Unexpected Large Branching Ratio for the *b*(1) state of N_2

C. Y. R. WU,[1] Y. C. LIN,[2] J. I. LO,[2] T.-S. YIH,[2] H. S. FUNG,[3] and Y. Y. LEE[3]
[1]*University of Southern California, Los Angeles, CA 90089-1341*
[2]*National Central University, Jhongli, Taiwan*
[3]*National Synchrotron Radiation Research Center, Hsinchu, Taiwan*

The excited states of N_2 can decay through several channels, namely, the EUV resonance fluorescence, the branching emission to the $a\ ^1\Pi_g$, $a''\ ^1\Sigma_g^+$, and possibly others, and the subsequent decade emission to the ground state $X\ ^1\Sigma_g^+$. One of the fundamental questions is the branching ratios for the decay channels. We have found that the $b(1)$ state decays through resonance fluorescence to the ground state and through the $b(1)\rightarrow a$ branching transition and the subsequent cascade $a\rightarrow X$ (LBH) emission. Both the $b(1)\rightarrow X$ and the $a\rightarrow X$ emission are dispersed and observed by a 0.2-m Seya-Namioka type vacuum monochromator. The integrated fluorescence intensities of the LBH band amount to 0.3-0.4 of the that of the $b(1)\rightarrow X$ bands at different N_2 pressures and temperature conditions. Assuming all the $b(1)\rightarrow a$ branching will end up in producing the LBH emission the branching ratio for $[a\rightarrow X]/[b(1)\rightarrow X]$ will be higher than 0.3. Base on transition frequency ratio alone the branching will only amount to 0.01. Strong perturbation mechanisms are known to take place in this complex energy region of N_2 theoretical calculations to support or repudiate our experimental results is warranted. We plan to carry out further study by using a 0.5-m spectrometer to disperse the fluorescence. The present results may be useful in the explanation of the important N_2 features in the dayglow of the Earth. We also plan to carry out the experiments at low temperatures to provide data that can be directly applicable to the characterization of the N_2 emissions in the atmospheres of Titan and Pluto. This research is based on work supported by NSF grant AST-0906158.