International Journal of Latest Research in Engineering and Technology (IJLRET)
ISSN: 2454-5031
www.ijlret.com || Volume 08 - Issue 03 || March 2022 || PP. 06-19

Following Electron Impact Excitation of Single ($_{30}$Zn, $_{31}$Ga, $_{32}$Ge, $_{33}$As, $_{34}$Se, $_{35}$Br, $_{36}$Kr, $_{37}$Rb, $_{38}$Sr, $_{39}$Y, $_{40}$Zr) atoms L_i Subshell Ionization Cross Sections by using Lotz's Equations

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Abstract: L shell and three L_i sub shells ionization cross sections σ_L and σ_{Li} following electron impact on ($_{30}$Zn, $_{31}$Ga, $_{32}$Ge, $_{33}$As, $_{34}$Se, $_{35}$Br, 36Kr, $_{37}$Rb, $_{38}$Sr, $_{39}$Y, $_{40}$Zr) atoms calculated. By using Lotz's equation in Matlab ionization cross section values obtained for 20 electron impact energy E_{0i}. These values chosen in $E_{L1i} < E_{0i} < 10E_{L1i}$ (first ionization energy E_{L1i} to about 14 E_{L1i} to 10,3 E_{L1i}; of (30Zn to37Rb);and 9,52 E_{L1i} to 7,55 E_{L1i};of ($_{38}$Sr to $_{40}$Zr) range for each atom. Lotz's parameters and special commands used for each ionization cross sections calculations. Starting all most from ionization threshold values; ionization cross sections are increasing rapidly with electron impact energy E_0. For higher E_0 values this increments getting smaller for every L_i sub shells. For smaller E_0 energy close to threshold; all ionization cross sections decrease. For a fixed electron impact energy while Z value increases from 30≤Z≤40; ionization cross sections decrease with Z. Results may help to understand similar findings which obtained from other electron impact excitation of Li subshells ionization cross sections studies for similar size single atoms.

Keywords: L_i sub shells ionization cross section calculations, Electron impact on single atoms(30≤Z≤40), Lotz's equations.

1. Introduction

Inner sub shell ionization cross section studies of free atoms by electron impact are subjects of ongoing research for many years [1,2,5-15].Inner shell ionization cross section information help us to understand, characterization of used target atoms in the following fields: astrophysics, plasma physics, radiation protection, energy transfer by electron impact on or in tissues study required[5,6,7,8]. In this study, L shell and L_i sub shells ionization cross sections σ_L and σ_{Li}(i =1,2,3) for $_{30}$Zn to $_{40}$Zr atoms are calculated. For each of atoms, 20 electron impact energy values E_{0i} are used. E_{0i}(i=1,.,20) values were chosen in about the $E_{L1i} < E_{0i} < 10E_{L1i}$ range for each atom. E_{Li} is the binding energy of $i^{th}L_i$(i =1,.,3) sub shells. If a neutral atom A bombarded by an electron with sufficiently big E_{0i} under $E_{Li} < E_{0i}$ conditions, firstly impacting electron emits bremsstrahlung then electron-single atom interaction occur. Target atom A becomes excited ions A^{+*} at $i^{th}L_i$ sub shell. Creation of electron holes in L_i sub shells depends on how big the E_{0i} compare to E_{Li}. Lotz put forward a semi-empirical formula at, for calculation of ionization cross sections for low energetic electron impact excitation of free atoms at inner shells which was based on Born Approximation(BA) [1,2,6]. Calculations for σ_L and σ_{Li}(i =1,2,3) of $_{30}$Zn, $_{31}$Ga, $_{32}$Ge, $_{33}$As, $_{34}$Se, $_{35}$Br, $_{36}$Kr, $_{37}$Rb, $_{38}$Sr, $_{39}$Y, $_{40}$Zr atoms carried out by using Lotz equations in Matlab program [7,9-12].

$$\sigma_{Li} = a_{Li}\, q_{Li}[\ln(E_o / E_{Li}) / E_o E_{Li}][1-b_i \exp(-c_i (E_o / E_{Li}))] \quad (1)$$

a_{Li}, b_{Li}, c_{Li} constants and q_{Li} of the i^{th} sub shell which are taken from Lotz [1,2]. q_{Li} are the number of equivalent electrons at i^{th} L_i sub shell and E_{Li} is the binding energy of the i^{th} sub shell. σ_{Li} are the ionization cross section of i^{th} sub shells. By using the Eq.1 and using sum of calculated σ_{Li} sub shells of each atom for 20 values of E_{0i}, σ_{Ltotal} of L shell calculated.

2. Method

L shell and L_i sub shells ionization cross sections σ_L and σ_{Li} for $_{30}$Zn to $_{40}$Zr atoms are calculated. Calculations done for 20 E_{0i}(i=1,..to, 20) values which they chosen in energy range of $E_{L1i} \leq E_{oi} \leq 10E_{L1i}$ for each atom. It means that for $_{30}$Zn, used over all E_{0i}values fall in 1,2keV< E_o <17keV range. E_{0i} values chosen according to the E_{L1i} of targeted atom which were taken from Gwyn, and Porter[3, 4]. Calculations carried out by using written commands for Lotz's Eq.1 in Matlab for each atom [1,2,9 -14]. The values of a_{Li}, b_{Li}, c_{Li} parameters and q_{Li} are given in the same order for L_i sub shells as:

For a_{Li} equal to (4, 2, 2)10^{-14}cm^2(eV)^2; for b_{Li} equal to 0.5, 0.92, 0,92; for c_{Li} equal to 0.6, 0.19, 0.19,and for q_{Li} equal to 2, 2, 4, values used[1-2, 9-12]. By using the Eq.1 and using sum of calculated σ_{Li} sub shells of each atom for 20 values of E_{0i}, σ_{Ltotal} of L shell calculated.

3. Results

Results for σ_L and σ_{Li}(i =1,2,3) of $_{30}$Zn to $_{40}$Zr for 20 E_{oi} are given in Table.1 to 11 under the name of each atom. Each table contains L sub shell ionization cross section results of one atom. All the Table captions are the same except the chemical symbol of elements which used for targeted atoms. Z dependency of ionization cross sections for a fixed E_{0i} = 10 keV impact given in Table 12 and in Figure.12. Ionization cross section values are given in b(barn) units in tables and in all figures.

Table.1 L subshell ionization cross section of $_{30}$Zn in 10^5 b.

E_0(keV)	$\sigma_{L1}.10^5$b	$\sigma_{L2}.10^5$b	$\sigma_{L3}.10^5$b	$\sigma_{Ltotal}.10^5$b
1,2	0,0013	0,0115	0,0277	0,0405
1,4	0,0565	0,0229	0,0512	0,1306
2,5	0,1692	0,0556	0,1183	0,3431
3,5	0,1874	0,0678	0,1432	0,3984
4	0,1881	0,0714	0,1503	0,4098
4,5	0,1866	0,0738	0,1552	0,4156
5	0,1835	0,0754	0,1584	0,4173
5,5	0,1796	0,0765	0,1603	0,4164
6	0,1753	0,0771	0,1614	0,4138
7	0,1663	0,0772	0,1614	0,4049
8	0,1574	0,0765	0,1595	0,3934
9	0,1491	0,0752	0,1566	0,3809
10	0,1415	0,0736	0,1531	0,3682
11	0,1346	0,0717	0,1491	0,3554
12	0,1283	0,0698	0,1448	0,3429
13	0,1226	0,0678	0,1407	0,3311
14	0,1175	0,0658	0,1364	0,3197
15	0,1127	0,0639	0,1323	0,3089
16	0,1084	0,062	0,1283	0,2987
17	0,1045	0,0602	0,1244	0,2891

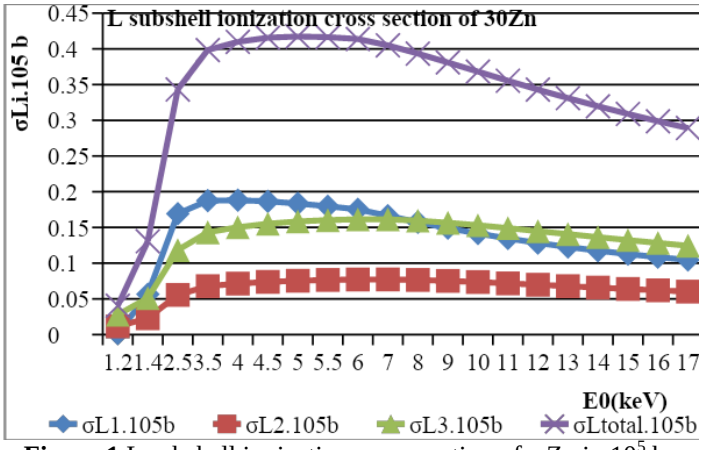

Figure.1 L subshell ionization cross section of $_{30}$Zn in 10^5 b.

Table.2 L subshell ionization cross section of $_{31}$Ga in 10^5 b.

E_0(keV)	$\sigma_{L1}.10^5$b	$\sigma_{L2}.10^5$b	$\sigma_{L3}.10^5$b	$\sigma_{Ltotal}.10^5$b
1,3	0,0003	0,0097	0,0221	0,0321
2	0,1065	0,0334	0,0722	0,2121
2,5	0,1359	0,0431	0,0922	0,2712
3,5	0,1571	0,0544	0,1153	0,3268
4	0,1595	0,0577	0,1221	0,3393
4,5	0,1594	0,0602	0,1271	0,3467
5	0,1578	0,0619	0,1305	0,3502
5.5	0,1552	0,0631	0,1328	0,3511

6	0,1521	0,0639	0,1343	0,3503
7	0,1453	0,0646	0,1354	0,3453
8	0,1382	0,0644	0,1348	0,3374
9	0,1314	0,0637	0,1331	0,3282
10	0,1251	0,0627	0,1308	0,3186
11	0,1192	0,0614	0,1279	0,3085
12	0,1139	0,0601	0,1249	0,2989
13	0,109	0,0585	0,1217	0,2892
14	0,1045	0,0571	0,1185	0,2801
15	0,1004	0,0555	0,1152	0,2711
16	0,0966	0,0541	0,1121	0,2628
17	0,0931	0,0525	0,1089	0,2545

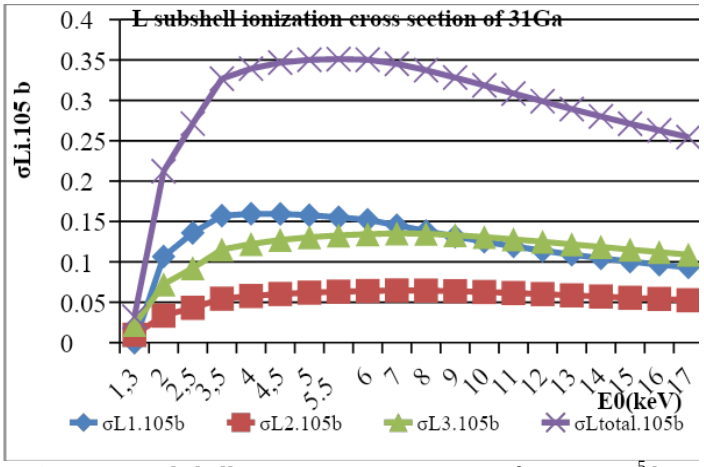

Figure.2 L subshell ionization cross section of $_{31}$Ga in 10^5 b.

Table.3 L subshell ionization cross section of $_{32}$Ge in 10^5 b

E_0(keV)	$\sigma_{L1}.10^5$b	$\sigma_{L2}.10^5$b	$\sigma_{L3}.10^5$b	$\sigma_{Ltotal}.10^5$b
1,5	-0,0031	0,0068	0,0171	0,0208
2	0,0769	0,0243	0,0534	0,1546
2.5	0,1064	0,0331	0,0714	0,2109
3,5	0,1297	0,0434	0,0927	0,2658
4	0,1334	0,0466	0,0992	0,2792
4,5	0,1346	0,0491	0,1042	0,2879
5	0,1342	0,0507	0,1075	0,2924
5,5	0,1328	0,0521	0,1102	0,2951
6	0,1308	0,0529	0,1118	0,2955
7	0,1258	0,0539	0,1136	0,2933
8	0,1204	0,0542	0,1139	0,2885
9	0,1149	0,0539	0,1131	0,2819
10	0,1098	0,0533	0,1117	0,2748
11	0,1049	0,0525	0,1098	0,2672
12	0,1004	0,0515	0,1076	0,2595
13	0,0963	0,0505	0,1053	0,2521
14	0,0924	0,0493	0,1028	0,2445
15	0,0889	0,0481	0,1003	0,2373
16	0,0827	0,0458	0,0954	0,2239
17	0,0821	0,0452	0,0942	0,2215

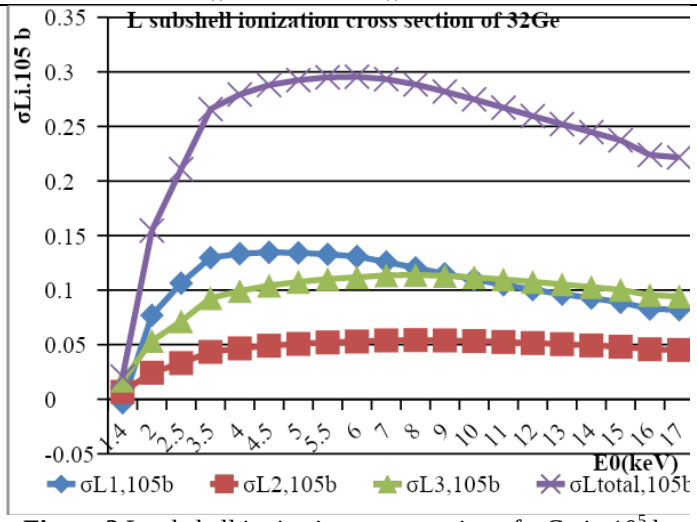

Figure.3 L subshell ionization cross section of $_{32}$Ge in 10^5 b

Table.4 L subshell ionization cross section of $_{33}$As in 10^5 b.

E_0(keV)	$\sigma_{L1}.10^5$b	$\sigma_{L2}.10^5$b	$\sigma_{L3}.10^5$b	$\sigma_{Ltotal}.10^5$b
1,5	-0,0045	0,0052	0,0138	0,0145
2	0,0546	0,0173	0,0386	0,1105
2,5	0,0838	0,0252	0,0549	0,1639
3,5	0,1085	0,0347	0,0744	0,2176
4	0,113	0,0377	0,0805	0,2312
4,5	0,1151	0,0399	0,0851	0,2401
5	0,1156	0,0416	0,0885	0,2457
5,5	0,1151	0,0429	0,0911	0,2491
6	0,1138	0,0439	0,0931	0,2508
7	0,1103	0,0451	0,0953	0,2507
8	0,1061	0,0456	0,0962	0,2479
9	0,1018	0,0457	0,0961	0,2436
10	0,0975	0,0454	0,0954	0,2383
11	0,0934	0,0449	0,0942	0,2325
12	0,0896	0,0442	0,0927	0,2265
13	0,0861	0,0435	0,0911	0,2207
14	0,0828	0,0427	0,0892	0,2147
15	0,0797	0,0418	0,0873	0,2088
16	0,0769	0,0409	0,0854	0,2032
17	0,0742	0,0401	0,0835	0,1978

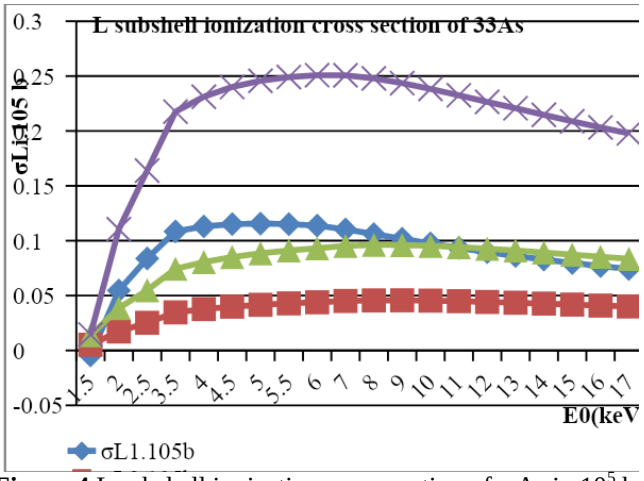

Figure.4 L subshell ionization cross section of $_{33}$As in 10^5 b.

Table.5 L subshell ionization cross section of $_{34}$Se in 10^5 b.

E_0(keV)	$\sigma_{L1}.10^5$b	$\sigma_{L2}.10^5$b	$\sigma_{L3}.10^5$b	$\sigma_{Ltotal}.10^5$b
1,5	-0,2213	0,0076	0,041	-0,1727
2	0,3509	0,1197	0,273	0,7436
2,5	0,6407	0,1912	0,4212	1,2531
3,5	0,8931	0,2776	0,5992	1,7699
4,5	0,9732	0,3264	0,6992	1,9988
5	0,9853	0,3428	0,7326	2,0607
5,5	0,9872	0,3555	0,7582	2,1009
6	0,9821	0,3654	0,7779	2,1254
6,5	0,9724	0,3729	0,7928	2,1381
7	0,9596	0,3786	0,8037	2,1419
8	0,9288	0,3855	0,8166	2,1309
9	0,8948	0,3882	0,8207	2,1037
10	0,8604	0,3879	0,8185	2,0668
11	0,8271	0,3854	0,8121	2,0246
12	0,7951	0,3813	0,8023	1,9787
13	0,7651	0,3762	0,7906	1,9319
14	0,7369	0,3703	0,7773	1,8845
15	0,7107	0,3639	0,763	1,8376
16	0,6862	0,3571	0,7482	1,7915
17	0,6634	0,3502	0,733	1,7466

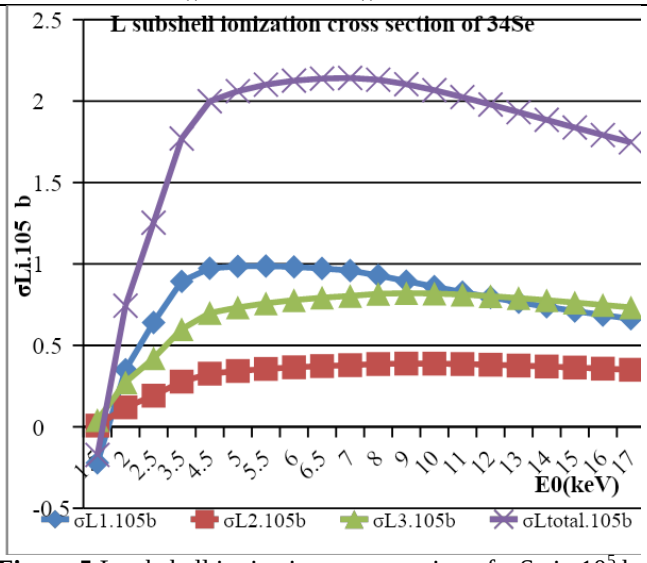

Figure.5 L subshell ionization cross section of $_{34}$Se in 10^5 b.

Table.6 L subshell ionization cross section of $_{35}$Br in 10^5 b.

E_0(keV)	$\sigma_{L1}.10^5$b	$\sigma_{L2}.10^5$b	$\sigma_{L3}.10^5$b	$\sigma_{Ltotal}.10^5$b
1,6	-0,2141	0,0009	0,025	-0,1882
2,3	0,3833	0,1196	0,271	0,7739
2,9	0,6119	0,1799	0,3961	1,1879
3,6	0,7464	0,2269	0,4932	1,4665
4,75	0,833	0,2747	0,5915	1,6992
5,5	0,8477	0,2943	0,6313	1,7733
6	0,8481	0,3041	0,6509	1,8031
6,5	0,8437	0,3117	0,6662	1,8216
7	0,8359	0,3177	0,678	1,8316
8	0,8142	0,3257	0,6935	1,8334
9	0,7883	0,3299	0,7008	1,819
10	0,761	0,3313	0,7024	1,7947
11	0,7337	0,3306	0,6998	1,7641
12	0,7072	0,3284	0,6943	1,7299
13	0,6819	0,3252	0,6865	1,6936
14	0,658	0,3212	0,6772	1,6564
15	0,6355	0,3166	0,6667	1,6188
16	0,6144	0,3116	0,6556	1,5816
17	0,5947	0,3064	0,6439	1,545
18	0,5761	0,3009	0,6319	1,5089

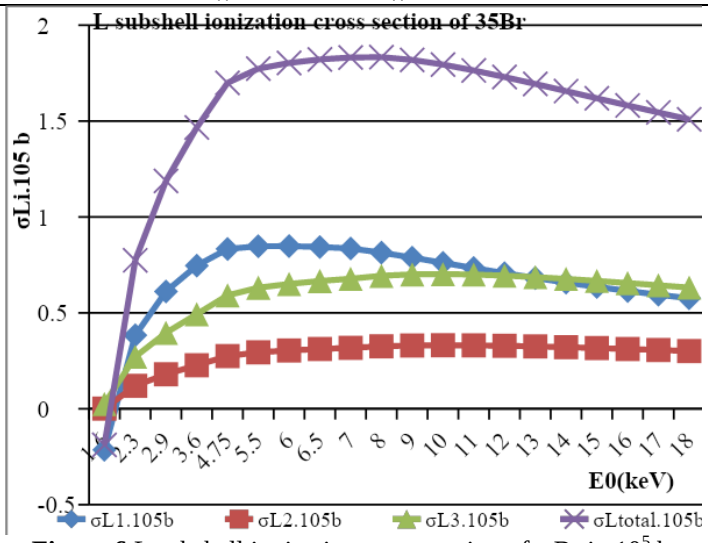

Figure.6 L subshell ionization cross section of $_{35}$Br in 10^5 b

Table.7 L subshell ionization cross section of $_{36}$Kr in 10^5 b

E_0(keV)	$\sigma_{L1}.10^5$b	$\sigma_{L2}.10^5$b	$\sigma_{L3}.10^5$b	$\sigma_{Ltotal}.10^5$b
1,75	-0,1576	0,0035	0,0281	-0,126
2,4	0,2951	0,0922	0,2125	0,5998
3	0,4976	0,1432	0,3185	0,9593
3,7	0,6216	0,1836	0,4023	1,2075
4,75	0,7037	0,2228	0,4833	1,4098
5,5	0,7251	0,2414	0,5212	1,4877
6	0,7298	0,2508	0,5403	1,5209
6,5	0,7297	0,2584	0,5555	1,5436
7	0,7261	0,2644	0,5677	1,5582
8	0,7121	0,2731	0,5847	1,5699
9	0,6931	0,2783	0,5943	1,5657
10	0,6719	0,2809	0,5987	1,5515
11	0,6501	0,2816	0,5992	1,5309
12	0,6283	0,281	0,5968	1,5061
13	0,6073	0,2792	0,5923	1,4788
14	0,5871	0,2768	0,5863	1,4502
15	0,5682	0,2737	0,5792	1,4211
16	0,5499	0,2702	0,5709	1,391
17	0,5328	0,2663	0,5622	1,3613
18	0,5167	0,2623	0,5531	1,3321

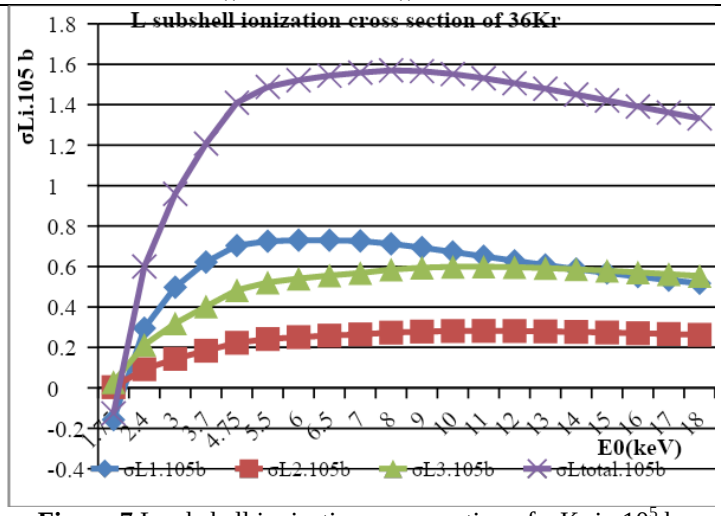

Figure.7 L subshell ionization cross section of $_{36}$Kr in 10^5 b

Table.8 L subshell ionization cross section of $_{37}$Rb in 10^5 b

E_0(keV)	$\sigma_{L1}.10^5$b	$\sigma_{L2}.10^5$b	$\sigma_{L3}.10^5$b	$\sigma_{Ltotal}.10^5$b
1,85	-0,1631	-0,0021	0,0147	-0,1505
2,5	0,2246	0,0723	0,1696	0,4665
3,2	0,4257	0,1218	0,2726	0,8201
3,9	0,5299	0,1551	0,3418	1,0268
5	0,605	0,1894	0,4129	1,2073
5,9	0,6273	0,2078	0,4505	1,2856
6,5	0,6317	0,2168	0,4688	1,3173
7	0,6314	0,2228	0,4809	1,3351
8	0,6238	0,2317	0,4986	1,3541
9	0,6105	0,2374	0,5096	1,3575
10	0,5944	0,2408	0,5157	1,3509
11	0,5771	0,2425	0,5183	1,3379
12	0,5594	0,2428	0,5182	1,3204
13	0,542	0,2422	0,5161	1,3003
14	0,5251	0,2408	0,5124	1,2783
15	0,5089	0,2388	0,5075	1,2552
16	0,4934	0,2364	0,5017	1,2315
17	0,4787	0,2336	0,4953	1,2076
18	0,4648	0,2306	0,4884	1,1838
19	0,4516	0,2274	0,4812	1,1602

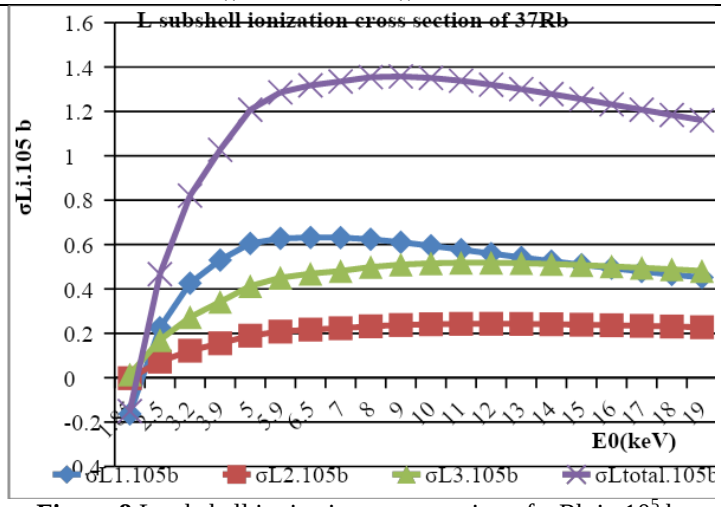

Figure.8 L subshell ionization cross section of $_{37}$Rb in 10^5 b

Table.9 L subshell ionization cross section of $_{38}$Sr in 10^4 b.

E_0(keV)	$\sigma_{L1}.10^4$b	$\sigma_{L2}.10^4$b	$\sigma_{L3}.10^4$b	$\sigma_{Ltotal}.10^4$b
2,1	-0,0663	0,0106	0,0391	-0,0166
2,6	0,167	0,0557	0,1332	0,3559
3,5	0,3801	0,1075	0,2412	0,7288
4,4	0,4773	0,1399	0,3086	0,9258
5,3	0,5233	0,1618	0,3538	1,0389
6,2	0,5432	0,1771	0,3854	1,1057
7	0,5486	0,1871	0,4056	1,1413
8	0,5461	0,1959	0,4234	1,1654
9	0,5376	0,2019	0,4352	1,1747
10	0,5259	0,2058	0,4426	1,1743
11	0,5124	0,2081	0,4467	1,1672
12	0,4983	0,2093	0,4483	1,1559
13	0,484	0,2095	0,448	1,1415
14	0,47	0,2089	0,4462	1,1251
15	0,4563	0,2078	0,4432	1,1073
16	0,4431	0,2063	0,4394	1,0888
17	0,4305	0,2044	0,4349	1,0698
18	0,4185	0,2022	0,4298	1,0505
19	0,4071	0,1999	0,4244	1,0314
20	0,3962	0,1974	0,4186	1,0122

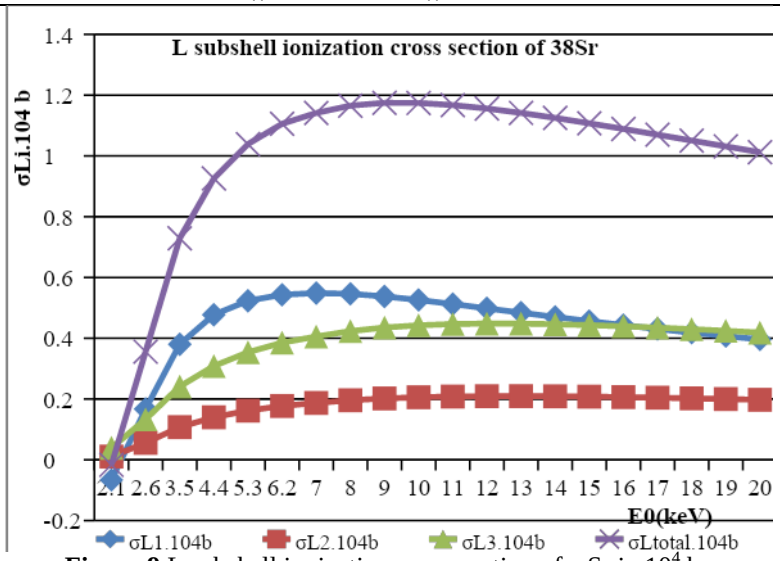

Figure.9 L subshell ionization cross section of $_{38}$Sr in 10^4 b.

Table.10 L subshell ionization cross section of $_{39}$Y in 10^4 b.

E_0(keV)	$\sigma_{L1}.10^4$b	$\sigma_{L2}.10^4$b	$\sigma_{L3}.10^4$b	$\sigma_{Ltotal}.10^4$b
2,1	-0,1405	-0,0055	0,0042	-0,1418
2,4	0,0094	0,0212	0,0599	0,0905
2,8	0,1479	0,0487	0,1174	0,314
3,3	0,2614	0,0747	0,1718	0,5079
3,9	0,3471	0,0981	0,2205	0,6657
4,5	0,4002	0,1156	0,2573	0,7731
5	0,4292	0,1273	0,2816	0,8381
5,5	0,4489	0,1369	0,3015	0,8873
6	0,4618	0,1449	0,3179	0,9246
6,5	0,471	0,1516	0,3317	0,9543
7	0,4745	0,1572	0,3431	0,9748
7,5	0,4764	0,1619	0,3527	0,991
8,5	0,4746	0,1692	0,3674	1,0112
9	0,4718	0,1721	0,3729	1,0168
10	0,4638	0,1762	0,3811	1,0211
11	0,4538	0,1789	0,3862	1,0189
12	0,4428	0,1806	0,3891	1,0125
13	0,4313	0,1814	0,3901	1,0028
14,5	0,4141	0,1813	0,3891	0,9845
15,8	0,3995	0,1804	0,3863	0,9662

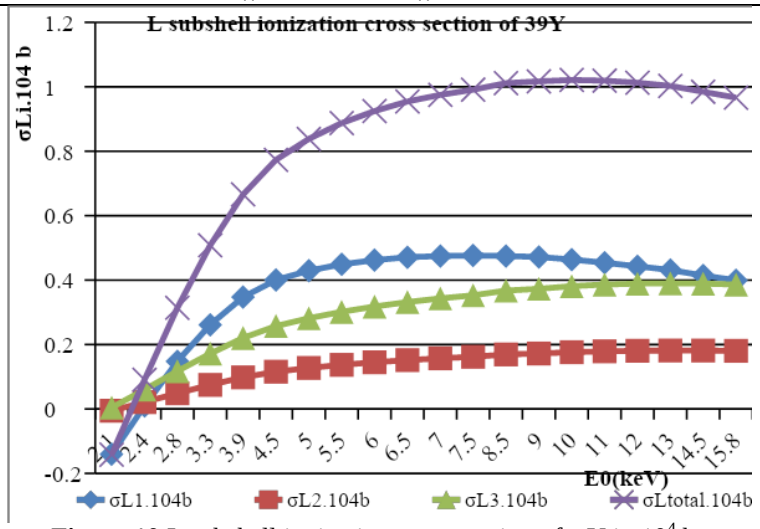

Figure.10 L subshell ionization cross section of $_{39}$Y in 10^4 b.

Table.11 L subshell ionization cross section of $_{40}$Zr in 10^4 b.

E_0(keV)	$\sigma_{L1}.10^4$b	$\sigma_{L2}.10^4$b	$\sigma_{L3}.10^4$b	$\sigma_{Ltotal}.10^4$b
2,25	-0,1172	-0,0045	0,0047	-0,117
2,5	-0,0116	0,0141	0,0434	0,0459
2,75	0,0702	0,0295	0,0759	0,1756
3	0,1348	0,0427	0,1036	0,2811
3,5	0,2285	0,0642	0,1484	0,4411
4,5	0,3344	0,0939	0,2108	0,6391
5	0,3642	0,1048	0,2333	0,7023
5,5	0,3851	0,1137	0,2519	0,7507
6	0,3995	0,1212	0,2675	0,7882
6,5	0,4092	0,1275	0,2805	0,8172
7	0,4153	0,1328	0,2915	0,8396
7,5	0,4188	0,1374	0,3007	0,8569
8,5	0,4201	0,1445	0,3152	0,8798
9	0,4188	0,1473	0,3208	0,8869
10	0,4137	0,1516	0,3294	0,8947
11	0,4063	0,1547	0,3352	0,8962
12	0,3977	0,1567	0,3388	0,8932
13,5	0,3837	0,1582	0,3413	0,8832
15	0,3694	0,1585	0,3412	0,8691
17	0,3508	0,1575	0,3381	0,8464

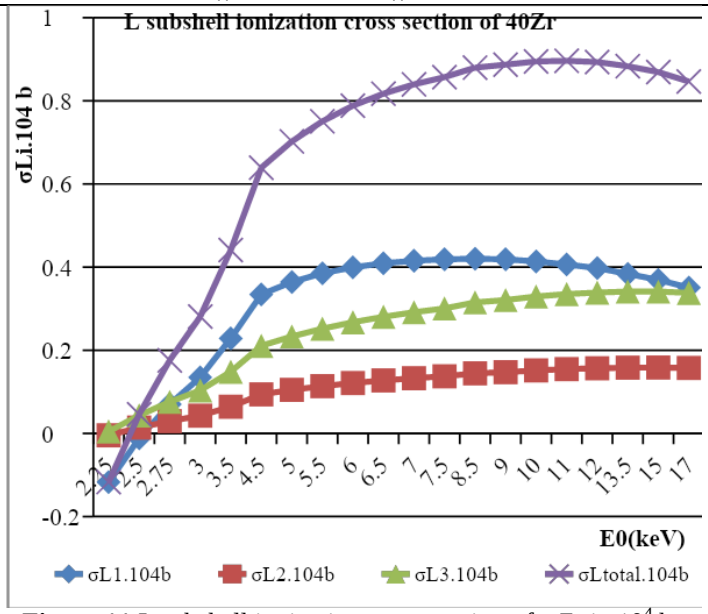

Figure.11 L subshell ionization cross section of $_{39}$Zr in 10^4 b.

Table.12 Z dependency of σ_{Li} of $_{30}$Zn to $_{40}$Zr for 10keV electron impact in 10^4 b.

Atom No	E_o(keV)	$\sigma_{L1}.10^4$ b	$\sigma_{L2}.10^4$ b	$\sigma_{L3}.10^4$ b	$\sigma_{Ltotal}.10^4$ b
30	10	14,151	7,362	15,311	36,824
31	10	12,511	6,271	13,081	31,863
32	10	10,98	5,331	11,172	27,483
33	10	9,749	4,539	9,541	23,829
34	10	8,604	3,879	8,185	20,668
35	10	7,61	3,313	7,024	17,947
36	10	6,719	2,809	5,987	15,515
37	10	5,944	2,408	5,157	13,509
38	10	5,259	2,058	4,426	11,743
39	10	4,638	1,762	3,811	10,211
40	10	4,137	1,516	3,294	8,947

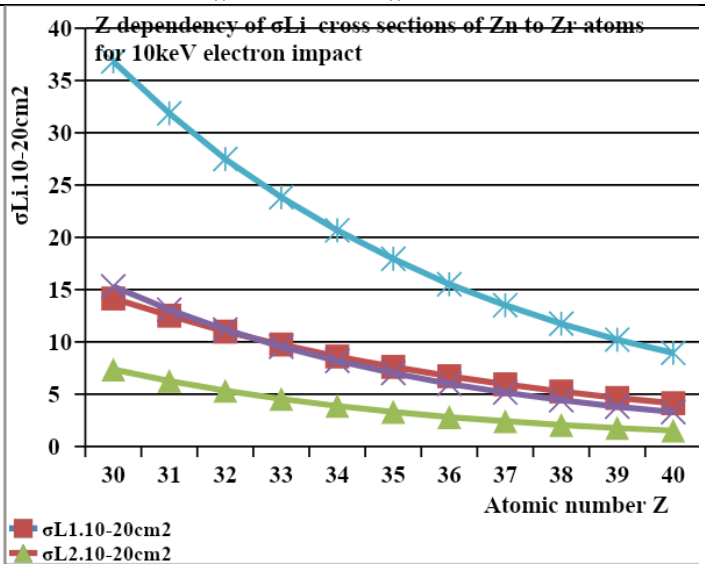

Figure.12 Z dependency of σ_{Li} of $_{30}$Zn to $_{40}$Zr for 10keV electron impact in 10^4 b.

4. Conclusions

L shell σ_L and σ_{Li} sub shells ionization cross sections of $_{30}$Zn, $_{31}$Ga, $_{32}$Ge, $_{33}$As, $_{34}$Se, $_{35}$Br, 36Kr, $_{37}$Rb, $_{38}$Sr, $_{39}$Y, $_{40}$Zr by electron impact results given in Tabs.1 to 11 and in Figs.1 to11. For L shell σ_L and for L_i sub shells σ_{Li} increase rapidly by E_{0i} while E_{0i} increases from $E_{L1i} \leq E_{0i} \leq 10E_{L1i}$ as shown in data Tables and at graphics in Figures. These increments of σ_L and.of σ_{Li} faster for very close to threshold energy values; increase by E_{0i} for data of each atom. Variation of σ_{Li} by E_{0i} near to E_{Li} region of L_i sub shells of each atom show similarity they are related to production of characteristic x ray yield rate of that sub shell. σ_{L1} always for small values of E_{0i} crosses σ_{L2} and σ_{L3}. Then σ_{L1}further gets bigger up to value of σ_{L2} for highest electron impact energies and crosses again σ_{L2} graphic for every atom. For a fixed E_{0i}=10 keV, while Z value increases from 30≤ Z ≤40 σ_L and σ_{Li} decrease: Variation for σ_{LTotal} is from 36,824.10^4 b to 8,947.10^4b As seeing at Tab.12 and Fig.12, L_i sub shells σ_{Li} (i=1,2,3) decrease from 14,151b to 4,137b; 7,362b to 1,516b 15,311b to 3,294b respectively. Results must be compared with experimental measurements and with other calculations such as Distorted wave Born approximation (DWBA) and Modified Relativistic Bethe Born Approximations (MRBEB) [5-15].

Acknowledgement

I would like to thank DUBAP of Dicle University (http://dubap.dicle.edu.tr) who allowed to use our project's computer(Reg.No:13-FF-53).

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