

Argon (Ar)

1. Recommended electron collision cross sections^[1]

The following cross section set was compiled so that it can reproduce the drift velocity, the ND_L , the Townsend's ionization coefficient and electronic excitation coefficients measured in Ar by the two-term Boltzmann code.

(1) Elastic momentum transfer cross section

Energy(eV)	Cross section(\AA^2)	Energy(eV)	Cross section(\AA^2)	Energy(eV)	Cross section(\AA^2)
0.00000	6.30000 ^[2]	0.20000	0.10100	5.00000	7.60000
0.01000	4.50000	0.21000	0.09200	6.00000	9.60000
0.01400	3.88000	0.22000	0.08600	7.00000	11.50000
0.01700	3.56000	0.23000	0.08500	8.00000	13.10000
0.02000	3.28000	0.24000	0.08700	9.00000	14.40000
0.02500	2.89000	0.25000	0.09100	10.00000	15.12000
0.03000	2.57000	0.26000	0.09800	11.00000	15.52000
0.03500	2.29000	0.28000	0.12000	12.00000	15.60000
0.04000	2.05000	0.30000	0.15100	13.00000	15.20000
0.05000	1.66200	0.32000	0.18800	14.00000	14.60000
0.06000	1.35700	0.32500	0.20600	15.00000	14.00000
0.07000	1.11400	0.40000	0.31700	16.00000	13.16000
0.08000	0.91600	0.50000	0.50400	17.00000	12.14000
0.09000	0.75400	0.65000	0.79200	18.00000	11.20500
0.10000	0.62100	0.80000	1.05000	20.00000	10.10000
0.11000	0.51100	1.00000	1.37000	25.00000	6.90000
0.12000	0.42000	1.20000	1.66000	30.00000	5.46000
0.13000	0.34800	1.50000	2.05000	40.00000	4.05000
0.14000	0.28400	1.70000	2.33000	50.00000	3.48000
0.15000	0.23300	2.00000	2.67000	60.00000	3.12000
0.17000	0.16100	2.50000	3.40000 ^[1]	70.00000	2.89000
0.18000	0.13500	3.00000	4.20000	80.00000	2.68000
0.19000	0.11500	4.00000	5.70000	100.00000	2.31000

(2) Electronic excitation cross section 1, Threshold = 11.549 eV, Energy loss = 11.549 eV

Energy(eV)	Cross section(\AA^2)	Energy(eV)	Cross section(\AA^2)	Energy(eV)	Cross section(\AA^2)
11.54900	0.00000 ^[3]	14.00000	0.01250	40.00000	0.00730
11.90000	0.00290	15.00000	0.02200	50.00000	0.00360
12.00000	0.00280	16.00000	0.03350	60.00000	0.00220
12.50000	0.00660	17.00000	0.04000	70.00000	0.00160
12.80000	0.00900	20.00000	0.03300	80.00000	0.00100
13.00000	0.00900	25.00000	0.02400	100.00000	0.00060
13.10000	0.01150	30.00000	0.01700	120.00000	0.00050
13.40000	0.00940	35.00000	0.01150		

(3) Electronic excitation cross section 2, Threshold = 11.624 eV, Energy loss = 11.624 eV

Energy(eV)	Cross section(\AA^2)	Energy(eV)	Cross section(\AA^2)	Energy(eV)	Cross section(\AA^2)
11.62400	0.00000 ^[3]	15.00000	0.02800	20.00000	0.04700
12.00000	0.00400	16.00000	0.03500	22.00000	0.05100
13.00000	0.01200	17.00000	0.04000	24.00000	0.05200
14.00000	0.02000	18.00000	0.04300	26.00000	0.05300

28.00000	0.05300	45.00000	0.04700	80.00000	0.03500
30.00000	0.05200	50.00000	0.04500	90.00000	0.03200
35.00000	0.05000	60.00000	0.04100	100.0000	0.03100
40.00000	0.04800	70.00000	0.03800		

(4) Electronic excitation cross section 3, Threshold = 11.723 eV, Energy loss = 11.723 eV

Energy(eV)	Cross section(Å ²)	Energy(eV)	Cross section(Å ²)	Energy(eV)	Cross section(Å ²)
11.72300	0.00000 ^[3]	14.00000	0.00250	40.00000	0.00190
11.90000	0.00060	15.00000	0.00450	50.00000	0.00120
12.00000	0.00060	16.00000	0.00610	60.00000	0.00090
12.50000	0.00130	17.00000	0.00750	70.00000	0.00070
12.80000	0.00180	20.00000	0.00660	80.00000	0.00060
13.00000	0.00180	25.00000	0.00600	100.0000	0.00050
13.10000	0.00230	30.00000	0.00450	120.0000	0.00040
13.40000	0.00190	35.00000	0.00290		

(5) Electronic excitation cross section 4, Threshold = 11.828 eV, Energy loss = 11.828 eV

Energy(eV)	Cross section(Å ²)	Energy(eV)	Cross section(Å ²)	Energy(eV)	Cross section(Å ²)
11.82800	0.00000 ^[3]	22.00000	0.11400	50.00000	0.17500
13.00000	0.02900	24.00000	0.12300	60.00000	0.17500
14.00000	0.04900	26.00000	0.13200	70.00000	0.17000
15.00000	0.06500	28.00000	0.14000	80.00000	0.16400
16.00000	0.07600	30.00000	0.14700	90.00000	0.15600
17.00000	0.08600	35.00000	0.16000	100.00000	0.15000
18.00000	0.09400	40.00000	0.17000		
20.00000	0.10300	45.00000	0.17300		

(6) Electronic excitation cross section 5, Threshold = 12.900 eV, Energy loss = 12.900 eV

Energy(eV)	Cross section(Å ²)	Energy(eV)	Cross section(Å ²)	Energy(eV)	Cross section(Å ²)
12.90000	0.00000 ^[3]	17.00000	0.32000	40.00000	0.48000
13.00000	0.00300	18.00000	0.40000	50.00000	0.43000
13.10000	0.00900	20.00000	0.50000	60.00000	0.40000
13.40000	0.03150	22.00000	0.53000	70.00000	0.37000
14.00000	0.07000	25.00000	0.53000	80.00000	0.33000
15.00000	0.15000	30.00000	0.52000	100.00000	0.28000
16.00000	0.24000	35.00000	0.50000	120.00000	0.25000

(7) Electronic excitation cross section 6, Threshold = 14.090 eV, Energy loss = 14.090 eV

Energy(eV)	Cross section(Å ²)	Energy(eV)	Cross section(Å ²)	Energy(eV)	Cross section(Å ²)
14.09000	0.00000 ^[3]	25.00000	0.14500	60.00000	0.25000
15.00000	0.02800	30.00000	0.16000	70.00000	0.26000
16.00000	0.05400	35.00000	0.19000	80.00000	0.26500
17.00000	0.07500	40.00000	0.21000	100.00000	0.27000
20.00000	0.10500	50.00000	0.23500	120.00000	0.26000

(8) Ionization cross section, Threshold = 15.755 eV, Energy loss = 15.755 eV

Energy(eV)	Cross section(Å ²)	Energy(eV)	Cross section(Å ²)	Energy(eV)	Cross section(Å ²)
15.75500	0.00000 ^[4]	16.50000	0.06690	17.50000	0.21200
16.00000	0.02020	17.00000	0.13370	18.00000	0.29400

18.50000	0.37700	25.00000	1.30000	50.00000	2.53400
19.00000	0.46000	25.50000	1.35000	52.50000	2.56000
19.50000	0.54600	26.00000	1.40800	55.00000	2.60000
20.00000	0.62700	28.00000	1.60000	57.50000	2.62000
20.50000	0.71300	30.00000	1.80000	60.00000	2.65700
21.00000	0.78700	32.00000	1.96000	65.00000	2.73000
21.50000	0.85800	34.00000	2.11000	70.00000	2.77000
22.00000	0.93300	36.00000	2.24000	75.00000	2.82000
22.50000	0.99400	38.00000	2.33000	80.00000	2.84000
23.00000	1.05600	40.00000	2.39000	85.00000	2.85000
23.50000	1.11700	42.50000	2.45000	90.00000	2.86000
24.00000	1.18000	45.00000	2.49000	95.00000	2.86000
24.50000	1.24000	47.50000	2.51000	100.0000	2.85000

- [1] Y. Nakamura and M. Kurachi, *J. Phys.D*, **21** (1988) 718 - 723
 [2] M. Hayashi and S. Ushiroda, *J. Chem. Phys.*, **78** (1983) 2621 - 2625
 [3] A. Chutjian and D. C. Cartwright, *Phys. Rev. A*, **23** (1981) 2178 - 2193
 [4] D. Rapp and P. Englander-Golden, *J. Chem. Phys.*, **43** (1965) 1464 - 1479

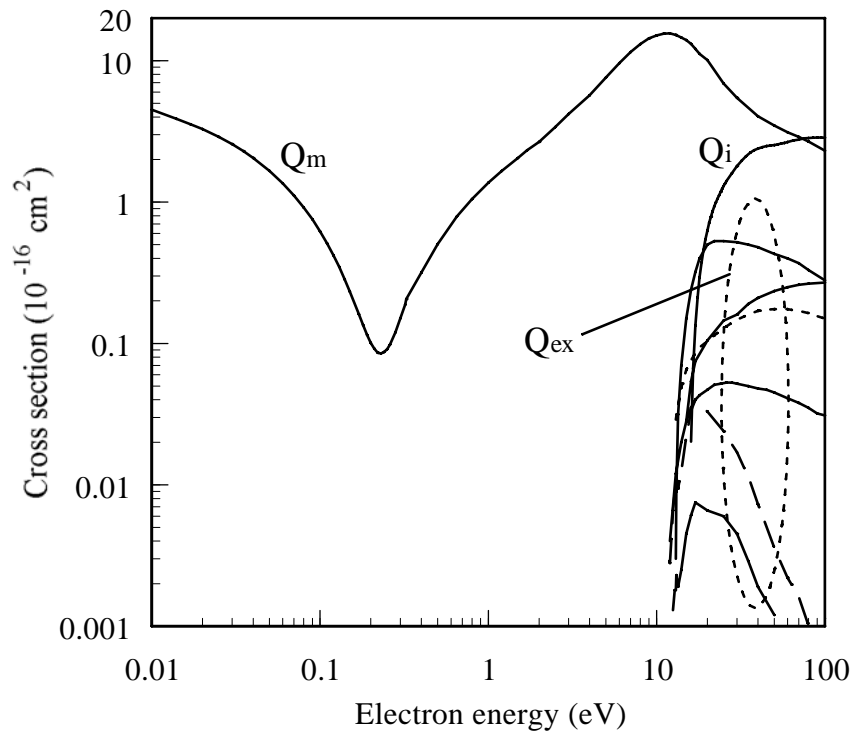


Fig.1 Recommended cross sections for Ar

2. Related electron swarm data

(1) Electron drift velocity, W, in Ar

E/N (Td)	W (10 ⁶ cm/s)	E/N (Td)	W (10 ⁶ cm/s)
0.01	0.094 ^[5]	0.10	0.165
0.02	0.108	0.12	0.174
0.03	0.120	0.15	0.185
0.05	0.137	0.18	0.194
0.08	0.155	0.20	0.200

0.25	0.213	0.213 ^[1]	3.	0.381
0.30	0.223	0.220	3.5	0.395
0.35	0.231	0.229	4.	0.412
0.40	0.239	0.236	4.5	0.438
0.45	0.246		5.	0.475
0.50	0.252	0.249	6.	0.564
0.55	0.258		7.	0.654
0.60	0.263	0.260	8.	0.761
0.65	0.268		10.	0.965
0.70	0.273	0.271	12.	1.170
0.75	0.276		14.	1.340
0.80	0.280	0.280	17.	1.630
0.90	0.288		20.	1.880
1	0.295	0.293	25.	2.240
1.2		0.306	30.	2.710
1.4		0.320	35.	3.110
1.7		0.335	40.	3.440
2.		0.344	50.	4.120
2.5		0.362		

[5] A. G. Robertson, *Aust. J. Phys.* **30** (1977) 39 - 49

[6] J. L. Pack et al., *J. Appl. Phys.* **71** (1992) 5363-5371

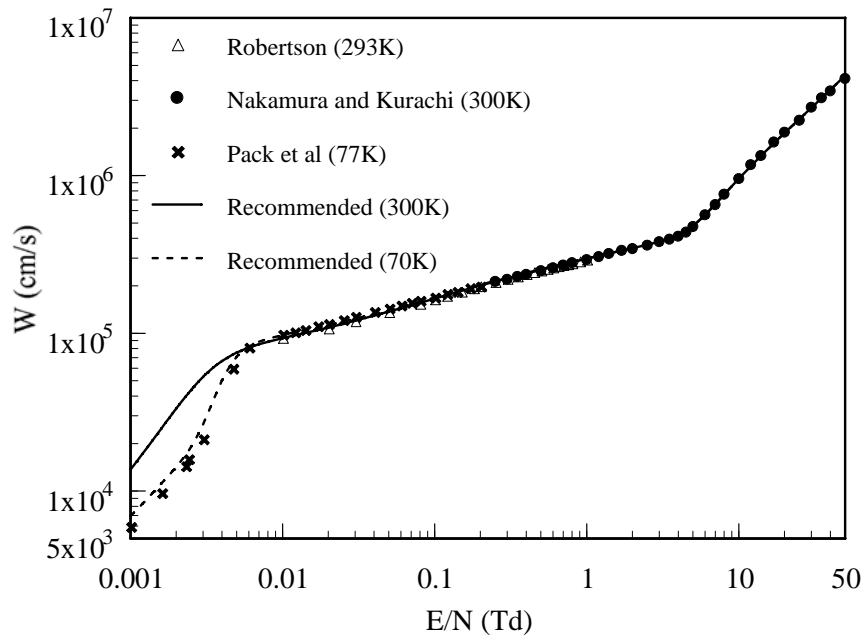


Fig.2 Electron drift velocity in Ar

(2) Product of longitudinal diffusion coefficient and gas number density, ND_L , in Ar

E/N (Td)	$ND_L (10^{22} \text{ cm}^{-1} \text{ s}^{-1})$	E/N (Td)	$ND_L (10^{22} \text{ cm}^{-1} \text{ s}^{-1})$
0.0023	1.807 ^[7]	0.35	2.39
0.003	8.664	0.4	2.35
0.014	5.201	0.5	2.22
0.06	3.812	0.6	2.13
0.25	2.58 ^[1]	0.7	1.99
0.3	2.62	0.8	1.85

1.0	1.77	8.0	3.18
1.2	1.67	10.	3.52
1.4	1.59	12.	3.37
1.7	1.38	14.	3.50
2.0	1.36	17.	3.48
2.5	1.24	20.	3.45
3.0	1.15	25.	3.51
3.5	1.22	30.	3.41
4.0	1.21	35.	3.54
5.0	1.88	40.	3.38
6.0	2.36	50.	3.48
7.0	2.96		

[7] J. L. Pack et al., *J. Appl. Phys.*, **71** (1992) 5363-5371

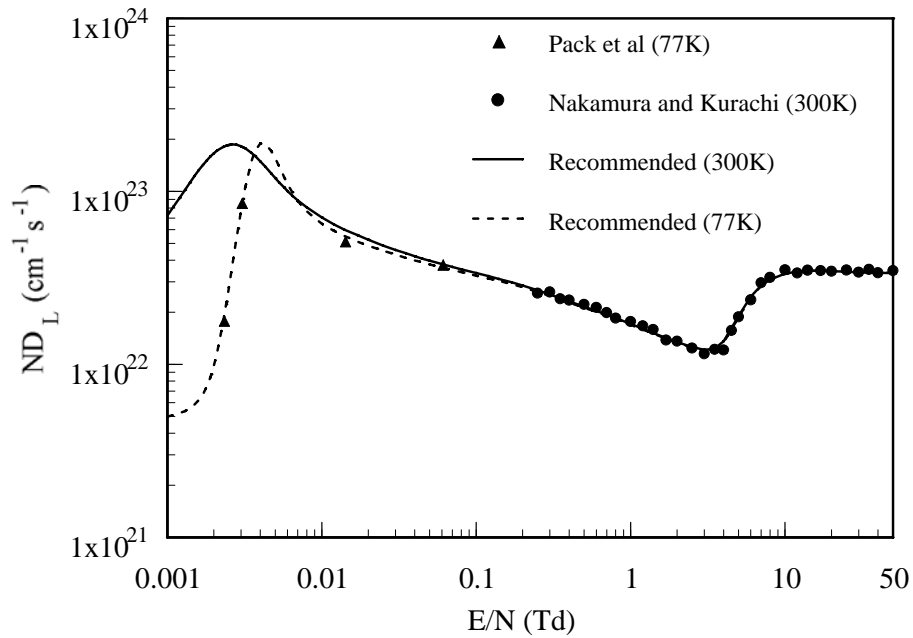


Fig.3 ND_L in Ar

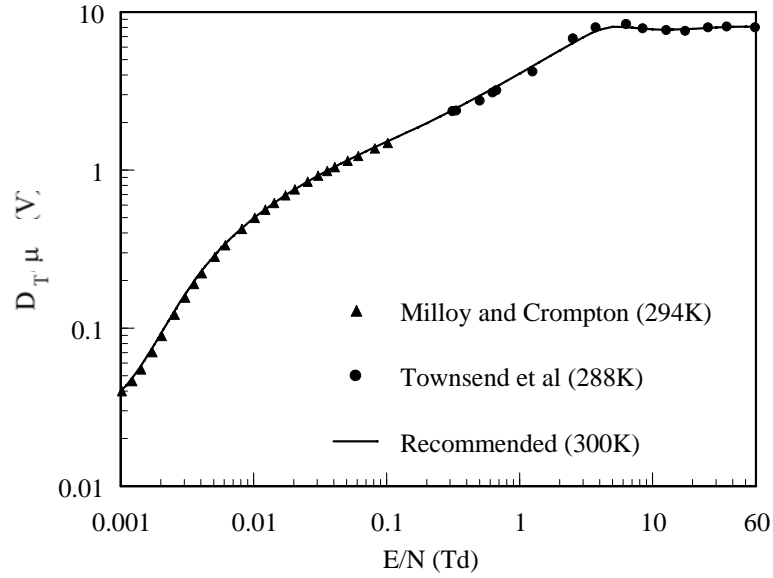
(3) Characteristic energy, D_T/μ , in Ar

E/N (Td)	D_T/μ (V)	E/N (Td)	D_T/μ (V)
0.001	0.0404 ^[8]	0.014	0.6283
0.0012	0.0468	0.017	0.7027
0.0014	0.0556	0.02	0.7659
0.0017	0.0715	0.025	0.8575
0.002	0.0904	0.03	0.9355
0.0025	0.1234	0.035	1.003
0.003	0.1584	0.04	1.061
0.0035	0.1929	0.05	1.163
0.004	0.2259	0.06	1.248
0.005	0.2865	0.08	1.391
0.006	0.3395	0.1	1.508
0.008	0.4304	0.313	2.36 ^[9]
0.01	0.5060	0.334	2.38
0.012	0.5705	0.501	2.75

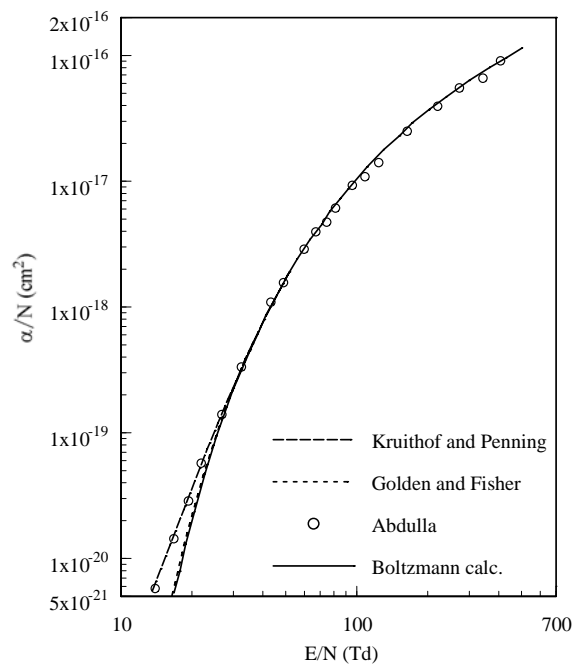
0.626	3.1	8.43	7.9
0.668	3.2	12.67	7.7
1.252	4.2	17.58	7.6
2.518	6.8	26.11	8.0
3.73	8.0	36.1	8.1
6.32	8.4	59.0	8.0

[8] H. B. Milloy and R. W. Crompton, *Aust. J. Phys.*, **30** (1977) 51-60

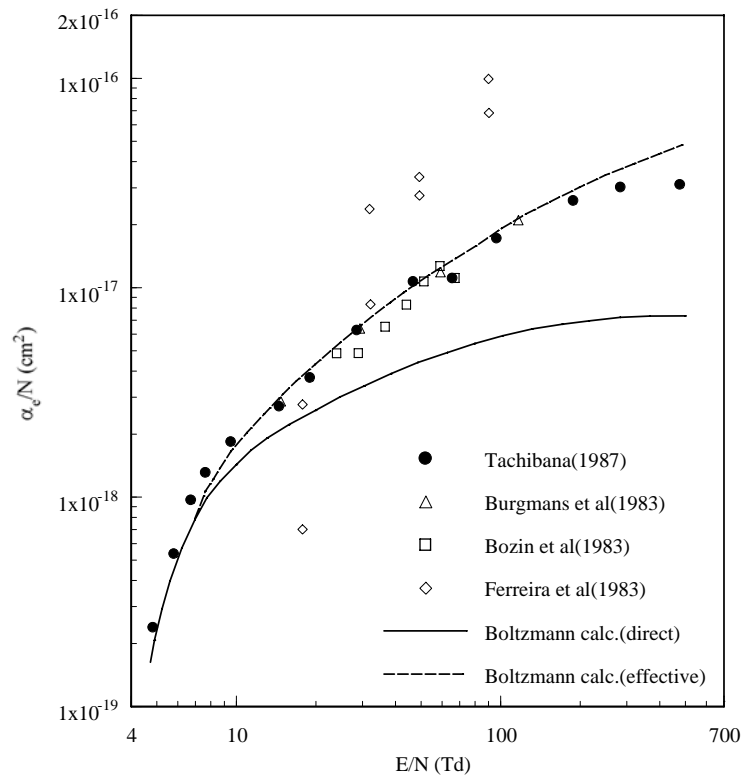
[9] J. S. Townsend et al., *Phil. Mag.* **44** (1922) 1033 –



(4) Ionization coefficient of argon



(5) Excitation coefficients for metastable state in argon



(6) Excitation coefficients for resonance states in argon

