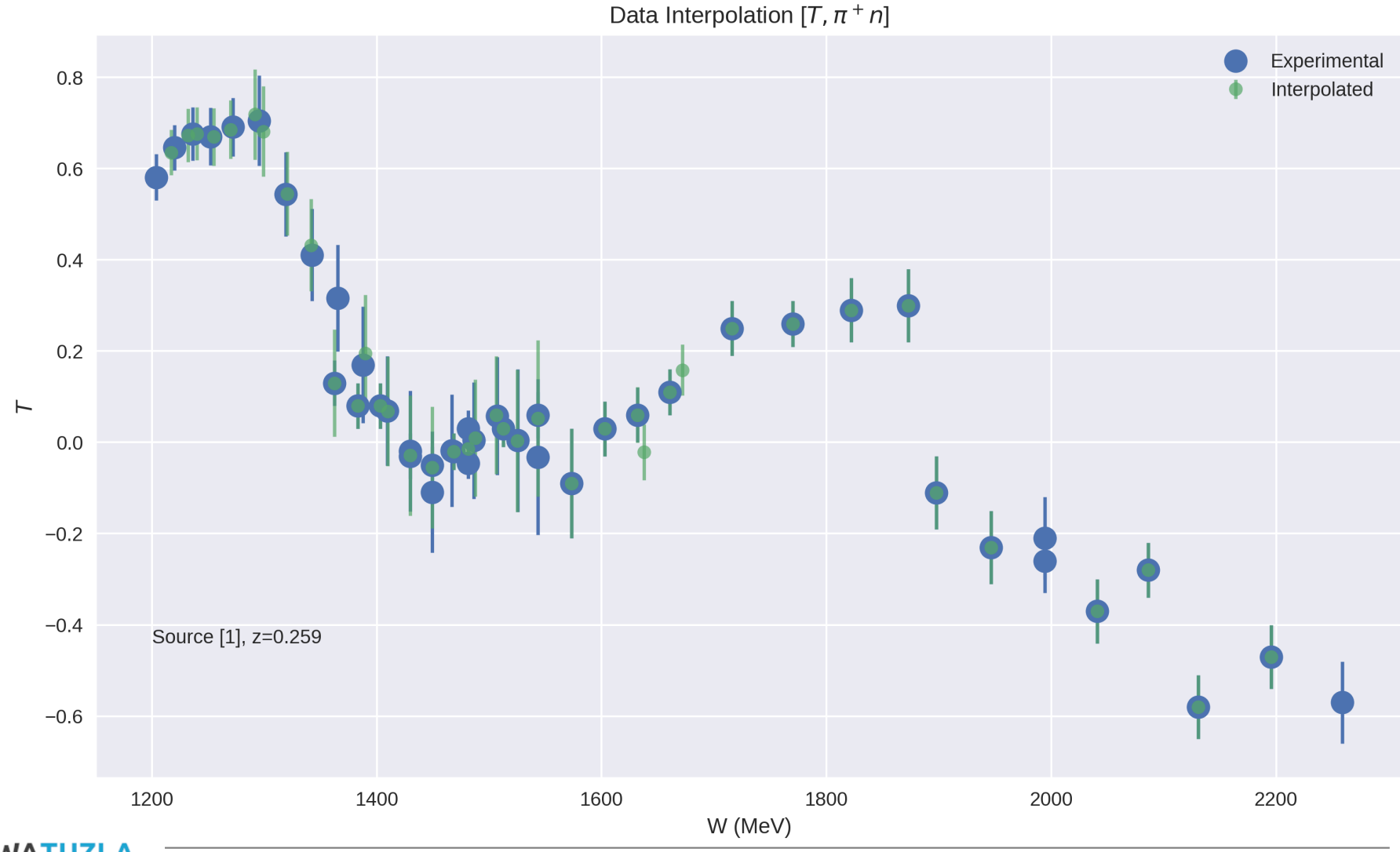
Data Interpolation: $\pi^+ n \quad H \quad z = 0.515$



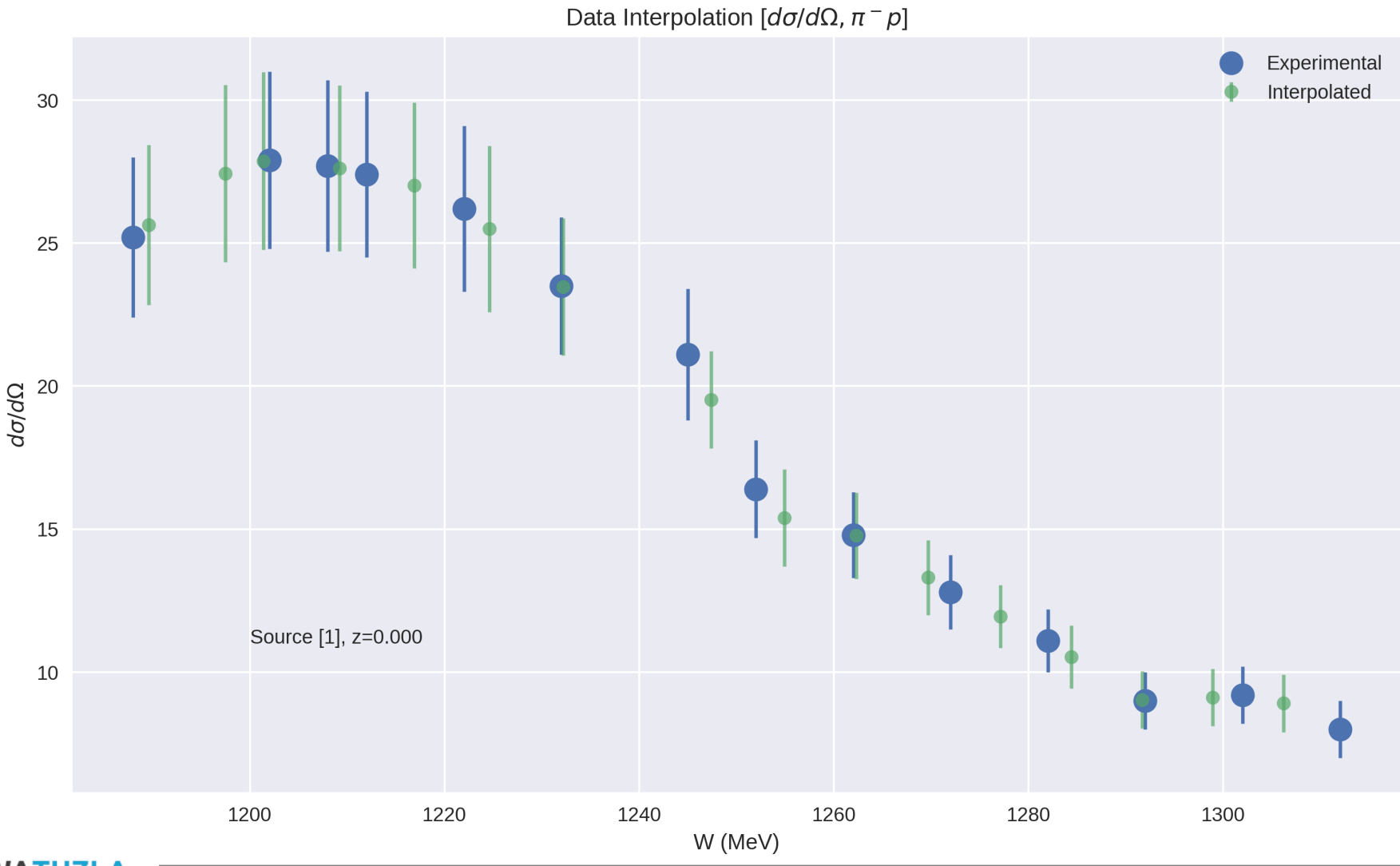
Data Interpolation: $\pi^+ n \quad P \quad z = 0.5$



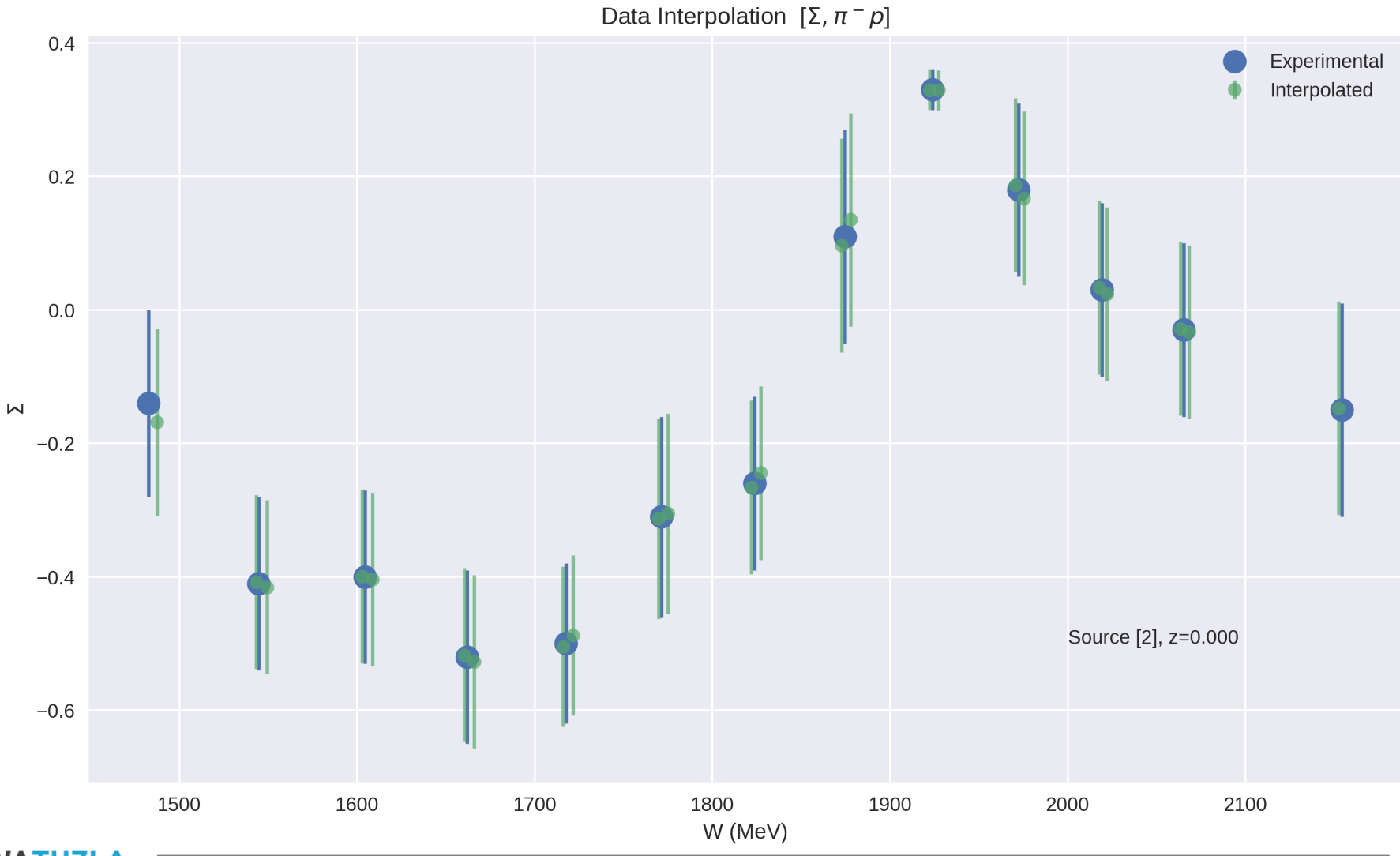
Data Interpolation: $\pi^+ n \quad T \quad z = 0.259$



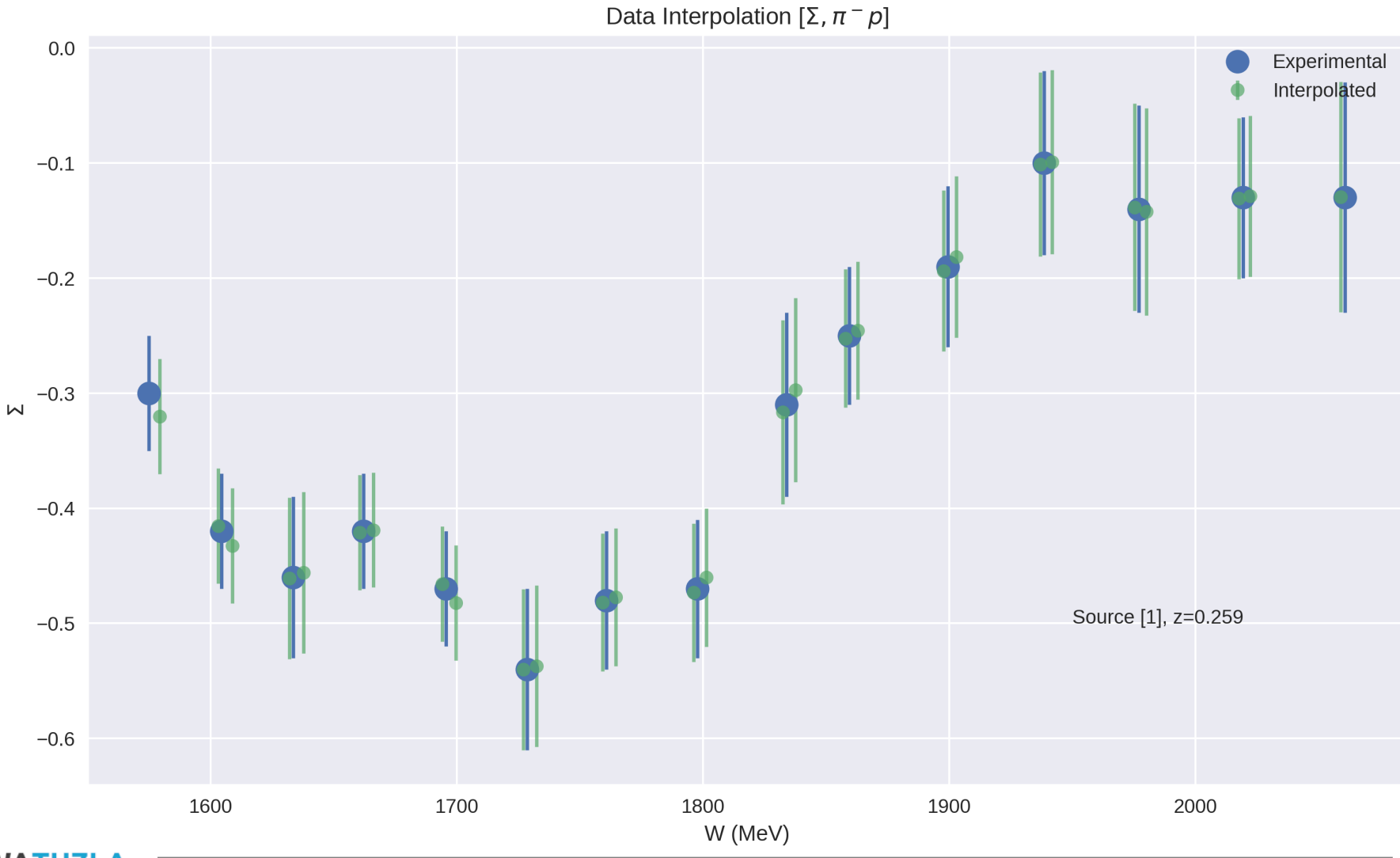
Data Interpolation: $\pi^- p \quad d\sigma/d\Omega \quad z = 0.0$



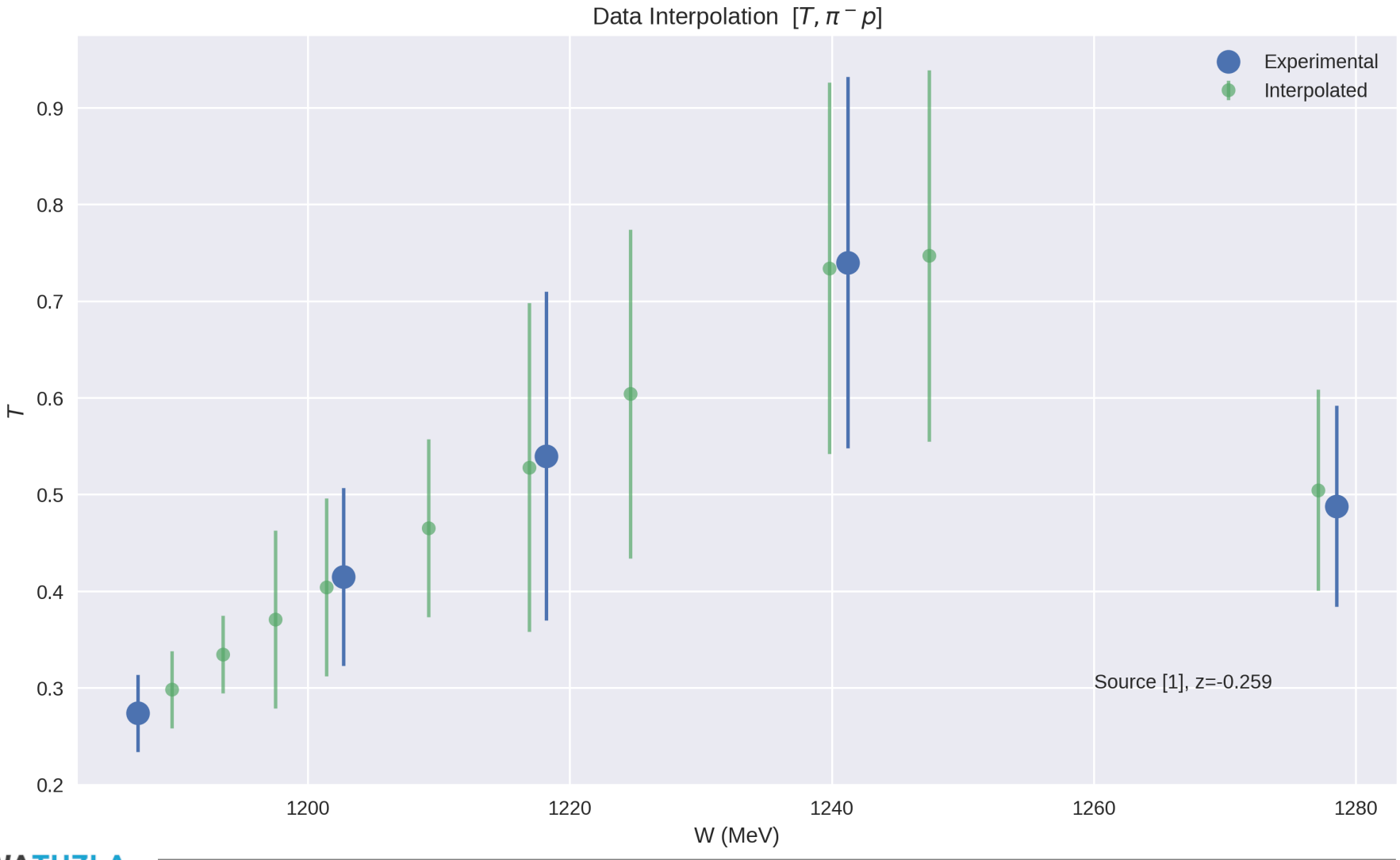
Data Interpolation: $\pi^- p \quad \Sigma \quad z = 0.0$



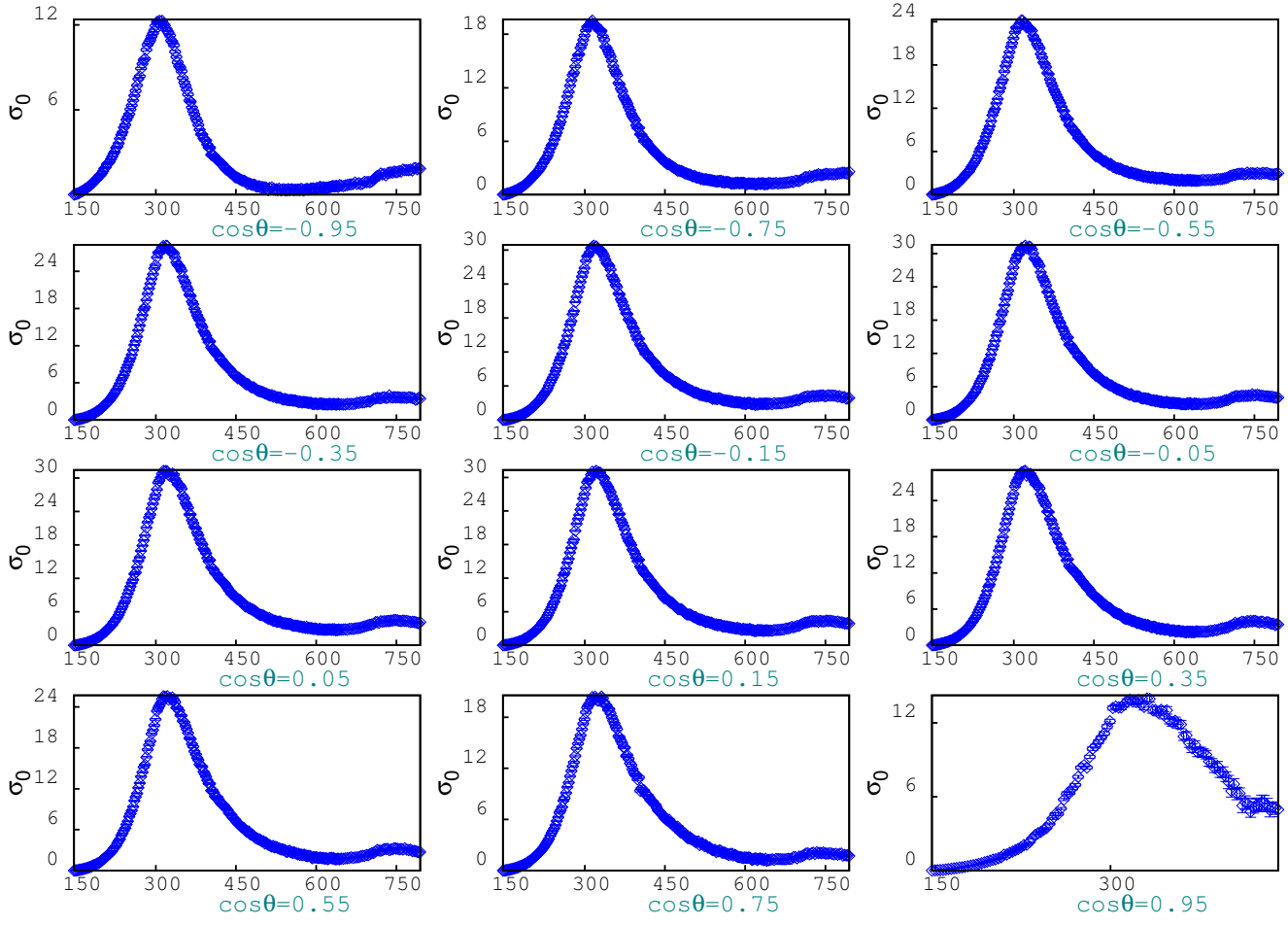
Data Interpolation: $\pi^- p \quad \Sigma \quad z = 0.259$



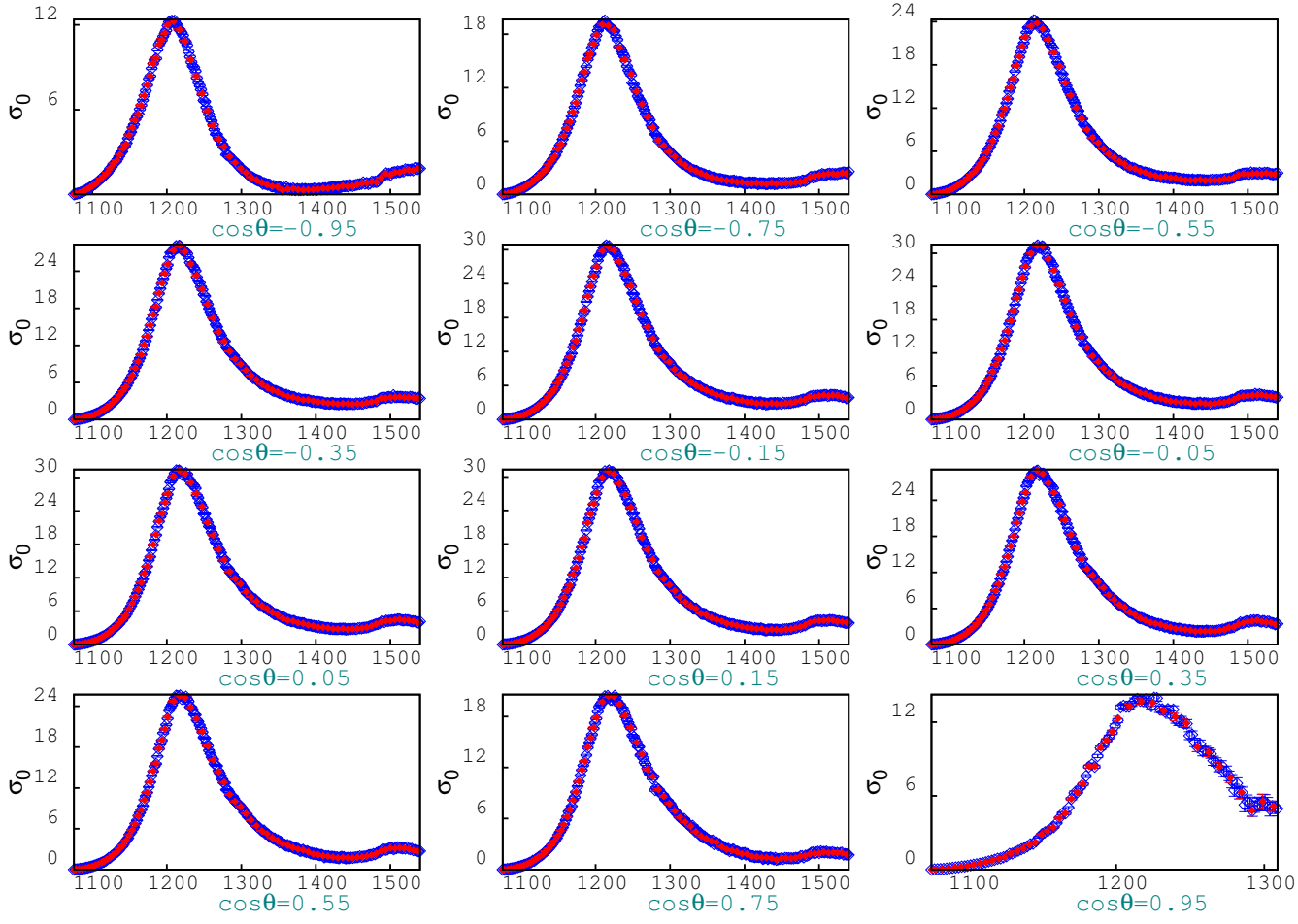
Data Interpolation: $\pi^- p \quad T \quad z = 0.259$



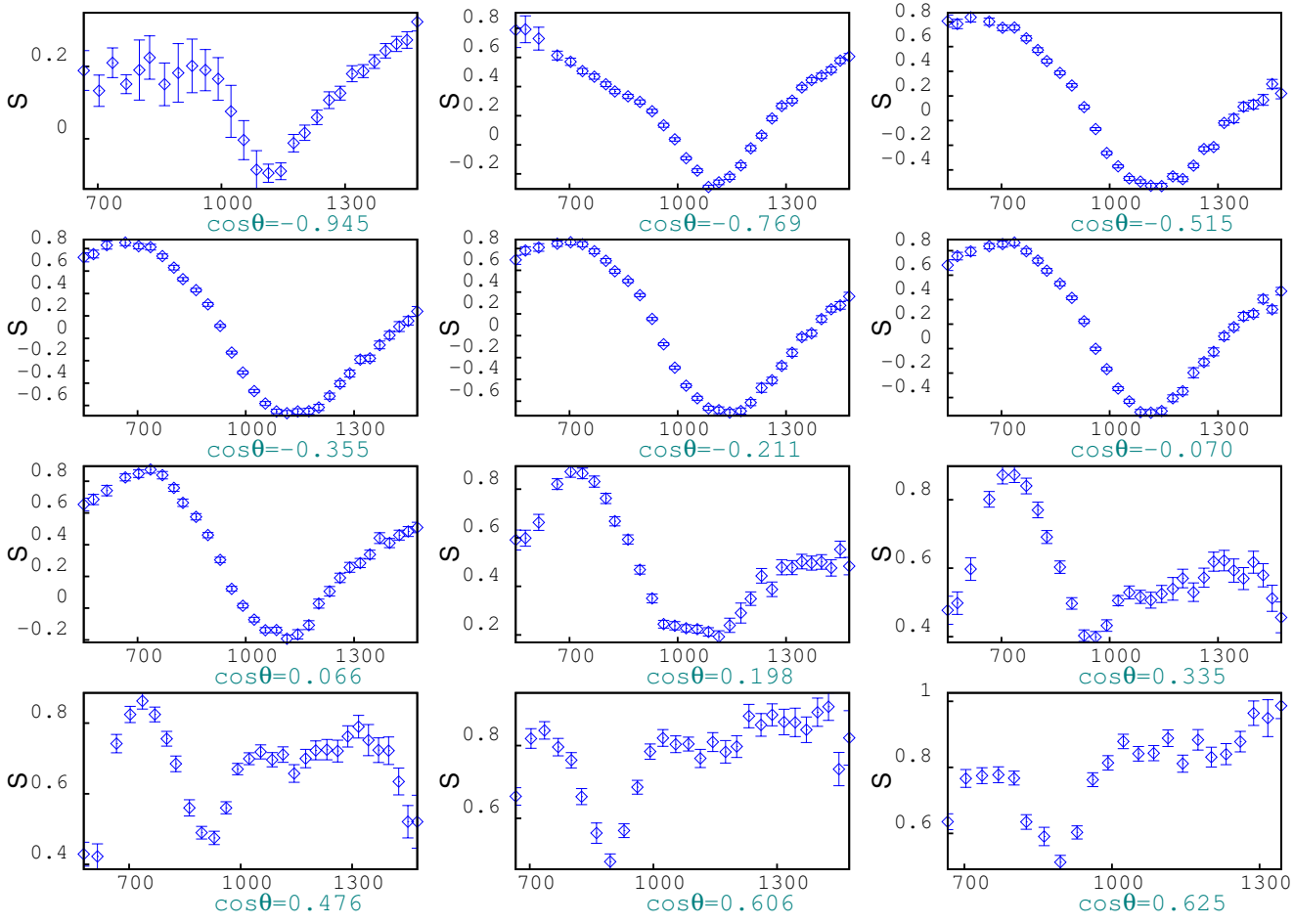
Data Interpolation: $\pi^0 p \quad d\sigma/d\Omega$



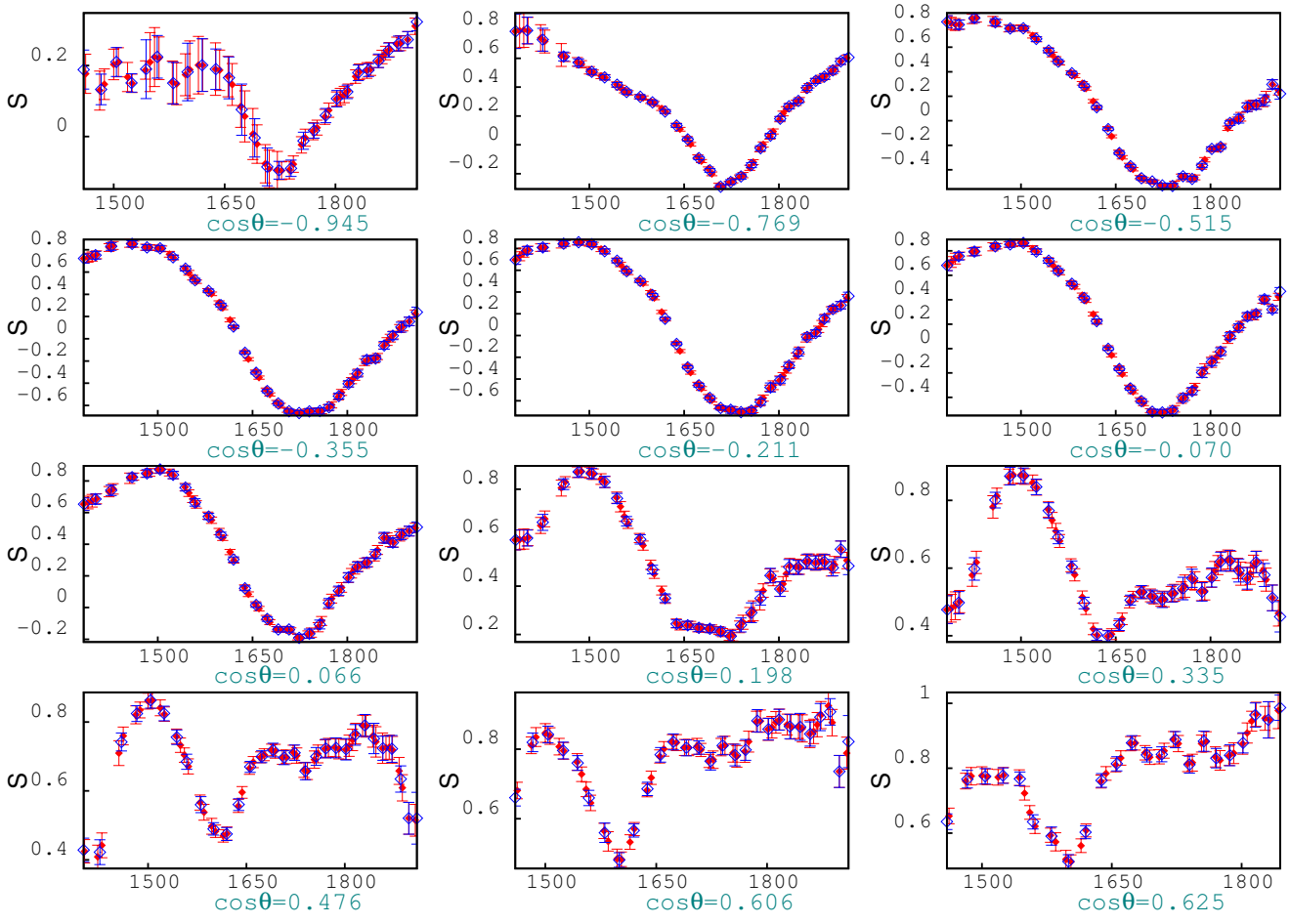
Data Interpolation: $\pi^0 p \quad d\sigma/d\Omega$



Data Interpolation: $\pi^0 p \quad \Sigma$



Data Interpolation: $\pi^0 p \quad \Sigma$



More details in 2018 Presentation

t binning

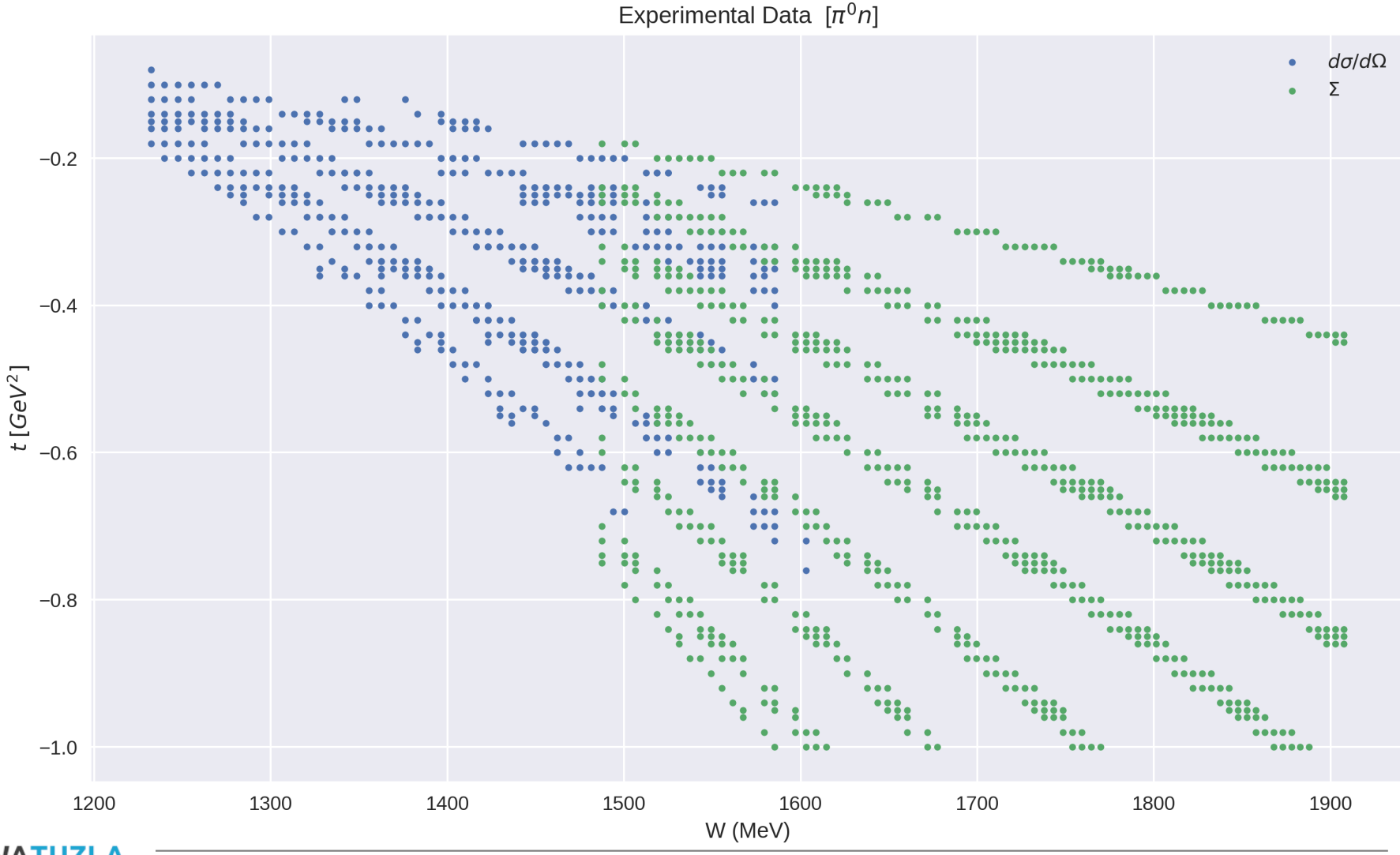
After performing s-binning at predefined energies, t-values were calculated using formula:

$$t_i = 2k(q cos\theta_i - \omega) + m_\pi^2$$

$$|cos\theta_i| \leq 1, \quad t_i \in [t_{min}, tmax]$$

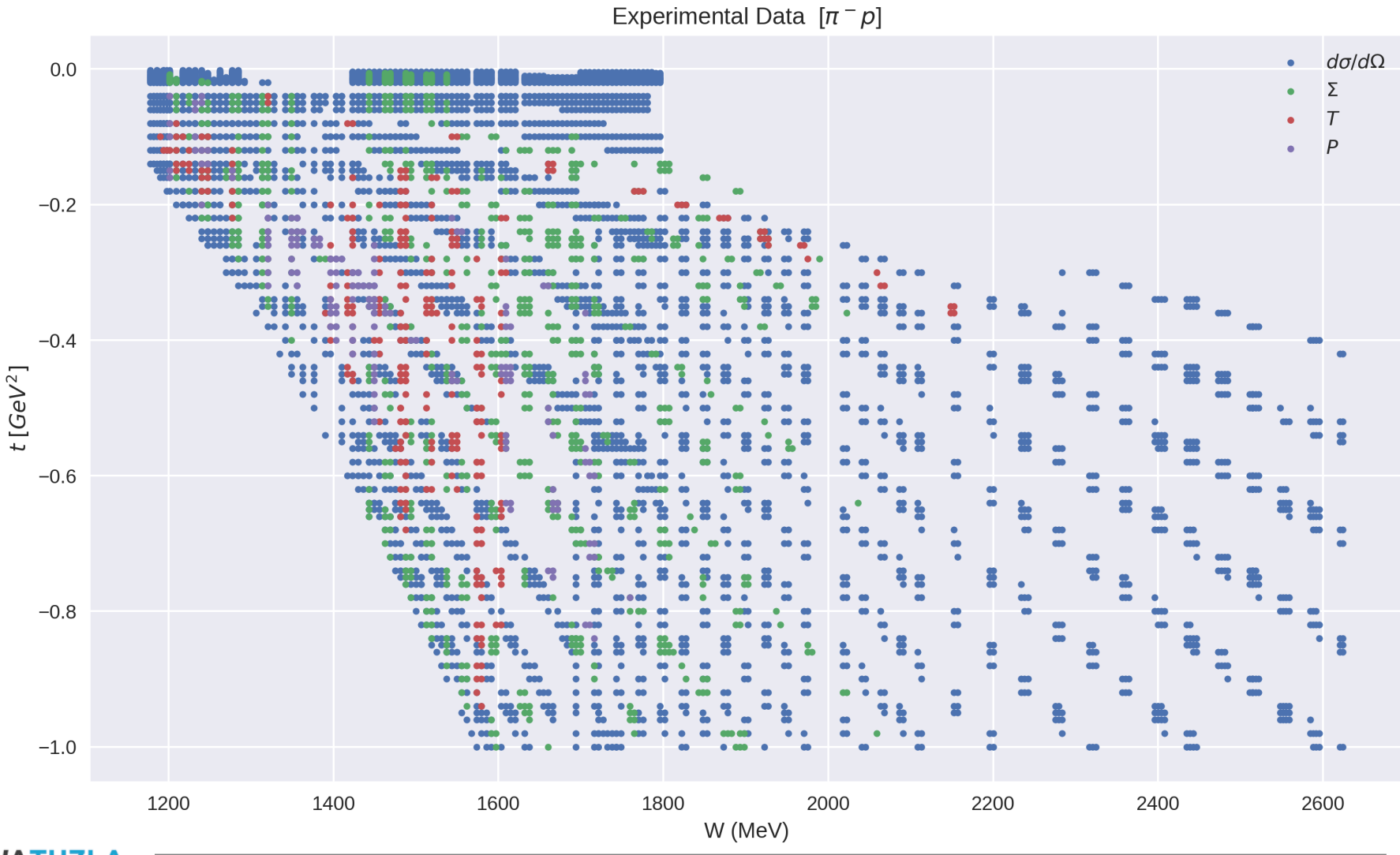
t binnig for $\pi^0 p$

t binnig for $\pi^0 n$

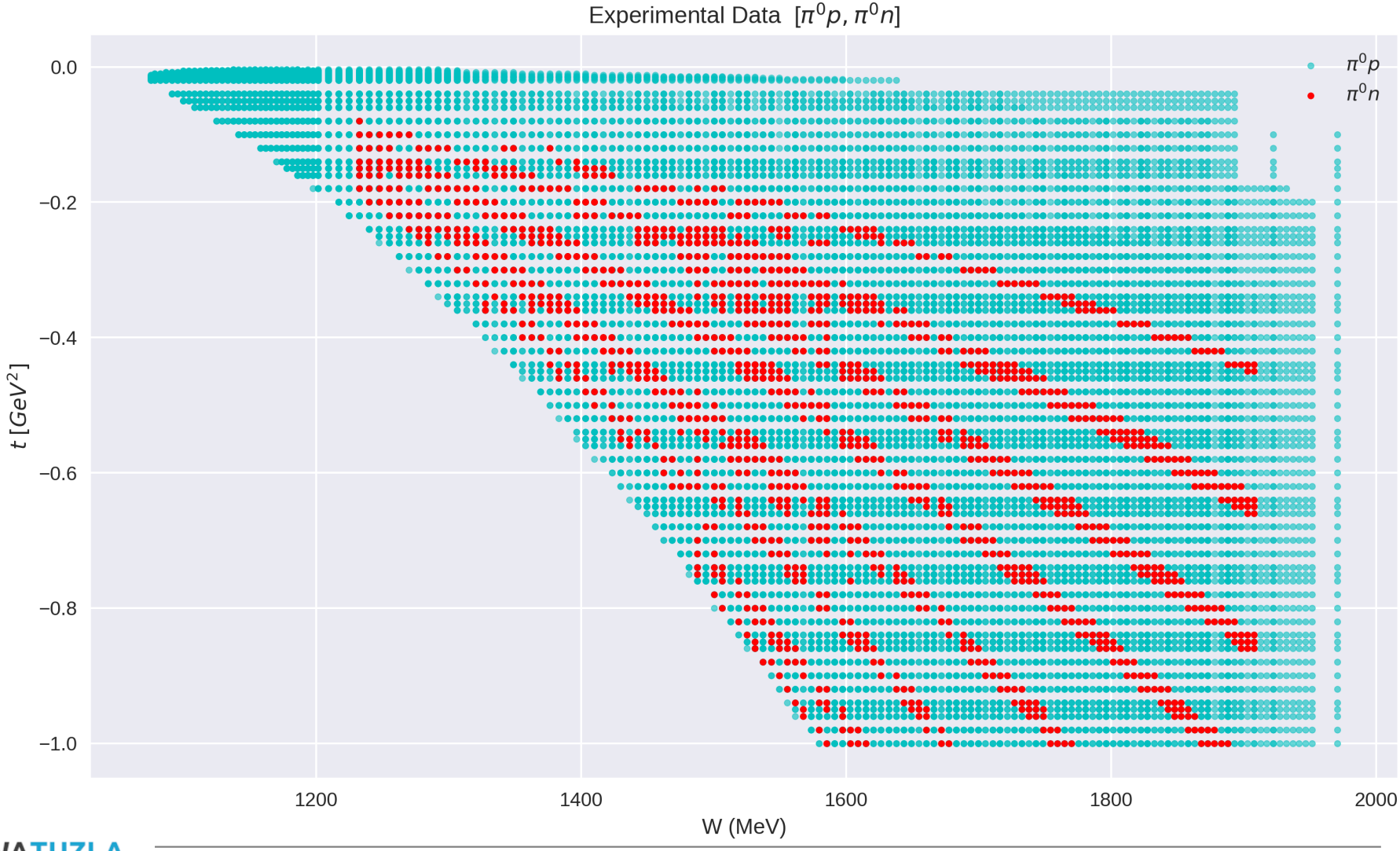


t binnig for $\pi^+ n$

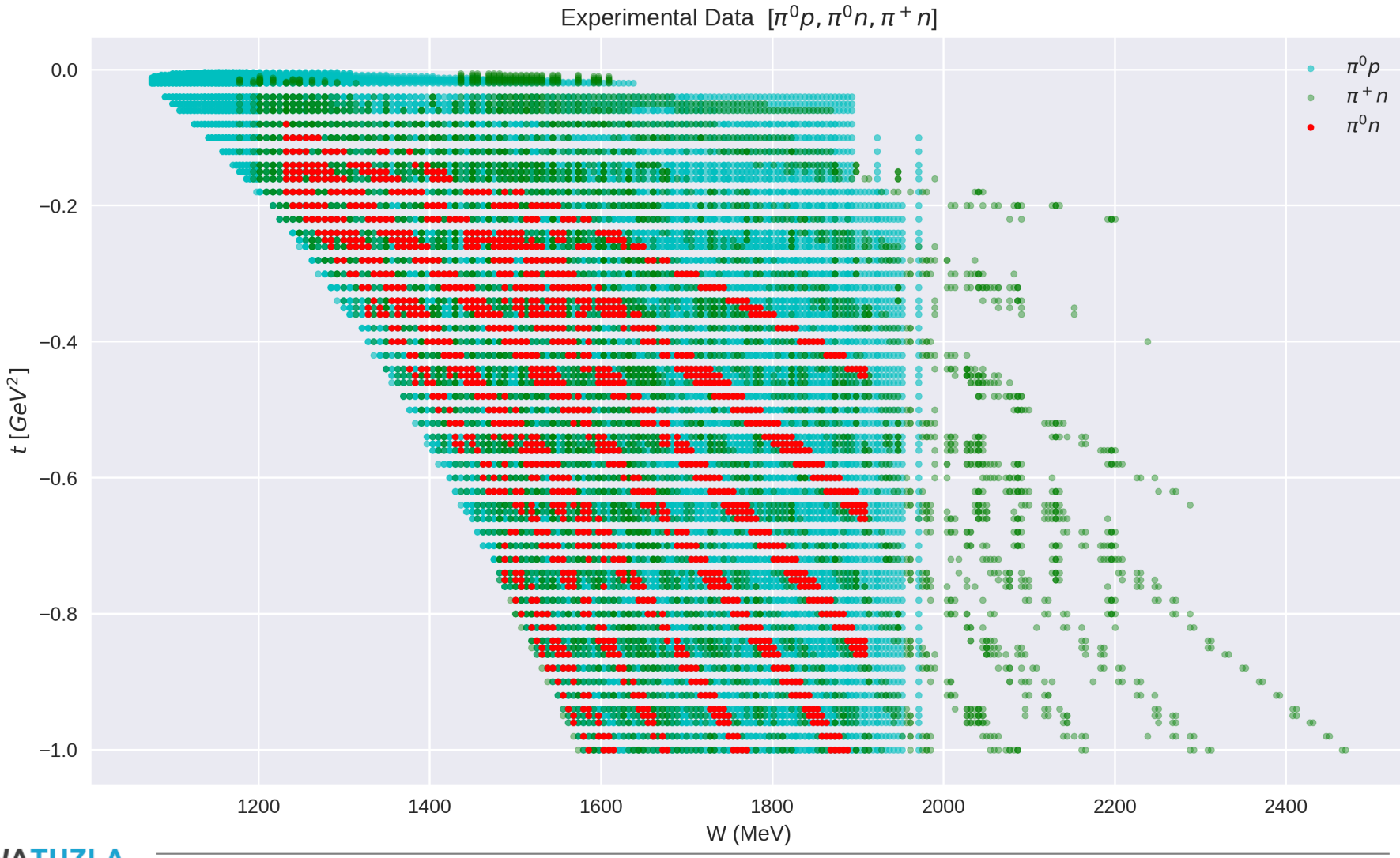
t binnig for $\pi^- p$



t binnig for $\pi^0 p + \pi^0 n$



t binnig for $\pi^0 p + \pi^0 n + \pi^+ n$



t binnig for $\pi^0 p + \pi^0 n + \pi^+ n + \pi^- p$