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ENERGY AND IONIZATION OF LIGHT PARTICLES AS A FUNCTION OF $H\rho$

Donald Johnson

August, 1951

Berkeley, California

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ENERGY AND IONIZATION OF LIGHT PARTICLES AS A FUNCTION OF Hρ

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Donald Johnson
Radiation Laboratory, Department of Physics,
University of California, Berkeley, California
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ρ	Hρ	P		D		H^3		He^3		He^4	
cm.	gauss cm.	E	$\frac{dE}{dx}$ *	E	$\frac{dE}{dx}$ *	E	$\frac{dE}{dx}$ *	E	$\frac{dE}{dx}$ *	E	$\frac{dE}{dx}$ *
1	21,700	.03		.02		.01		.04		.03	
1.5	32,550	.04		.02		.01		.05		.04	
2	43,400	.09		.04		.03		.12		.09	
2.5	54,250	.10		.05		.03		.13		.10	
3	65,100	.20	351	.10		.07		.27		.20	
3.5	75,950	.30	298	.15		.10		.40		.30	
4	86,800	.40	259	.20		.13		.50		.40	
4.5	97,650	.50	226	.25		.17		.70		.50	
5	108,500	.60	202	.28		.20		.80		.60	
5.5	119,350	.70	180	.35		.23		.90		.70	
6	130,200	.80	160	.40	343	.27		1.1		.80	
6.5	141,050	1.0	146	.50	321	.33		1.3		1.0	
7	151,900	1.1	140	.55	296	.37		1.5		1.1	
7.5	162,750	1.3	128	.65	271	.43		1.7		1.3	
8	173,600	1.4	122	.74	257	.47		1.9		1.4	
8.5	184,450	1.6	110	.82	228	.53	347	2.1		1.6	
9	195,300	1.8	98	.92	224	.60	336	2.4		1.8	
9.5	206,150	2.0	86	1.0	208	.67	320	2.7		2.0	
10	217,000	2.3	78.5	1.1	198	.76	300	3.1	580	2.3	
10.5	227,850	2.5	73.5	1.3	187	.83	284	3.3	560	2.5	
11	238,700	2.7	68.5	1.4	178	.91	275	3.6	539	2.7	
11.5	249,550	3.0	61.0	1.5	165	1.0	258	4.0	510	3.0	
12	260,400	3.2	58.8	1.6	158	1.1	247	4.3	488	3.2	
12.5	271,250	3.5	55.5	1.8	147	1.2	233	4.7	456	3.5	
13	282,100	3.8	52.2	1.9	146	1.3	227	5.1	424	3.8	584
13.5	292,950	4.1	49.1	2.1	142	1.4	218	5.5	392	4.1	572
14	303,800	4.4	46.6	2.2	140	1.5	211	5.9	368	4.4	560
14.5	314,650	4.7	44.0	2.4	132	1.6	204	6.3	344	4.7	539
15	325,500	5.1	40.8	2.5	128	1.7	193	6.8	314	5.1	512
15.5	336,350	5.4	39.1	2.7	125	1.8	189	7.2	302	5.4	500
16	347,200	5.7	37.3	2.9	122	1.9	182	7.6	289	5.7	488
16.5	358,050	6.1	35.2	3.1	116	2.1	173	8.1	274	6.1	464
17	368,900	6.5	33.5	3.3	110	2.2	169	8.7	259	6.5	440
17.5	379,750	6.9	31.8	3.5	104	2.3	162	9.2	247	6.9	416
18	390,600	7.3	30.4	3.7	98	2.4	156	9.7	235	7.3	392
18.5	401,450	7.7	29.2	3.9	92	2.6	151	10.3	225	7.7	368
19	412,300	8.1	27.9	4.1	86	2.7	147	10.8	217	8.1	344
19.5	423,150	8.5	26.9	4.3	82.3	2.9	146	11.3	209	8.5	331
20	434,000	9.0	25.5	4.5	78.5	3.0	145	12.0	200	9.0	314
20.5	444,850	9.4	24.7	4.8	75.5	3.2	142	12.5	194	9.4	305
21	455,700	9.9	23.6	5.0	73.5	3.3	140	13.2	186	9.9	294
21.5	466,550	10.4	22.7	5.2	71.5	3.5	135	13.9	178	10.4	284
22	477,400	10.9	21.9	5.5	68.5	3.6	133	14.5	171	10.9	274
22.5	488,250	11.4	21.1	5.7	65.5	3.8	128	15.2	163	11.4	259

ρ	$H\rho$	P		D		H^3		He^3		He^4	
cm.	gauss cm.	E	$\frac{dE}{dx}$*	E	$\frac{dE}{dx}$*	E	$\frac{dE}{dx}$*	E	$\frac{dE}{dx}$*	E	$\frac{dE}{dx}$*
23	499,100	11.9	20.4	6.0	61.0	4.0	126	15.9	158	11.9	244
23.5	509,950	12.4	19.7	6.2	60.1	4.1	125	16.5	154	12.4	240
24	520,800	12.9	19.0	6.5	58.8	4.4	122	17.2	149	12.9	235
24.5	531,650	13.4	18.4	6.8	56.8	4.6	117	17.9	144	13.4	229
25	542,500	14.0	17.8	7.0	55.5	4.7	115	18.7	139	14.0	222
25.5	553,300	14.6	17.2	7.3	53.8	4.9	110	19.5	134	14.6	215
26	564,200	15.1	16.7	7.7	52.2	5.1	116	20.1	131	15.1	209
26.5	575,050	15.7	16.1	8.0	50.5	5.3	102	20.9	126	15.7	203
27	585,900	16.3	15.7	8.2	49.1	5.5	98	21.7	122	16.3	196
27.5	596,750	16.9	15.2	8.5	47.9	5.7	94	22.5	119	16.9	191
28	607,600	17.5	14.8	8.8	46.6	5.9	90	23.3	115	17.5	186
28.5	618,450	18.1	14.4	9.2	45.1	6.1	86	24.1	112	18.1	181
29	629,300	18.8	13.9	9.5	44.0	6.4	82.7	25.1	108	18.8	176
29.5	640,150	19.5	13.5	9.8	42.4	6.6	80.6	26.0	105	19.5	169
30	651,000	20.1	13.2	10.1	40.8	6.8	78.5	26.8	102	20.1	163
31	672,700	21.5	12.5	10.7	39.1	7.2	75.5	28.7	97.1	21.5	156
32	694,400	22.8	12.0	11.5	37.3	7.6	72.4	30.4	92.7	22.8	149
33	716,110	24.3	11.3	12.2	35.2	8.1	68.5	32.4	87.6	24.3	141
34	737,800	25.5	10.9	12.9	33.5	8.7	65.1	34.0	84.7	25.5	134
35	759,500	27.1	10.4	13.8	31.8	9.2	62.2	36.1	80.8	27.1	127
36	781,200	29.0	9.8	14.6	30.4	9.8	58.8	38.7	76.0	29.0	122
37	802,900	30.6	9.3	15.5	29.2	10.4	56.5	40.8	72.9	30.6	117
38	824,600	32.0	9.0	16.5	27.9	11.0	54.1	42.7	70.1	32.0	112
39	846,300	33.7	8.6	17.3	26.9	11.5	52.2	44.9	66.8	33.7	108
40	868,000	35.4	8.3	18.0	25.5	12.0	50.7	47.2	64.1	35.4	102
41	889,700	37.0	8.0	19.0	24.7	12.7	48.5	49.3	61.7	37.0	99
42	911,400	38.6	7.7	19.9	23.6	13.3	46.6	51.5	59.2	38.6	94
43	933,100	40.7	7.4	20.8	22.7	13.9	44.9	54.2	56.8	40.7	91
44	954,800	42.2	7.2	21.8	21.9	14.6	42.8	56.3	55.0	42.2	88
45	976,500	44.1	6.9	22.7	21.1	15.3	40.8	58.8	52.8	44.1	84
46	998,200	46.5	6.6	23.9	20.4	15.9	39.7	62.0	50.9	46.5	82
47	1,019,600	48.1	6.5	25.0	19.7	16.6	38.5	64.1	49.6	48.1	79
48	1,041,600	50.0	6.2	26.0	19.0	17.3	37.3	66.7	48.0	50.0	76
49	1,063,300	52.0	6.1	26.9	18.4	18.0	36.2	69.4	46.5	52.0	74
50	1,085,000	54.8	5.8	28.0	17.8	18.8	35.0	73.1	44.5	54.8	71
51	1,106,700	56.1	5.7	29.4	17.2	19.8	33.5	74.8	43.6	56.1	69
52	1,128,400	58.2	5.5	30.5	16.7	20.6	32.3	77.6	42.2	58.2	67
53	1,150,100	60.3	5.4	31.7	16.1	21.2	31.5	80.4	40.8	60.3	64
54	1,171,800	62.6	5.2	32.8	15.7	22.0	30.4	83.5	39.2	62.6	63
55	1,193,500	65.0	5.1	34.0	15.2	22.9	29.6	86.7	38.2	65.0	61
56	1,215,200	67.5	4.9	35.0	14.8	23.5	29.1	90.0	37.1	67.5	59
57	1,236,900	70.2	4.8	36.3	14.4	24.8	27.9	93.6	36.0	70.2	58
58	1,258,600	72.2	4.7	37.5	13.9	25.6	27.1	96.3	35.3	72.2	56
59	1,280,300	74.5	4.6	38.8	13.5	26.3	26.3	99.3	34.5	74.5	54
60	1,302,000	78.0	4.4	40.3	13.2	27.0	25.5	104	33.2	78.0	53

ρ	Hρ	P		D		H^3		He^3		He^4	
cm.	gauss cm.	E	$\frac{dE}{dx}$ *	E	$\frac{dE}{dx}$ *	E	$\frac{dE}{dx}$ *	E	$\frac{dE}{dx}$ *	E	$\frac{dE}{dx}$ *
61	1,323,700	80.8	4.3	41.5	12.8	28.0	24.9	108	32.0	80.8	51
62	1,345,400	82.3	4.2	42.6	12.5	29.0	24.2	110	31.4	82.3	50
63	1,367,100	84.0	4.2	43.9	12.3	29.9	23.6	112	30.8	84.0	49
64	1,388,800	87.3	4.0	45.5	12.0	30.8	23.1	116	30.2	87.3	48
65	1,410,500	89.7	3.9	47.0	11.6	31.9	22.5	120	29.6	89.7	47
66	1,432,200	93.8	3.8	48.5	11.3	32.9	21.9	125	28.8	93.8	45
67	1,453,900	95.5	3.8	50.0	11.1	34.0	21.4	127	28.4	95.5	44
68	1,475,600	98.1	3.7	51.3	10.9	35.0	20.9	131	27.5	98.1	44
69	1,497,300	102	3.6	52.8	10.7	36.0	20.4	136	26.4	102	43
70	1,519,000	105	3.5	54.5	10.4	36.9	20.3	140	26.0	105	42
71	1,540,700	107	3.5	56.3	10.1	38.0	20.0	143	25.6	107	41
73	1,584,100	112	3.4	59.0	9.7	40.0	19.4	149	25.0	112	39
76	1,649,200	122	3.2	63.8	9.0	43.3	18.5	163	23.5	122	
80	1,736,000	135	2.9	70.8	8.3	47.8	17.2	180	21.6	135	
84	1,822,800	149	2.7	78.0	7.7	52.5	15.9	199	19.6	149	
88	1,909,600	161	2.6	85.4	7.2	58.1	14.3	215	18.4	161	
93	2,018,100	178	2.4	95.2	6.7	64.4	12.5	237	16.8	178	
98	2,126,600	198	2.3	105	6.1	70.6	11.7	264		198	
103	2,235,100	215	2.1	116	5.7	78.8	10.7	287		215	
108	2,343,600	235	2.0	127	5.2	85.8	9.8	313		235	
113	2,452,100	254	1.9	140		94.7	9.3	339		254	
119	2,582,300	280	1.8	153		104	8.8	373		280	
125	2,712,500	303	1.7	169		115	8.2	404		303	
131	2,842,700	333	1.7	186		126	7.6	444		333	
137	2,972,900	356	1.6	201		138	6.9	475		356	
144	3,124,800	388	1.5	223		151	6.2	517		388	
151	3,276,700	420	1.5	244		167	5.9	560		420	
158	3,428,600	454	1.4	268		183	5.5	606		454	
166	3,602,200	492	1.4	289		200	5.1	656		492	
174	3,775,800	532	1.3	318		220	4.7	709		532	
182	3,949,400	572	1.3	344		239		763		572	
191	4,144,700	619	1.2	374		262		825		619	

The energy values are generally accurate to 5%, except in the low energy region, and except for He^3 and He^4 for which a non-relativistic conversion was made.

The $\frac{dE}{dx}$ values were obtained for protons in helium from the Aron tables except below 1 Mev. The rest of the $\frac{dE}{dx}$ columns were obtained by approximate non-relativistic proportionalities and interpolation over wide ranges. Therefore no greater accuracy than 15% can be assigned to them.

* The $\frac{dE}{dx}$ values are relative to Minimum ionization.