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On the hyperfine structures of the ground state(s) in the ^{6}Li and ^{7}Li atoms

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Hyperfine structure of the ground 2^2S-states of the three-electron atoms and ions is investigated. By using our recent numerical values for the doublet electron density at the atomic nucleus we determine the hyperfine structure of the ground (doublet) 2^2S-state(s) in the ^{6}Li and ^{7}Li atoms. Our predicted values (228.2058 and 803.5581 MHz, respectively) agree well with the experimental values 228.20528(8) MHz (^{6}Li) and 803.50404(48) MHz (^{7}Li (R. G. Schlecht and D. W. McColm, Phys. Rev. **142**, 11 (1966))). The hyperfine structures of a number of lithium isotopes with short life-times, including ^{8}Li, ^{9}Li, and ^{11}Li atoms are also predicted. The same method is used to obtain the hyperfine structures of the three-electron ^{7}Be$^+$ and ^{9}Be$^+$ ions in their ground 2^2S-states. Finally, we conclude that our approach can be generalized to describe the hyperfine structure in the triplet n^3S-states of the four-electron atoms and ions.

Table 1. Predicted and observed hyperfine structures and hyperfine structure splittings in the ground ^2S−state(s) in the ^{6}Li and ^{7}Li atoms and ^{9}Be$^+$ ion (in MHz). Experimental data have been taken from: R. G. Schlecht and D. W. McColm, Phys. Rev. **142**, 11 (1966)

^{6}Li	f_N	I_N	$E_{hf}(1)$	$E_{hf}(2)$	ΔE_{hf} (predicted)	ΔE_{hf} (experiment)
^{6}Li	0.8220473	1^+	-76.0684 ($F = \frac{3}{2}$)	152.1372 ($F = \frac{1}{2}$)	228.2058	228.20528(8)
^{7}Li	3.2564268	$\left(\frac{3}{2}\right)^-$	-502.2238 ($F = 1$)	301.3343 ($F = 2$)	803.5581	803.50404(48)
^{8}Li	1.653560	2^+	-306.0252 ($F = \frac{5}{2}$)	229.5189 ($F = \frac{3}{2}$)	535.5441	——
^{9}Li	3.43678	$\left(\frac{3}{2}\right)^-$	-530.0388 ($F = 1$)	318.0233 ($F = 2$)	848.0621	——
^{11}Li	1.653560	$\left(\frac{3}{2}\right)^-$	-566.1925 ($F = 1$)	339.7154 ($F = 2$)	905.9078	——
^{7}Be$^+$	-1.39928	$\left(\frac{3}{2}\right)^-$	-927.1002 ($F = 1$)	556.2601 ($F = 2$)	1483.3603	——
^{9}Be$^+$	-1.177432	$\left(\frac{3}{2}\right)^-$	-780.1136 ($F = 1$)	468.0681 ($F = 2$)	1248.1818	——

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