MARATHON Counting Rates Estimation

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Abstract

A preliminary calculation of counting rates for MARATHON is introduced in this report. So far, it is assumed -as told by Jessie- that the maximum angle for the LHRS is 38.5 with the tritium platform still connected. The maximum angle value should be confirmed in the following few weeks. For now, I checked the counting rates using the kinematics Makis suggested (Table.1). In Table.2, I tried to change the kinemtatics only for the highest x point at the maximum angle ,38.5, to reach $W^2 \sim 3.5$.

Input Values

- Target Densities:

  $$\rho_{H3} = 0.00363\ (\times 0.85)$$

  $$\rho_{He3}=0.00425\ (\times 0.9)$$

  $$\rho_{H2}=0.00568\ (\times 0.9)$$

  The values between ( ) are multiplied by the densities due to beam-heating effects.

- HRS Acceptance:

  Energy acceptance: $|\delta E^{'}| < 4.5\%$

  Angle acceptance: $|\theta_{tg}| < 0.045$ rad, $|\phi_{tg}| < 0.032$ rad.

The total angular acceptance range for both HRS's is:

$$2 \times (2 \times 0.045) \times (2 \times 0.032) \approx 0.01\ sr$$

- Target Length: The full target length is 25 cm. However, an approximate effective length (12 cm) is used in this calculation.

- Beam current:

$$I = 20\ \mu A$$

- Target Luminosities:

$$Lum_{H3} = 0.93\ \times 10^{36}\ cm^{-2}.s^{-1}$$

$$Lum_{He3} = 1.15\ \times 10^{36}\ cm^{-2}.s^{-1}$$

$$Lum_{H2} = 2.31\ \times 10^{36}\ cm^{-2}.s^{-1}$$

- For the rate estimation, the number of events needed for each x point is assumed to be 25k

- For each kinematic point, π/e ratio was calculated using Wiser fitting.

- For the cross section calculation, Whitlow's fit (Phys. Lett. **B282** , 475 (1995)) was used.

- Radiative effect and isoscaler correction were not applied in this calculation (yet!)

Table 1: Cross Sections and Counting Rates for MARATHON

x	E	E'	θ	W^2	$\sigma(^3\text{He})$ $(\frac{nb}{sr.GeV})$	$\sigma(^3\text{H})$ $(\frac{nb}{sr.GeV})$	$\sigma(^2\text{H})$ $(\frac{nb}{sr.GeV})$	CR(^{3}He) Hz	CR(^{3}H) Hz	CR(D) Hz	t(^{3}He) (h)	t(^{3}H) (h)	t(D) (h)	π/e
0.825	10.6	2.70	38.1	3.47	0.0269	0.0216	0.0162	0.08	0.05	0.09	92.26	142.1	76.5	2
0.785	10.6	3.00	34.5	3.94	0.0635	0.0494	0.0376	0.20	0.12	0.23	35.18	56.0	29.6	1
0.745	10.6	3.00	33.6	4.52	0.1070	0.0821	0.0630	0.33	0.21	0.39	20.87	33.7	17.7	1
0.705	10.6	3.00	32.7	5.09	0.1722	0.1316	0.1012	0.54	0.33	0.63	12.97	21.0	11.0	1
0.665	10.6	3.00	31.7	5.65	0.2681	0.2055	0.1579	0.83	0.52	0.98	8.33	13.5	7.1	2
0.625	10.6	3.00	30.7	6.23	0.4068	0.3144	0.2404	1.27	0.79	1.50	5.49	8.8	4.6	2
0.585	10.6	3.00	29.7	6.80	0.6045	0.4724	0.3590	1.88	1.19	2.24	3.69	5.9	3.1	2
0.545	10.6	3.00	28.6	7.37	0.8825	0.6985	0.5270	2.74	1.75	3.29	2.53	4.0	2.1	2
0.505	10.6	3.00	27.5	7.94	1.2695	1.0191	0.7629	3.95	2.56	4.76	1.76	2.7	1.5	3
0.465	10.6	3.00	26.4	8.51	1.8060	1.4720	1.0927	5.62	3.69	6.81	1.24	1.9	1.0	3
0.425	10.6	3.00	25.2	9.08	2.5514	2.1131	1.5548	7.93	5.30	9.69	0.88	1.3	0.7	4
0.385	10.6	3.00	24.0	9.65	3.5904	3.0242	2.2049	11.17	7.59	13.75	0.62	0.9	0.5	5
0.345	10.6	3.00	22.7	10.22	5.0593	4.3365	3.1319	15.73	10.88	19.52	0.44	0.6	0.4	6
0.305	10.6	3.00	21.3	10.79	7.1801	6.2651	4.4817	22.33	15.72	27.94	0.31	0.4	0.2	7
0.265	10.6	3.00	19.8	11.36	10.3485	9.1937	6.5141	32.18	23.06	40.61	0.22	0.3	0.2	9
0.225	10.6	3.00	18.3	11.93	15.2888	13.8270	9.7053	47.54	34.68	60.50	0.15	0.2	0.1	11
										Total hours	186.9	293.4	156.3	

Table 2: Cross Sections and Counting Rates for MARATHON , using different kinematics for highest x point

x	E	E'	θ	W^2	$\sigma(^3\text{He})$ $(\frac{nb}{sr.GeV})$	$\sigma(^3\text{H})$ $(\frac{nb}{sr.GeV})$	$\sigma(^2\text{H})$ $(\frac{nb}{sr.GeV})$	CR(^{3}He) Hz	CR(^{3}H) Hz	CR(D) Hz	t(^{3}He) (h)	t(^{3}H) (h)	t(D) (h)	π/e
0.825	10.6	2.66	38.5	3.49	0.0260	0.0209	0.0156	0.07	0.05	0.09	97.05	149.5	80.5	2
0.785	10.6	3.00	34.5	3.94	0.0635	0.0494	0.0376	0.20	0.12	0.23	35.18	56.0	29.6	1
0.745	10.6	3.00	33.6	4.52	0.1070	0.0821	0.0630	0.33	0.21	0.39	20.87	33.7	17.7	1
0.705	10.6	3.00	32.7	5.09	0.1722	0.1316	0.1012	0.54	0.33	0.63	12.97	21.0	11.0	1
0.665	10.6	3.00	31.7	5.65	0.2681	0.2055	0.1579	0.83	0.52	0.98	8.33	13.5	7.1	2
0.625	10.6	3.00	30.7	6.23	0.4068	0.3144	0.2404	1.27	0.79	1.50	5.49	8.8	4.6	2
0.585	10.6	3.00	29.7	6.80	0.6045	0.4724	0.3590	1.88	1.19	2.24	3.69	5.9	3.1	2
0.545	10.6	3.00	28.6	7.37	0.8825	0.6985	0.5270	2.74	1.75	3.29	2.53	4.0	2.1	2
0.505	10.6	3.00	27.5	7.94	1.2695	1.0191	0.7629	3.95	2.56	4.76	1.76	2.7	1.5	3
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0.265	10.6	3.00	19.8	11.36	10.3485	9.1937	6.5141	32.18	23.06	40.61	0.22	0.3	0.2	9
0.225	10.6	3.00	18.3	11.93	15.2888	13.8270	9.7053	47.54	34.68	60.50	0.15	0.2	0.1	11
										Total hours	191.7	300.7	160.2	