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The $1sn_1l_1n_2l_2$ electron spectra of lithium atoms

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Synopsis The energy-loss spectrum of scattered electrons due to the excitation of the $1sn_1l_1n_2l_2$ autoionizing states and the ejected-electron spectrum arising from the decay of these states in lithium atoms were measured at scattering angle 54.7° and 80 eV impact energy. A comparative analysis of excitation and decay channels of autoionizing states was performed.

The electron energy spectra, if measured in excitation channel (scattered electrons) and in decay channel (ejected electrons) give almost complete set of data on the excitation and decay dynamics of autoionizing states, including metastable and quasimetastable states. Possessing a simple electron structure and a large difference in binding energies of valence and subvalence shells, lithium is a convenient target for such studies.

In the present work, the energy-loss and ejected-electron spectra arising from the excitation and decay of the $1sn_1l_1n_2l_2$ autoionizing states in lithium atoms were measured at scattering angle 54.7° and 80 eV impact energy. The data were obtained by using the electron spectrometer described earlier [1]. Spectra were recorded at incident electron energy resolution of 0.4 eV and ejected-electron energy resolution of 0.15 eV. The uncertainties of energy scales were estimated to be ±0.07 eV and ±0.05 eV for incident and ejected electrons, respectively.

Figure 1 shows the measured electron spectra in an excited-state energy region 55.5-63.5 eV. Excitation energies and assignment of lines 1-9 are given in table 1.

Table 1. Excitation energies (in eV) and assignment of lines in electron spectra of lithium.

Line	E_{exc}	Assignment
1	56.39	$(1s2s^2)^2S$
2	57.40	$(1s2s2p)^4P$
3	58.91	$1s(2s2p^3P)^2P$
4	60.41	$1s(2s2p^1P)^2P$
5	60.75	$(1s2p^2)^4P$
6	61.07	$(1s2p^2)^2D$
7	61.62	$(1s2p^2)^2P$
8	62.0	$1s2s(^3S)3s^2S$
9	62.4	$1s2s(^3S)3p^2P$

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Comparing the spectra shows that most of lines are observed simultaneously in both spectra though there is no correlation in their relative intensities. Line 7 observed only in energy-loss spectrum reflects the excitation of the $(1s2p^2)^2P$ state which is metastable against autoionization [2]. Lines 1, 8 are weak in energy-loss spectrum but they are strong enough in ejected-electron spectrum. Reverse situation one may see for M_1, M_3 core-excited bands of Li_2 [3]. Both peculiarities may reflect an essential difference in angular distribution of scattered and ejected electrons.

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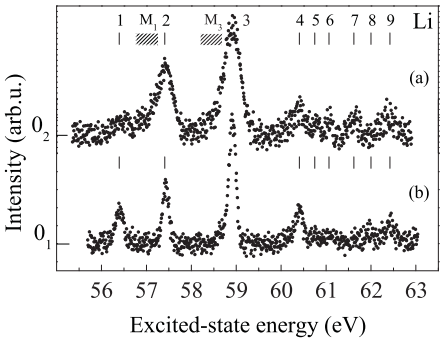

Figure 1. Energy-loss spectrum (a) and ejected-electron spectrum (b) of lithium at 80 eV.

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