THE A $^1\Sigma_u^+$ STATE OF $^7Li_2$ FROM 2 TO 102 Å

A. J. ROSS, F. MARTIN, P. CROZET, I. RUSSIER-ANTOINE, *Laboratoire de Spectrométrie Ionique et Moléculaire (UMR 5579 CNRS), Bâtiment Kastler, Université Lyon I, Domaine Scientifique de la Doua, 69622 Villeurbanne Cedex, France*; A. M. LYYRA, *Department of Physics, Temple University, Philadelphia, PA 19122-6082, U.S.A*; and C. LINTON, *Physics Department, University of New Brunswick, Fredericton, NB, Canada E3B 5A3*.

The $A\ ^1\Sigma_u^+$ state of $^7Li_2$ has been observed in several types of experiment : absorption, laser induced fluorescence, stimulated emission pumping. We recorded the absorption spectrum on a Fourier transform spectrometer using a heatpipe source; Doppler-limited linewidths were about 0.1 cm^{-1}. This experiment probed vibrational levels 0-20 and rotational levels 0-60. A selection of *A-X* laser-induced fluorescence spectra was also recorded, exciting $v \leq 5$ in the A state; they describe the $X^1\Sigma_g^+$ ground state up to v = 10. We used optical-optical double resonance excitation to excite the E or $F^1\Sigma_g^+$ states, and recorded $F - A$ and $E - A$ infrared fluorescence ($0 \leq v \leq 87$,$16 \leq J \leq 26$) again by FT spectrometry. The SEP experiment probed the A state through all-optical triple resonance, using $G \leftarrow A \leftarrow X$ excitation.[a] Rotational levels $2 \leq J \leq 22$ were probed at high resolution for $27 \leq v \leq 62$, and calibrated against the iodine atlas.

Data reduction led to a set of 1385 rovibrational energies in the A state, which were fitted to a numerical potential energy curve. A photoassociation experiment performed at Rice University[b] furnishes accurate binding energies with respect to the Li(2s) + Li(2p) $^2P_{1/2}$ asymptote for $J \leq 2$ in levels $65 \leq v \leq 97$. Because several vibrational levels were observed both in photoassociation and in fluorescence, an experimental dissociation energy can be deduced from the sum of binding energies (measured in photoassociation) and vibrational energies established with respect to the potential minimum (from fluorescence data), giving D_e = 9352.16 $\pm$ 0.02 cm^{-1}. This value can be compared with the value obtained for the A state of $^6Li_2$, D_e = 9352.032 $\pm$ 0.008 cm^{-1} to reveal a very small non Born-Oppenheimer contribution to the molecular potential. The full set of energies can be reproduced from a numerical potential curve extending beyond 100 Å.

[a] K. Urbanski, S. Antonova, A. Yiannopoulou, A. M. Lyyra, Li Li and W. C. Stwalley ,J. Chem. Phys. 104 2813 (1996)

[b] E. Abraham, N. Ritchie, W. McAlexander and R. Hulet, J. Chem. Phys. 103 7773 (1995)