Fermi National Accelerator Laboratory

FERMILAB-TM-1926

Calculated Secondary Yields for Proton Broadband Using DECAY TURTLE

Allan Sondgeroth

Fermi National Accelerator Laboratory
P.O. Box 500, Batavia, Illinois 60510

February 1995

Operated by Universities Research Association Inc. under Contract No. DE-AC02-76CHO3000 with the United States Department of Energy

Disclaimer

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

Calculated Secondary Yields for Proton Broadband
Using DECAY TURTLE

Allan Sondgeroth
Janurary 5, 1995

Tabulated information:

For 100Gev Tune:

Location	Yield [N/P(incident)]	Average Energy [Gev]
DS end of target box	6.91E-2	287
PB4CON	7.20E-2	258
DS end of PB4	4.40E-2	350
US end of PB5	4.40E-2	350
DS end of Neutral Dump	7.64E-3	143
DS end of PB5	1.80E-3	103
US end of PB6	1.80E-3	103
DS end of PB6	1.14E-3	100

For 250Gev Tune:

Location	Yield [N/P(incident)]	Average Energy [Gev]
DS end of target box	6.88E-2	287
PB4CON	6.48E-2	279
DS end of PB4	3.73E-2	407
US end of PB5	3.73E-2	407
DS end of Neutral Dump	3.79E-3	227
DS end of PB5	6.60E-4	250
US end of PB6	6.60E-4	250
DS end of PB6	4.02E-4	239

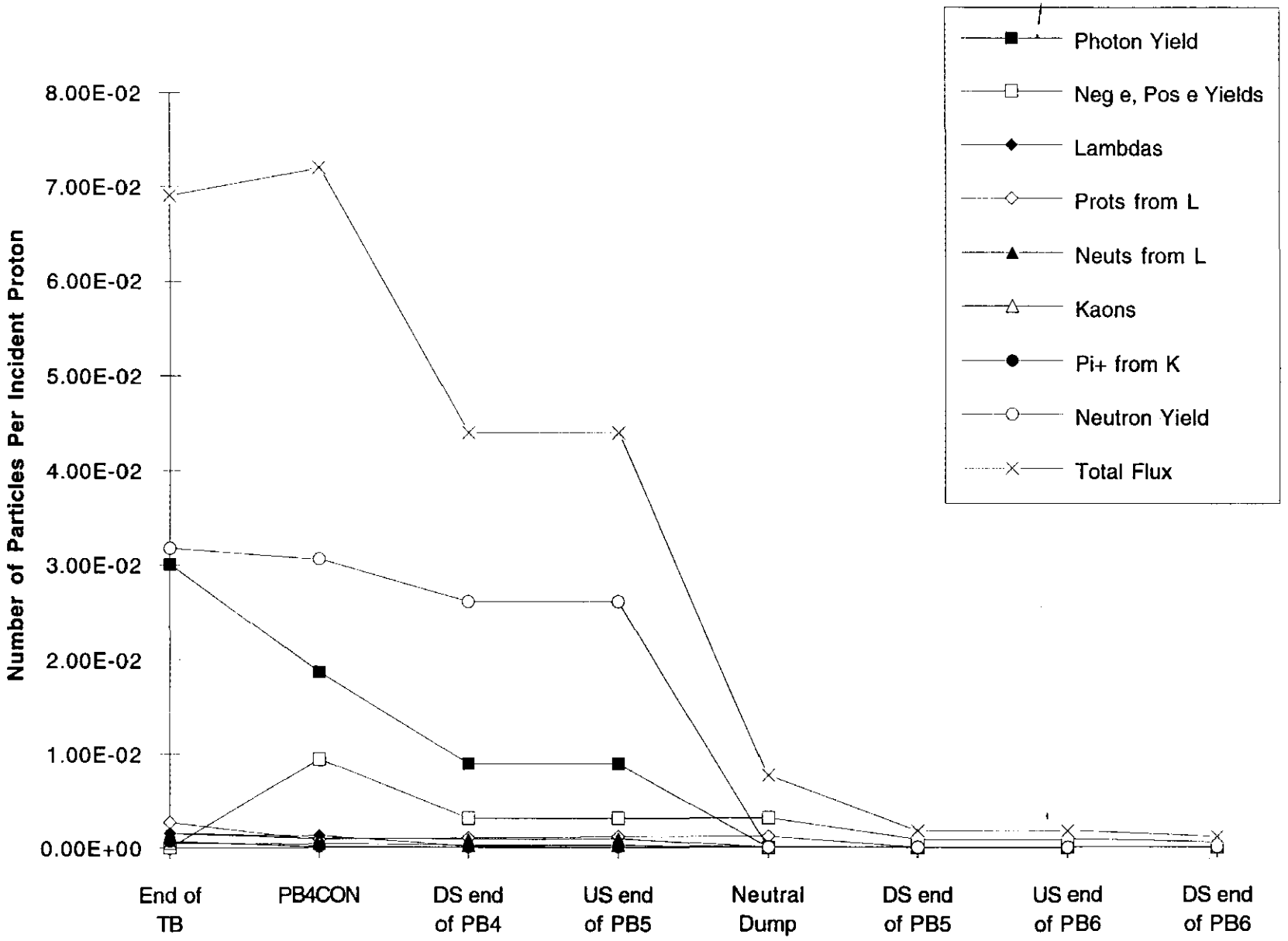
Methodology:

The calculations for the yields were done by Al Sondgeroth and Anthony Malensek. We used the DECAY deck called PBSEC_E.DAT from the CMS DECKS library. After obtaining the run modes and calibration modes from the liason physicist, Selcuk Cihangar, we made individual decay runs, using DECAY

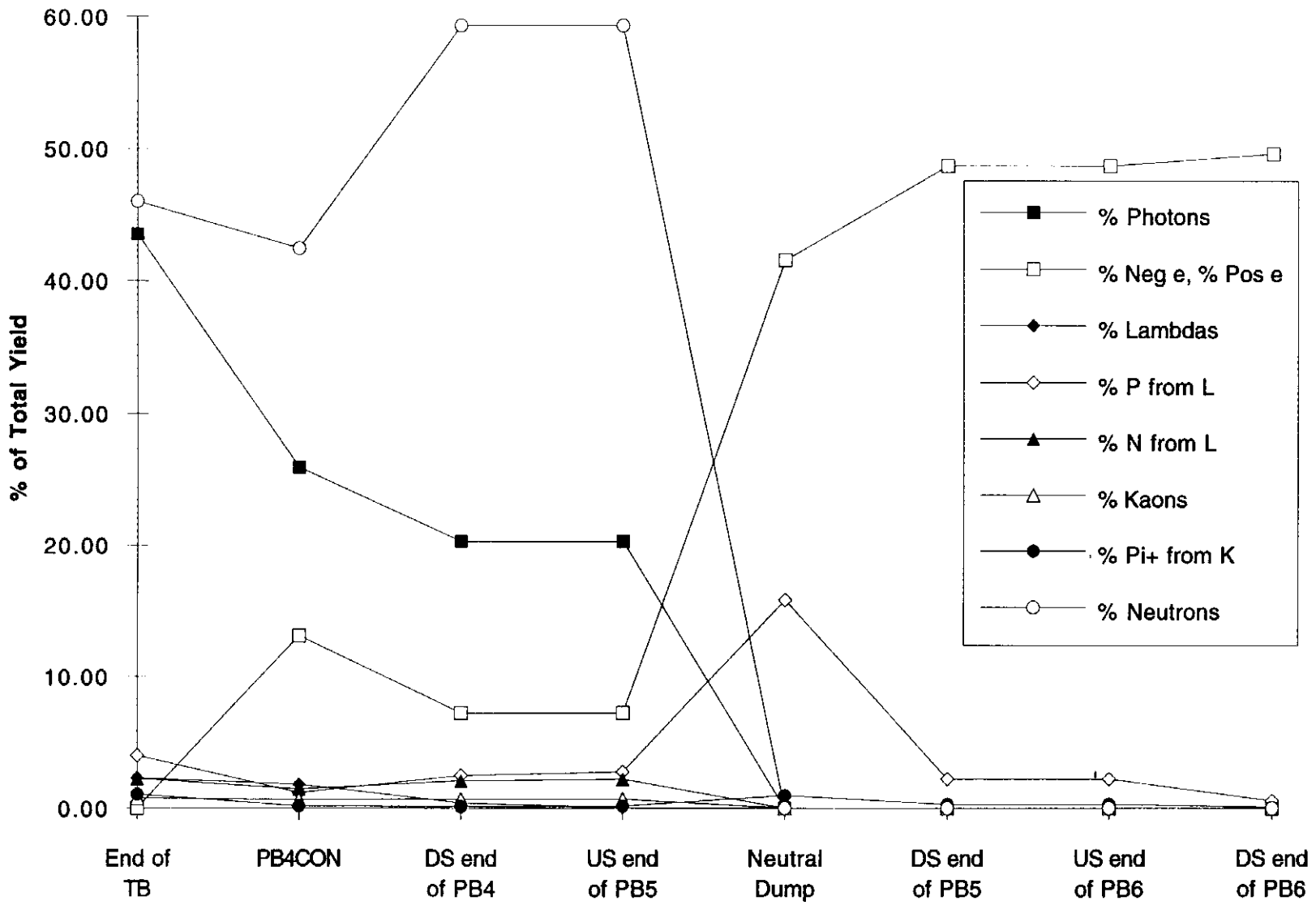
TURTLE from the CMS libaries and a production spectrum subroutine which was modified by Anthony, for each particle and decay mode for all particle types coming out of the target box. Results were weighted according to branching ratios for particles with more than one decay mode. The production spectra were produced assuming berylium as the target. The optional deterium target available to broadband will produce slightly higher yields. It should be noted that we did not include pion yields from klong decays because we could not simulate three body decays. Pions from klongs would add a very small fraction to the total yield.

Attached you will find charts and a spreadsheet with more detailed information. For more information, including computer runs, contact Al Sondgeroth by phone at X8516 or by e-mail at FNALV::SONDGEROTH.

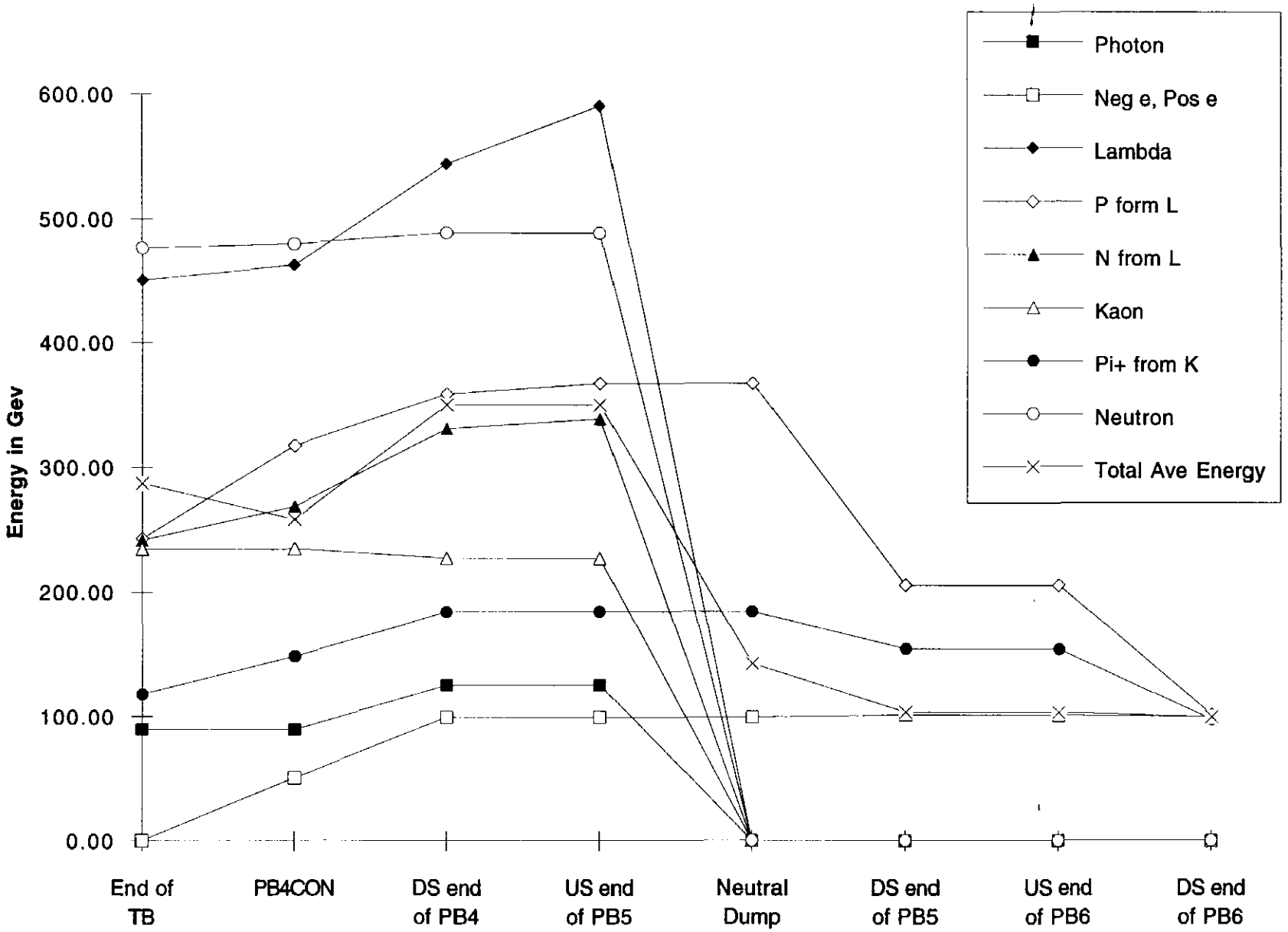
PB Yield Chart (100Gev tune)



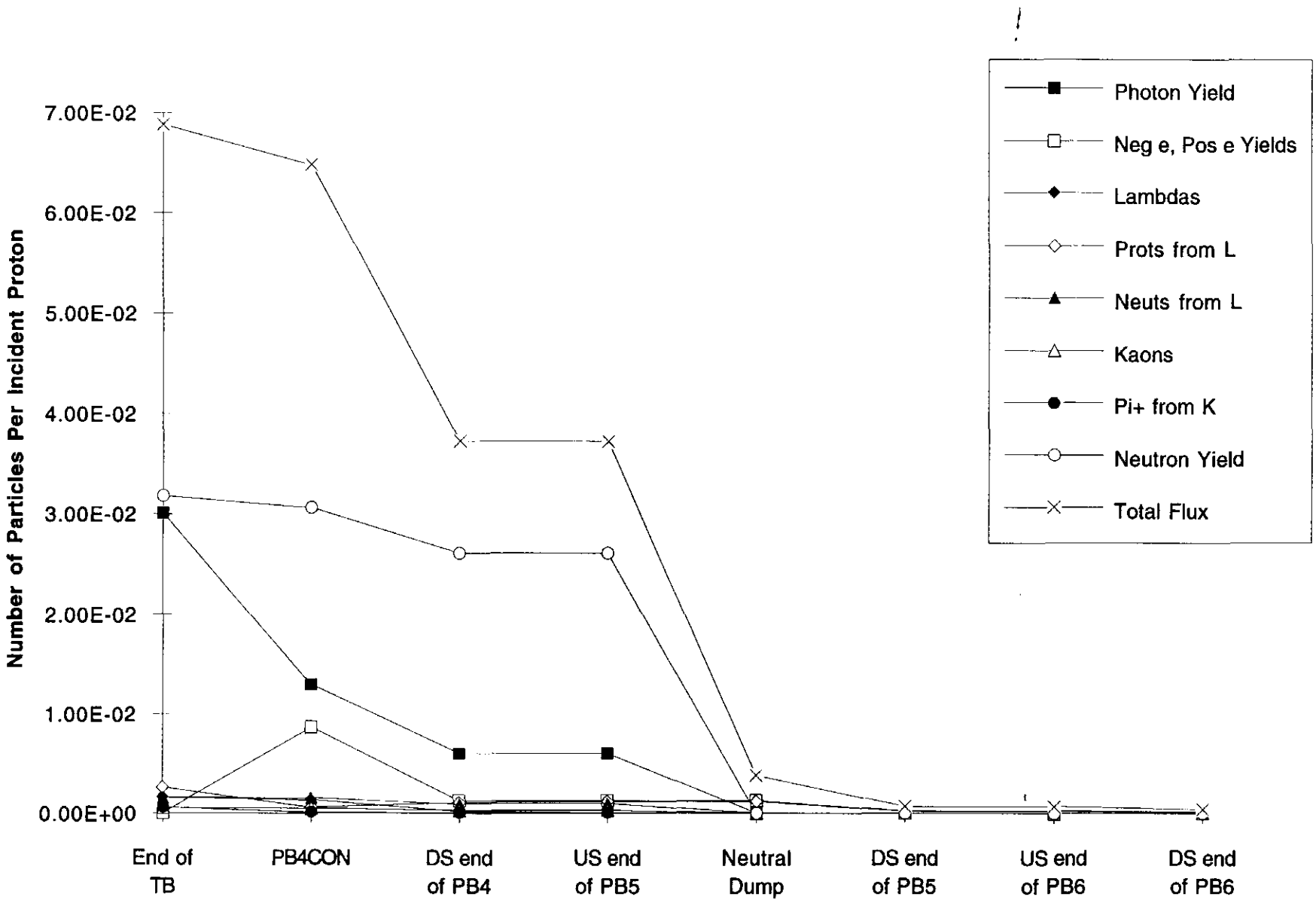
PB Percent Chart (100Gev Tune)



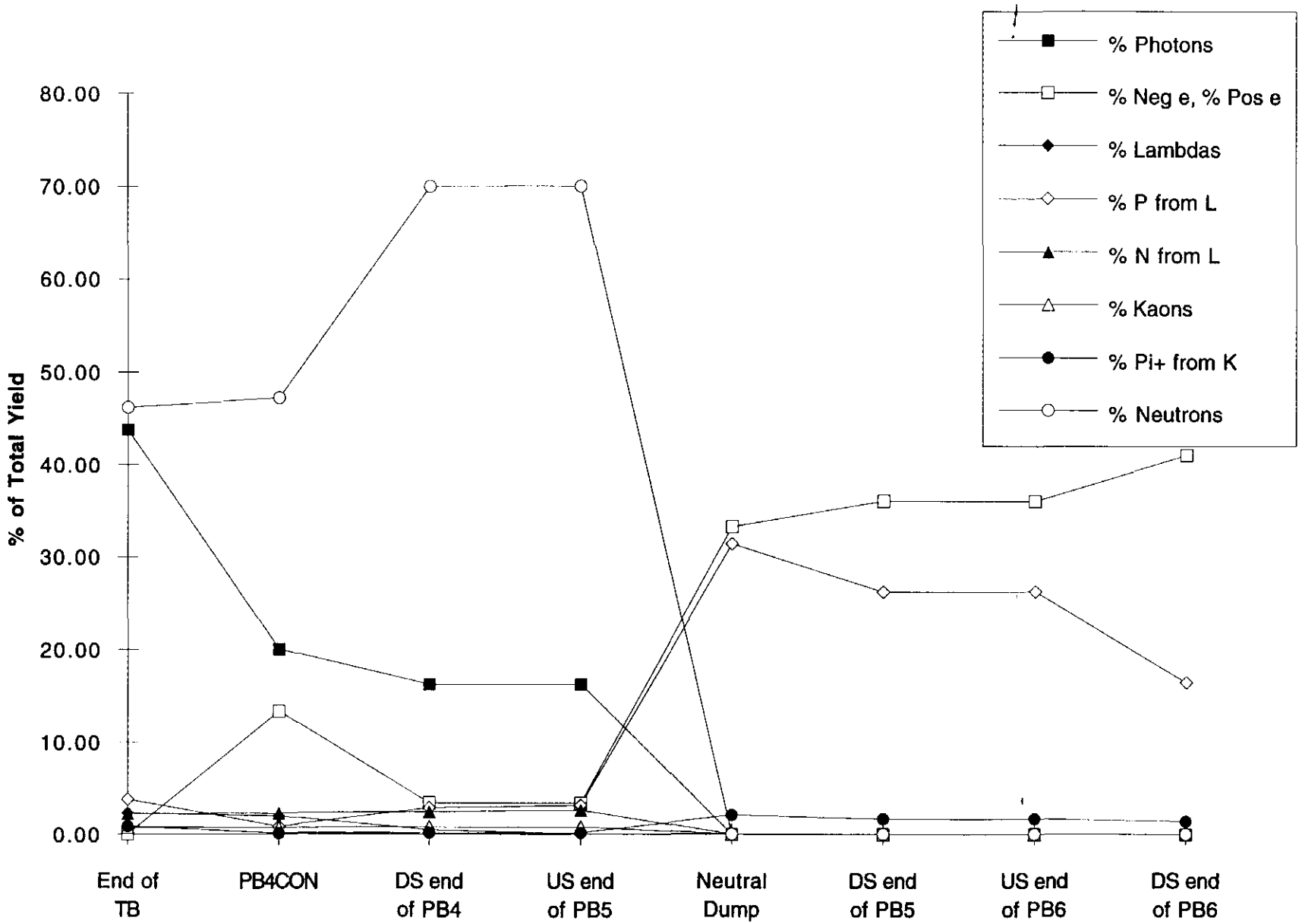
PB Average Energy (100Gev Tune)



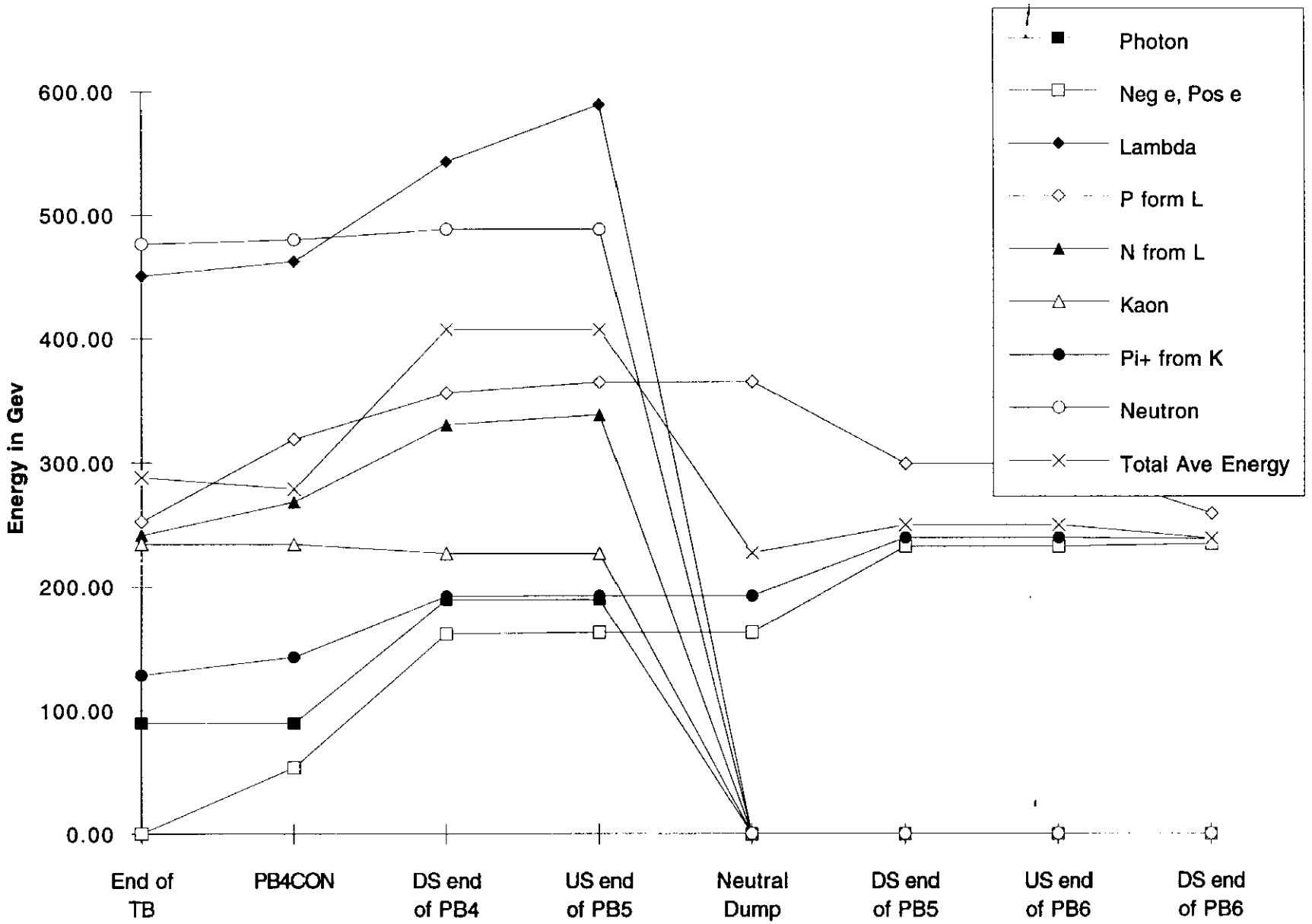
PB Yield Chart (250Gev Tune)



PB Percent Chart (250 Gev Tune)



PB Average Energy (250Gev Tune)



Beamline	z-range	Enclosure	Energy	Photon Yield N/P(inc)	Photon % of Total Flux	Photon Ave Energy	Neg e Yield N/P(inc)	Neg e % of Total Flux	Neg e Ave Energy	Pos e Yield N/P(inc)	Pos e % of Total Flux	Pos e Ave Energy	Lamdas N/P(inc)	Lambda % of Total Flux	Lambda Ave Energy
PB	6076-6089	PB4	100Gev	3.01E-02	43.57	89.57	0.00E+00	0.00	0.00	0.00E+00	0.00	0.00	1.59E-03	2.30	450.85
	6089-6270	PB4		1.87E-02	25.96	89.57	9.46E-03	13.13	50.73	9.46E-03	13.13	50.73	1.30E-03	1.80	462.44
	6270-6370	16" Pipe		8.92E-03	20.29	125.20	3.18E-03	7.23	99.07	3.18E-03	7.23	99.07	1.91E-04	0.43	543.62
	6370-6470	24" Pipe		8.92E-03	20.29	125.20	3.18E-03	7.23	99.23	3.18E-03	7.23	99.23	8.21E-05	0.19	565.93
	6470-6538	30" Pipe		8.92E-03	20.29	125.20	3.18E-03	7.23	99.33	3.18E-03	7.23	99.33	3.85E-05	0.09	578.32
	6538-6573	PB5		8.92E-03	20.29	125.20	3.18E-03	7.23	99.33	3.18E-03	7.23	99.33	2.22E-05	0.05	590.62
	6573-6665	PB5		0.00E+00	0.00	0.00	3.18E-03	41.60	99.33	3.18E-03	41.60	99.33	0.00E+00	0.00	0.00
	6665-6918	20" Pipe		0.00E+00	0.00	0.00	8.78E-04	48.74	100.73	8.78E-04	48.74	100.73	0.00E+00	0.00	0.00
	6918-7180	PB6		0.00E+00	0.00	0.00	8.78E-04	48.74	100.73	8.78E-04	48.74	100.73	0.00E+00	0.00	0.00
	7180-	PB7		0.00E+00	0.00	0.00	5.64E-04	49.65	99.60	5.64E-04	49.65	99.60	0.00E+00	0.00	0.00
PB	6076-6089	PB4	250Gev	3.01E-02	43.75	89.57	0.00E+00	0.00	0.00	0.00E+00	0.00	0.00	1.59E-03	2.31	450.84
	6089-6270	PB4		1.30E-02	20.05	89.57	8.64E-03	13.33	53.65	8.64E-03	13.33	53.65	1.30E-03	2.01	462.44
	6270-6370	16" Pipe		6.06E-03	16.26	189.54	1.27E-03	3.41	161.90	1.27E-03	3.41	161.90	1.91E-04	0.51	543.47
	6370-6470	24" Pipe		6.06E-03	16.27	189.54	1.26E-03	3.38	162.74	1.26E-03	3.38	162.74	8.23E-05	0.22	565.78
	6470-6538	30" Pipe		6.06E-03	16.27	189.54	1.26E-03	3.38	163.14	1.26E-03	3.38	163.14	3.86E-05	0.10	578.05
	6538-6573	PB5		6.06E-03	16.27	189.54	1.26E-03	3.38	163.14	1.26E-03	3.38	163.14	2.22E-05	0.06	589.94
	6573-6665	PB5		0.00E+00	0.00	0.00	1.26E-03	33.25	163.14	1.26E-03	33.25	163.14	0.00E+00	0.00	0.00
	6665-6918	20" Pipe		0.00E+00	0.00	0.00	2.38E-04	36.05	232.40	2.38E-04	36.05	232.40	0.00E+00	0.00	0.00
	6918-7180	PB6		0.00E+00	0.00	0.00	2.38E-04	36.05	232.40	2.38E-04	36.05	232.40	0.00E+00	0.00	0.00
	7180-	PB7		0.00E+00	0.00	0.00	1.65E-04	41.08	234.50	1.65E-04	41.08	234.50	0.00E+00	0.00	0.00

Prots from Lamdas N/P(inc)	P from L % of Total Flux	P form L Ave Energy	Neuts from Lambdas N/P(inc)	N from L % of Total Flux	N from L Ave Energy	Kaons * N/P(inc)	Kaon % of Total Flux	Kaon Ave Energy	Pi+ from K N/P(inc) **	Pi+ from K % of Tot Flux	Pi+ from K Ave Energy	Pi- from K N/P(inc) ***
2.76E-03	4.00	242.82	1.56E-03	2.26	241.72	5.42E-04	0.78	234.48	7.25E-04	1.05	117.96	0.00
8.56E-04	1.19	317.70	1.05E-03	1.46	268.52	4.78E-04	0.66	234.29	1.26E-04	0.17	149.08	0.00
1.10E-03	2.50	358.52	9.13E-04	2.08	330.77	3.16E-04	0.72	226.94	7.22E-05	0.16	183.79	0.00
1.17E-03	2.66	363.74	9.52E-04	2.17	335.52	3.13E-04	0.71	226.54	7.34E-05	0.17	184.41	0.00
1.20E-03	2.73	366.21	9.67E-04	2.20	337.69	3.11E-04	0.71	226.75	7.34E-05	0.17	184.37	0.00
1.21E-03	2.75	367.17	9.74E-04	2.22	338.53	3.09E-04	0.70	226.96	7.36E-05	0.17	184.42	0.00
1.21E-03	15.83	367.17	0.00E+00	0.00	0.00	0.00E+00	0.00	0.00	7.36E-05	0.96	184.43	0.00
3.99E-05	2.21	205.36	0.00E+00	0.00	0.00	0.00E+00	0.00	0.00	5.67E-06	0.31	154.56	0.00
3.99E-05	2.21	205.36	0.00E+00	0.00	0.00	0.00E+00	0.00	0.00	5.67E-06	0.31	154.56	0.00
6.76E-06	0.59	101.62	0.00E+00	0.00	0.00	0.00E+00	0.00	0.00	1.10E-06	0.10	97.71	0.00
2.60E-03	3.78	252.77	1.56E-03	2.27	241.72	5.42E-04	0.79	234.48	6.08E-04	0.88	128.52	0.00
5.81E-04	0.90	319.15	1.51E-03	2.32	268.52	4.80E-04	0.74	234.29	9.08E-05	0.14	143.52	0.00
1.08E-03	2.90	355.90	9.13E-04	2.45	330.79	3.16E-04	0.85	226.97	7.86E-05	0.21	192.22	0.00
1.15E-03	3.09	361.38	9.52E-04	2.56	335.53	3.13E-04	0.84	226.56	7.97E-05	0.21	192.67	0.00
1.17E-03	3.14	363.95	9.68E-04	2.60	337.71	3.11E-04	0.83	226.75	7.98E-05	0.21	192.62	0.00
1.18E-03	3.17	364.95	9.74E-04	2.62	338.55	3.09E-04	0.83	226.96	7.99E-05	0.21	192.66	0.00
1.19E-03	31.40	365.12	0.00E+00	0.00	0.00	0.00E+00	0.00	0.00	7.99E-05	2.11	192.66	0.00
1.73E-04	26.20	299.14	0.00E+00	0.00	0.00	0.00E+00	0.00	0.00	1.12E-05	1.70	239.76	0.00
1.73E-04	26.20	299.14	0.00E+00	0.00	0.00	0.00E+00	0.00	0.00	1.12E-05	1.70	239.76	0.00
6.61E-05	16.46	258.97	0.00E+00	0.00	0.00	0.00E+00	0.00	0.00	5.56E-06	1.38	238.44	0.00

Pi- from K % of Tot Flux	Pi- from K Ave Energy	Neutron Yield N/P(inc)	Neutron % of Total Flux	Neutron Ave Energy	Total Flux N/P(inc)	Ave Energy of Tot Flux	(AE**0.8)*TF	Comments
0.00	0.00	3.18E-02	46.04	476.61	6.91E-02	287.06	6.39	Highest beam power, for electrons, is 100Gev
0.00	0.00	3.06E-02	42.48	479.96	7.20E-02	258.33	6.13	Location of PB4CON
0.00	0.00	2.61E-02	59.36	488.56	4.40E-02	349.85	4.77	
0.00	0.00	2.61E-02	59.36	488.56	4.40E-02	349.67	4.77	All yields calculated with PB4SW off.
0.00	0.00	2.61E-02	59.36	488.56	4.40E-02	349.61	4.76	
0.00	0.00	2.61E-02	59.36	488.56	4.40E-02	349.58	4.76	
0.00	0.00	0.00E+00	0.00	0.00	7.64E-03	142.55	0.40	U.S. end of neutral dump.
0.00	0.00	0.00E+00	0.00	0.00	1.80E-03	103.22	0.07	
0.00	0.00	0.00E+00	0.00	0.00	1.80E-03	103.22	0.07	
0.00	0.00	0.00E+00	0.00	0.00	1.14E-03	99.61	0.05	
0.00	0.00	3.18E-02	46.22	476.61	6.88E-02	287.92	6.38	Run mode is 250Gev electrons and positrons.
0.00	0.00	3.06E-02	47.20	479.96	6.48E-02	279.08	5.87	Location of PB4CON
0.00	0.00	2.61E-02	70.01	488.56	3.73E-02	407.43	4.57	
0.00	0.00	2.61E-02	70.05	488.56	3.73E-02	407.39	4.56	All yields calculated with PB4SW off.
0.00	0.00	2.61E-02	70.07	488.56	3.72E-02	407.33	4.56	
0.00	0.00	2.61E-02	70.08	488.56	3.72E-02	407.31	4.56	
0.00	0.00	0.00E+00	0.00	0.00	3.79E-03	227.18	0.29	U.S. end of neutral dump.
0.00	0.00	0.00E+00	0.00	0.00	6.60E-04	250.01	0.05	
0.00	0.00	0.00E+00	0.00	0.00	6.60E-04	250.01	0.05	
0.00	0.00	0.00E+00	0.00	0.00	4.02E-04	238.58	0.03	
								* Includes contributions from Kshorts and Klongs.
								** Includes only pions from Kshort decays. We can't simulate three body Klong decays
								*** Program unreliable for Pi- decay products.