HIGH-RESOLUTION NEAR-INFRARED SPECTROSCOPY OF THE SECOND NEGATIVE SYSTEM OF O$_2^+$

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The second negative system ($A^2\Pi_u - X^2\Pi_g$) of O$_2^+$ has been spectroscopically studied for over 70 years due to the significant role it plays in the chemistry of the upper atmosphere. More recently, the (2,18), (4,20), (6,20), (3,18), (3,19), and (4,19) bands were observed in the near infrared. While scanning for N$_2^+$ lines in a pure helium discharge containing N$_2$ as an impurity (<8 ppm) for another experiment, we serendipitously found two new bands of O$_2^+$, (2,19) and (5,21). The O$_2^+$ ions were produced in a liquid-nitrogen-cooled positive-column plasma containing 1 Torr of He, where most likely the dominant source of oxygen in the plasma is a small leak in the vacuum system. The spectra were obtained with a Ti:sapphire laser (11,000-13,000 cm$^{-1}$) using velocity modulation, phase modulation with heterodyne detection, noise subtraction, and optical multi-passing. A detailed analysis of the newly observed bands will be presented.

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