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IONIZATION ENERGY LOSS OF ELECTRONS AND THEIR RANGE IN LIQUID HYDROGEN

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February 24, 1958

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ABSTRACT

Ionization energy loss, dT/dx, of electrons in liquid hydrogen is tabulated for parameters applicable to bubble chamber operation. Ranges are also given.

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We have calculated and tabulated the ionization energy loss dT/dx of electrons in liquid hydrogen at bubble chamber operating density, $\rho = 0.0586$ g/cm^3. Values of dT/dx (in Mev/cm) are tabulated versus kinetic energy T (in Mev), and momentum p (in Mev/c), from T = 0.001 Mev to 400 Mev. The electron "Range," $R \equiv \int (dT/dx)^{-1}\, dx$, in cm, is also tabulated over the same interval. This range neglects radiative energy loss. (Above 340 Mev, radiative energy loss is greater than ionization loss.[1]) The calculation was made by inserting I = 15.6 ev,[2] A = 1.0080, and $\rho = 0.0586$ g/cm^3 into the tabulated calculations by Aron, Hoffman, and Williams.[3,4]

[1] E. Segrè, Experimental Nuclear Physics (Wiley, New York, 1953), Vol I. p. 266.

[2] Ibid., p. 233.

[3] Aron, Hoffman, and Williams, Range-Energy Curves, AECU-663 (2d Rev), 1049, p. 90 ff.

[4] Although dT/dx and R are tabulated to six digits, no significance should be attached to dE/dx beyond three figures, nor to R at all (expect as a useful upper limit) in the energy region where radiative energy loss is important.

Momentum, energy, energy loss, and range of electrons in liquid hydrogen

p (Mev/c)	T (Mev)	dT/dx (Mev/cm)	Range (Radiative energy loss neglected) (cm)
0.03198	0.001	1.97266×10^{-1}	2.53465×10^{-5}
0.04525	0.002	1.14789	9.66294
0.05545	0.003	8.29469×10^{0}	1.98586×10^{-4}
0.06406	0.004	6.56941	3.37154
0.07166	0.005	5.47605	5.02605
0.07853	0.006	4.71658	7.02054
0.08487	0.007	4.15600	9.26370
0.09077	0.008	3.72421	1.18304×10^{-3}
0.09633	0.009	3.38051	1.46320
0.10159	0.010	3.10008	1.77449
0.11660	0.011	2.86657	2.10818
0.11139	0.012	2.66894	2.47203
0.11599	0.013	2.49937	2.85741
0.12043	0.014	2.35215	3.27211
0.12472	0.015	2.22309	3.70757
0.12887	0.016	2.10897	4.17164
0.13290	0.017	2.00725	4.65580
0.13682	0.018	1.91601	5.16793
0.14063	0.019	1.83369	5.69954
0.14436	0.020	1.75900	6.25854
0.16178	0.025	1.46954	9.52215
0.17765	0.030	1.27088	1.3054×10^{-2}
0.19234	0.035	1.12572	1.73825
0.20610	0.040	1.01479	2.19299
0.21912	0.045	9.27147×10^{-1}	2.72301
0.23151	0.050	8.56106	3.27096
0.24338	0.055	7.97312	3.89053
0.25479	0.060	7.47827	4.52464
0.26580	0.065	7.05586	5.22725
0.27647	0.070	6.69100	5.94144
0.28683	0.075	6.37264	6.72135
0.29691	0.080	6.09239	7.51023
0.30674	0.085	5.84378	8.36234
0.31635	0.090	5.62176	9.22107
0.32575	0.095	5.42219	1.01408×10^{-1}
0.33496	0.100	5.24192	1.10649
0.41928	0.150	4.08640	2.20143
0.49436	0.200	3.50351	3.53158
0.56390	0.250	3.15636	5.04016
0.62975	0.300	2.92904	6.68843
0.69295	0.350	2.77079	8.44575
0.75418	0.400	2.65584	1.02091×10^{0}
0.81387	0.450	2.56974	1.2206
0.87234	0.500	2.50373	1.41785
0.92982	0.550	2.45223	1.61969
0.98649	0.600	2.41152	1.82539
1.04248	0.650	2.37898	2.03416
1.09789	0.700	2.35282	2.24557
1.15281	0.750	2.33164	2.45905
1.20729	0.800	2.31440	2.67433
1.26141	0.850	2.30049	2.89102
1.31520	0.900	2.28916	3.10892
1.36870	0.950	2.27999	3.32779
1.42195	1.000	2.27263	3.53741
1.94498	1.500	2.25326	5.75664
2.45843	2.00	2.27217	7.97303
2.96730	2.50	2.30013	1.01549×10^{1}
3.47359	3.00	2.32948	1.23203
3.97829	3.50	2.35796	1.44482
4.48194	4.00	2.38468×10^{-1}	1.65620
4.98486	4.50	2.40969	1.86423
5.48724	5.00	2.43296	2.07126
5.98922	5.50	2.45468	2.27531
6.49090	6.00	2.47497	2.4787
6.99233	6.50	2.49411	2.67938
7.49357	7.00	2.51183	2.87968
7.99466	7.50	2.52865	3.07753
8.49562	8.00	2.54455	3.27518
8.99648	8.50	2.55985	3.47055
9.49724	9.00	2.57390	3.66586
9.99793	9.50	2.58750	3.85907
10.49055	10.00	2.60047	4.05235
15.50257	15.0	2.70462	5.93617
20.50459	20.0	2.78004	7.75769
25.50586	25.0	2.83896	9.53752
30.50670	30.0	2.88734	1.12827×10^{2}
35.50728	35.0	2.92829	1.30027
40.50772	40.0	2.96381	1.46577
45.50811	45.0	2.9952	1.63777
50.50837	50.0	3.02327	1.79971
55.50859	55.0	3.0487	1.96851
60.50882	60.0	3.07193	2.12776
65.50900	65.0	3.09330	2.29416
70.50908	70.0	3.11313	2.45108
75.50925	75.0	3.13132	2.61540
80.50935	80.0	3.14878	2.77045
85.50945	85.0	3.16498	2.93301
90.50953	90.0	3.18025	3.08643
95.50961	95.0	3.19471	3.24746
100.50970	100.0	3.20843	3.39945
110.50980	110	3.23392	3.70988×10^{2}
120.50991	120	3.25719	4.01503
130.50997	130	3.27860	4.32397
140.51005	140	3.29843	4.62510
150.51011	150	3.3169	4.93038
160.51016	160	3.33417	5.22812
170.51021	170	3.35039	5.53026
180.51025	180	3.36569	5.82509
190.51029	190	3.38016	6.12453
200.51032	200	3.39389	6.41681
210.51035	210	3.40695	6.71384
220.51038	220	3.4194	7.00386
230.51041	230	3.43131	7.29876
240.51043	240	3.4427	7.58675
250.51045	250	3.45362	7.87972
260.51047	260	3.46412	8.16586
270.51049	270	3.47423	8.45708
280.51051	280	3.48396	8.74154
290.51053	290	3.49336	9.03115
300.51054	300	3.50244	9.31406
310.51055	310	3.51122	9.60219
320.51055	320	3.51972	9.88366
330.51058	330	3.52795	1.01704×10^{3}
340.51059	340[a]	3.53594	1.04505
350.51060	350	3.5437	1.07360
360.51062	360	3.55124	1.10142×10^{3}
370.51062	370	3.55858	1.12992
380.51063	380	3.56573	1.15762
390.51064	390	3.57268	1.18601
400.51065	400	3.57946	1.21360

[a]Above 340 Mev, radiative energy loss is greater than ionization loss.