

Confirmation of New Even-parity Energy Levels of La I by Laser-Induced Fluorescence Spectroscopy

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In continuation of the previous work done at the Institute of Experimental Physics of Graz University of Technology [1], we tried to confirm new even-parity energy levels of atomic Lanthanum (La I) by at least one laser excitation in the near infrared wavelength region at the Laser Spectroscopy Laboratory of Istanbul University. The levels were found when performing laser-spectroscopic investigations in the yellow spectral range. Despite of all efforts no further excitation of these levels - and thus no confirmation of their existence - was possible in the visible range.

We performed laser-induced fluorescence spectroscopy, using a continuous wave tuneable titan-sapphire laser (Coherent MBR-110 pumped by Coherent Verdi 18 W) as narrow-band light source and a hollow cathode discharge lamp (described in ref. [2]) as source of free La atoms. We investigated the hyperfine structure of seven La I lines in the wavelength region of 750 nm to 865 nm ($11\,560\text{ cm}^{-1}$ to $13\,330\text{ cm}^{-1}$). Laser-induced fluorescence signals were filtered with a grating monochromator (McPherson 207) and detected with a photomultiplier (Hamamatsu PM R928) for all current lines.

On the basis of yet not confirmed data of new levels, possible excitation transitions within the range of our laser system as well as possible fluorescence wavelengths were calculated (as decay lines from the new energy levels) using the classification program [3]. Then we tried to excite and detect the proposed transitions, but not all these trials were successful. Finally seven spectral lines could be excited with the laser light and detected by laser-induced fluorescence.

We succeeded in confirming five levels. The magnetic dipole hyperfine constant A for the new levels could be obtained by fitting the recorded hyperfine patterns with the computer program Fitter [4] (the quadrupole hyperfine constant B was assumed to be zero, since the La nucleus has a very small electric quadrupole moment). The results for energy, J value, parity and magnetic dipole hyperfine constant A agree well with the preliminary values.

new even level		
J	energy (cm^{-1})	A (MHz)
3/2	25 558.770	250 (5)
9/2	32 448.352	360 (3)
9/2	43 199.08	100 (2)
5/2	42 041.20	58 (10)
3/2	42 819.72	-32 (2)

Table 1: *New even energy levels of La I*

References

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